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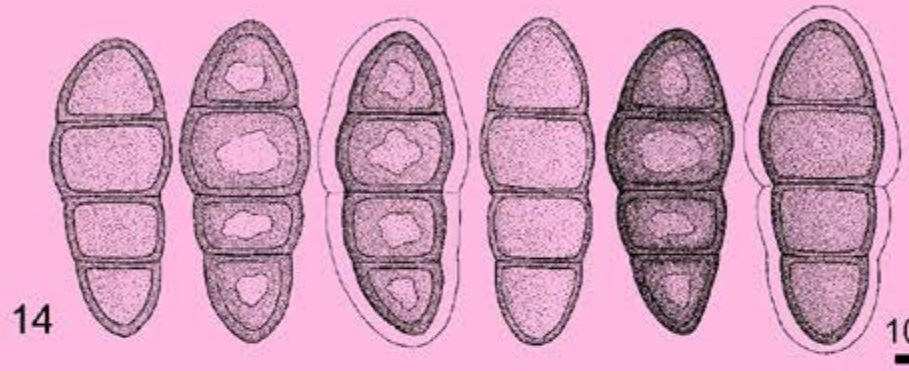

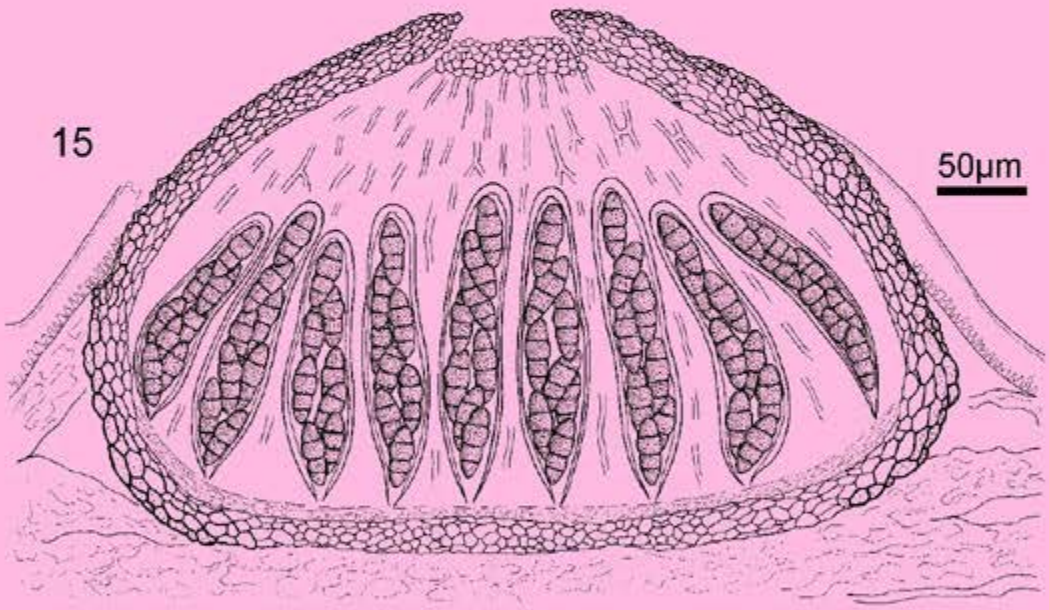

Tanaka, Hirayama & Iqbal
FIGS 14–15. *Diadema ahmadii* sp. nov.
(p. 340)

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Genera of *Pezizales* of Argentina 1. An updating of selected genera

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Abstract — Twenty-two genera of *Pezizales* from Argentina belonging to families *Discinaceae, Helvellaceae, Morchellaceae, Pezizaceae, Pyronemataceae, Sarcoscyphaceae,* and *Sarcosomataceae* are reviewed according to new nomenclatural and taxonomical parameters. Some changes in type species selection are noted and relationships among genera based on microscopical, ultramicoscopical, and molecular data are discussed. The related anamorphs, when known, are briefly described.

Resumen — Se revisan y actualizan veintidós géneros de *Pezizales* de Argentina pertenecientes a las familias *Discinaceae, Helvellaceae, Morchellaceae, Pezizaceae, Pyronemataceae, Sarcoscyphaceae* y *Sarcosomataceae* de acuerdo con nuevos conceptos taxonómicos y nomenclaturales. Se incluyen algunos cambios en la designación de las especies tipos con respecto a trabajos anteriores de la autora y comentarios de las relaciones filogenéticas entre los géneros, considerando datos microcópicos, ultramicroscópicos y moleculares. Se describen brevemente los anamorfos de cada género, cuando se los conoce.

Key words — *Ascomycota*, cup-fungi, taxonomy, biodiversity

Introduction

About fifty years after the my first publication on discomycetes of Argentina, I thought that perhaps it would be worthwhile to produce an update of my work on the taxonomy of this group, mainly regarding current concepts and nomenclature of the genera.

During this time, generic concepts have been enriched and refined by the use of modern tools such as scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Moreover, molecular studies have helped clarify relationships between taxa, leading to hypothetical phylogenies.

Advances in the nomenclature of various discomycete taxa have also required changes to some generic and specific names used in my previous papers. However, as generic limits differ from author to author, I am giving my views and provide generic descriptions that cover my concepts.

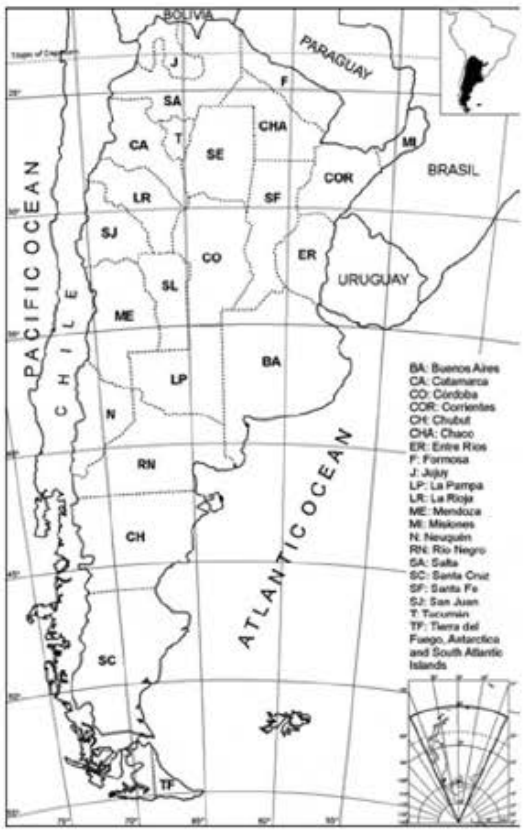


FIG. 1. Map of Argentina

Argentina is an extensive country covering an area of 2,766,891 km^2, extending from 21°46'S to 55°03'S and 53°38'W to 73°35'W. The altitude decreases from W to E, ranging from the Andes, whose highest point is 6,962 m to sea level at the Atlantic coast, but with its lowest depression (–105m) in the Patagonian plateau. It encompasses different climates, from subtropical in the north, temperate in the center and south, and to polar if the Argentine Sector of Antarctica is included. The mycobiota is therefore very diverse. So far, many territories are still poorly explored regarding the discomycete biota and many genera and species are yet to be discovered.

At present, there are approximately 37 genera of *Pezizales* recognized from Argentina. I refer only to 22 in this contribution, choosing those that have been recently monographed or studied with ultrastructural or molecular tools. The remaining shall be treated in a next contribution.

The genera are presented in alphabetical order and include a description, type species, habitat, geographical distribution in Argentina, notes on related genera, and a bibliography. Abbreviated literature is presented at the end of the generic descriptions and full references can be found in the literature. Each genus is illustrated with a species recorded in Argentina, which is depicted in a plate (PLATES 1–22). A map (FIG. 1) shows the provinces with the abbreviations listed in the accompanying legend. Taxonomic categories above genera follow Kirk et al. (2008) and the website "Index Fungorum" (http://www.indexfungorum.org/BSM./bsm.asp). Electronic libraries such as Cybertruffle (http//cybertruffle.org.

uk/cyberliber) and Biblioteca electrónica del Ministerio de Ciencia y Tecnología de la Argentina (http//www.biblioteca.mincyt.gov.ar) were very valuable information sources for this paper.

Ultrastructural references include Bellemère et al. (1990), Kimbrough (1994), Kimbrough & Curry (1986), Kimbrough & Gibson (1989, 1991), Kimbrough et al. (1990), Li & Kimbrough (1995, 1996a,b) and Meléndez-Howell et al. (2003). Molecular data were extracted from Hansen et al. (1999, 2001), Hansen & Pfister (2006), Harrington et al. (1999), Landvik et al. (1997, 1999), Læssøe & Hansen (2007), Liu & Zhuang (2006), O´Donnell et al. (1997), Perry et al. (2007), Perry & Pfister (2008), Tedersoo et al. (2006), and Weinstein et al. (2002).

Taxonomy

Acervus Kanouse emend. Pfister (*Pyronemataceae*)

Ascomata apothecial, medium-sized, superficial, sessile to subsessile, at first globose becoming shallow cupulate (cleistohymenial), scattered to gregarious, sometimes concrescent forming masses of several cm across arising from a mycelium agglomerated in a dense mat mixed with the substratum, firm fleshy consistency; disc bright yellow to orange, the pigment soluble in water and alcohol; margin entire or lobate, reflexed and undulate; external surface concolorous with the disc or paler, pruinose to furfuraceous. Ectal excipulum of textura globulosa to angularis composed of isodiametric cells, the most superficial smaller than the internal ones and containing orange granules, bearing flexuous, cylindrical, short, obtuse hair with few septa. Medullary excipulum well developed, of a lax textura intricata composed of hyaline hyphae with swollen articles. Subhymenium of dense textura globulosa, the cells containing pigment and smaller than those of the excipulum. Asci cylindrical, 8-spored, J–, dehiscence indistinct. Paraphyses robust, cylindrical, subclavate or irregularly enlarged, containing pigmented granules near the apex, pluriseptate. Ascospores uninucleate, 1-seriate, multiguttulate, hyaline, broad ellipsoidal with blunt ends to subglobose, smooth, thin-walled.

Type species: ***Acervus aurantiacus*** Kanouse Pap. Mich. Acad. Sci. 23:149. 1938 [= *A. epispartius* (Berk. & Broome) Pfister].

Habitat: on damp soil, sometimes among grass, rotten wood and debris.

Anamorph: unknown.

Notes: *Acervus* is an earlier synonym of *Phaedropezia* Le Gal. It shares with *Caloscypha* Boud. a bright orange-yellow disc and the same type of septal structure. TEM studies of the hyphae revealed that a membrane-like translucent band borders the pore plug where the Woronin bodies are crystalloid, a view that supports the inclusion of both genera in the same tribe of the *Pyronemataceae*. However, *Caloscypha* differs in the ascomata that turn green or bluish with age or when touched or broken. *Ascosparassis* Kobayasi is similar to *Acervus*

in its small, guttulate ascospores, robust paraphysis, and orange ascoma of sparassoid habit. Formerly *Acervus* was placed in the *Sarcosomataceae* or *Sarcoscyphaceae* because asci were considered suboperculate. Other authors held the view that dehiscence is somewhat bilabiate, as in *Caccobius* Kimbr. and *Thelebolus* Tode (*Thelebolaceae*). Nevertheless operculate asci can be observed in the Argentine collection of *A. epispartius* (PLATE 1, FIG. 3). The fact that ascospores are uninucleate instead of multinucleate reinforces the view that *Acervus* belongs to the *Pyronemataceae*. This family is considered here in a wider sense than in Kimbrough's (1989) proposal (in accordance with Kirk et al. 2008). Molecular phylogenetic studies show discrepancies in the concept of *Pyronemataceae*. Some authors consider it monophyletic, others think it is polyphyletic, but they agree that *Acervus* occupies an isolated place that forms a separate monophyletic group.

DISTRIBUTION IN ARGENTINA: only one collection of *A. epispartius* — cited as *A. aurantiacus* — has been found in Argentina from BA.

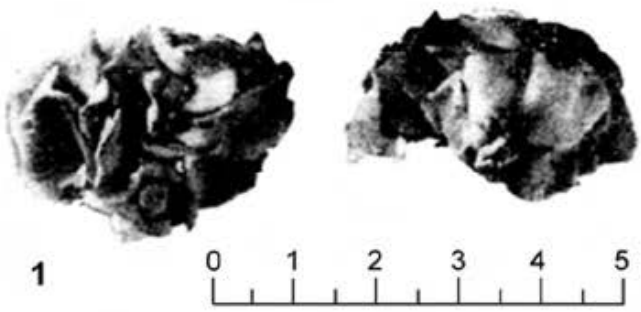
ILLUSTRATION: Pl. 1, 1–6. *Acervus epispartius*.

LITERATURE: Eckblad 1968; Gamundí 1970; Kimbrough 1989; Kimbrough & Curry 1986; Kirk et al. 2008; Korf 1963, 1988; Le Gal 1953; Liu & Zhuang 2006; Moravec 1983; Perry et al. 2007; Pfister 1975; Pfister & Bessette 1985; Pfister & Halling 1989; Zhuang & Wang 1998.

Aleuria (Pers.) Fuckel (*Pyronemataceae*)

ASCOMATA apothecial, small to large, up to 8 cm diam., superficial, sessile to subsessile, cupuliform to cochleate, scattered, gregarious or cespitose, bright coloured; disc smooth, yellow, orange to reddish orange, margin conspicuous; external surface paler than the disc, whitish in dried specimens, pruinose, furfuraceous to tomentose. ECTAL EXCIPULUM of textura angularis to textura globulosa of isodiametric or elongated cells, the external ones ending in superficial, hyphoid, short, obtuse, hyaline hairs. MEDULLARY EXCIPULUM of textura intricata composed of hyaline hyphae densely arranged. Septal pores of excipular cells (TEM) have a lamellate structure and globose Woronin bodies are associated with them. SUBHYMENIUM an orange-yellow zone of textura angularis, of small cells. ASCI cylindrical, 8-spored, J–. PARAPHYSES pluriseptate, subclavate or bent at the apex, containing granules of carotenoids (major pigments β- and γ-carotene, ester of aleuriaxanthine) that turn green with iodine. ASCOSPORES uninucleate, 1-seriate, containing 1-2 guttules, hyaline to pale yellowish, ellipsoidal, with a conspicuous cyanophilic ornamentation ridge- or net-like, sometimes forming apicula at both ends or with prominent pointed warts.

PLATE 1. 1–6. *Acervus epispartius* (LPS 35273). 1. Concrescent ascomata: frontal and lateral view. 2. Vertical section of the ascoma: h, hymenium, sh subhymenium. 3. Ascus apex. 4. Hymenium: a, mature asci, p, paraphyses. 5. Ascospores. 6. Vertical section at the base of the ascoma: c, excipulum, hc, basal hyphae.



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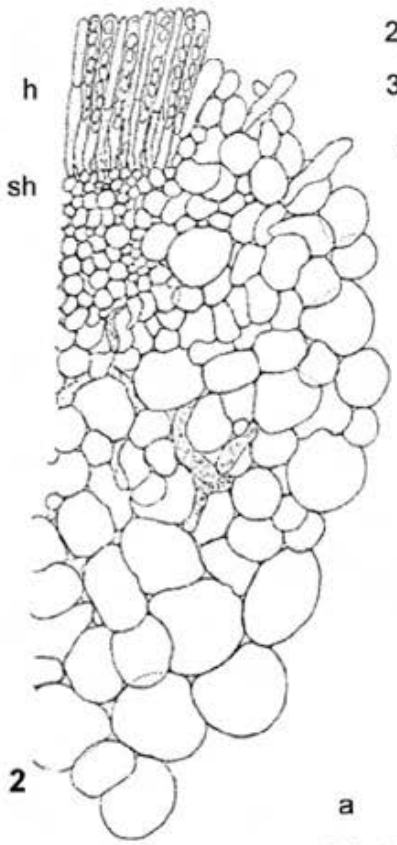

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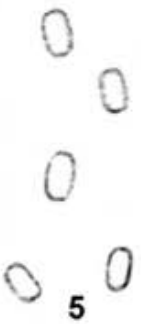

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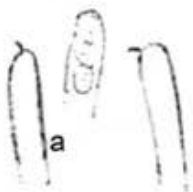

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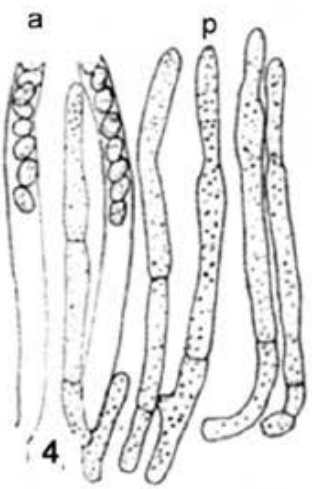

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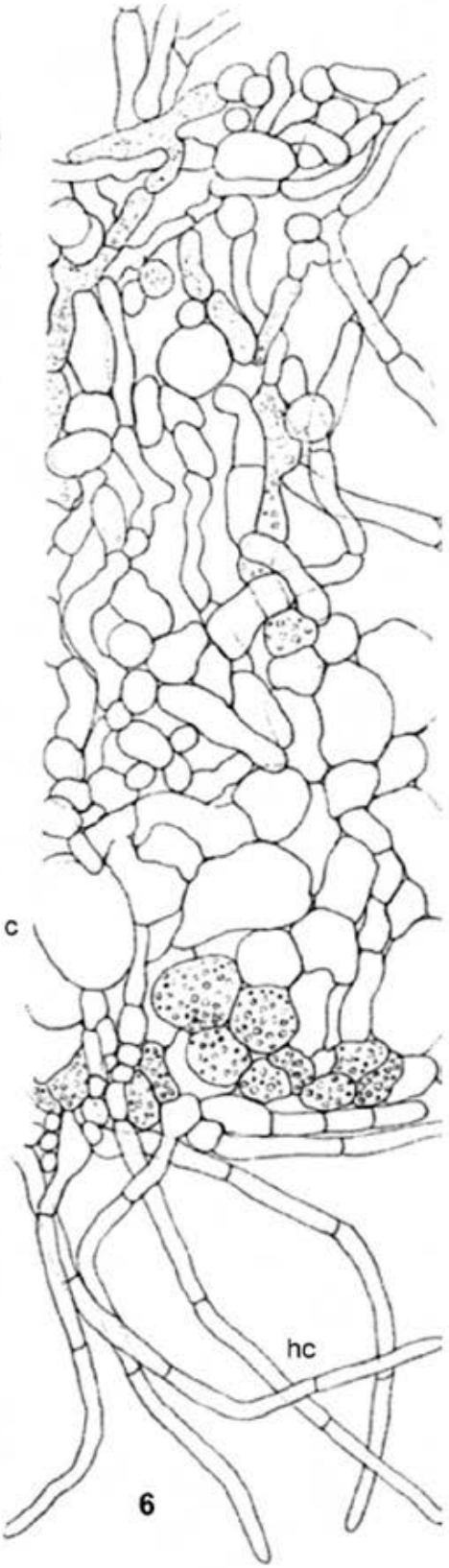

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TYPE SPECIES: ***Aleuria aurantia*** (Pers.) Fuckel, Jahrb. Nassauischen Vereins. Naturk. 23–24: 325. 1870.

HABITAT: on sandy soil, rich forest soil or gravy soil along paths, frequently on disturbed sites, sometimes among grass or mosses.

ANAMORPH: unknown.

NOTES: The cosmopolitan species *Aleuria aurantia* is commonly named orange peel peziza. The genus is close to *Melastiza* due to its mostly reticulate ascospores and paraphyses containing the same carotenoid pigments but differs in the external surface of the apothecium. This similarity led Moravec to unite them under the older name, *Aleuria*, with two subgenera *Aleuria* and *Melastiza*. At least one of Moravec's arguments (i.e., 'the same habitat'; see NOTES under *Melastiza*) for merging both genera is dubious. *Rhodopeziza* is also similar, sharing the coloured hymenium and the cyanophilic ascospore ornamentation, but differs in the weak J+ ascus wall reaction (see NOTES under *Rhodopeziza*). TEM studies of septal structure in the ascal cell and the ascogenous hyphae show a granular opaque matrix, which borders the pore, appearing in older asci as a fan-shaped plug with a lamellate electron-translucent torus adjacent to the pore rim (referred to as the 'aleurioid' type). A phylogram derived from SSU rDNA sequences suggests that *Aleuria* is related to *Byssonectria* P. Karst. and forms a group containing the genera *Scutellinia, Cheilymenia,* and *Pyronema* Carus (Landvik et al. 1997). This clade is not supported by another study based on nLSU rDNA sequences (Perry et al. 2007). It appears that the presence of carotenoid pigment is of little phylogenetic significance.

DISTRIBUTION IN ARGENTINA: *A. aurantia* is the only species recorded, distributed in BA, N, RN, SC, TF.

ILLUSTRATION: Pl. 2, 1–6. *Aleuria aurantia.*

LITERATURE: Arpin 1969; Gamundí 1960, 1975; Gamundí & Horak 2003; Gamundí et al. 2004; Häffner 1993; Kaushal 1976; Kimbrough 1989, 1994; Kimbrough & Curry 1986; Landvik et al. 1997; Liu & Zhuang 2006; Moravec 1972, 1994a; Perry et al. 2007; Rifai 1968; Spooner & Yao 1995.

Aleurina Massee (*Pyronemataceae*)

ASCOMATA apothecial, medium-sized, superficial, sessile to subsessile, scattered to gregarious, cup shaped to discoid at maturity, the base with abundant subhyaline hyphae often enmeshing soil particles; disc olivaceous, brown to

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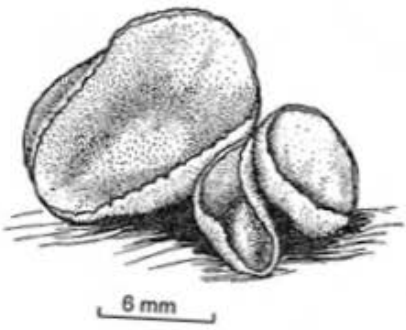
PLATE 2. 1–6. *Aleuria aurantia* (BAFC 21059). Ascomata. 2. Medullary excipulum. 3. Receptacle: surface hairs. 4. Ascospores. 5. Vertical section of the ascoma: sh, subhymenium, m, medullary excipulum, c, ectal excipulum. 6. Ascus and paraphyses.



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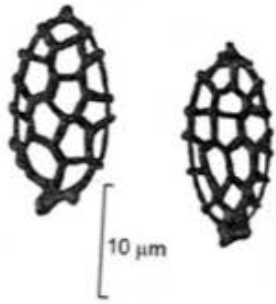

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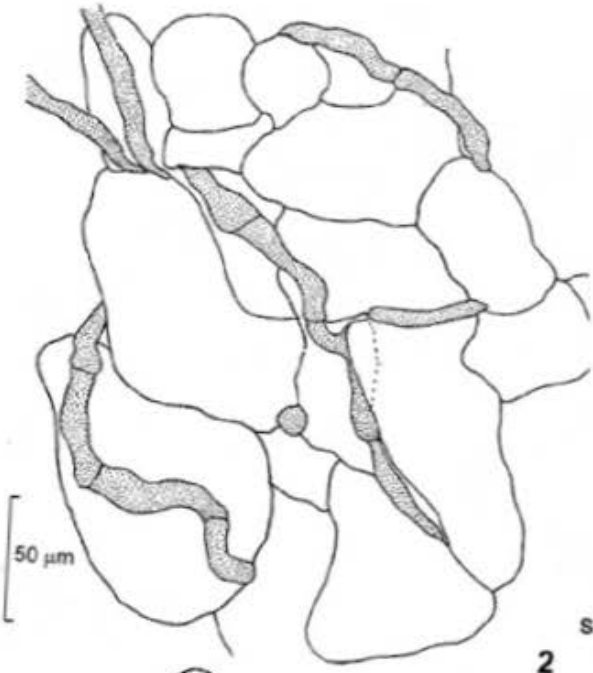

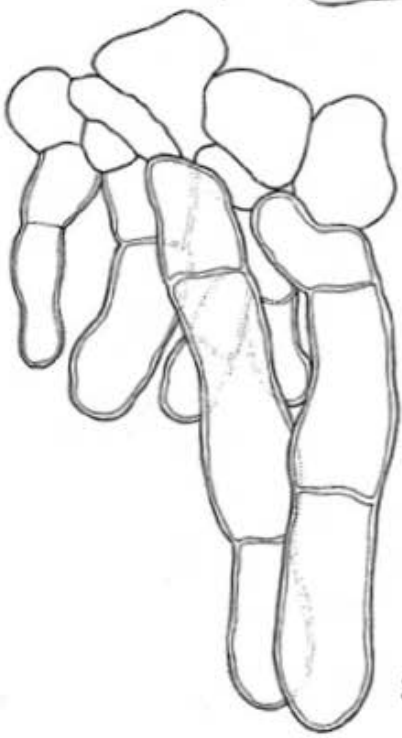

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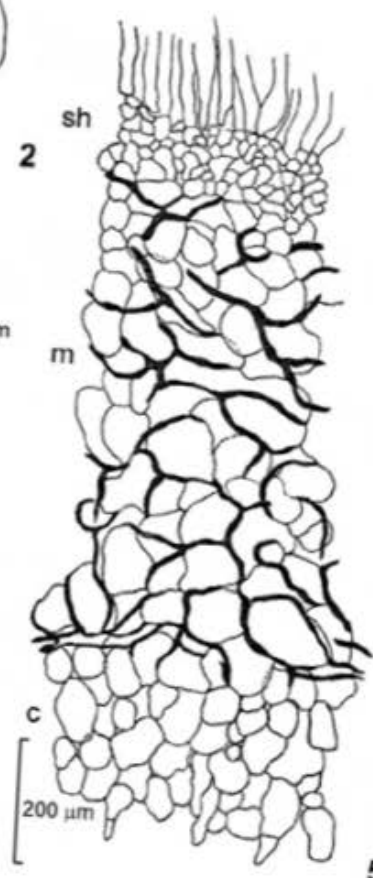

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purplish brown; external surface brown to reddish brown, smooth but pustulate near the margin. ECTAL EXCIPULUM a textura angularis of isodiametric to elongated polygonal light brown cells disposed at right angle to the surface, the most superficial smaller, subglobose with thick dark brown walls, aggregated to form the marginal pustules, sometimes with an extra inner layer of small cells with dark brown walls. MEDULLARY EXCIPULUM of textura intricata, composed of pale brown hyphae running horizontally. SUBHYMENIUM of compact textura intricata. ASCI cylindrical, 4- or 8-spored, J–. PARAPHYSES subcylindrical, subclavate or subcapitate, containing a dark, opaque, brown pigment at the apex, septate. ASCOSPORES uninucleate, 1-seriate, mostly 2-guttulate, hyaline to pale yellow, ellipsoidal, ornamented with cyanophlic conical or rounded warts or spines.

TYPE SPECIES: ***Aleurina tasmanica*** Massee, Bull. Misc. Inf., Kew 1898.

HABITAT: on soil sometimes among bryophytes, wood, or duff.

ANAMORPH: unknown.

NOTES: *Aleurina* is an earlier synonym of *Jafneadelphus* Rifai (1968). It is close to *Jafnea* Korf emend. Rifai in the structure of the ectal excipulum but this genus has superficial brown hairs, a cushion-like pseudostipe, and fusoidal to fusiform-ellipsoidal ascospores. It is also distinct from *Eoaleurina* Korf & W.Y. Zhuang characterized by the ectal excipulum of textura globulosa to angularis with cells of thin, hyaline walls, the most superficial with pigmented cytoplasm. *Smardaea* Svrček differs in the presence of a purplish, water-soluble pigment in the medullary excipulum. A phylogenetic analysis based on LSU rDNA sequences places *Aleurina* in a group that includes *Smardaea.*

DISTRIBUTION IN ARGENTINA: Two species are recorded: *A. argentina* (Rifai) Korf & W.Y. Zhuang, and *A. echinata* (Gamundí) Korf & W.Y. Zhang from N, RN, TF.

ILLUSTRATION: Pl. 3, 1–8. *Aleurina echinata.*

LITERATURE: Eckblad 1968; Dissing 2000; Gamundí 1972a, 1975; Gamundí et al. 2004; Hansen et al. 2001; Korf 1960; 1973a; Rifai 1968; Zhuang & Korf 1986.

Anthracobia Boud. (*Pyronemataceae*)

ASCOMATA apothecial, small- to medium-sized, sessile, discoid, gregarious of fleshy consistency; disc, smooth, plane to concave, yellowish, ochraceous, orange, reddish to grayish brown; margin conspicuous, undulated, sometimes striated due to tufts of hairs; external surface punctuate, covered irregularly

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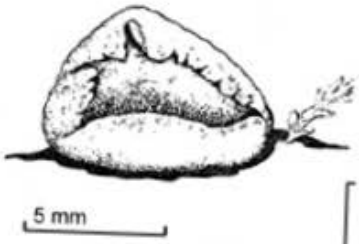
PLATE 3. 1–8. *Aleurina echinata* (BAFC 20856). 1. Ascoma. 2. Detail of the medullary excipulum (m) and inner layer of the ectal excipulum (ci) .3. Vertical section of the ascoma: h, hymenium, sh, subhymenium, c, ectal excipulum, m, ci, as in FIG. 2. 4. Sketch of a vertical section of the ascoma: h, m, c, as is FIG. 3. 5. Ascospores. 6. Detail of ectal excipulum. 7. Paraphyses. 8. Ascus.



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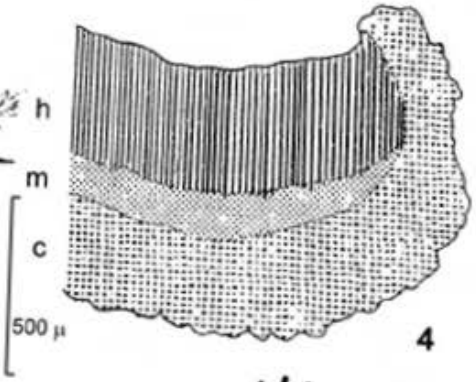

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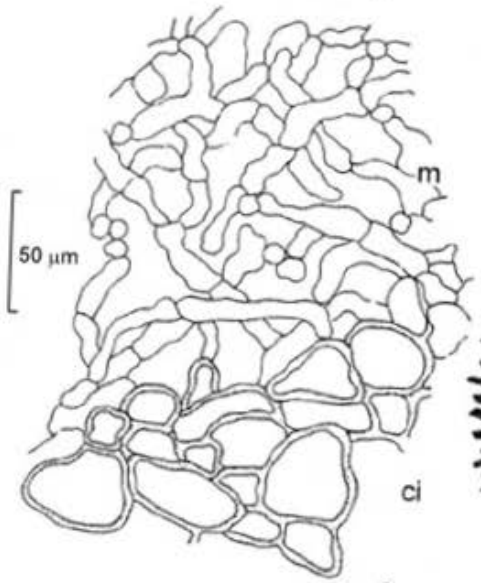

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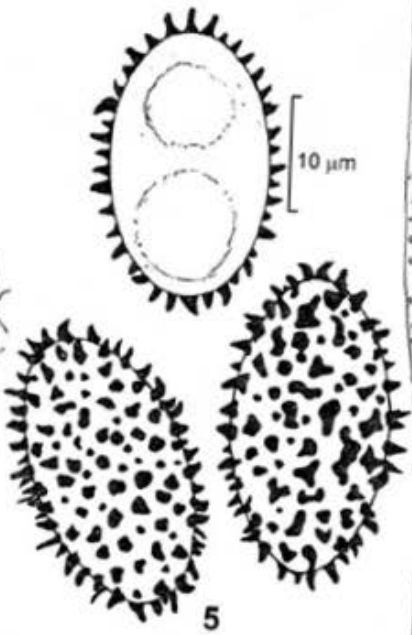

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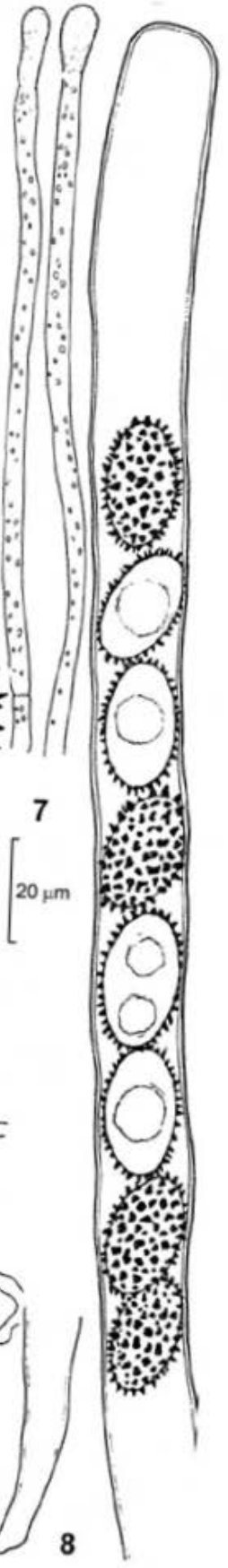

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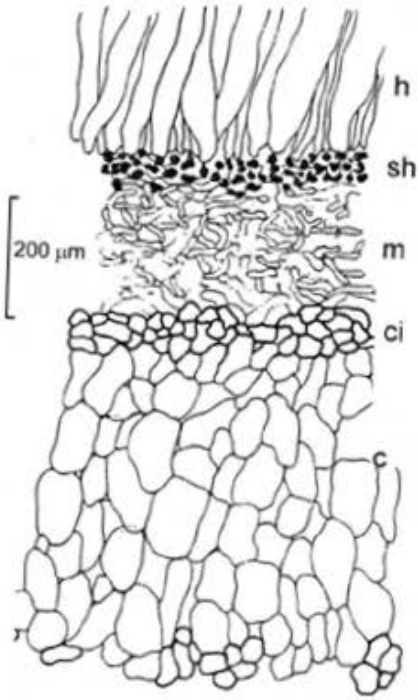

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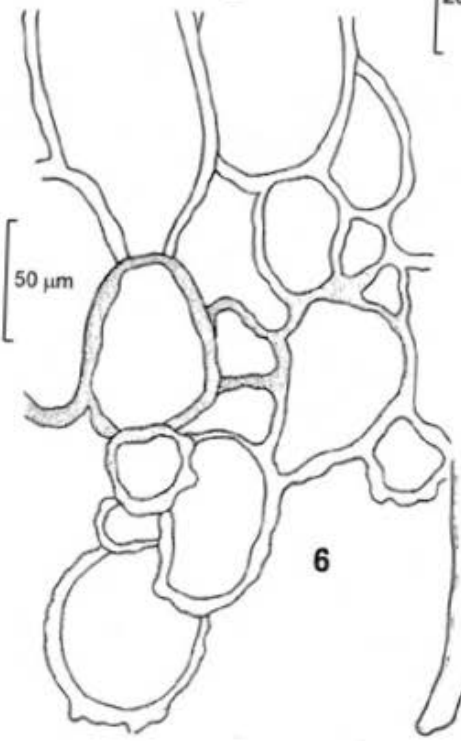

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8

with bunches of short, superficial, brown, blunt, flexuous or straight hairs with few septa. ECTAL EXCIPULUM of textura angularis composed of isodiametric cells of hyaline to brownish walls, arranged in rows perpendicular to the external surface, the most superficial extending sometimes to form hairs. MEDULLARY EXCIPULUM of textura intricata, hyaline. ASCI cylindrical, 8-spored, J–. PARAPHYSES clavate at the apex and containing granules of pigment. ASCOSPORES uninucleate, 1-seriate, 2- to multiguttulate, sometimes with de Bary bubble, hyaline, smooth, ellipsoidal.

TYPE SPECIES: ***Anthracobia melaloma*** (Alb. & Schwein.) Arnould, Bull. Soc. Mycol. France 9:112. 1893.

HABITAT: anthracobiontic, typically on burnt soil or charred wood.

ANAMORPH: *Scytalidium*-like, as registered in Kirk et al. (2008). *Scytalidium* Pesante is a dematiaceous hyphomycete that forms chains of brown and hyaline, 0–1 septate arthroconidia.

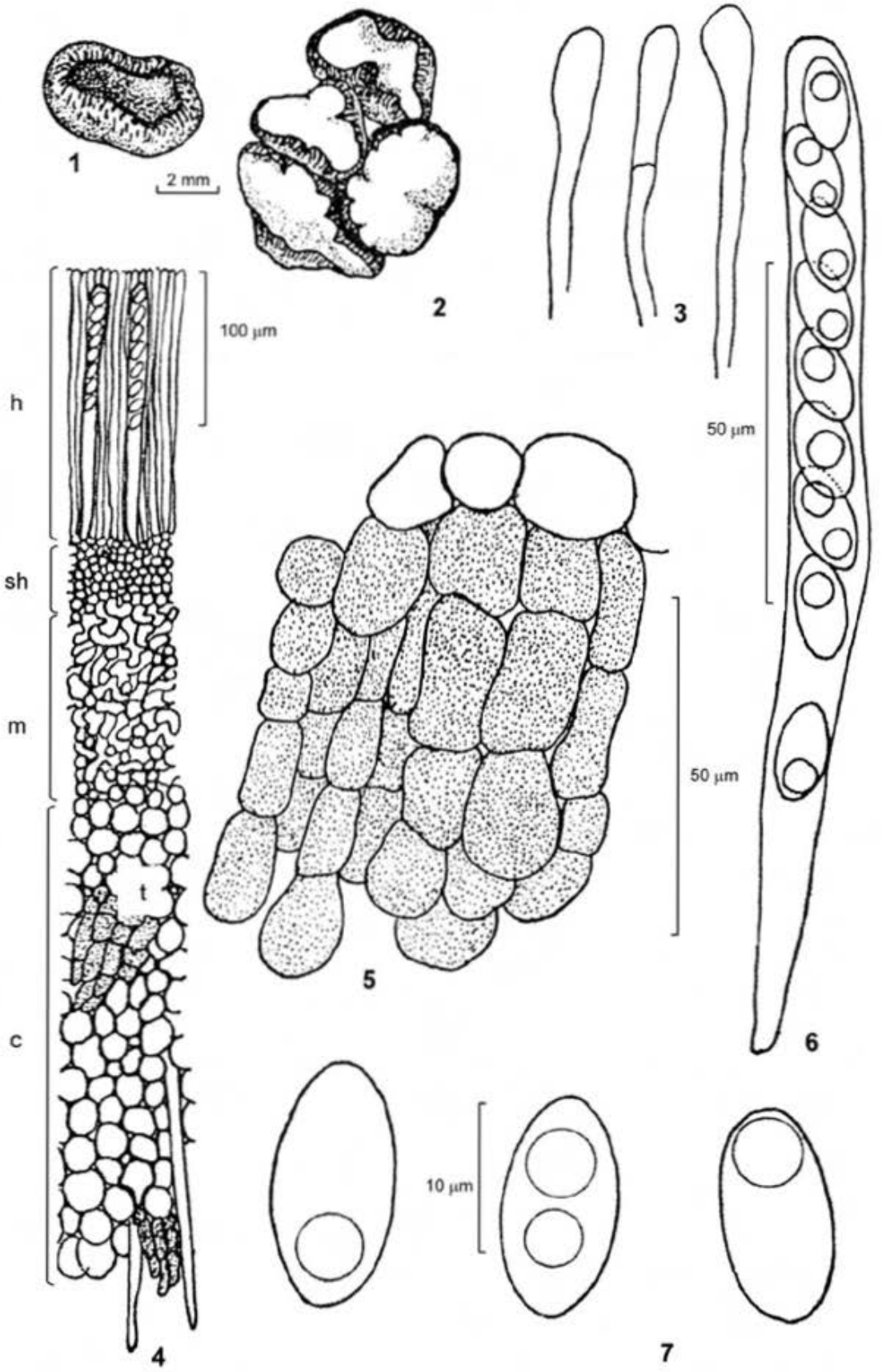
NOTES: *Anthracobia* is similar to *Melastiza* that also has blunt, brown, short hairs but in this genus the ascospores have ornamented epispore (see description of *Melastiza*). Septal structure in *Anthracobia* ascogenous hyphae (TEM) shows pores filled with an electron-opaque granular matrix, and paraphyses with crystalloid, hexagonal, or rectangular Woronin bodies around the septal pore. It is also related to *Trichophaea*, which has long, pointed hairs. Recent phylogenetic studies based on partial sequences of nLSU rDNA support this relationship but boundaries between both genera remain unclear. It is also suggested that both genera are non-monophyletic. Another molecular study based in SSU rDNA sequences support the close relationship between *Anthracobia* and *Sphaerosporella* (Svrček) Svrček & Kubička, distinct by its globose ascospores. In a recent ecological paper the authors hypothesize that *Anthracobia*, as other postfire fungi, is one of the pivotal species in early restoration of forest systems after disturbance, binding soil particles in the absence of plant roots and potentially helping to reestablish the vegetation.

DISTRIBUTION IN ARGENTINA: Two species are recorded: *A. melaloma* and *A. maurilabra* (Cooke) Boud. from BA, ER, S.

ILLUSTRATION: Pl. 4, 1–7. *Anthracobia melaloma*.

LITERATURE: Claridge et al. 2009; Dennis 1978, 1995; Dissing 2000; Gamundí 1960, 1975; Hansen & Pfister 2006; Kimbrough & Curry 1986; Kirk et al. 2008; Liu & Zhuang 2006; Perry et al. 2007; Rifai 1968; Sigler & Carmichael 1976; Sigler & Wang 1990; Svrček & Kubička 1961; Yao & Spooner 1995c, 1996b.

PLATE 4. 1–7. *Anthracobia melaloma* (LPS 18527). 1. Ascoma. 2. Gregarious ascomata. 3. Paraphyses. 4. Vertical section of the ascoma: h, hymenium, sh, subhymenium, m, medullary excipulum, c, ectal excipulum, t, tuft of hairs. 5. Detail of the ectal excipulum. 6. Ascus. 7. Ascospores.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7

Cheilymenia Boud. (*Pyronemataceae*)

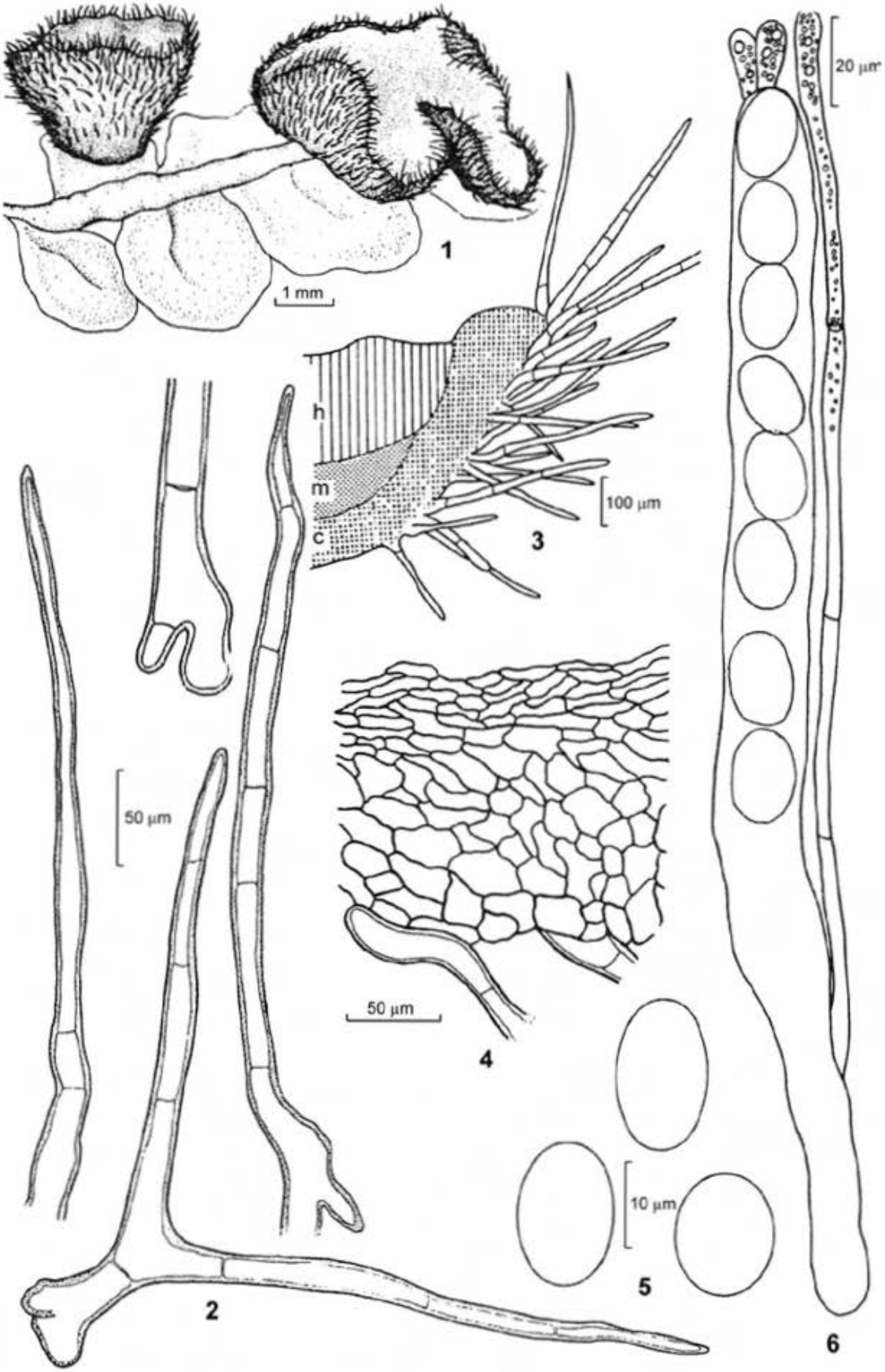
ASCOMATA apothecial small- to medium-sized, superficial, sessile, barrel-shaped, lenticular or scutellate, scattered to gregarious, usually bright coloured; disc smooth, plane to convex, yellow, orange to reddish; margin conspicuous, hairy; external surface the same colour of the disc or paler; hairs hyaline, yellowish to brown, 100–1000 µm long, pluriseptate, simple, forked or bulbous at the base, arising deeply from the excipulum, in some species also with superficial hairs, stellate or hyphoid, mainly at the base of the ascoma. ECTAL EXCIPULUM of textura angularis to textura globulosa of isodiametric cells. MEDULLARY EXCIPULUM poorly differentiated, a textura intricata to epidermoidea of hyaline hyphae. ASCI cylindrical to subcylindrical, operculate, usually 8-spored, J–. PARAPHYSES pluriseptate, straight, subclavate at the apex, usually containing carotenoid granules, γ-carotene as a major pigment. ASCOSPORES uninucleate, 1-seriate, usually eguttulate, hyaline to pale yellowish, ellipsoidal, smooth or verruculose, longitudinally striate, cristulate with crests that can anastomose, the perispore easily separable and delicate, cyanophilic.

TYPE SPECIES: ***Cheilymenia stercorea*** (Pers.) Boud., Icones Mycol. Liste Préliminaire [3] 1904.

HABITAT: on soil, plant debris, dung, liverworts.
ANAMORPH: unknown.

NOTES: *Cheilymenia* is closely related to *Scutellinia*. Both share morphogical characters such as hairs arising deeply from the excipulum and the same major pigment. TEM studies in apothecial tissues of *Cheilymenia* revealed that pores in ascogenous hyphae are occluded by Woronin bodies covered by a deeply staining amorphous electron opaque substance, a scutellinioid-type feature that is shared with *Scutellinia*. A SSU rDNA sequence-based study shows that *C. coprinaria* (Cooke) Boud. [= *C. fimicola* (De Not. & Bagl.) Dennis] and some species of *Scutellinia* are sister groups and that *C. stercorea* is closer to *Byssonectria*. Other studies support the view that this genus is not monophyletic. Several features separate *Cheilymenia* from *Scutellinia:* A) *Cheilymenia* has also superficial hairs and otherwise the rooting hairs can be pigmented or hyaline; B) ascospores eguttulate, if verruculose or striate, show a delicate outer wall (perispore) that separates when treated with lactic acid; and C) globose ascospores have never been recorded. Some species of *Cheilymenia* are related to *Coprobia* but the latter has hairless apothecia, the excipulum totally of textura globulosa, and the robust and capitate paraphyses. However, based on SEM studies in the

PLATE 5. 1–6. *Cheilymenia villosa* (LPS 36718). 1. Ascomata on liverworts. 2. Marginal hairs. 3. Sketch of a vertical section of the ascoma: h, hymenium, m, medullary excipulum, c, ectal excipulum. 4. Ectal excipulum with basal hairs. 5. Ascospores. 6. Ascus and paraphyses.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ascospore wall, Moravec merged both genera under *Cheilymenia*, proposing an infrageneric classification and recognizing nine sections, including *Coprobiae*. I think that in the sense of this author the concept of the genus is a very wide assemblage of diverse species.

DISTRIBUTION IN ARGENTINA: two species are recorded from a Central province (BA): *C. hyalochaeta* (Speg.) Gamundí and *C. fraudans* (P. Karst.) Boud. and seven species from Patagonia (N, RN, SC, T, TF): *C. megaspora* (Gamundí) J. Moravec, *C. fimicola C. humarioides* (Rehm) Gamundí, *C. raripila* (W. Phillips) Dennis, *C. stercorea*, *C. theleboloides* (Alb. & Schwein.) Boud., *C. villosa* Gamundí.

ILLUSTRATION: Pl. 5, 1–6. *Cheilymenia villosa*.

LITERATURE: Arpin 1969; Denison 1964; Gamundí 1960, 1966, 1972b, 1975; Gamundí et al. 2004; Kimbrough 1994; Kimbrough & Curry 1986; Liu & Zhuang 2006; Moravec 1968, 1984, 1989, 1990, 1994b, 1998, 2003, 2005, 2006; Perry et al. 2007; Wu & Kimbrough 1992.

Cookeina Kuntze (*Sarcoscyphaceae*)

ASCOMATA apothecial, medium-sized to large, cup shaped, superficial, sessile, subsessile to stipitate, scattered to gregarious, usually bright coloured, but occasionally pale; disc concave, smooth, in several shades of orange, pink, reddish, purplish or brownish; margin conspicuous, elevated; external surface, pruinose, furfuraceous or hirsute, paler than the disc; furfuration consisting of conical mounds; hairs, when present, fasciculate, covering margin and receptacle, sometimes down the stipe, arising from the medullary or ectal excipulum. ECTAL EXCIPULUM thin, of textura angularis to globulosa of isodiametric cells arranged in rows perpendicular to the surface where they aggregate in conical or dome-like projections that gives the scurfy appearance to the receptacle. MEDULLARY EXCIPULUM well developed, a textura porrecta of hyaline hyphae parallel to the surface of the receptacle, sometimes forming a gelatinous layer, which gives a subgelatinous consistency to the ascoma. ASCI cylindrical to subcylindrical, suboperculate (asymmetrical operculum), thick walled (three layers visible with TEM), contracted below forming an apendiculate base, 8-spored, J–, maturing simultaneously. PARAPHYSES pluriseptate, filiform, straight, profusely branched near the apex, sometimes anastomosing and forming a delicate net, containing carotenoids (major pigment phillipsiaxanthine). ASCOSPORES multinucleate, 1-seriate, containing 1–2 large guttules, hyaline to pale yellowish, ellipsoidal to fusoid, sometimes apiculate at both ends and inaequilateral, smooth or striate, in this case with longitudinal ridges that occasionally anastomose between them or connected

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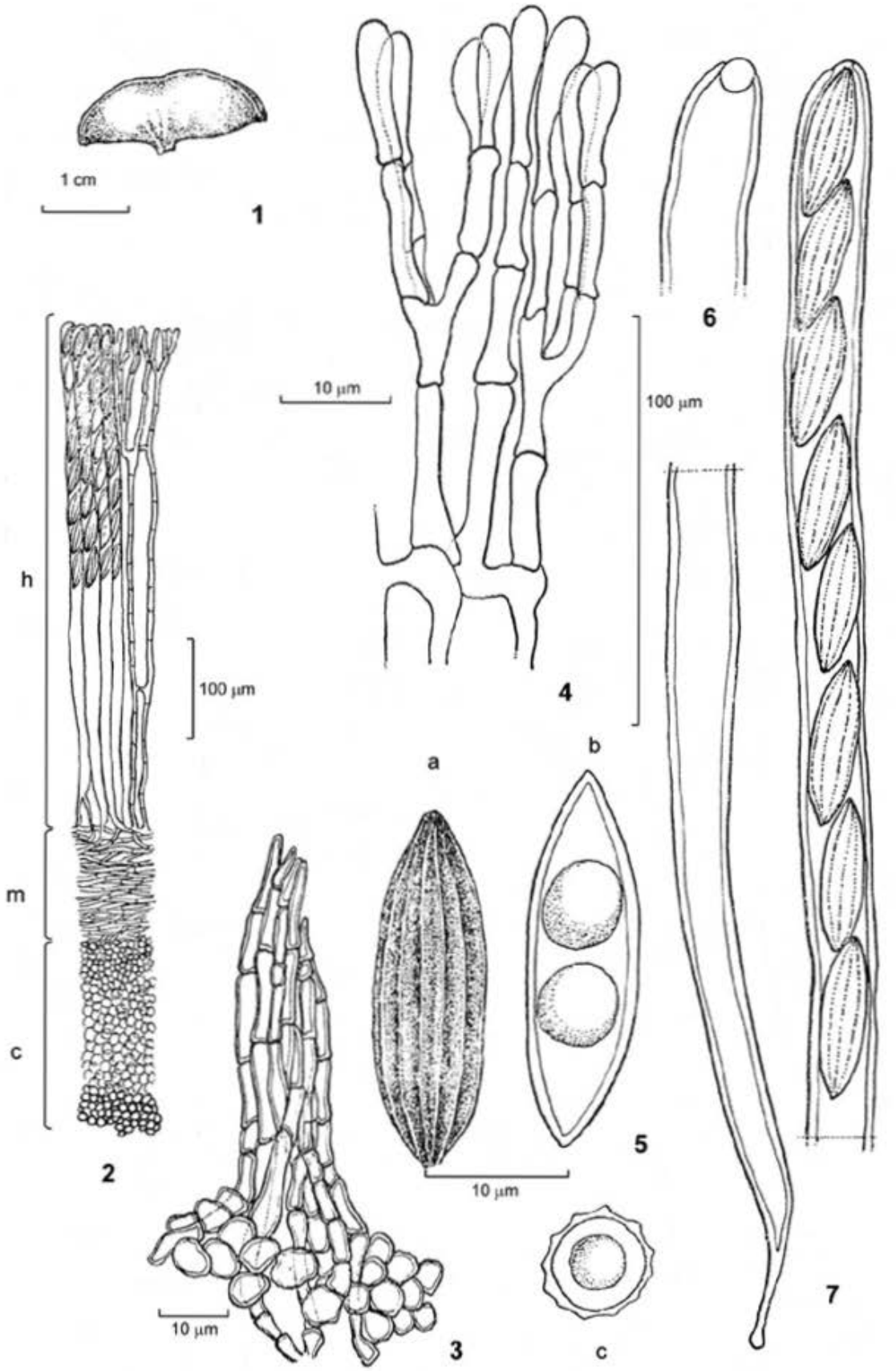
PLATE 6. 1–7. *Cookeina venezuelae* (LIL, Singer T-2291). 1. Ascoma. 2. Vertical section of the ascoma: h, hymenium, m, medullary excipulum, c, ectal excipulum. 3. Fascicle of excipular hairs. 4. Paraphyses. 5. Ascospores: a, surface view, b, optical vertical section, c, optical cross section. 6. Ascus apex. 7. Ascus.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100 µm
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a
b
10 µm
5
10 µm
3
c
7

by fine transverse markings not stained with lactic blue (cyanophobic), wall two layered.

TYPE SPECIES: ***Cookeina tricholoma*** (Mont.) Kuntze, Revisio Genera Plantarum 2: 849. 1892.

HABITAT: on fallen angiosperm branches, logs, dead twigs or wood and debris.

ANAMORPH: ascospores germinate giving rise to globose to subglobose, hyaline, conidium-like structures.

NOTES: *Cookeina* shows affinities with *Microstoma* Bernstein, *Boedijnopeziza* S. Ito & S. Imai, and *Phillipsia*. *Microstoma* differs in having a multilayered excipulum, simple, flexuous hairs, and universally smooth ascospores. Molecular analysis shows that *Cookeina* and *Microstoma* Bernstein are sister groups. Morphologically *Boedijnopeziza* differs from *Cookeina* by its turbinate or urceolate ascoma and the origin of hairs. Molecular studies demonstrate a close relationship between both genera suggesting synonymy. Therefore the type species, *Boedijnopeziza insititia* (Berk. & M.A. Curtis) S. Ito & S. Imai has been transferred to *Cookeina*. *Phillipsia,* which differs in the microstructure of the ectal excipulum, a textura intricata to porrecta that gives a coriaceous consistency to the ascoma, the simple superficial hairs, and the universally inequilateral ascospores, is widely recognized as different from *Cookeina*.

This genus is pantropical and distributed in the tropics and subtropics. The drawings of *C. venezuelae* (Berk. & M.A. Curtis) Le Gal that illustrate this genus are based on collections from Tucumán, Argentina (LIL T-2291) and show only longitudinal ridges but not the fine transversal interconnecting ridges noted by Iturriaga and Pfister on material from Colombia (FH 1161).

DISTRIBUTION IN ARGENTINA: *C. colensoi* (Berk.) Seaver, *C. tricholoma,* and *C. venezuelae* are recorded from the subtropical area: BA, J, M, T.

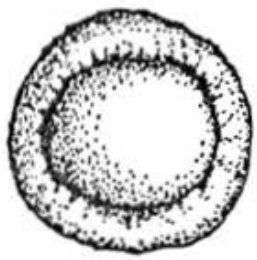
ILLUSTRATION: Pl. 6, 1–7. *Cookeina venezuelae.*

LITERATURE: Arpin 1969; Boedijn 1933; Cabello 1988; Denison 1967; Eckblad 1968; Gamundí 1957a, 1959, 1983; Harrington et al. 1999; Iturriaga & Pfister 2006; Le Gal 1953; Meléndez-Howell et al. 2003; Romero & Gamundí 1986; Paden 1975, 1984; Weinstein et al. 2002; Zhuang & Wang 1998.

Coprobia Boud. (*Pyronemataceae*)

ASCOMATA apothecial, small, superficial, sessile, scutellate to pulvinate, gregarious, ochraceus-orange, disc plane to convex, often granulose due to the protruding ripe asci; external surface hairless, paler than the disc. EXCIPULUM 1-layered, of textura globulosa comprising large, isodiametric cells up to 100 µm,

PLATE 7. 1–7. *Coprobia granulata* (LPS 27324). 1–2. Ascomata. 3. Vertical section of the ascoma: h, hymenium, sh, subhymenium, e, excipulum. 4. Paraphyses. 5. Ascus. 6. Mature ascospore. 7. Young ascospore.



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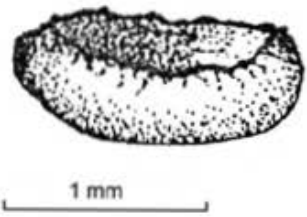

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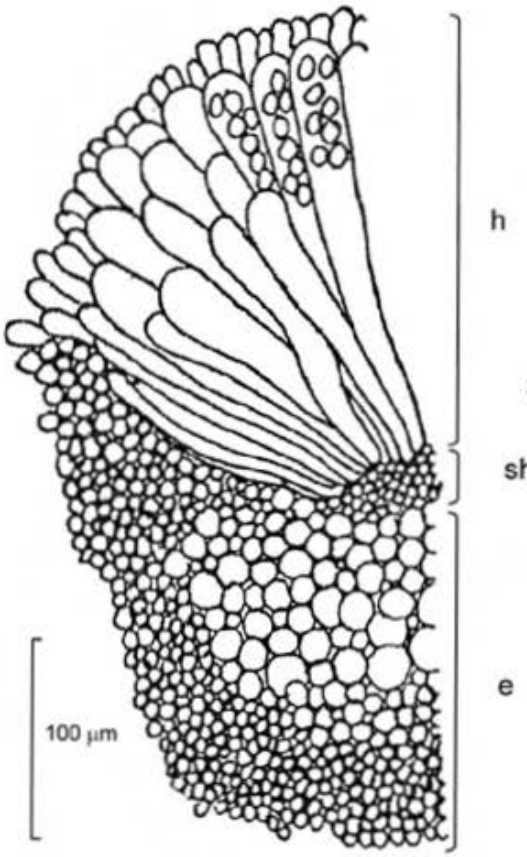

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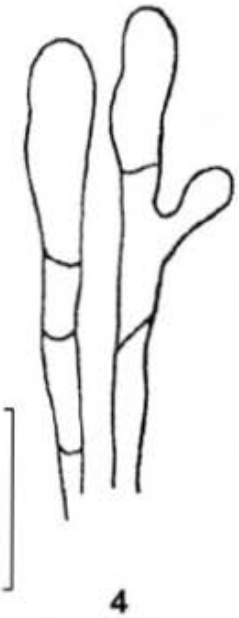

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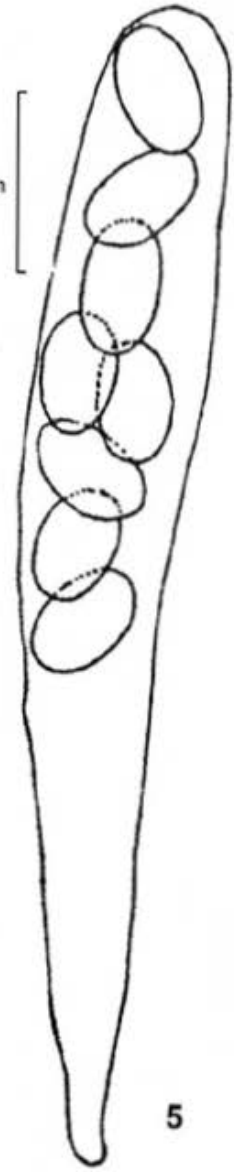

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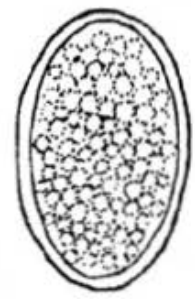

7

in the exterior of the receptacle smaller in the inner part. Asci subcylindrical, operculate, 8-spored, J–. Paraphyses pauci-septate, robust, straight, capitate at the apex, containing granules of carotenoids (major pigments β- and γ-carotene). Ascospores uninucleate, 1-seriate, hyaline, without oil guttules, ellipsoidal, smooth or finely striate, with the outer wall easily loosened when heated in lactic acid.

Type species: ***Coprobia granulata*** (Bull.) Boud., Hist. class. Discom. d'Europe: 69. 1907.

Habitat: on dung of several herbivorous mammals and manure.
Anamorph: unknown.

Notes: *Coprobia* is related to *Cheilymenia*. Main distinctions are: a) the latter is conspicuously hairy, the hairs being rooting and sometimes having superficial hairs; b) the excipulum usually differenciated in two layers; and c) paraphyses are more slender than in *Coprobia*. Moravec at first recognized *Coprobia*, including also a new species, but in his later revision of *Cheilymenia*, he considered *Coprobia* a section of *Cheilymenia* (see Notes under *Cheilymenia*). His conception of this genus is very wide and is based mainly on the morphology of the ascospores. Other authors maintain *Coprobia* as a separate genus, emphasizing the structure of the excipulum, entirely of textura globulosa, and the receptacle devoid of hairs. These features are nowadays accepted in discomycete taxonomy as valuable characters for distinguishing genera. I accept this view. Furhermore, in *Coprobia granulata* the hymenial surface appears rough from protruding asci and capitate paraphysis, a character absent in *Cheilymenia*.

Distribution in Argentina: only *C. granulata* is recorded from BA. Rehm (1899) described *Humaria granulata* f. *guanaconis* Rehm and *Humaria guanaci* Rehm from Tierra del Fuego, both on "guanaco" (*Lama guanicoe*) dung. These most probably are *Coprobia granulata*, but the type specimens are both missing.

Illustration: Pl. 7, 1–7. *Coprobia granulata*.

Literature: Arpin 1968; Dennis 1978, 1986, 1995; Gamundí 1960, 1975; Gamundí et al. 2004; Moravec 1984; Rifai 1968; Rehm 1899.

Geopora Harkn. emend. Burds. (*Pyronemataceae*)

Ascomata cupulate, globose to subglobose, solitary or gregarious; hypogeous forms closed but sometimes opening superficially at maturity, discharging ascospores actively (puffing); hymenial surface concave or convoluted; outer surface covered by a dense mat of dark hairs. Hymenium smooth or convoluted (ptychothecia). Ectal excipulum of textura angularis, cells up to 60 µm diam.,

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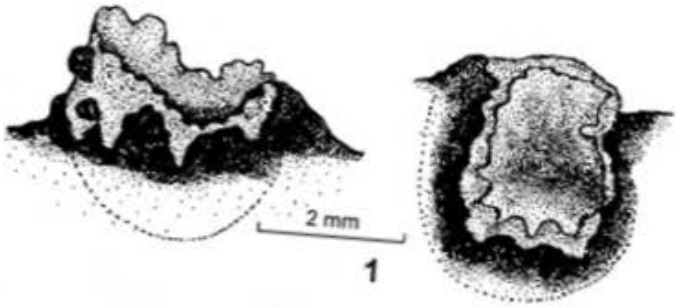
Plate 8. 1–6. *Geopora arenicola* (BAFC 21685). 1. Ascomata: lateral and frontal view. 2. Ascospores. 3. Vertical section of the ascoma: h, hymenium, m, medullary excipulum, c, ectal excipulum, p, hairs. 4. Detail of hairs. 5. Paraphyses. 6. Ascus base and upper portion.



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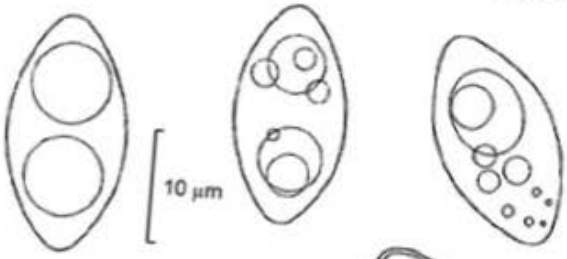

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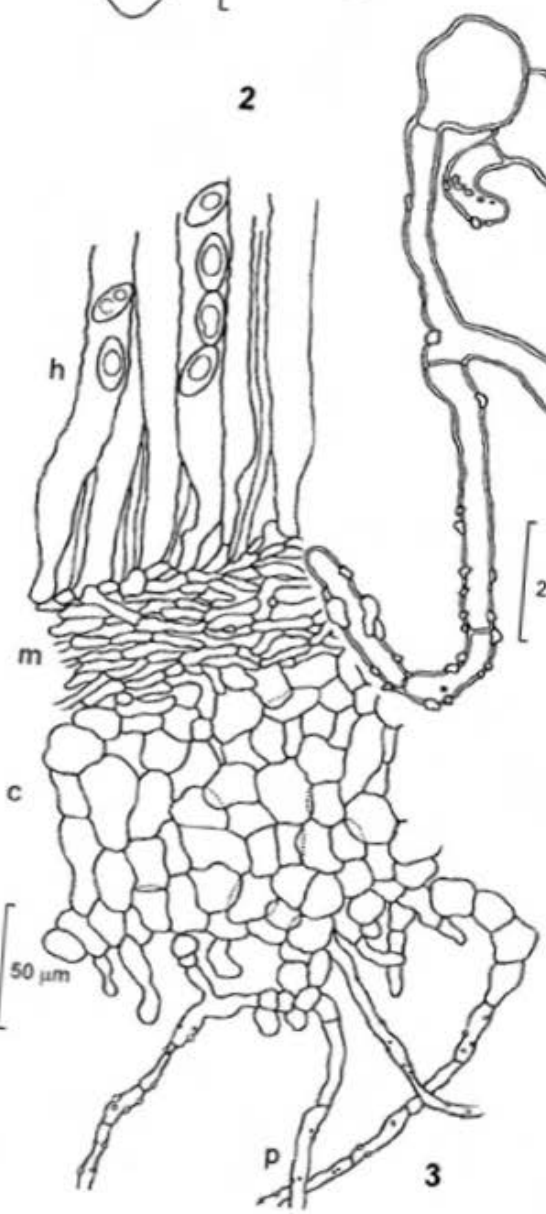

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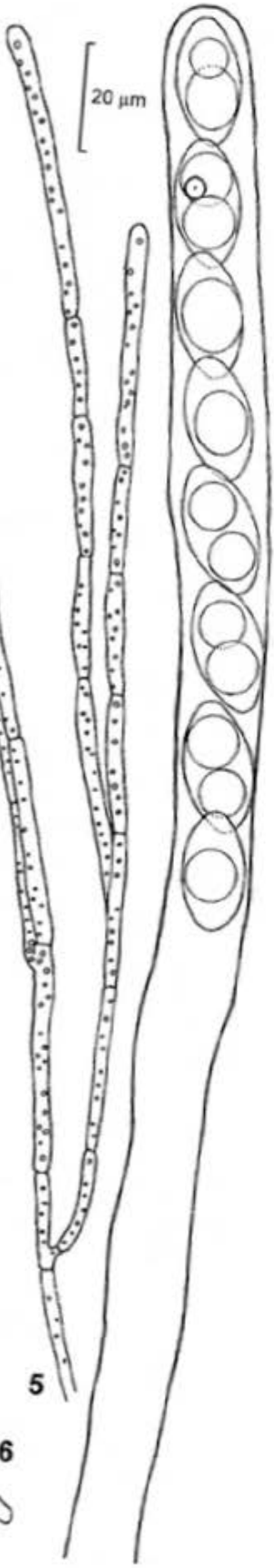

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thick walled, dark, giving rise to superficial, flexuous, pigmented hairs, ending in obtuse tip (8–14 µm thick), simple or branched, multiseptate. MEDULLARY EXCIPULUM a textura intricata of hyaline, thin walled hyphae. ASCI cylindrical, operculate, 8-spored, J–, arranged in a hymenial layer. PARAPHYSES slender, thin walled, septate, hyaline or slightly swollen at the apex. ASCOSPORES uninucleate, uniseriate, 1- or multiguttulate, containing oil droplets, hyaline, thin-walled, smooth, subglobose to elliptical, sometimes collapsing laterally.

TYPE SPECIES: ***Geopora cooperi*** Harkn., Bull. California Acad. Sci. 1: 168. 1885.

HABITAT: in or on soil, under various species of trees or shrubs.
ANAMORPH: unknown.

NOTES: *Geopora* is here considered in the concept of Burdsall, which contains not only the hypogeous but also the epigeous species included by Boudier in *Sepultaria* (Cooke) Boud. The type species, *G. cooperi*, may be hypogeous as well as epigeous. The position of the ascoma regarding the soil surface, which appears to have evolved independently multiple times within the *Pyronemataceae*, is not considered diagnostic for the genus or phylogenetically significant. Formerly placed in *Tuberales*, *Geopora* was moved by Burdsall to the *Pezizales* (*Pyronemataceae*) because the asci are operculate. The genus is related to *Hydnocystis* Tul. & C Tul. (formerly *Tuberales*, now also *Pezizales*), which has asci without operculum and paraphyses forming an epithecium. *Geopora* is also related to *Trichophaea* (*Pezizales, Pyronemataceae*), which differs in possessing rigid hairs. A molecular study demonstrated that some *Geopora* species are mycobionts forming ectomycorrhiza with coniferous and deciduous trees. The corresponding phylogenetic analysis suggests affinities with *Tricharina*.

DISTRIBUTION IN ARGENTINA: widely distributed in the Northern Hemisphere, only one species is recorded: *Geopora arenicola* (Lév.) Kers, cited as *Sepultaria arenicola* (Lév.) Massee from BA, ME, RN, TF.

ILLUSTRATION: Pl. 8, 1–6. *Geopora arenicola*.

LITERATURE: Boudier 1885; Burdsall 1968; Gamundí 1960, 1975; Korf 1973a; Læssøe & Hansen 2007; Tedersoo et al. 2006; Trappe 1979; Yang & Korf 1985a,b; Yao & Spooner 1996a; Zhang & Yu 1992.

Gyromitra Fr., nom. cons. (*Discinaceae*)

ASCOMATA apothecial, cupulate, discoid, convex to undulate or pileate with pileus irregularly lobed or convoluted, medium-sized to large; superficial, subsessile to distinctly stipitate; solitary or scattered; fleshy consistency, leathery when dry; hymenium yellow-brown, orange-brown, chesnut-brown

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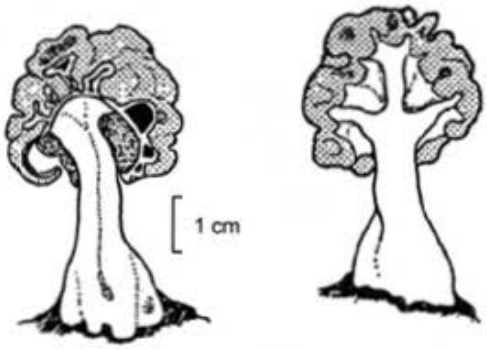
PLATE 9. 1–7. *Gyromitra antarctica* (BAFC 22009). 1. Ascomata. 2. Sketch of a cross section of the pileus: h, hymenium, m, medullary excipulum. 3. Detail of medullary excipulum (m, in FIG. 2). 4. External hyphae from the stipe. 5. Paraphyses. 6. Ascospores. 7. Ascus base and upper portion.



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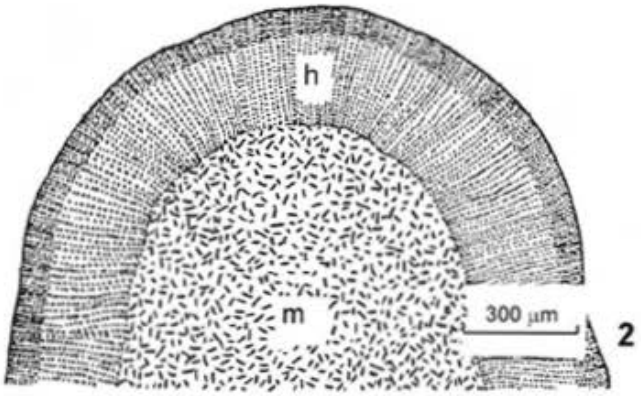

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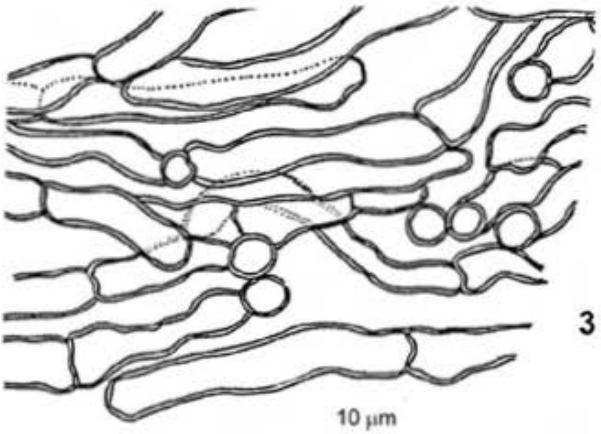

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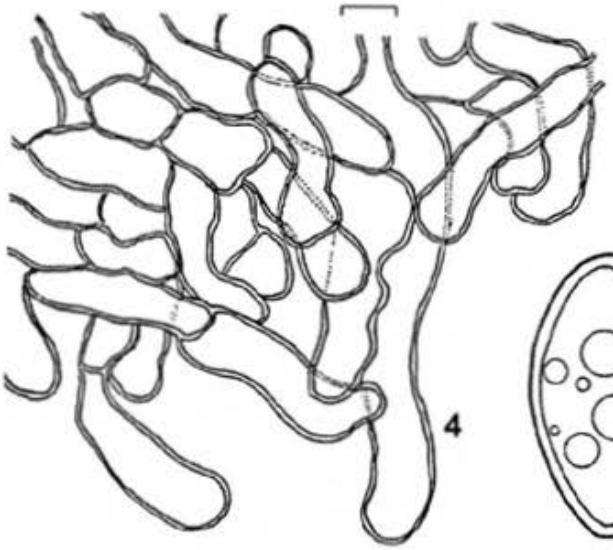

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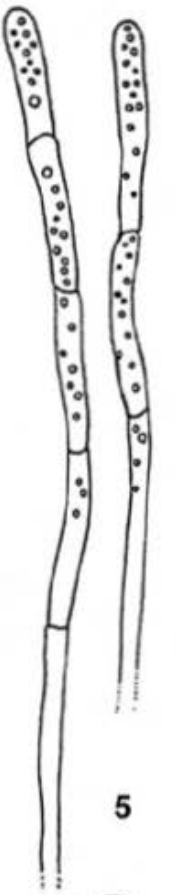

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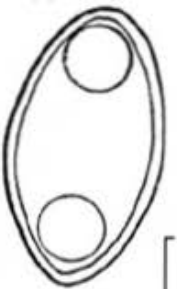

6

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to dark brown; margin free, recurved; external surface glabrous to pubescent, paler than the hymenium; stipe cylindrical, terete or slightly sulcate, tapering or bulbous near the base, solid, hollow or lacunose, white or with a reddish tinge at the base, glabrous to pubescent. EXCIPULUM entirely of textura intricata at maturity, composed of hyaline, inflated hyphae with septal structure (TEM) showing pores occluded by an electron-dense material and surrounded by elongate Woronin bodies. ASCI cylindrical to subcylindrical, 8-spored, J-. PARAPHYSES straight or forked, robust, slightly enlarged at the apex, with an extracellular incrusted and/or intracellular diffuse reddish brown pigment. ASCOSPORES 4-nucleate, 1–2 seriate, usually containing 1–2 lipid guttules, if 3 the central one larger, hyaline, ellipsoidal to subfusoidal, with or without apiculi at both poles, smooth, verruculose to finely reticulate (SEM), with cyanophilic perispore.

TYPE SPECIES: ***Gyromitra esculenta*** (Pers.) Fr. Summa Veg. Scand., Pars Posterior: 346. 1849.

HABITAT: on soil in deciduous or coniferous forests along path and disturbed areas or on decaying wood, in springtime.

ANAMORPH: unknown.

NOTES: *Gyromitra* is taken here in the wide sense of Harmaja to include *Discina* (Fr.) Fr., *Paradiscina* Benedix, and *Neogyromitra* S. Imai; the first is considered a subgenus distinguished by subsessile, convex ascomata and 3-guttulate, apiculate ascospores, features that Harmaja considered of quantitative value, since the excipulum and ascospore wall structures are similar. TEM study of the origin of ascospore walls in *Gyromitra* showed that apiculum and/or spore wall arise from blebbing of the primary wall material through the epispore into the secondary wall upon which a fibrillar deposit from the perisporic sac forms the ornamentation. It shares with *Helvella* 4-nucleate ascospores with lipid guttules and the septal ultrastructure, but the pileus and excipular structures differ. (See description of *Helvella*). Some species of *Gyromitra* are poisonous due to a heat-labile substance called gyromitrin. *Gyromitra* (false morel or lorchel) also shows affinity with *Morchella* (known commonly as morel, a precious edible mushroom) because of the pileate ascomata. Both coexist in similar habitats in springtime in SW Argentina. The collector should recognize the latter by the typically honeycombed ochre or grey-brown pileus.

DISTRIBUTION IN ARGENTINA: only one species, *G. antarctica* Rehm, is recorded with certainty from the Andean-Patagonian forest from N, RN.

ILLUSTRATION: Pl. 9, 1–7. *Gyromitra antarctica*.

LITERATURE: Abbott & Currah 1997; Benedix 1966, 1969; Eckblad 1968; Gamundí 1960, 1971; Gamundí & Horak 2003; Gamundí et al. 2004; Harmaja 1973, 1976a,b; Häffner 1987; Kimbrough 1994; Kimbrough et al.1990; Kimbrough & Gibson 1991.

Helvella L. (*Helvellaceae*)

ASCOMATA epigeous, cupulate, auriculoid or pileate with a pileus discoid, saddle-shaped or lobate, rarely sparassoid, small to large, superficial, subsessile to stipitate, solitary, scattered or gregarious, of fleshy consistency; hymenium (disc) whitish to cream coloured, grayish, brown to black; margin free, involute to recurved, undulate, entire to crenate, sometimes with crystalline deposits; external surface glabrous, pubescent to villose, concolorous or paler than the disc; stipe cylindrical, terete or externally sulcate, with longitudinal ribs that may anastomose and invade the receptacle, solid, hollow or lacunose, white, cream coloured or pale grayish to dark gray-brown, glabrous, pubescent to villose. ECTAL EXCIPULUM of textura prismatica to angularis, composed of doliform cells arranged in rows perpendicular to the surface, the outermost clavate, hyaline or with brownish walls, or aggregated in fascicles. MEDULLARY EXCIPULUM a textura intricata of hyaline, branched hyphae, mostly loosely arranged. ASCI cylindrical tapered to the base, aporhynchous or pleurorhynchous, 8-spored, J–. PARAPHYSES straight, cylindrical or slightly enlarged at the apex, hyaline or containing dark brown pigment, pluriseptate. ASCOSPORES 4-nucleate, 1-seriate, usually containing one large lipid guttule, hyaline, broad ellipsoidal to subfusoidal, smooth to verruculose. STIPE in cross section, when it is hollow, shows an extra inner layer like the ectal excipulum.

TYPE SPECIES: ***Helvella crispa*** (Scop.) Fr., Systema Mycologicum 2(1): 14. 1822.

HABITAT: on damp sandy, clayish, or rich soils, along paths in deciduous and coniferous forests or artic-alpine vegetation, occasionally on decaying wood.
ANAMORPH: unknown.

NOTES: As a very old name, *Helvella* (or *Elvela*) has been subject to different interpretations and typifications. Modern authors concur in the selection of the type species as presented here. The genus is widely distributed in the Northern Hemisphere and only occasionally collected in Argentina in sites planted with boreal trees. Phylogenetic classifications propose to place it in the family *Helvellaceae*, which includes not only epigeous genera such as *Helvella* but also the related hypogeous *Barssia* Gilkey and *Balsamia* Vittad., formerly placed in the *Tuberaceae*. *Helvella* shares with *Gyromitra* the 4-nucleate ascospores, the same spore wall ontogeny, lipid guttules, and the septal ultrastructure of excipular hyphae (TEM), except that *Helvella* usually has spherical Woronin bodies (see description of *Gyromitra*). *Helvella* is related to *Underwoodia*, which has distinctive ascoma morphology with a pileus completely adnate to stipe and coarsely ornamented ascospores. Earlier authors suggested a synonymy with *Helvella*, but various molecular studies support *Underwoodia* as a separate genus (see also *Underwoodia*). *Wynnella* Boud. is currently considered a synonym of *Helvella*. *Pindara* Vel. has been merged with *Helvella* supported

by molecular studies. Several species of *Helvella* have ectomycorrhizal lifestyle. Molecular analyses indicate that they are mycobionts of *Quercus robur* and *Fagus sylvatica*.

DISTRIBUTION IN ARGENTINA: two species, *H. leucomelaena* (Pers.) Nannf. (= *Acetabula nemoralis* Speg.) and *H. leucopus* Pers. have been recorded from BA and N, in gardens and parks.

ILLUSTRATION: Pl. 10, 1–9. *Helvella leucopus*.

LITERATURE: Abbott & Currah 1988, 1997; Berthet 1964; Dissing 1966; Gamundí 1960; Gamundí & Giaiotti 1998; Harmaja 1974; Häffner 1987; Hansen & Pfister 2006; Kimbrough 1991, 1994; Kimbrough & Gibson 1990; Korf 1973a; Landvik et al. 1999; Nannfeldt 1937; O'Donnell et al. 1997; Tedersoo et al. 2006.

Melastiza Boud. (*Pyronemataceae*)

ASCOMATA apothecial, medium-sized to large, superficial, sessile, scutellate to cupuliform, scattered to gregarious, bright coloured, disc smooth, plane to concave, orange to red; margin conspicuous, entire or undulate, pruinose to furfuraceous; external surface concolorous with the disc, paler at the base. ECTAL EXCIPULUMA a textura globulosa to angularis comprising isodiametric cells, smaller towards the surface, sometimes brownish; hairs disposed in tufts, giving the margin and the receptacle a pruinose appearance, short, obtuse, brown-walled, with few septa, arising from superficial cells. MEDULLARY EXCIPULUM a textura intricata of densely arranged hyaline hyphae. ASCI cylindrical, 8-spored, J– PARAPHYSES pluriseptate, subclavate or bent at the apex, containing granules of carotenoid pigments (β- and γ- carotene, ester of aleuriaxanthine) that turned green with iodine. ASCOSPORES 1-seriate, uninucleate, 1–2 guttulate, hyaline to pale yellowish, ellipsoidal, with a conspicuous cyanophilic net-like ornamentation, with spiny or hood-like projections at both ends, or with coarse, irregular warts.

TYPE SPECIES: ***Melastiza miniata*** (Fuckel) Boud., Icon. Mycol. Liste Sér. 1[3].

HABITAT: on damp, bare, or sandy soil, sometimes among mosses or on burnt places.

ANAMORPH: unknown.

NOTES: According to Korf (1985) the correct name for *M. miniata*, type species of the genus, is *M. cornubiensis* (Berk. & Br.) J. Moravec. *Melastiza chateri* (W.G. Sm.) Boud.) is often found in association with *Aleuria aurantia* in damp and mossy places but can be distinguished easily by the margin and external surface

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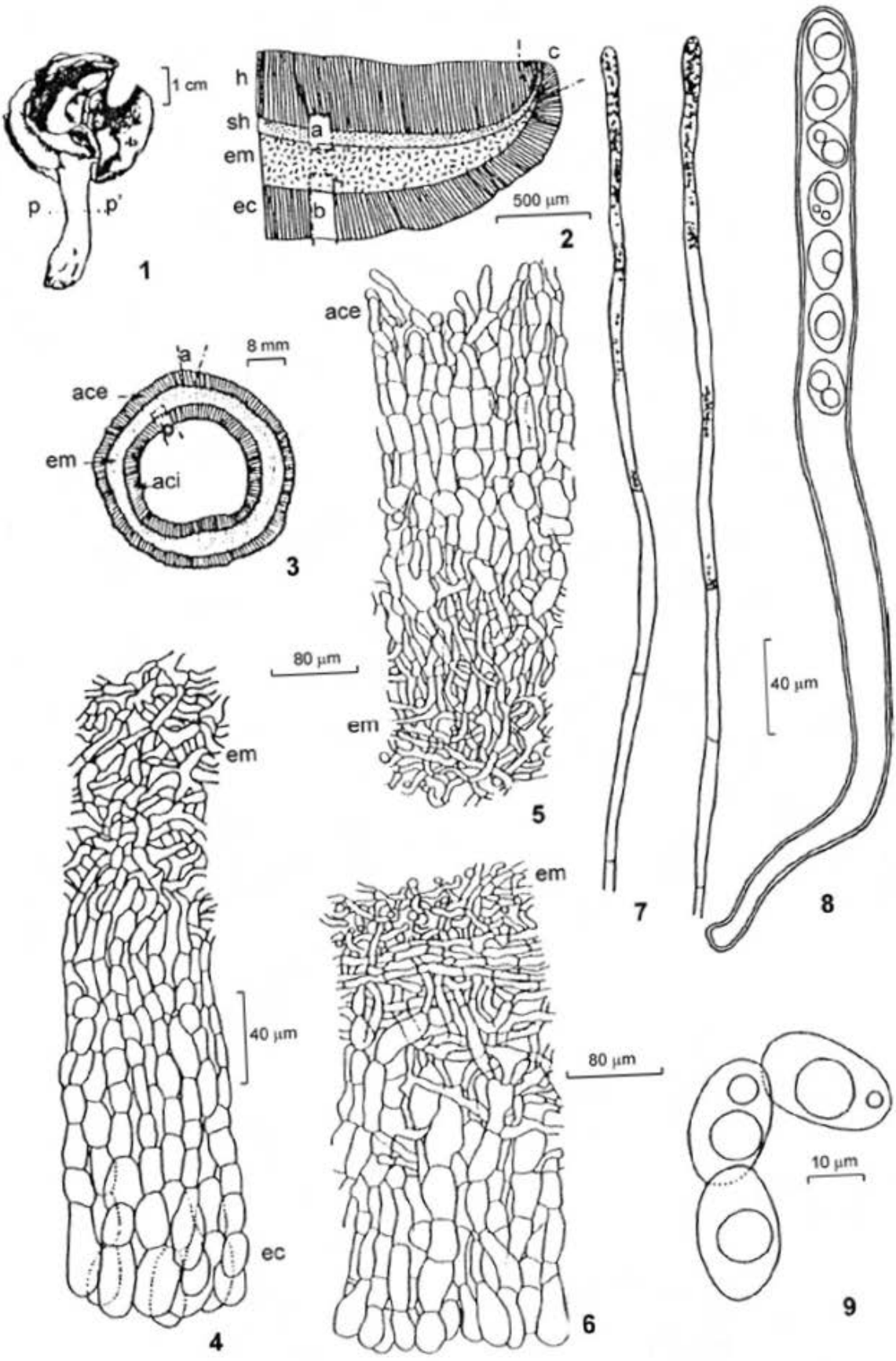
PLATE 10. 1–9. *Helvella leucopus* (BCRU 1489). 1. Ascoma. 2. Sketch of a vertical section of the pileus: h, hymenium, sh, subhymenium, em, medullary excipulum, ec, ectal excipulum. 3. Sketch of a cross section of the stipe (p-p′ in FIG. 1)): aci, internal ectal excipulum, em, medullary excipulum, ace, external ectal excipulum. 4. Vertical section of the pileus: detail of b in FIG 2. 5–6. Detail of a cross section of the stipe (a, b in FIG. 3). 7. Paraphyses. 8. Ascus. 9. Ascospores.


1 cm
p
p'
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h
sh
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a
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8 mm
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80 µm
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5
7
8
40 µm
em
40 µm
ec
4
em
80 µm
6
10 µm
9

of the ascoma. *Melastiza* is close to *Aleuria* (see NOTES under *Aleuria*), as was pointed out by various authors. Moravec united both genera, placing *Melastiza* as a subgenus of *Aleuria*. His viewpoint is supported by: a) the same type of ornamentation; b) the same carotenoid composition in paraphyses (β- and derivates of γ- carotene); and c) the same habitat. He neglected the difference concerning hairy (*Melastiza)* vs. hairless *(Aleuria)* ascomata. The hairy feature and hair morphology is often considered important in distinguishing genera within the *Pezizales* (see treatment of *Cheilymenia* and *Coprobia*), so that some authors accept *Melastiza* as a good genus. We adhere to the view that only species with superficial, dark, blunt hairs belongs to *Melastiza* and others with acuminate hairs should be excluded.

DISTRIBUTION IN ARGENTINA: only *M. chateri* is recorded from TF.

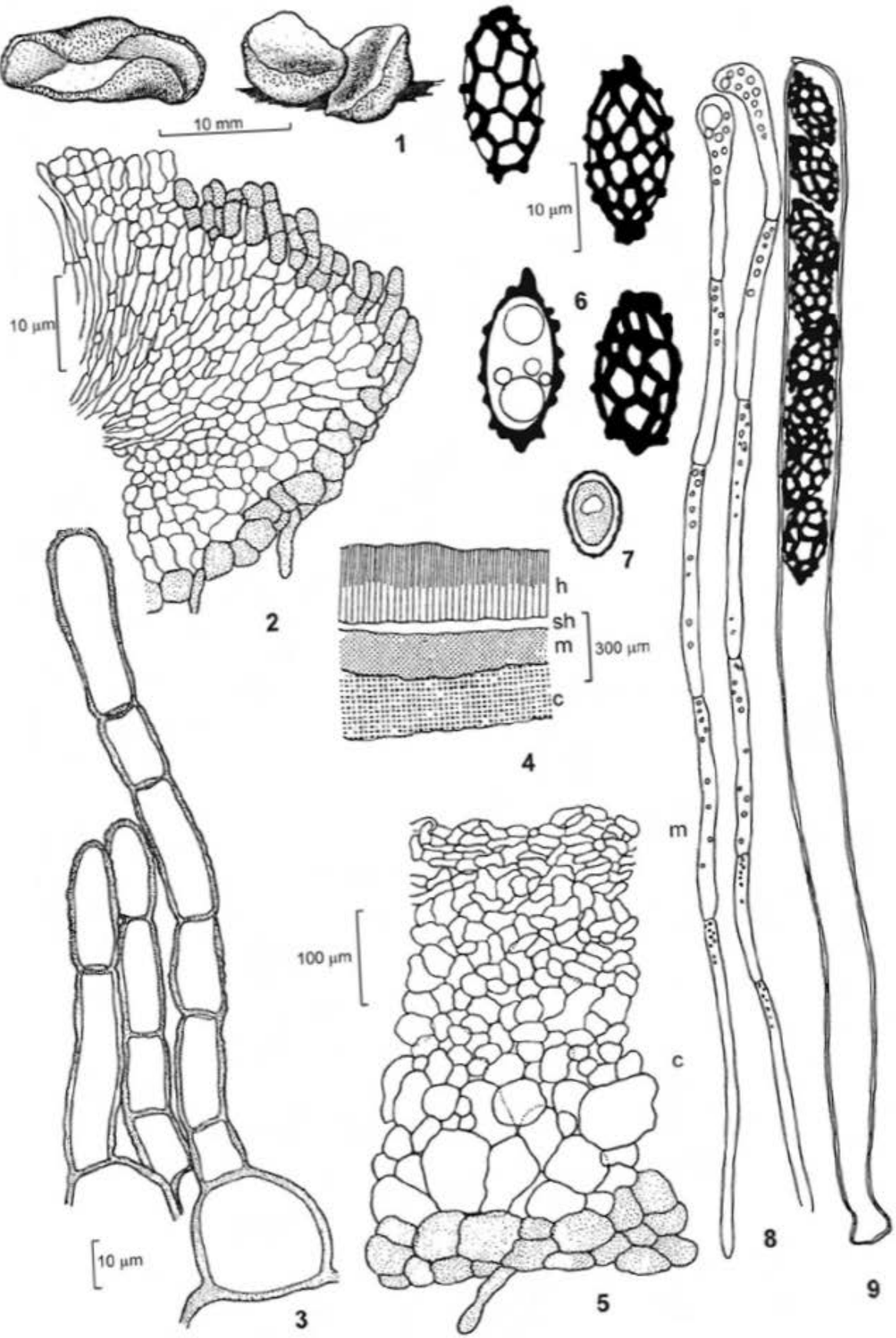
ILLUSTRATION: Pl. 11, 1–9. *Melastiza chateri.*

LITERATURE: Arpin 1968; Arroyo & Calonge 1988; Dennis 1978, 1986, 1995; Dissing 2000; Gamundí 1975; Gamundí et al. 2004; Korf 1985; Lassueur 1980; Le Gal 1958; Maas Geesteranus 1967; Moravec 1972, 1994a; Rifai 1968; Yao & Spooner 1995a,b.

Morchella Dill. ex Pers. (*Morchellaceae*)

ASCOMATA pileate, stipitate, large, up to 30 cm high, superficial, gregarious, of fleshy to paperaceous consistency; pileus conical, ovoid to globose, alveolate, alveolae isodiametric or elongate, separated by sterile ribs, giving a honeycomb-like aspect, adnate or separated from the stipe by a shallow groove, or in some species a deep groove; hymenium covering the alveola, ochre, yellow-brown, yellow-orange or grayish-brown, primary ribs concolorous or darker than the hymenium, sterile, longitudinal and anastomosing, sometimes connected with secondary transverse ribs covered by the hymenium; stipe cylindrical or slightly furrowed, bulbous or tapering to the base, hollow, externally glabrous, furfuraceous or scaly, usually whitish or cream, always paler than the pileus. MEDULLARY EXCIPULUM of textura angularis, hyaline. STIPE comprising a cortical layer of textura globulosa to angularis composed of hyaline cells, the most external cylindrical, aggregated in tufts to form furfurations or scales and a inner layer of textura intricata, hyaline. ASCI cylindrical, 8-spored, thin walled, J–. PARAPHYSES robust, straight or curved, capitate, clavate or irregularly enlarged at the apex, diffusely pigmented. ASCOSPORES 1-seriate, multinucleate, at maturity eguttulate, after puffing with external, polar guttules, hyaline to subhyaline, ellipsoidal to subfusoidal, smooth or with delicate longitudinal striation (SEM). Spore print yellowish to orange-pinkish.

PLATE 11. 1–9. *Melastiza chateri* (BAFC 21982). 1. Ascomata. 2. Marginal excipulum. 3. Detail of hairs. 4. Sketch of a vertical section of the ascoma: h, hymenium, sh, subhymenium, m, medullary excipulum, c, ectal excipulum. 5. Detail of the excipulum: m and c, as in FIG. 4. 6. Mature ascospores in surface view and optical section. 7. Immature ascospore. 8. Paraphyses. 9. Ascus.


10 mm
1
10 µm
6
10 µm
7
2
h
sh
m
300 µm
c
4
m
100 µm
c
10 µm
3
5
8
9

TYPE SPECIES: ***Morchella esculenta*** (L.) Pers., Syn. Meth. fung. 2: 618. 1801.

HABITAT: on calcareous or sandy soils in conifer/deciduous forests or in nearby prairies, disturbed places mixed with charcoal, in orchards or gardens. Saprotrophs and ectomycorrhizal.

ANAMORPH: ***Costantinella*** Matr. Conidiophores mononematose, hyaline, conidiogenous cells disposed in whorls, strongly recurved, denticulate; conidia hyaline, sympodioblastic, globose to subglobose.

NOTES: *Morchella* as here understood includes *Mitrophora* Lév., which differs only in having a deep groove separating the cap from the stipe. As a genus *Morchella* is easily identified by its honeycombed pileus but difficult to define due to the uniformity of microscopic features and the variation of morphotypes in nature. In their enzyme-linked immunoabsorbent assay of *Morchella esculenta* complex, for instance, Jung et al. (1993) concluded that immunologically distinguishable forms do produce easily distinguishable morphotypes.(e.g. *M. esculenta*). One proposed classification considers three sections (*Adnatae, Semiadnatae, Distantes*) based on the macroscopic separation of pileus and stipe. *Morchella* shares a pileate ascoma with *Helvella* but differs in the microstructure of the pileus and multinucleate ascospores (see description of *Helvella*). Different also is *Verpa* Sw., which has a campanulate, longitudinally furrowed or reticulate pileus with a free margin and 2–8 ascospores. Molecular generated phylogenies suggest that *Morchella*, *Verpa,* and *Disciotis* Boud. comprise a clade that is sister to *Gyromitra–Hydnotrya.* Some species form sclerotia in nature and in vitro. Ectomycorrhizae have been demonstrated between some species of *Morchella* and conifers *(Abies, Picea, Pinus*). It has been suggested that in nature *Morchella* spp. follow two ecological strategies — either pioneer saprotrophs and ephemeres on disturbed soils or perennial ectomycorrhizals with vascular plants in forests. In both cases they form sclerotia in winter. Fructification in vitro was first reported by Ower and registered as a US Patent. Later a life cycle could be reproduced from ascospores to ascomata suggesting two alternate pathways, via a) primary mycelium that may form a sclerotium that after overwintering can produce an ascoma or b) crossing two compatible primary mycelia that after plasmogamy form a heterokaryotic secondary mycelium that may produce a sclerotium that finally forms the ascoma. Sclerotia in vitro derived from polysporic cultures have been observed in *Morchella* spp. associated with *Austrocedrus chilensis* in Argentina

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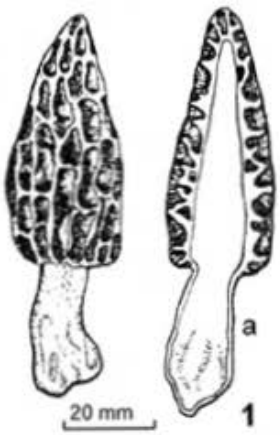
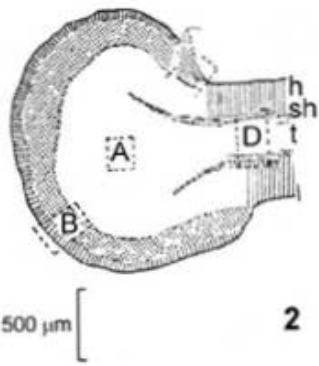
PLATE 12. 1–9. *Morchella elata* (LPS 35912). 1. Ascomata: a, in vertical section. 2. Sketch of a cross section of the pileus: h, hymenium, sh, subhymenium, t, medullary excipulum, A–B, rib. 3. Detail of B in FIG. 2. 4. Sketch of a longitudinal section of the stipe: ce, cortical layer, t, trama, ci, internal layer. 5. Detail of the D in FIG. 2. 6. Detail of B in FIG. 4. 7. Paraphyses. 8. Ascus. 9. Ascospores.



1



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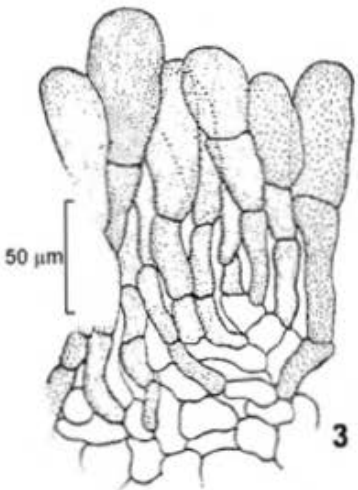

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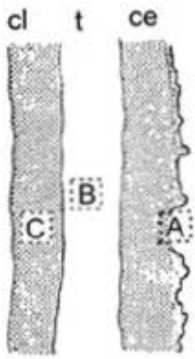
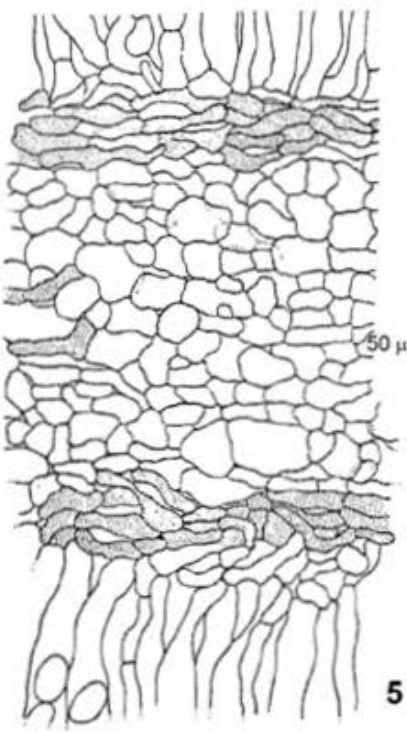
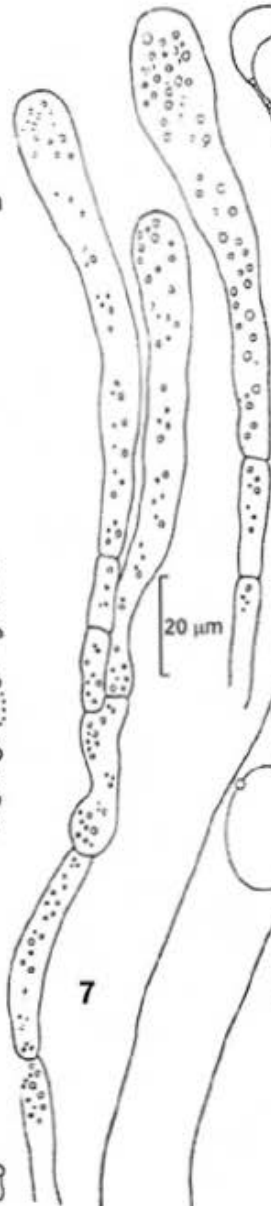


4



5

6



7

8

9

(unpublished results). Spawn and a kit for outdoors cultivation of *Morchella* spp. are now commercially available.

DISTRIBUTION IN ARGENTINA: Five species are recorded in Argentina: *M. esculenta*, *M. intermedia* Boud., *M. elata* Fr., *M. patagonica* Speg., *M. semilibera* DC. from CO, N, RN, TF. There are several unidentified collections preserved in LPS and BCRU.

ILLUSTRATION: Pl. 12, 1–9. *Morchella elata.*

LITERATURE: Boudier 1897; Buscot 1992, 1993; Buscot & Kottke 1990; Dahlstrom et al. 2000; Dissing 2000; Domínguez de Toledo 1987; Eckblad 1968; Hennebert & Bellemère 1979; Jung et al. 1993; Gamundí 1975; Gamundí & Horak 2003; Jacquetant 1984; Landvik et al. 1997; O'Donnell et al. 1997; Ower 1982; Paden 1972; Parguey-Leduc et al. 1998; Rifai 1968; Volk & Leonard 1990.

Nothojafnea Rifai (*Pyronemataceae*)

ASCOMATA apothecial, small- to medium-sized, superficial, subsessile, gregarious, cup shaped; disc deeply concave, reddish brown to dark brown; external surface brown to reddish brown paler than the disc, felty; hairs short, slender, pauciseptate, straight or curved, hyaline or subhyaline, sometimes with a brownish sap. ECTAL EXCIPULUM a textura angularis of isodiametric or polygonal light brown cells disposed at right angle to the surface, some superficial cells clavate, thick walled, containing brownish sap. MEDULLARY EXCIPULUM of compact textura intricata, composed of hyaline, slender hyphae running horizontally. ASCI subcylindrical, rather thick walled, 8-spored, J–. PARAPHYSES subclavate, simple, containing brownish pigment at the apex, pluriseptate. ASCOSPORES 1-seriate, hyaline, when young multiguttulate, ellipsoidal, ornamented with small warts weakly stained with lactic blue.

TYPE SPECIES: ***Nothojafnea cryptotricha*** Rifai, Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. 2de Reeks, 57(3): 94. 1968.

HABITAT: on soil.

ANAMORPH: unknown.

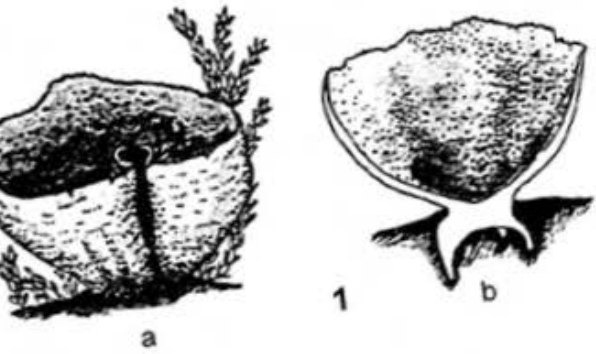
NOTES: *Nothojafnea* is close to *Jafnea*. The latter genus differs in having brown-walled hairs and fusoidal to fusiform-ellipsoidal ascospores. It is also distinct from *Aleurina* in ascospores and hairs. (See description of *Aleurina*.)

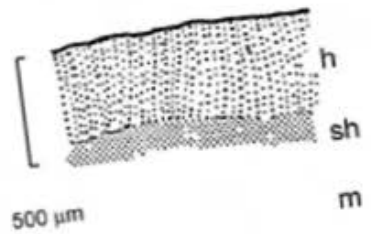
DISTRIBUTION IN ARGENTINA: Only one species is recorded: *N. thaxteri* (Cash) Gamundí from CH, N and RN.

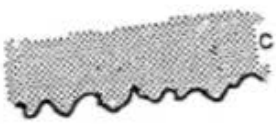
ILLUSTRATION: Pl. 13, 1–6. *Nothojafnea thaxteri.*

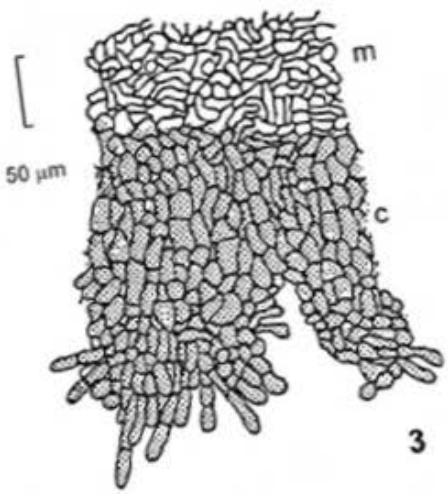
LITERATURE: Eckblad 1968; Gamundí 1972a, 1999; Gamundí et al. 2004; Korf 1960, 1973a; Rifai 1968; Zhuang & Korf 1986.

PLATE 13. 1–6. *Nothojafnea thaxteri* (BAC 5838). 1. Ascomata: a, side view, b, vertical section. 2. Sketch of a vertical section of the ascoma: h, hymenium, sh, subhymenium, m, medullary excipulum, c, ectal excipulum. 3. Detail of the excipulum: m, c, as in FIG. 2. 4. Ascospores: a, optical section, b, surface view. 5. Hairs of the ectal excipulum. 6. Ascus and paraphyses.


a
b
1


h
sh
m
500 µm


c
2


m
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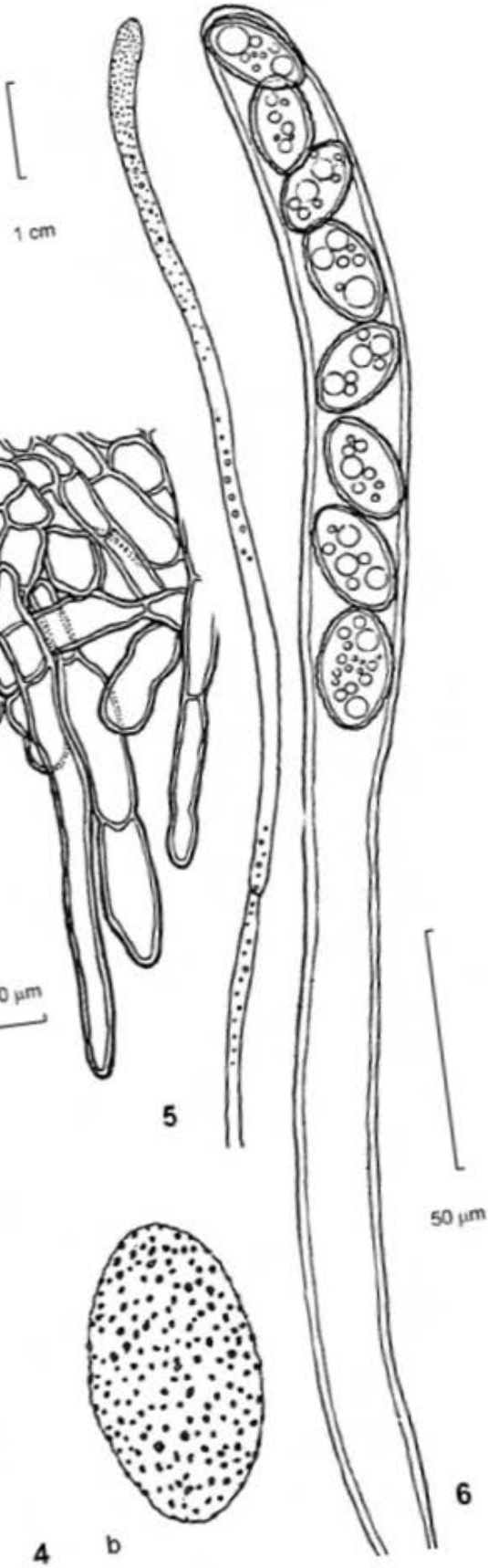
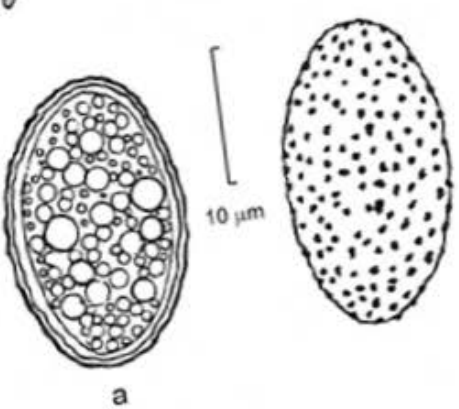
50 µm
3


1 cm
10 µm
5
50 µm
6


10 µm
a
4
b

Phillipsia Berk., nom. cons. (*Sarcoscyphaceae*)

Ascomata apothecial, small to large, cup shaped, sometimes asymmetrical, superficial, sessile, subsessile to stipitate, scattered to gregarious, usually bright coloured; disc shallow or deeply concave, smooth or umbilicate, in several shades of orange, pink, reddish, yellow, purplish or brownish violet; exterior furfuraceous to tomentose, paler than the disc, consisting of simple, hyphal, flexuous, superficial, hyaline hairs. Ectal excipulum, thin, a textura porrecta to intricata of hyaline hyphae, running more or less parallel to the surface of the receptacle. Medullary excipulum well developed, of loose textura intricata. Asci cylindrical to subcylindrical, suboperculate, thick walled, gradually attenuated towards the base, 8-spored, J–. Paraphyses pluriseptate, filiform, straight, hyaline, simple or branched, sometimes anastomosing with each other, containing carotenoids (major pigment phillipsiaxanthine). Ascospores 1-seriate, multinucleate, containing 1–2 guttules, hyaline to pale yellowish, ellipsoidal with acute ends to subapiculate, inaequilateral, with longitudinal ridges that occasionally anastomose or wrinkled, and ornamentation arising from the primary wall, cyanophobic.

Type species: ***Phillipsia domingensis*** (Berk.) Berk., J. Linn. Soc., Bot. 18: 388. 1881.

Habitat: on fallen angiosperm branches or wood.

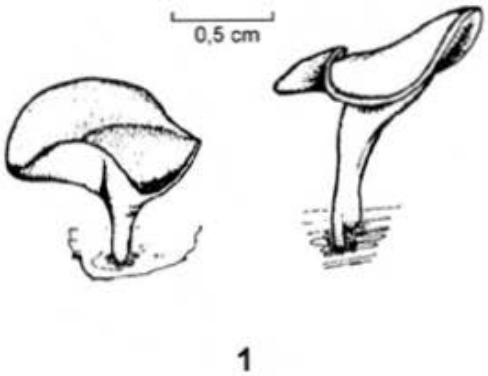
Anamorph: ***Molliardiomyces*** Paden. Germinating ascospores produce conidiophores with conidiogenous cells with sympodial or percurrent proliferation, conidia holoblastic, subglobose, hyaline.

Notes: *Phillipsia* shows a great variability in disc colour, which in the same species can vary, for example, from deep pink to whitish. Some species contain a particular carotenoid pigment, phillipsiaxanthin. The genus is close to *Cookeina* in sharing similar ascospore ornamentation, suboperculate ascus apex, and the same major pigment but differing in other characters (see Notes under *Cookeina*).

Nanoscypha Denison, also with a *Molliardiomyces* anamorph, differs in excipular structure and 4-spored asci. *Sarcoscypha* (Fr.) Boud. differs in its equilateral, subcylindrical, and always smooth ascospores. The type of ascospore germination is similar to *Sarcoscypha*.

ITS-based molecular studies of *Phillipsia* imply four main lineages that are supported by ascospore morphology: 1) the *P. domingensis* complex, which includes ascospores ornamented with separate and few longitudinal ridges;

Plate 14. 1–7. *Phillipsia domingensis* (BAFC 30278). 1. Ascomata. 2. Sketch of a vertical section of the ascoma in the basal zone: m, medullary excipulum, c, ectal excipulum, t, tomentum. 3. Detail of a section of the ascoma at the lateral zone: m and c, as in fig. 2. 4. Ascospores: a, surface view; b, optical section. 5. Detail of a vertical section of the ascoma at the basal zone: m, c, and t, as in fig 2. 6. Paraphyses. 7. Ascus.



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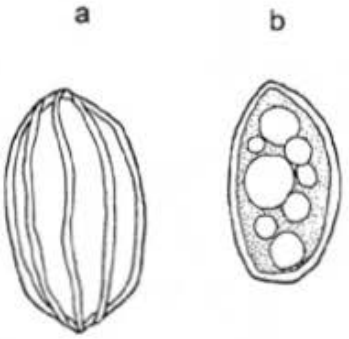

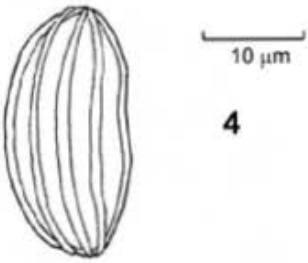

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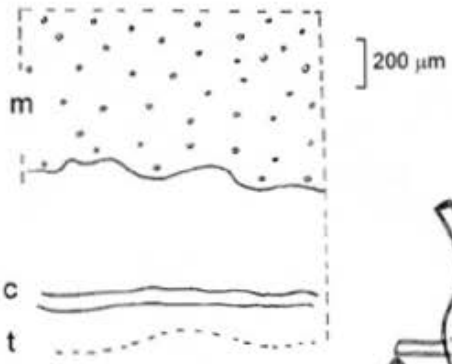

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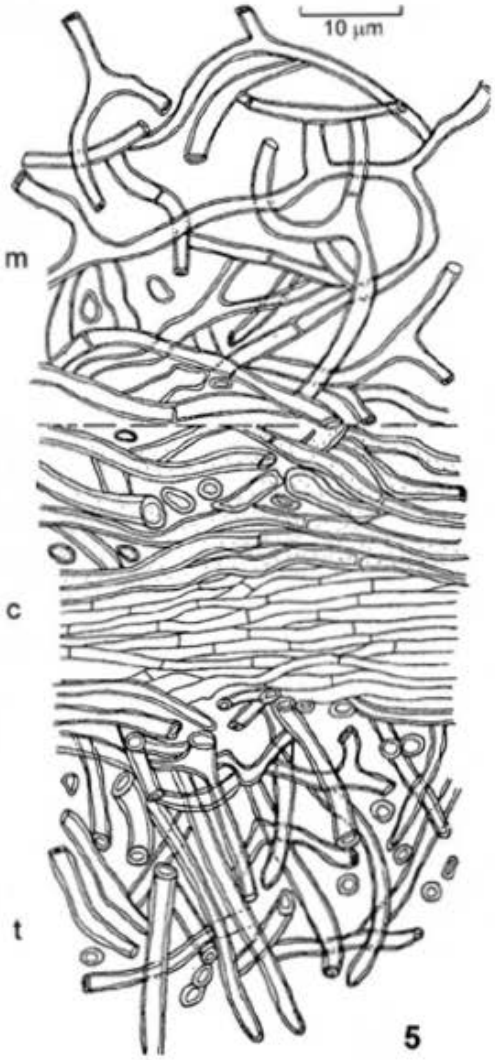

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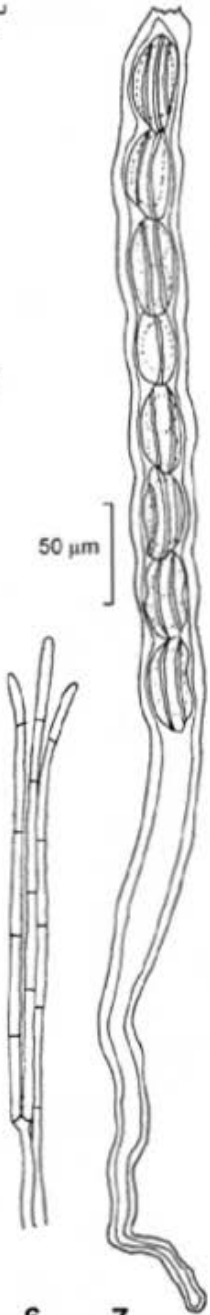

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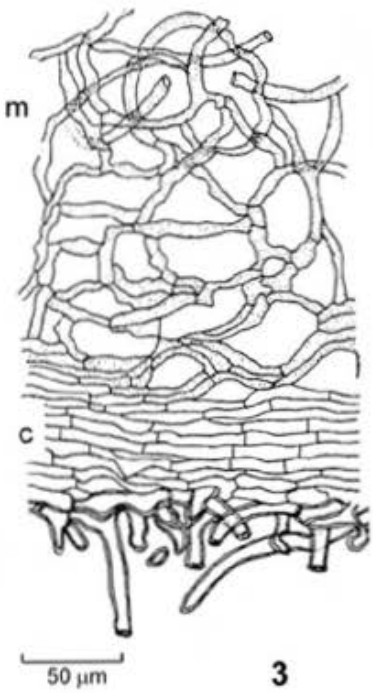

3

2) *P. olivacea*, with smooth or wrinkled ascospores; 3) *P. crispata*, with fine, profuse longitudinal, parallel ridges; and 4) *P. carnicolor* Le Gal with broad, irregular, longitudinal ridges sometimes anastomosing. It is suggested that colour of the ascomata should be used with caution as a taxonomic character. The genus is pantropical, reaching subtropical areas.

DISTRIBUTION IN ARGENTINA: four species have been recorded: *P. domingensis*, *P. hartmannii* (W. Phillips) Rifai, *P. crispata* (Berk. & M.A. Curtis) Le Gal and *P. olivacea* Rick (the last cited as *P. rugospora* Paden) from M, T.

ILLUSTRATION: Pl. 14, 1–7. *Phillipsia domingensis*.

LITERATURE: Arpin 1969; Boedijn 1933; Cabello 1988; Denison 1969, 1972; Hansen et al. 1999; Harrington et al.1999; Kirk et al. 2008; Le Gal 1953; Li & Kimbrough 1996b; Paden 1974, 1977, 1984, 1986; Romero & Gamundí 1986; Zhuang & Wang 1998.

Plectania Fuckel (*Sarcosomataceae*)

ASCOMATA apothecial, medium-sized to large, cup shaped, superficial, sessile to substipitate, scattered to gregarious, of tough gelatinous consistency; disc deeply concave, dark brown to black, smooth, gelatinous, drying cracked; external surface felty to tomentose, dark or a little paler than the disc, venose near the base. ECTAL EXCIPULUM thin, a textura globulosa to angularis of isodiametric, brown-walled cells ending in flexuous, brown, thick-walled, densely intertwined hairs. MEDULLARY EXCIPULUM of a loose textura intricta, well developed, composed of hyaline, branched, septate hyphae embedded in a gelatinous matrix. ASCI cylindrical, thick-walled, contracted below forming an apendiculate base, with a central operculum, 8-spored, J–. PARAPHYSES filiform, pluriseptate, sometimes profusely branched near the apex and anastomosing, forming a delicate net, hyaline or containing a diffuse pigment. ASCOSPORES 1-seriate, multinucleate, hyaline to pale yellowish, containing many guttules, ellipsoidal to asymmetrically fusoidal or suballantoid, smooth or covered by non-cyanophilic transverse ridges on the convex side that occasionally anastomose.

TYPE SPECIES: ***Plectania melastoma*** (Sowerby) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 324. 1870.

HABITAT: on twigs, plant debris, decaying logs, sometimes covered with mosses, in coniferous and deciduous forests.

ANAMORPH: ***Conoplea*** Pers. Conidiomata synnematous, pulvinate, sometimes with a stromatic base or groups of conidiophores mononematous scattered on the

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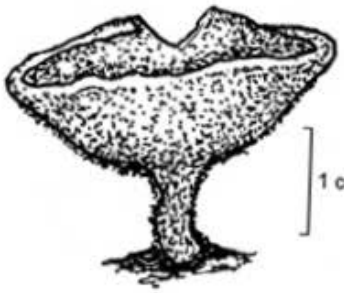
PLATE 15. 1–5. *Plectania chilensis* (Lazo Pu-28). 1. Ascoma. 2. Sketch of a vertical section of the ascoma: h, hymenium, sh, subhymenium, m, medullary excipulum, c, ectal excipulum. 3. Detail of the excipulum, m and c, as in FIG. 2, p, hairs. 4. Ascospores. 5. Ascus base and upper portion and paraphyses.



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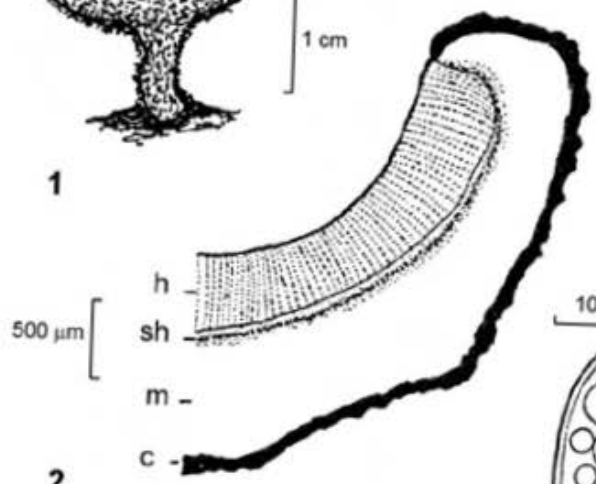

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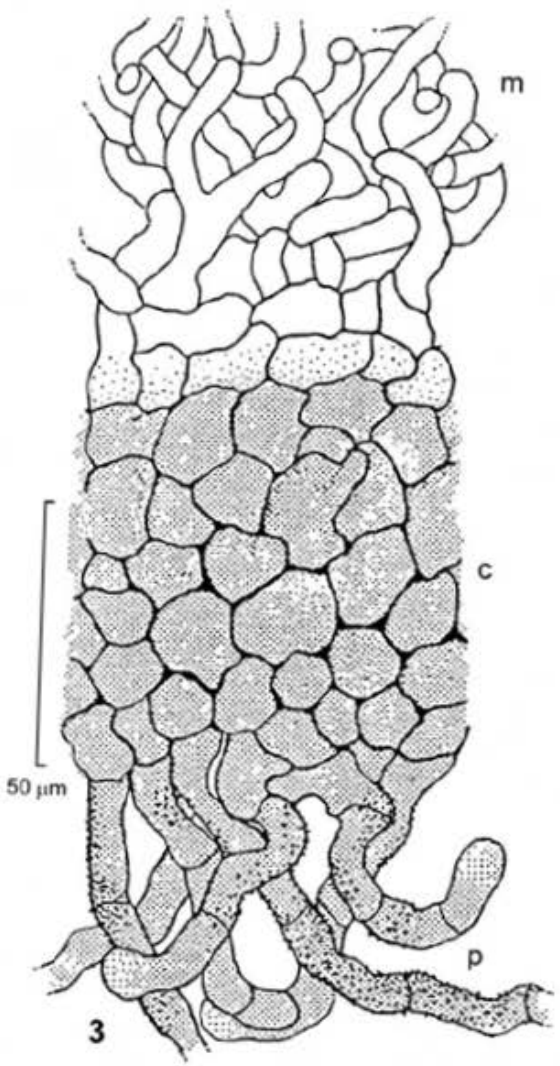

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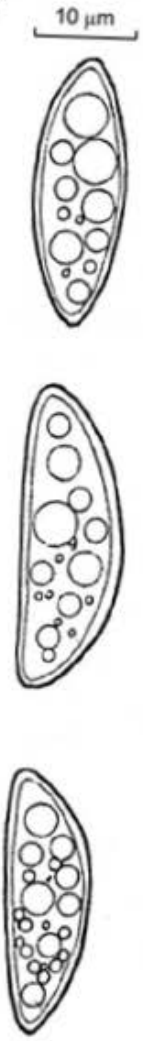

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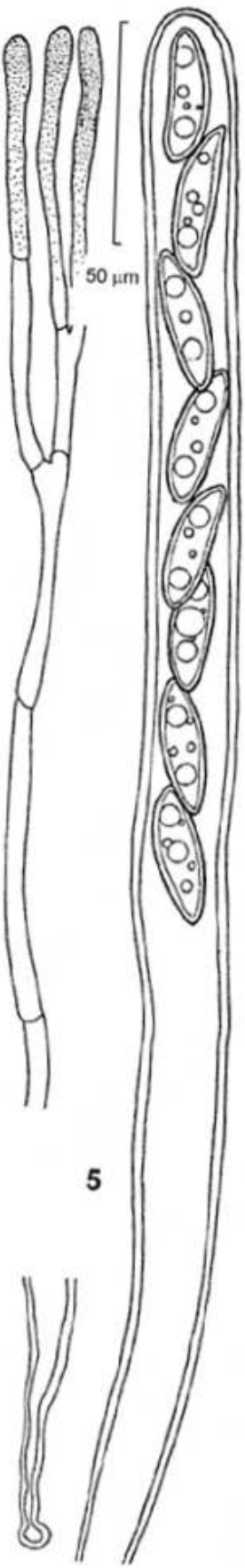

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substratum; conidiophores geniculate, arborescent, brownish; conidiogenous cells sympodioblastic; conidia holoblastic, unicellular, globose to ellipsoidal, brownish, smooth or verrucose, with a slit or pore.

NOTES: According to modern authors, *Plectania* is related to *Urnula* Fr., which also has black, large ascomata but lacks the gelatinous medullary excipulum. Ultrastructural studies (TEM) comparing ascus walls of the *Plectania* and *Urnula* type species show that they have a similar structure. *Pseudoplectania* Fuckel, which is perhaps another close genus, has globose ascospores, with different ontogeny of the walls, as demonstrated by ultrastructural studies (TEM). The mature ascospore wall in *Plectania* is composed of primary wall, epispore, and secondary wall, while *Pseudoplectania* lacks the secondary wall. *Sarcosoma* Casp. differs in its highly gelatinous, turbinate ascomata. *Galiella* Nannf. & Korf is distinguished by ascospore walls with cyanophylic ornamentation. SSU rDNA and 18S r RNA sequence-based analyses support all genera mentioned above in the *Sarcosomataceae*, a monophyletic or paraphyletic family different from the *Sarcoscyphaceae*, as previously suggested from ultrastructure (TEM) of the ascus-wall layers.

DISTRIBUTION IN ARGENTINA: two species are recorded: *P. chilensis* (Mont.) Gamundí and *P. rhytidia* (Berk.) Nannf. & Korf from: BA, CH, M, N, RN.

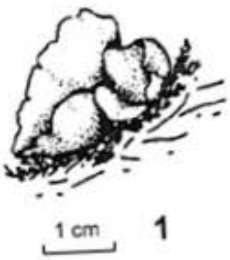
ILLUSTRATION: Pl. 15, 1–5.*Plectania chilensis*.

LITERATURE: Bellemère et al. 1990; Benkert 2005; Cabello 1988; Dissing 2000; Donadini 1985; Eckblad 1968; Gamundí 1971; Gamundí & Giaiotti 1998; Gamundí et al. 2004; Harrington et al. 1999; Hughes 1960; Korf 1957, 1973a; Le Gal 1953; Landvik et al. 1997; Li & Kimbrough 1995; Liu & Zhuang 2006; Paden 1972; Rifai 1968; Romero & Gamundí 1986; Sutton & Hennebert 1994.

Rhodopeziza Hohmeyer & J. Moravec (*Pezizaceae*)

ASCOMATA apothecial, medium-sized to large, superficial, sessile to subsessile, cupuliform to cochleate; margin pruinose; disc smooth, concave sometimes undulate, orange reddish (*miniatus*); margin conspicuous, pruinose; external surface smooth. ECTAL EXCIPULUM of textura angularis to textura globulosa, composed of cells larger than the medullary cells. MEDULLARY EXCIPULUM a textura globulosa to angularis of cells occasionally intermixed with hyphae. ASCI cylindrical, operculate, 8-spored, the whole wall turning blue with iodine (J+). PARAPHYSES simple, pluriseptate, subclavate and bent towards the apex, containing granules of a carotenoid pigment, that turns green with iodine. ASCOSPORES, 1-seriate, with one evanescent guttule, hyaline to pale yellowish,

PLATE 16. 1–9. *Rhodopeziza tuberculata* (LPS 37095). 1. Ascomata. 2. Sketch of a vertical section of the ascoma: h, hymenium, e, excipulum. 3. Detail of the excipulum in the internal zone. 4. Immature ascospores. 5. Mature ascospores. 6. Detail of the excipulum in the external zone. 7. Dehiscent ascus. 8. Paraphyses. 9. Ascus.



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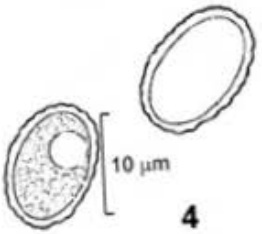

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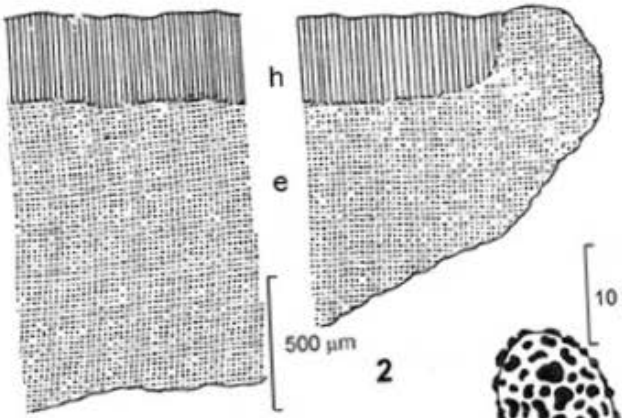

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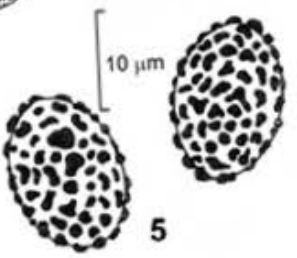

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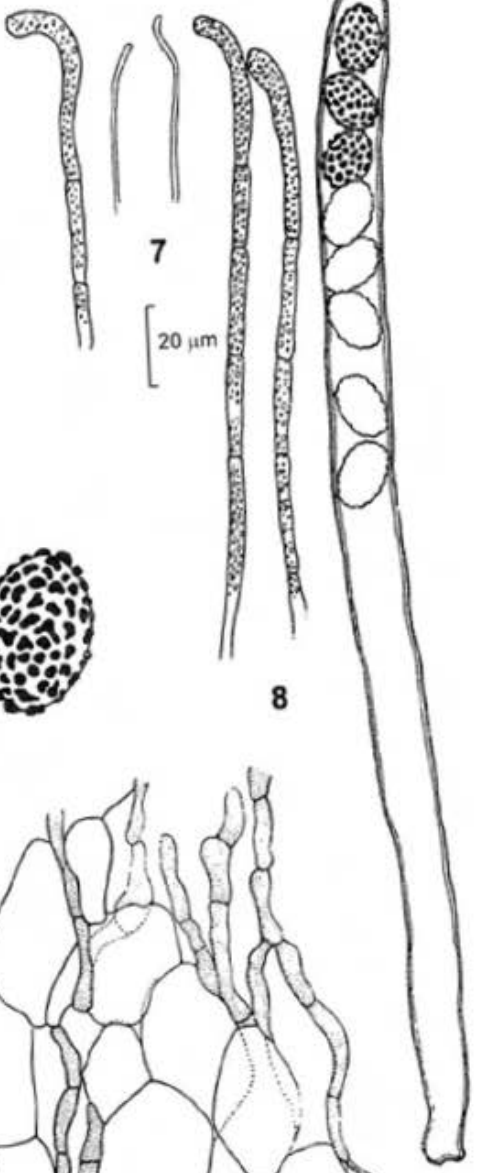

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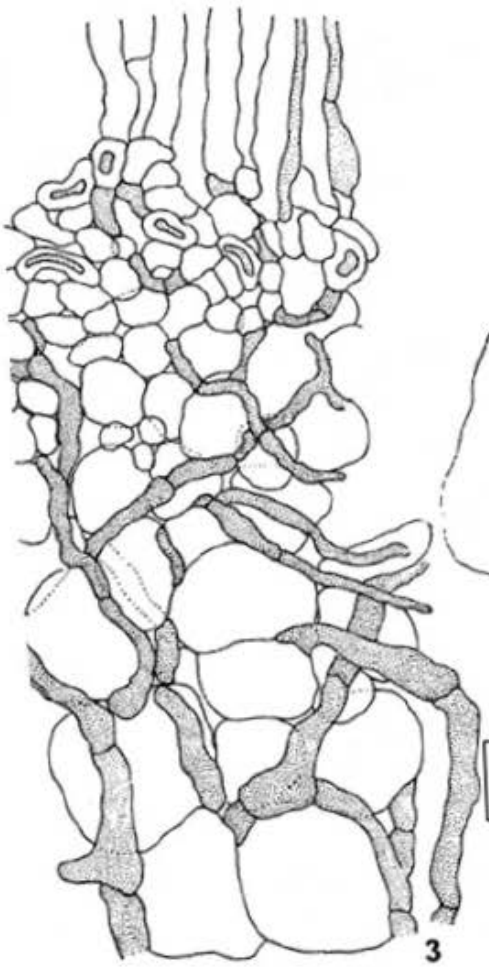

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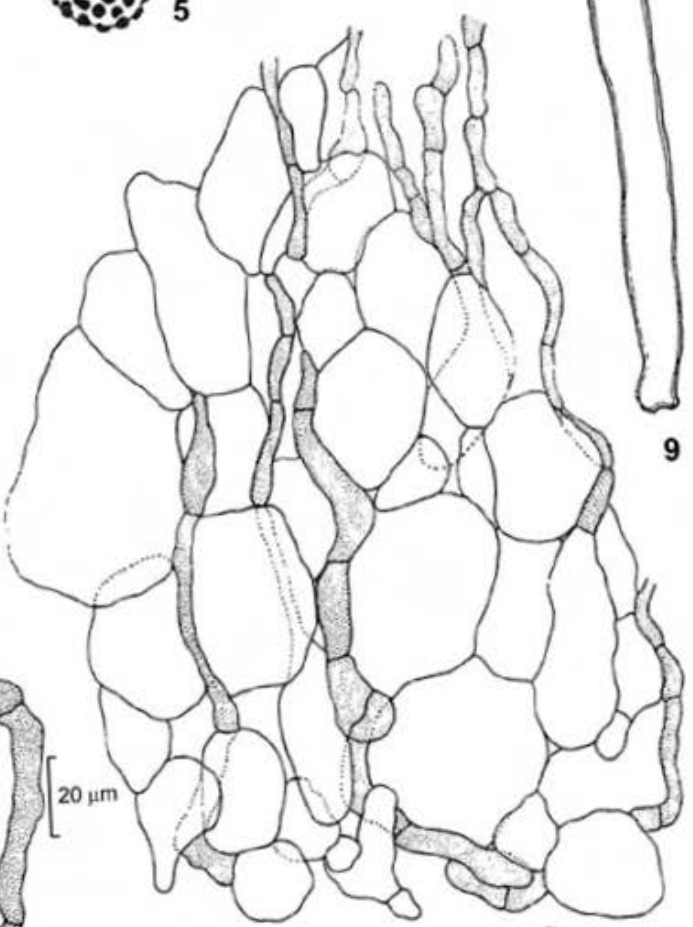

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broadly ellipsoidal, tuberculate, with tubercules isolated, conical to truncate, conspicuously cyanophilic.

TYPE SPECIES: ***Rhodopeziza tuberculata*** (Gamundí) J. Moravec & Hohmeyer, Czech Mycol. 47(4): 261. 1995 ["1994"].

HABITAT: on soil, among liverworts.
ANAMORPH: unknown.

NOTES: *Rhodopeziza* is very similar to *Aleuria* (*Pyronemataceae*), both macroscopically and microscopically, sharing a brightly coloured hymenium (due to a carotenoid pigment in the paraphyses), subhymenium, and excipular structure. Main differences are the tuberculate (instead of reticulate) ascospores and a weak J+ reaction of the entire ascus wall (compared to J– in *Aleuria*). This character led Hohmeyer and Moravec to create the monotypic genus *Rhodopeziza*. On the other side, if we emphasize the character of carotenoid pigment plus the diffuse iodine reaction of the ascus wall, the closest genus would be *Iodophanus* Korf (*Pezizaceae*). Moravec placed *Rhodopeziza* in the *Pezizales*. Eriksson and Hawksworth, based on the presence of iodine positive asci, decided to incorporate the genus into the *Pezizaceae* while referring *Aleuria* to the *Pyronemataceae*. A J+ ascus wall is currently accepted as a phylogenetically more important character than the pigmentation of the hymenium. It would be desirable to collect the type species again to confirm the iodine positive ascus wall as a character that defines the taxonomic position of the genus.

DISTRIBUTION IN ARGENTINA: *R. tuberculata* was only found in TF cited as *Aleuria tuberculata* Gamundí. It has not been reported elsewhere in the world.

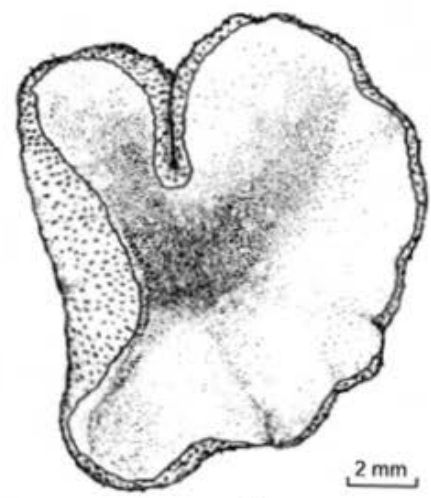
ILLUSTRATION: Pl. 16, 1–9. *Rhodopeziza tuberculata*.

LITERATURE: Eriksson & Hawksworth 1995; Gamundí 1975; Gamundí et al. 2004; Hansen et al. 2001; Häffner 1993; Moravec 1994b.

Scutellinia (Cooke) Lambotte, nom. cons. (*Pyronemataceae*)

ASCOMATA apothecial, small- to medium-sized, superficial, sessile, saucer-shaped, gregarious, usually bright coloured; disc smooth to undulate, from orange, red, to reddish-brown, exceptionally white; margin and external surface hairy, ochraceous to brownish; hairs setose, simple, brown to brownish black, multiseptate, with thick lateral walls, thin septa and forked bases arising deeply from the excipulum, up to 3000 µm long, the marginal hairs longer than the lateral; superficial hairs shorter, brownish, simple, rarely bifurcate at the base. ECTAL EXCIPULUM of textura angularis to textura globulosa. MEDULLARY EXCIPULUM of textura intricata, with hyphae densely arranged horizontally.

PLATE 17. 1–7. *Scutellinia doelloi* (LPS 35716). 1. Ascoma. 2. Vertical section of the ascoma. 3. Detail of the margin. 4. Setose hairs. 5. Ascospores. 6. Paraphyses. 7. Ascus: upper portion.



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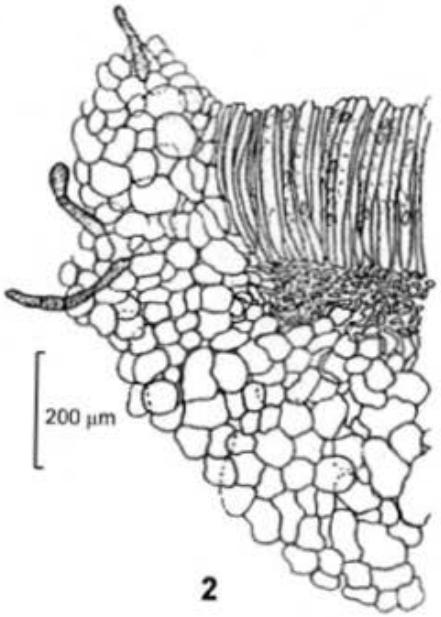

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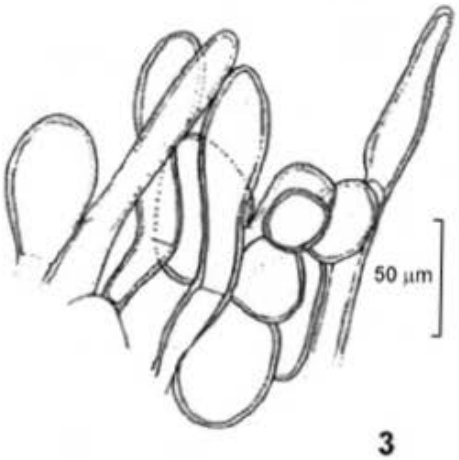

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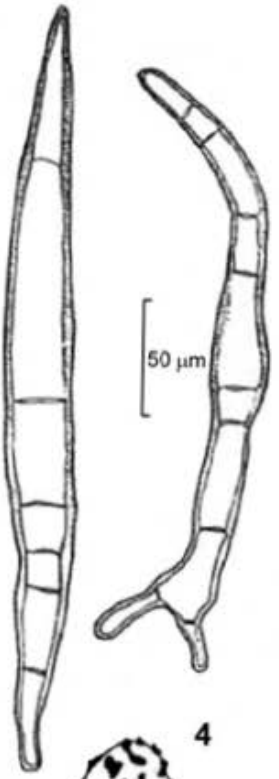

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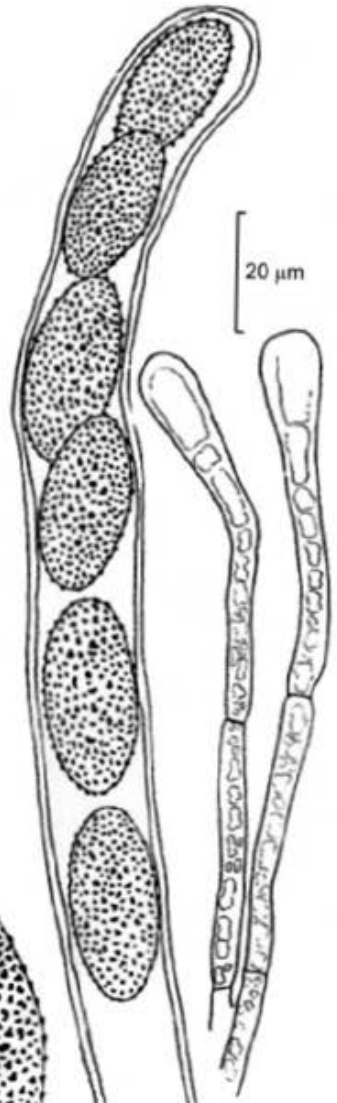

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Asci cylindrical, operculate, usually 8-spored, less commonly 2–4 spored, J–. Paraphyses multiseptate, straight, club-shaped to pear-shaped at the apex, usually containing granules of carotenoid pigments—major pigment γ-carotene—that turn green in iodine and blue in sulphuric acid in fresh material. Ascospores 1-seriate, uni- to multinucleate, uni- to multiguttulate, globose, ellipsoidal to subfusoidal, hyaline to pale yellowish, ornamented with warts, spines, ridges or a reticulum intensely dying with lactic-blue (cyanophilic), rarely smooth.

Type species: ***Scutellinia scutellata*** (L.) Lambotte, Mém. Soc. Roy. Sci., Liège, sér. 2, 1: 199. 1887.

Habitat: on soil, wood and plant debris, in wet places, sometimes associated with mosses and liverworts.

Anamorph: unknown.

Notes: *Scutellinia* is taken in the sense of modern authors to replace *Lachnea* (Fr.) Gillet (typified by an inoperculate discomycete) and *Ciliaria* Quél. (an illegitimate name). The name *Patella* F.H. Wigg. was rejected after Korf & Schumacher's (1986) proposed to designate *Scutellinia* a nomen conservandum. *Scutellinia* is related to *Cheilymenia*, which has also rooting hairs (which can be either brown or hyaline in that genus). Recent nLSU rDNA sequence analyses suggest affinity between these genera, which TEM studies on septal pores also support. (See Notes under *Cheilymenia*.)

Scutellinia differs from *Anthracobia*, which has blunt, non-rooting hairs and biguttulate ascospores. Cultures in PDA may produce mycelium with brown, monilioid chlamydospore chains. Germinating ascospores may give rise to microconidia. According to substrata, they have been classified in three ecological groups: humus saprotrophs, xylosaprotrophs, and forest saprotrophs. A worldwide monograph was provided by Schumacher who used cladistic analysis and proposed an infrageneric classification with two subgenera, *Scutellinia* and *Legalia*, both represented in Argentina. Phylogenetic relationships derived from partial SSU and LSU rDNA sequence data suggest the main core of *Scutellinia* spp. is closely related to *Cheilymenia fimicola*, but the remaining *Cheilymenia* spp. resolve quite distantly and form a group with *Trichophaea–Anthracobia*. The carotenoid pigment of the disc is characteristic of *Scutellinia* spp. except in *S. nivea* T. Schumach., which has a pale hymenium. The last character and rooted hairs are shared with *Paratrichophaea* Trigaux, but in that genus the ascospores are smooth or slightly punctuate and eguttulate.

Distribution in Argentina: Species recorded from Patagonia (N, RN, TF): *S. badioberbis* (Cooke) Kuntze, *S. bifurcata* Gamundí, *S. colensoi* Massee ex Le Gal, *S. doelloi* (Speg.) Le Gal, *S. hirta* (Schumach.) Cooke, *S. hirtella* (Rehm) Kuntze, *S. kerguelensis* (Berk.) Kuntze, *S. nigrohirtula* (Svrček) Le Gal, *S. nivalis* (Boud.) Le Gal,

S. patagonica (Rehm) Gamundí, *S. setosa* (Nees) Kuntze, *S. torrentis* (Rehm) T. Schumach. (= *S. marginata* Gamundí), *S. scutellata*, *S. trechispora* (Berk. & Broome) Lambotte, *S. umbrata* f. *antarctica* (Rehm) Gamundí, *S. umbrorum* (Fr.) Lambotte. Species recorded from Central and N Argentina: *S. balansae* (Speg.) Gamundí, *S. cubensis* (Berk.) M.A. Curtis, *S. jungneri* (Henn.) Clem. [cited as *S. lurida* (Henn. & E. Nyman) Le Gal] and *S. olivascens* (Cooke) Kuntze (= *S. lusatiae* (Cooke) Kuntze) from BA, J, ME, MI.

ILLUSTRATION: Pl. 17, 1–7. *Scutellinia doelloi*.

LITERATURE: Arpin 1969; Denison 1961; Gamundí 1956, 1960, 1964, 1975; Gamundí et al. 2004; Kaushal et al. 1983; Kimbrough & Curry 1986; Korf & Schumacher 1986; Kullman 1982; Le Gal 1966, 1969, 1974; Liu & Zhang 2006; Perry et al. 2007; Pfister 1988; Rifai 1968; Romero & Gamundí 1986; Schumacher 1988, 1990; Svrček 1971; Trigaux 1985; Vooren et al. 2005; Waraitch 1977; Wang 1998; Yao & Spooner 1995a; Zhuang & Wang 1998.

Sowerbyella Nannf. (*Pyronemataceae*)

ASCOMATA apothecial, epigeous, medium-sized to large, cupulate, superficial, stipitate, scattered to gregarious, sometimes concrescent at the stipe, of fleshy consistency; disc bright yellow to yellow-orange; margin involute, entire to undulate; external surface tomentose, paler than the disc; stipe cylindrical, longitudinally venose, sometimes enlarged in the middle portion and hollow, half or totally buried in the substratum. ECTAL EXCIPULUM of textura globulosa to angularis with cells arranged in rows perpendicular to the surface, the outermost ending in hyphose, obtuse, septate, hyaline hairs that form the tomentum. MEDULLARY EXCIPULUM well developed, a textura intricata of hyaline hyphae sometimes with swollen articles. ASCI cylindrical tapering below, 8-spored, J–. PARAPHYSES straight, cylindrical or slightly enlarged at the apex, hyaline, pluriseptate. ASCOSPORES 1-seriate, uninucleate, hyaline, ellipsoidal, containing 2 guttules, smooth, verrucose, spiny or reticulate, the reticulum being complete or incomplete and derived from the perispore, cyanophilic.

TYPE SPECIES: ***Sowerbyella radiculata*** (Sowerby) Nannf., Svensk Bot. Tidskr. 32: 119. 1938.

HABITAT: on damp soil, rotten twigs, and leaves, in woodlands among mosses.

ANAMORPH: unknown.

NOTES: *Sowerbyella* was originally described as having verrucose ascospores and included only two species. It differs from other yellow or orange taxa in paraphyses that do not turn green with iodine and in stipitate ascomata. (See *Aleuria*.) They share the brightly coloured disc, fleshy consistency, and type of ascospore ornamentation. *Otidea* (Pers.) Bonord., which is somewhat related, is distinguished by ascomata that are usually ear-shaped and glabrous and smooth ascospores. A revision of the type species of *Sowerbyella* using SEM

for studying the ascospore ornamentation revealed that the marking forms a complete or incomplete reticulum that can vary throughout the same collection. Molecular studies support this viewpoint and show that *Sowerbyella* forms an isolated clade with an unresolved position in the family *Pyronemataceae*. If this new concept of *Sowerbyella* is accepted, the genus is undoubtedly closely related to *Aleuria*.

DISTRIBUTION IN ARGENTINA: Only one species is recorded from the Andean-Patagonian forest, *S. rhenana* (Fuckel) J. Moravec, from CH, N, RN.

ILLUSTRATION: Pl. 18, 1–8. *Sowerbyella rhenana*.

LITERATURE: Benkert 2005; Eckblad 1968; Gamundí 1960, 1964; Gamundí & Horak 2003; Gamundí et al. 2004; Korf 1972; Moravec 1985, 1988, 1994b; Nannfeldt 1938; Perry et al. 2007; Yao & Spooner 2006; Zhuang 2009.

Tricharina Eckblad emend. Chin S. Yang & Korf (*Pyronemataceae*)

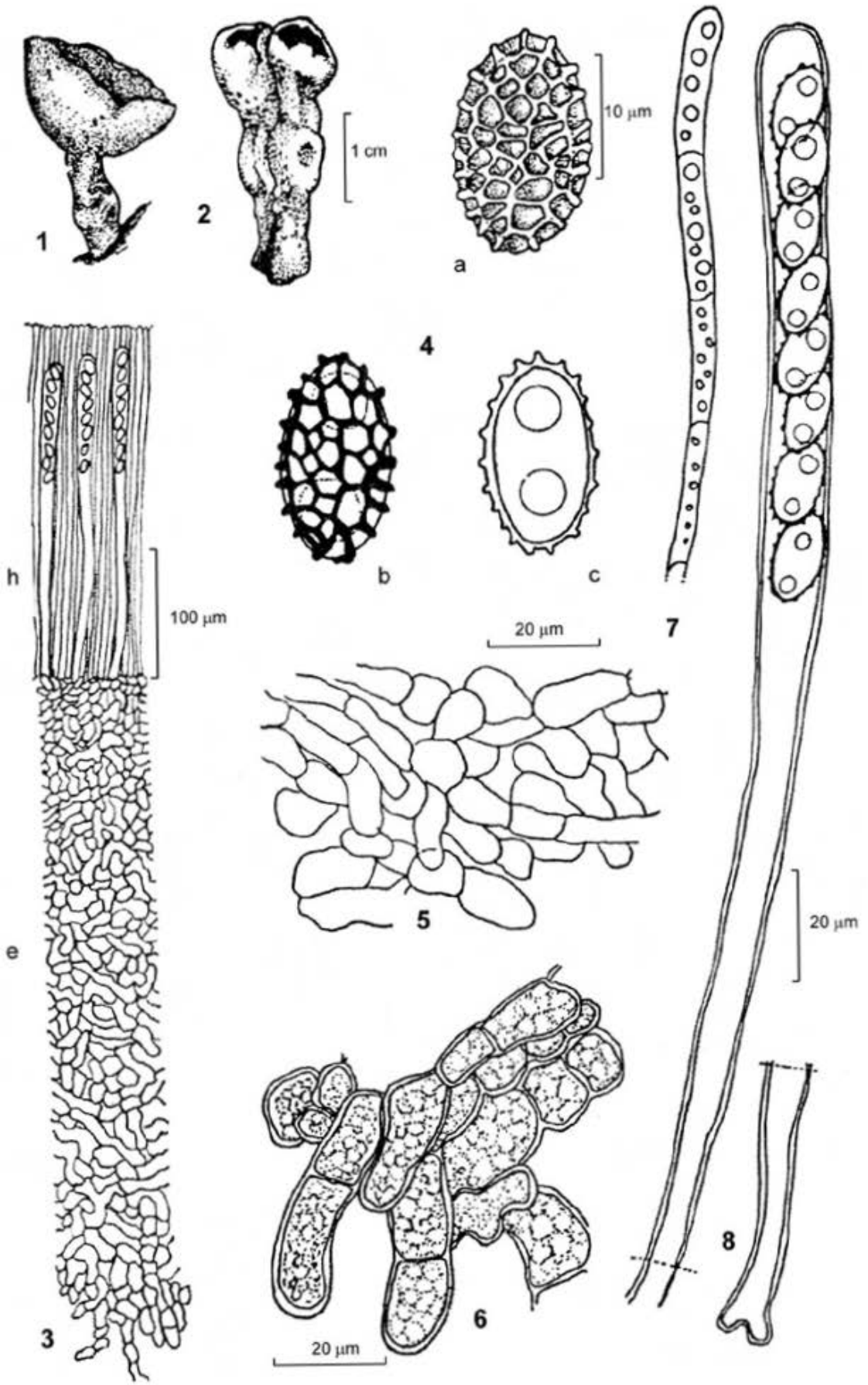
ASCOMATA apothecial, small- to medium-sized, deeply cupulate to discoid, of fleshy consistency, gregarious, sessile, superficial and broadly sessile to partially sunken in the substrate; disc, smooth, white, gray, yellow, orange to brown; margin conspicuous, hairy, with fascicles of hairs arising from the outermost cells of the excipulum, simple, straight or flexuous, pluriseptate, acute or obtuse at the apex with basal cells usually inflated, hyaline, subhyaline or brown-walled. ECTAL EXCIPULUM a textura angularis to globulosa of hyaline or subhyline cells or the outermost layers with brown-walled cells. MEDULLARY EXCIPULUM of textura intricata, hyaline. ASCI cylindrical, usually 8-spored, J–. PARAPHYSES simple, slightly enlarged at the apex. ASCOSPORES usually 1-seriate, uninucleate, eguttulate, but sometimes with polar granules, hyaline, immature ascospores with the cytoplasm staining blue in cotton blue, at maturity very refractive, yellowish with a cyanophylic sheath discernible with cotton blue, ellipsoidal to subfusoidal, smooth or ornamented with fine warts, sometimes arranged in longitudinal stripes.

TYPE SPECIES: ***Tricharina gilva*** (Boud. ex Cooke) Eckblad, Nytt Mag. Bot. 15: 60. 1968.

HABITAT: on burnt soil, decayed wood and plant debris.

ANAMORPH: ***Ascorhizoctonia*** Chin S. Yang & Korf, a *Rhizoctonia*-like anamorph. Mycelium superficial or embedded in the agar-media, hyaline to brownish. Forms aggregates of monilioid, branched cell-chains; cells doliiform containing oil globules.

PLATE 18. 1–8. *Sowerbyella rhenana* (BAFC 20579). 1. Mature ascoma. 2. Concrescent young ascomata. 3. Vertical section of the ascoma: h, hymenium, e, excipulum. 4. Ascospores: a, surface view unstained, b, idem. stained with lactic blue, c, optical section. 5. Detail of the excipulum. 6. Excipular furfurations. 7. Paraphyses. 8. Ascus: upper and lower portions.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3
6
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8

NOTES: *Tricharina* is similar to *Trichophaea* (see below) and is also related to *Wilcoxina* Chin S. Yang & Korf, which differs in hairs that cover the entire receptacle down to the base and a narrower, uninflated basal cell. Its anamorph is the chlamydosporic *Complexipes* C. Walker emend. Chin S. Yang & Korf, which forms ectomycorrhizae.

Trichophaeopsis, a segregate of *Trichophaea* that is also similar but characterized by bifurcate hairs, is distinguished by an ectal excipulum formed by horizontally elongated, thick-walled brown cells and ascospores lacking oil globules but with de Bary bubbles.

The relationship of *Tricharina* with *Geopora* is supported by molecular studies using partial nLSU rDNA and SSU rDN sequences from various species of both genera that differ morphologically in ascospore guttulation and hair morphology (see description of *Geopora*). The figures given to illustrate the genus *Tricharina* were published as *Trichophaea fimbriata* (Quél.) Gamundí (1966) after examination of the type specimen in Cooke's Herbarium (K). In the revision of *Tricharina* by Yang & Korf (1985), *T. fimbriata* is considered a synonym of *T. gilva* for nomenclatural reasons, a view that I accept. However, the Argentine collection has ascospores that agree in form and size [15–16.6(–18.3) × 8.3–10 µm] with the type specimen of *Lachnea fimbriata* Quél. Brummelen (1983) stated that *T. gilva* is very variable in ascospore size and length/breath ratio.

DISTRIBUTION IN ARGENTINA: two species are recorded: *T. gilva* (= *Trichophaea fimbriata* (Boud. ex Cooke) Gamundí and *T. striispora* (Rifai) Chin S. Yang & Korf, from BA and RN.

ILLUSTRATION: Pl. 19, 1–7. *Tricharina gilva*.

LITERATURE: Barrera & Romero 2001; Brummelen 1983; Dennis 1978; Dissing 2000; Eckblad 1968; Egger 1996; Gamundí 1966, 1975; Gamundí & Lorenzo 2001; Gamundí et al. 2004; Korf 1985; Korf & Erb 1972; Liu & Zhuang 2006; Perry et al. 2007;Svrček & Kubička 1961; Wu & Kimbrough 1996; Yang & Korf 1985a,b; Yang & Kristiansen 1989.

Trichophaea Boud. (*Pyronemataceae*)

ASCOMATA apothecial, small- to medium-sized, sessile, discoid to pateliform, gregarious, of fleshy consistency; disc smooth, plane to concave, whitish, pale bluish, grayish to pale ochraceous grayish; margin conspicuous, hairy, covered with scattered, long, superficial hairs, isolated or in fascicles, acute and rigid, pluriseptate, thin-walled, hyaline, yellowish or brown, simple sometimes with

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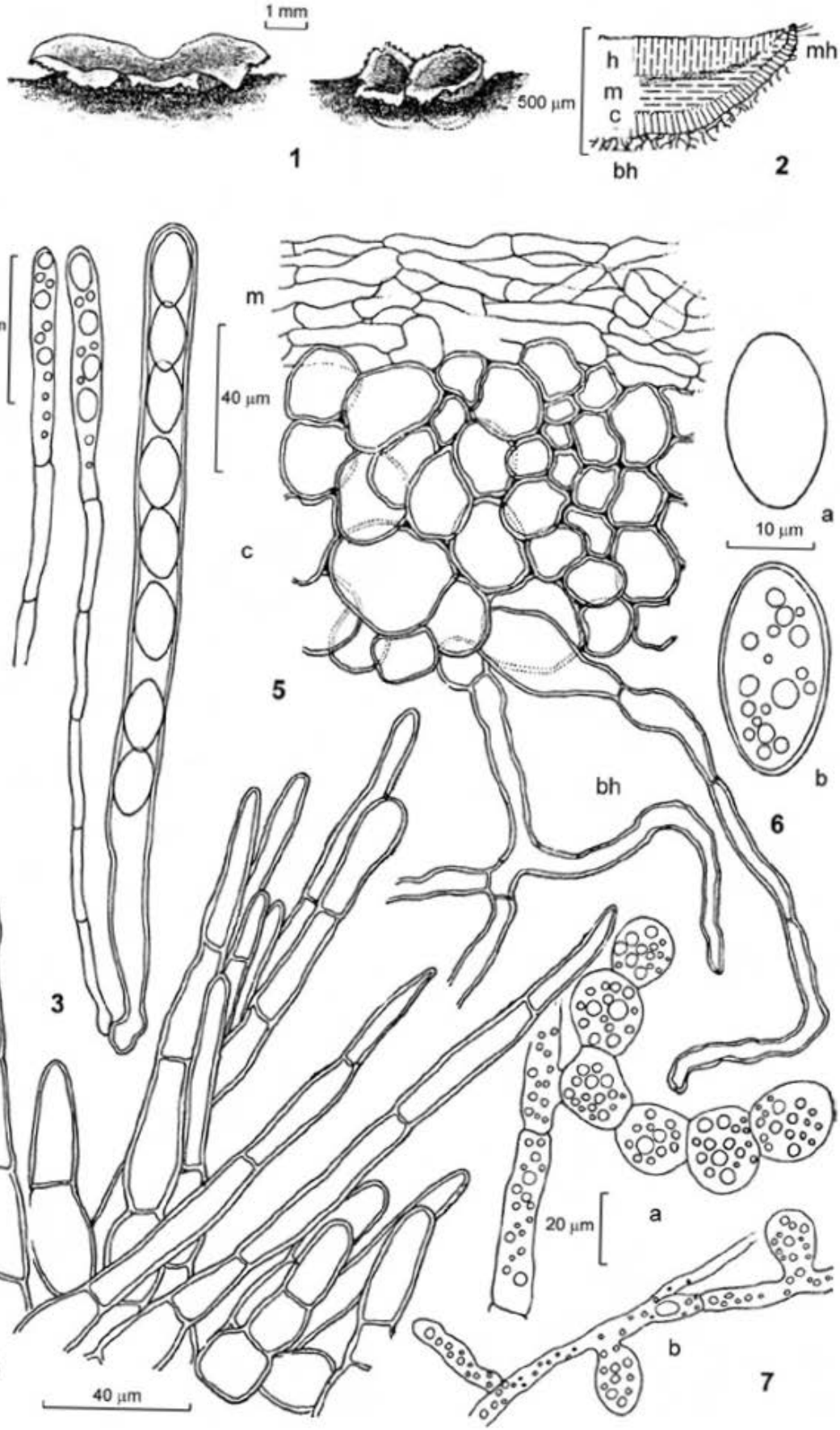
PLATE 19. 1–7. *Tricharina gilva* (BAFC 22002). 1. Ascomata. 2. Sketch of a vertical section of the ascoma: h, hymenium, m, medullary excipulum, c. ectal excipulum, bh, basal hairs, mh, marginal hairs. 3. Ascus and paraphyses. 4. Marginal hairs. 5. Vertical section of the ascoma: m, c and bh as in FIG. 2. 6. Ascospores: a, surface view, b, optical section. 7. Immerse mycelia in a 4-week culture at room temperature: a, filter paper medium, chlamydospore-like cells, b, APG medium, young mycelium.


1 mm
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mh
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m
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4
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a
10 µm
b
20 µm
a
b
7

a bulbous base or atenuated at the base; external surface concolorous with the disc or brownish. ECTAL EXCIPULUM of textura angularis to globulosa, composed of isodiametric cells with hyaline or brown walls, arranged in rows perpendicular to the external surface, the most superficial sometimes forming patches of brown cells from where the hairs arise. MEDULLARY EXCIPULUM of textura intricata, hyaline. ASCI cylindrical, 8-spored, J–. PARAPHYSES simple, clavate at the apex, hyaline, septate. ASCOSPORES 1-seriate, uninucleate, hyaline, subglobose, ellipsoidal to fusoid, smooth or ornamented with small to large warts, guttulate, sometimes with de Bary bubble.

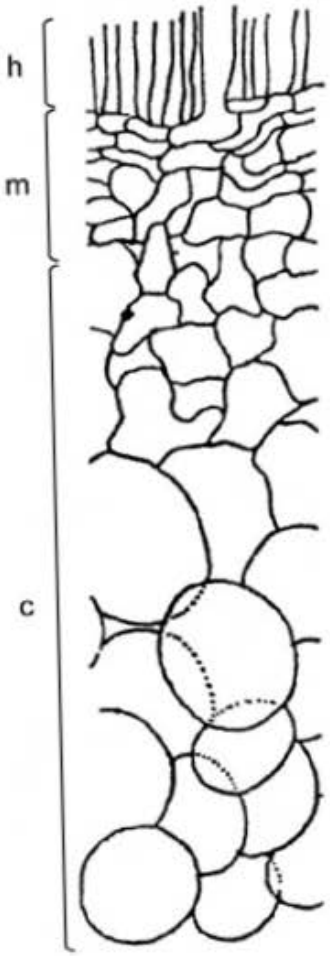
TYPE SPECIES: ***Trichophaea woolhopeia*** (Cooke & W. Phillips) Arnould, Bull. Soc. Mycol. France 9: 112. 1893.

HABITAT: on clayish or burnt soil, on plant debris and mushroom beds.
ANAMORPH: ***Dichobotrys*** Hennebert. Conidiophores mononematose, hyaline, erect, dichotomously furcate at about half height, with primary and secondary branches; conidiogenous cell sympodioblastic; conidia holoblastic, hyaline, unicellular, subglobose to napiform, smooth.

NOTES: *Trichophaea* is related to other hairy *Pyronemataceae* such as *Anthracobia* but differs in its long, pointed hairs (see *Anthracobia* above). Some species of both genera may colonize burnt places but can be distinguished at first sight by the colour of the disc. Also related is *Sphaerosporella*, which has globose, uniguttulate ascospores. Ultrastructure examination of the ascospore wall led some authors to reunite *Sphaerosporella* and *Trichophaea*. Both genera also have the same anamorph genus, *Dichobotrys*. *Trichophaeopsis* differs in its bifurcate hairs and superficial excipular cells arranged in vertical rows. *Tricharina* also shows affinity with *Trichophaea*, which has an *Ascorhizoctonia* anamorph. *Paratrichophaea* differs in its setiform hairs arising deeply in the excipulum and eguttulate ascospores. Some species of pyrophilous *Trichophaea* can complete the life cycle in vitro but ascospores may need to be submitted to a heat shock to stimulate germination. Others, non-pyrophilous, can form ectomycorrhiza with *Betula* and *Picea*, a symbiosis confirmed by experimental and molecular studies. Ultrastructural septal structure (TEM) showed that *Trichophaea* has the aleurioid-type of ascospores (see NOTES in *Aleuria*). Results on ascospore ontogeny demonstrated that smooth-spored and pyrophilous species form *Dichobotrys* anamorphs, whereas rough-spored species are non-pyrophilous and do not form anamorphs. Phylograms generated from SSU rDNA data analyses suggest affinity with *Wilcoxina*, which has *Complexipes* anamorphs.

PLATE 20. 1–6. *Trichophaea gregaria* (LIL, Singer T-2266). 1. Ascoma. 2. Vertical section of the ascoma: h, hymenium, m, medullary excipulum, c, ectal excipulum. 3. Ascospores in optical section and surface view. 4. Paraphyses. 5. Ascus. 6. Marginal hair. 7. Basal hair, base and terminal portion.

1



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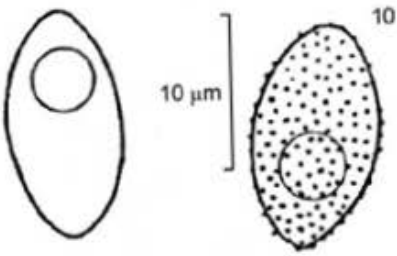

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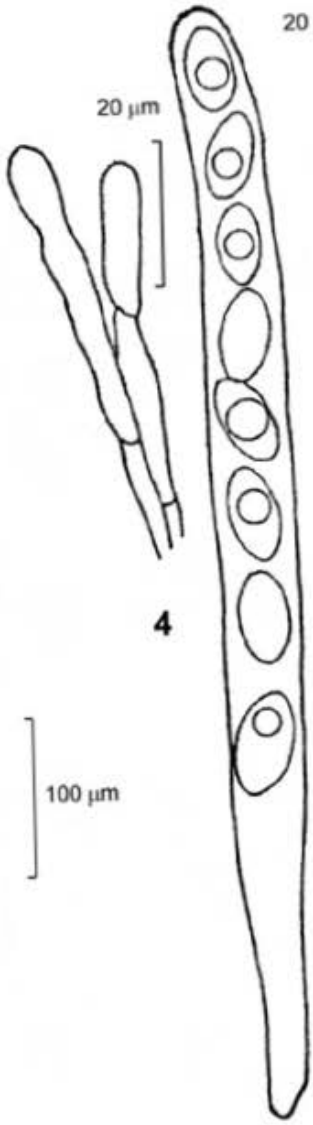

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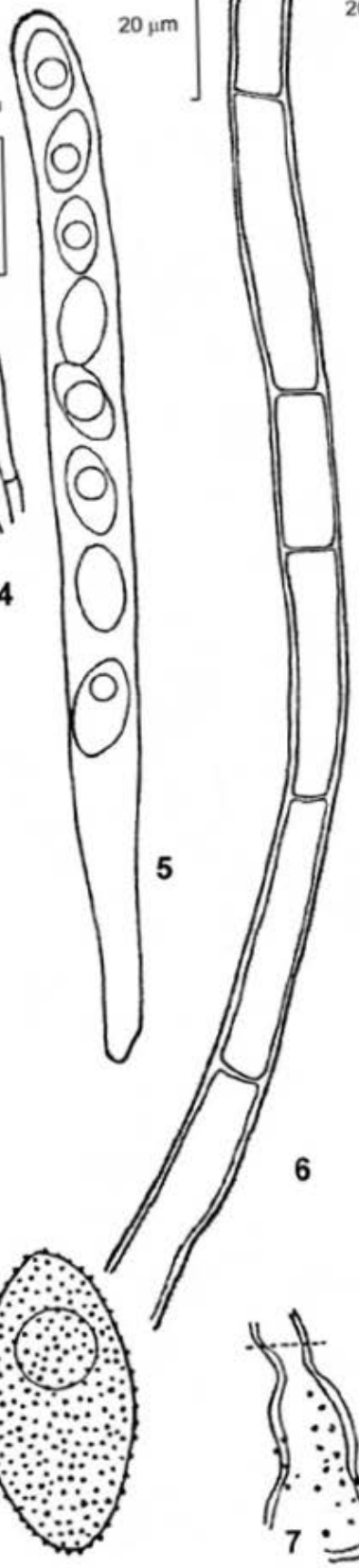

5 6

7

Partial nLSU rDNA sequence analyses suggest that *Trichophaea* is non-monophyletic. A clade "7", with smooth ascospores and *Dichobotrys* anamorph suggest a close connection with *Sphaerosporella*, while clade "8" (diagnosed by ornamented ascospores and without any anamorph) is related to *Wilcoxina*.

DISTRIBUTION IN ARGENTINA: one species was found: *T. gregaria* (Rehm). Boud. from BA.

ILLUSTRATION: Pl. 20, 1-7. *Trichophaea gregaria*.

LITERATURE: Coetzee & Eicker 1994; Dennis 1978, 1981; Dissing 2000; Gamundí 1960; Hennebert 1973; Hennebert & Bellemère 1979; Kanouse 1958; Kimbrough 1994; Korf 1988; Korf & Erb 1972; Landvik et al. 1997; Liu & Zhuang 2006; Maas Geesteranus 1967; Perry et al. 2007; Pfister 1988; Rifai 1968; Tedersoo et al. 2005; Trigaux 1985; Svrček & Kubička 1961; Vooren et al. 2005; Webster et al. 1964; Wu & Kimbrough 1995; Yang & Korf 1985a,b.

Trichophaeopsis Korf & Erb (*Pyronemataceae*)

ASCOMATA apothecial, minute to small, turbinate, gregarious, of fleshy consistency, sessile; disc plane or concave, whitish to dull yellow; margin elevated, undulate, hairy; external surface densely covered by straight, dark brown, acute, thick-walled, pluriseptate setae, some of them bifurcate usually with two unequal branches, the longest pointing upwards, lower part of the ascoma covered with flexuous hyaline to brownish, thin-walled, simple hairs, with a bulbous base. Setae and hairs are of superficial origin. ECTAL EXCIPULUM of textura prismatica, one- or two-layered, composed of thick-walled, brown cells, in surface view horizontally elongated. MEDULLARY EXCIPULUM well developed, of a compact textura intricata, hyaline. ASCI cylindrical, 4–8-spored, J–. PARAPHYSES simple, filiform, hyaline. ASCOSPORES usually 1-seriate, uninucleate, eguttulate, smooth or punctuate, hyaline or pale yellowish and very refractive, sometimes with a de Bary bubble.

TYPE SPECIES: ***Trichophaeopsis bicuspis*** (Boud.) Korf & Erb, Phytologia 24(1): 18. 1972.

HABITAT: on dung, soil or plant debris.
ANAMORPH: unknown.

NOTES: *Trichophaeopsis* is characterized by its very thin, dark ectal excipulum and bifurcate setae that separate it from *Trichophaea* with simple hairs and different type of ectal excipulum (compare descriptions). The genus, which includes two species (and one subspecies), it is said by its authors to occupy an isolated position among the operculate discomycetes. It was recently suggested

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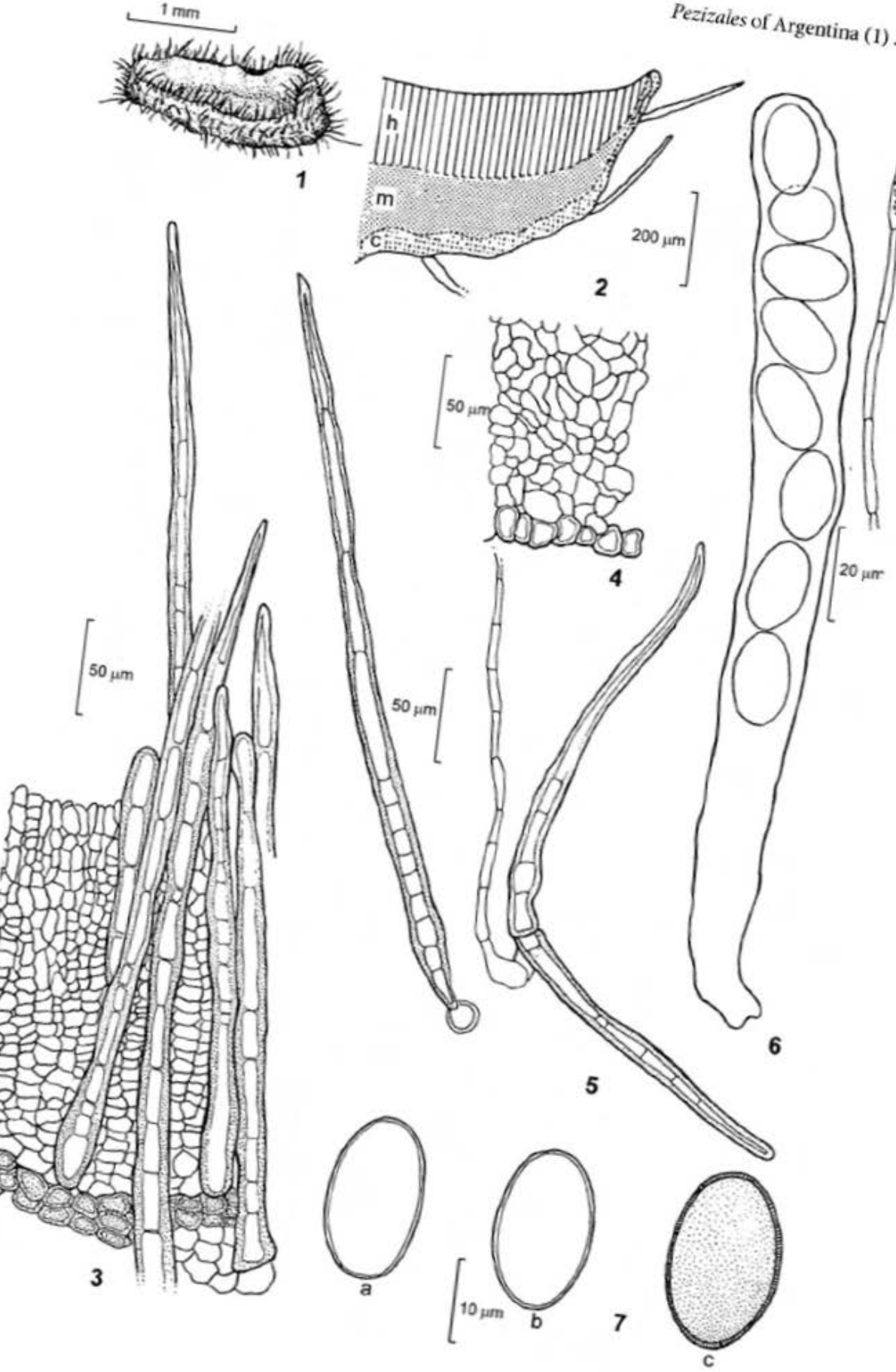
PLATE 21. 1–7. *Trichophaeopsis bicuspis* subsp. *eguttulispora* (LPS 36891). 1. Ascoma. 2. Sketch of a vertical section of the ascoma: h, hymenium, m, medullary excipulum, c, ectal excipulum. 3. Margin and ectal excipulum in surface view. 4. Detail of the ectal excipulum. 5. Setiform and hyphoid hairs. 6. Ascus and paraphyses. 7. Ascospores: a, b unstained, c, iodine stained.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10 µm
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that its closest relative is *Rhizoblepharia* Rifai. This relationship seems remote, as hairs in this genus are rooting, the ascospores are fusoid and covered with transverse, cyanophobic ridges recalling those of some *Sarcoscyphaceae*. *Wilcoxina* is different in excipular structure and hairs. *Paratrichophaea* differs basically in its simple setae that arise in the medullary excipulum. Molecular studies using parsimony and Bayesian analysis of partial sequences of SSU and LSU rDNA suggests a relationship of *Trichophaeopsis* with *Wilcoxina* and a group of *Trichophaea* spp. The synonymy of *Trichophaea gilva* (Boud. ex Cooke) Gamundí, a homotypic synonym of *Tricharina gilva,* with *Trichophaea eguttulispora* Gamundí that appeared in Gamundí et al. (2004: 141) is erroneous; the correct name of the latter taxon is *Trichophaeopsis bicuspis* subsp. *eguttulispora* (Gamundí) Korf.

ILLUSTRATION: Pl. 21, 1–7. *Trichophaeopsis bicuspis* subsp. *eguttulispora.*

DISTRIBUTION IN ARGENTINA: only *T. bicuspis* subsp. *eguttulispora* from TF.

LITERATURE: Barrera & Romero 2001; Dissing 2000; Dissing & Paulsen 1976; Gamundí 1975; Gamundí et al. 2004; Häffner & Krieglsteiner 1991; Hansen & Pfister 2006; Korf 1977; Korf & Erb 1972; Landvik et al. 1997; Liu & Zhuang 2006; Perry & Pfister 2008; Perry et al. 2007; Pfister 1988; Trigaux 1985; Vooren et al. 2005; Yang & Korf 1985a;b; Yang & Kristiansen 1989.

Underwoodia Peck (*Helvellaceae*)

ASCOMATA pileate, cylindrical or clavate, straight or slightly curved, large, up to 25 cm long, superficial, stipitate with the pileus completely adnate to the stipe, gregarious to cespitose, sometimes concrescent, of fleshy consistency drying leathery, internally entirely hollow or alveolate; hymenium brown, grayish-brown or black, covering the upper part of the ascoma, smooth or sulcate; stipe cylindrical, somewhat bulbous at the base, smooth or sulcate with longitudinal ribs that may anastomose, internally hollow or lacunose and externally minutely furfuraceous, paler than the hymenium or whitish. PILEUS in transverse section showing: a) hymenium as the outermost layer, followed by b) a trama of compact textura intricata and c) a palisade-like inner layer of textura prismatica. STIPE 3-layered, composed of: a) External palisade-like layer composed of septate hyphae disposed in rows perpendicular to the surface, the outermost ending freely to form the furfurations; b) Medium layer (trama) of textura intricata of hyaline, septate hyphae; c) Inner layer palisade-like of hyaline hyphae, similar

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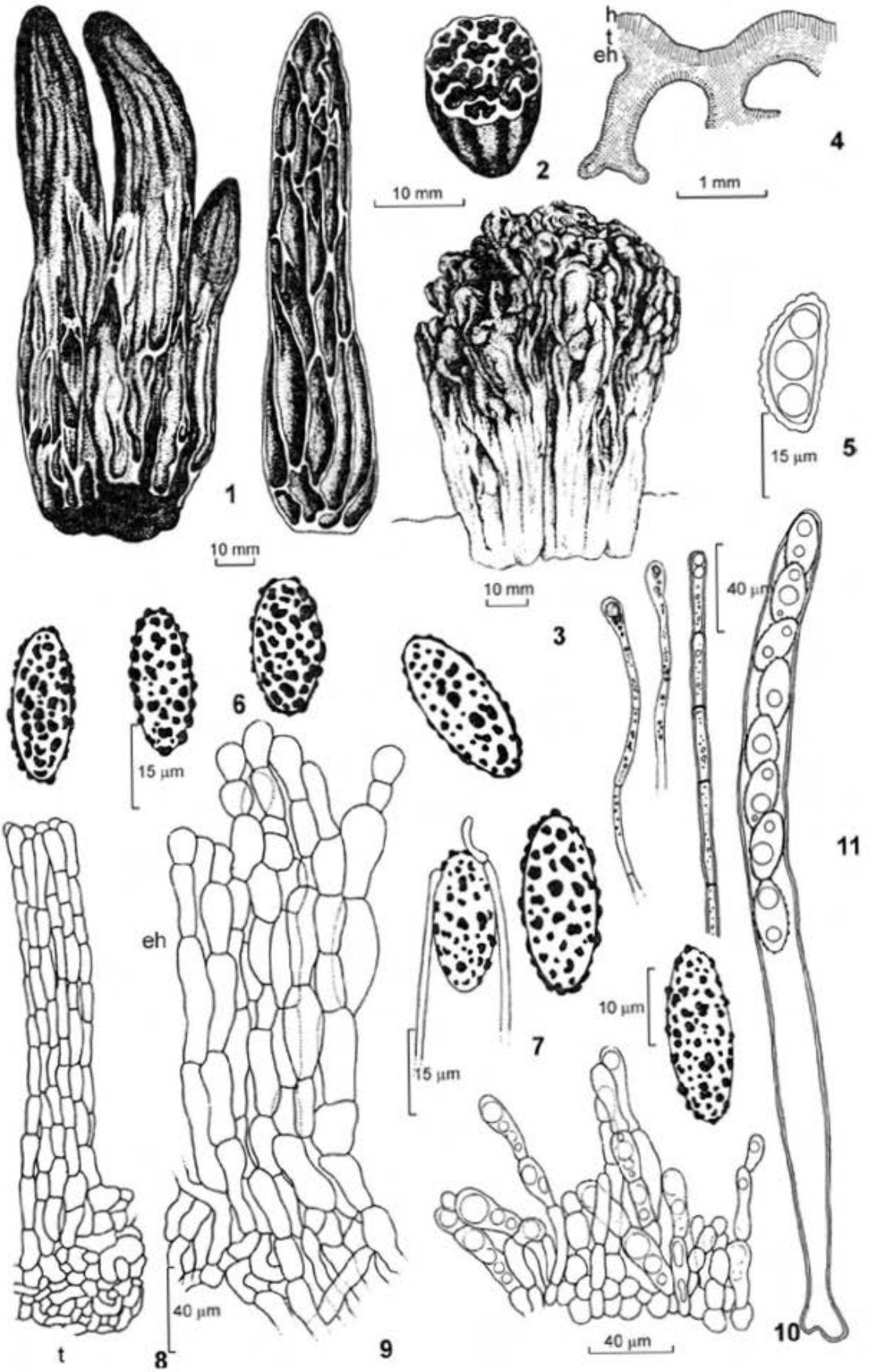
PLATE 22. 1–11. *Underwoodia fuegiana* (BAFC 20001). 1. Ascomata, one in vertical section. 2. Cross section of the ascoma at the pileus level. 3. Several concrescent ascomata. 4. Sketch of a cross section of the pileus: h, hymenium, t, trama, eh, palisade-like layer. 5. Ascospore, optical section. 6. Ascospores, surface view. 7. Dehiscent ascus. 8. Detail of the palisade-like layer of the pileus: eh, t, as in FIG. 4. 9. Detail of the palisade-like layer of the stipe. 10. Detail of stipe furfuration. 11. Ascus and paraphyses.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t

to the inner layer of the pileus. Asci cylindrical to subcylindrical, 8-spored, pleurorhynchous, J–. Paraphyses straight or curved and slightly enlarged at the apex, someties forked near the base, containing pigmented granules or diffused pigment. Ascospores 1–2 seriate, 4-nucleate, containing 1–3 guttules, hyaline to subhyaline, ellipsoidal to subfusoidal, coarsely verrucose or papulose, warts rounded of unequal size, cyanophilic.

Type species: ***Underwoodia columnaris*** Peck, Ann. Rep. N.Y. St. Mus. 43: 32. 1890.

Habitat: on soil in the forest or in disturbed prairies nearby forests, sometimes among mosses and ferns, occasionally on wood.
Anamorph: unknown.

Notes: *Underwoodia* is the legitimate name for *Geomorium* Speg. It shares with *Helvella* the character of 4-nucleate ascospores but dictinct by its adnate pileus and ascospore rougher ornamentation. Formerly several authors suggested the synonymy with *Helvella* but others considered it a separate genus. Recent studies confirm the identity of *Underwoodia* as a genus (See Notes under *Helvella).* Moreover, phylogenetic relationships derived from molecular studies suggest that *Underwoodia* diverges from *Helvella* and from the hypogeous genera *Barssia* and *Balsamia*, all included in the family *Helvellaceae*. Species of North America are recorded as poisonous but no data on this respect have been recorded for the Argentinian collections. No type of mycorhiza has been confirmed for this genus, but our personal field observation on *U. singeri* Gamundí & E. Horak shows rhizomorphs arising from the base of the stipe which are in contact with the root system of vascular plants. *U. fuegiana* occasionally shows a sparassoid form derived from confluent ascomata when growing in grazing land.

Distribution in Argentina: two species are recorded in the Andean-Patagonian forests: *U. fuegiana* (Speg.) Gamundí and *U. singeri*. from: N, RN, TF.

Illustration: Pl. 22, 1–11. *Underwoodia fuegiana*.

Literature: Ammirati et al. 1985; Abbott & Currah 1997; Dissing 1966; Eckblad 1968; Gamundí 1957b, 1975; Gamundí & Horak 1979, 2003; Korf 1973a; Landvik et al. 1999; O´Donnell et al. 1997; Rifai 1968.

Acknowledgments

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Notes on *Trametes* from the Brazilian Amazonia

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Abstract — *Trametes supermodesta* is reported as new to Brazil and the collection represents the second from South America. *Trametes ochroflava* and *T. pavonia* represent first records for the Brazilian Amazonia. A description of *T. supermodesta* and a key to the accepted species of *Trametes* reported for the Brazilian Amazonia are provided.

Key words — *Polyporaceae*, diversity

Introduction

Trametes is a cosmopolitan genus proposed by Fries and comprises about 48–50 species so far (www.indexfungorum.org; Kirk et al. 2008). The species of *Trametes* cause white rot of dead hardwood and (rarely) conifers. The genus is characterized by its sessile to effused–reflexed, light–colored basidiomata, poroid hymenial surface with round, angular to irregular pores, trimitic hyphal system, presence or absence of cystidia, and ellipsoid to allantoid, hyaline, smooth basidiospores that do not react in Melzer's reagent (Ryvarden & Gilbertson 1993).

Despite the high biodiversity of the Brazilian Amazonia, the knowledge about *Trametes* is still scarce, with only nine species reported: *T. cotonea*, *T. cubensis*, *T. lactinea*, *T. marianna* (Pers.) Ryvarden 1973, *T. maxima*, *T. membranacea*, *T. modesta*, *T. pubescens* (Schumach.) Pilát 1939, and *T. villosa* (Gomes-Silva & Gibertoni 2009). *Trametes supermodesta* was first described from Venezuela (Ryvarden & Iturriaga 2003), and we provide a description of the species based on collections from the Brazilian Amazonia, a key of the species of the genus in the area, and comments on the species recently collected or deposited in INPA.

Material and methods

The Amazonia covers an area of 4,196,943 km² out of which approximately 50% belongs to Brazil (Capobianco et al. 2001), in the states of Acre, Amapá, Amazonas, Pará, Roraima, Rondônia, half of Mato Grosso (54%), and part of Maranhão (34%) and Tocantins (9%) (IBGE 2003).

Field trips were undertaken four times from 2007 to 2008 in the state of Rondônia and four times from 2006 to 2008 in the state of Pará. In Rondônia, the study areas were located in Estação Ecológica de Cuniã (08°04'S 63°31'W) of the city of Porto Velho, the state capital and Parque Natural Municipal de Porto Velho (08°45'S 63°54'W). Both areas are covered mostly by open ombrophilous forest and transition forest with savanna. In Pará, the Estação Científica Ferreira Penna (1°44'S 51°27'W) includes typical Amazonian ecosystems and its flora is one of the richer in the Amazonian basin (Lisboa 2002). Additionally, three areas in Rondônia were also visited at irregular intervals, and specimens deposited in INPA were also studied.

The basidiomata were analyzed macro– (shape, color, hymenial surface) and micromorphologically (hyphal system, presence/absence and measurements of sterile structures and basidiospores). Microscopical observations were made from slide preparations with 5% KOH, stained with 1% of aqueous phloxine, and Melzer's reagent (Ryvarden 1991). Color designations follow Watling (1969). The specimens are deposited in the HFSL and in URM.

Results

Thirteen species of *Trametes* are reported for the Brazilian Amazonia. *Trametes supermodesta,* previously was only from its type locality, is reported for the second time. Although recently described, several earlier collections had already been deposited in INPA. *Trametes ochroflava* and *T. pavonia* are new records for the Brazilian Amazonia and, together with another seven species that are new records for individual Brazilian States in Amazonia, were studied only from collections deposited in INPA, underscoring the importance of herbaria revisions and accessibility of herbaria records.

Taxonomy

Trametes supermodesta Ryvarden & Iturr., Mycologia 95(6): 1074 (2003).

Basidiomata annual, pileate, semicircular to flabelliform with a contracted base, solitary or gregarious, up to 3.5–5 cm wide and 2.3–3.5 cm high, 0.2 mm thick, slightly flexible. Abhymenial surface glabrous, dull, concentrically zonate, slightly sulcate, cinnamon (10) to buff (52). Margin entire, acute, concolorous with the abhymenial surface. Context homogeneous, fibrous, thin, up to 0.1 mm thick, cinnamon (10) to buff (52), red in KOH. Tubes more or less concolorous with the pore surface, thin, up to 0.1 mm thick. Hymenial surface with angular pores next to the margin and irregular to slightly decurrent in the rest of the hymenial surface, 2–3 per mm, fawn (29) to clay pink (30).

Hyphal system trimitic; generative hyphae hyaline to yellow, clamped, thin-walled, 2–3.5 µm; skeletal hyphae yellow, thick-walled, 3–5 µm; binding hypha hyaline to yellow, thick-walled to solid, 2–3.5 µm. Cystidia absent. Basidia not observed. Basidiospores cylindrical, hyaline, thin-walled, smooth, inamyloid, 8–9 × 2.8–3.5 µm.

SUBSTRATE — on deciduous wood.

MATERIAL EXAMINED: BRAZIL. Amazonas: loc. n. det., 10.VII.1971, G.T. Prance et al.14035-14074 (INPA 32250, INPA 32289); 24.VII.1971, G.T. Prance et al. 14545 (INPA 32761); 16.IX.1980, B. Lowy et al. 185-196 (INPA 100113, INPA 100083); Presidente Figueiredo, 27.II.1985, C. Dick 678 (INPA 185927); Manaus, 17.II.1990, M.A. de Jesus 1454 (INPA 192699, as *T. modesta*); 17.VII.1990, M.A. de Jesus 1449 (INPA 192695, as *T. modesta*); Pará: Oriximiná, 27.VI.1980, V.L.R. Bononi 618 (INPA 103601); 28.VI.1980, V.L.R. Bononi 658 (INPA 103622); 30.VI.1980, V.L.R. Bononi 816 (INPA 103723); Rondônia: loc. n. det., 4.VII.1968, K.P. Dumont et al. 63-65 (INPA 65103, INPA 65105, as *T. scabrosa*); 6.VII.1968, K.P. Dumont et al. 98 (INPA 65136, as *T. scabrosa*); 23.V.1984, R.D. Goos et al. 1631 (INPA 125136); 1.VI.1984, R.D. Goos et al. 1719 (INPA 125221); Porto Velho, Parque Natural Municipal de Porto Velho, VII.2007, A.C. Gomes-Silva 06-60 (URM 79570, URM 79579); Estação Ecológica de Cuniã, II.2007, A.C. Gomes-Silva 236 (URM 79578); Roraima: Alto Alegre, 10.VI.1986, K.F. Rodrigues et al. 885-895 (INPA 143282, INPA143289); 10.VI.1986, E.S.S. da Silva 410 (INPA 154906, INPA 154940); loc. n. det., 18.VI.1986, B. Lowy et al. 2069 (INPA 145354, as *Daedalea* sp.).

REMARKS: *Trametes supermodesta,* first described from Venezuela by Ryvarden & Iturriaga (2003), is recognized by its large pores and long basidiospores. *Trametes supermodesta* may be mistaken for *T. modesta* due to its similar basidiomata color, but the pores are larger (2–3 per mm) in *T. supermodesta* than in *T. modesta* (6–10 per mm). The Brazilian specimens of *T. supermodesta* differ macroscopically from the original description by the smaller pores (2–3 per mm vs. 3–4 per mm in the original) and thinner basidiomata.

Key to the species of *Trametes* recorded from the Brazilian Amazonia

1a. Context with black lines 2
1b. Context without black lines 4
2a. Pores daedaloid, 2–3 per mm, basidiospores 4.5–5.5 µm long ..... *T. maxima*
2b. Pores regular or lacerate, 1–5 per mm, basidiospores 5–8.5 µm long 3
3a. Pores dentate to lacerate, 1–3 per mm, basidiospores cylindrical to allantoid 5.5–8.5 × 2.5–3.5 µm ..... *T. villosa*
3b. Pores angular to circular, 4–5 per mm, basidiospores cylindrical 5–6 × 1.5 µm ..... *T. versicolor*
4a. Abhymenial surface with reddish cuticle from the base ..... *T. cubensis*
4b. Abhymenial surface without reddish cuticle from the base 5
5a. Abhymenial surface azonate or slightly zoned 6
5b. Abhymenial surface strongly zoned 9

6a. Abhymenial surface tomentose to finely pubescent, context not reacting in KOH ..... *T. pubescens*

6b. Abhymenial surface velutine to glabrous, context reacting in KOH 7

7a. Basidiomata white to cream, context dark brown in KOH, basidiospores cylindrical-ellipsoid 4–7.5 × 2–3 µm ..... *T. lactinea*

7b. Basidiomata pale pinkish brown, context red in KOH, basidiospores cylindrical 8

8a. Pores 6–10 per mm, basidiospores 4–6 × 1.5–2 µm ..... *T. modesta*

8b. Pores 2–3 per mm, basidiospores 8–9 × 2.8–3.5 µm ..... *T. supermodesta*

9a. Basidiomata sessile to effused-reflexed, basidiospores cylindrical 10

9b. Basidiomata sessile, basidiospores cylindrical-ellipsoid to ellipsoid 12

10a. Basidiomata ochraceous to brown, abhymenial surface smooth to tuberculate, glabrous, context homogeneous, basidiospores 4 µm long ..... *T. ochroflava*

10b. Basidiomata whitish to cream, abhymenial surface finely velutine to tomentose, context cottony or fibrous, basidiospores up to 3.5 µm long 11

11a. Context cottony, pores 3–5 per mm, dissepiments entire, basidiospores 7–11 × 2.5–3.5 µm ..... *T. cotonea*

11b. Context fibrous, pores 5–6 per mm, dissepiments lacerate to dentate, basidiospores 4.5–6 × 2–2.5 µm ..... *T. membranacea*

12a. Abhymenial surface glabrous, pores round, basidiospores cylindrical-ellipsoid, 6–7 × 2–2.5(–3) µm ..... *T. marianna*

12a. Abhymenial surface tomentose, pores angular, basidiospores ellipsoid, 5–6 × 3–4 µm ..... *T. pavonia*

Trametes cotonea (Pat. & Har.) Ryvarden, Norw. JI Bot. 19: 236 (1972).

≡ *Polyporus cotoneus* Pat. & Har., Bull. Soc. mycol. Fr. 9: 208 (1893).

MATERIAL EXAMINED: BRAZIL. Amazonas: Presidente Figueiredo, 3.IV.1984, M.A. de Jesus 390 (INPA 185336, as *T. nivosa*); Rondônia: loc. n. det., 27.X.1979, R. H. Petersen 273 (INPA 110762, as *Polyporus* sp.); Roraima: Caracaraí, 16.XI.1977, I. de J. Araújo et al. 437-506 (INPA 76964, INPA 77217); loc. n. det., 30.XI.1977, I. de J. Araújo et al. 733 (INPA 78452, as *T. membranacea*).

DESCRIPTION — Ryvarden & Johansen (1980).

DISTRIBUTION — Pantropical (Ryvarden & Johansen 1980, Ryvarden 2000). In Brazil, reported for the states of Acre, Pará (Gomes-Silva & Gibertoni 2009), and now for the states of Amazonas, Rondônia and Roraima.

NOTES — This species can be recognized in the field by the flexible, cream basidiomata. Macroscopically it is similar to *T. membranacea* but differs by shorter basidiospores.

Trametes cubensis (Mont.) Sacc., Syll. Fung. 9: 198 (1891).

≡ *Polyporus cubensis* Mont., Annls Sci. Nat., Bot., sér. 2, 8: 364 (1837).

MATERIAL EXAMINED: BRAZIL. Acre: loc. n. det., 10.X.1980, B. Lowy et al. 585 (INPA 100437, as *Polyporus* sp.); 26.X.1980, B. Lowy et al. 988 (INPA 100762, as *Polyporus* sp.); Amazonas: loc. n. det., 6.XI.1977, E.M.L. Freire 158 (INPA 70059); 22.V.1978, R. Singer &

I.J Araújo 11033 (INPA 76881, as *Microporellus* sp.); 1.VIII.1979, A.C. Webber 62 (INPA 84271, as *Fomitopsis* sp.); 16.IX.1980, B. Lowy et al. 170 (INPA 100084, as *Polyporus* sp.); Presidente Figueiredo, 21.IX.1983, M.A. de Jesus 31-32 (INPA 183649, INPA 183650); Fonte Boa, 1.XI.1986, E.S.S. da Silva et al. 923 (INPA 155037); Pará: Itaituba, 29.IX.1977, M. A. Sousa 8-38 (INPA 84083, INPA 84082, as "*Fomitopsis cubensis*"); Rondônia: loc. n. det., 29.VI.1968, K.P. Dumont et al. 12 (INPA 64827, as *T. scabrosa*); Porto Velho, Parque Natural Municipal de Porto Velho, VII.2007, A.C. Gomes-Silva 276 (URM 79554); Roraima: loc. n. det., 24.VII.1974, G.T. Prance et al. 21386-21366 (INPA 112093, as *Polyporus phlebeius*, INPA 45341); Boa Vista, 21.XI.1977, L. de L. J. Aguiar et al. 665 (INPA 78384).

DESCRIPTION — Gilbertson & Ryvarden (1987).

DISTRIBUTION — Neotropical, and subtropical areas of the USA (Gilbertson & Ryvarden 1987). In Brazil, reported for the states of Pará (Gomes-Silva & Gibertoni 2009), Bahia, Paraná, Pernambuco, Rio Grande do Sul, São Paulo and Santa Catarina (Baltazar & Gibertoni 2009). It is a new record for the states of Acre, Amazonas, Rondônia and Roraima.

NOTES — This species can be recognized in the field by the dimidiate basidiomata with a reddish cuticle from the base.

Trametes lactinea (Berk.) Sacc., Syll. Fung. 6: 343 (1888).

■ *Polyporus lactineus* Berk., Ann. Mag. nat. Hist. 10: 373 (1842).

MATERIAL EXAMINED: BRAZIL. Acre: loc. n. det., 11.X.1980, B. Lowy et al. 644 (INPA 100484, as *Polyporus* sp.); Amazonas: Manaus, 1.II.1992, M.A. de Jesus 1523 (INPA 192732); 28.IV.1996, K. Vohland 1808 (INPA 216386, as *T. menziesii*); Pará: Melgaço, VIII.2007, T. B. Gibertoni (URM 79949, URM 79950); II.2008, T. B. Gibertoni (URM 79951); Rondônia: Porto Velho, Bairro Arigolândia, VII.2007, A.C. Gomes-Silva 41 (URM 79557); Estação Ecológica de Cuniã, VII.2008, A.C. Gomes-Silva 568-584 (URM 79555, URM 79556); Fazenda Mucuim, VII.2007, A.C. Gomes-Silva 106-156-261 (URM 79558, URM 79564, URM 79566); Parque Natural Municipal de Porto Velho, II.2007, A.C. Gomes-Silva 05-04-14 (URM 79561, URM 79562, URM 79569); VII.2007, A.C. Gomes-Silva 62-259 (URM 79563, URM 79565); II/2008, A.C. Gomes-Silva 461-462-450-455 (URM 79559, URM 79560, URM 79567, URM 79568).

DESCRIPTION — Núñez & Ryvarden (2001).

DISTRIBUTION — Pantropical (Núñez & Ryvarden 2001). In Brazil, recorded in the state of Pará (Gomes-Silva & Gibertoni 2009). It is a new record for the states of Acre, Amazonas and Rondônia.

NOTES — The glabrous abhymenial surface and variable brown color of the basidiomata are similar to those of *Lenzites elegans* (Spreng.) Pat., but this species is macroscopically different due to its thicker basidiomata and the lamellate to sinuous hymenial surface.

Trametes maxima (Mont.) A. David & Rajchenb., Mycotaxon 22(2): 315 (1985).

■ *Irpex maximus* Mont., Annls Sci. Nat., Bot., sér. 2, 8: 364 (1837).

MATERIAL EXAMINED: BRAZIL. Acre: loc. n. det., 24.IV.1971, G.T. Prance et al. 12411 (INPA 30734); Amazonas: loc. n. det., 4.IV.1978, R.B. Singer & I. de J. Araújo 10930

(INPA 76880, as *Irpex* sp.); Roraima: Caracaraí, 16.XI.1977, I. de J. Araújo et al. 421 (INPA 76948, as *Coriolus maximus*).

DESCRIPTION — Gilbertson & Ryvarden (1987).

DISTRIBUTION — Neotropical, also known in subtropical areas of the USA (Gilbertson & Ryvarden 1987). In Brazil, recorded in the state of Amapá and Pará (Gomes-Silva & Gibertoni 2009). It is a new record for the states of Acre, Amazonas and Roraima.

NOTES — The hydnoid hymenial surface and the context with black zone characterize this species.

Trametes membranacea (Sw.) Kreisel, Monografias, Ciências, Univ. Habana, Ser. 4, 16: 83 (1971).

- *Boletus membranaceus* Sw., Fl. Ind. Occid. 3: 1922 (1806).

MATERIAL EXAMINED: BRAZIL. Amazonas: Manaus, 22.I.1978, I. de J. Araújo et al. 976 (INPA 78748, as *Coriolus* sp.); 22.VI.1985, M.A. de Jesus 726 (INPA 185959); 1.VI.1990, M.A. de Jesus 1392 (INPA 192659); Pará: Itaituba, 29.IX.1977, M.A. de Sousa & L.F. Coêlho 55 (INPA 74633, as *Coriolus pinsitus*).

DESCRIPTION — Gilbertson & Ryvarden (1987).

DISTRIBUTION — Neotropical, also known in subtropical areas of the USA and Argentina (Gilbertson & Ryvarden 1987). In Brazil, recorded in the state of Amapá, Pará (Gomes-Silva & Gibertoni 2009), Bahia, Minas Gerais, Paraíba, Paraná, Pernambuco, Rio Grande do Sul, Santa Catarina (Baltazar & Gibertoni 2009) and now found in Amazonas.

NOTES — This species is characterized by the papyraceous, flabelliform, cream to beige basidiomata. It is similar to *T. pavonia*, but differing by the cylindrical basidiospores.

Trametes modesta (Kunze) Ryvarden, Norw. JI Bot. 19: 236 (1972).

- *Polyporus modestus* Kunze, in Weigelt, Surinam Exsiccati (1828)

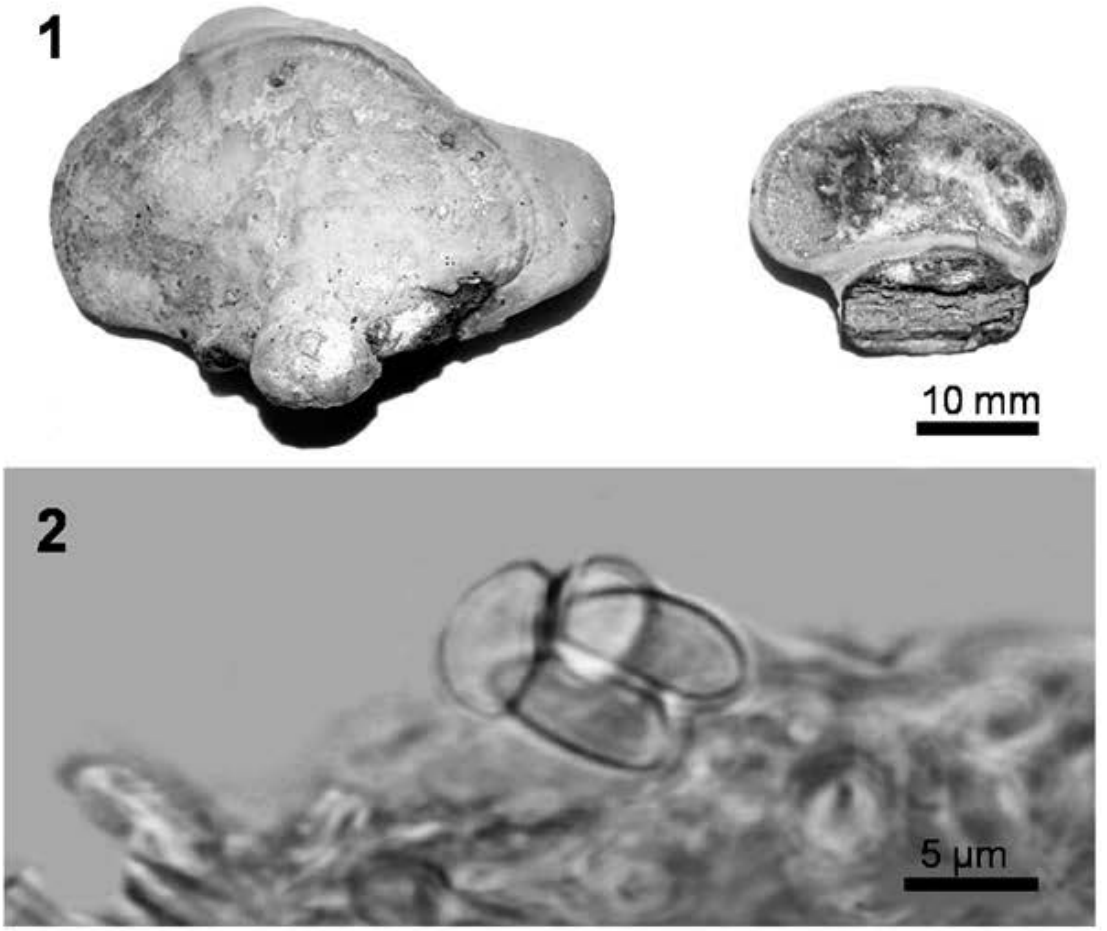
MATERIAL EXAMINED: BRAZIL. Acre: Rio Branco, 24.IX.1980, B. Lowy et al. 247 (INPA 100178, as *Polyporus* sp.); 7.X.1980, B. Lowy et al. 510-511 (INPA 100427, INPA 100478, as *Polyporus* sp.); 9.X.1980, B. Lowy et al. 554 (INPA 100407, as *Polyporus* sp.); 20.X.1980, B. Lowy et al. 819 (INPA 100669, as *Polyporus* sp.); 24.X.1980, B. Lowy et al. 906 (INPA 100777, as *Polyporus* sp.); 1.XI.1980, B. Lowy et al. 1018 (INPA 100842, as *Polyporus* sp.); loc. n. det., 27.IX.1980, B. Lowy et al. 309 (INPA 100279, as *Polyporus* sp.); 28.IX.1980, B. Lowy et al. 332 (INPA 100233); 4.XI.1980, B. Lowy et al. 1102-1094 (INPA 100866, INPA 100928, as *Polyporus* sp.); Amazonas: Aripuanã, 23.IV.1985, K.F. Rodrigues et al. 307 (INPA 128981, as *Polystictus* sp.); Barcelos, 14.II.1984, G.J. Samuels et al. 303 (INPA 129337); 17.II.1984, G.J. Samuels et al. 354 (INPA 129388); 19.II.1984, G.J. Samuels et al. 458 (INPA 129486); 28.II.1984, G.J. Samuels et al. 545 (INPA 129569); 29.II.1984, G.J. Samuels et al. 592 (INPA 129612); Itacoatiara, 14.XI.1966, G.T. Prance et al. 3175 (INPA 18727); 31.XII.1966, G.T. Prance et al. 3628 (INPA 19214); 23.VII.1968, K.P. Dumont et al. 147 (INPA 65183, as *Coriolus* sp.); Manaus, 13.V.1977, M.A. de Sousa 150 (INPA 74656, as *Coriolopsis byrsina*); 10.IX.1977, M.A. de Sousa & I. de J. Araújo 147 (INPA 74654, as *Coriolopsis byrsina*); 1.XI.1977, E.M. de L. Freire 1 (INPA 92688, as *Coriolopsis byrsina*); 28.VI.1978, R. B. Singer & I. de J. Araújo 11266

(INPA 82954, as *Polyporus modestus*); 1.VIII.1978, R. B. Singer & I. de J. Araújo 11342 (INPA 82956, as *Polyporus modestus*); 27.VI.1983, M.A. de Jesus 132 (INPA 183814); 29.VII.1983, M.A. de Jesus 125 (INPA 183808); 22.V.1985, M.A. de Jesus 735-746 (INPA 185965, INPA 185976); 6.X.1985, K.F. Rodrigues et al. 801 (INPA 137087); 22.VI.1989, R.E. Hanada 1006 (INPA 186282); 17.VII.1990, M.A. de Jesus 1448 (INPA 192694); 14.XII.1990, M.A. de Jesus 1433 (INPA 192686); 17.XII.1990, M.A. de Jesus 1455 (INPA 192700); 9.I.1992, R.E. Hanada 1522 (INPA 192731); 15.IX.1992, M.A. de Jesus 1533 (INPA 192739); 9.II.1993, M.A. de Jesus 1542 (INPA192744); Manicoré, 14.IV.1985, K.F. Rodrigues et al. 126 (INPA 128926, as *Polystictus* sp.); Novo Aripuanã, 23.IV.1985, K.F. Rodrigues et al. 323 (INPA 128987); Presidente Figueiredo, 25.VI.1984, M.A. de Jesus 443 (INPA 185381); loc. n. det., 6.X.1966, G.T. Prance et al. 2602 (INPA 18770, as *Polyporus modestus*); 1.XI.1977, E. M. de L. Freire 145 (INPA 70048, as *Coriolopsis* sp.); 14.I.1978, I. de J. Araújo et al. 887 (INPA 78643, as *Polyporus* sp.); 21.I.1978, M. L. Farr et al. 176 (INPA 164405); 22.I.1978, M. L. Farr et al. 222 (INPA 164432); Pará: Itaituba, 29.IX.1977, M.A. de Sousa & L. F. Coêlho 19 (INPA 74690, as *Fomitopsis* sp.); 1.X.1977, M.A. de Sousa & L. F. Coêlho 82 (INPA 74528, as *Coriolopsis* sp.); 2.X.1977, M.A. de Sousa & L. F. Coêlho 105 (INPA 74534, as *Coriolopsis* sp.); 4.X.1977, M.A. de Sousa & L. F. Coêlho 19 (INPA 74627, as *Fomitopsis* sp.); Oriximiná, 17.VI.1980, V.L.R. Bononi 347 (INPA 103419, as *Polyporus* sp.); 19.VI.1980, V.L.R. Bononi 439 (INPA 103483); 29.VI.1980, V.L.R. Bononi 788 (INPA 103706); 1.VII.1980, V.L.R. Bononi 889 (INPA 103766, as *Coriolus* sp.); 2.VII.1980, V.L.R. Bononi 970 (INPA 103829, as *Coriolus* sp.); Melgaço, VII.2006, T. B. Gibertoni (URM 79929, URM 79928, URM 79931, URM 79934, URM 79927, URM 79930, URM 79932, URM 79933, URM 79935); VII.2007, T. B. Gibertoni (URM 79937, URM 79944, URM 79941, URM 79943, URM 79940, URM 79942, URM 79938, URM 79945, URM 79948, URM 79939, URM 79936); II.2008, T. B. Gibertoni (URM 79947, URM 79946); Rondônia: loc, n. det., 3.VII.1968, K.P. Dumont et al. 56-61 (INPA 65097, INPA 65101); Porto Velho, Parque Natural Municipal de Porto Velho, II.2007, A.C. Gomes-Silva 172-241 (URM 79217, URM 79572); VII.2007, A.C. Gomes-Silva 06-52-53-173-191-233-237 (URM 79570, URM 79571, URM 79216, URM 79218, URM 79221, URM 79219, URM 79220); II.2008, A.C. Gomes-Silva 285-318 (URM 79024, URM 79025); VII.2008, A.C. Gomes-Silva 613-619 (URM 79576, URM 79577); Estação Ecológica de Cuniã, VII.2007, A.C. Gomes-Silva 233-237-242 (URM 79219, URM 79220, URM 79222); VII.2008, A.C. Gomes-Silva 566-567-578 (URM 79573, URM 79574, URM 79575); Roraima: Alto Alegre, 10.VI.1986, E.S.S. da Silva et al. 465-412 (INPA 154936, INPA 154908);12.VI.1986, K.F. Rodrigues et al. 948 (INPA 143328); 19.VI.1986, K.F. Rodrigues et al. 1052 (INPA 143400); Boa Vista, 21.XI.1977, L. de L. J. Aguiar et al. 701 (INPA 78420); 19.VII.1989, M.A. de Jesus 886 (INPA 186191); Caracaraí, 16.XI.1977, I. de J. Araújo et al. 461 (INPA 76988); loc. n. det., 13.I.1969, G.T. Prance et al. 9275 (INPA 26410); 17.I.1969, G.T. Prance et al. 9320 (INPA 26456); 6.II.1969, G.T. Prance et al. 9643 (INPA 26779); 24.III.1971, G.T. Prance et al. 11197 (INPA 29598, as *Coriolopsis* sp.).

DESCRIPTION — Gilbertson & Ryvarden (1987).

DISTRIBUTION — Pantropical (Núñez & Ryvarden 2001). In Brazil, it was recorded in the states of Bahia, Pernambuco, São Paulo (Baltazar & Gibertoni 2009), Acre, Amazonas, Pará, Rondônia, Roraima (Gomes-Silva & Gibertoni 2009), and Mato Grosso (Gibertoni & Drechsler-Santos 2010).

NOTES — The species may be confused with *T. supermodesta*, but is distinguished by the smaller pores (6–10 per mm) and basidiospores (4–6 × 1.5–2 µm).



FIGURES 1–2. *Trametes ochroflava*. 1. Basidiomata. 2. Basidiospores.

Trametes ochroflava Cooke, Grevillea 9(no. 49): 12 (1880). FIGURES 1–2

MATERIAL EXAMINED: BRAZIL. Acre: loc. n. det., 17.X.1980, B. Lowy et al. 750 (INPA 100602, as *Polyporus* sp.); 22.X.1980, B. Lowy et al. 850 (INPA 100679, as *Polyporus* sp.); Amazonas: Humaitá, 25.XI.1966, G.T. Prance & J.F. Ramos 3316 (INPA 18891); loc. n. det., 20.IX.1977, M.A. de Sousa 330 (INPA 74749); Rondônia: loc. n. det., 2.VI.1984, R.D. Goos et al. 1760 (INPA 125259, as *Polyporus* sp.); Roraima: loc. n. det., 17.XI.1977, I. de J. Araújo et al. 570 (INPA 77559, as *Daedalea* sp.); 18.VII.1986, B. Lowy et al. 2208 (INPA 145485, as *Ganoderma* sp.); Pará: Oriximiná, 28.VI.1980, V.L.R. Bononi 679 (INPA 103633).

DESCRIPTION — Ryvarden (1988).

DISTRIBUTION — Known from Brazil (Ryvarden 1988). In Brazil, reported from the states of Bahia, Rio de Janeiro and Rio Grande do Sul (Baltazar & Gibertoni 2009). It is a new record for the Brazilian Amazonia.

NOTES — This species (FIG 1) resembles poroid specimens of *Lenzites elegans*, which are whitish and thinner. The basidiospores were not found in the type and not previously known (Ryvarden 1988), but a few were seen in INPA 18891 (FIG 2) and are cylindrical, hyaline, thin-walled, 8–10 × 4 µm.

Trametes pavonia (Hook.) Ryvarden, Norw. Jl Bot. 19: 236 (1972), nom. illegit., non (Berk.) Fr. 1851.

= *Boletus pavonius* Hook., Syn. Pl. 1: 10 (1822).

MATERIAL EXAMINED: BRAZIL. Amazonas: Barcelos, 11.VII.1985, E.S.S. da Silva et al. 283 (INPA 153723); Manaus, 13.V.1977, M.A. de Sousa & I. de J. Araújo 88-325 (INPA 74662, INPA 74718); 28.I.1997, M.A. de Jesus 1912 (INPA 216449); 2.V.1997, A. Luis 2270 (INPA 192823); loc. n. det., 26.VI.1971, G.T. Prance et al. 13735 (INPA 31951, as *Coriolopsis* sp.); Rondônia: loc. n. det., 8.XI.1979, R. H. Petersen 445 (INPA 110933, as *Polyporus* sp.); Roraima: Alto Alegre, 21.VI.1986, K.F. Rodrigues et al. 1090 (INPA 143431); loc. n. det., 18.VI.1986, B. Lowy et al. 2169 (INPA 145449, as *Polyporus* sp.).

DESCRIPTION — Gilbertson & Ryvarden (1987).

DISTRIBUTION — Tropical America to northern Argentina (Gilbertson & Ryvarden 1987). In Brazil, reported from the states of Alagoas, Pernambuco and Santa Catarina (Baltazar & Gibertoni 2009). It is a new record for the Brazilian Amazonia.

NOTES — This species is similar to *T. membranacea*, but the flexible, concentrically zonate basidiomata distinguish *T. pavonia*.

Trametes versicolor (L.) Lloyd, Mycol. Writ. 6: 1045 (1921).

= *Boletus versicolor* L., Sp. pl. 2: 1176 (1753).

MATERIAL EXAMINED: BRAZIL. Amazonas: Novo Aripuanã, 27.IV.1985, K.F. Rodrigues 388 (INPA 129004, as *Daedalea* sp.); loc. n. det., 12.VIII.1977, M.A. de Sousa 244 (INPA 74642, as *Coriolus* sp.).

DESCRIPTION — Núñez & Ryvarden (2001).

DISTRIBUTION — Cosmopolitan (Núñez & Ryvarden 2001). In Brazil, in Pará (Gomes-Silva & Gibertoni 2009), Bahia, Paraná, Rio Grande do Sul, São Paulo, Santa Catarina (Baltazar & Gibertoni 2009) and now in Amazonas.

NOTES — This species is characterized by the thin, tomentose, zonate basidiomata, also extremely variable in color.

Trametes villosa (Sw.) Kreisel, Monografias, Ciências, Univ. Habana, Ser. 4, 16: 83 (1971).

= *Boletus villosus* Sw., Fl. Ind. Occid. 3: 1923 (1806).

MATERIAL EXAMINED: BRAZIL. Amazonas: Manaus, 6.III.1997, M.A. de Jesus 2060 (INPA 192826, as *T. menziesii*); 2.V.1997, M.A. de Jesus 2269 (INPA 192827, as *T. menziesii*); 1.VII.1997, M.A. de Jesus 2346 (INPA 192818); 21.X.1997, M.A. de Jesus 2501 (INPA 192820); Roraima: Alto Alegre, 12.VI.1986, K.F. Rodrigues et. al. 938 (INPA 143318); 16.VI.1986, K.F. Rodrigues et. al. 996 (INPA 143363); 17.VI.1986, E.S.S. da Silva et al. 483 (INPA 154950); 18.VI.1986, K.F. Rodrigues et. al. 1037 (INPA 143391); 21.VI.1986, K.F. Rodrigues et. al. 1071 (INPA 143415); Boa Vista, 20.VII.1989, M.A. de Jesus 920 (INPA 186221); loc. n. det., 24.VII.1974, G.T. Prance et al. 21368 (INPA 45343, as *Coriolus pinsitus*); 16.VI.1986, B. Lowy et al. 1227 (INPA 144553, as *Coriolus* sp.).

DESCRIPTION — Gilbertson & Ryvarden (1987).

DISTRIBUTION — Neotropical, also known from subtropical areas in the USA and Argentina (Gilbertson & Ryvarden 1987). In Brazil, recorded in the states of Amapá,

Pará, Roraima (Gomes-Silva & Gibertoni 2009), Bahia, Paraná, Rio de Janeiro, Rio Grande do Sul, São Paulo, Santa Catarina (Baltazar & Gibertoni 2009, Gibertoni & Drechsler-Santos 2010), and now in Amazonas.

NOTES— The thin basidiomata with large pores (2–3/mm) characterizes this species.

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Leucoagaricus dacrytus – a new species from New Jersey, U.S.A.

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Abstract — *Leucoagaricus dacrytus* (*Agaricaceae*) is described as new from an old-growth *Quercus rubra* forest in New Jersey, U.S.A. This is a relatively small, brown species exuding golden drops over its surface, with a pileus with cobwebby patches (a cutis-like pileus covering), narrowly clavate cheilocystidia, and oblong-amygdaloid spores. It is close to the European species *La. tener*, from which it differs in the slightly smaller spores and in nrITS sequences.

Key words — biodiversity, North America, taxonomy

Introduction

Several unknown lepiotaceous fungi were discovered during long-term mycological research in the Oakmoss Mycological Preserve, a forest with old-growth *Quercus rubra* and many secondary trees (*Fagus, Betula, Cornus, Acer, Carya, Prunus*, and sassafras) in New Jersey; the specimens were sent to the first author for identification. One of them is a striking brown species with golden droplets on the surfaces of the basidiocarps. A literature search (starting with Lincoff 1991, Bessette et al. 1997, moving to Murrill 1914, Kauffman 1924, and Smith 1954, 1966) did not result in a fitting name. Here it is described as a new species, based on the morphology and the nrITS sequences, and it is compared with *Leucoagaricus tener* (P.D. Orton) Bon from Europe, and species with similar general morphology from other parts of North America and Europe.

Material & methods

Macroscopic descriptions were based on the photos and notes provided by the second author. Standard methods for describing basidiocarps were applied, using the

terminology of Vellinga & Noordeloos (2001). Colour codes are according to the Online Auction Color Chart™, indicated by 'oac' before a number. Microscopical observations were made on dried material. The notation [115,6,5] indicates that measurements were made on 115 spores in six samples in five collections. At least 15 spores were measured per collection. The lamellar characters and spore shape and size were observed in Congo Red in 10% ammonia followed by ammonia only, and the pileus covering was observed in 10% ammonia. The following abbreviations are used: L for number of lamellae, l for number of lamellulae between two lamellae, avl for average length, avw for average width, Q for quotient of length and width, and avQ for average quotient. The abbreviation *L.* is used for *Lepiota*, *La.* for *Leucoagaricus* and *Lc.* for *Leucocoprinus*. All collections are in UC. Herbarium abbreviations are according to Holmgren & Holmgren (1998). The Latin description of the new species has been deposited in MycoBank.

DNA was extracted from dried material using a Qiagen DNeasy® Blood and Tissue kit (Qiagen, Valencia, CA, USA). The nrITS region was amplified with the ITS-1F/ITS-4 primer set with an MJ PTC-100™ thermocycler (Applied Biosystems, Foster City, CA, USA) under conditions previously described (Gardes & Bruns 1993). PCR products were cleaned using 0.5 µl of ExoSAP IT (USB Corp, Cleveland, OH, USA) per reaction and cycled at 37°C for 45 min, followed by 80°C for 15 min. Sequencing was performed using Big Dye chemistry and an ABI PRISM 3100 Genetic Analyzer (both from Applied Biosystems, Foster City, CA, USA). Sequences were edited and contigs assembled using Sequencher 4.2.2 (Gene Codes Corporation, Ann Arbor, MI, USA). Newly produced sequences were deposited in GenBank, and their accession numbers are listed with the collections and all accession numbers are given in FIG. 3. American *Leucoagaricus* species with brown to black cobwebby patches on the pileus surface were chosen for sequence comparisons, mainly from species in the *L. atrodisca* species complex in California, but also based on BLAST searches in GenBank (Altschul et al. 1990). The sequences were aligned with the program MAFFT version 6 (Katoh et al. 2002, Katoh & Toh 2008). For the phylogenetic analyses the Maximum Parsimony option in PAUP* v4 (Swofford 2002) was used. *Chlorophyllum rachodes* (Vittad.) Vellinga and *Leucoagaricus americanus* (Peck) Vellinga were chosen as outgroup. The analyses were only performed to determine whether the sequences matched sequences of previously sequenced species and collections.

Taxonomy

Leucoagaricus dacrytus Vellinga, **sp. nov.** FIGURES 1 & 2

MYCOBANK MB516742

Leucagarico tenero *similis, sporis nonnihil minoribus (i.e. 5.9–7.4 µm longis 2.9–4.1 µm latis, in medio 6.3–6.8 µm longis 3.5–3.9 µm latis) plus quam 50 basibus ceteris in ITS1 differt.*

HOLOTYPE: "U.S.A., New Jersey, Hunterdon Co., Lebanon, Oakmoss Mycological Preserve, R.B. Balsley, 11 Sept 2006 (UC)."

ETYMOLOGY—from the Greek δακρυτος, tearful, because of the presence of drops on the basidiocarps.

PILEUS 10–33 mm, when very young paraboloid to hemispherical with inflexed margin, expanding to plano-convex, and finally applanate with low and broad

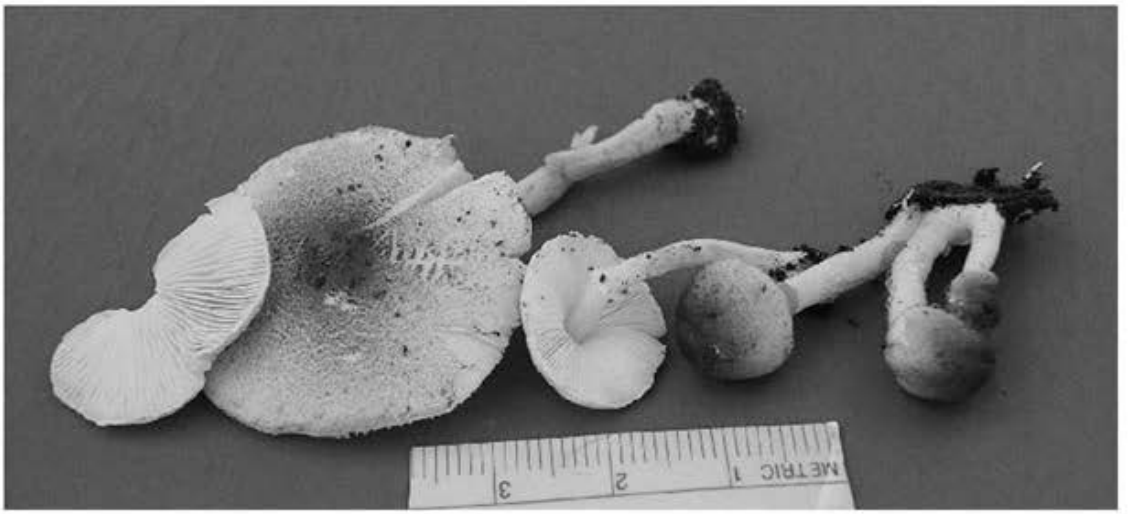

FIG. 1. *Leucoagaricus dacrytus* — Habitus (from Balsley, 12 July 2006).

umbo, when young almost completely dull brown (oac702) except for a marginal, lighter zone, later only brown at umbo, and very light at margin, covered in small fibrillose-cobwebby patches to tufts, dense at centre, thinner at margin and there showing off-white background, on drying slightly sulcate for up to 5 mm at margin, covered with scattered drops, changing from golden yellow (oac856) to brown with age. LAMELLAE, L = 45–55, l = 1(–3), moderately crowded to crowded (2–3/1 mm, measured at pileus margin), free, relatively close to stipe, off-white to pale cream coloured, with concolourous not obviously cystidiose edge. STIPE 20–50 × 1.5–3.5 mm cylindrical and slightly wider, 3–5 mm, at utmost base, off-white above annulus, below annulus off-white changing to pale yellow with age, slightly darker when scratched, when fresh covered in pale yellow to yellow (oac856) drops, sometimes with basal white tomentum, hollow, with white mycelial cords at base. ANNULUS an ascending funnel with small flaring part, off white, with golden drops on underside. SMELL none.

BASIDIOSPORES [105,6,5] in side view 5.9–7.4 × 2.9–4.1 µm, avl × avw = 6.3–6.8 × 3.5–3.9 µm, Q = 1.5–2.15, avQ = 1.7–1.85, oblong-amygdaliform, with rounded apex, in frontal view oblong-ovate, with guttule, thick-walled some with a hint of an apical germ pore, young spores in particular congophilous, cyanophilous, dextrinoid, when young clearly metachromatic in Cresyl Blue, later less evidently so. BASIDIA 13.5–27 × 6.0–8.5 µm, with 4 sterigmata, without clamp connection. LAMELLA EDGE sterile, with a band of cystidia. CHEILOCYSTIDIA 22–50 × 6–13 µm, narrowly clavate to subutriform, some clavate, some slightly strangulated, subtly variable in shape, slightly thick-walled, and colourless. PLEUROCYSTIDIA absent. PILEUS COVERING cutis-like, made up of strands of hyphae with up to 5 coloured elements in a row; terminal elements, slightly differentiated and wider than penultimate elements, 27–95

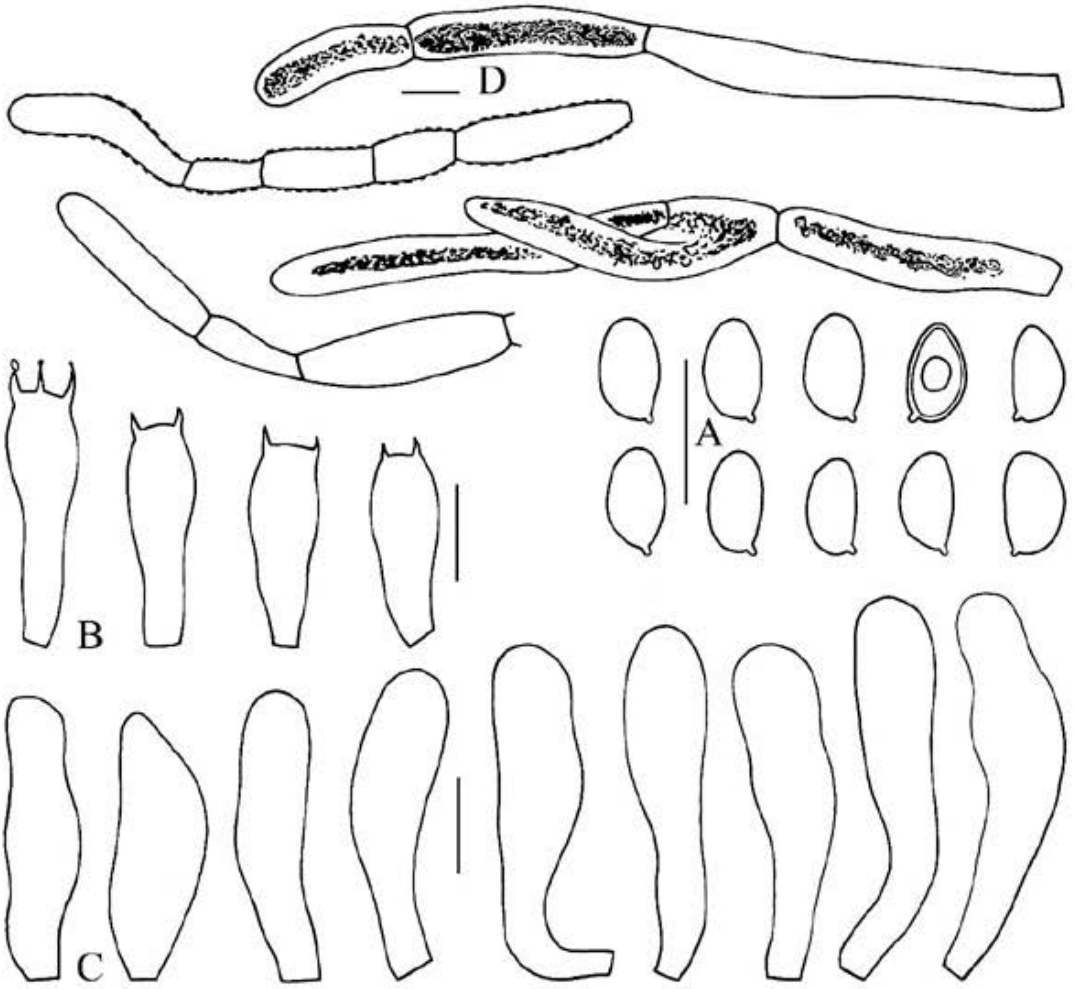

FIG. 2. *Leucoagaricus dacrytus* — A. spores, B. basidia, C. cheilocystidia, D. pileus covering elements (all from Balsley, 30 Aug. 2007). Scale bars are 10 µm.

× 5–12.5(-23) µm, with rounded apex; pigment brown, intracellular in big blob, or parietal and incrusting, in all elements, also the terminal ones. CLAMP CONNECTIONS absent.

HABITAT & DISTRIBUTION — In small groups, on decayed wood, most likely from *Quercus rubra*, in a deciduous forest (old growth *Quercus rubra* plus various other deciduous trees); so far only known from one spot at the type locality in New Jersey. July–Sept.

COLLECTIONS EXAMINED—U.S.A., **New Jersey**, Hunterdon Co., Lebanon, Oakmoss Mycological Preserve, 12 July 2006, R.B. Balsley (nrITS GU903308); ibidem, 8 Sept 2006, R.B. Balsley; ibidem, 11 Sept 2006, R.B. Balsley (nrITS GU903309)(Holotype, UC); ibidem, 26 Aug 2007, R.B. Balsley; ibidem, 30 Aug 2007, R.B. Balsley.

Discussion

Leucoagaricus dacrytus is characterized by brownish tinges in the pileus, the golden drops exuded on the basidiocarp surface, and microscopically by the

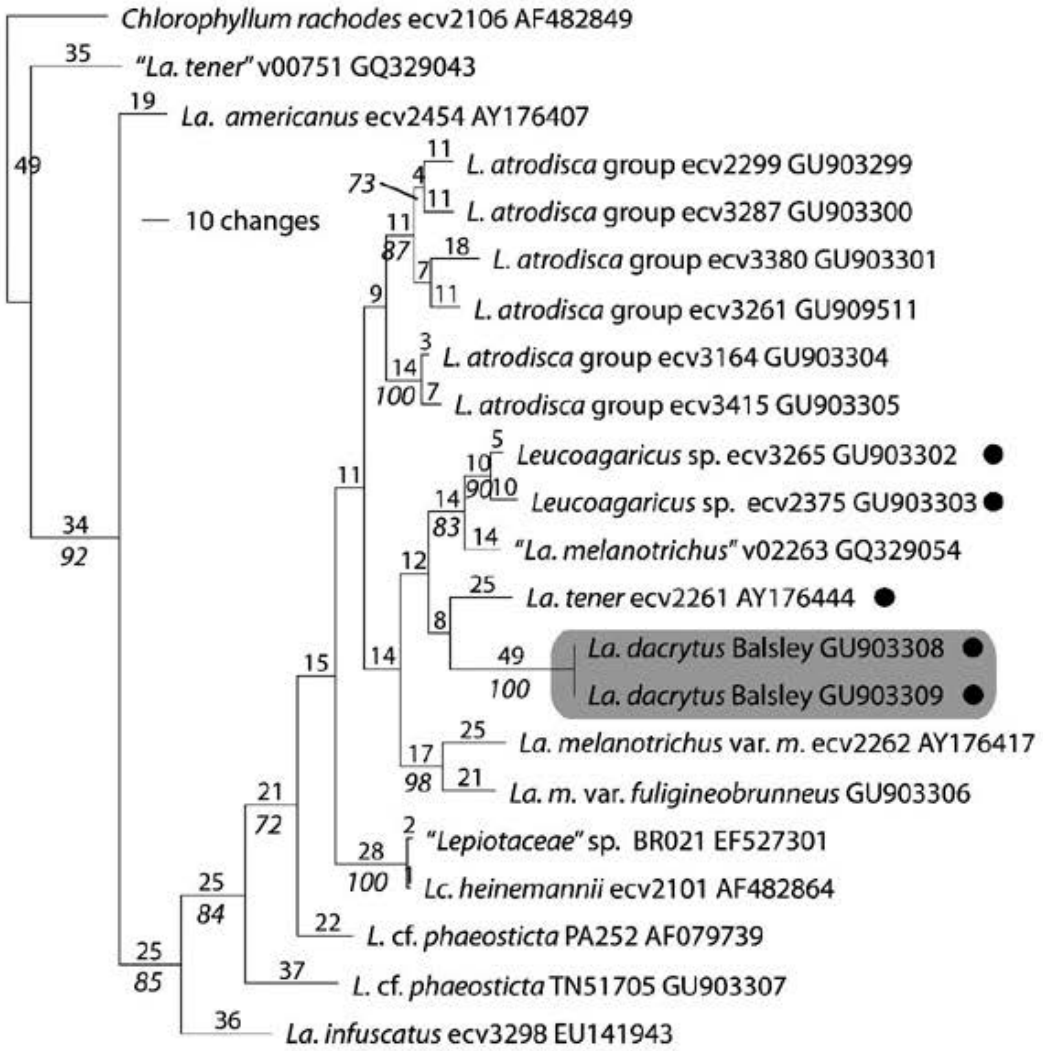

FIG. 3. Phylogram based on parsimony analyses of the nrITS region of a selection of *Leucoagaricus* and *Leucocoprinus* species with brown to black cobwebby scales made up of repent hyphae on the pileus surface. The one and only most parsimonious tree is presented, based on 211 informative characters. The numbers above branches refer to the number of changes, those below, in italics, to bootstrap values. The symbol ● indicates the presence of exudates. The newly described species *La. dacrytus* is highlighted. *Chlorophyllum rachodes* and *La. americanus* are outgroup taxa.

relatively small spores, the narrowly clavate cheilocystidia, and the cutis-like pileus covering with intracellular and incrusting pigments.

It is close, both morphologically and molecularly, to the European species *La. tener*, which differs in having smaller basidiocarps, slightly longer and wider spores, and more cylindrical cheilocystidia (Orton 1960, Uljé 1984, Vellinga 2001). These morphological differences are small and subtle. The nrITS sequences of both taxa are quite different (FIG. 3), with at least 50 different base pair positions in the ITS1 alone.

Drops on the basidiocarp surface are not restricted to these two species, but are found in many species in the *Leucoagaricus/Leucocoprinus* clade of the *Agaricaceae*, such as *Leucocoprinus cepistipes* (Sowerby) Pat. (sensu Lange 1935), and *Lc. lacrymans* T.K.A. Kumar & Manim. The former often has drops on its greyish pileus, stipe, and annulus, but the spores have a germ pore, and the cheilocystidia are big with an apical excrescence (e.g. Vellinga 2001). *Leucocoprinus lacrymans* from India also has spores with a germ pore, stains reddish when damaged, and has long, cylindrical cheilocystidia (Kumar & Manimohan 2004).

Neither the origin of the drops, nor the composition of them is known for this group of fungi. Many polypore species exude drops during the growing period, and it is known that *Pseudoinonotus dryadeus* (Pers.) T. Wagner & M. Fisch. exudates have a negative effect on the growth of gram positive bacteria (Blackwell & Adams 1985).

Other species that bear some resemblance to the presently described species are the following: *Leucoagaricus brunneocingulatus* (P.D. Orton) Bon, known from the United Kingdom (Orton 1960) and Italy (Migliozzi & Perrone 1991), lacks drops, is red-brown on the pileus, and has a brown-rimmed annulus. The brown-scaled *La. brunneosquamulosus* P. Mohr & Dähncke, described from the Canary Islands, is clearly different because of the spores with a distinct germ pore and upright cylindrical to narrowly lageniform terminal elements in the pileus covering, and the narrow, cylindrical cheilocystidia (Mohr & Ludwig 2004). *Leucoagaricus infuscatus* Vellinga is another brown-squamulose species, with a cutis-like pileus covering; its brown pileus centre contrasts with the white background, and the absence of drops and the narrowly clavate to almost capitate cheilocystidia differentiate it from *La. dacrytus* (Vellinga 2007).

Sequences of species with comparable, but almost black pileus coverings, such as *L. atrodisca* Zeller, *La. melanotrichus* (Malençon & Bertault) Trimbach and *Lc. heinemannii* Migl., have been added to the group for comparison with *La. dacrytus* and *La. tener*, along with some unnamed species from California. Grey-brown species with drops on the basidiocarps are indicated in the resulting hypothetical phylogeny of FIG. 3. This group is species rich, with representatives all over the world, and desperately in need of morphological revision.

The species described and depicted by La Chiusa (1999) as *La. tener* is different from the original as described by Orton (1960); it lacks drops, the pileus covering is made up of velvety patches, not the cobwebby patches of *La. tener*, and its nrITS sequence (GenBank accession number GQ329043) differs significantly from the Dutch collection of *La. tener* (GenBank accession number AY176444; FIG. 3). Likewise, Migliozzi & Coccia's interpretation of *La. tener* differs from Orton's concept (Migliozzi & Coccia 1990, Vellinga 2001), though an nrITS sequence is not available for their specimens.

It is possible that *La. dacrytus* was described under a different name from North America, although the presence of droplets on the basidiocarps is not mentioned in any of the species descriptions, nor in the keys to the *Lepiota* species provided by Murrill (1914) and Kauffman (1924). Murrill included in his key all the species known at that time, and described by Peck, Morgan and others. The presence of droplets could have been noticed by the collector, but interpreted as unimportant or the result of external factors, such as rain. Reid (1995) did not report the presence of drops on *La. tener* basidiocarps, though Orton (1960) in the original description, did notice them. Recently, the presence of drops was omitted in the description of *L. furfuraceipes* Han C. Wang & Zhu L. Yang, a new species from Yunnan, China, and northern Thailand (Wang & Yang 2005). This species is common in northern Thailand, where the first author has repeatedly collected it; drops were always present on stipe and annulus, leaving dark spots on the annulus margin.

This paper hopefully will draw attention to the taxonomic significance of exudate drops on the basidiocarps of lepiotaceous fungi, and will also provide a stimulus to investigate this group of beautiful fungi in the eastern parts of North America.

Acknowledgments

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A new pathogen of scale insects, *Aschersonia fusispora* sp. nov. (*Clavicipitaceae*) from Guangxi Province, China

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Abstract — A new anamorphic species, *Aschersonia fusispora*, is described and illustrated based on collections from a natural forest in Guangxi Province of China. The species, which occurs on unidentified *Coccidae* larvae, is characterized with thinly pulvinate, slightly convex, pale orange stromata that are surrounded by a broad membranous hypothallus, wide ostiolar openings, and a 0.3–0.5 µm conidial width.

Key words — entomopathogenic fungus, taxonomy, new taxa

Introduction

Species of the fungal genus *Aschersonia* Mont. (teleomorph *Hypocrella* Sacc.) parasitize scale insects (*Coccidae* and *Lecaniidae*, *Homoptera*) and whiteflies (*Aleyrodidae*, *Homoptera*) throughout tropical and (less often) subtropical regions, often resulting in epizootic events (Montagne 1848; Petch 1921; Mains 1959a,b; Chaverri et al. 2008; Mongkolsamrit et al. 2009; Qiu & Guan 2010). They are characterized by brightly colored pulvinate, subglobose or discoid stromata sometimes having a hypothallus, phialidic conidiogenous cells, the presence of pycnidial paraphyses, and unicellular, fusiform, and hyaline conidia which are produced in a mass of copious slime (Petch 1925; Mains 1959b; Chaverri et al. 2005, 2008).

During a survey on the biodiversity of insecticidal fungi in Guangxi province of China in 2008, two specimens of entomopathogenic *Aschersonia* were collected in evergreen broadleaved forests of the Huaping National Nature Reserve and the Maoershan National Nature Reserve. The general morphology

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of the specimens, such as flask-shaped pycnidia formed in stroma, slender branched conidiophores, fusoid conidia, and parasitism on homopteran insects, fit the generic concept of *Aschersonia*. The narrow and short-fusoid conidia, thinly pulvinate, slightly convex, pale orange stromata, and the presence of a broad membranous hypothallus differ from any described *Aschersonia* species.

Materials and methods

Two collections from Guangxi province were studied. Conidiomata were carefully dissected with a razor blade and mounted in water or lactic acid mixed with cotton blue on a slide. The method of fungal measurements and microscopic features used in this study is the same as that described previously by Qiu et al. (2009). Colour names were described following Kornerup & Wanscher (1967). The voucher specimens studied were deposited in the Mycology Herbarium, Fujian Agricultural and Forestry University (MHFAFU).

Taxonomy

Aschersonia fusispora Jun Z. Qiu, C.Y. Sun & Xiong Guan, **sp. nov.** FIGS. 1A–F

MYCOBANK MB 515186

Stromata pulvinata, vel circularia, ex hyphis dense coactis composita, deorsum sparsa, hypothallum membranaceum ad 1.5 mm diam. 0.5 mm altum flavo-brunneum formantia, superficie aliquot orificiis ut punctis magnis visibilibus praedita. Pycnidialia, plerumque singula, in medio stromate immersa, 91–126 µm alta, 61–81 µm diam. Phialides cylindricae, ad 10 µm longae. Paraphyses pycnidiales praesentes, filiformes, flexuosae, ad 78 µm longae, 0.9 µm latae. Conidia fusoidea, utrinque rotundata 2.8–3.5 × 0.3–0.5 µm.

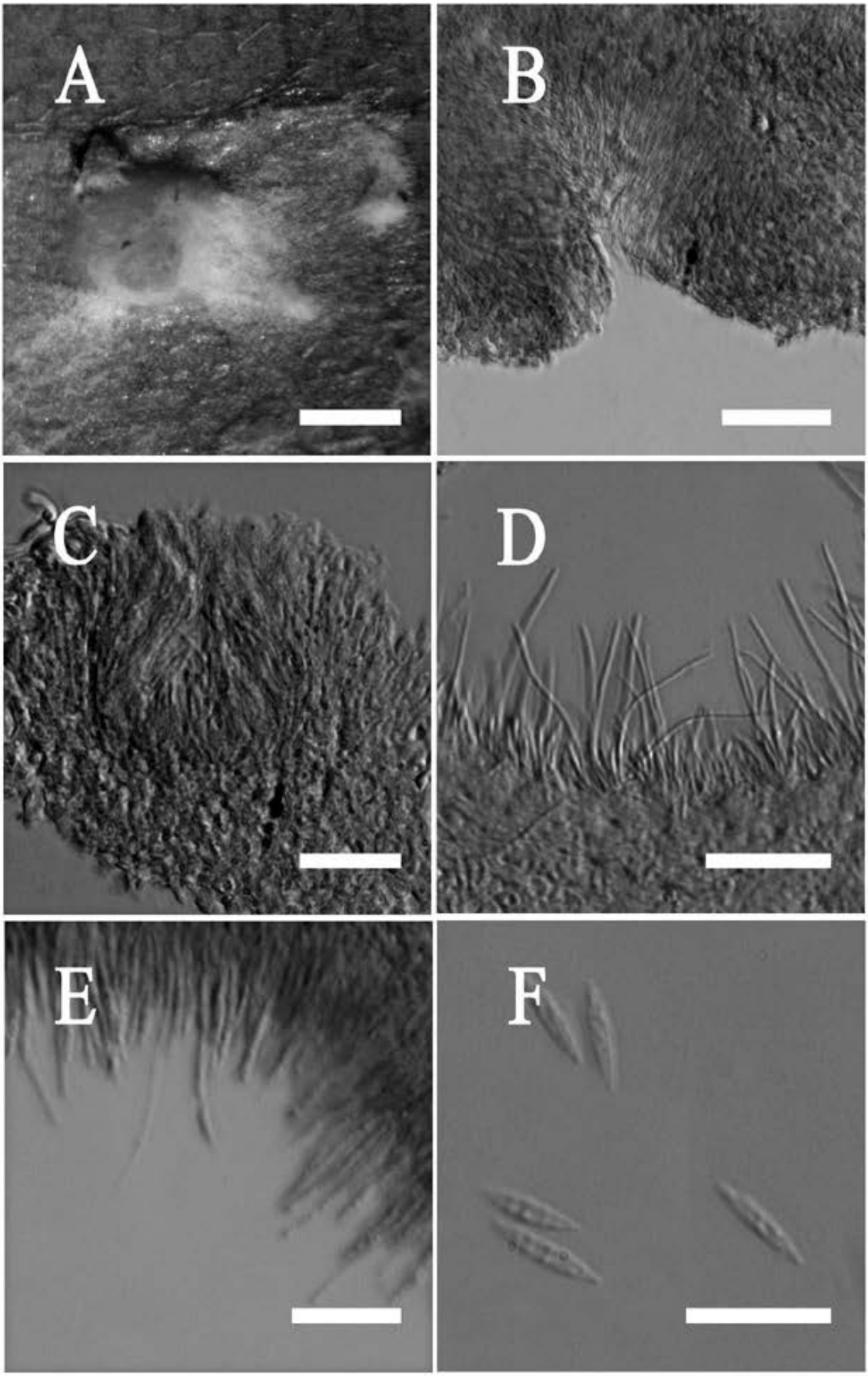
TYPE — J.Z. Qiu, C.Y. Sun & X. Guan 367, MHFAFU 20837 **(holotype)** on *Coccidae;* Huaping National Nature Reserve, Guangxi Prov., Lingui County, Huaping, China, alt. 1600 m, 28.X.2008; J.Z. Qiu, C.Y. Sun & X. Guan 388, MHFAFU 20858 **(paratype)** on *Coccidae;* Maoershan National Nature Reserve, Guangxi Prov., Longsheng County, Maoershan, China, alt. 1200 m, 29.X.2008.

ETYMOLOGY — Refers to the fusiform conidia of this species.

TELEOMORPH: None known.

STROMATA thinly pulvinate, circular, slightly convex, consisting of dense hyphae, base spreading, forming a brownish-yellow membranous hypothallus up to 1.5 mm diam., 0.5 mm high, pale orange when fresh, several ostiolar openings as large dots visible on the surface. PYCNIDIA usually single, embedded in the centre of the stroma, 91–126 µm high, 61–81 µm diam. Conidiogenous cells phialidic, cylindrical, up to 10 µm long. PARAPHYSES present, linear, filiform,

FIG.1 *Aschersonia fusispora*. A: Stroma; B: Pycnidium; C: Longitudinal section of a flask-shaped pycnidium; D: Paraphyses; E: Conidiophores and conidiogenous cells; F: Conidia.
Scale bars: A = 1 mm; B,C,D = 50 µm; E = 20 µm; F = 5 µm.


A
B
C
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E
F

flexuous, up to 78 µm long, 0.9 µm wide. CONIDIA fusoid, sometimes narrowly fusiform, with rounded ends, 2.8–3.5 × 0.3–0.5 µm.

COMMENTS—*Aschersonia fusispora* is characterized by the pale orange, thinly pulvinate, small stromata, the small conidia, the wide ostiolar openings, and the presence of paraphyses and hypothallus. Two previously described species of *Aschersonia*, *A. microspora* Sacc. and *A. minutispora* Hywel-Jones & Mongkolsamrit (Petch 1921, Mains 1959a,b, Hywel-Jones & Evans 1993, Chaverri et al. 2005, 2008, Mongkolsamrit et al. 2009) also have spores of the similar size. However, *A. microspora* differs in having pale brown stromata consisting of dense interwoven hyphae and globose or narrowly oval and wider conidia (2–4 × 1.5 µm), and lacking pycnidia. *A. minutispora* differs in possessing larger cream-brown stromata (2.5 mm in diam., 2 mm high), more voluminous pycnidia (350–400 µm high, 300–350 µm in diam.), bigger conidia (5–6 × 1.2–1.5 µm), and longer pycnidial paraphyses up to 150 µm long and 1.5 µm in width.

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Two new species of *Septobasidium* (*Septobasidiaceae*) and *S. pallidum* new to China

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Abstract — Two new species, *Septobasidium meridionale* on *Litsea cubeba* associated with *Aulacaspis* sp. and *S. aulacaspidis* on an unidentified tree associated with *Aulacaspis* sp., are described. *Septobasidium pallidum* on *Zanthoxylum bungeanum*, *Z. simulans*, and *Pyrus phaeocarpa* is new to China.

Key words — *Pucciniomycetes*, *Septobasidiales*, taxonomy

Previously, a new species of *Septobasidium* was found in Hainan province (Lu & Guo 2009a). In December 2009, many specimens of *Septobasidium* were collected from the same area. Among them, an additional two new species are described as follows:

Septobasidium meridionale C.X. Lu & L. Guo, **sp. nov.** FIGS. 1–7

MYCOBANK MB 518060

Basidiomata resupinata, 4–8.5 cm longa, 1–6 cm lata, alba vel brunnea, margine determinata, superficie laevia vel vulutina, in sectione 840–1000 µm crassa. Subiculum brunneum vel hyalinum, 20–50 µm crassum. Columnae hyalinae vel brunneolae, 40–130 µm altae, 40–340 µm latae, ex hyphis 3–4 µm latis compositae, superne ramosae tunc strato hypharum 580–780 µm alto formatae, interdum strata horizontalia formantes. Hymenium 40–90 µm crassum, hyalinum vel brunneum. Basidia cyclindrica, recta vel curvata, 4-cellularia, 27–36 × 7–9.5 µm, hyalina vel brunneola. Sine probasidio. Basidiosporae non visae. Haustoria ex hyphis irregulariter spiralibus constantia.

TYPE: On *Litsea cubeba* Pers. (*Lauraceae*): China, Hainan, Bawangling, Nanchahe, alt. 600 m, 11.XII.2009, Y.F. Zhu & L. Guo 128, HMAS 240076 (**holotype**), associated with *Aulacaspis* sp. (*Diaspididae*).

*corresponding author

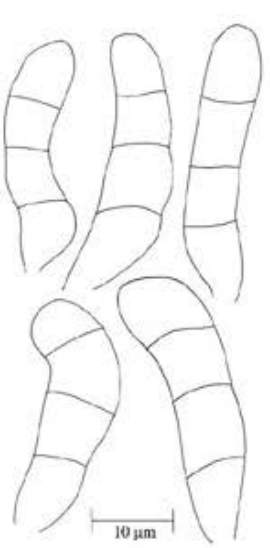

FIG. 1. Basidia of *Septobasidium meridionale* (HMAS 240076, holotype).

Basidiomata on trunks and branches, resupinate, perennial, 4–8.5 cm long, 1–6 cm wide, white or brown; margin determinate; surface smooth or velutinous. In section 840–1000 µm thick. Subiculum 20–50 µm thick, brown or hyaline. Pillars hyaline or brownish, 40–130 µm high, 40–340 µm wide, hyphae of pillars 3–4 µm thick. Hyphal layer 580–780 µm high, sometimes forming a horizontal layer. Hymenium 40–90 µm thick, hyaline or brown. Basidia arising directly from the hyphae, cylindrical, straight or curved, 4-celled, 27–36 × 7–9.5 µm, hyaline or brownish, without a probasidial cell. Basidiospores not seen. Haustoria consisting of irregularly coiled hyphae.

REMARKS: Morphologically, *Septobasidium meridionale* is similar to *S. septobasidioides* (Henn.) Höhn. & Litsch., from which it differs in having short pillars (40–130 µm vs 350–450 µm) and smaller basidia (27–36 × 7–9.5 µm vs 40–55 × 8.4–10 µm), and sometimes forming a horizontal layer.

Septobasidium aulacaspidis C.X. LU & L. GUO, **sp. nov.** FIGS. 8–12

MYCOBANK MB 518061

Basidiomata resupinata, 0.2–7 cm longa, 0.1–5 cm lata, alba vel cinnamomeo-brunnea, margine indeterminata, superficie laevia vel velutina, in sectione 360–550 µm crassa. Subiculum brunneum, 30–50 µm crassum. Columnae hyalinae vel brunneolae, 200–260 µm altae, 20–120 µm latae. Hymenium 50–80 µm crassum. Basidia cyclindrica, recta vel curvata, 4-cellularia, 28–50 × 5–10 µm, hyalina vel brunnea. Basidiosporae ovoideae vel reniformes, 10–16 × 4–5.5 µm. Sine probasidio. Haustoria ex hyphis irregulariter spiralibus constantia.

FIGS. 2–7. *Septobasidium meridionale* (HMAS 240076, holotype). 2. Basidiomata on trunk. 3–4. Sections of basidiomata. 5–6. Basidia (arrows). 7. Haustoria.


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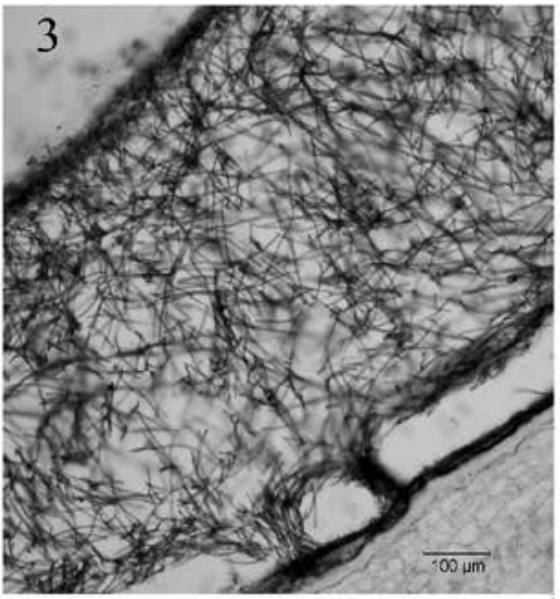
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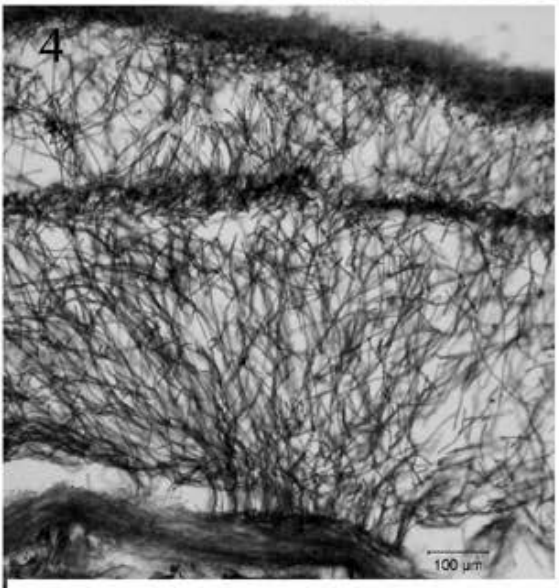
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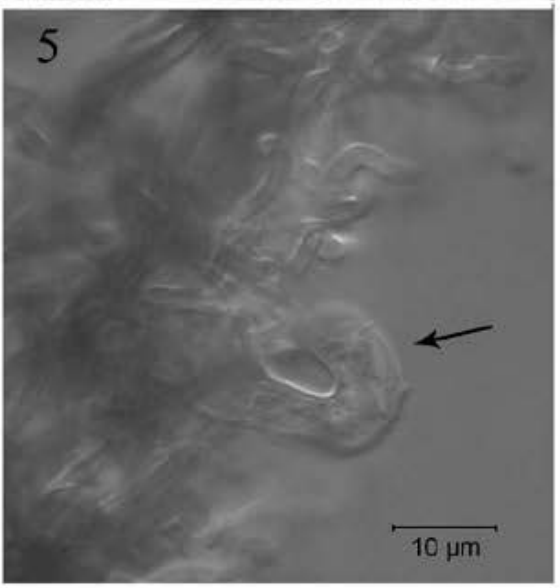
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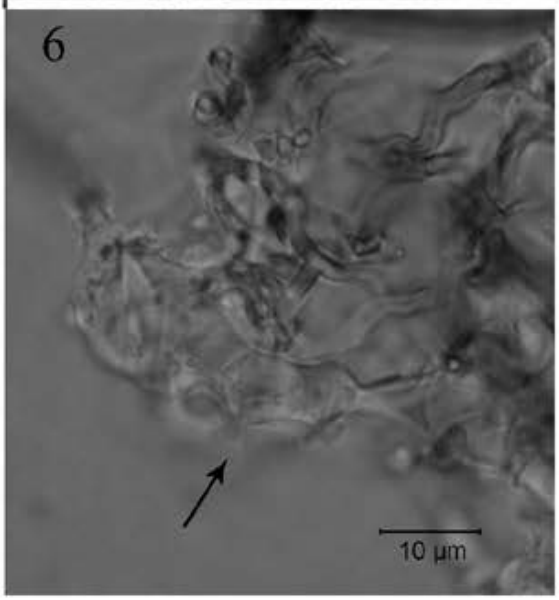
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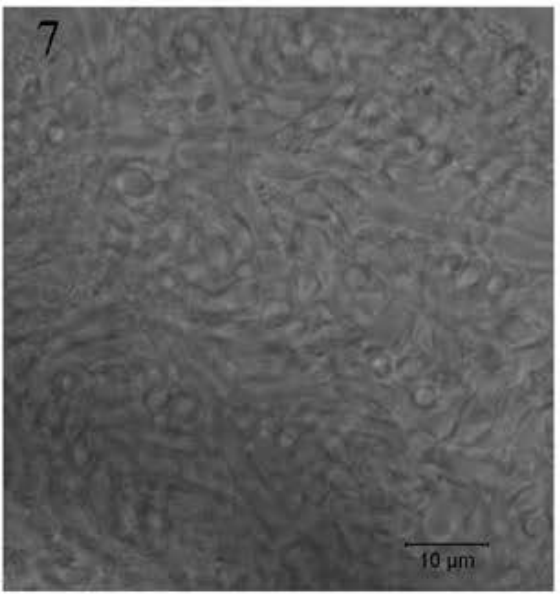
7
10 µm

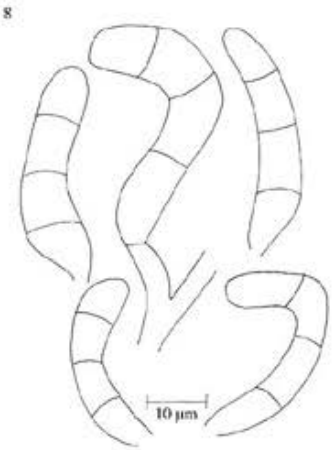

FIG. 8. Basidia of *Septobasidium aulacaspidis* (HMAS 240074, holotype).

TYPE: On unidentified tree [probably *Neolitsea* sp. (*Lauraceae*)]: China, Hainan, Jianfengling, alt. 900 m, 11.XII.2009, S.H. He 2803, HMAS 240074 **(holotype)**, associated with *Aulacaspis* sp. (*Diaspididae*).

Basidiomata on trunks, resupinate, subcircular or irregular, often confluent 0.2–7 cm long, 0.1–5 cm wide, white or cinnamon-brown; margin indeterminate; surface smooth or velvety. In section 360–550 μm thick. Subiculum 30–50 μm thick, brown. Pillars 200–260 μm high, 20–120 μm wide, hyaline or brownish. Hymenium 50–80 μm thick, with irregularly arranged upright hymenial hyphae. Basidia arising directly from the hyphae, cylindrical, straight or curved, 4-celled, 28–50 × 5–10 μm, hyaline or brown, without a probasidial cell. Sterigmata conical, 5–13 × 2 μm. Basidiospores ovoid or reniform, 10–16 × 4–5.5 μm, pale yellowish brown. Haustoria consisting of irregularly coiled hyphae.

REMARKS: *Septobasidium aulacaspidis* is similar to *S. pallidum*, but differs mainly in having indeterminate margin, smooth and velvety surfaces of basidiomata, and tall pillars (200–260 μm vs 84 μm). *Septobasidium pallidum* has determinate margin, non-velvety surface of basidioma, and short pillars.

Recently, several specimens of a *Septobasidium* sp. on *Zanthoxylum bungeanum* and *Pyrus phaeocarpa* were collected in Sichuan province. They were identical to a specimen of *Septobasidium* sp. on *Zanthoxylum simulans* previously deposited in our herbarium. No basidia were found in the specimen. The fungus is identified as *S. pallidum*, a species unrecorded previously in China:

FIGS. 9–12. *Septobasidium aulacaspidis* (HMAS 240074, holotype). 9. Basidiomata on trunk. 10. Section of basidioma. 11. Basidia (arrows). 12. Haustoria. FIGS. 13–16. *Septobasidium pallidum* (HMAS 199578). 13. Basidiomata on trunk. 14. Section of basidioma. 15. Basidium (arrow). 16. Haustoria.


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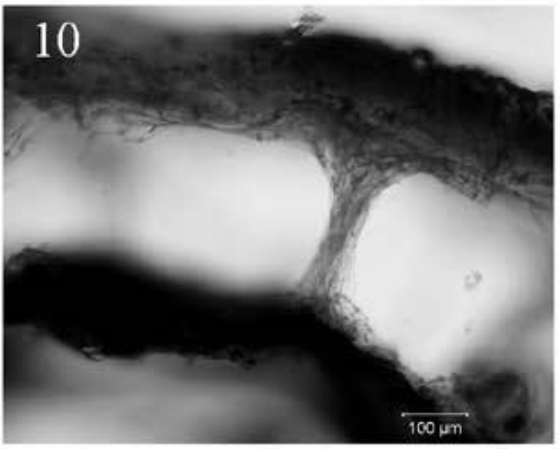

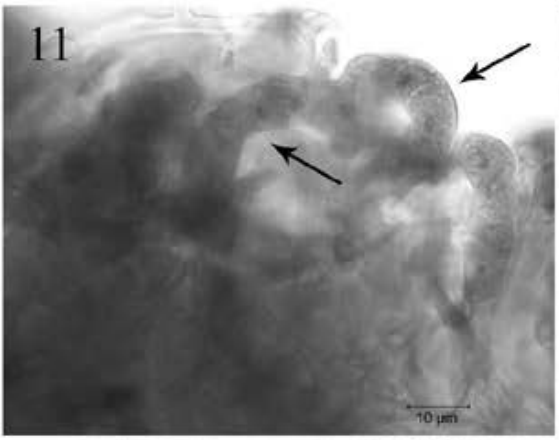

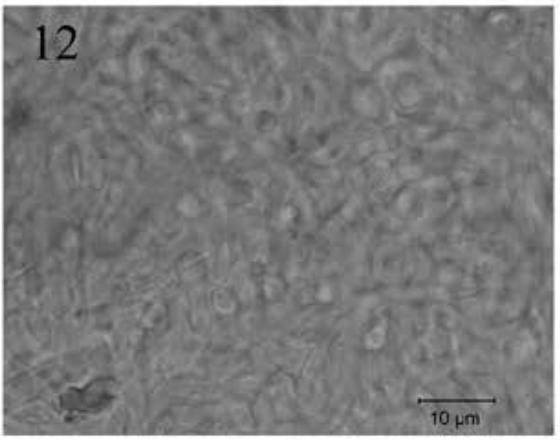


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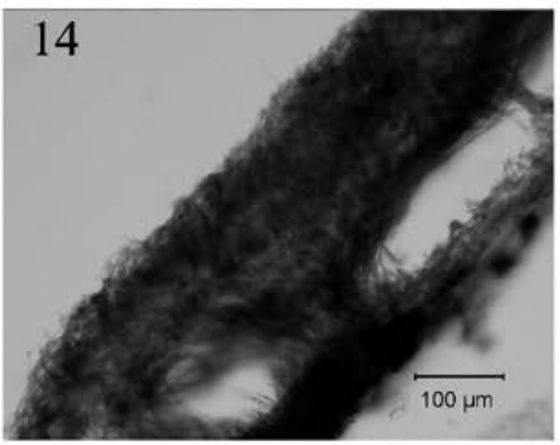

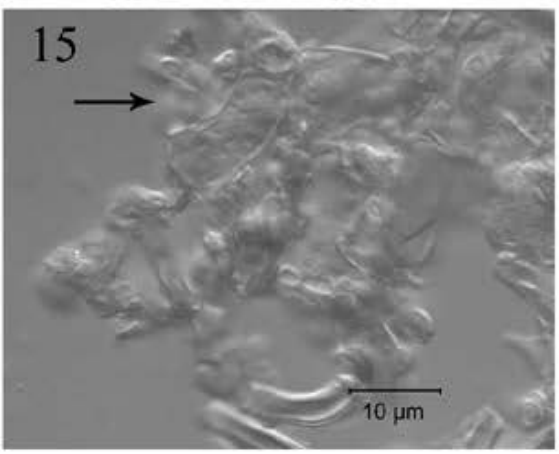

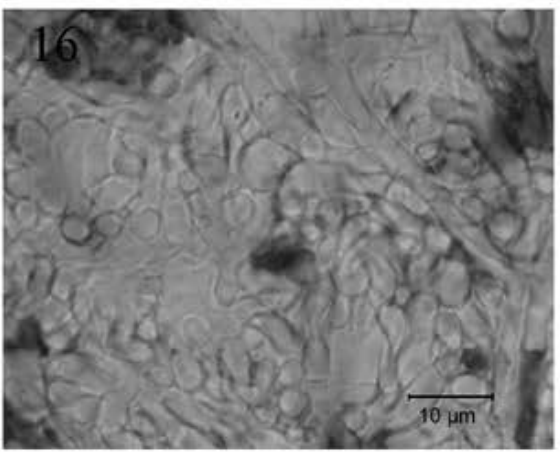

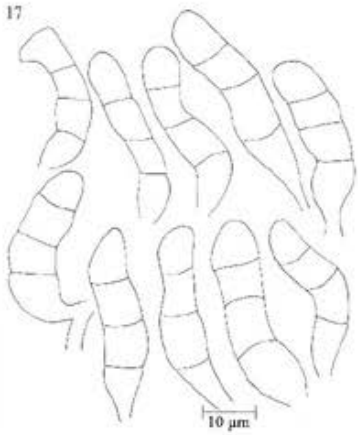

FIG. 17. Basidia of *Septobasidium pallidum* (HMAS 199578).

Septobasidium pallidum Couch ex L.D. Gómez & Henk, Lankesteriana 4(1): 88, 2004. FIGS. 13–17

Basidiomata on trunks and branches, resupinate, subcircular, 0.2–7 cm long, 0.2–3 cm wide, patches frequently confluent, tilleul buff, yellowish-brown or brown; surface often smooth, with mounds and wrinkles, sometimes cracked; margin determinate, white. In section 220–510(–720) μm thick. Subiculum 20–60 μm thick. Pillars 40–90 μm high, 20–140 μm thick. Hyphal layer 100–400(–600) μm high. Hymenium 50–100 μm thick. Basidia arising directly from the hyphae without a probasidial cell, cylindrical, straight or slightly curved, 4-celled, 17–38(–42) × 6–12 μm, hyaline or brown. Sterigmata 12–27 μm long, 2–3 μm wide. Hymenial hyphae irregularly arranged. Basidiospores not seen. Haustoria consisting of irregularly coiled hyphae.

SPECIMENS EXAMINED: On *Zanthoxylum bungeanum* Maxim. (*Rutaceae*): China, Sichuan, Jinyang, alt. 1100 m, 15.VIII.2009, S.H. He, C.X. Lu, Y.F. Zhu & L. Guo 2680, HMAS 199578; Jinyang, alt. 600 m, 15.VIII.2009, S.H. He, C.X. Lu, Y.F. Zhu & L. Guo 2686, HMAS 196491; Jinyang, Wuke, alt. 1100 m, 15.VIII.2009, S.H. He, C.X. Lu, Y.F. Zhu & L. Guo 2681, HMAS 199582; Jinyang, Mufu, alt. 1600 m, 15.VIII.2009, S.H. He, C.X. Lu, Y.F. Zhu & L. Guo 2685, HMAS 196487; Mianning, Manshuiwan, Ganghe, alt. 1740 m, 24.VIII.2009, S.H. He, C.X. Lu, Y.F. Zhu & L. Guo 2789, HMAS 196493; Xide, Mianshan, Dengxiangying, alt. 2300 m, 23.VIII.2009, S.H. He, C.X. Lu, Y.F. Zhu & L. Guo 2781, HMAS 196492.

On *Zanthoxylum simulans* Hance (*Rutaceae*): China, Sichuan, Hanyuan, 14.XII.1937, Y. Hu, HMAS 10165.

On *Pyrus phaeocarpa* Rehder (*Rosaceae*): China, Sichuan, Xide, Tanshan, alt. 1860 m, 23.VIII.2009, S.H. He, C.X. Lu, Y.F. Zhu & L. Guo 2784, HMAS 199628.

To date, 26 species of *Septobasidium* have been reported in China (Sawada 1933, Couch 1938, Teng 1963, Tai 1979, Kirschner & Chen 2007, Lu & Guo 2009a,b,c, 2010, Lu et al. 2010) including the three species reported in this paper.

Acknowledgements

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Volume 113, pp. 95–99 July–September 2010

Taxonomic studies of *Helminthosporium* from China 5. Two new species from Hunan and Sichuan Province*

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Abstract — Two new species of the genus *Helminthosporium* are reported from China: *H. bambusicola* and *H. hunanense*. Type specimens are deposited in the Herbarium of Henan Agricultural University: Fungi (HHAUF).

Key words — systematics, hyphomycetes, saprobes

In the course of a survey of *Helminthosporium* species in China, our previous research revealed eleven new species and five new records from China (Zhang et al. 2003, 2004, 2007, 2009). In this paper we describe two new species of this genus. Specimens studied are deposited in the Herbarium of Henan Agricultural University: Fungi (HHAUF).

Helminthosporium bambusicola Meng Zhang, H.Y. Wu & Zhen Y. Wang, **sp. nov.**

MYCOBANK MB 516715 FIG. 1

In substrato naturali coloniae effusae, atrae, pilosae. Mycelium plerumque immersum. Stromata partim superficialia et, partim immersa, atrobrunnea, pseudoparenchymatica, 10 µm alta, 25 µm lata. Conidiophora singularia spice lateribusque hypharum vel fasciculata ex stromata quoque, oriunda, simplicia, cylindrica, recta vel flexuosa, septata, levia, brunnea, interdum apicem versus pallidiora, 55–247 µm longa, 4–6 µm crassa, poris conidiiferis ad apicem et infra 1–2 septa supera praedita. Conidia obclavata, recta vel flexuosa, levia, pallide brunnea, 5–8-distoseptata, 36–66 µm longa, 6–11 µm crassa, apicem versus ad 2.0–4.5 µm gradatim attenuata.

HOLOTYPE: ON DEAD *BAMBUSA* SP. CULM, Sichuan, China, 16. VIII 2008, coll. Z.Y. Wang, HHAUF $_{08}$ 0266.

ETYMOLOGY: Named for the substrate.

* Supported by The National Natural Science Foundation of China (30870018 and 30970016)

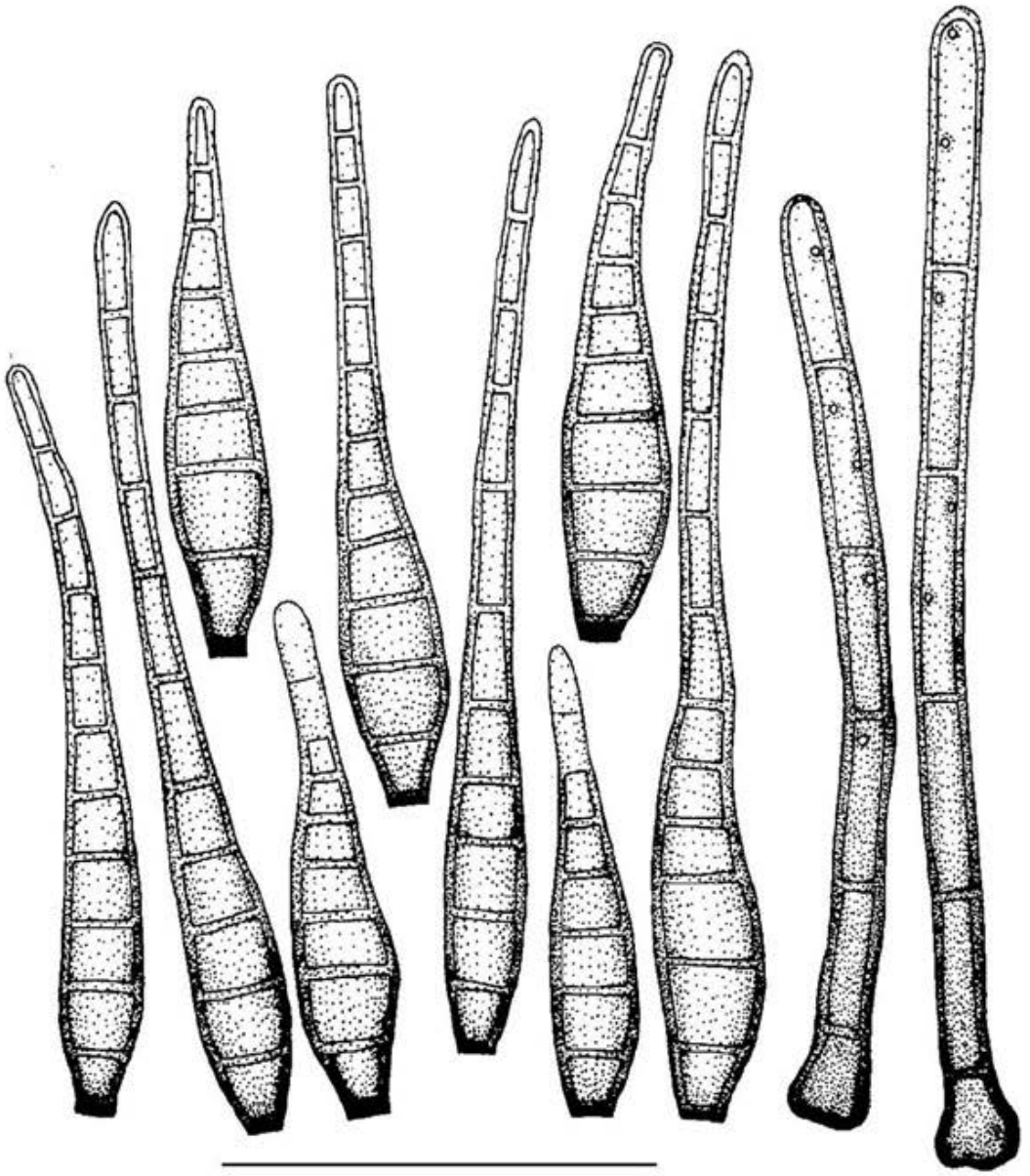

FIG. 1 *Helminthosporium bambusicola* (ex holotype, bar = 50 μm)
Conidia and conidiophores on natural substratum

Colony effused, black, hairy in the substrata. Mycelium mostly immersed in the substrata. Stromata partly superficial, partly immersed in the substrata, dark brown, pseudoparenchymatous, up to 10 μm tall, 25 μm wide. Conidiophores arising in fascicles from the upper cells of the stromata or solitary from the swelled cell of the mycelium, simple, cylindrical, straight or flexuous, thick-walled, smooth, brown, paler towards the apex, 55–247 μm long, 4–6 μm wide, with well-defined small pores (conidiogenous loci) at the apex and laterally just beneath the upper 1–2 septa. Conidia straight or slightly flexuous, obclavate, thin-walled 1–1.5 μm thick, smooth, pale brown, paler towards the apex, 5–8-

distoseptate, 36–66 µm long, 6–11 µm wide, narrowing towards the apex to 2–4.5 µm wide, scar not distinct at the base.

COMMENTS: Cooke (1892) published *Helminthosporium bambusae* on *Bambusa spinosa* Roxb. ex Buch.-Ham., a species distinguished by fewer distosepta (3–5) and slightly larger (60–70 µm long, 12 µm wide) conidia with slightly thinner (≤1.5 µm) walls. Although the two species inhabit identical substrates, we feel that the morphological differences, while minor, support naming a new species. The new taxon also resembles *H. solani* Durieu & Mont. (Ellis 1961) in its conidial shape and size. However, *H. solani* is a pathogen on solanaceous hosts, has larger conidiophores (120–600 µm long, 9–15 µm wide at the base, 6–9 µm wide at the apex), and slightly thicker (≥ 2 µm) conidial walls.

Helminthosporium hunanense Meng Zhang, H.Y. Wu & Zhen Y. Wang, **sp. nov.**

MYCOBANK MB 516716 FIG. 2

In substrato naturali coloniae effusae, atrae, pilosae. Mycelium plerumque immersum. Stromata nulla. Conidiophora singularia vel 2–3 fasciculata ex spice lateribusque hypharum oriunda, recta vel flexuosa, cylindrica, septata, levia, brunnea vel atrobrunnea, interdum apicem versus pallidiora, 70–226 µm longa, 5–7 µm crassa, poris conidiiferis ad apicem et infra 1–3 septa supera praedita. Conidia obclavata, recta vel curvata, levia, moderate brunnea, apicem versus pallidiora, 4–12-distoseptata, 56–127 µm longa, 10–14 µm crassa, apicem versus ad 2–4 µm gradatim attenuata, basi cicatrice majuscula fusca praedita.

HOLOTYPE: On dead branches of an unidentified tree, Zhangjiajie, Hunan , China, 2 IX 2009, coll. M. Zhang, HHAUF $_{09}$0451.

ETYMOLOGY: Named for the collection locality (province).

Colony effused, black, hairy in the substrata. Mycelium mostly immersed in the substratum. Stromata absent. Conidiophores arising solitary or in fascicles from the cells of the mycelium, simple, straight or flexuous, septa at 17–31 µm intervals, thick-walled, cylindrical, smooth, brown, 70–226 µm long, 5–7 µm wide just above the base cell which 8.5–14 µm wide, with well-defined small pores at the apex and laterally beneath the upper 1–3 septa. Conidia obclavate, straight or curved, thin-walled, 1–1.5 µm thick, smooth, middle brown, paler towards the apex, 4–12-distoseptate, 56–127 µm long, 10–14 µm wide in the widest part, narrowing towards the apex to 2–4 µm wide, with a blackish-brown scar at the base, 1.5 µm thick.

COMMENTS: The new species is most closely related to *Helminthosporium dalbergiae* M.B. Ellis in conidial morphology (shape and size). *H. dalbergiae* differs from this fungus by its much larger (300–550 µm long, 10–12 µm wide) conidiophores that arise from stromata and thicker (≥ 2µm) conidial walls.

The thinner conidial wall may be helpful in distinguishing both *H. hunanense* and *H. bambusicola* from other *Helminthosporium* species.

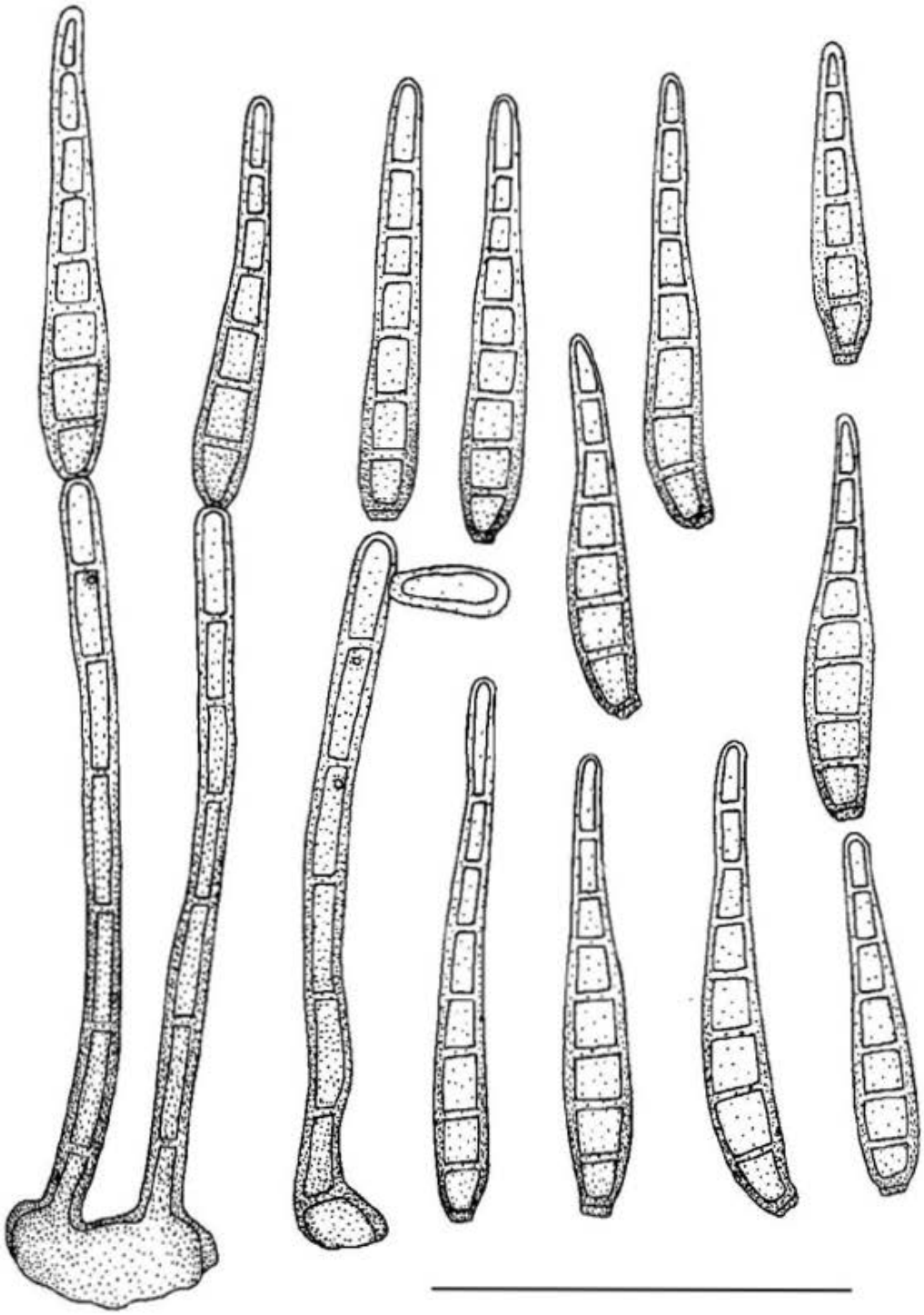

FIG. 2 *Helminthosporium hunanense* (ex holotype, bar = 50 μm)
Conidia and conidiophores on natural substratum

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Glomus candidum, a new species of arbuscular mycorrhizal fungi from North American grassland

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Abstract — A new species of arbuscular mycorrhizal fungi, *Glomus candidum* is described. The species produces spores singly in the soil. Spores are white to very pale yellow, usually globose to subglobose, 87–157 µm diam. Spore wall consists of two adherent layers. The outer layer is hyaline, mucilaginous, and stains very pale pink in Melzer's reagent. This layer can be observed in young spores and often degrades at maturity. The inner layer is hyaline and laminated, but occasionally the innermost group of laminae are pigmented a pale yellow to give the impression of two separated layers.

Resumen — Se describe una nueva especie de hongo formador de micorrizas arbusculares, *Glomus candidum*. La especie produce esporas libres en el suelo. Las esporas son blancas a amarillo muy pálido, usualmente globosas a subglobosas, 87–157 µm de diámetro. La pared de la espora consiste en dos capas adherentes. La capa externa a menudo se degrada con la madurez, es hialina, mucilaginosa, y se tiñe, sólo en las esporas jóvenes, de rosado muy pálido en reactivo de Melzer. La capa interna es hialina y laminada, pero a veces el grupo más interno de láminas aparece pigmentado de amarillo claro dando la impresión de dos capas separadas.

Key words — classification, molecular phylogeny, species description, taxonomy

Introduction

In studies of arbuscular mycorrhizal (AM) fungal ecology in an old field plant community on the campus of Duke University in Durham, North Carolina, a new species of *Glomus* was discovered with spores that were white to opaque

§ Deceased

when old (Bever et al. 1996, 2001). This fungus was subsequently used in multiple experiments on plant-soil feedback (Bever 2002), context dependence of plant growth promotion (Reynolds et al. 2005, Reynolds et al. 2006), effects on plant tolerance and defense against above-ground herbivores (Bennett & Bever 2007, Bennett et al. 2009), fungal competition (Bennett & Bever 2009) and preferential plant allocation (Bever et al. 2009). In the present paper, we describe this as a new species, *Glomus candidum*, sp. nov. based on morphology of mature spores as defined for the genus *Glomus* by Morton (1996) and Stürmer & Morton (1997), and the molecular studies of sequence from the large subunit (LSU) of the nuclear ribosomal (nrRNA) gene.

Materials and methods

Samples consisting of soil and roots fragments were collected from the rhizosphere of *Allium vineale* L., *Anthoxanthum odoratum* L., *Plantago lanceolata* L. and *Panicum sphaerocarpon* Elliott growing in the field plot. Soils were mixed 1:1 (v/v) with silica sand that had been autoclaved for 1 hour at 120°C, then placed in greenhouse Deepots™ (Stuewe and Sons, Corvallis, OR), and seeded with either *Sorghum halepense* (L.) Pers. or *Sorghum bicolor* (L.) Moench separately. In addition, rhizosphere soil was collected to establish trap cultures using the above field plant species as hosts as described by Bever et al. (1996). Cultures were maintained in a cool season greenhouse (4–21°C) at Duke University. After 20 wk and once dried in situ, pot contents were harvested and stored at 4°C for 2 mo. Sporulation of the new *Glomus* sp. was particularly abundant with *Pa. sphaerocarpon* (note *Glomus candidum* = *Gl.* sp. D1 in Bever et al. 1996, = *Gl.* "*white*" in Bever et al. 2009, = *Gl. hyalinulum* (ined.) in Msiska & Morton 2009).

Spores were extracted from soil by wet sieving and decanting followed by centrifugation in a 20–60% sucrose density gradient (Daniels & Skipper 1982). Healthy spores were pipetted onto roots of 10–12 d old *S. bicolor* seedlings. Each inoculated seedlings were then transplanted into 4 × 21 cm Cone-tainers™ (Stuewe and Sons, Corvallis, OR) containing a sterile loamy soil:sand mix (1:2 v/v), adjusted to pH 6.2 and grown for 120 d in a growth room at the International Culture Collection of (Vesicular) Arbuscular Mycorrhizal Fungi (INVAM) at West Virginia University with a temperature range of 21–28°C, 225 µmol $m^{-2}s^{-1}$ light intensity and a 14-h photoperiod.

Once monospecific cultures of *G. candidum* was successfully established, the contents of selected Cone-tainers™ were placed in the center of 15-cm pot, surrounded with the same growth medium described earlier, seeded with sudan grass (*Sorghum sudanense* (Piper) Stapf and grown for another five months. This isolate (deposited in INVAM as NC268) and single spore cultures, maintained as pure cultures for more than ten years in the Bever lab collection, were used to describe the new species, *G. candidum*.

Spore size was measured with an ocular micrometer and color of spores was determined under reflected light from a two-branch fiber optic illuminator (color temp 3400 K) to co-illuminate spores and a printed color chart (INVAM color chart). The colors on the chart were composed of various percentages of the component colors: cyan, magenta, yellow and black. Spores were preserved in 0.05% $NaNO_3$ at 4°C.

Spores were also mounted in polyvinyl alcohol lacto-glycerol (PVLG) (Koske & Tessier 1983) and PVLG mixed with Melzer's reagent (1:1 v/v) to observe and measure spore subcellular structures. Slides of the spores were incubated in a conventional oven at 65°C for 24–48 hours and deposited as permanent vouchers at Oregon State University (OSC), Corvallis, OR; Harvard University (FH), Cambridge, MA; INVAM, the Bever lab collection and personal collection of W. Kaonongbua. Selected images of the spores were captured by a Sony CCD video camera on a Nikon Eclipse E600 Microscope. Color images in this paper are available from the corresponding author upon request.

The LSU nrRNA gene sequence (GU980757) was obtained from a single spore of the new fungus and was similarly subjected to various analyses (BLAST search, similarity index) as previously described (Kaonongbua et al. 2010). Additional LSU nrRNA sequences broadly representing the phylum Glomeromycota and outgroups (*Mortierella polycephala* – AF113464 and *Basidiobolus ranarum* – AF113452) were acquired from the NCBI's GenBank and then aligned using Clustal X (v. 2.0) (Larkin et al. 2007). After manual inspection and editing, a phylogenetic reconstruction based on the Neighbor-Joining (NJ) method with Kimura's 2-paremeter model of nucleotide substitution was performed using MEGA4 (Tamura et al. 2007) with 1000 bootstrap replications.

Taxonomy

Glomus candidum Furrazola, Kaonongbua & Bever, **sp. nov.** FIG. 1

MycoBank MB516798

Sporocarpia ignota. Sporae in solo singilatim efformatae, terminales, globosae vel subglobosae, 87–157 µm diam., candidus vel pallide luteae. Sporae tunica strata duabus: stratis exterior hyalino, inmundo, caduco, 1.7–4.3 µm crasso; stratis secundo hyalinae vel pallide lutei, subtiliter laminato, 3.7–9.4 µm crasso. Hyphae subtendentes 6–21 µm diam., rectae vel recurvatae, porus septatus. Hyphae tunica strata duabus. Mycorrhizae vesicular-arbusculares formans.

HOLOTYPE: UNITED STATES. NORTH CAROLINA: Durham County on Duke University Campus, from an old field on the corner of Alexander Drive and University Avenue. September 1992, *JD Bever*, from culture IU-06. Deposited at OSC as broken spores mounted permanently on a glass slide, and labeled as 'holotype'.

ETYMOLOGY: from the Latin: '*candidus*' (white) referring to the white color of the spores under stereomicroscope.

Spores formed singly in soil and roots; globose to subglobose, 87–157 µm diam (mean = 125 µm, n = 125); white, with a few spores becoming a pale yellow color (0-0-5-0) with age. Spores have a thin "halo" under reflected light (FIG. 1.1) when all spore wall layers are present. The spore wall consists of two adherent layers (FIGS. 1.2–1.3). The outer layer (L1) is hyaline, mucilaginous initially, becoming more granular as it begins to decompose, 1.7–4.3 µm thick, often adherent to the inner structural laminate layer, staining very pale pink in Melzer's reagent in juvenile spores only. With age, this layer degrades and decomposes naturally, after which it appears granular and may accumulate some debris. The inner layer (L2) is laminated, 3.7–9.4 µm thick (mean =

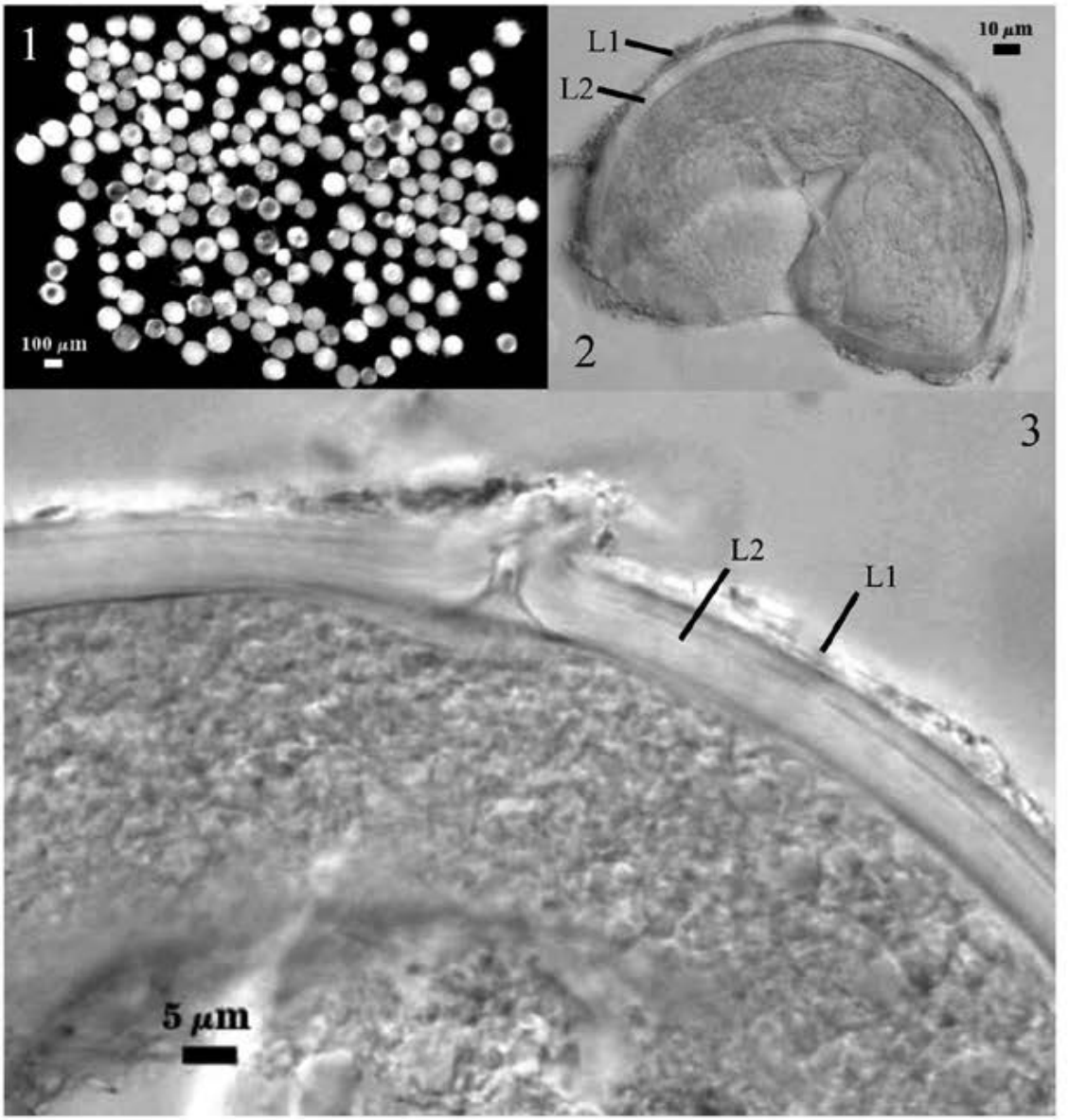

FIGURE 1. *Glomus candidum*, Reference Accession NC268. 1, Color and shape of spores under the dissecting microscope; note the halo around some spores. 2, Spore wall composed by two layers (L1 and L2). 3, A larger magnification showing an improved view of wall composition.

6.1, n = 40). It is often uniformly hyaline, but in a few spores, an innermost group of laminae (sublayers) is pigmented a pale yellow (0-15-0-0) to give the appearance of two separates layers of occasionally equal thickness. This color separation is not consistent in all spores. No part of the laminate layer reacted in Melzer's reagent. Subtending hyphae is single, straight or occasionally recurved, cylindrical to slightly flared, 6–21 µm wide at spore base. Some spores lack the subtending hyphae due to breakage close to the spore base. In mature spores, the innermost sublayer(s) of the laminate layer of the spore wall, usually forms a thin septum (1.0–1.7 µm thick); positioned 2–16 µm in the hyphal lumen. In

some spores, the occlusion is a hyaline plug, or the lumen of subtending hyphae remains open. The subtending hyphal wall consists of a continuation of both layers of the spore wall. The L2 layer tapers gradually to 1 µm thick, 20–25 µm from the spore base.

MYCORRHIZAE: *G. candidum* has been observed to form arbuscules and vesicles typical of *Glomeraceae*.

DISTRIBUTION AND HABITAT: This species is known from an old field on the campus of Duke University, Durham County, North Carolina. Soil pH in this field averaged 5.2. Soil phosphorus ranged from 7.6 to 48.9 $kg.ha^{-1}$ and averaged 17.8 $kg.ha^{-1}$. The average percent organic matter at the sampling sites was 4.2 and the range varied from 1.07 to 14.13. Fungi with similar morphology have also been isolated from Indiana, Maryland, and West Virginia.

MYCORRHIZAL ASSOCIATIONS: Found in the rhizosphere of *Al. vineale*, *An. odoratum*, *Pl. lanceolata*, and *Pa. sphaerocarpon* in the field plot. Formed arbuscular mycorrhizae on *S. bicolor*, *S. halepense*, *S. sudanense*, and *Zea mays* in greenhouse-grown pot cultures.

MOLECULAR PHYLOGENETIC ANALYSIS: The LSU nrRNA gene tree clearly places the new fungus as a member of the *Glomus* group B (Schwarzott et al. 2001) along with sequences from *Glomus claroideum* N.C. Schenck & G.S. Sm., *Glomus etunicatum* W.N. Becker & Gerd., and *Glomus luteum* L.J. Kenn. et al. and with 100% statistical support (FIG. 2).

Discussion

Our phylogenetic analysis of the LSU nrRNA gene sequences placed *G. candidum* in *Glomus* Group B sensu Schwarzott et al. (2001). This is consistent with the phylogeny generated by the β-tubulin gene using an isolate of *G. candidum* from Maryland (Msiska & Morton 2009). Both of these studies were limited by using only a single sequence from a single spore of the new AM fungal species. Thus the molecular work cannot test the extent of genetic divergence within this species or between *G. candidum* and other species in this clade.

Spores of *G. candidum* differ in morphology from other species in *Glomus* Group B, including *G. claroideum*, *G. lamellosum* Dalpé et al., and *G. luteum*. Spore size range of *G. candidum* overlaps with that of *G. claroideum* (87–157 and 70–180 µm, respectively); however, both species differ in their spore ontogenies. Whereas fully formed spores of *G. claroideum* show four layers (Stürmer & Morton 1997), spores of *G. candidum* develop only two layers. Occasionally, the innermost group of laminae (sublayers) of *G. candidum* spore wall layer 2 may appear as a separate layer due to slight pigmentation. In addition, the pore of the subtending hypha of *G. claroideum* spores is occluded either by a sublayer (lamina) of the laminate spore wall layer 3 and spore wall

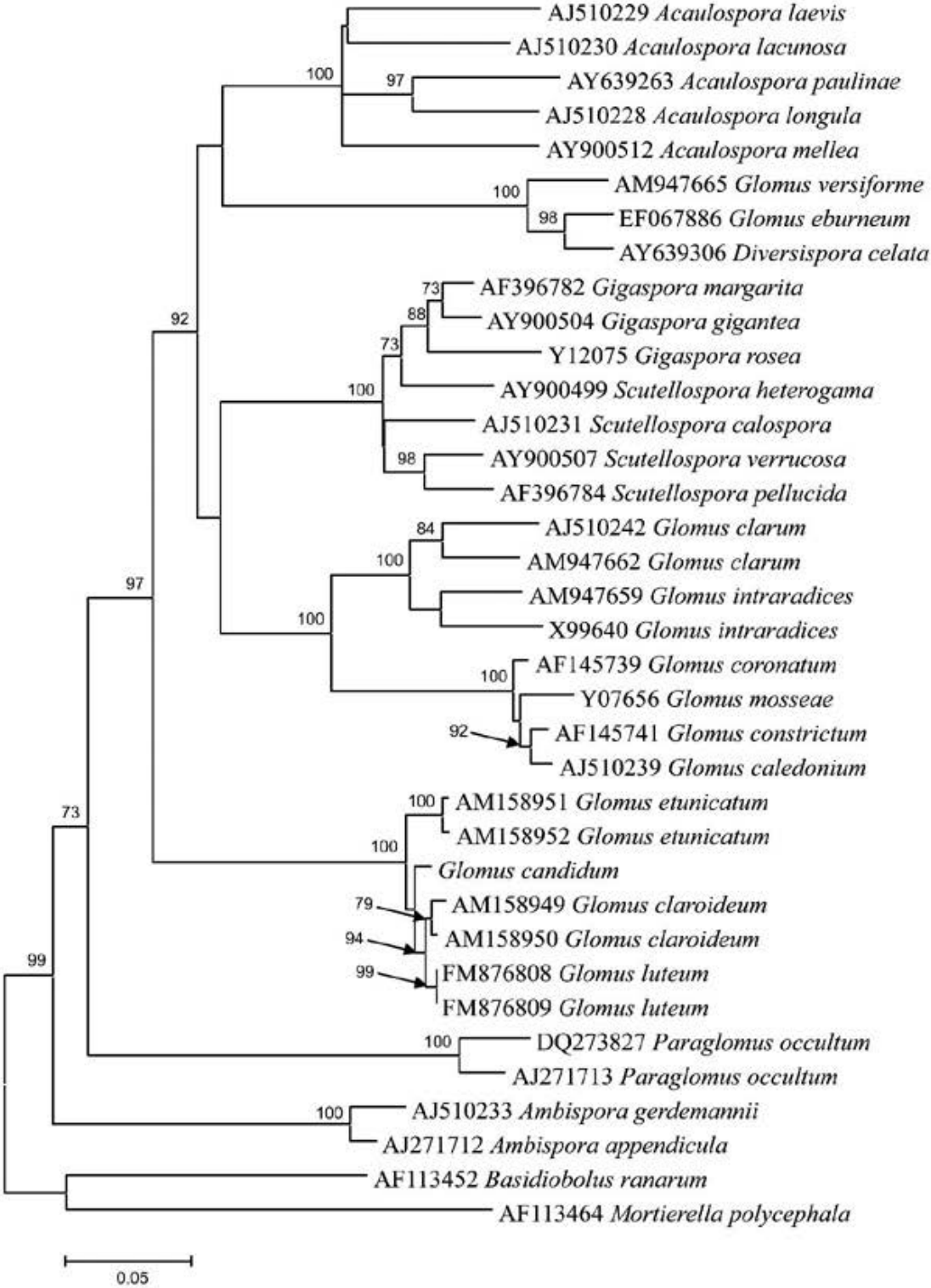

FIGURE 2. Neighbor-joining tree inferred from partial nrLSU sequences showing the taxonomic position of *Glomus candidum* as a member of the *Glomus* "Group B". The numbers on the tree braches are bootstrap support values based on 1000 replications of the neighbor-joining analysis (values are not shown if it is below 70%). Sequences of *Mortierella polycephala* (AF113464) and *Basidiobolus ranarum* (AF113452) were used as outgroups. The scale indicates the number of base substitutions per site.

layer 4 or only by spore wall layer 4. In contrast, in *G. candidum* the closure is by the presence of a thin septum or a mucilaginous plug.

When viewed under a dissecting microscope, *G. candidum* spores also resemble those of *G. lamellosum* because of their similar size range (87–157 and 98–142 × 122–162 µm, respectively) and their whitish to pale yellow pigmentation (Dalpé et al. 1992). However, *G. lamellosum* spores have been described with a spore wall composed of three layers persisting in mature spores, with the outermost one significantly thicker than the first layer of *G. candidum* (4–14 µm and 1.7–4.3 µm thick, respectively) and the flexible innermost layer not observed in the species being described here.

Glomus luteum forms spores slightly bigger than those formed by *G. candidum* (up to 180 µm in diam) and *G. luteum* spores have been described with four layers, including a flexible innermost layer (Kennedy et al. 1999), which is lacking in the spore wall of *G. candidum*. In addition, *G. luteum* spores have been described as pale yellow to dark yellow with a brownish tint in color compared to the white spores of *G. candidum*. With age, spores of *G. candidum* may turn pale yellow, but examinations of crushed spores under a compound microscope can readily separate *G. candidum* from the three species listed above based on the number of layers of their spore wall. In addition, in PVLG + Melzer's, the outermost layer of *G. candidum* reacts very pale pink while the reactions are darker pink in *G. claroideum*, pinkish-red in *G. luteum* and non-reactive in *G. lamellosum*.

Spores of *G. candidum* bear superficial similarity to other phylogenetically unrelated *Glomus* species producing white/hyaline spores, including *G. diaphanum* J.B. Morton & C. Walker, *G. clarum* T.H. Nicolson & N.C. Schenck, and *G. manihotis* R.H. Howeler et al. under a stereomicroscope. The spore wall structure of *G. candidum* was initially judged most similar to *G. diaphanum* according to Bever et al. (1996). However, even though spore wall layers 1 and 2 of both species are similar in their phenotypic and biochemical properties, the latter species also has a flexible layer 3 in the spore wall, which is missing in the former species.

On the rare occasions in which the innermost group of laminae (sublayers) of spore wall layer 2 of *G. candidum* is pigmented, its spore can resemble those of *G. clarum* and *G. manihotis* (Stürmer & Morton 1997). This can be particularly difficult to discern under low magnification, but *G. candidum* spores never reach as dark a tint as do those of *G. clarum* and *G. manihotis*. Spores of *G. clarum* and *G. manihotis* are also bigger (up to 260 µm in diam) than those of *G. candidum*, whose biggest spores reach approximately 160 µm in diam. In addition, in *G. clarum* and *G. manihotis* the external mucilaginous layer reacts strongly in Melzer's reagent (pinkish-red to light purple), while the reaction of the same layer in *G. candidum* is very pale pink and only occurs in juvenile

spores. Finally, molecular tools clearly identify that *G. candidum* is a member of *Glomus* group B, while *G. diaphanum*, *G. clarum*, and *G. manihotis* are in *Glomus* group A sensu Schwarzott et al. (2001) (Msiska & Morton 2009).

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New record of *Circinella muscae* from a hydrocarbon polluted sand beach of Tabasco, Mexico

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Abstract — During a survey of fungal biodiversity from Mexican sand beaches, an uncommon fungus of the subphylum *Mucoromycotina* was isolated from the intertidal area of Playa Paraiso, State of Tabasco. A study of culture isolates demonstrated that it is a mucoraceous species belonging to the genus *Circinella* characterized by sporangiophores bearing circinate branches terminated by globose sporangia with persistent sporangial walls. Several sandy soil samples placed in sterile re-sealable plastic bags were processed in the laboratory within 4 h. Plates of corn meal agar inoculated with 0.5 g of sandy soil were incubated 15 d. The fungus produced sympodially branched sporangiophores with fertile circinate branches bearing one or two sporangia, or a single sporangium and a sterile spine. Sterile spines were light in color and the globose sporangia had persistent walls bearing globose, hyaline sporangiospores. The characters of the Mexican isolate agree with those described for *C. muscae*. Few zygomycete studies have been conducted in Mexico, making this the first recorded mucoraceous fungus isolated from a sand beach environment in the country.

Key words — arenicolous fungi, endopsammon, Gulf Coast of Mexico, tropical seashore

Introduction

At the national level, little is known about fungal communities that inhabit the endopsammon in Mexico (González et al. 1998, 2000). During a survey of fungal biodiversity from Mexican sand beaches, an uncommon fungus of the phylum *Zygomycota* was isolated from the intertidal area of Playa Paraiso, State of Tabasco. A study of the characteristics of this isolate on culture media demonstrated that it is a mucoraceous species belonging to the genus *Circinella*

Tiegh. & G. Le Monn., characterized by the production of sporangiophores bearing circinate branches terminated by globose multispored sporangia with persistent sporangial walls. After the genus was monographed by Hesseltine & Fennell (1955), several additional species were described (Hesseltine & Ellis 1961, Faurel & Schotter 1965, Patil & Kale 1981, Arambarri & Cabello 1996). *Circinella* currently includes nine species with an apparently worldwide distribution (Benny 2006). Members of this genus usually have been isolated from soil, dung, fermented cacao beans, musty nuts, and more recently, *C. lacrymispora* was described from hydrocarbon-polluted soil from the coast of Argentina (Arambarri & Cabello 1996). The biotechnological potential of *Circinella* has been explored by Nakagawa et al. (1995) who performed the biochemical conversion of milbemycins with *C. umbellata*.

Materials & methods

Playa Paraiso is located on the southeast coast of the Gulf of Mexico (18°24'00"N 93°13'59"W) in the County of Paraiso, a petroleum extraction zone characterized by numerous lagoons, estuaries, and swamps. It receives 1,751 mm of annual precipitation with a median annual temperature of 26°C. In this study, the beach was sampled August 18, 2001, during low tide; three sandy soil samples of 50 g each were collected and placed in sterile Ziploc® bags and were processed in the laboratory within 4 h. The surface of six plates of corn meal agar (Difco) prepared with artificial seawater (Instant Ocean®) with antibiotics (chloramphenicol 1 mg/ml, penicillin 500 µ/ml, streptomycin 300 µg/ml added after autoclaving) were inoculated each one with 0.5 g of sandy soil and incubated 15 d at 25°C. After this incubation, a mucoraceous fungus was transferred to mucor agar (Hesseltine 1954, Hesseltine & Fennell 1955), potato dextrose agar, malt agar and V8 vegetable juice agar without antibiotics for descriptive purposes. The fungus was identified with the keys published by Hesseltine & Fennell (1955) and Arambarri & Cabello (1996). The culture and slide of this isolate are deposited in the fungal collection of Herbario Nacional (MEXU) of the Institute of Biology, Universidad Nacional Autónoma de México.

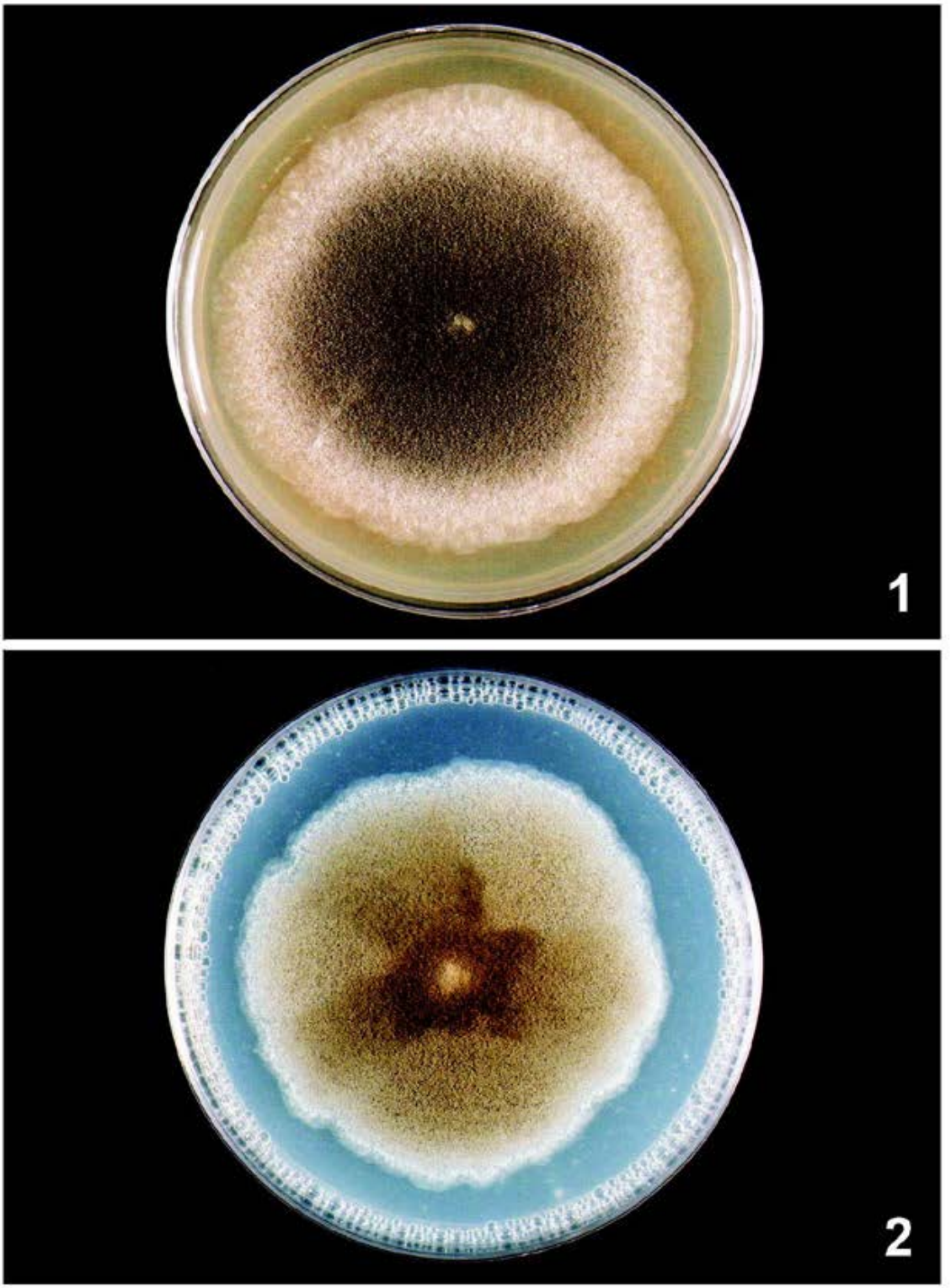
Results

A total of 28 fungal isolates were recovered from the sandy soil samples of Paraiso Beach, and 42 colony-forming units were obtained per gram of soil. *Circinella muscae* was an uncommon species with a low relative abundance value (0.14%).

Circinella muscae (Sorokīn) Berl. & De Toni, Sylloge Fungorum 7: 216. 1888.

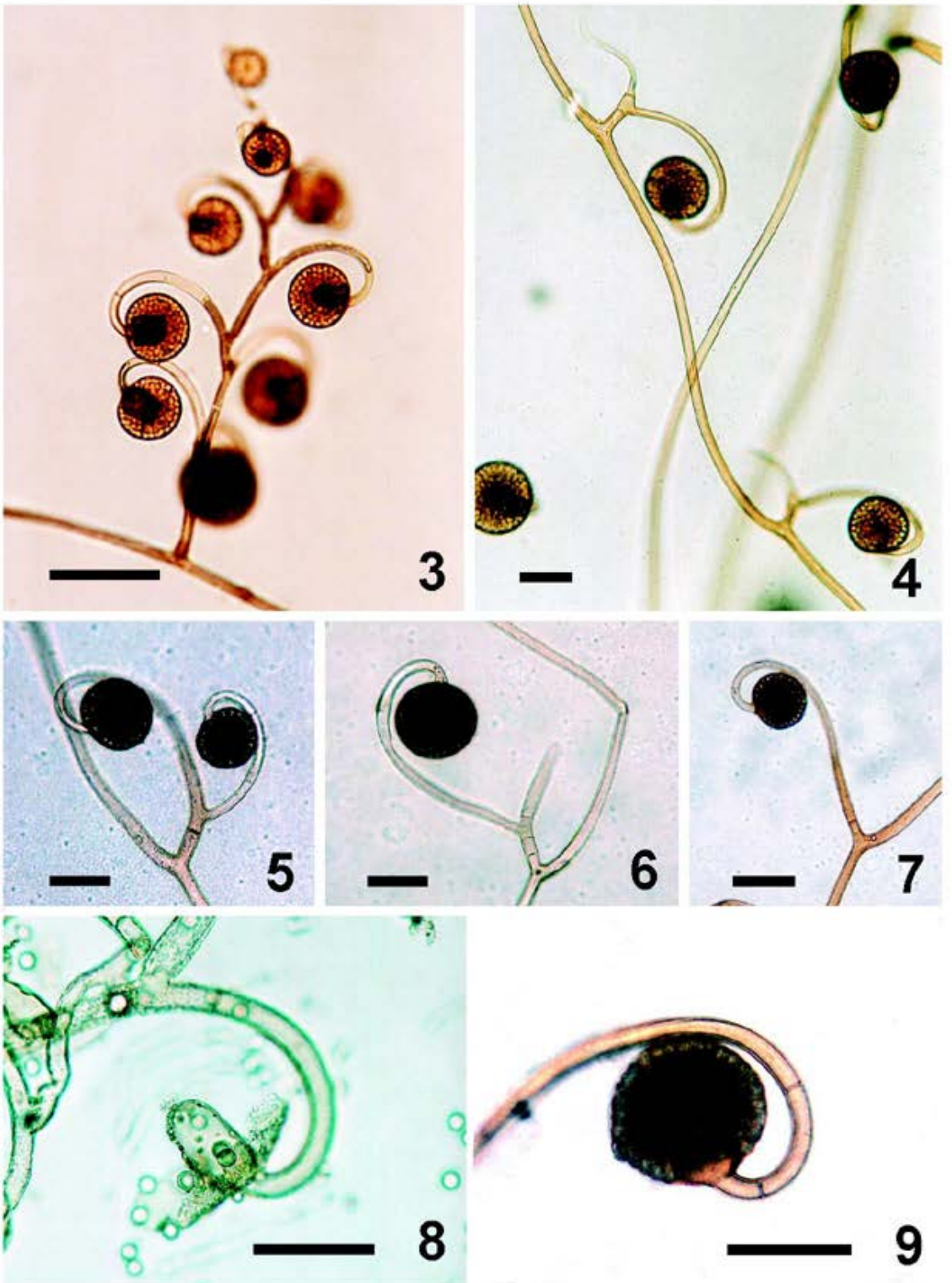
FIGS 1–9

SPECIMEN EXAMINED: MEXICO. State of Tabasco: Paraiso Co., Paraiso Beach (18°24'00"N 93°13'59"W), from intertidal soil sand, 18 Aug 2001, *N. Murueta-Figueroa, M.C. González*. MEXU 25512, dehydrated specimen, slide and culture MGSW20.



FIGS. 1, 2. *Circinella muscae*. 1. Colony appearance on V8 vegetable juice agar after 7 days at 25°C. 2. Colony appearance on potato dextrose agar after 7 days at 25°C. Petri dishes: 100 mm diam.

Mycelium forming a uniform, dense colony on the surface of the agar, relatively slow-growing, reaching a diam. of 75 mm after 7 days at 22–23°C. Colony



Figs. 3–7 *Circinella muscae*. 3. Lateral branch of aerial sporangiophore with a sympodial arrangement of small sporangia. 4. Aerial sporangiophore showing lateral branches with sterile spines and circinate sporangia. 5–7. Aerial sporangiophore with lateral branches bearing two sporangia, a sporangium and a sterile spine, or one sporangium. 8. Columella of sporangium with basal collar and sporangiospores. 9. Characteristic two septa near end of lateral sporangial branch. All bars = 50 μm.

initially white, then gray, becoming cinnamon brown with age (FIGS 1, 2). Colony consisting of a layer of short sporangiophores overgrown by longer, aerial sporangiophores. Short sporangiophores erect, up to 1 cm high, arising from hyphae on the agar surface, nonseptate, recurving at apex to form a terminal sporangium. Short sporangiophores with closely spaced, sympodial branches, each with an apical circinate sporangium, frequently with a few large sporangia and a cluster of smaller sporangia. Aerial sporangiophores very long, up to 6 cm in length, sometimes with two main branches, straight to wavy, but never spirally coiled. Aerial sporangiophores with scattered, alternate lateral branches terminated by a large circinately attached sporangium, or dichotomously branched, with two sporangia, a sporangium and a sterile spine, or occasionally with two sterile spines; a few lateral branches bear a sympodial arrangement of small sporangia and without spines (FIGS 3–7). Sporangial branches usually with a basal septum and sometimes with one or two additional septa near the sporangium (FIG. 9). Sporangia globose, nonapophysate, with a columella and persistent wall, at first hyaline, then dark gray and appearing black in reflected light. Large sporangia 46–72(–92) µm diam (sd = 12.9, n = 25), small sporangia 18–28 µm diam (sd = 4.9, n = 25), the different sizes readily discernable under the dissecting microscope. Sporangiophores and sporangial branches light brown in color. Columellae variable in shape, subglobose, oblong or conical, smooth, sometimes with a short, hyaline apical protuberance, 21–42 µm high × 15–32 µm wide. A large, broad collar often remains around the base of the columella after breakdown of the sporangial wall (FIG. 8). Sporangia filled with numerous sporangiospores that are liberated when the wall eventually breaks up. Sporangiospores globose, subglobose to ovoidal, 5–7 × 5–6.6 µm, hyaline and smooth, appearing dark brown to black in mass. Zygospores not observed.

Discussion

The tropical species *Circinella mucoroides* Saito is morphologically close to *C. muscae* in producing subglobose, multispored sporangia on circinate sporangiophores, globose sporangiospores, and the presence of sterile spines. However, *C. mucoroides* has spirally twisted sporangiophores that often bear branches that only form spines, whereas *C. muscae* has straight to wavy sporangiophores with branches that typically bear sporangia along with sterile spines. The change in colony color from gray to brown with age also is characteristic of *C. muscae*.

Although no extensive studies of zygomycetes have been conducted in Mexico, several other species of zygomycetes have been reported from the country. Benny & Benjamin (1975, 1976) isolated *Backusella ctenidia* (Durrell & M. Fleming) Pidopl. & Milko ex Benny & R.K. Benj., *Benjaminiella poitrasii*

(R.K. Benj.) Arx (as *Mycotypha poitrasii* (R.K. Benj.) Benny & R.K. Benj.), *Chaetocladium brefeldii* Tiegh. & G. Le Monn., *Cokeromyces recurvatus* Poitras, *Dichotomocladium elegans* Benny & R.K. Benj., *D. robustum* Benny & R.K. Benj., *Thamnostylum lucknowense* (J.N. Rai et al.) Arx & H.P. Upadhyay, *T. nigricans* (Tiegh.) Benny & R.K. Benj. and *Zychaea mexicana* Benny & R.K. Benj. from rodent and lizard dung in northern Mexico. Earlier, Zenteno-Zevada et al. (1955) reported *Rhizopus* sp. on *Annona* sp. in Veracruz and *R. stolonifer* (Ehrenb.) Vuill. (as *R. nigricans* Ehrenb.) on potato from Chihuahua and Guanajuato. Ulloa & Herrera (1971) isolated *R. stolonifer* and *Mucor racemosus* Fresen. from pozol; and Pérez-Silva (1976) isolated *Thamnostylum piriforme* (Bainier) Arx & H.P. Upadhyay (as *Helicostylum piriforme* Bainier) from cow dung from the Distrito Federal. Samaniego et al. (1988) isolated *Actinomucor elegans* (Eidam) C.R. Benj. & Hesselt., *Mucor* sp., *Phycomyces* sp., and *Rhizopus arrhizus* A. Fisch. from soils in Coahuila State. Moretti & Robledo (1988) isolated *Mucor* sp., *Rhizopus* sp., and *Syncephalastrum* sp. from air samples in Mexico City in the Distrito Federal; and Ramírez-Guíllen & Guzmán (2003) reported *Thamnidium elegans* Link on a decaying basidioma of *Lepiota* sp. from Veracruz. Trigos et al (2008) isolated *Circinella minor* Lendn. from "ejote" (*Phaseolus vulgaris* L.), also in Veracruz.

The physical and chemical properties of a soil may determine the fungal diversity that inhabits that ecosystem. The fungal diversity of coastal sand beaches still is unknown for the most part. The sandy soil of beaches probably has a high and characteristic mycobiota composed of species adapted to that particular marine environment where the ascomycetes are the more common and best studied group (Kohlmeyer & Kohlmeyer 1979, Dunn & Baker 1983). This is the first record of a mucoraceous fungus isolated from a sand beach environment in Mexico. Because this fungus was isolated from hydrocarbon polluted sand, chemical studies need to be performed to investigate its potential biotechnological value.

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Two *Oudemansiella* species with echinulate basidiospores from South America with *O. macracantha* lectotypified

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Abstract—A recent collection of *Oudemansiella steffenii* from the State of Pernambuco, Brazil, is described and compared to the type of *O. macracantha*, which is lectotypified here. Photographs of both basidiomes and microstructures are also provided.

Key words— *Agaricales*, Neotropics, *Physalacriaceae*, taxonomy

Introduction

Recent molecular and phylogenetic studies showed that species covered by dense long hairs, such as *Xerula hispida* Halling & G.M. Muell. (1999) and *X. setulosa* (Murrill) R.H. Petersen & T.J. Baroni (2007), form a well supported clade while non-hispid species of *Xerula* Maire and *Oudemansiella* Speg. s. str. taxa form another (Mueller et al. 2001). The bootstrap value between these clades is low and the hairy *Xerula* and all other *Oudemansiella* sensu Singer (1986) represent two distinct genera also supported by recent morphological studies (Wang et al. 2008, Yang et al. 2009).

Among the sections proposed in the rearrangement of *Oudemansiella* by Yang et al. (2009), the species with echinulate basidiospores, *O. steffenii* and *O. macracantha*, initially placed at the subgenus level by Clémençon (1979), belong to sect. *Dactylosporina* (Clémençon) Pegler & T.W.K Young, as already reported by Pegler & Young (1986).

In this study, recent collections of *O. steffenii* and the type of *O. macracantha* were studied in order to clarify the species concepts among the taxa of sect. *Dactylosporina*.

Materials and methods

Microscopic observations were made from material mounted in 3% KOH and Congo Red solutions. Presentation of basidiospore data follows the methodology proposed by Tulloss et al. (1992), but utilizing a single basidioma (Wartchow 2009). The notation "[*a*/*b*/*c*]" at the beginning of the spore data set is to be read "*a* spores measured from *b* basidiomes taken from *c* collections." Other abbreviations include L(W) = basidiospore length (width) average from a single basidiome, Q = the length : width ratio range as determined from all measured basidiospores, and **Q** = the Q value averaged from all basidiospores measured within a single basidiome. Color codes used in the description of the species are those from Watling (1969). Herbaria codes and names follow Holmgren & Holmgren (2001). Description of dried material of *O. macracantha* follows the style of the type studies of Yang (2000).

Taxonomy

Oudemansiella steffenii (Rick) Singer, Lilloa 26: 66. 1953. FIGS. 1–7

MATERIAL EXAMINED: BRAZIL. **Pernambuco**, Recife, Campus UFPE, 01.vi.2007, *J. Pereira s.n.* (URM 79226).

Basidiome medium-sized. PILEUS to 65 mm in diam., plano-umbonate to concave-umbonate, brown ('milk coffee' 26) to slightly paler ('snuff brown' 17) at margin, narrowly sulcate-striate (5–10 mm) when fresh, more indistinct in dried state; context thin, fleshy. LAMELLAE adnexed to somewhat sub-free, white to cream, somewhat brown at edges, 4–8 mm wide, subdistant; lamellulae very common, 14–20 mm long, frequently truncate. STIPE 95 × 4–8 mm, cylindrical above bulb to tapering near apex, brown ('clay buff' 32 to 'snuff brown' 17); bulb inflating to 6–12 mm, pseudorrhiza very long, 25–100 mm; context pale cream, solid.

BASIDIOSPORES [25/1/1] 12–15.5 × 11–14.5 µm (without ornamentation), **L** = 13.2 µm, **W** = 12.7 µm, Q = 1.00–1.11(–1.16), **Q** = 1.04, globose only infrequently subglobose, moderately thick walled, strongly spinose with > 30 spines (2–)3.5–5(–5.5) µm long, subacute to subobtuse, infrequently with acute tips, inamyloid, colorless, with guttulate contents. BASIDIA 50–60 × 13–15 µm, clavate, 4-sterigmate, sterigmata to 9 × 4.5 µm (width measured at base). PLEUROCYSTIDIA scattered 60–120 × 18–36 µm, fusoid to lageniform, rounded-obtuse to subcapitate, infrequently subacute, thick-walled (1.5–3 µm), hyaline, colorless. CHEILOCYSTIDIA not observed. PILEIPELLIS a hymenoderm layer consisting of elements 22–45 × 14.5–22 µm, somewhat to broadly clavate or more or less pyriform (e.g. 30 × 11 µm or 70 × 22 µm), all rounded-obtuse at

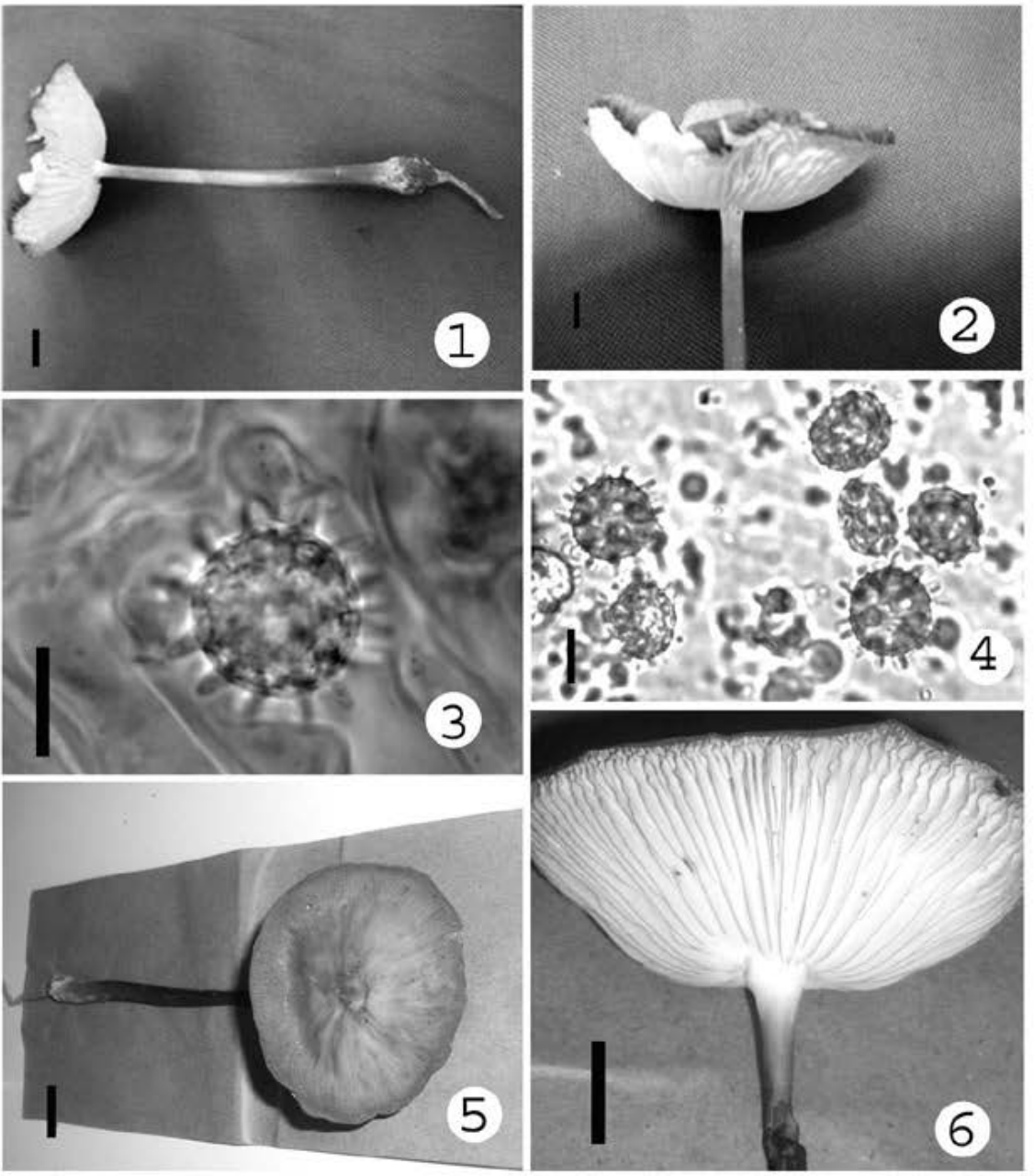

FIG. 1–6. *Oudemansiella steffenii*. 1–2. Basidiome (URM 79226). 3–4. Basidiospores (URM 79226). 5–6. Basidiome (URM 79227). Scale bar is 10 mm for basidiomes and 10 µm for microstructures. (Photos: 1–4 by J. Pereira; 5–6 by A.C. Gomes-Silva).

apex, brownish or slightly paler pigmented, walls to 1 µm thick, arising from a hypoderm of filamentous hyphae 4–8 µm wide. LAMELLA TRAMA regular to somewhat sub-irregular, with filamentous hyphae frequently septate, 3–6 µm wide, somewhat inflated to 13–18 µm, occasionally clamped.

HABITAT: Solitary or scattered, on soil (attached to buried rotting wood?) in urban area.

ADDITIONAL SPECIMENS EXAMINED: BRAZIL, **Pernambuco**, Recife, 'Reserva Ecológia Dois Irmãos', 03.vii.2006, *F. Wartchow 10/2006* (URM 80090); São Vicente Férrer, 'Mata do Estado', 26.vi.2008, *V.R.M. Coimbra & F. Wartchow s.n.* (URM 80091); **Rio Grande do Sul**, Santa Maria, Camobi, 'Morro do Elefante', 20.i.2001, *F. Wartchow 05/01* (SMDB 9189); Vera Cruz, Travessa Dona Josefa, 26.v.1987, *J. Putzke s.n.* (HCB 12143); **Rondônia**, Porto Velho, PVH, 22.i.2008, *A.C. Gomes-Silva 348* (URM 79227).

DISTRIBUTION: Argentina, Bolivia, Costa Rica, Colombia, Mexico, Panamá, and Venezuela [Singer 1964, Halling & Mueller 1999 as *Xerula steffenii* (Rick) Boekhout & Bas, probably Petersen 2008 as *Xerula macracantha* (Singer) Boekhout & Bas]. Brazil: Amazonas, Minas Gerais, Paraná, Pernambuco, Rio Grande do Sul, São Paulo [Singer 1964, Putzke & Pereira 1988, Souza & Aguiar 2004, Capelari & Gugliotta 2005 as *Dactylosporina steffenii* (Rick) Dörfelt, Sobestiansky 2005, de Meijer 2006 as *Xerula steffenii*, Drechsler-Santos et al. 2007, Rosa & Capelari 2009 as *Dactylosporina steffenii*]. *Oudemansiella steffenii* is a new record from the State of Rondônia, North Brazil.

REMARKS: Our description of *O. steffenii* is based on material recently collected in Pernambuco. It differs from *O. macracantha* in the following: (1) the larger basidiomata, (2) a more robust stipe, and (3) more numerous spines in the basidiospores. On the other hand, our material of *O. steffenii* shares with *O. macracantha* the pileus color and relatively long spines in some of the basidiospores. For a better understanding of species concepts among the echinulate spored species of *Oudemansiella*, the type of *O. macracantha* from Bolivian Amazon region was analyzed.

Other materials of *O. steffenii* analyzed (HCB 12143, SMDB 9189, URM 79227) show some differences in comparison with the Pernambuco collection. The majority of basidiospores of these materials have spines that are only rarely longer than 3 µm, except for URM 80091, in which at least one basidiospore showed spines up to 5 µm long. Previous descriptions (Singer 1964, Putzke & Pereira 1988, Halling & Mueller 1999, Capelari & Gugliotta 2005) also describe shorter basidiospore spines for *O. steffenii* compared to *O. macracantha*.

In URM 79226 (described above) thicker walled cystidia were also observed compared to those observed by the authors cited above; wall thickness, however, is not taxonomically diagnostic, since other collections (e.g., URM 80091) also had thick-walled cystidia.

In URM 79226 and SMDB 9189, an entirely brown pileus was observed, and in URM 79227 (recently collected in Amazon Forest, state of Rondônia), grayish tints were present in the sulcate margin, and spines mostly 2–3 µm long (occasionally ranging to 3.5 µm long) were observed. The pileus color pattern and spine length are also obvious features of *O. steffenii*.

Oudemansiella macracantha Singer, Sydowia 15: 59. 1962 ('1961'). FIGS. 8–12

MATERIAL EXAMINED: BOLIVIA, **Vaca Diez**, Depto. Beni, Guayaramerín, 16.iii.1956, *R. Singer B 1997* (BAFC 51670 **lectotypus hic designatus**); same place, 17.iii.1956, *R. Singer B 2112* (LIL).

PILEUS 6–8 mm in diam., plane, surface brown ('snuff brown 17') to vinaceous brown ('umber 18'), somewhat paler at center ('milk coffee 28'), margin entire. LAMELLAE adnate, subclose to subdistant, buff ('buff 52'), edge slightly darker; lamellulae rare or absent. STIPE to 80 × 0.5 mm (fragmented), cylindric but slightly tapering upward.

BASIDIOSPORES [40/2/2] (10–)11–15(–16) × (9.5–)10.5–14(–15) µm (without ornamentation), **L** = 13.4 µm, **W** = 12.8 µm, Q = 1.00–1.07(–1.17), **Q** = 1.04, globose, only infrequently subglobose or broadly ellipsoid, moderately thick walled, strongly spinose having about 23 spines mostly 4.5–5.5 µm, only occasionally 2–2.5 µm long and only occasionally to 7 µm long (in R. Singer B 2112), tips subacute, inamyloid, colorless, with guttulate contents. BASIDIA 67 × 22 µm, clavate, 4-sterigmate, up to 9 × 4.5 µm (width measured at base). PLEUROCYSTIDIA difficult to locate (probably due to age of material), 60–72 × 27 µm, fusoid, rounded-obtuse, wall slightly thickened, hyaline, colorless. CHEILOCYSTIDIA not observed. PILEIPELLIS a hymenoderm consisting of elements 22 × 17 µm, broadly clavate, occasionally narrowly clavate or more or less pyriform, all rounded-obtuse at apex, brownish pigmented. STIPITIPELLIS covered by caulocystidia 27–95(–180) × 14.5–22.5(–27), common, fusoid-lageniform, brownish pigmented that is somewhat condensed. LAMELLA TRAMA regular or appearing somewhat subregular, with filamentous hyphae frequently septate, 2.5–5.5 µm wide, occasionally clamped.

HABITAT: On buried wood in tropical rain forests, rather common, but scattered, fruiting in rainy seasons (Singer 1964).

DISTRIBUTION: This species is restricted to the frontier Amazon region between Brazil and Bolivia.

REMARKS: *Oudemansiella macracantha* previously was known only from the Bolivian Amazon region (Singer 1964), although recently it was reported from Argentina and Mexico by Petersen (2008 as *Xerula macracantha*), who reported an additional feature that could segregate the echinulate spored *Oudemansiella*: in *O. macracantha*, the spines remain turgid in spite of the vacuum applied by electron microscope, while in *O. steffenii* they are partially collapsed after SEM preparation. This observation was entirely based on recently collected material and not the type. Petersen (2008) also reported that the number and length of basidiospore spines in *O. macracantha* were more numerous and longer than those of *O. steffenii*. This conclusion, however, does not match satisfactorily with Singer (1964) who cited 38–42 spines per basidiospore in *O. steffenii* and only 23 in *O. macracantha*. Fewer spines were also observed on the type. The images provided by Petersen (2008) probably correspond to *O. steffenii* due the relatively shorter basidiospore spines depicted compared to the type specimen.

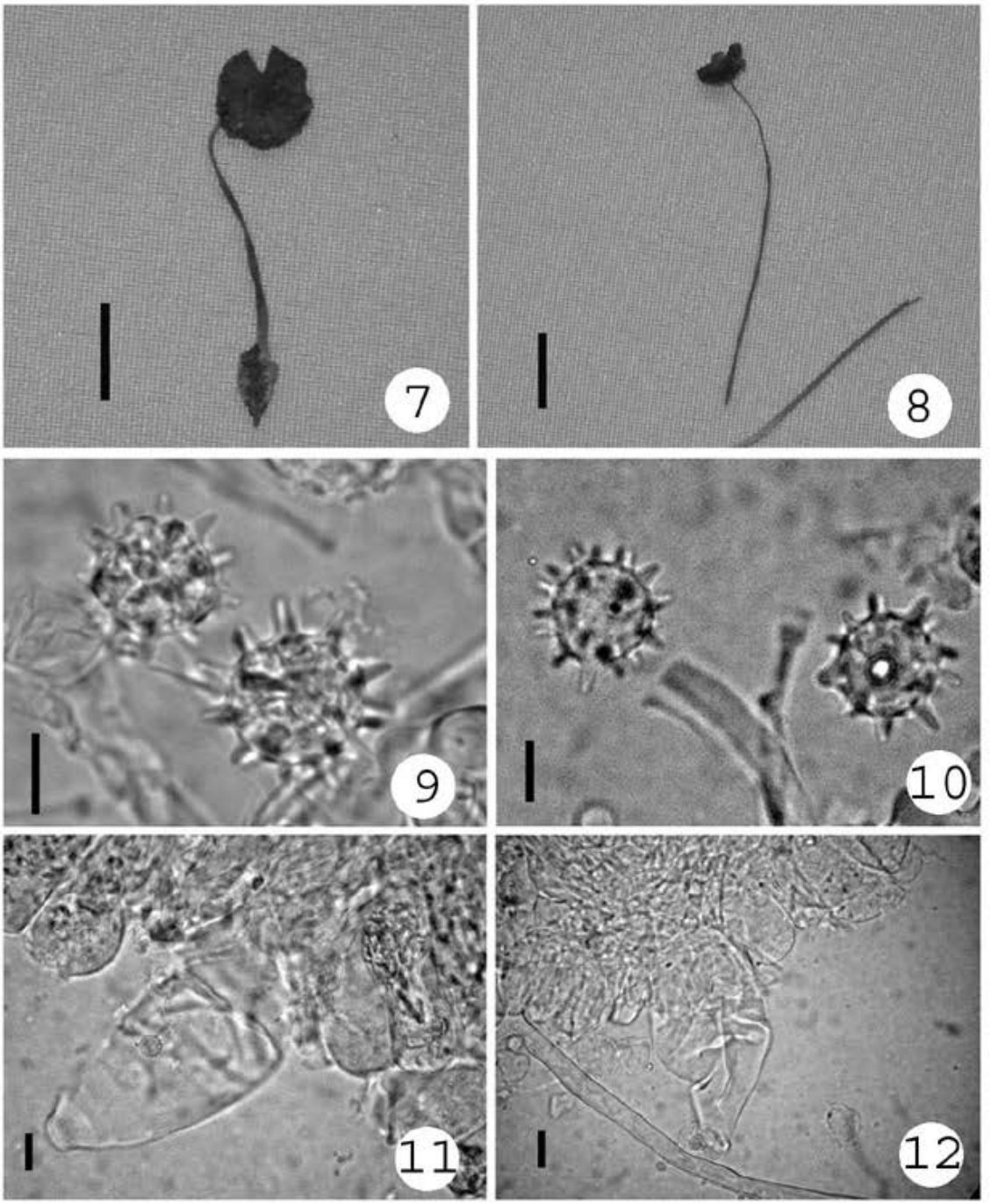

Fig. 7. *Oudemansiella steffenii*. Dry basidioma (HCB 12143).
Fig. 8–12. *Oudemansiella macracantha*.
8. Lectotype. 9–10. Basidiospores. 11–12. Pleurocystidia.
Scale bar is 10 mm for basidiomes and 10 µm for microstructures.
(Photos: 7–12 by F. Wartchow).

The material from the State of São Paulo referred to as *O. macracantha* by Pegler (1997) is thought to represent *O. steffenii* by Capelari & Gugliotta (2005), although they did not study the type; the material from Paraná is missing (de Meijer 2006).

Summarizing, *O. macracantha* is a well defined species that Singer (1964) differentiated by the small pileus (< 15 mm in diam.), longer and much more slender stipe, and basidiospores with longer, less numerous spines.

Oudemansiella macracantha appears, in fact, restricted to its type locality. Some collections of *O. steffenii* (e.g., HCB 12143, URM 80090) also present a relatively slender basidiome like the type material of *O. macracantha*, but they have the proportionally shorter stipe and obviously shorter spines that are more commonly to *O. steffenii*.

We also address in this paper the issue of the type collection for *O. macracantha*. In the protologue, Singer (1962) implied Singer B 2525 as holotype, not citing any other material. Later, Singer (1964) indicated that the collection under this number had a putative isotype at BAFC. However, the B 2525 holotype cannot be located at LIL (A. Hladki pers. corr.), and the B 2525 isotype collection cannot be located at BACF (S. Pereira, pers. corr.). On the other hand, Singer B 1997 and Singer B 2112 are the only specimens deposited in BAFC and LIL, respectively. They were collected in 1956 and identified by Singer himself, and, although no determination date is noted on the herbarium sheet label, we believe that they represent part of the original material of the species (McNeill et al. 2006: Art. 9.10).

The authors also asked whether any material labeled as *Oudemansiella macracantha* is available at F, FH, or MICH, institutions where Rolf Singer also worked and deposited materials (Mueller 1995, Mueller & Wu 1997). All responded that no materials exist under this name. The exsiccata of INPA are available at Species Link System < www.splink.org.br/index> and no exsiccatum named *O. macracantha* is available in this herbarium. Thus, the authors choose here to designate Singer B 1997 (BAFC 51670) as the lectotype of *O. macracantha*.

Oudemansiella glutinosa Singer from Colombia, which also has ornamented basidiospores, differs from *O. macracantha* and *O. steffenii* in the gelatinized zones in pileus and stipe and the considerably smaller basidiospores (14–16.5 × 12–14 µm, including the 2–3 mm high ornamentation; Singer 1989). The basidiospores of *O. macracantha* and *O. steffenii* range more than 20 mm with ornamentations (Singer 1964).

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Disciseda bovista, recently collected from northern Italy, and *Lycoperdon defossum*, a synonym of *D. candida*

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Abstract — The rare *Disciseda bovista* is described from northern Italy (Piedmont) based upon a recent collection. This is the second documented collection of the species from Italy, and the first in recent times. The study of Vittadini's original material labelled as *Lycoperdon defossum*, a taxon considered by many authors as a synonym of *D. bovista*, reveals that it should be ascribed to *D. candida* and, as such, represents the first record of the species from Italy.

Key words — *Agaricales*, *Lycoperdaceae*, *Catastoma*, red lists, taxonomy

Introduction

Disciseda Czern. (= *Catastoma* Morgan) is a genus belonging to the gasteroid lineage of the *Agaricaceae* Chevall. s.l. (Bates et al. 2009, Gube 2009), where it forms the *Disciseda*-clade (Larsson & Jeppson 2008), which is basal to the rest of the taxa formerly placed within the *Lycoperdaceae* Chevall. The genus has a worldwide distribution, but all the species are restricted to xeric habitats. In the latest edition of the DICTIONARY OF THE FUNGI (Kirk et al. 2008), fifteen *Disciseda* species are recognized.

The genus is characterized by semi-hypogeous basidiomes with a loose mycelial connection, and a peculiar type of dehiscence (e.g. Mattirolo 1934, Ahmad 1950, Mitchel et al. 1975, Jeppson 1997, Calonge 1998, Moreno et al. 2003). The ostiole develops in the basal zone of the endoperidium; then the exoperidium cracks along the circumference of the basidiome and the upper part gets detached from its hypogean portion. When disturbed by atmospheric agents, the detached basidiome will turn over and, consequently, exposes the basal portion of the endoperidium, which places the ostiole in the apical

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position. The portion of the exoperidium that initially covered the apical parts of the semi-hypogeous basidiome remains attached to the base as a kind of cap encrusted with soil particles and vegetal debris. Kreisel (1962) termed these fungi 'geanemochorous tumblers', since the whole basidiome is blown by the wind, causing basidiospore dispersal.

This paper reports on the occurrence of the rare and threatened *Disciseda bovista* in Piedmont, northern Italy, and provides observations on previous Italian collections. Furthermore, we provide our analysis of Vittadini's collection originally labelled *Lycoperdon defossum*, a taxon considered by some mycologists to represent a synonym of *D. bovista*.

Material and methods

The macro- and micromorphological features are described from notes taken from fresh material. The micromorphological features were observed from dried material mounted in distilled water and Congo red. Spore size is expressed both as a range and mean value based on 26 randomly chosen basidiospores. Basidiospore measurements do not include either sterigma or ornamentation.

Author citations follow Index Fungorum (http://www.indexfungorum.org/Names/AuthorsOfFungalNames.asp). Herbarium abbreviations are according to Thiers (2010).

Taxonomy

Disciseda bovista (Klotzsch) Henn., Beiblatt zur Hedwigia 42: 128, 1903, sub "Lloyd, G.G. *Catastoma*". FIGS. 1a–g

≡ *Geastrum bovista* Klotzsch, Nov. Actorum Acad. Caes. Leop.-Carol. Nat. Cur. 19(Suppl. 1): 243, 1843.

≡ *Catastoma bovista* (Klotzsch) Hollós, in Hennings, Verh. Bot. Vereins Prov. Brandenburg 43: VI, 1901.

= *Globaria debreceniensis* Hazsl., Verh. Zool.-Bot. Ges. Wien 26: 226, 1876.

≡ *Bovista debreceniensis* (Hazsl.) De Toni, Sylloge Fungorum 7: 476, 1888.

≡ *Catastoma debreceniense* (Hazsl.) Hollós, Termés. Közl. 56: 186, 1900.

≡ *Disciseda debreceniensis* (Hazsl.) Hollós, Termés. Füz. 25: 102, 1902.

= *Bovista subterranea* Peck, Bot. Gazette (Crawfordsville) 4(10): 216, 1879.

≡ *Catastoma subterraneum* (Peck) Morgan, J. Cincinnati Soc. Nat. Hist. 14: 143, 1892.

≡ *Disciseda subterranea* (Peck) Coker & Couch, Gast. East. U.S. and Canada: 141, 1928.

SELECTED DESCRIPTIONS: Kers (1975: 420–427); Calonge (1998: 79–80).

SELECTED ICONOGRAPHY: Mattirolo (1934: FIGS. 1–16); Kers (1975: FIG. 2); Jeppson (1997: FIG. 1); Jordal et al. (2007: FIG. 1).

BASIDIOME (8–)10–26 mm in diam. × 9–15 mm in height, globose, subglobose, regular to gibbous, sometimes lobed and depressed, mottled. Immature basidiomes completely enveloped by the exoperidium (Fig. 1a) resembling the protective cases of some trichopteran larvae. Mature basidiomes enveloped at the base by remnants of the exoperidium that forms a thick mycelial pad, heavily

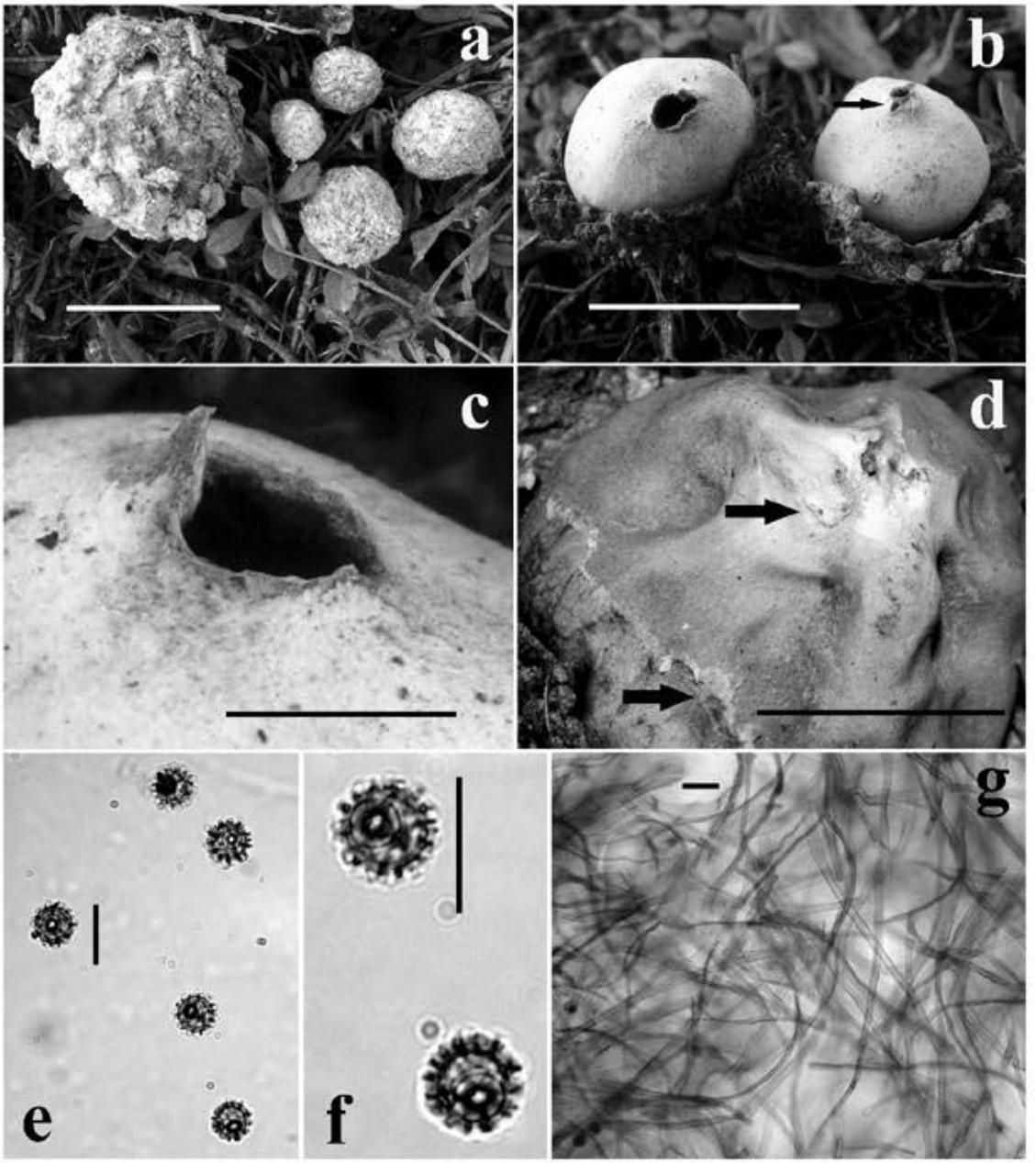

FIGURE 1. *Disciseda bovista* (TO HG1998). a. Immature basidiomes with intact and encrusted exoperidium. b. Ripe and inverted basidiomes with crumbling exoperidium; arrow = double ostiole. c. Ostiole. d. Mottled endoperidium lacking an evident ostiole, with remnants of the pseudoparenchymatic exoperidial layer (arrows). e, f. Basidiospores. g. Capillitium. Bars: a = 10 mm; b = 20 mm; c = 2mm; d = 20 mm; e, f = 10 µm; g = 20 µm.

encrusted with plant debris and particles of soil (FIG. 1b). Old basidiomes often colonized by green algae. OSTIOLE (1–)2 mm in diam., orbicular to irregularly-shaped and torn (FIG. 1c); in some ripe specimens no ostiole has been observed; occasionally additional little ostioles are present. EXOPERIDIUM colour very difficult to discern as the exoperidium is heavily encrusted with debris,

whitish to greyish brown. ENDOPERIDIUM white to light grey, then yellowish-brown, coriaceous, leathery, persistent, glabrous to rimulose-pubescent, often with small patches, remnants of the pseudoparenchymatic exoperidial layer (FIG. 1d). GLEBA light brown to dark brown, cottony at first, soon becoming pulverulent.

BASIDIOSPORES (5.8–)6.0–7.4(–7.6) × (5.5–)5.8–7.0(–7.1) µm, on average 6.68 × 6.38 µm, Q = 1.0–1.07, Qm = 1.046 (n = 26), globose, baculate, *Terfezia*-like, warts cylindrical or truncate-conical, up to 0.5–1 µm long, yellowish brown in water mounts, with a central to eccentric large oil drop (FIG. 1e, f); sterigmal remnants (pedicels) short (up to 2–3 µm in length) or absent. CAPILLITIUM of the *Lycoperdon*-type, 2.5–5 µm in diam., with rounded tips, thick-walled (up to 1.0 µm), fragile, pale brown in water mounts, straight to undulate, rarely finely encrusted, sometimes with small-sized pores, septate, often disarticulating at the septum, occasionally with dichotomous branching (FIG. 1g). EXOPERIDIUM two-layered: (1) outer mycelial layer, with 2–4 µm wide hyphal elements, interwoven with plant matter and particles of soil; (2) inner pseudoparenchymatous layer, gelatinous, up to 1 mm thick, made up of 10–20 µm in diam., rounded, thin-walled cells. ENDOPERIDIUM consisting of 2–5 µm wide, thin and thick walled hyphae.

HABITAT. Terrestrial, found in an ex-vineyard arid soil partially covered with xerophilic mosses.

MATERIAL EXAMINED – ITALY: Piedmont, Perosa Canavese (Torino), 45° 23' 55.19" N, 7° 50' 02.14" E, 262 m a.s.l., 10 Dec. 2009, *legit* L. Panno, *det.* A. Vizzini (TO HG1998).

Discussion

Distributed in Europe and America (Coker & Couch 1928, Calonge 1998, Kreisel 2001), where it typically grows in dry, sandy, sunlit and usually steppe-like habitats (Kers 1975, Calonge 1998, Jordal et al. 2007, Stasińka 2008), *D. bovista* is a rare gasteroid species that seems to be declining in Northern Europe. As a consequence, it has been included in the red-lists of rare and threatened macromycetes of several European countries (e.g. Switzerland, Senn-Irlet et al. 1997; The Netherlands, Arnolds & Kuyper 1996; Italy, Venturella et al. 1997; Austria, Krisai-Greilhuber 1999; Denmark, Stoltze & Pihl 1998; Poland, Wojewoda & Ławrynowicz 2004; Sweden, Gärdenfors 2005).

Disciseda bovista is characterized by the 6–7 µm diam., strongly ornamented spores, with *Terfezia*-like, truncate-conical warts, and without long sterigmal remnants. Among the closest allies, *D. candida*, which macromorphologically may be easily confused with *D. bovista*, is clearly distinguished by the smaller (3.5–5.5 µm), finely ornamented basidiospores (e.g. Kers 1975, Jeppson 1986, Mornand 1990, Moyersoen & Demoulin 1996, Calonge 1998, Poumarat et al.

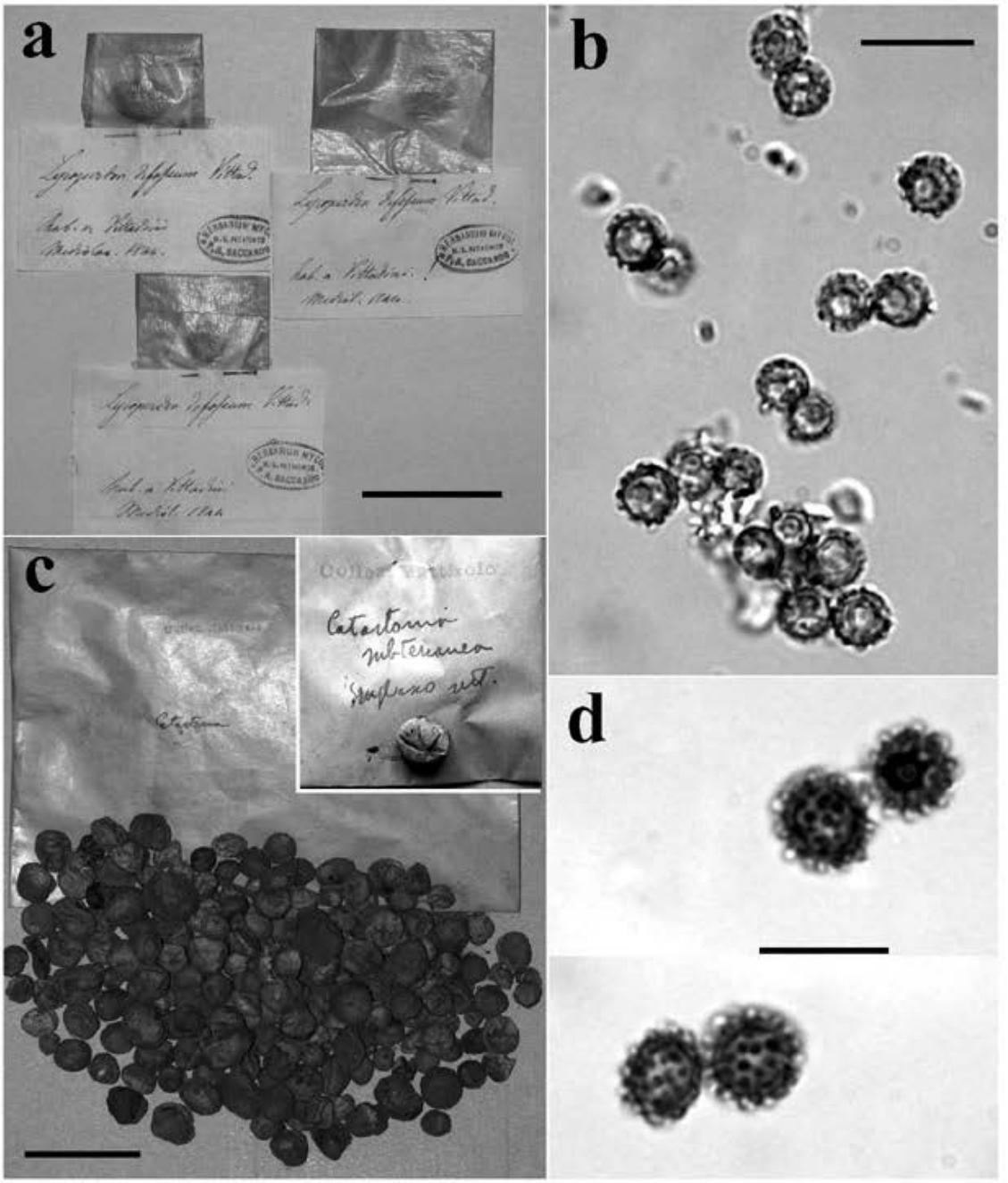

FIGURE 2. a–b. Vittadini's collection (PAD) – *Lycoperdon defossum*. a. Basidiomes. b. Basidiospores. c–d. Mattirolo's collection (TO) – *Catastoma subterraneum*. c. Basidiomes. d. Basidiospores. Bars: a, c = 5 cm; b, d = 10 µm.

2000, Sarasini 2005, Bates et al. 2009). *Disciseda cervina* (Berk.) Hollós has smaller (4.0–5.6 µm), smooth to asperulate basidiospores and an endoperidium often with purplish hues (Hollós 1903, Poumarat 2003, Bates et al. 2009), while the recently described *D. nigra* Dörfelt & H. Nowak from Germany differs in its blackish mature endoperidium and larger basidiospores (7.5–8.5 µm) with warts up to 1.8 µm high (Dörfelt & Nowak 2002).

As regards collections of *D. bovista* previously reported from Italy, the Italian Checklist (Onofri et al. 2005) mentions only one find from Sardinia (Brotzu 1994) included in a local checklist without any supporting data: no description, iconography, observations, or herbarium number were provided. Photos and description of the species, included in the monograph on epigeous gasteromycetes by the Italian specialist Sarasini (2005), refer to Spanish specimens.

Many authors consider *Lycoperdon defossum* Vittad. (Vittadini 1842) a synonym of *Disciseda bovista* [e.g. Petri 1909, Lloyd (Mattirolo 1934), Mattirolo 1934, Calonge 1998; but see Moravec 1958 and Sarasini 2005]. According to Stafleu & Cowan (1986), Vittadini's original specimens are preserved at TO and PAD, which we checked for *L. defossum* collections. The collection cited by Mattirolo (1934) and probably examined by Lloyd (Mattirolo 1934) is missing from TO, but we have located Vittadini's original material in Saccardo's herbarium (PAD). That collection consists of three pressed specimens from Milan (Fig. 2a) with 4–5.5 µm diam., finely to medium ornamented basidiospores (Fig. 2b) that clearly support the material in *D. candida*. This collection represents the first record of the species from Italy.

While studying and sorting out Mattirolo's herbarium of epi- and hypogeous gasteromycetoid fungi housed at TO, we were able to study a very large collection (consisting of over a hundred specimens, Fig. 2c) labelled as *Catastoma subterraneum* made in the Turin hinterland (Mattirolo 1934). Based on spore features, the collection also appears to represent *D. bovista* (Fig. 2d).

In conclusion, our paper describes the second collection — the first in recent times — of *Disciseda bovista* from Italy that can be documented with certainty. We also demonstrate that *Lycoperdon defossum* is not a synonym of *D. bovista*, but rather of *D. candida*:

Disciseda candida (Schwein.) Lloyd, Mycol. Writ. 1: 100, 1902.

= *Lycoperdon defossum* Vittad., Monogr. Lycoperd.: 33, 1842, nom. illegit., non Batsch 1789.

≡ *Globaria defossa* Quél., Bull. Soc. Bot. France 24: 327, 1878, nom. nov.

■ *Bovista defossa* (Quél.) De Toni, Syll. Fung. 7: 101, 1888.

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Our most sincere thanks are due to Prof. G. Moreno (Univ. Alcalá de Henares, Madrid, Spain) and to Dr. L. Guzmán Dávalos (Universidad de Guadalajara, Zapopan, Mexico) for their pre-submission reviews, to Prof. E. Grilli (Popoli, Italy) for improving the English text, to Dr. R. Marcucci (Herbarium, Padova) for sending the specimen of *Lycoperdon defossum*, and to Dr. S. Voyron (University of Turin, Italy) for his technical support.

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HKU(M) moves to IFRDC Kunming

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Abstract — The University of Hong Kong Mycological Herbarium (HKU(M)) has been relocated to the International Fungal Research & Development Centre, Chinese Academy of Forestry, in Kunming, Yunnan, PR China. The official acronym of the herbarium is IFRD. New IFRD numbers for 30 generic types and 238 specific types transferred from HKU(M) are listed here.

Key words — tropical fungal specimens

Introduction

Between 1993 and December 2006, K.D. Hyde and co-workers published 388 scientific papers describing 60 new genera, 411 new species, and numerous other collections of tropical fungi (e.g., Poon & Hyde 1998, Wong & Hyde 2001, Ho et al. 2002, Kumar & Hyde 2004). Most type material from these publications was deposited in the Herbarium of the University of Hong Kong (official acronym = HKU). However, the herbarium was unwilling to curate the fungal specimens due to lack of funding. Therefore, all fungal specimens were curated by Helen Y.M. Leung in a separate wing of the herbarium known as HKU(M). Than et al. (2008) and Tang et al. (2009) also deposited specimens in HKU(M).

K.D. Hyde, the mycologist at the University of Hong Kong, resigned from his post on 31 December 2007. The University did not replace him and had no interest in maintaining the fungal herbarium, which comprised 7934 mostly

tropical fungal specimens, including 60 generic types and 411 specific types. A decision was therefore made to move the herbarium to where it is now located in the International Fungal Research & Development Centre in Kunming, PR China. The new herbarium was registered with Index Herbariorum in early 2008 and has the official acronym IFRD. The curator is Dr. Hang Chen.

The purpose of this paper is to list the types of genera and species that have been moved to IFRD and accessioned with new numbers. TABLE 1 lists 241 new IFRD numbers with their HKU(M) equivalents.

Unfortunately, many specimens were misplaced during transit from Hong Kong to Kunming, and we are still searching for these specimens. In a later paper, we will list any additional types that have been located, including isotypes or paratypes (if available), for any whose holotypes are missing at the present time.

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TABLE 1. New IFRD numbers assigned to 30 generic types and 238 specific types. (All collections are holotypes, unless explicitly labelled as isotypes or paratypes.)

SPECIES	ACCESSION NUMBERS	
	ORIGINAL	NEW
Acrodictys liputii L. Cai et al.	HKU(M)) 16490 [isotype]	IFRD 8640 [isotype]
Acrogenospora ovalis Goh et al.	HKU(M) 4743	IFRD 8641
Acrogenospora verrucospora Hong Zhu et al.	HKU(M) 17494	IFRD 8642
Amarenographium sinense Joanne E. Taylor et al.	HKU(M) 3989	IFRD 8643
Aniptodera inflatiascigera K.M. Tsui et al.	HKU(M) 4672	IFRD 8644
Aniptodera intermedia K.D. Hyde & Alias	HKU(M) 7468	IFRD 8645
Aniptodera mauritaniensis K.D. Hyde et al.	HKU(M) 2616	IFRD 8646
Aniptodera palmicola K.D. Hyde et al.	HKU(M) 2205	IFRD 8647
Annulatascus joannae K.M. Tsui et al.	HKU(M) 12177	IFRD 8648
Annulatascus palmietensis Goh et al.	HKU(M) 2206	IFRD 8649
Annulatascus triseptatus S.W. Wong et al.	HKU(M) 3129	IFRD 8650
Anthostomella acuminata B.S. Lu & K.D. Hyde	HKU(M) 2118	IFRD 8651
Anthostomella applanata B.S. Lu & K.D. Hyde	HKU(M) 2109	IFRD 8652
Anthostomella aquatica K.D. Hyde & Goh	HKU(M) 2774	IFRD 8653
Anthostomella birima Joanne E. Taylor et al.	HKU(M) 3909	IFRD 8654
Anthostomella caffrariae B.S. Lu & K.D. Hyde	HKU(M) 2140	IFRD 8655
Anthostomella clypeosa Joanne E. Taylor et al.	HKU(M) 3633	IFRD 8656
Anthostomella colligata K.D. Hyde & B.S. Lu	HKU(M) 2160	IFRD 8657
Anthostomella frondicola K.D. Hydeet al.	HKU(M) 535	IFRD 8658
Anthostomella kapitiae Whitton et al.	HKU(M) 5007	IFRD 8659
Anthostomella longa B.S. Lu et al.	HKU(M) 7311	IFRD 8660
Anthostomella manawatua Whitton et al.	HKU(M) 5008	IFRD 8661
Anthostomella meerensis B.S. Lu & K.D. Hyde	HKU(M) 2134	IFRD 8662
Anthostomella notabilis Joanne E. Taylor et al.	HKU(M) 4294	IFRD 8663
Anthostomella nypae K.D. Hyde et al.	HKU(M) 7305	IFRD 8664
Anthostomella nypensis K.D. Hyde et al.	HKU(M) 7306	IFRD 8665
Anthostomella nypicola K.D. Hyde et al.	HKU(M) 7307	IFRD 8666
Anthostomella oblongata B.S. Lu & K.D. Hyde	HKU(M) 7313	IFRD 8667
Anthostomella okatina Whitton et al.	HKU(M) 5013	IFRD 8668
Anthostomella palmae K.D. Hyde & B.S. Lu	HKU(M) 2209	IFRD 8669
Anthostomella raphiae B.S. Lu & K.D. Hyde	HKU(M) 2146	IFRD 8670
Anthostomella spiralis K.D. Hyde & B.S. Lu	HKU(M) 2119	IFRD 8671
Anthostomella variabilis B.S. Lu & K.D. Hyde	HKU(M) 2091	IFRD 8672
Anthostomella xuanenensis Joanne E. Taylor et al.	HKU(M) 4064	IFRD 8673
Apioclypea cocoicola Joanne E. Taylor et al.	HKU(M) 4344	IFRD 8674
Apioclypea nonapiospora Joanne E. Taylor et al.	HKU(M) 3657	IFRD 8675

Apioclypea nypicola K.D. Hyde et al.	HKU(M) 1629	IFRD 8676
Apioclypea phoenicicola K.D. Hyde et al.	HKU(M) 1665	IFRD 8677
Apiospora sinensis K.D. Hyde et al.	HKU(M) 3963	IFRD 8678
Appendicospora hongkongensis Yanna et al.	HKU(M) 5301	IFRD 8679
Aqualignicola hyalina Ranghoo et al. **[generic type]**	HKU(M) 12178	IFRD 8680
Aquaphila albicans Goh et al. **[generic type]**	HKU(M) 2856	IFRD 8681
Aquaticola longicolla K.M. Tsui et al.	HKU(M) 5159	IFRD 8682
Aquaticola minutiguttulata K.M. Tsui et al.	HKU(M) 12275	IFRD 8683
Aquaticola triseptata K.M. Tsui et al.	HKU(M) 12222	IFRD 8684
Arecacicola calami Joanne E. Taylor et al. **[generic type]**	HKU(M) 1126a	IFRD 8685
Arecomyces bruneiensis K.D. Hyde	HKU(M) 1728	IFRD 8686
Arecomyces dicksonii K.D. Hyde	HKU(M) 2641	IFRD 8687
Arecomyces epigenus K.D. Hyde	HKU(M) 1529	IFRD 8688
Arecomyces frondicola K.D. Hyde **[generic type]**	HKU(M) 1713	IFRD 8689
Arecomyces hedgeri K.D. Hyde	HKU(M) 2685	IFRD 8690
Arecomyces sekoyae K.D. Hyde	HKU(M) 2682	IFRD 8691
Arecomyces tetrasporus K.D. Hyde	HKU(M) 2714	IFRD 8692
Ascolacicola aquatica Ranghoo & K.D. Hyde **[generic type]**	HKU(M) 5243	IFRD 8693
Ascomauritiana lignicola Ranghoo & K.D. Hyde **[generic type]**	HKU(M) 5255	IFRD 8694
Ascominuta lignicola Ranghoo & K.D. Hyde **[generic type]**	HKU(M) 5246	IFRD 8695
Ascotaiwania nitriformis Ranghoo & K.D. Hyde	HKU(M) 5224	IFRD 8696
Ascotaiwania pallida K.D. Hyde & Goh	HKU(M) 3247	IFRD 8697
Astrocystis nypae G.J.D. Sm. & K.D. Hyde	HKU(M) 1626	IFRD 8698
Astrocystis selangorensis G.J.D. Sm. & K.D. Hyde	HKU(M) 1625a	IFRD 8699
Astrocystis sinensis Joanne E. Taylor et al.	HKU(M) 4087	IFRD 8700
Astrosphaeriella aequatoriensis K.D. Hyde & J. Fröhl.	HKU(M) 2707	IFRD 8701
Astrosphaeriella immersa Joanne E. Taylor et al.	HKU(M) 3683	IFRD 8702
Astrosphaeriella lenticularis K.D. Hyde & J. Fröhl.	HKU(M) 2733	IFRD 8703
Astrosphaeriella papillata K.D. Hyde & J. Fröhl	HKU(M) 2018	IFRD 8704
Astrosphaeriella splendida K.D. Hyde & J. Fröhl.	HKU(M) 2732	IFRD 8705
Ayria appendiculata Fryar & K.D. Hyde **[generic type]**	HKU(M) 15553	IFRD 8706
Balaniopsis dendroidea Whitton et al.	HKU(M) 5098	IFRD 8707
Balaniopsis kirkii Whitton et al.	HKU(M) 5099	IFRD 8708
Boerlagiomyces grandisporus S.J. Stanley & K.D. Hyde	HKU(M) 2978	IFRD 8709
Botryosphaeria archontophoenicis Joanne E. Taylor et al.	HKU(M) 3539	IFRD 8710
Botryosphaeria brunneispora Joanne E. Taylor et al.	HKU(M) 3987	IFRD 8711
Brachydesmiella verrucosa Goh et al.	HKU(M) 5855	IFRD 8712

Brachysporiopsis chinensis Yanna et al. **[generic type]**	HKU(M) 13660	IFRD 8713
Brunneiapiospora aequatoriensis K.D. Hyde et al.	HKU(M) 2656	IFRD 8714
Brunneiapiospora daemonoropis K.D. Hyde et al.	HKU(M) 1974	IFRD 8715
Brunneiapiospora javensis K.D. Hyde et al. **[generic type]**	HKU(M) 1121b	IFRD 8716
Brunneosporella aquatica Ranghoo & K.D. Hyde **[generic type]**	HKU(M) 5251	IFRD 8717
Camposporium fusisporum Whitton et al.	HKU(M) 12925	IFRD 8718
Camposporium ramosum Whitton et al.	HKU(M) 12924	IFRD 8719
Canalisporium exiguum Goh & K.D.Hyde	HKU(M) 3349	IFRD 8720
Canalisporium variabile Goh & K.D. Hyde	HKU(M) 7438	IFRD 8721
Cancellidium pinicola S.Y. Yeung et al.	HKU(M) 17167	IFRD 8722
Capsulospora trachycarpa Joanne E. Taylor et al.	HKU(M) 3986	IFRD 8723
Cataractispora appendiculata K.D. Hyde et al.	HKU(M) 3120	IFRD 8724
Cataractispora aquatica K.D. Hyde et al. **[generic type]**	HKU(M) 3123	IFRD 8725
Cataractispora viscosa K.D. Hyde et al.	HKU(M) 3130	IFRD 8726
Ceuthospora palmicola Joanne E. Taylor et al.	HKU(M) 4125	IFRD 8727
Chaetopsina alexandrae Joanne E. Taylor et al.	HKU(M) 3623	IFRD 8728
Chaetopsina hongkongensis Goh & K.D. Hyde	HKU(M) 2623	IFRD 8729
Chloridium cocoicola Joanne E. Taylor et al.	HKU(M) 4228	IFRD 8730
Circinotrichum palmicola Joanne E. Taylor et al.	HKU(M) 3933	IFRD 8731
Clohiesia lignicola K.M. Tsui et al.	HKU(M) 5539	IFRD 8732
Clypeosphaeria uniseptata K.M. Tsui et al.	HKU(M) 8095	IFRD 8733
Cordana uniseptata L. Cai et al.	HKU(M) 17163	IFRD 8734
Curvatispora singaporensis V.V. Sarma & K.D. Hyde **[generic type]**	HKU(M) 12457	IFRD 8735
Cytoplacosphaeria phragmiticola Poon & K.D. Hyde	HKU(M) 5191	IFRD 8736
Dactylaria biguttulata Goh & K.D. Hyde	HKU(M) 3334	IFRD 8737
Dactylaria hyalotunicata K.M. Tsui et al.	HKU(M) 5377	IFRD 8738
Dactylaria lakebarrinensis Goh & K.D. Hyde	HKU(M) 3162	IFRD 8739
Dactylaria obscuriseptata Goh & K.D. Hyde	HKU(M) 4738(PC7)	IFRD 8740a
Dactylaria plovercovensis Goh & K.D. Hyde	HKU(M)4738(PC7A)	IFRD 8740b
Diaporthe palmarum Joanne E. Taylor et al.	HKU(M) 4064	IFRD 8741
Dictyochaeta microcylindrospora Whitton et al.	HKU(M) 4932	IFRD 8742
Dictyochaeta multisetula Whitton et al.	HKU(M) 4922	IFRD 8743
Dictyochaeta plovercovensis Goh & K.D. Hyde	HKU(M) 4724	IFRD 8744
Dictyochaeta renispora Whitton et al.	HKU(M) 4914	IFRD 8745
Dictyochaeta seychellensis Whitton et al.	HKU(M) 4926	IFRD 8746
Dictyosporium canisporum L. Cai & K.D. Hyde	HKU(M) 17156	IFRD 8747
Dictyosporium giganticum Goh & K.D. Hyde	HKU(M) 2184	IFRD 8748
Dictyosporium tetraploides L. Cai & K.D. Hyde	HKU(M) 17146	IFRD 8749

Dictyosporium tetraseriale Goh et al.	HKU(M) 5327	IFRD 8750
Digitodesmium heptasporum L. Cai & K.D. Hyde	HKU(M) 17158	IFRD 8751
Elegantimyces sporidesmiopsis Goh et al. **[generic type]**	HKU(M) 5378	IFRD 8752
Endomelanconium phoenicicola Yanna et al.	HKU(M) 10023	IFRD 8753
Endophragmiella bitriseptata Goh et al.	HKU(M) 5184	IFRD 8754
Endophragmiella triseptata K.M. Tsui et al.	HKU(M) 5402	IFRD 8755
Endosporoideus pedicellatus W.H. Ho et al. **[generic type]**	HKU(M) 10066	IFRD 8756
Everhartia phoenicis Yanna et al.	HKU(M) 10504	IFRD 8757
Fluviatispora boothii Fryar & K.D. Hyde	HKU(M) 15792	IFRD 8758
Frigidispora colnensis K.D. Hyde & Goh **[generic type]**	HKU(M) 3244	IFRD 8759
Frondisphaeria joanneae J. Fröhl. & K.D. Hyde	HKU(M) JF 718	IFRD 8760
Guestia gonetropospora G.J.D. Sm. & K.D. Hyde **[generic type]**	HKU(M) 3347	IFRD 8761
Halosarpheia heteroguttulata S.W. Wong et al.	HKU(M) 2806	IFRD 8762
Helicorhoidion nypicola K.D. Hyde & Goh	HKU(M) 8276	IFRD 8763
Helicosporium gigasporum K.M. Tsui et al.	HKU(M) 8091	IFRD 8764
Herpotrichia dalisayi K.D. Hyde & Aptroot	HKU(M) 2582	IFRD 8765
Herpotrichia nypicola K.D. Hyde & Alias	HKU(M) 5192	IFRD 8766
Hydropisphaera ciliata Joanne E. Taylor et al.	HKU(M) 3581	IFRD 8767
Jahnula granulosa K.D. Hyde & S.W. Wong	HKU(M) 2167	IFRD 8768
Jahnula poonythii K.D. Hyde & S.W. Wong	HKU(M) 2396	IFRD 8769
Jahnula seychellensis K.D. Hyde & S.W. Wong	HKU(M) 3239	IFRD 8770
Jobellisia viridifusca K.M. Tsui & K.D. Hyde	HKU(M) 8045	IFRD 8771
Kionochaeta australiensis Goh & K.D. Hyde	HKU(M) 2308	IFRD 8772
Koorchaloma novojournalis Yanna et al.	HKU(M) 7436	IFRD 8773
Koorchaloma spartinicola V.V. Sarma et al.	HKU(M) 10378	IFRD 8774
Lachnum cylindricum W.Y. Zhuang & K.D. Hyde	HKU(M) 10356	IFRD 8775
Lachnum granulatum W.Y. Zhuang et al.	HKU(M) 7177	IFRD 8776
Lanceispora phyllophila V.V. Sarma & K.D. Hyde	HKU(M) 8298	IFRD 8777
Lasiosphaeria alexandrae Joanne E. Taylor et al.	HKU(M) 3521	IFRD 8778
Lasiosphaeria alexandricola Joanne E. Taylor et al.	HKU(M) 3667	IFRD 8779
Lasiosphaeria chapmanii Joanne E. Taylor et al.	HKU(M) 7867	IFRD 8780
Leptosphaeria ginimia K.M. Tsui et al.	HKU(M) 16115	IFRD 8781
Leptosphaeria nypicola K.D. Hyde & Alias	HKU(M) 7160	IFRD 8782
Lignincola nypae K.D. Hyde & Alias	HKU(M) 6521	IFRD 8783
Linocarpon alpiniae K.D. Hyde	HKU(M) 1632	IFRD 8784
Linocarpon apiculatum K.D. Hyde	HKU(M) 1213	IFRD 8785
Linocarpon appendisporum K.D. Hyde	HKU(M) 1209	IFRD 8786
Linocarpon aquaticum K.D. Hyde	HKU(M) 1545	IFRD 8787
Linocarpon australiense K.D. Hyde	HKU(M) 1056	IFRD 8788

Linocarpon breve K.D. Hyde	HKU(M) 1097	IFRD 8789
Linocarpon carinisporum K.D. Hyde	HKU(M) 1830	IFRD 8790
Linocarpon falciformisporum K.D. Hyde	HKU(M) 1212	IFRD 8791
Linocarpon lamniae Whitton et al.	HKU(M) 12707	IFRD 8792
Linocarpon luteocollum Joanne E. Taylor et al.	HKU(M) 3573	IFRD 8793
Linocarpon zingiberacicola K.D. Hyde	HKU(M) 1920	IFRD 8794
Lophiostoma maquilingense K.D. Hyde & Aptroot	HKU(M) 2580	IFRD 8795
Mangrovispora irregularis Yanna et al.	HKU(M) 10877	IFRD 8796
Massarina beaurivagea Poonyth et al.	HKU(M) 10262	IFRD 8797
Massarina grandispora Joanne E. Taylor et al.	HKU(M) 4097	IFRD 8798
Massarina mauritiana Poonyth et al.	HKU(M) 10239	IFRD 8799
Massarina phragmiticola Poon & K.D. Hyde	HKU(M) 5188	IFRD 8800
Massarina proprietunicata K.M. Tsui et al.	HKU(M) 8058	IFRD 8801
Massarina rhizophorae Poonyth et al.	HKU(M) 10208	IFRD 8802
Massarina sanguineo-ostiolata Aptroot et al.	HKU(M) 7879	IFRD 8803
Massarina thalassioidea K.D. Hyde & Aptroot	HKU(M) 1882 [paratype]	IFRD 8804 [paratype]
Mauritiana rhizophorae Poonyth et al. [generic type]	HKU(M) 10219	IFRD 8805
Menisporopsis multisetulata K.M. Tsui et al.	HKU(M) 4662	IFRD 8806
Monochaetiopsis lakefuxianensis L. Cai et al. [generic type]	HKU(M) 8280	IFRD 8807
Monodictys melanocephaloides Goh & K.D. Hyde	HKU(M) 3334	IFRD 8808
Monodictys trichocladiopsis Goh & K.D. Hyde	HKU(M) 4739	IFRD 8809
Monotosporella sphaerica Yanna & K.D. Hyde	HKU(M) 13287	IFRD 8810
Muyocopron hongkongense Joanne E. Taylor et al.	HKU(M) 3684	IFRD 8811
Nemania saladerana G.J.D. Sm. & K.D. Hyde	HKU(M) 3348	IFRD 8812
Neolinocarpon enshiense K.D. Hyde et al.	HKU(M) 3989	IFRD 8813
Neolinocarpon inconspicuum K.D. Hyde et al.	HKU(M) 3564	IFRD 8814
Neolinocarpon nonappendiculatum K.D. Hyde et al.	HKU(M) 3505	IFRD 8815
Neolinocarpon nypicola K.D. Hyde & Alias	HKU(M) 6518	IFRD 8816
Niessliа palmicola K.D. Hyde et al.	HKU(M) 4257	IFRD 8817
Nigromammilla calami K.D. Hyde & J. Fröhl. [generic type]	HKU(M) JF 863	IFRD 8818
Ophioceras guttulatum K.M. Tsui et al.	HKU(M) 12171	IFRD 8819
Ophioceras hongkongense K.M. Tsui et al.	HKU(M) 12226	IFRD 8820
Ornatispora palmicola K.D. Hyde et al. [generic type]	HKU(M) 2684	IFRD 8821
Oxydothis bambusicola Shenoy et al.	HKU(M) 17480	IFRD 8822
Oxydothis ianei Joanne E. Taylor et al.	HKU(M) 4060	IFRD 8823
Palmicola bipolaris Joanne E. Taylor et al.	HKU(M) 3823	IFRD 8824
Paraceratocladium malaysianum Goh & K.D. Hyde	HKU(M) 5854	IFRD 8825
Parahendersonia trachycarpa Joanne E. Taylor et al.	HKU(M) 4141	IFRD 8826

Paraniesslia tuberculata K.M. Tsui et al. [generic type]	HKU(M) 4647	IFRD 8827
Periconia trachycarpicola Joanne.E. Taylor et al.	HKU(M) 3957	IFRD 8828
Phaeophleospora striae Joanne E. Taylor et al.	HKU(M) 4127	IFRD 8829
Phialogeniculata africana Goh et al.	HKU(M) 2122	IFRD 8830
Phomatospora archontophoenicis Joanne E. Taylor et al.	HKU(M) 3641	IFRD 8831
Phomatospora nypicola K.D. Hyde & Alias	HKU(M) 7468	IFRD 8832
Phragmitensis ellipsoidea M.K.M. Wong et al.	HKU(M) 8001	IFRD 8833
Podosporium biseptatum Joanne E. Taylor et al.	HKU(M) 4235	IFRD 8834
Polybulbophiale palmicola Goh & K.D. Hyde [generic type]	HKU(M) 4717	IFRD 8835
Polytretophora macrospora Whitton et al.	HKU(M) 14024	IFRD 8836
Porosphaerellopsis bipolaris K.M. Tsui & K.D. Hyde	HKU(M) 12397	IFRD 8837
Pseudohalonectria fuxianii L. Cai et al.	HKU(M) 16126	IFRD 8838
Pseudohalonectria miscanthicola Shenoy et al.	HKU(M) 17487	IFRD 8839
Pyricularia oncosperma Yanna et al.	HKU(M) 10174	IFRD 8840
Quintaria aquatica K.D. Hyde & Goh	HKU(M) 848	IFRD 8841
Ramichloridium lignicola K.M. Tsui et al.	HKU(M) 12271	IFRD 8842
Rivulicola aquatica Ranghoo & K.D. Hyde	HKU(M) 5214	IFRD 8843
Roussoella angustispora D.Q. Zhou et al.	HKU(M) 9144	IFRD 8844
Roussoella saltuensis K.D. Hyde	HKU(M) 2717	IFRD 8845
Saccardoella aquatica K.M. Tsui et al.	HKU(M) 5371	IFRD 8846
Saccardoella minuta L. Cai & K.D. Hyde	HKU(M) 17102 [isotype]	IFRD 8847 [isotype]
Septoriella trachycarpi Joanne E. Taylor et al.	HKU(M) 3986	IFRD 8848
Sorokina frondicola Joanne E. Taylor et al.	HKU(M) 3626	IFRD 8849
Spadicoides minuta L. Cai et al.	HKU(M) 17165	IFRD 8850
Spadicoides palmicola Goh & K.D.Hyde	HKU(M) 4785	IFRD 8851
Spirodecospora bambusicola B.S. Lu et al. [generic type]	HKU(M) 7303	IFRD 8852
Sporoschisma parcicuneatum Goh & K.D. Hyde	HKU(M) 2550	IFRD 8853
Stachybotrys reniverrucosa Whitton et al.	HKU(M) 13093	IFRD 8854
Stachybotrys waitakere Whitton et al.	HKU(M) 13099	IFRD 8855
Staurophoma calami Yanna et al.	HKU(M) 7156	IFRD 8856
Stictis ecclesiensis Joanne E. Taylor et al.	HKU(M) 4042	IFRD 8857
Stratiphoromyces brunneisporus Goh & K.D. Hyde [generic type]	HKU(M) 4779	IFRD 8858
Striatodecospora bambusae D.Q. Zhou et al. [generic type]	HKU(M) 9143	IFRD 8859
Submersisphaeria bambusicola D.Q. Zhou & K.D. Hyde	HKU(M) 9045	IFRD 8860
Sungaiicola bactrodesmiella Fryar & K.D. Hyde [generic type]	HKU(M) 15201	IFRD 8861
Tamsiniella labiosa S.W. Wong et al. [generic type]	HKU(M) 2276	IFRD 8862
Torrentispora crassiparietis Fryar & K.D. Hyde	HKU(M) 15667	IFRD 8863

Torrentispora fusiformis Fryar & K.D. Hyde	HKU(M) 16048	IFRD 8864
Triadelphia australiensis Joanne E. Taylor et al.	HKU(M) 3587	IFRD 8865
Tribulatia appendicospora Joanne E. Taylor et al. **[generic type]**	HKU(M) 3620	IFRD 8866
Trichocladium englandense K.D. Hyde & Goh	HKU(M) 3255	IFRD 8867
Trichocladium nypae K.D. Hyde & Goh	HKU(M) 8276	IFRD 8868
Vibrissea nypicola K.D. Hyde & Alias	HKU(M) 6519	IFRD 8869
Vismaya chaturbeeja V.V. Sarma & K.D. Hyde **[generic type]**	HKU(M) 12457	IFRD 8870
Wardomycopsis trachycarpicola Joanne E. Taylor et al.	HKU(M) 16496	IFRD 8871
Xylaria queensiandica Joanne E. Taylor et al.	HKU(M) 3564	IFRD 8872
Xylomyces giganteus Goh et al.	HKU(M) 3188	IFRD 8873
Xylomyces pusillus Goh et al.	HKU(M) 4614	IFRD 8874
Zygosporium pacificum Whitton et al.	HKU(M) 12914	IFRD 8875
Zygosporium pandanicola Whitton et al.	HKU(M) 12919	IFRD 8876

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Studies on *Microthyriaceae:* some excluded genera

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Abstract — The genera *Asteronia*, *Dictyoasterina*, *Helminthopeltis*, and *Hidakaea* are presently included in the *Microthyriaceae*. We have examined the types, and their characters do not agree with this familial placement. We redescribe these four poorly known genera and suggest a more appropriate placement of these genera. *Asteronia* produces subglobose ascomata that develop on dark mycelium with copious hyphopodia on the host surface and should be placed in the *Asterinaceae* or *Meliolaceae*. *Dictyoasterina* has a black mycelial net, superficial hyphae with lateral hyphopodia, and globose ascomata with an ostiole and can be placed in *Asterinaceae*. The monotypic *Helminthopeltis*, characterized by elongated longitudinally cleft ascomata and filiform hyaline one-celled ascospores, should be placed in *Rhytismataceae; H. almeidaeana* is probably a synonym of a species in *Lophodermium*. *Hidakaea* has brown ascomata and unitunicate asci and should be considered in *Hypocreales*.

Key words — *Asteronia sweetiae*, *Dictyoasterina conopharyngiae*, *Helminthopeltis almeidaeana*, *Hidakaea tumidula*, taxonomy

Introduction

We are conducting studies on the *Dothideomycetes* in order to provide a natural classification (Zhang et al. 2008, 2009). As part of this work we are restudying the type species of the 49 genera placed in the *Microthyriaceae*, a poorly known but interesting family within the *Dothideomycetes* (Lumbsch & Huhndorf 2007). The important morphological characters of *Microthyriaceae* are superficial, flattened, dimidiate ascomata, the cells of upper wall of which are organized in

a radiating pattern, while a lower peridium is generally lacking. Members have a central ostiolar opening, cylindrical or broadly clavate to saccate, bitunicate and fissitunicate asci and ascospores that are hyaline or brown (Ryan 1924, 1926; Kirk et al. 2008). We have thus far examined several taxa within *Microthyriaceae* and in this paper report on four poorly known genera and their types: *Asteronia* (Hennings 1895) represented by *Asteronia sweetiae*, *Dictyoasterina* (Hansford 1947) represented by *Dictyoasterina conopharyngiae*, *Helminthopeltis* (Sousa da Câmara 1950) represented by *Helminthopeltis almeidaeana*, and *Hidakaea* (Hino & Katumoto 1955) represented by *Hidakaea tumidula*. Full descriptions of these taxa and suggestion for their taxonomic placement are provided.

Materials and methods

Type specimens of *Asteronia sweetiae*, *Dictyoasterina conopharyngiae*, *Helminthopeltis almeidaeana*, and *Hidakaea tumidula* were obtained from K, IMI, LISE and YAM, respectively. Ascomata were rehydrated in 3% KOH prior to examination and sectioning. Specimens were examined under a stereo microscope (Leica MZ16A) and fine forceps were used to remove one or two ascomata, which were mounted in water, Melzer's, Congo red, or cotton blue reagents. Observations and photographs were made under the light microscopes (Nikon E800 and Leica DM3000). For some hyaline structures differential interference contrast microscopy was used.

Hand sections were cut with a sharp razor blade and thin (8 µm) sections were cut using a Leica CM1100 freezing microtome. The sections were transferred to a drop of water or a drop of cotton blue for examination and photography.

Taxonomy

Asteronia (Sacc.) Henn., Hedwigia 34: 104, 1895. FIG. 1A–I

TYPE SPECIES: *Asteronia sweetiae* Henn., Hedwigia 34: 104, 1895.

≡ *Parodiopsis sweetiae* (Henn.) G. Arnaud, Annales des Épiphyties. 7: 53, 1921.

Colonies forming darkened regions on the underside of leaves, resembling a "sooty mold" to the unaided eye. Ascomata 130–180 µm high × 110–140 µm diam, gregarious, or some scattered, superficial, subglobose to globose, subcoriaceous, brown to black-brown, with an indistinct ostiole (FIGS 1A, B, C). Peridium 17–24 µm wide, one layered, composed of black-brown isodiametric cells of textura angularis (FIGS 1D, E). Hamathecium not apparent. Asci 60–93 × 20–27 µm (mean = 72 × 22.8 µm), 8-spored, bitunicate, oblong to broadly cylindrical, with a short pedicel, 8–9 µm long, 6.5–7.5 µm wide, apically rounded with an ocular chamber (FIGS 1F, H). Ascospores 33–46 × 4–6.5 µm (mean = 40.8 × 5.4 µm), tri-seriate to multiseriate, guttulate, thin-walled, straight or slightly curved, fusoid-ellipsoidal, widest in the middle part of the apical cell, with broadly rounded apex and tapering to a narrowly rounded base, hyaline, 1-septate, septum nearly central but nearer to apex, wall rough (FIGS 1G, I).

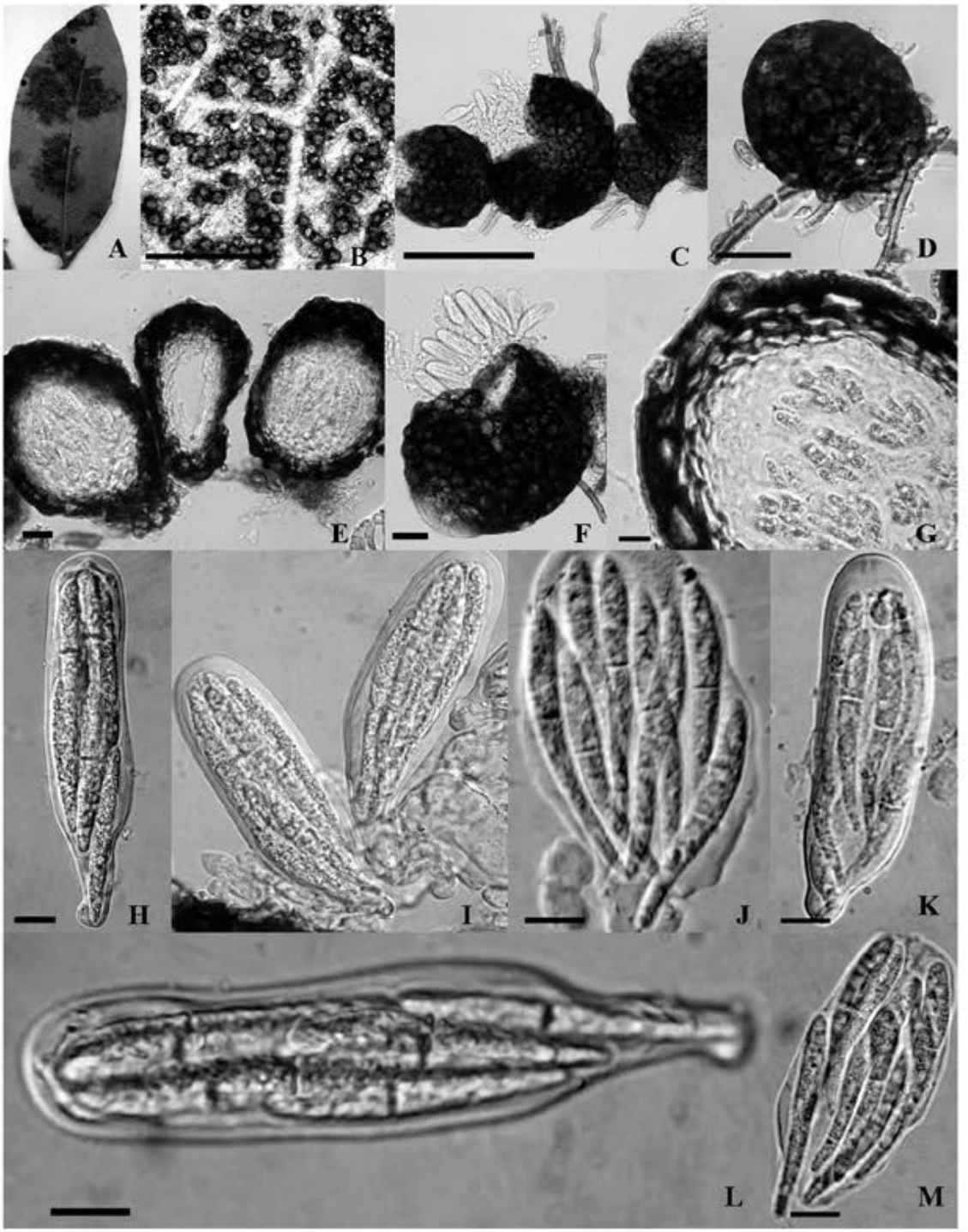

FIG. 1. *Asteronia sweetiae* (from holotype). A. Colonies of fungus on underside of host leaves. B. Appearance of ascomata on the host surface. C. Squash mount of ascoma. D, E. Section of ascomata. Note peridium. F, H. Asci Note the pedicel and ocular chamber. G, I. Ascospores. Scale bars: B = 200µm, C = 20 µm, D–I = 10 µm.

SPECIMEN EXAMINED: BRAZIL, Estado de Minas Gerais; on leaves of *Sweetia* sp. (*Fabaceae*), June 1892, E. Ulé (1968) (K (M) 159800, holotype).

Asteronia was described as a monotypic genus represented by *Asteronia sweetiae*. Subsequently, Hennings (1908) added *A. lauraceae* Henn. to the

genus. Two other names listed under *Asteronia* by Index Fungorum are errors for *Asterina appendiculosa* (Mont. & Berk.) Mont. and *Asterina erysiphoides* Kalchbr. & Cooke, species that were not included in *Asteronia* by Hennings (1895, 1908) and which have not been accepted or recombined by subsequent authors. Saccardo & Sydow (1899: 693) described *A. sweetiae* as parasitic with mycelium on the lower surface of leaves, ascomata that are subglobose and gregarious, and asci that are bitunicate with 8 spores. *Asteronia* is currently placed in the family *Microthyriaceae* (Lumbsch & Huhndorf 2007). However, the familial classification of *Asteronia* has been long confused. Hennings (1895) placed *Asteronia* in *Perisporiaceae* (= *Meliolaceae*), Saccardo & Sydow (1899) in *Microthyriaceae* subfam. *Asterinoideae*, Hennings (1908) in *Microthyriaceae*, and Arnaud (1921) in *Parodiellinaceae* (= *Parodiopsidaceae*).

Asteronia sweetiae has globose, ostiolate ascomata that form on black mycelium, while asci form from the base of ascomata. These characters and lack of flattened thyriothecia indicate that this genus is not well placed in *Microthyriaceae*. A more suitable family is probably *Asterinaceae* or *Meliolaceae*. However, there are no sequence data for *Asteronia* in GenBank and fresh collections are needed in order to establish the phylogenetic relationship of this genus.

Dictyoasterina Hansf., Proceedings of the Linnean Society of London 159: 39, 1947. FIG 2A–K

TYPE SPECIES: *Dictyoasterina conopharyngiae* Hansf., Proceedings of the Linnean Society of London 159: 39, 1947.

Epiphytic on the upper surface of leaves, appearing as blackened areas, which are rounded and shiny, scattered over the leaf, with superficial hyphae present, forming a black mycelia net (FIGS 2A, B). Superficial hyphae, black to brownish, parallel and anastomosing, with sparse, lateral hyphopodia, hyphopodia nearly circular, black-brown, 20.5–28 µm (mean = 26 µm) (FIG 2D). Ascomata 38–100 µm high, 90–220 µm diam, superficial, gregarious, roughly globose, black, subcoriaceous or less carbonaceous, with a central ostiole (FIG 2C). Peridium 6–18 µm wide comprised of three layers of cells, black-brown to pale brown, outer layer of black brown cells compressed, inner layer of isodiametric cells of textura epidermoidea (FIGS 2E, G). Hamathecium of dense, long pseudoparaphyses, 50–61 × 1.5–3 µm (mean = 55× 2.4 µm) unbranched (FIGS 2F, I). Asci 32–47.5 × 8–13 µm (mean = 35.9 × 9.9 µm), 8-spored, bitunicate, fissitunicate, clavate to short cylindrical, with a short knob-like pedicel 1.7–3.2 µm, and inconspicuous apical structure (FIG 2H). Ascospores 9.5–15 × 3–6 µm (mean = 11.8 × 4.4 µm), biseriate to overlapping triseriate, oblong-ellipsoid to obovate, 1-septate, hyaline, strongly constricted at the septum, upper cell oval, wider and shorter than the cone-shaped lower cell, guttulate, smooth-walled (FIGS 2J, K).

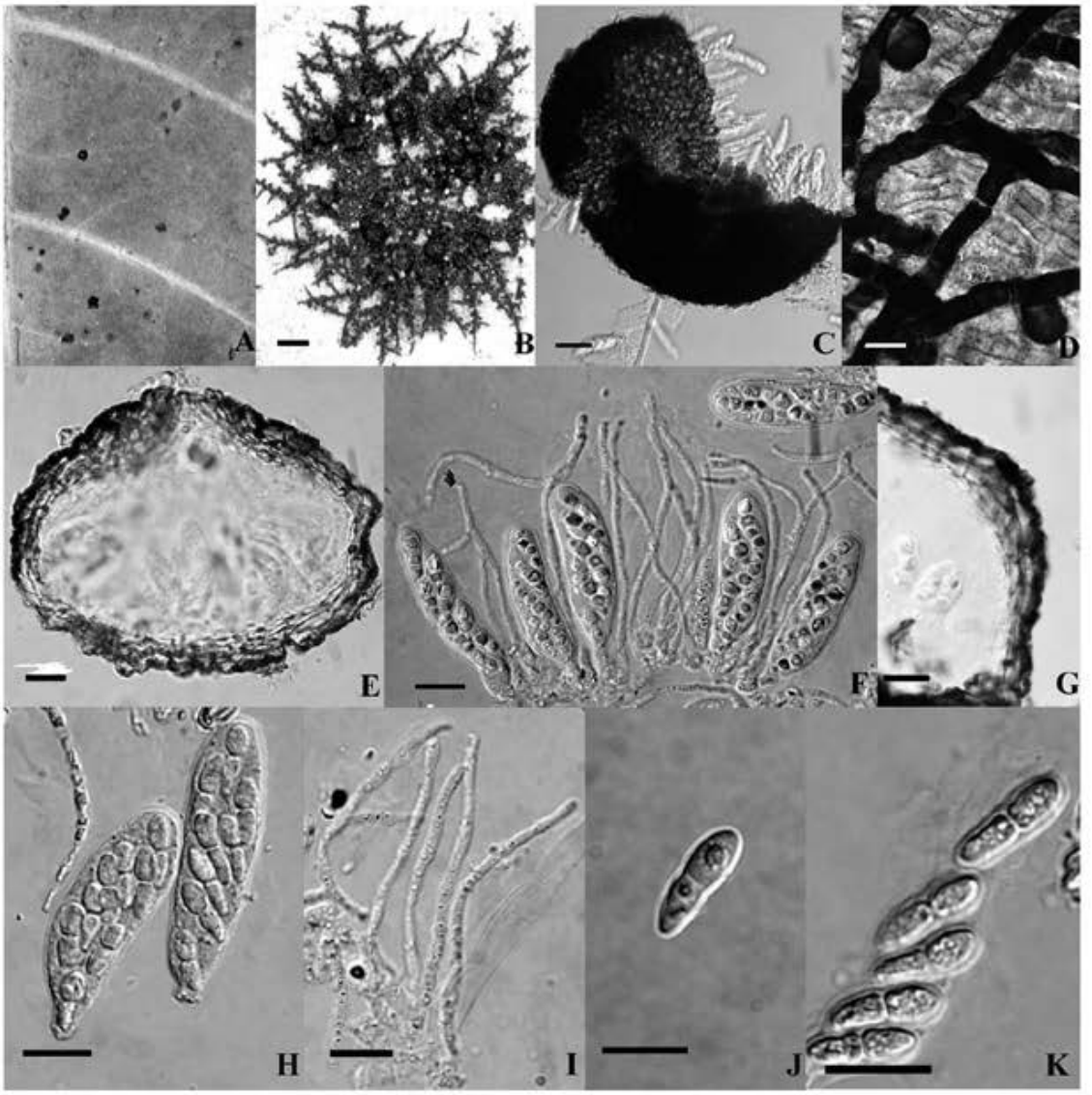

FIG. 2. *Dictyoasterina conopharyngiae* (from holotype). A. Appearance of fungus on surface of leaf. B. Appearance of colony and ascomata on the host surface. C. Squash mount of ascoma. D. Hyphopodia. E. Section of ascoma. Note the peridium which comprises several layers of cells. F. Asci and paraphyses. G. Peridium. H. Asci mounted in Melzer's reagent. I. Paraphyses. J, K. Ascospores becoming red when mounted in Congo red and yellow to light brown in Melzer's reagent. Scale bars: B = 200µm, C = 20 µm, D–K = 10 µm.

SPECIMEN EXAMINED: UGANDA, Entebbe, on leaf of *Conopharyngia holstii* (*Apocynaceae*), December 1945, C.G. Hansford, (IMI5298, holotype).

Dictyoasterina was described as a monotypic genus represented by *D. conopharyngiae* and was placed into the family *Asterinaceae* (Hansford 1947). In the latest Myconet, *Dictyoasterina* is removed into the family *Microthyriaceae* (Lumbsch & Huhndorf 2007).

Dictyoasterina conopharyngiae has superficial mycelium and clearly ostiolate, globose ascomata; these morphological characters make it distinct

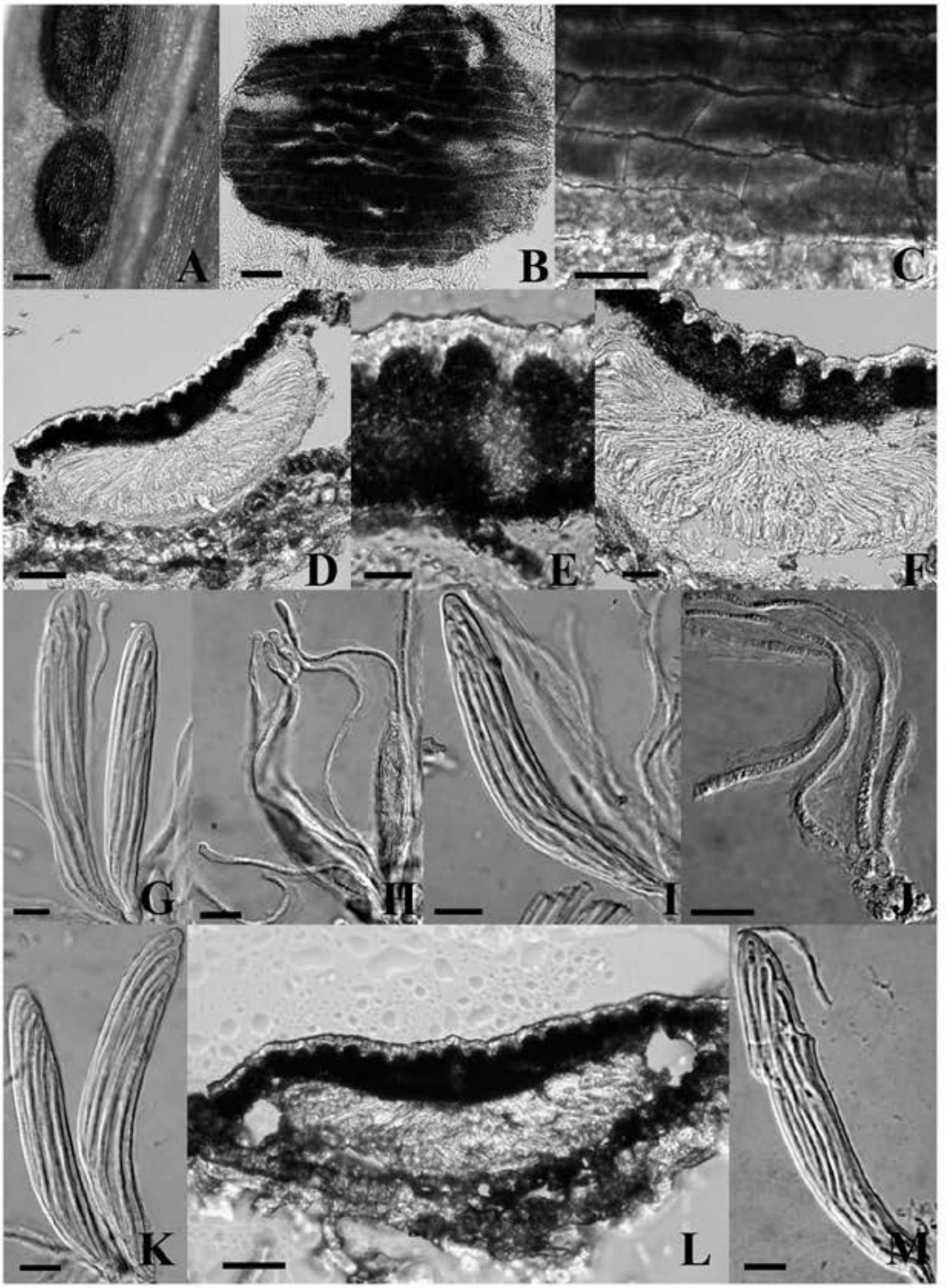

FIG.3. *Helminthopeltis almeidaeana* (from holotype). A. Appearance of ascomata on the host surface. B, C. Squash mount of ascoma. D–F, L. Section of ascomata. Note peridium. G, I, K, M. Unitunicate asci. H, J. Ascospores. Scale bars: A = 500 μm, B = 20 μm, C–M = 10 μm.

from *Microthyriaceae*. We suggest that *Dictyoasterina* be excluded from *Microthyriaceae* and transferred to a more suitable family, such as the

Asterinaceae, although the presence of pseudoparaphyses should be considered. As there are no sequences for this genus in GenBank, fresh collections and DNA sequence analyses are still needed to establish taxonomic placement.

Helminthopeltis Sousa da Câmara, Agronomia Lusitana 12: 102, 1950. FIG 3A–M

TYPE SPECIES: *Helminthopeltis almeidaeana* Sousa da Câmara, Agronomia Lusitana 12: 102, 1950.

Necrotrophic or biotrophic on the surface of leaves of conifers, forming black oval spots. Superficial mycelium absent. *Ascomata* 140–205 µm long × 75–110 µm wide, about 100–150 µm high, solitary or grouped in pairs, scattered, superficial, clypeate, oblong or elongated, with a longitudinal cleft-like opening, subcoriaceous, black to brown (FIGS 3A, B, C). Peridium 50–72 µm thick at the apex, 25–35 µm thick at base, two-layered, composed of hyaline pseudoparenchymatous cells and an inner layer of isodiametric cells of textura angularis (FIGS 3D–F, L). Hamathecium sparse or absent. Asci 60–117 × 10–18 µm (mean = 77 × 15.2 µm), at least 8-spored (or more than 8-spored), not fissitunicate, cylindrical to oblong, thin-walled, parallel arrangement (FIGS 3G, I, K, M). Ascospores 62.5–83 × 2–3.5 µm (mean = 70.9 × 2.8 µm), parallel seriate, broad filiform to wire-like, hyaline, aseptate, wall smooth (FIGS 3H, J).

SPECIMENS EXAMINED: PORTUGAL, Minho Serra do Gerez (Pico Borrageiro), on leaf of *Juniperus communis* (*Cupressaceae*), 3 July 1948, M. de Sousa da Câmara (LISE 50024, holotype).

Sousa da Câmara (1950) erected *Helminthopeltis* as a monotypic genus for *H. almeidaeana,* which is found only in Europe (Kirk et al. 2008). The 2007 Outline of *Ascomycota* (Lumbsch & Huhndorf 2007) places *Helminthopeltis* into *Microthyriaceae.* We suggest that *H. almeidaeana* is better placed in *Lophodermium* (*Rhytismataceae*) but do not transfer the species here as it has probably already been described in this large genus under another name.

Hidakaea I. Hino & Katum., Bulletin of the Faculty of Agriculture, Yamaguchi University 6: 38, 1955. FIG 4A–K 5A–D

TYPE SPECIES: *Hidakaea tumidula* I. Hino & Katum., Bulletin of the Faculty of Agriculture, Yamaguchi University 6: 38, 1955.

Saprobic or parasitic on stems of bamboo, causing black to brown spots. Ascomata 260–270 µm diam. 120–160 µm high, solitary or gregarious, flattened against the host surface, subglobose, in section hemispherical, brown, subcoriaceous but membranous at the base, smooth from above, unilocular, with a central ostiole (FIGS 4A, B). Ostiole 6.0–6.5 µm. Peridium 41–63 µm wide, brown-black at the sides, other parts light brown, in the sagittal section, comprising a few layers of cells, outer cells appear pseudoparenchymatous and cell wall very thin, on the base cells isodiametric, black-brown (FIGS 4C,

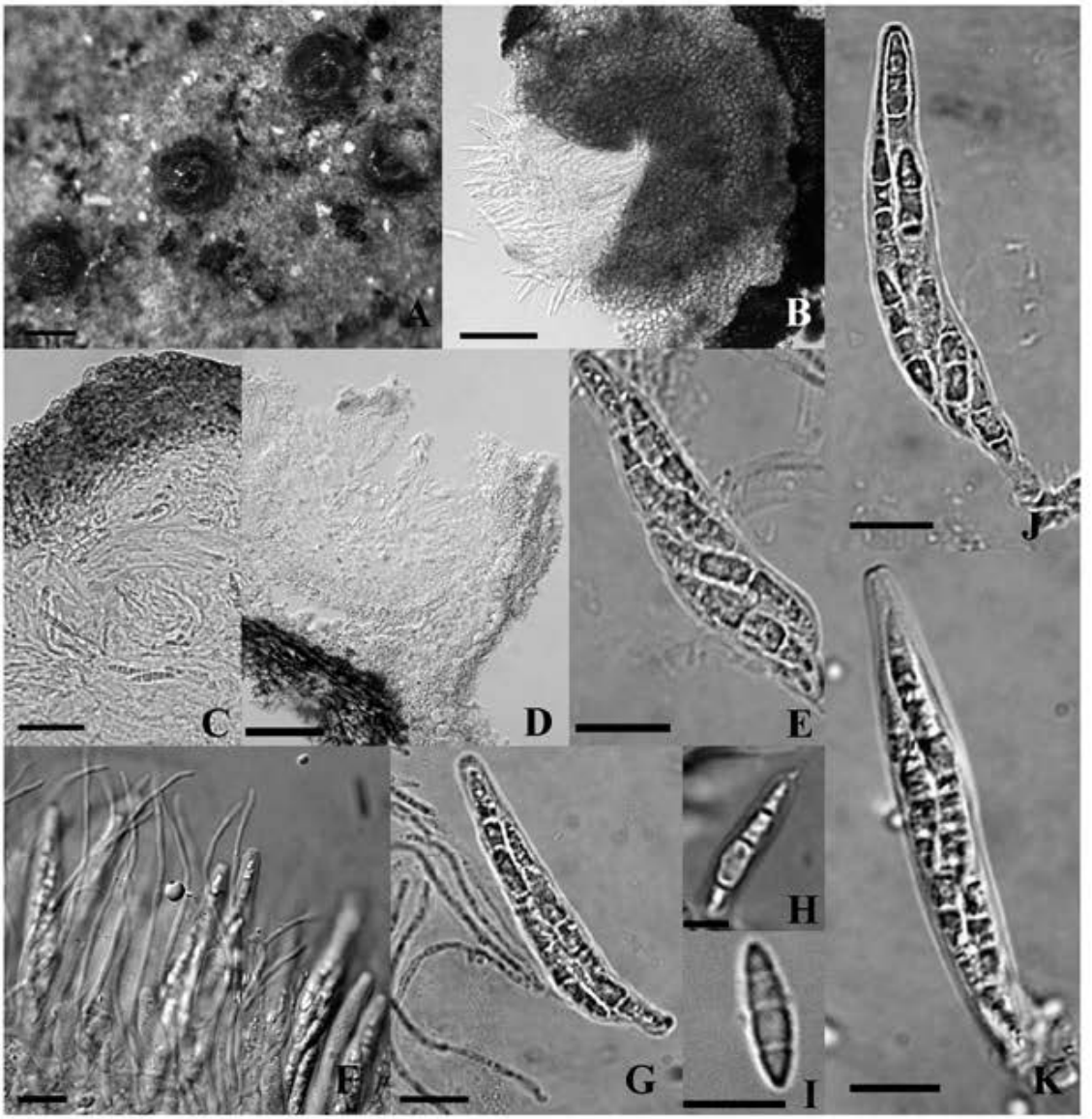

FIG. 4. *Hidakaea tumidula* (from holotype). A. Appearance of ascomata on the host surface. B. Squash mount of ascoma. C, D. Section of ascoma. Note the peridium. E, J, K. Asci. Note the pedicel and the apical ring structure. F, G. Paraphyses which are longer than asci. H, I. Ascospores. Note the three septa and inconspicuous sheath. Scale bars: A = 200 μm; B, C, D = 20 μm; E–G, J, K = 10 μm; H, I = 5 μm.

D). Hamathecium comprising paraphyses, 70–105 × 1–2 μm, embedded in mucilage, and longer than asci (FIGS 4F, G). Asci 71–82 × 7–10 μm, 8-spored, unitunicate, cylindrical-clavate or oblong, with a short pedicel 6 × 4 μm, apically rounded with inconspicuous apical structure (FIGS 4E, J, K). Ascospores 16–20.5 × 2.5–4 μm, 2-seriate, fusiform, tapering gradually at one or both ends, or pointed, hyaline or pale, 3-septate, slightly constricted at septa, smooth-walled, some with sheath (FIGS 4H, I).

SPECIMEN EXAMINED: JAPAN, Sagami Province, Qoyama, on dead stems of *Pleioblastus vaginatus* (*Poaceae, Bambusoideae*), September 1952, Hino and Katumoto (YAM 20296, holotype).

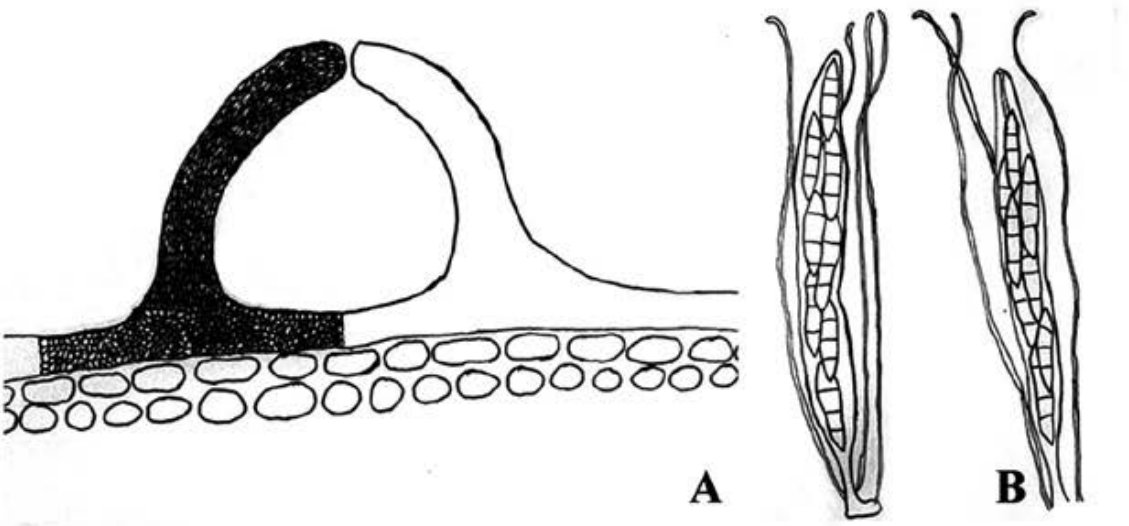

FIG. 5. *Hidakaea tumidula* (line drawing from holotype). A. Ascoma. B. Asci.

Hino & Katumoto (1955) established *Hidakaea* as a monotypic genus with *H. tumidula* as the type species and suggested that it should be placed into *Microthyriaceae* based on ascomata with a scutate structure, superficial subglobose ostiolate ascomata, and bitunicate, clavate or cylindrical-clavate asci. The scutate structure and bitunicate asci described in the prologue were not observed in the holotype. The unitunicate ascus of *Hidakaea* does not belong in *Dothideales* and *Microthyriaceae*. The species should be placed the *Sordariomycetes* where it may have affinities with the *Chaetosphaeriales* or *Hypocreales*. The brown colour of the ascomata is typical of species in the *Hypocreales*, and the asci and ascospores are also characteristic of this order. We therefore suggest that *Hidakaea* belongs in *Hypocreales* incertae sedis.

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A new species of non-lichenized genus *Stictis* (*Ostropales, Lecanoromycetes*) from India

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Abstract — *Stictis subbrachyspora* is described as new species from India. The new species is characterized by a non-lichenized habit; round, effigurate, chroodiscoid apothecia with white pruinose, lacerate margins, and transversely 19–32 loculate small ascospores measuring 45–55 × 4–5 µm. *Stictis himalayanus* is published as a new combination based on *Chroodiscus himalayanus*.

Key words — *Stictidaceae*, corticolous, *Ascomycota*, *Conotrema*

Introduction

The family *Stictidaceae* (*Ostropales, Lecanoromycetes, Ascomycota*) accommodates a large group of lichenized and non-lichenized fungi. The species of the genus *Stictis* Pers. are perhaps the best known example of individuals representing the same fungal species having the ability to live either in a lichenized state (with algal symbionts) or as saprotrophs (non-lichenized), depending on the substrate (Wedin et al. 2004).

Sherwood (1977a,b, 1979) provided a comprehensive account of c. 65 species and separated *Stictis* from allied genera based on the orbicular fruiting body opening by pores, periphysoids in an apothecial margin that extends down the whole length, a hymenium that splits away from the margin when dry, a thick crystalline layer in the ascoma margin and a non-parasitic niche. The ascospores exhibit variation in shape (cylindrical or filiform), size, and septation (with 3–300 septa). *Stictis* was segregated from the closely related *Conotrema* based on the lichenized living strategy and scattered crystals in apothecial margin of the latter (Gilenstam 1969, Sherwood 1977a). A phylogenetic account by Wedin et al. (2006) suggests that *Stictis* is paraphyletic and congeneric with

Conotrema. The other closely related genera — *Schizoxylon* and *Carestiella* — differ from *Stictis* in lacking a periphysoidal layer and having disintegrated spores (Wedin et al. 2005).

Seven *Stictis* taxa have been reported previously from India: *S. bengalensis* U.P. Singh & Pavgi, *S. indica* Tilak & Nanir, *S. kamatii* Tilak & S.B. Kale, *S. lantanae* Tilak & Nanir, *S. marathwadensis* Tilak & S.B. Kale, *S. stellata* subsp. *intermedia* (Speg.) M.P. Sharma & R. Sharma, and *S. tilakii* S.B. Kale & S.V.S. Kale (Kale & Kale 1970, Sharma & Sharma 1983, Singh & Pavgi 1966, Tilak & Kale 1969, 1970; Tilak & Nanir 1975). Some of these are no longer considered to belong in *Stictis*, and others are of dubious application. Sherwood (1977a) synonymized *S. bengalensis* under *S. radiata* (L.) Pers. subsp. *radiata* and recombined *S. lantanae* as *Schizoxylon lantanae* (Tilak & Nanir) Sherwood, placing S. *indica* in synonymy. Sherwood (1977a) was unable to obtain material of *S. kamatii*, *S. marathwadensis*, and *S. tilakii* for study; on the basis of their protologues, she considered that *S. marathwadensis* was probably a *Stictis* sp. distinct from *S. radiata* but was unable to suggest better taxonomic placements for *S. kamatii* and *S. tilakii*.

The present paper reveals the existence of a non-lichenized corticolous species from India that fits well in the genus *Stictis* and is described here as new to science.

Materials and methods

The material (preserved in LWG, the National Botanical Research Institute lichen herbarium) was examined morphologically, anatomically, and chemically. Thin hand-cut sections of apothecia and thallus were mounted in plain water, cotton blue, 5% KOH, and iodine solution and observed under a compound microscope. Chemical spot tests and TLC methods follow methods by Orange et al. (2001). The minimum and maximum measurements of ascospore and other anatomical features are based on the examination of at least five different mature ascomata.

Taxonomic description

Stictis subbrachyspora S. Joshi & Upreti, **sp. nov.** FIGURE 1

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Thallus corticolus. Ascocarpi primum immerse, erumpescentes, profunde cupulati, 0.5–0.6 mm diam., margin, albo, lacerato. Margo in sectione 60–120(–125) µm crassus. Exipulum proprium brunneum, 30–65 µm crassum; stratum crystallinum 25–50 µm crassum. Periphysoidea ramose, 15–25 µm. Paraphyses filiformes, ramosae, 1–1.5 µm. Asci 8-spori, 80–90(–100)×5–6 µm crassum, I+ carulescens. Sporae 45–55 × 4–5 µm, involutae, I+ aurantiaco-lutescentes.

TYPUS: INDIA, West Bengal, Jalpaiguri district, Jaigaon, on bark on a river bank, 07.04.1987, D.K. Upreti & M. Ranjan 201675 (LWG–**holotype**).

A non-lichenized fungus, corticolous, forming a hyaline epiphloeodal hyphal felt or thallus, 20–50 µm thick. Ascomata, urceolate, solitary, sometimes aggregated in two, at first immersed, opening by a pore, becoming erumpent and finally nearly superficial, 0.5–0.6 mm in diam., round, chroodiscoid; disc brownish to flesh coloured, densely pruinose, splitting away from the margin, up to 0.4 mm in diam., deeply immersed; margin radiate, effigurate, lacerate, 5–6 lobed, white-pruinose, eroded in older apothecia, 60–120(–145) µm thick in cross section, hyaline to darken in older apothecia, sometimes layered, entirely encrusted in crystals.

Outer exciple layer 40–80 µm thick; inner exciple layer brown, 30–65 µm thick, branched periphysoids present, forming the innermost layer of the margin, 15–25 µm long, separated from the outer wall by crystals (of 20–40 µm in size); crystals forming a dense layer along the inner margin of apothecia, 25–50 µm thick. Epihymenium indistinct, granular, hyaline to slightly brownish, usually covered by 20–40 µm high crystalline layer, hymenium hyaline, inspersed, separated from the margin in dry condition, 100–135(–200) µm high, I+ golden yellow to wine-red; sub-hymenium, 30–50(–260) µm high, hyaline to darken in older apothecia, I+ blue. Paraphyses filiform, branched, with thickened apical cell, dense, conglutinate, 1.0–1.5 µm wide, I+ blue in epihymenial region. Ascus 8-spored, cylindrical, bitunicate, 80–90(–200) × 5–6 µm, I+ blue; ascospores cylindrical to fusiform, hyaline, transversely septate, sheathed, 19–32 loculate, locules broader than longer, 45–55 × 4–5 µm, golden yellow in Iodine solution.

CHEMISTRY: Thallus K+ reddish, PD–, C–; no lichen substance in TLC (Solvent system A).

DISTRIBUTION AND ECOLOGY: At present the new species is known only from the northern and eastern states of India, where it is found growing luxuriantly on tree bark in tropical moist deciduous forest at 140–900 m altitudes.

ADDITIONAL SPECIMEN EXAMINED: INDIA, Uttarakhand, Jim Corbett Tiger Reserve, Dugadda, on tree bark, 03 Dec. 1999, D. K. Upreti 217467 (LWG).

REMARKS: *Stictis subbrachyspora* is characterized by non-lichenized thalli, round erumpent, chroodiscoid apothecia with radiate, lacerate, pruinose margins, flesh coloured deeply immersed discs, branched paraphyses, periphysoids in the innermost layer, a crystalline layer between excipulum and periphysoids, brown inner exciple, and relatively small 8-spored asci and ascospores measuring 80–90(–100) × 5–6 µm and 45–55 × 4–5 µm respectively.

Stictis brachyspora Sacc. & Berl. is similar to *S. subbrachyspora* in its white pruinose apothecial disc, thick crystalline layer separating periphysoids from outer wall, I+ blue paraphyses at epihymenial region, and an amyloid hymenium that splits away from the margin when dry; it differs in having broadly open immersed apothecia that do not become erumpent, larger ascospores (65–90

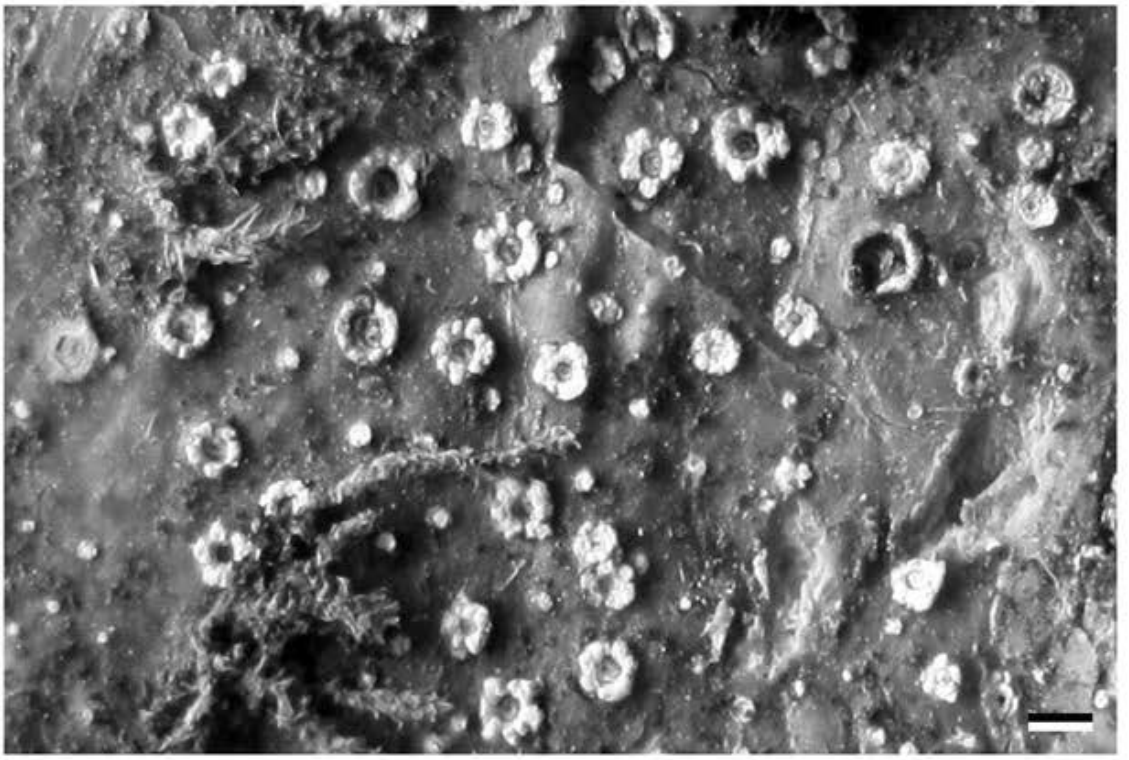

FIGURE 1. Thallus and apothecial morphology of *Stictis subbrachyspora* (Holotype). Scale: 0.5 mm.

× 3.5–4.5 µm), and an apothecial margin that is 40 µm thick and colourless throughout in cross section.

Stictis friabilis (W. Phillips & Plowr.) Sacc. & Traverso resembles the new species in its 0.3–0.6 mm, erumpent, nearly superficial apothecia with deeply fissured pruinose margins, branched propoloid paraphyses, and small ascospores (55–70 × 2.5–3.5 µm). However, *S. friabilis* differs in having I– paraphyses in epihymenial region, a distinctly reddish apothecial disc with a fleshy yellow-pruinose margin, colourless proper exciple, and unsheathed ascospores (the sheathed ascospore character is not cited in the description by Sherwood, 1977a).

Other closely related taxa *S. lupini* W. Phillips & Harkn. and *S. dumontii* Sherwood, with small ascospores of 45–60 × 3–3.5 µm and 55–65 × 3–3.5 µm respectively, differ from *S. subbrachyspora* in having immersed apothecia. Further, *S. lupini* differs in having an entire apothecial margin, unbranched periphysoids, simple paraphyses, and indistinct exciple while *S. dumontii* differs in having 4-spored asci.

Stictis radiata subsp. *radiata* is comparable to new species in having a lacerate, white-pruinose, apothecial margin, deeply immersed disc, I+ blue subhymenial region, and irregularly branched paraphyses; however, the larger asci (120–250 × 5–8 µm) and unsheathed larger ascospores differentiate it from *S. subbrachyspora*.

Stictis marathwadensis, considered a good representative of the genus, is close to *S. subbrachyspora* in having round apothecia with lobed margins but differs in having white to black apothecia and acicular ascospores that are almost as long as the asci (220–285 × 0.6–1.6 µm).

The genus *Stictis* has a worldwide distribution but most species are common in coastal areas and moist humid cloud forests of tropical countries.

An Indian specimen previously placed in thelotremataceous group due to uncertainty in the delimitation of *Ostropales* has been reevaluated and is now transferred to *Stictis* as follows:

Stictis himalayanus (Nayaka & Upreti) S. Joshi & Upreti, **comb. nov.**

MycoBank MB518077

Basionym: *Chroodiscus himalayanus* Nayaka & Upreti, Mycotaxon 98: 247. 2006.

The taxon is characterized by chroodiscoid apothecia with prominent white exfoliating margins, hyaline proper exciples densely inspersed with calcium oxalate crystals, distinct periphysoids, and acicular transversely septate golden yellow I+ ascospores measuring 40–78(–85) × 3–5 µm. It is similar to *Stictis lupini* and *S. brachyspora* in having simple paraphyses and small ascospores measuring 45–60 × 3–3.5 µm and 65–90 × 3.5–4.0 µm respectively but differs in having erumpent apothecia, orange-brown discs, radially fissured apothecial margins, and 2–3 spored asci. The species is restricted to the Himalayas and was found growing on trees in Great Himalayan National Park, Himachal Pradesh, at an altitude of 2200 m.

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Perisporiopsis lateritia, a new species on decaying leaves of *Hevea* spp. from the Amazon basin in Peru

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Abstract — The genus *Perisporiopsis (Ascomycota, Dothideomycetes, Parodiopsidaceae)* occurs on the underside of decaying leaves, mostly in tropical regions. A new species of *Perisporiopsis, P. lateritia*, is described that can be distinguished from other species in the genus by a combination of teleomorph and anamorph characteristics, such as ascospore size, size and shape of microconidia and macroconidia of the *Septoidium* anamorph, and the plant host (*Hevea*). This species is known only from the Peruvian Amazon.

Key words —leaf litter fungi, loculoascomycetes, systematics, taxonomy

Introduction

The plant genus *Hevea* (*Euphorbiaceae*) is known for the ability to produce latex that is processed to obtain natural rubber. The best-known species for production of natural rubber is *Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg. Other species in the genus include *H. benthamiana* Müll. Arg., *H. guianensis* Aubl., *H. nitida* Müll. Arg., and *H. pauciflora* (Spruce ex Benth.) Müll. Arg., as well as others that are rare (Schultes 1956). Although *Hevea* includes economically important species, the fungi associated with these hosts have not been explored (Araujo et al. 2004, Gazis & Chaverri 2010). As part of a study to characterize endophytic and ex planta fungi, e.g. saprophytes, of wild trees of *H. brasiliensis* and *H. guianensis*, ascomata of an unidentified species of *Perisporiopsis* Henn. (*Ascomycota, Dothideomycetes, Parodiopsidaceae*) were collected from decaying leaves in two locations in the Peruvian Amazon. Based on morphological data, this unidentified ascomycete is described here as a new species. A diagnostic sequence of the internal transcribed spacer region of the nuclear ribosomal DNA (ITS) has been deposited in Genbank.

Materials & methods

Source of specimens

Decaying leaves were collected near the base of wild *Hevea brasiliensis* and *H. guianensis* trees in old growth forests in two sites in the Peruvian Amazon, i.e. Los Amigos and Tambopata (Dept. Madre de Dios, Prov. Manu and Tambopata, respectively). Two specimens (P.C. 811 and P.C. 987) included ascomata of this unusual fungus. Ascospore germination was attempted by isolating asci and ascospores onto BBL™ cornmeal-dextrose-agar (CMD), supplemented with antibiotics (Sigma-Aldrich streptomycin-neomycin-penicillin). Plates were incubated at 25°C with alternating 12 h light/12 h darkness. However, ascospores did not germinate after one week. Specimens are preserved in the U.S. National Fungus Collection (BPI).

Morphological characterization

To observe internal and microscopic characteristics, the ascomata were rehydrated briefly in KOH, then supported by Tissue-Tek O.C.T. Compound 4583 (Miles Inc., Elkhart, Indiana, U.S.A.), and sectioned with a freezing microtome at a thickness of ca. 15 µm. Characteristics of asci and ascospores were observed by rehydrating the ascomata in 3% KOH, removing part of the centrum with a fine glass needle, and placing it on a glass slide. Characteristics of the anamorph on the natural substrata were also observed. Measurements of continuous characters such as length and width were made using Scion Image software beta version 4.0.2 (Scion Corporation, Frederick, Maryland, U.S.A.). Continuous measurements are reported as the extremes (maximum and minimum) in brackets separated by the 95% confidence interval. Color terminology is from Rayner (1970).

Source of ITS sequence

To obtain a representative ITS sequence, DNA was extracted from the ascomata of P.C. 811 by removing centrum contents with a fine glass needle and placing them in the bead-beating microtubes of the PowerPlant™ DNA isolation kit (MO BIO Laboratories, Inc., Carlsbad, California, U.S.A.). The primers used for ITS were ITS 5 and ITS 4 (White et al. 1990). PCR reactions were run in an Eppendorf Mastercycler EP using the parameters described in Gazis & Chaverri (2010). PCR products were cleaned using ExoSAP-IT® (USB Corporation, Cleveland, Ohio, U.S.A.) following the manufacturers instructions. Clean PCR products were sequenced at the DNA Sequencing Facility (Center for Agricultural Biotechnology, University of Maryland, College Park, Maryland, U.S.A.). Sequences were assembled and edited with Sequencher 4.9 (Gene Codes, Madison, Wisconsin, U.S.A.). The ITS sequence was deposited in Genbank as accession number FJ884129.

Taxonomy

Perisporiopsis lateritia P. Chaverri & Gazis, **sp. nov.** PLATE A–H

MYCOBANK — MB518067

Perisporiopsis melioloides *similis. Ascospores (65.0–)66.0–75.5(–78.0) × 18.0–21.5(–23.0) µm.* Septoidium *macroconidia ovoideus fusiformes ad cymbiformes, (59.0–)61.5–69.0 (–80.0) × (15.7–)16.5–18.0(–19.3) µm, longitudo/crassitudo 3.7–3.8(–4.2). Microconidia*

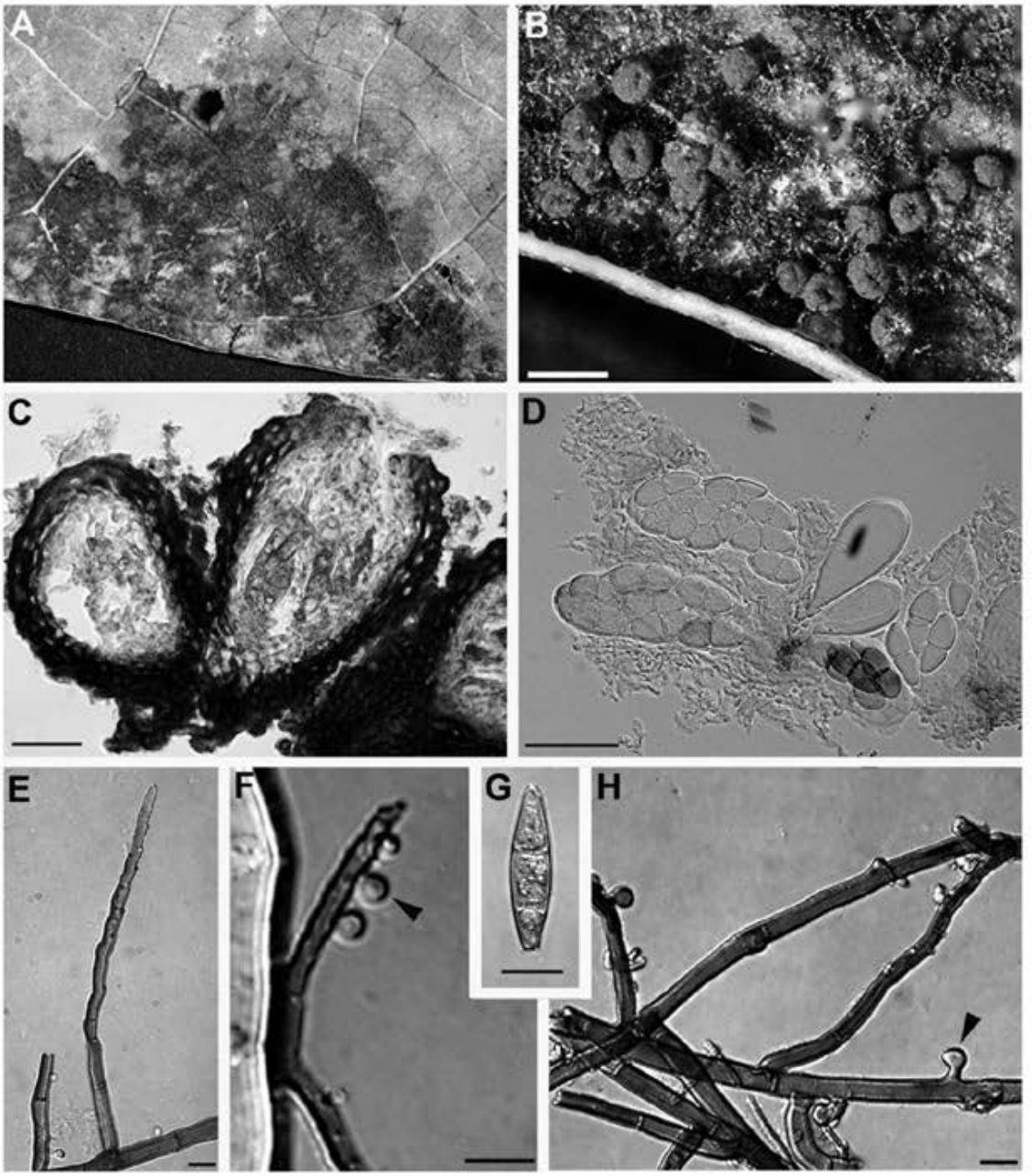

PLATE. *Perisporiopsis lateritia* Holotype P.C. 811 = *BPI 880185*. A, B. Ascomata and dark mycelium on the underside of leaves. C. Longitudinal section of ascomata. D. Asci and ascospores. E, F. Denticulate conidiophore of the microconidial anamorph. F. Arrow indicates globose microconidia. G. *Septoidium* macroconidium. H. Simple stomatopodia indicated by arrow.

Bars: B = 1 mm; C, D = 100 µm; E–H = 10 µm.

globosae ad subglobosae, 4.5–5.5 × 4.8–5.5 µm, longitudo/crassitudo 1.0–1.1. Stomatopodii simplex.

TYPE: 17 June 2007, coll. R. Gazis, H.C. Evans, P. Chaverri; (**Holotype** BPI 880185, *P.C. 811*) on underside of decaying leaves of *Hevea brasiliensis*, Picaflor Research Station, near Tambopata River, Prov. Tambopata: Dept. Madre de Dios, Peru. GenBank accession number FJ884129.

ETYMOLOGY: The name is Latin for brick red, in reference to the color of the ascomata.

TELEOMORPH – Mycelium superficial, hypophyllous, extensive, appearing black, anastomosing to form a close network, almost subiculum-like, with simple, knob-shaped stomatopodia. Ascomata superficial on mycelium, aggregated, associated with a hyphomycetous dematiaceous anamorph (i.e. *Septoidium*). Ascomata dark brown to black, almost completely covered with a sienna to brick tomentum, except near the apex where they appear black, subglobose to obovoid, 300–310 × 420–450 µm (n = 5), non-ostiolate, irregularly dehiscent at apex; ascomatal wall composed of one region of 2–3 layers of thick-walled cells, textura angularis. Asci few, generally less than 5, 200–220 × 80–90 µm (n = 10), obovoid, sessile to short stalked, somewhat thickened at apex, eight-spored. Ascospores 1-septate, strongly constricted at septum, initially hyaline, later pale brown or fawn, smooth to slightly spinulose, broadly fusiform to ovoid, somewhat inequilateral, with apical cell slightly larger than basal cell, (65.0–) 66.0–75.5(–78.0) × 18.0–21.5(–23.0) µm (average = 70.5 × 20 µm, n = 30).

ANAMORPH – Both macro- and microconidia of the hyphomycetous anamorph observed on natural substrata. For the macroconidial anamorph (i.e. *Septoidium*) no conidiogenous cells observed. Macroconidia ovoid, fusiform to cymbiform, truncate at base, smooth, pale brown, sometimes with tinges of pale grayish rose, 2-septate, (59.0–)61.5–69.0(–80.0) × (15.7–) 16.5–18.0(–19.3) µm (average = 65.2 × 17.2 µm, n = 10), length/width ratio 3.7–3.8(–4.2) (average = 3.8, n = 30). Microconidial anamorph with erect conidiophores, brown near base, pale brown almost hyaline near tip, simple, not branching, septate, with scattered denticles on upper part; conidiogenous cells polyblastic, sympodial, with small denticles; microconidia borne on denticles, globose to subglobose, unicellular, almost hyaline, sometimes apiculate at base, 4.5–5.5 × 4.8–5.5 µm (average = 5 × 5.2 um), length/width ratio 1.0–1.1 (average = 1.0, n = 8).

HABITAT – On the underside of decaying *Hevea* spp. leaves in old growth forests. Known only from Peru.

ADDITIONAL SPECIMEN EXAMINED: PERU. DEPT. MADRE DE DIOS: PROV. MANU, LOS AMIGOS RESEARCH STATION, NEAR LOS AMIGOS RIVER, on underside of decaying leaves of *Hevea guianensis*, July 2007, coll. R. Gazis *BPI 880186 (= P.C. 987)*.

NOTES – *Perisporiopsis* includes 19 species, all of them occurring on decaying leaves in tropical regions; most are described in Sivanesan (1984). A manuscript under review (Chaverri & Gazis) shows that *Perisporiopsis* is also a common endophyte and soil inhabitant. *Perisporiopsis lateritia* is most similar to *P. melioloides* (Berk. & M.A. Curtis) Arx in having a reddish tomentum covering the ascomata and relatively large ascospores. *Perisporiopsis melioloides* has conidia that are significantly wider than those of *P. lateritia*. In addition, the stomatopodia of *P. melioloides* are lobed while in *P. lateritia* they are simple. Other species with a reddish covering on the ascomata are *P. brasiliensis*

(Bat. & Nascim.) Arx, *P. cecropiae* (R.E.D. Baker) Arx, *P. fusispora* (Pat.) Arx, *P. kwangensis* (Henn.) Arx, and *P. megalospora* (Sacc. & Berl.) Arx. Most of these species have smaller ascospores than *P. lateritia*, and *P. fusispora* has multiseptate, fusiform ascospores. In addition, *P. brasiliensis* has *Septoidium* macroconidia that are generally 3-septate, *P. cecropiae* has macroconidia generally 1-septate, *P. fusispora* has 3-septate macroconidia, *P. kwangensis* has smaller microconidia, and *P. megalospora* has lobed stomatopodia and larger microconidia than *P. lateritia*.

Among species of *Perisporiopsis*, host preferences seem to exist, i.e. most species are from plants of close taxonomic affinity (Sivanesan 1984). For example, *Perisporiopsis brachystegiae* (Henn.) Arx and *P. fusispora* are known only from legumes in Africa and Tropical America, respectively. *Perisporiopsis megalospora* is known from various genera in the *Malpighiales* such as *Banisteriopsis, Hiraea, Mascagnia*, and *Tetrapteris*; and *P. melioloides* from the *Myrtaceae*. Only two other species have been found on *Euphorbiaceae*, namely *P. hurae* (R.E.D. Baker & Dale) Arx ["*urae*"] and *P. kwangensis*; these two species are morphologically distinct from *P. lateritia*.

All species of *Perisporiopsis*, except *P. lantanae* (F. Stevens) R.W. Barreto, have *Septoidium* macro- and microconidial anamorphs. In Barreto et al. (1995), *P. lantanae* is described as having a pycnidial anamorph, more typical of a *Leptosphaeria*. In addition, the ascospores illustrated in Barreto et al. (1995), resemble *Leptosphaeria*. Therefore, it is likely that this species may not belong in *Perisporiopsis*.

Whether the phenotypic characteristics used to separate species of *Perisporiopsis*, i.e. ascospores, conidia, and host, have phylogenetic significance remains unknown. This genus has not been included in phylogenetic studies of the *Dothideomycetes* (Schoch et al. 2009). Its relationship with other genera in the *Parodiopsidaceae* is unclear. Given the small ascomata, few asci, lack of interthecial elements and occurrence on leaves, one would suspect a relationship with the *Mycosphaerellaceae* sensu lato. However, in a recently submitted manuscript by Chaverri & Gazis, phylogenetic analyses of nuclear ribosomal DNA suggest a close relationship with *Leptosphaeriaceae* and *Phaeosphaeriaceae*.

Key to species of *Perisporiopsis*

Modified from Sivanesan (1984)

1. Ascospores always one-septate, conidia transversely multiseptate or staurosporous 2

1. Ascospores with one or more septa, conidia transversely multiseptate 9

2. Conidia staurosporous 3

2. Conidia straight 4

3. Ascospores 25–33 x 7–12 µm, conidia 50–100 x 10–16 µm, on *Lophira (Ochnaceae)* ..... *P. lophirae*

3. Ascospores 30–52 x 10–15 µm, conidia 50–140 x 28–56 µm, on legumes ..... *P. brachystegiae*

4. Conidia 1–2-septate 5

4. Conidia 2–3-septate 8

5. Ascomata in shades of orange or red, not brown or black 6

5. Ascomata brown or black. 7

6. Ascospores 40–50 × 11–15 µm, conidia 57–68 × 12–15 µm, microconidia 5–9 × 2–3 µm, on *Alchornea, Pera, Sapium* and other *Euphorbiaceae* ..... *P. kwangensis*

6. Ascospores 36–51 × 12–15 µm, conidia 36–45 × 15–20 µm, microconidia 5–7.5 × 3–4 µm, on *Cecropia (Cecropiaceae)* ..... *P. cecropiae*

6. Ascospores 40–55 × 12–16 µm, conidia 60–80 × 12–15 µm, microconidia 7–10 × 5–7 µm, on *Banisteriopsis, Hiraea, Mascagnia*, and *Tetrapteris*, and other *Malpighiales* ..... *P. megalospora*

6. Ascospores 30–75 × 16–21 µm, conidia 55–79 × 12–16 µm, microconidia 4–7 × 3–5 µm, on *Myrtaceae*. ..... *P. melioloides*

6. Ascospores 66–76 × 18–22 µm, conidia 61–69 × 16–18 µm, microconidia 4.5–5.5 × 4.5–5.5 µm, on *Hevea (Euphorbiaceae)*. ..... *P. lateritia*

7. Ascospores 35–45 × 20–24 µm, conidia 40–63 × 17–21 µm, microconidia absent, on *Mauria (Anacardiaceae)* ..... *P. escharoides*

7. Ascospores 40–45 × 10–14 µm, conidia 40–56 × 18–20 µm, microconidia 3–5 × 1.5–2.5 µm, on *Buddleja (Scrophulariaceae)* ..... *P. torrendii*

7. Ascospores 36–52 × 13–20 µm, conidia 60–65 × 18–20 µm, microconidia 9–12 × 8–10 µm, on *Oryctanthus (Loranthaceae)* ..... *P. sydowii*

7. Ascospores 55–66 × 17–21 µm, conidia 56–80 × 23–38 µm, microconidia 2.5–4 × 2–2.5 µm, on *Hura (Euphorbiaceae)*. ..... *P. hurae* ["*urae*"]

8. Ascospores 27–38 × 12–15 µm, conidia 50–72 × 12–14 µm, microconidia 5–7.5 × 4–6.5 µm, on *Tapirira*. ..... *P. brasiliensis*

8. Ascospores 45–60 × 12–16 µm, conidia 62–80 × 16–22 µm, microconidia 6–8 × 2–3 µm, on *Clusia (Clusiaceae)* ..... *P. clusiae*

9. Ascospores 1–5-septate, 52–86 × 11–15 µm, conidia 65–100 × 14–17 µm, on *Struthanthus* and other *Loranthaceae*. ..... *P. struthanthi*

9. Ascospores 1–3-septate 10

10. Ascospores 50–70 × 9–12 µm, conidia 50–77 × 12–14, on legumes. ..... *P. fusispora*

10. Ascospores 60–82 × 9–14 µm, conidia 80–100 × 15–18 µm, on *Calophyllum (Clusiaceae)*. ..... *P. portoricensis*

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Two new species of *Phylloporia* (*Basidiomycota, Hymenochaetaceae*) from China

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Abstract — The knowledge of *Phylloporia* in China is briefly summarized, and an identification key to the Chinese species in the genus is supplied. Two new species, *P. hainaniana* and *P. oblongospora*, are described and illustrated. The former species is characterized by its triquetrous pileus in section, relatively larger pores (4–6 per mm), and bigger, ellipsoid basidiospores (4.6–5.6 × 3–3.6 µm). *Phylloporia oblongospora* differs from other species in the genus by its homogeneous context, larger pores (2–4 per mm), and oblong ellipsoid basidiospores (4–4.8 × 2–2.5 µm).

Key words — basidiomycetes, polypore, taxonomy, wood-rotting fungi

Introduction

Phylloporia Murrill was defined for annual and monomitic species with duplex context and tiny coloured spores (Ryvarden 1991). However, based on the molecular and morphological study, some perennial and dimitic species were included in the genus, and they all form a monophyletic clade (Wagner & Ryvarden 2002). A modified definition on genus was proposed by Wagner &

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Ryvarden (2002), which includes annual to perennial, monomitic to dimitic species with duplex context and tiny coloured spores. Twelve species are accepted worldwide, most occurring in the tropics (Murrill 1904, Ryvarden & Johansen 1980, Wagner & Ryvarden 2002).

During the study on wood-decaying fungi from southern China, two species of *Phylloporia* could not be identified to any known species. They are described in the present paper as *Phylloporia hainaniana* and *P. oblongospora*. In addition, an identification key to the species of *Phylloporia* occurring in China is provided.

Materials and methods

The studied specimens were deposited in herbaria as cited below. The microscopic procedure follows Cui et al. (2007). In presenting the variation in the size of the spores, 5% of measurements were excluded from each end of the range, and given in parentheses. In the text the following abbreviations are used: IKI = Melzer's reagent, IKI– = negative in Melzer's reagent, KOH = 5% potassium hydroxide, CB = Cotton Blue, CB+ = cyanophilous, CB– = acyanophilous, L = mean spore length (arithmetic average of all spores), W = mean spore width (arithmetic average of all spores), Q = variation in the L/W ratios between the specimens studied, n = number of spores measured from given number of specimens. Sections were studied at magnification up to ×1000 using a Nikon Eclipse E 80i microscope and phase contrast illumination. Drawings were made with the aid of a drawing tube. Special colour terms follow Petersen (1996) and Anonymous (1969).

Taxonomy

Phylloporia hainaniana Y.C. Dai & B.K. Cui, **sp. nov.** FIG. 1

MycoBank MB 513324

Carpophorum annuum, pileatum, imbricatum; facies pororum bubalina vel mellea, pori rotundi vel angulati, 4–6 per mm. Systema hypharum monomiticum, hyphae septatae sine fibulis, hyphae contexti 3–8 µm, hyphae tomenti 4–9 µm, setae nullae; sporae flavidae, ellipsoideae, crassitunicatae, 4.6–5.6 × 3–3.6 µm.

TYPE. — China. Hainan Province, Qiongzhong County, Limushan Nature Reserve, on living angiosperm tree, 23.V.2008 Dai 9460 (**holotype** in IFP).

ETYMOLOGY — *hainaniana* (Lat.): refers to Hainan, the province name in China.

FRUITBODY — Basidiocarps annual, pileate, a few imbricate, broadly attached, soft corky and without odour or taste when fresh, becoming corky when dry; pileus triquetrous in section, projecting up to 0.7 cm, 1 cm broad and 10 mm thick at base. Pileal surface olivaceous buff when fresh, becoming fulvous when dry, azonate, tomentose; margin obtuse, buff yellowish. Poroid surface buff when fresh, becoming cinnamon buff when dry, more or less shining; margin

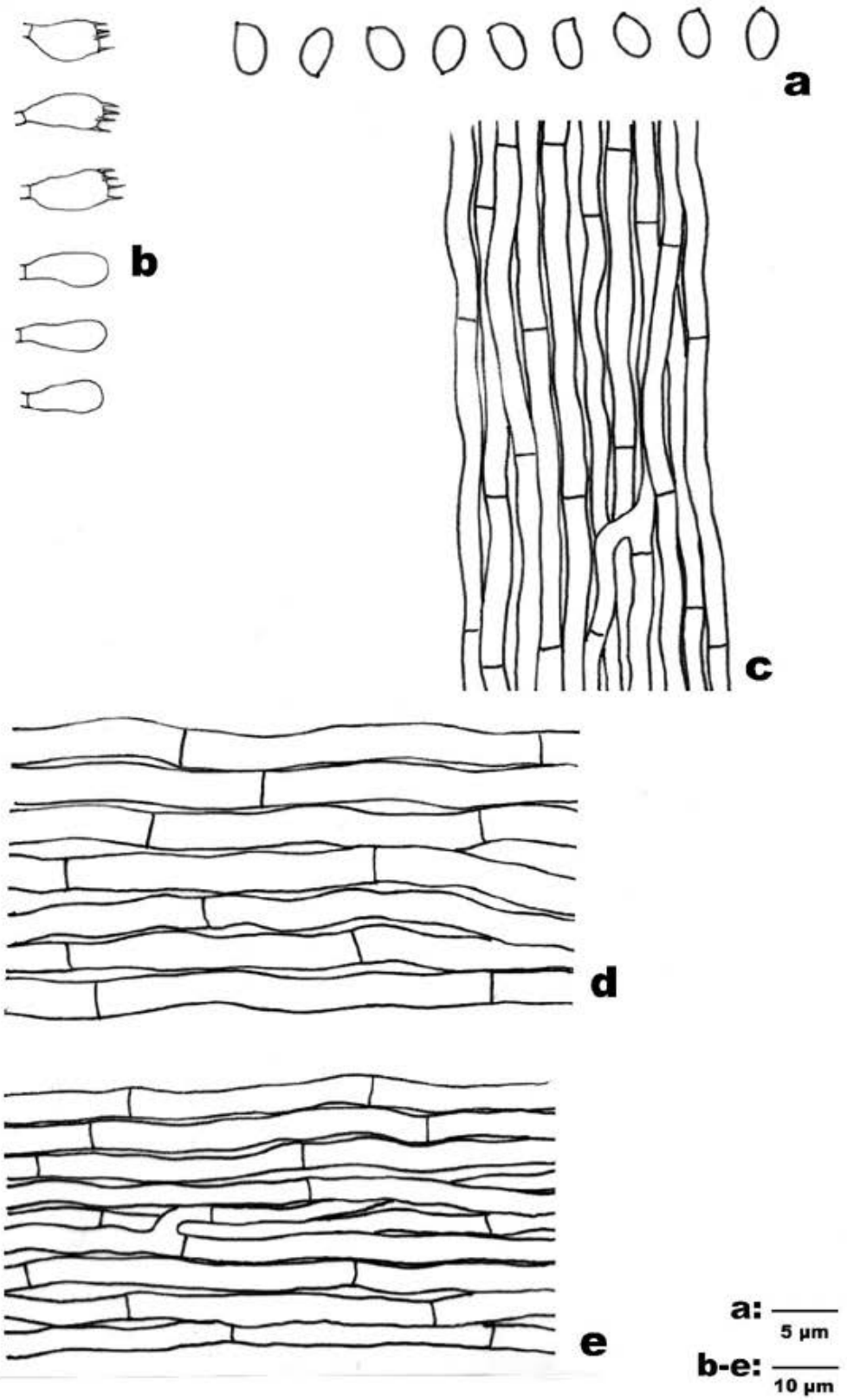

FIG. 1. Microscopic structures of *Phylloporia hainaniana* (drawn from the holotype). a: Basidiospores. b: Basidia and basidioles. c: Hyphae from tube trama. d: Hyphae from tomentum. e: Hyphae from context.

buff-yellow, narrow to almost lacking; pores circular or angular, 4–6 per mm, dissepiments thin, entire to slightly lacerate. Context cinnamon to fulvous, corky, up to 8 mm thick, duplex, a black line present, lower context hard corky, ca. 3 mm thick, upper tomentum soft corky, ca. 5 mm thick. Tubes cinnamon, slightly darker than pore surface, up to 2 mm long.

HYPHAL STRUCTURE — Hyphal system monomitic; all septa without clamp connections; tissue becoming bloody red but otherwise unchanged in KOH.

CONTEXT — Hyphae in the lower context pale yellowish brown, thin- to slightly thick-walled with a wide lumen, rarely branched, regularly arranged, 3–8 μm in diam; hyphae of tomentum yellowish brown, thin- to slightly thick-walled with a wide lumen, rarely branched, frequently simple septate, straight, regularly arranged, moderately CB+, some collapsed, 4–9 μm in diam; hyphae in the black zone dark brown, distinctly thick-walled with a narrow lumen, strongly agglutinate, winding and interwoven.

TUBES — Tramal hyphae hyaline to pale yellowish brown, thin-walled, occasionally branched, frequently simple septate, straight, parallel along the tubes, weakly or moderately CB+, 3–5 μm in diam. Setae absent; basidia clavate, with four sterigmata and a simple septum at the base, 13–23 × 4–6 μm; basidioles mostly pear-shaped, slightly smaller than basidia.

SPORES — Basidiospores ellipsoid, yellowish, fairly thick-walled, usually bearing a small guttule, more or less collapsed, IKI–, moderately CB+, (4.2–)4.6–5.6 (–6) × (2.8–)3–3.6(–3.9) μm, L = 5 μm, W = 3.11 μm, Q = 1.61 (n = 30/1).

ADDITIONAL SPECIMEN (PARATYPE) EXAMINED — **China.** Hainan Prov., Ledong County, Jianfengling Nature Reserve, angiosperm twig, 17.XI.2007 Cui 5160 (BJFC).

REMARKS — The pileate basidiocarps with a tomentum, a monomitic hyphal structure, ellipsoid, yellowish, and fairly thick-walled basidiospores, and a growth on living stem of shrub, make the species distinct in *Phylloporia*. The basidiospores of this species (4.6–5.6 × 3–3.6 μm) are the largest so far recorded for the genus, all other species having basidiospores less than 5 μm in greatest dimension (Wagner & Ryvarden 2002).

Phylloporia verae-crucis (Berk. ex Sacc.) Ryvarden has slightly smaller basidiospores (4–4.5 × 3–3.5 μm, Wagner & Ryvarden 2002); however, it sometimes has a laterally stipe, and its pores are distinctly smaller (7–9 per mm, Wagner & Ryvarden 2002). In addition, it lives on soil over buried wood, and occurs in South America (Wagner & Ryvarden 2002).

Following the identification key to the genus by Wagner & Ryvarden (2002), *Phylloporia hainaniana* would be close to *Phylloporia ampelina* (Bondartsev & Singer) Bondartsev, which has brittle and chalky basidiocarps and staining upper surface. In addition, its basidiospores are smaller (3.2–4 × 2.5–2.8 μm), and it grows on *Vitis* and is found so far in Central Asia (Bondartsev 1953).

Phylloporia oblongospora Y.C. Dai & H.S. Yuan, **sp. nov.** FIG. 2

MYCOBANK MB 513325

Carpophorum annuum, pileatum; facies pororum fulva, pori poroundi vel angulati, 2–4 per mm. Systema hypharum monomiticum, hyphae septatae sine fibulis, hyphae contexti 4–6 µm, setae nullae; sporae flavidae, oblongo-ellipsoideae, crassitunicatae, 4–4.8 × 2–2.5 µm.

TYPE. — China. Guangxi Auto. Reg., Longzhou County, Nonggang Nature Reserve, on living branch of angiosperm tree, 14.VII.2007 Zhou 179 (**holotype** in IFP).

ETYMOLOGY — *oblongospora* (Lat.): refers to oblong ellipsoid basidiospores.

FRUITBODY — Basidiocarps annual, pileate, soft corky and without odour or taste when fresh, becoming corky to fragile when dry, pileus circular, projecting up to 2 cm, 3 cm broad and 5 mm thick at base. Pileal surface yellowish brown when dry, concentrically zonate, velutinate to smooth; margin sharp, concolorous to pileal surface. Poroid surface fulvous brown when dry; margin buff-yellow, up to 2 mm wide; pores circular to angular, 2–4 per mm, dissepiments very thin, strongly lacerate. Context cinnamon buff, soft corky, thin, up to 1 mm thick, homogeneous. Tubes concolorous to pore surface, slightly darker than context, up to 4 mm long.

HYPHAL STRUCTURE — Hyphal system monomitic; all septa without clamp connections; tissue becoming bloody red but otherwise unchanged in KOH.

CONTEXT — Contextual hyphae pale yellowish, thin- to fairly thick-walled with a wide lumen, occasionally branched, frequently septate, more or less flexuous, loosely interwoven, 4–6 µm in diam.

TUBES — Tramal hyphae hyaline to pale yellowish, thin-walled, rarely branched, frequently simple septate, more or less straight, subparallel along the tubes, 2–4 µm in diam. Setae absent; basidia clavate, with four sterigmata and a simple septum at the base, 10–15 × 4.5–5.5 µm; basidioles in shape similar to basidia, slightly smaller.

SPORES — Basidiospores oblong ellipsoid, slightly curved, yellowish, fairly thick-walled, smooth, IKI–, moderately CB+, (3.9–)4–4.8(–4.9) × (1.9–)2–2.5(–2.6) µm, L = 4.33 W = 2.15 µm, Q = 2.01 (n = 30/1).

REMARKS — *Phylloporia oblongospora* is characterized by an annual growth, homogenous context, large pores, and oblong ellipsoid basidiospores. It has homogenous context, which is exceptional in *Phylloporia;* however, its hyphal structure, basidiospores, and living environment fit the genus well.

Phylloporia oblongospora and *P. fruticum* (Berk. & M.A. Curtis) Ryvarden share very similar pore morphology, but the latter species has distinct duplex context and especially broadly ellipsoid to subglobose basidiospores (3–4.5 × 2.5–3 µm, Wagner & Ryvarden 2002).

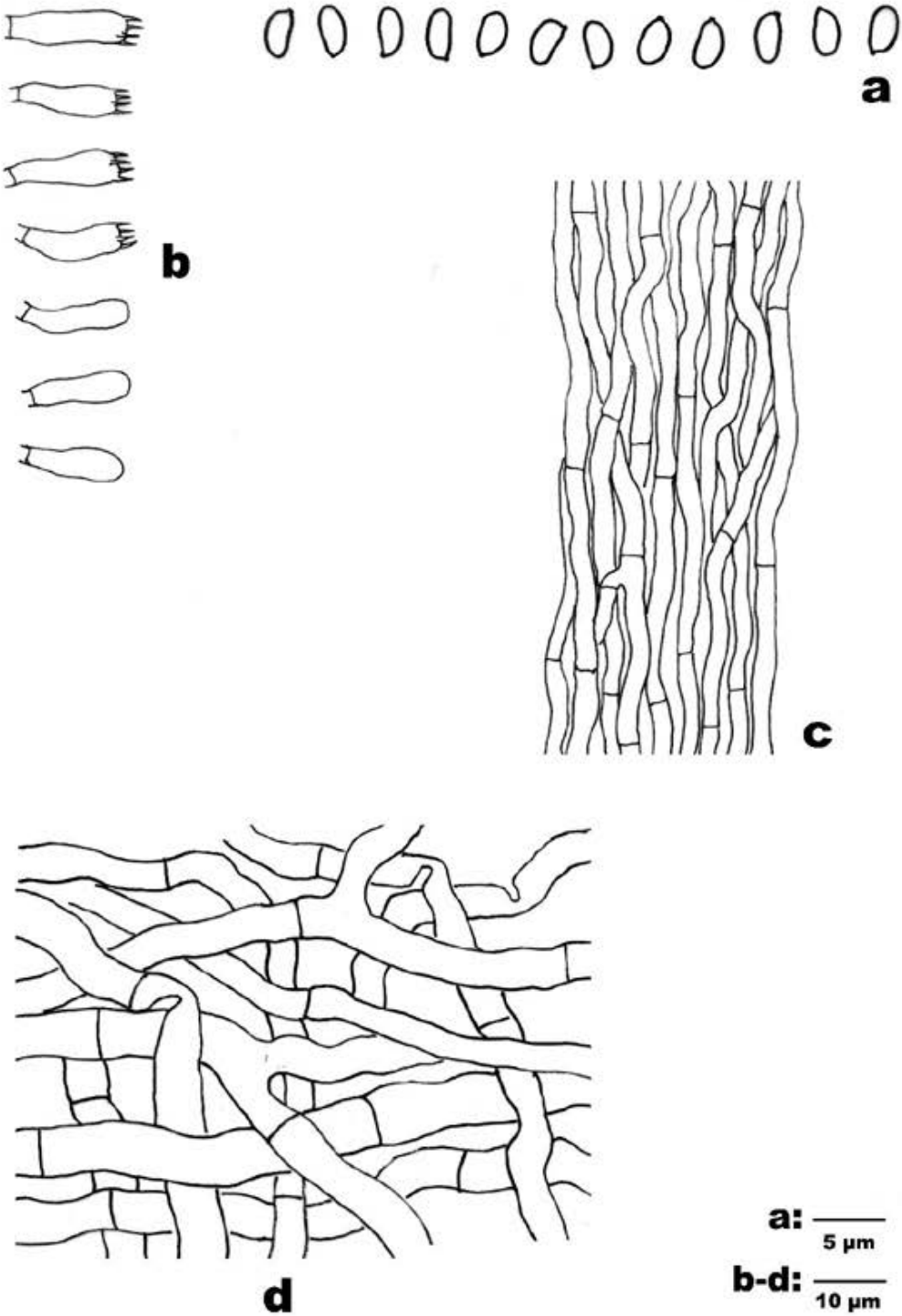

Fig. 2. Microscopic structures of *Phylloporia oblongospora* (drawn from the holotype).
a: Basidiospores. b: Basidia and basidioles.
c: Hyphae from tube trama. d: Hyphae from context.

So far, six species in *Phylloporia* have been recorded from China (Dai 1999, Dai et al. 2007a, b, Li et al. 2007, Cui et al. 2008). An identification key to the species of *Phylloporia* occurring in China is provided as following.

Key to species of *Phylloporia* in China

(spore dimensions are provided after species names)

1. Basidiocarps perennial, margin acute, hyphae in the upper tomentum acyanophilous 2
1. Basidiocarps annual, margin obtuse, hyphae in the tomentum moderately cyanophilous 3
2. Pores 6–8 per mm, hyphal system dimitic, cystidioles present ..... *P. ribis* (Schumach.) Ryvarden
   (2.8–)3–3.8(–4.1) × (1.9–)2–2.6(–2.7) µm,
   L = 3.51 µm, W = 2.22 µm, Q = 1.34–1.58 (n = 60/2)
2. Pores 8–11 per mm, hyphal system monomitic, cystidioles absent ..... *P. pectinata* (Klotzsch) Ryvarden
   (2.4–)2.7–3.3(–3.6) × (1.9–)2–2.5(–2.8) µm,
   L = 2.96 µm, W = 2.21 µm, Q = 1.33–1.35 (n = 60/2)
3. Pores 2–4 per mm, context homogeneous; basidiospores oblong ellipsoid ..... *P. oblongospora*
   (3.9–)4–4.8(–4.9) × (1.9–)2–2.5(–2.6) µm,
   L = 4.33, W = 2.15 µm, Q = 2.01 (n = 30/1).
3. Pores 4–9 per mm, context duplex, basidiospores ellipsoid 4
4. Pores 4–6 per mm, basidiospores > 4.6 µm in length ..... *P. hainaniana*
   (4.2–)4.6–5.6(–6) × (2.8–)3–3.6(–3.9) µm,
   L = 5 µm, W = 3.11 µm, Q = 1.61 (n = 30/1)
4. Pores 6–9 per mm, basidiospores < 4.6 µm in length 5
5. The tomentum up to 1.5 cm thick, concentrically zonate, hyphae of tomentum 5–9 µm in diam, tramal hyphae distinctly thick-walled, infrequently septate ..... *P. weberiana* (Bres. & Henn. ex Sacc.) Ryvarden
   (3–)3.4–4.1(–4.5) × (2–)2.2–3(–3.2) µm,
   L = 3.76 µm, W = 2.52 µm, Q = 1.49 (n = 30/1)
5. The tomentum up to 0.5 cm thick, azonate, hyphae of tomentum 4–6 µm in diam, tramal hyphae fairly thick-walled, frequently septate ..... *P. bibulosa* (Lloyd) Ryvarden
   3.1–)3.5–4.6(–5) × (2.1–)2.3–3.2(–3.7) µm,
   L = 4.12 µm, W = 2.74 µm, Q = 1.44–1.57 (n = 60/2)

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Revised description of *Pseudocercospora cornicola*

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Abstract — *Pseudocercospora cornicola* (basionym *Cercospora cornicola*), the causal organism of cercospora leaf spot on flowering dogwood, was redescribed and illustrated from its type material and from fresh collections made in Alabama, where it is of common occurrence. Sequence data was obtained from four isolates to support the morphological data for species and generic concepts. The appropriateness of its generic classification is discussed and comments are made on previous descriptions and circumscription of the genera *Cercospora*, *Pseudocercospora*, and *Pseudocercosporella*.

Key words — *Cornus florida*, hyphomycete, sequence analysis, taxonomy

Introduction

The hyphomycetous anamorph *Cercospora cornicola* was first named and described in 1896, based on a collection made the previous year on languishing leaves of *Cornus florida* at Ocean Springs, Mississippi by S.M. Tracy & F.S. Earle. The fungus was described by Tracy & Earle (1896) as follows:

> "Epiphyllous, on irregular brown deadened spots without a definite border, 5–10 mm. Hyphae densely clustered from a nodular base, very short, continuous, somewhat flexuous, olivaceous, 11–15 by 3–4 μm; conidia slender, thread-like, somewhat curved, mostly continuous, hyaline or light olivaceous, 60–70 by 2–3 μm."

Type specimens were deposited in the herbaria of Cornell University (CUP), the U.S. Department of Agriculture (BPI), Rutgers College (RUT), Columbia University, and Harvard University (FH).

Chupp (1953) emended Tracy & Earle's description of *C. cornicola*, describing it thusly:

> "Leaf spots irregular brown areas without definite borders, 5–10 mm in extent; fruiting epiphyllous; stroma small, dark, globular, 20–40 μm in diameter; fascicles dense to very dense; conidiophores very pale

olivaceous brown, delicate, wavy, uniform in width and color, septa not visible, not or rarely mildly geniculate, not branched, rounded tip, spore scars not visible, 2–3.5 × 10–25 µm; conidia narrowly obclavate, subhyaline to very pale olivaceous, mildly curved, obconic base, subacute tip, septa indistinct, 2–3 × 20–70 µm."

Hosts were listed as *Cornus florida*, *C. officinalis* Siebold & Zucc., *C. controversa* Hemsl., and *Cornus* spp. (Chupp 1953).

The original description of *Cercospora* by Fresenius allowed a broad concept of the genus to be adopted, as a result of which hundreds of species were classified within it. However, it has subsequently been broken down into smaller, more narrowly defined, segregate genera, including *Pseudocercospora* Speg. and *Pseudocercosporella* Deighton. Modern descriptions of these two genera can be found in Ellis (1971) and Braun (1995), respectively. *Cercospora cornicola* lacks the prominent, thickened conidiophore and conidial scars typical of *Cercospora* and hence was reclassified by Guo & Liu (1989) as *Pseudocercospora cornicola*, but it was not given a comprehensive, updated description.

Pseudocercospora and *Pseudocercosporella* are closely related genera that are part of a continuum (Braun 1995). The main difference between the two is that *Pseudocercosporella* consists of fungi with colorless conidiophores and conidia and well-developed, hyaline or subhyaline, rarely pigmented, stromata, whereas *Pseudocercospora* species have pigmented conidiophores and conidia (Braun 1995).

Pseudocercospora cornicola occurs commonly on living leaves of flowering dogwood (*C. florida*) in the southeastern United States. Records exist of its occurrence in Japan (Chupp 1953) and China (Guo & Liu 1989). Recent fresh collections obtained in Alabama and examination of the type material of *C. cornicola* has allowed the opportunity to provide a more thorough taxonomic description with illustration.

Taxonomic description

Pseudocercospora cornicola (Tracy & Earle) Y.L. Guo & X.J. Liu, Mycosystema 2: 232, 1989. FIG. 1

≡ *Cercospora cornicola* Tracy & Earle, Bulletin of the Torrey Botanical Club 23:205, 1896.

Leaf spots necrotic lesions, vein-limited, angular, irregularly shaped, up to 10 mm in diameter, and often confluent. Mycelium internal; composed of branched, septate, pale brown hyphae; and 2–3 µm in diameter. Caespituli epiphyllous, consisting of punctiform fascicles, olivaceous brown, discrete, usually abundant, and gregarious to somewhat scattered. Stroma well-developed; erumpent; partly superficial, partly immersed; pale to mid-brown; composed of densely packed, predominately isodiametric, subglobose to somewhat angular cells; pseudoparenchymatous; and up to 70 µm in diameter. Conidiophores

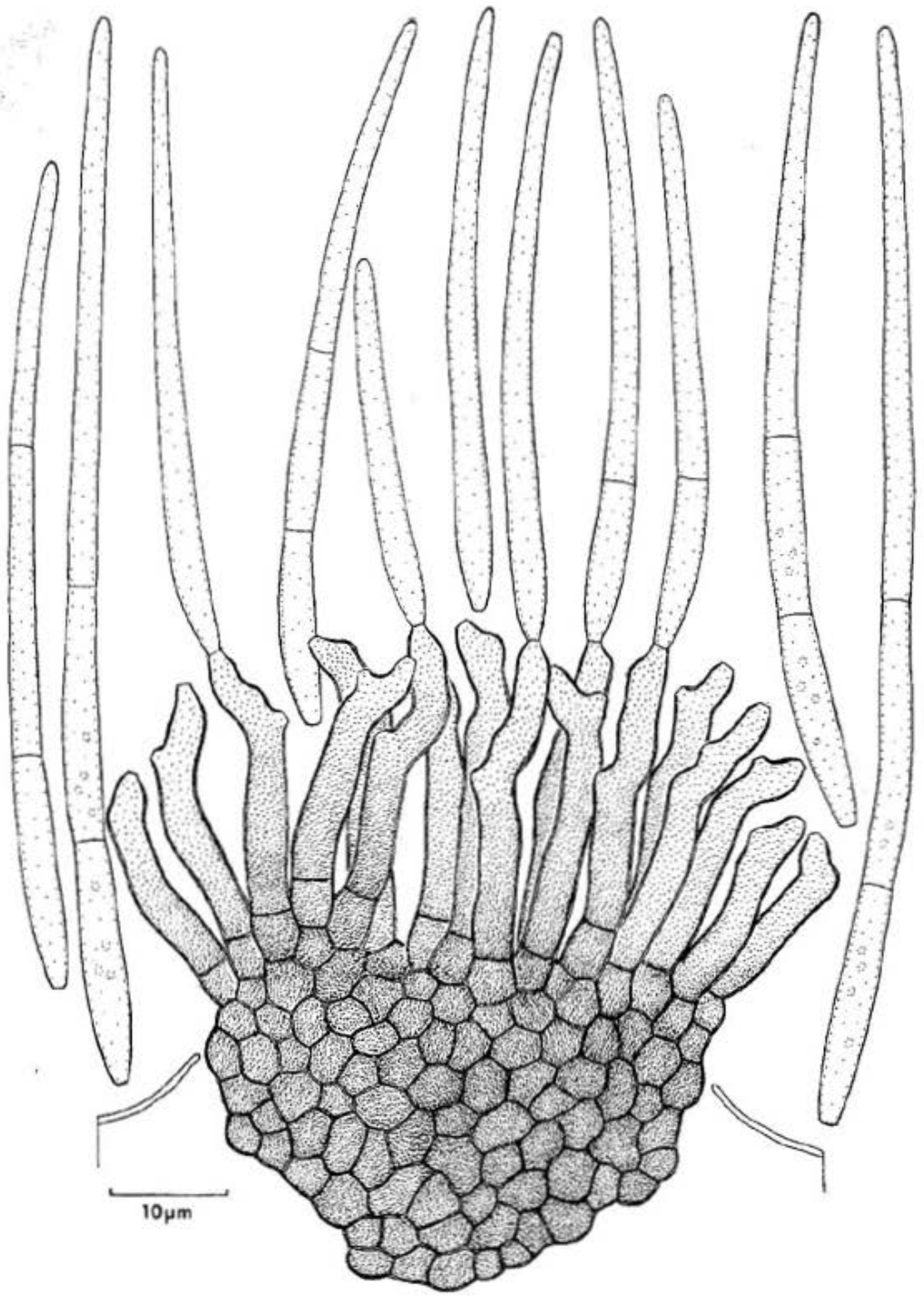

FIGURE 1. *Pseudocercospora cornicola* caespituli.

numerous in dense fascicles, pale olivaceous brown, smooth walled, cylindrical, straight, or slightly curved, becoming geniculate distally with age, usually one septum, 2–3 µm in width, up to 4 µm at the base, and up to 25 µm in length. Conidia narrowly obclavate, hyaline to very pale olivaceous-brown, straight to slightly curved, faintly septate, usually 1–2 septa, sometimes 3 septa, obtuse at apex, truncate at base, 2–3 µm in width, and 20–70 µm in length.

Cosmopolitan on living leaves of *C. florida* L.

COLLECTIONS EXAMINED (all on *Cornus florida*): ALABAMA—Elmore County, Wetumpka: August 31, 2005, K. N. Conner, AUA; Lee County, Auburn: August 31, 2005, K. N. Conner, AUA. MISSISSIPPI—Ocean Springs: September 29, 1895 [CUP-039517, **isotype**].

Sequence analysis

Four isolates of *P. cornicola* (collected from Auburn, Lee County and Wetumpka, Elmore County, Alabama) were grown on Acidic Potato Dextrose Agar (APDA) at 30°C for 4 weeks. DNA was extracted with an UltraClean™ Microbial DNA Isolation Kit (MoBio Laboratories, Carlsbad, CA) following manufacturers recommendations. The DNA was amplified using universal fungal primers 2234C and 3126T, designed to amplify the 3' end of the 18S ribosomal RNA gene, internal transcribed spacer 1, 5.8S ribosomal RNA gene, internal transcribed spacer 2, and the 5' end of the 28S ribosomal RNA gene (Ranjard et al. 2001). The PCR products (approximately 500 bp) were sequenced and deposited in GenBank (accessions GU573789, GU573790, GU991657, and GU991658). The four sequences were compared to those present in GenBank using the nucleotide basic local alignment search tool (nBLAST) to support the morphological data and generic placement (Altschul et al. 1990).

Discussion

Although currently classified in *Pseudocercospora*, *P. cornicola* has some characteristics in common with taxa placed in *Pseudocercosporella*, particularly the presence of conidiophores bearing inconspicuous, unthickened, colorless conidial scars and filiform, thin-walled conidia whose base is also unthickened (Braun 1995). On account of this, *Pseudocercosporella* might be a more appropriate generic home for this species. However, the stromata and conidiophores are somewhat pigmented and therefore its placement in *Pseudocercospora* is probably warranted. This taxon is, essentially, an entity with features that are intermediate between the two genera. The ITS sequence data showed a 98% similarity between the four isolates and 97% or higher similarity with other *Pseudocercospora* sequences found in GenBank. Furthermore, the *P. cornicola* sequences showed 91% or lower similarity to *Cercospora* sequences and 83%

or lower similarity to *Pseudocercosporella* sequences found in GenBank, which supports the generic placement.

The revised description differs notably from previous accounts in that the stroma is well developed and up to 70 µm in diameter, the conidiophores become geniculate distally with age and usually contain one septum, and the conidia are faintly septate, usually containing 1–2 and sometimes 3 septa. With this new description there should be no confusion as to the identity of *P. cornicola* on flowering dogwoods.

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Taxonomic implications of antheridial variability in forty-five watermold isolates: a statistical analysis

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Abstract – Morphological variability of sexual features used in watermold identification renders species identifications difficult and calls into question the taxonomic utility of these characters. Herein I have employed chi square statistical analysis to quantify antheridial character state distribution differences between replicate pairs of 38 isolates representing the saprolegniaceous genera *Achlya*, *Saprolegnia*, *Thraustotheca*, and 7 non-sporulating watermolds. Thirty-nine of 45 pairs differed at or below the P=.05 significance level, suggesting that current morphological species concepts are inadequate, at least for *Achlya* and *Saprolegnia*.

Key words – *Oomycota*, *Saprolegniaceae*, morphology, systematics

Introduction

Identification of watermolds (*Saprolegniales*, *Oomycota*) belonging to the genera *Achlya* Nees and *Saprolegnia* Nees has long been problematic owing principally to extensive morphological overlap among recognized species (Johnson et al. 2002). Hulvey et al. (2007) studied this problem in 55 isolates of *Saprolegnia* and demonstrated that little correlation exists between species boundaries based on sexual morphology and those based on gene sequence analysis.

More recently, Sheffer & Padgett (2008) demonstrated that variations in oospore diameter, oospore centricity, antheridial origin, and antheridial appression among subcultures of a single *Saprolegnia* isolate were as great as those that have been used to separate different species in other studies. Their study called into question the taxonomic validity of these sexual characters. The principal unanswered question arising from their report was whether or not the isolate in question was aberrant or demonstrated a degree of variability that applied to the genus or family as a whole. The present study was designed to answer this larger question by assessing the extent of antheridial variability between replicate colonies of 45 isolates belonging to *Achlya* (26 isolates),

Saprolegnia (10 isolates), *Thraustotheca* Humphrey (2 isolates), and non-sporulating watermolds (7 isolates).

Materials and methods

I extracted the data for the current investigation from a much broader study (hereafter referred to as the 'master study') aimed at reevaluating the taxonomic foundation of the family *Saprolegniaceae*. In the course of the master study, approximately 490 watermolds either were acquired from culture collections (the Centraalbureau voor Schimmelcultures [CBS] and the American Type Culture Collection [ATCC]) or isolated from soil samples collected in Italy, Australia, Costa Rica, Canada, Hawaii, and the continental United States. All culture numbers cited herein (TABLE 1) refer to stocks maintained, during the master study, in the watermold culture collection at the University of North Carolina Wilmington.

All isolations from soil were made using standard methods (Johnson 1956, Seymour 1970) as modified below. Soil samples (10 g) were dispensed into disposable 15 × 100 mm Petri dishes, flooded with distilled water (DW), and baited with sterile, shelled hemp seeds (hs). Culture plates then were incubated at room temperature until watermold colonies developed. Axenic cultures subsequently were derived by single spore or hyphal tip isolations from gross cultures and maintained on hs in water and on Difco corn meal agar (CMA) in preparation for microscopic analysis.

Morphological characterization of all axenic isolates required 10 replicate, DW-grown subcultures for each watermold. These were initiated first by infesting 10 sterile hs for 24 h at the edge of CMA-grown colonies then transferring individual, infested hs to separate Petri dishes containing 20 mL of DW. After incubation at room temperature for 24 to 48 h isolates were identified to genus by observing zoosporangial discharge from 10 primary sporangia. Incubation then continued for up to 14 days until mature oogonia and antheridia were visible.

As asexual and sexual features matured through time, individual colonies (of the 10 replicates for each isolate) were harvested for morphological characterization; qualitative data were recorded on separate data sheets (one data sheet per replicate subculture). These observations were made using Olympus phase contrast microscopes with 400× magnification. During data collection we attempted to record 50 observations for all sexual characters presented by a particular colony at the time of harvest, but rarely were unobstructed views of this number available.

Of the 490 watermolds acquired in the master study we identified all that produced zoosporangia to genus. About half of the axenic cultures subsequently produced sexual features, but few were good fits to described species. I limited isolates for the present statistical analysis to those with 50 character state observations of the same sexual character on each of two separate data sheets (i.e. from two separate replicate colonies of the same isolate). Ultimately only 45 isolates met this criterion and of those only two sexual characters (antheridial origin and antheridial appression) consistently presented the required sample sizes. Thirty-five cultures qualified for statistical analysis for both antheridial characters and the remaining 10 qualified for one character. Hereafter the two replicates for each qualifying culture are referred to as a 'replicate pair' (RP).

All RPs in the test pool presented 3 character states for antheridial origin – monoclinous, diclinous, and androgynous – , and 3 for antheridial appression – apical, lateral, and projections (illustrations in Johnson 1956). Members of each RP were compared for uniformity of character state distribution (for both characters) using Chi square statistical analysis. For calculation purposes I used the mean value (per character state) as the 'expected' value for the particular RP. This necessitated doubling each 'calculated' Chi square to derive the value used for comparison to the appropriate tabular Chi square value. I considered $P=.05$ to be the maximum level for statistical significance.

Results

TABLE 1 presents results of Chi square comparisons of all 45 RPs. In all cases I made the conservative assumption that any RP for which one character had insufficient data for comparison (less than 50 observations) did not differ for that character. This being the case, when results for all genera were combined I found that only 6 of 45 RPs had no significant differences for either character. Of the remaining 39 all exhibited differences in at least one character. Furthermore 15 of 45 exhibited significant differences for both characters.

Separating results by genus revealed that all 10 RPs of *Saprolegnia* differed with respect to one or both characters, both RPs of *Thraustotheca* differed for one character, and all seven non-sporulating RPs differed for one or both characters. *Achlya* RPs were the least variable, yet 12 of 26 pairs differed with respect to one character while 8 differed for both.

Discussion

In light of the present data (TABLE 1), it is apparent that the statistically significant variability reported by Sheffer & Padgett (2008) was not aberrant but may be typical not only for *Saprolegnia* but also for *Achlya*. I am keenly aware that drawing sweeping conclusions based on data for only two sexual characters is risky. Consequently, I visually inspected raw data (from the master study described above) for other watermolds that did not qualify for the present analysis and found comparable variability in oogonial and oospore characters.

I carefully reviewed historical monographs of saprolegniaceous genera (Coker 1923, Coker & Matthews 1937, Johnson 1956, Scott 1961, Seymour 1970) and found no mention of statistical tests ever having been applied to assess variability of taxonomic characters. Clearly results reported herein demonstrate that this omission represents a serious taxonomic problem that introduces an unacceptable level of subjectivity into identifications of *Achlya* and *Saprolegnia* isolates.

New watermold species currently are being erected at an alarmingly rapid pace (e.g. Steciow 2001a,b, 2002, 2003a,b, Steciow & Elides 2002a,b,c, Steciow

TABLE 1. Chi square significance levels per replicate pair for antheridial characters

GENUS	STOCK CULTURE NUMBER^	ANTHERIDIAL ORIGIN	ANTHERIDIAL APPRESSION
Achlya	223	**	**
Achlya	234	ID[b]	**
Achlya	243	ID	***
Achlya	246	P>.25	***
Achlya	247	P>.1	***
Achlya	267	*	***
Achlya	276	**	***
Achlya	281	***	P>.25
Achlya	287	P>.25	***
Achlya	313	ID	***
Achlya	326	*	***
Achlya	342	P>.25	***
Achlya	347	*	***
Achlya	362	***	***
Achlya	367	*	ID
Achlya	418	**	***
Achlya	451	**	P>.1
Achlya	455	**	P>.1
Achlya	456	P>.1	P>.25
Achlya	460	P>.1	P>.1
Achlya	462	P>.1	P>.25
Achlya	463	P>.05	P>.25
Achlya	465	P>.25	***
Achlya	469	P>.25	ID
Achlya	485	P>.25	P>.1
Achlya	487	**	*
Saprolegnia	105	ID	***
Saprolegnia	217	***	ID
Saprolegnia	254	***	P>.25
Saprolegnia	257	P>.25	*
Saprolegnia	262	**	***
Saprolegnia	280	**	P>.25
Saprolegnia	284	***	P>.25
Saprolegnia	361	***	***
Saprolegnia	383	*	P>.1
Saprolegnia	472	**	***
Thraustotheca	60	ID	***
Thraustotheca	325	ID	***
Unknown[a]	277	P>.25	*
Unknown	291	***	ID
Unknown	292	**	***
Unknown	299	***	**
Unknown	380	*	*
Unknown	382	P>.1	***
Unknown	424	***	*

^ UNC-W watermold culture collection. [a] Unknowns did not produce zoosporangia. [b] ID = insufficient data for statistical comparison, * indicates P≤.05, ** indicates P≤.01, *** indicates P≤.001.

et al. 2007, Steciow & Marano, 2008, Paul & Steciow 2004, 2008, Johnson et al. 2005, Amal et al. 2006, Sati & Paliwal 2006), yet no descriptions have been accompanied by morphological variability assessments. Continuing this practice inevitably will render watermold taxonomy progressively more problematic.

Recent literature (e.g. Leclerc et al. 2000, Bouzenzana et al. 2006, Hulvey et al. 2007, Dieguez-Uribeondo et al. 2007, Fregeneda-Grandes et al. 2007) reflects a gratifying expansion both of biochemical and gene sequence information that no doubt will be of great value in comprehensive revision of *Oomycete* taxonomy. Such studies, however, represent only the start of a necessary baseline that must develop more fully before meaningful revision can emerge. Few scientists would argue with the paradigm that genes determine biochemistry, which determines morphology. I must infer, therefore, that the variability reported herein reflects some currently unknown disconnect between genes and morphology that renders present concepts of *Achlya* and *Saprolegnia* species inadequate.

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New records of lichens and lichenicolous fungi from Iran and their biogeographical significance

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Abstract — In this paper, 80 lichen taxa and 9 lichenicolous fungi are reported as new to Iran. These include a tropical element represented by *Lithothelium obtectum* and *Melanotopelia africana*, and a North American element with *Lecanora flowersiana*, *L. juniperina*, *L. percrenata*, and *L. wetmorei*. The full checklist is available on http://www.mycotaxon.com

Key words — lichenized fungi, new species records, biogeography

Introduction

The recently revised checklist of lichenized, lichenicolous, and allied fungi for Iran (Seaward et al. 2008) includes 632 records based on literature records and voucher material, which means an increase of 224 species as compared to an earlier list (Seaward et al. 2004). Nevertheless, the exploration of the Iranian lichen flora appears far from being complete, with Valadbeigi et al. (2010) and Haji Moniri & Sipman (2009) having added another 24 species new to this region. The present paper reports 89 additional lichens and lichenicolous fungi new to Iran.

Iran is one of the world's most mountainous countries and largely occupied by the Iranian Plateau. Extended lowlands exist only along the coasts of the Caspian Sea and in Khuzestan. The specimens for the present study were collected from six different provinces (FIG. 1) in areas with a wide range of ecological characteristics.

Fig. 1. Study areas in the six provinces:
I, Azarbayejan; II, Gilan; III, Gorgan; IV, Hamedan; V, Ilam; VI–VIII, Mazandaran.

Materials and methods

The study is based on material collected by the first author during 2004–2009. The specimens are deposited in TARI (the Research Institute of Forests and Rangelands, Tehran), with some duplicates in B (Botanischer Garten und Botanisches Museum Berlin) and the private herbarium of the first author (VH). The morphology of all specimens was studied with a stereomicroscope. The chemistry was mostly investigated by using standard spot tests. Identifications were confirmed by comparison with specimens kept in the herbarium of B or by consultation with specialists. In critical cases, chemical analyses were carried out using TLC following Orange et al. (2001), using Merck silica gel 60 F254 pre-coated glass TLC plates in solvent systems A, B', and C. Identification of the substances was confirmed by running the extract next to a reference sample with known chemistry (co-chromatography).

Phytogeographical discussion

These reports confirm that the lichen flora of Iran is mostly composed of boreal, mediterranean, and central-asian phytogeographical elements (often

widespread, as would be expected) but that it includes other lichen-floristic elements as well.

Species with a major distribution in the Himalaya and East Asia have been previously reported, such as *Cladonia awasthiana* Ahti & Upreti (Seaward et al. 2004, Ahti & Sohrabi 2006) and *Leptogium trichophorum* Müll. Arg. (Haji Moniri & Sipman 2009). Both occur in the northern mountain range, which can be considered a continuation of the Himalayas. *Cladonia awasthiana* seems widespread in the Hyrcanian forest area, while *L. trichophorum* is known so far only from a single collection around the 2500 m elevation in Northern Khorasan.

Pyrgidium montellicum (Beltr.) Tibell, reported by Seaward et al. (2004), was the first indication of a tropical element in the Iranian lichen flora. This species is mainly known from the Palaeotropics, although with outliers reported as far north as Italy (Tibell 1982, 1996). Three additional species with a predominantly tropical distribution are reported here from Iran: *Lithothelium obtectum* (Müll. Arg.) Aptroot, hitherto known to be pantropical and very common in India (Aptroot 1991); *Melanotopelia africana* Sérus. et al., known previously from tropical continental Africa, La Réunion (Sérusiaux et al. 2009) and Borneo (*Sipman 31228* in herb. B); and *Siphula decumbens* Nyl., known from the Neotropics and the Palaeotropics with an extension to Japan (Kantvilas et al. 2005). All were found in Iran along the Caspian coast in the Hyrcanian forest zone. However, the altitudinal range is 450–2600 m, and not all grow in forest habitats.

Some additional species appear to represent a North American element. This element had earlier been indicated by a group of lichens that are rather common in Iran and surroundings, although they are absent from Western Europe: *Ramalina sinensis* Jatta, *Lecanora thysanophora* R.C. Harris, and *Pyrenula subelliptica* (Tuck.) R.C. Harris (Seaward et al. 2008; for extra-Iranian distribution see Purvis et al. 1992, Brodo et al. 2001, Harris 1989). Based on the treatment of the North American representatives of the *Lecanora dispersa* group by Śliwa (2007), several further species are reported here: *Lecanora flowersiana* H. Magn., *L. juniperina* Śliwa, *L. percrenata* H. Magn., and *L. wetmorei* Śliwa. Of these only *L. percrenata* had been previously reported from outside North America, from Central Asia (Śliwa 2007). The species of this element seem to be widely distributed in Iran.

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First records of *Clathrus* (*Phallaceae, Agaricomycetes*) from the Northeast Region of Brazil

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Abstract — Two *Clathrus* specimens were collected in Northeastern Brazil during the rainy season in 2008. One specimen was identified as *C. chrysomycelinus* and the other is described as a new species, *C. cristatus*, which is distinguished by its pale red to pink receptacle and crests along the edge. Full descriptions with illustrations of the collected specimens and a key to species of *Clathrus* from Brazil are provided.

Key words — *Clathraceae*, gasteromycetes, Neotropical mycodiversity

Introduction

Clathrus P. Micheli ex L. was validated in 1753; the type species is *C. ruber* P. Micheli ex Pers. According to the most recent edition of the Dictionary of Fungi, this genus embraces 16 species, which are widespread in tropical and subtropical areas (Kirk et al. 2008).

In his treatment of the *Clathraceae,* Dring (1980) recognized 15 species and a specimen that he labelled "*Clathrus* species 1" due to the fact of having studied only a single basidioma preserved in spirit on which to base his formal diagnosis. García & López (1995) later proposed *C. mexicanus* as a new species; examination of the type material by one of us (Dr. Calonge), however, led to the conclusion that its taxonomic status is doubtful, because the basidioma

is abnormal and does not give enough information to clarify its real identity (Calonge et al. 2004). Other recent additions to the genus are *C. xiningensis* (H.A. Wen) B. Liu. (Fan et al. 1994) and *C. hainanensis* X.L. Wu (Wu 1998).

The genus is characterized by a latticed, clathrate receptacle composed of hollow, tubular arms that arise from the basal tissue within the volva (Miller & Miller 1988). The deliquescent gleba usually develops on the inner side of the receptacle and the basidiospores are elliptical and smooth (Dring 1980). The unpleasant odor produced by the gleba attracts flies and other insects, contributing to basidiospore dissemination (Maldonado-Ramírez & Torres-Pratts 2005).

The existence of the genus in Brazil has been known since the 19th century. Fidalgo (1974) reported that a *Clathrus* specimen gathered in 1826 by William John Burchell comprised the first collection of a gasteroid fungus in the country. To date, five *Clathrus* species have been recorded from Brazil (see key below) and their range is so far restricted to the Southern regions (Trierveiler-Pereira & Baseia 2009). *Clathrus chrysomycelinus,* which is the species with the widest distribution in the country, has been recorded from four states: Rio Grande do Sul (Rick 1961), Santa Catarina (Möller 1895), Paraná (de Meijer 2006), and São Paulo (Bononi et al. 1984). Two other species recorded from Brazil, *C. americanus* Lloyd and *C. pseudocrispus* Lloyd, are considered synonyms of *C. crispus* Turpin (Dring 1980).

During recent field expeditions in preserved areas of Northeastern Brazil, two distinct species of *Clathrus* were collected, one of them new to science. The purpose of this study is to present full descriptions and photos of these species and an identification key to species of *Clathrus* recorded from Brazil.

Materials and methods

Gasteromycete collection was carried out during the rainy season of 2008 (March-August) in preserved forests areas of Northeastern Brazil. RPPN Fazenda Tamanduá (7°00'35"S, 37°23'50"W) is a 325 ha remnant of 'caatinga' (xeric shrubland and thorn forest), located in the city of Santa Terezinha, state of Paraíba. Parque Ecológico João de Vasconcelos Sobrinho (8°17'00"S, 35°58'3"W), also known as 'Brejo dos Cavalos', is a 359 ha remnant of the Atlantic rain forest located in the city of Caruaru, state of Pernambuco.

Basidiomata were examined and photographed in the field. A taxonomic study was performed by observing macro and microscopic features according to Miller & Miller (1988) and Dring (1980). For scanning electron microscopy (SEM), a few drops of isopropyl alcohol were added to gleba samples, coated with gold-palladium on an Ion Sputter Coater, and observed under a Shimadzu SSX-550 scanning electron microscope. Colours were coded according to Kornerup & Wanscher (1978), with the indication "KW" bracketed in the text, and simultaneously described. Vouchers were dried slowly and are kept in the herbaria UFRN-fungi and URM (Holmgren & Holmgren 1998).

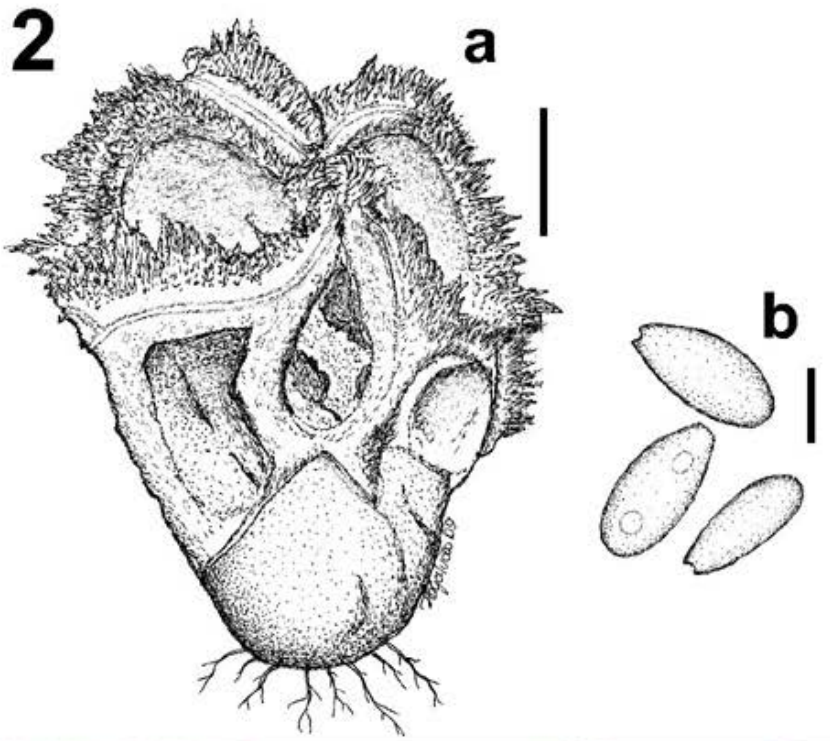
FIGURE 1. *Clathrus cristatus*. Basidiome in situ (scale bar = 2 cm).

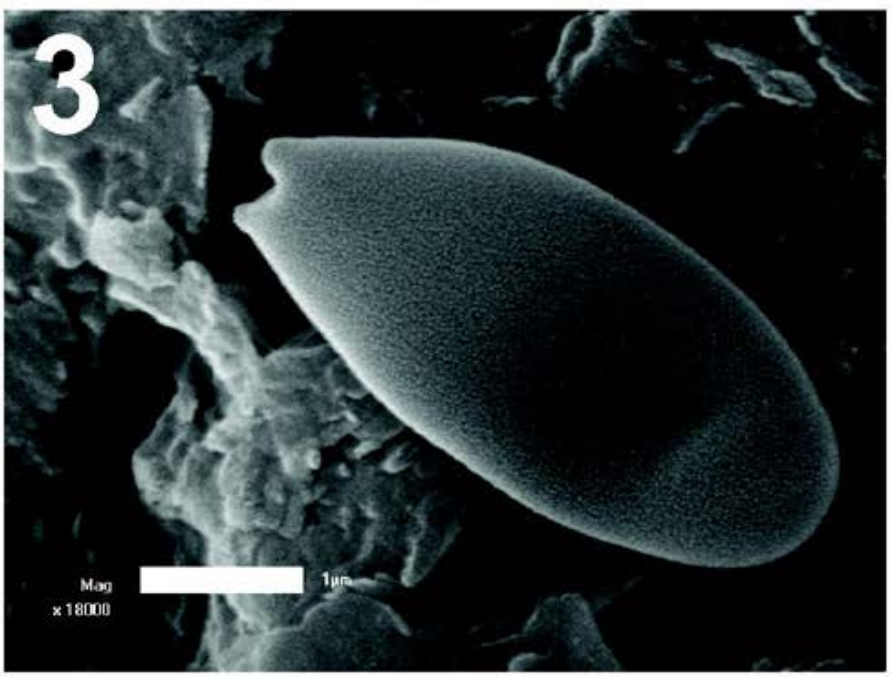
Taxonomy

Clathrus cristatus Fazolino, Calonge & Baseia, **sp. nov.** FIGS 1–3

MYCOBANK MB 515357

Volva 1.5–2 cm diam., subglobosa, brunnea-pallida, reticulata, irregulariter dehiscenten, rhizomorphis basalis albis. Receptaculo 5 cm alto, 3 cm lato; obovoideo, clathrato cum rami in dispositio symmetricus, roseus in parte externa et scarlatinus ad facies interna, margine cristata. Gleba in facies interna ad rami, olivaceus, odore grato; basidiosporis 3.5–5 × 1.5–2 micra, cylindrico-ellipsoideis, chlorohyalinis, laevis.





FIGURES 2–3. *Clathrus cristatus*.
2a. Basidiome (scale bar = 1 cm), 2b. Basidiospores (scale bar = 2 µm).
3. SEM of basidiospore (scale bar = 1 µm).

TYPE — BRAZIL. PARAÍBA: Santa Terezinha. RPPN Fazenda do Tamanduá. col. E.P. Fazolino 068. 23.III.2008 (*UFRN-FUNGI 0492*, **holotype**).

ETYMOLOGY — *cristatus* refers to the presence of crests on the edge of the top network.

Volva 1.5–2 cm diam., subglobose, light brown (KW 5D7), with a network of grooves, rooting at the base by several whitish hyphal strands (rhizomorphs); dehiscence by irregular splitting of the apex. Receptacle 5 cm high × 3 cm diam, obovoid, clathrate with a more or less symmetrical arrangement of the arms to give an irregular network of about eight meshes, with longitudinal grooves at the top ones (FIG. 1, 2), arms 4–6 mm in length, fused at the base, pastel red (KW 10A4) on the outside, shading to red (KW 10A7) within, transverse section of an arm shows two flattened tubes; upper meshes are surrounded by a fringe of crests, crests 1–5 mm long. Gleba borne on the inner face of the arms, distributed all along the arms, olivaceous (KW 3F7), odour of cheese; basidiospores 3.5–5 × 1.5–2 µm, cylindric-ellipsoid, faintly greenish tinted (chlorohyaline), smooth (FIG. 1, 3), at high magnification the surface may appear rugulose, but this is an artifact.

HABITAT — growing solitary on sandy soil.

TAXONOMIC REMARKS — *Clathrus cristatus* is distinguished by its pale red to pink receptacle and crests along the arms edges. *Clathrus preussii* Henn. also shows a fringe of teeth along the edge but these are fewer, smaller and shorter and the receptacle is dirty white. *Clathrus cristatus* arms may also resemble *Laternea pusilla* Berk. & M.A. Curtis, but a careful analysis will show that the receptacle morphology is quite different between the two species.

Clathrus chrysomycelinus Möller, Bot. Mitt. Trop. 7: 22 (1895). FIG 4

MATERIAL EXAMINED — **BRAZIL. PERNAMBUCO: Caruaru.** Parque Ecológico João de Vasconcelos Sobrinho, col. L. Trierveiler-Pereira & al., 105. 17.VI.2008 (*URM 80094*).

Volva 1.9 cm high × 2.9 cm diam, ellipsoid, external layer dark brown (KW 6F4), internal layer yellowish grey (KW 3B2), content gelatinous, rotting at the base by a central rhizomorph, up to 9 cm long, dull yellow (KW 3B4). Receptacle 5.4 cm high × 4 cm diam, subglobose to obovate, meshes more or less hexagonal, isodiametric in the upper part and elongates below, where the arms are fused and form a short stipe, arms very fragile, slender and flattened (Fig. 4), white (KW 3A1) to pale yellow (KW 4A3), stipe 1.5 cm high × 1 cm diam. Gleba restrict to glebifers that are situated at the arms junctions, olive (KW 2F6), foetid; basidiospores 3.5–4.5 × 1.5–2 µm, ellipsoid, chlorohyaline, smooth.

HABITAT — growing solitary on soil among litter.

TAXONOMIC REMARKS — Due to its white color, *C. chrysomycelinus* resembles *C. preussii* but lacks the fringe of teeth along the edge. The species may also be confused with the two *Ileodictyon* species: *I. cibarium* Tul. & C. Tul. and *I. gracile* Berk., since the receptacle color and the arm morphology are somewhat

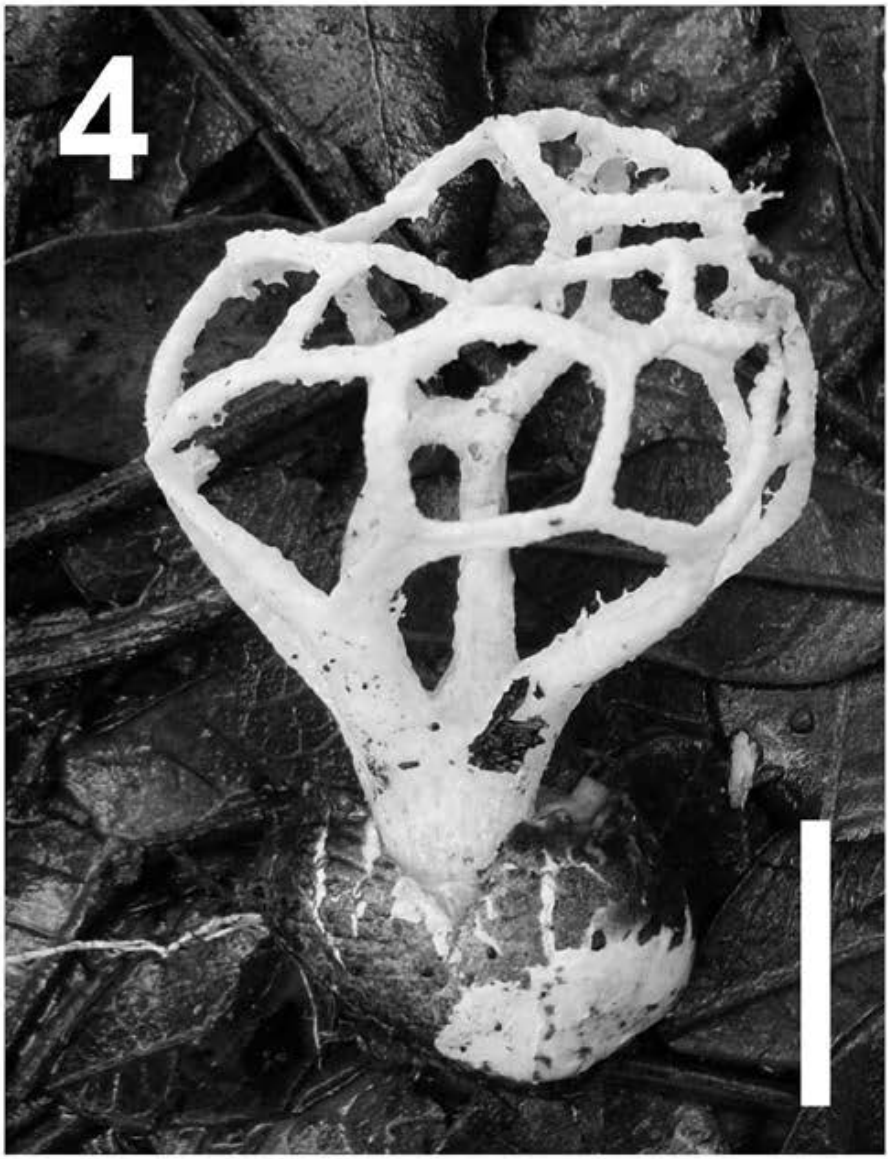


FIGURE 4. *Clathrus chrysomycelinus*. Basidiome in situ (scale bar = 2 cm).

similar. However, in *Ileodictyon* the receptacle arms are not fused to form a short stipe and the whole receptacle occasionally becomes detached from the volva. Moreover, *Ileodictyon* species have a gelatinous receptacle and simple tubular (circular in trans-section) arms without dorsiventral differentiation (Dring 1980, Miller & Miller 1988).

Key to *Clathrus* species recorded from Brazil

1a. Receptacle white, yellowish white to pale yellow 2
1b. Receptacle bright red, reddish orange to very pale red 3
2a. Arms with a fringe of small membranous teeth along the edge ..... *C. preussii*
2b. Arms without a fringe of membranous teeth ..... *C. chrysomycelinus*

3a. Receptacle pale red to pink, dense membranous teeth along the edge . . *C. cristatus*

3b. Receptacle bright red to reddish orange, arms without membranous teeth 4

4a. Receptacle formed by 2-5 thick, columnar arms, not forming meshes *C. columnatus*

4b. Receptacle arms forming meshes 5

5a. Arms massive, up to 1 cm wide, triangular in transaction, meshes surrounded by gleba, gleba forming a crown . . . . . *C. crispus*

5b. Arms slender, more or less circular in transaction, meshes without gleba forming a crown . . . . . *C. pusillus*

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Cladonia, Lecanographa, Ochrolechia, and *Placidium* species new to Turkey

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Abstract—*Cladonia dahliana, Lecanographa grumulosa, Ochrolechia inaequatula* and *Placidium imbecillum* are reported for the first time from Turkey. For each species a short description is presented.

Key Words—biodiversity, biota, Giresun, lichen, new record

Introduction

Studies on the lichen biota of Turkey are not as extensive as in many European countries. In the last two years, many new lichen species were reported for the lichen biota of Turkey (e.g. Candan & Özdemir Türk 2008, Çobanoğlu et al. 2008, Halici & Aksoy 2009, Kinalioğlu 2009, Öztürk & Güvenç 2010, Yazici & Aptroot 2008). So far a total of 518 species have been reported from Trabzon and 431 from Giresun province. The present paper is a further contribution to ongoing lichens exploration in the country.

Materials and methods

Specimens were collected in Trabzon and Giresun provinces between year 2005 and 2007. They were identified with various lichen guides (e.g. Brodo et al. 2001, Purvis et al. 1992, Wirth 1995) and determined by H. Sipman. Vouchers are preserved in the herbarium of the Faculty of Science and Arts, Giresun University, Giresun, Turkey; with some duplicates in personal herbarium of H. Sipman. The accession numbers of the collections are given in parentheses after the locality details.

Species recorded

Cladonia dahliana Kristinsson FIG. 1

Primary thallus squamulose dominant, 1–5 mm broad, 3–10 mm long, incised, the surface mostly finely rugose, greenish above, white below. Podetia

FIG. 1. *Cladonia dahliana*, habitus. Scale: 1 mm.

up to 4–5 mm tall, corticated, green, gradually tapered towards base. Cups to 4 mm wide, generally dentate at the rim. Apothecia brown, on the cup margins. Medulla K+ yellow, PD+ yellow.

SPECIMEN EXAMINED: Giresun, Dereli, Karagöl mountains, 40°35'51"N, 38°10'30"E, 3050 m, 29 Jul. 2007, on soil, *det. H. Sipman, (Kınalıoğlu* 1575*)*.

Known from Iceland, Greenland, Baffin Island on the steep soil banks and hillsides or in the steep sides of snow patches facing south (Kristinsson 1974). In Turkey the specimen was collected from soil at high altitude.

A detailed description of northern European material is provided by Kristinsson (1974).

DISCUSSION: The Turkish material differs from the northern European specimens by having podetia and a wider primary squamulose thallus.

Lecanographa grumulosa (Dufour) Egea & Torrente FIG. 2

Thallus crustose, greyish, mostly thick, cracked-areolate. Apothecia 0.3–1.5 mm diam, black, sessile when old, roundish to ellipsoid: disc plane, white pruinose, crenulate margins. Asci 8-spored, grumulosa type. Ascospores 13–18 × 3–4 µm in size, colourless, 3–4-celled when young and 5–6-celled when mature. Pycnidia not observed. Thallus and apothecial pruina C+.

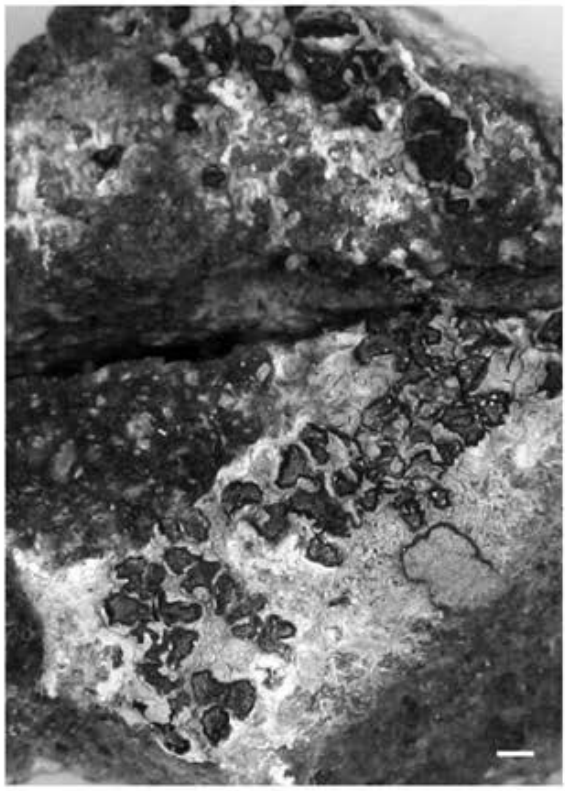

FIG. 2. *Lecanographa grumulosa*, habitus. Scale: 1 mm.

SPECIMEN EXAMINED: Giresun, Gülburnu, sea shore, 40°57'50"N, 38°39'14"E, 1 m, 10 June 2006, on siliceous rock, det. H. Sipman, (Kınalıoğlu 1462). Giresun, Keşap, Değirmenağzı village, 40°58'2"N, 38°38'33"E, 12 m, 12 Dec. 2006, on siliceous rock, det. H. Sipman, (Kınalıoğlu 1511).

Known from Europe on dry ± calcareous rocks and mortar, often on sheltered underhangs and shaded walls (Purvis et al. 1992, Egea et al. 1993). In Turkey the specimens were collected only from siliceous rock.

A detailed description of European material (as *Lecaxanactis grumulosa*) is provided by Purvis et al. (1992) and Egea et al. (1993).

DISCUSSION: The Turkish representatives of *Lecanographa grumulosa* differ from European specimens by larger apothecia and slightly larger ascospores. (Egea et al. (1993) cite ascospores as 12–17(–19) × 3–4) µm, although Purvis et al. (1992) list sizes up to 14–23 × 3–4(–5) µm). The Turkish collection differs ecologically in occurring only on siliceous rock at coastal localities.

Ochrolechia inaequatula (Nyl.) Zahlbr. FIG. 3

Thallus thick, uniformly grey-white. Soralia to 1.5 mm diam., sorediata coarse. Photobiont chlorococcoid. Apothecia not observed. Thallus PD+ pale orange.

FIG. 3. *Ochrolechia inaequatula*, habitus. Scale: 1 mm.

SPECIMEN EXAMINED: Trabzon Araklı, S of Kızılkaya Yaylası, 40°40' 21"N, 40°01'24"E, 2350 m, 18 Aug. 2005, on moss, *det. H. Sipman, (Kınalıoğlu 1474).*

Known from Scotland and Scandinavia on the bryophyte mats on exposed mountain ridges and on tops of boulders (Purvis et al. 1992). In Turkey the specimen was collected from moss at high altitude.

A detailed description of British material is provided by Purvis et al. (1992).

DISCUSSION: The soralia are smaller in the Turkish specimen than in the British material. Original descriptions of this species report soralia up to 2–3 mm diam. (Purvis et al. 1992).

Placidium imbecillum (Breuss) Breuss FIG. 4

Thallus squamulose, squamules 3–5 mm wide, adpressed to the substratum, dark brown or with a reddish tinge. Perithecia frequent, black, half immersed. Ascospores *colourless*, 13–17 × 6–7.5 µm. Thallus C–, K–, KC–, PD–.

SPECIMEN EXAMINED: Trabzon, Araklı, SE of Paskalar Yaylası, 40°40'03"N, 40°01'41"E, 2400 m, 17 Aug. 2005, on soil, det. H. Sipman, (Kınalıoğlu 1471)

Known from western Europe (Austrian Alps) and several isolated stations in southern Europe on soil (Nimis & Martellos 2004, Breuss 1990). In Turkey the specimen was also collected from soil.

A detailed description of Italian material (as *Catapyrenium imbecillum*) is provided by Nimis & Martellos (2004).

DISCUSSION: The squamules and ascospores of the Turkish material are slightly smaller than in the Italian collection. In the Italian specimen the squamule sizes are (2)3–6 mm wide, and the ascospores sizes are (12)14–18 ×6–8 µm.

FIG. 4. *Placidium imbecillum*, habitus. Scale: 1 mm.

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New species of *Hypoxylon* from western Europe and Ethiopia

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Abstract — Three new species of *Hypoxylon* are described from France, Portugal, and the United Kingdom based on new combinations of teleomorphic morphology. *Hypoxylon fuscoides* is related to *H. fuscum* but differs in having purple pigments. *Hypoxylon lusitanicum* is similar to *H. perforatum* but differs in having orange stromatal pigments. *Hypoxylon gibriacense* features glomerulate stromata and resembles the American *H. shearii* but has discoid ostiolar areas and different ascospores. In this context, *H. addis*, collected from Ethiopia, is also newly described because it appears morphologically similar to *H. gibriacense*. Their secondary metabolite profiles, as inferred from high performance liquid chromatography coupled with diode array detection and mass spectrometric detection (HPLC-DAD/MS), confirm their uniqueness as compared to related species. Lecanoric acid (widely distributed in lichenized ascomycetes) is revealed to as the major stromatal metabolite of *H. addis* and is for the first time reported as present in a xylariaceous species. A new key to European *Hypoxylon* species is provided.

Key words —*Xylariaceae*, chemotaxonomy, systematics, pyrenomycetes

Introduction

Hypoxylon Bull. has traditionally comprised the largest genus of family *Xylariaceae* with (fide Index Fungorum) over 1100 epithets associated with the generic name. The revision by Ju & Rogers (1996) introduced new species concepts based on a combination of teleomorphic and anamorphic characters

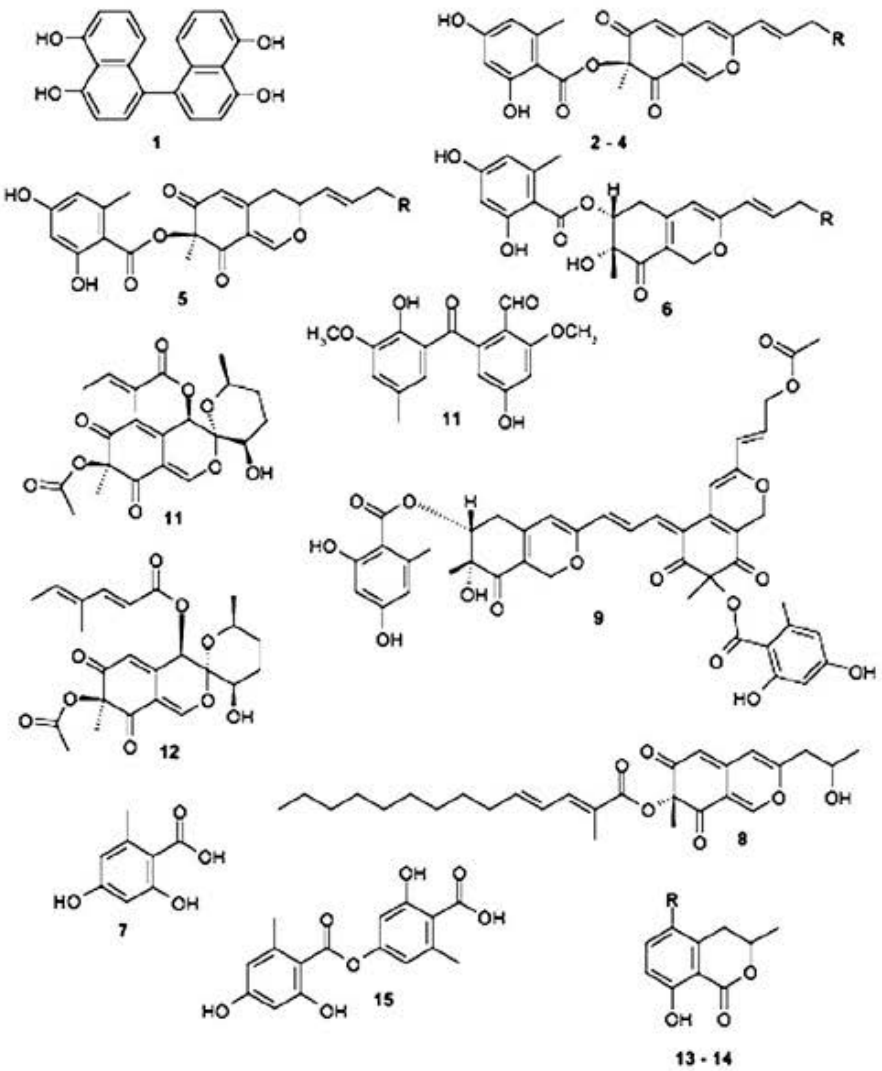

FIG. 1. Chemical structures of characteristic pigments and other secondary metabolites of *Hypoxylon* and allied genera, detected in this study by HPLC. **1**: Binaphthalene tetrol (BNT); **2**: Mitorubrin (R = H); **3**: Mitorubrinol (R = OH); **4**: Mitorubrinol acetate (R = $OCCH_3$); **5**: Hypomiltin (R = $OCCH_3$); **6**: Rubiginosin A (R = $OCCH_3$); **7**: Orsellinic acid; **8**: Rubiginosin C; **9**: Rutilin A; **10**: Daldinal A; **11**: Daldinin C; **12**: Daldinin E; **13**: Mellein.(R = H) **14**: 5-Methylmellein (R = CH_3); **15**: Lecanoric acid..

in conjunction with chemotaxonomy (i.e., stromatal pigment colors in 10% KOH). *Hypoxylon* was thus restricted to stromatic pyrenomycetes with an essentially homogenous stromatal context and *Nodulisporium*-like anamorphs. After erection of the genus *Annulohypoxylon* Y.M. Ju et al. (Hsieh et al. 2005) for sect. *Annulata* of *Hypoxylon* sensu Ju & Rogers (1996), *Hypoxylon* s. str. is now restricted to their sect. *Hypoxylon*.

In past years, we have studied several thousands of herbarium specimens and fresh material of *Hypoxylon* spp. from around the world. In addition to the characters deemed diagnostically important by Ju & Rogers (1996), we

studied secondary metabolite profiles recorded by high performance liquid chromatography coupled with diode array detection and mass spectrometry (HPLC-DAD/MS; cf. Hellwig et al. 2005, Stadler et al. 2001, 2004, 2008). Such HPLC profiles have proved quite valuable, because the production of secondary metabolites was largely found to be consistent in a given species, with the characteristic stromatal metabolites remaining stable even in ancient specimens collected up to 200 years previously. Due to this work, a comprehensive matrix of chemical and morphological data has become available that facilitates substantially the recognition of new taxa. On the other hand, novel biologically active compounds with potential utility were often encountered in rare species of *Hypoxylon*, as exemplified by the discoveries of rutilins (Quang et al. 2005) and carneic acids (Quang et al. 2006).

The current paper describes four new species of *Hypoxylon* from Western Europe and Eastern Africa that deviate significantly from all described taxa with respect to their morphological and chemotaxonomic traits.

Materials and methods

Teleomorphic structures were microscopically observed in water (to study ascospore morphology), in Melzer's reagent (to test for amyloid ascal apical structures), in Chlorazol black (to measure ascal stipes), and in 10% KOH (to test for perispore dehiscence). In cases of apparent absence or lack of reactivity of ascal apical structures in Melzer's reagent, a pretreatment by 3% KOH was attempted. Ascospores were measured in water at 1000x magnification. KOH-extractable pigments were obtained as described in Ju & Rogers (1996). Color codes follow Rayner (1970). Ascospores were photographed in water or 10% KOH. Anamorphic structures were observed microscopically in water at 400–1000× magnification using phase contrast.

Cultures were obtained from ascospores prepared from perithecial contents on yeast-malt glucose (YMG) medium supplemented by antibiotics (Stadler et al. 2008). For morphological studies, the cultures were grown YMG and Difco Oatmeal agar (OA).

HPLC analyses of stromatal methanolic extracts were carried out according to Stadler et al. (2008) in two different gradients, using UV-visual detection (HPLC-UV/Vis) with diode array detection (DAD) and mass spectrometric detection (HPLC-MS) in both the positive and negative electrospray ionisation (ESI) mode. Secondary metabolites were identified by matching their retention times (Rt), HPLC-DAD and HPLC-ESI-MS spectra with external or internal standards of pure compounds that had been obtained previously. HPLC data of extracts and pure compounds from previous studies on *Xylariaceae* (Hellwig et al. 2005, Bitzer et al. 2007, Stadler et al. 2004, 2008) were also used for comparison. Cultures were propagated on YMG medium, and their extracts analyzed on the occurrence of secondary metabolites as described by Bitzer et al. (2008). Some compounds that were detected in the new taxa described herein or in morphologically similar species are depicted in Fig. 1. The trivial names of these compounds have been assigned a **bold** number in the legend of Fig. 1, to which they are referred in the taxonomic part.

Hypoxylon fuscoides J. Fourn., P. Leroy, M. Stadler & Roy Anderson, **sp. nov.**

MycoBank MB 516748 Figs 2–4

A Hypoxylon fuscum *differt granulis violaceis ad vinaceis in KOH dissolutis; a* Hypoxylon rosieri *differt ascosporibus ellipsoideo-inequilaterales, apicibus angustatis, 9.5–12.5 × 5–6 µm µm, riminibus germinativis sigmoideis praeditae. Status anamorphosis ad genero* Virgariella *similis.*

Type: FRANCE, Vosges, Forêt de Rambervilliers, on bark of *Betula pendula* (*Betulaceae*), 7.X.2003, Paul Leroy, PL 03142B (**Holotype** – LIP; culture in MUCL 52670 and CBS 126418).

Etymology: Latin, for its strong resemblance to *Hypoxylon fuscum*

Stromata (Fig. 2) erumpent from bark, pulvinate, slightly constricted at base, gregarious, separate to coalescent, 1.4–3 mm diam × 0.8–1.4 mm thick; surface pruinose, Brown Vinaceous (84), pruina made up of red brown granules turning bluish green in 10% KOH, slightly uneven, with perithecial contours not exposed, with a thick layer of yellowish waxy granules beneath the surface turning colorless in 10% KOH, the whole stroma yielding Vinaceous Purple (101) pigments in 10% KOH; the tissue beneath the perithecia 0.5–1.2 µm thick, greyish brown with blackish marks, soft-textured. Perithecia subglobose to obovoid, rarely slightly tubular, 0.32–0.38 mm high × 0.13–0.22 mm diam. Ostioles umbilicate, inconspicuous. Asci (Fig. 3) cylindrical, short-stipitate, 8-spored, readily deliquescent, 100–120 µm total length, the spore bearing-parts 70–84 µm long × 7–8 µm broad, the stipes 24–42 µm long, with a discoid apical ring 0.5–0.8 µm high × 3–3.4 µm broad, bluing in Melzer's reagent. Paraphyses filiform, septate. Ascospores (Fig. 3) 9.5–12.5 × 5–6 µm (M = 11 × 5.4 µm, n = 30) ellipsoid slightly inequilateral with narrowly rounded to acute ends, brown, smooth, with a conspicuous spore- length sigmoid germ slit, swelling rapidly in water; perispore dehiscent in 10% KOH, thin-walled, with faint transverse striae. Epispore smooth.

Cultures and anamorph: Colonies on OA covering Petri dish in 2–3 weeks, at first white, becoming Hazel (88), velvety, azonate, with diffuse margins; reverse remaining uncolored. Sporulating regions in patches, vinaceous buff (86). Conidiogenous structure referable to the *Virgariella*-like branching pattern as defined by Ju & Rogers (1996), hyaline, smooth to finely roughened. Conidiogenous cells (Fig. 4) hyaline, smooth, 8–14(–25) × 2.5–4 µm, often arranged repetitively at the tips of the conidiophores (Fig. 4), so that up to ten conidiogenous cells are produced in succession. Conidia hyaline, smooth, ellipsoid, 5–7 × 2.5–3 µm.

Secondary metabolites: HPLC profiling (Fig. 5a) revealed that this species differs from all morphochemotypes of *H. fuscum,* we have hitherto studied, regardless from which host plants their stromata have been encountered, in lacking daldinins C, E and F and daldinal A. The lack of these pigments clearly

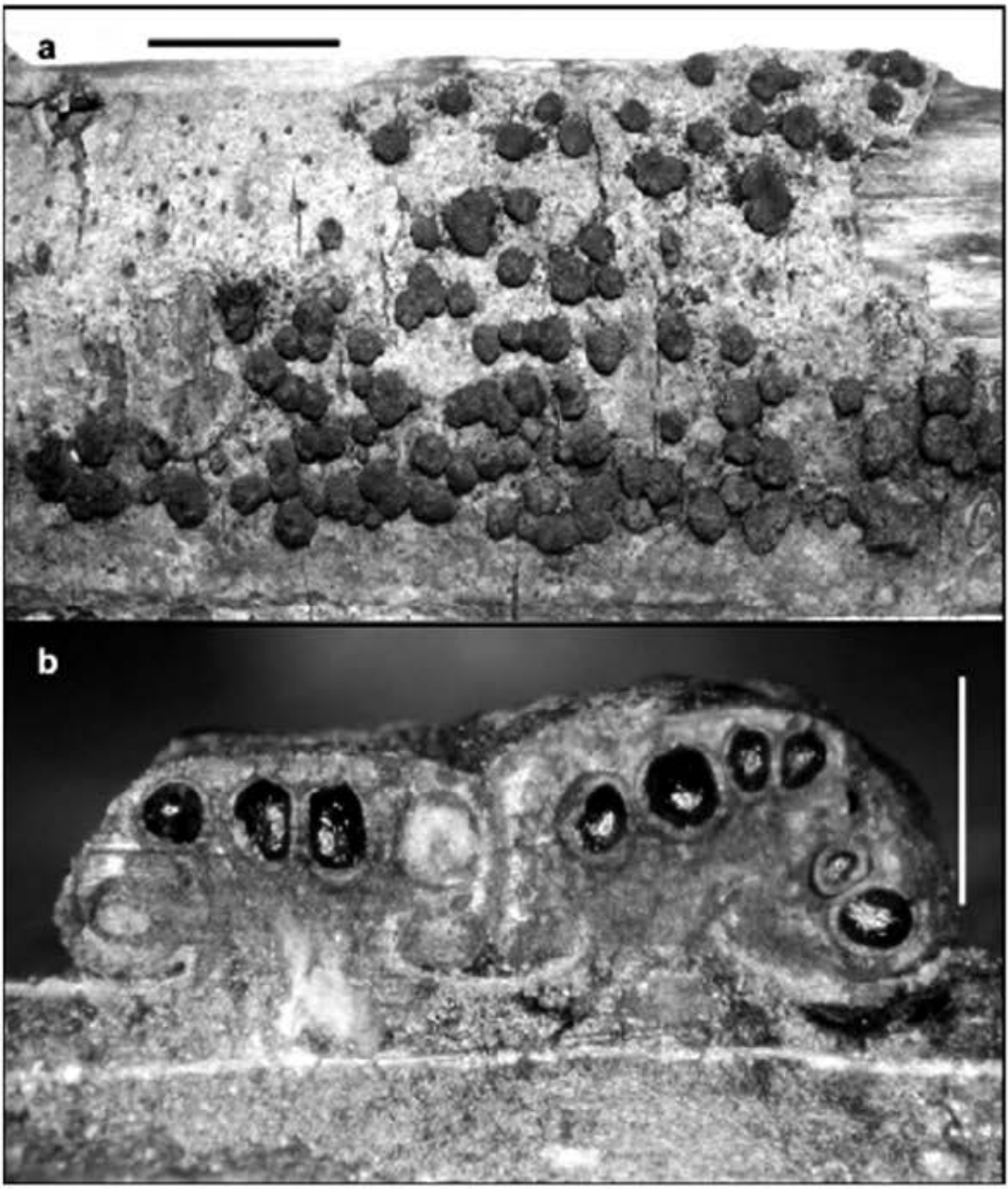

FIG. 2. Stromata of *Hypoxylon fuscoides*, from holotype (PL 03142B). a. Stromatal habit on the natural substrate. b. Section through stroma, showing the ruptured periderm and perithecial arrangement. Scale bars: a. 1cm, b: 1 mm.

accounts for the pigments in KOH being purple, rather than olivaceous brown. Binaphthalenes (in particular binaphthalene tetrol, BNT) were found to be the prevailing stromatal metabolites. The cultures produced 5-methylmellein (**14**) as major component in YMG medium.

FURTHER SPECIMENS EXAMINED: **UNITED KINGDOM, NORTHERN IRELAND. Vice-county H37 (Armagh),** OXFORD ISLAND (J045620), on bark of fallen branches of *Alnus incana* (*Betulaceae*), 18.X.2007. R. Anderson. **Vice-county H38 (Down),** BELFAST, Belvoir Forest, (J333693), on bark of fallen branches of *Alnus incana*, 5.II.2008. R. Anderson (K, culture in MUCL 52423).

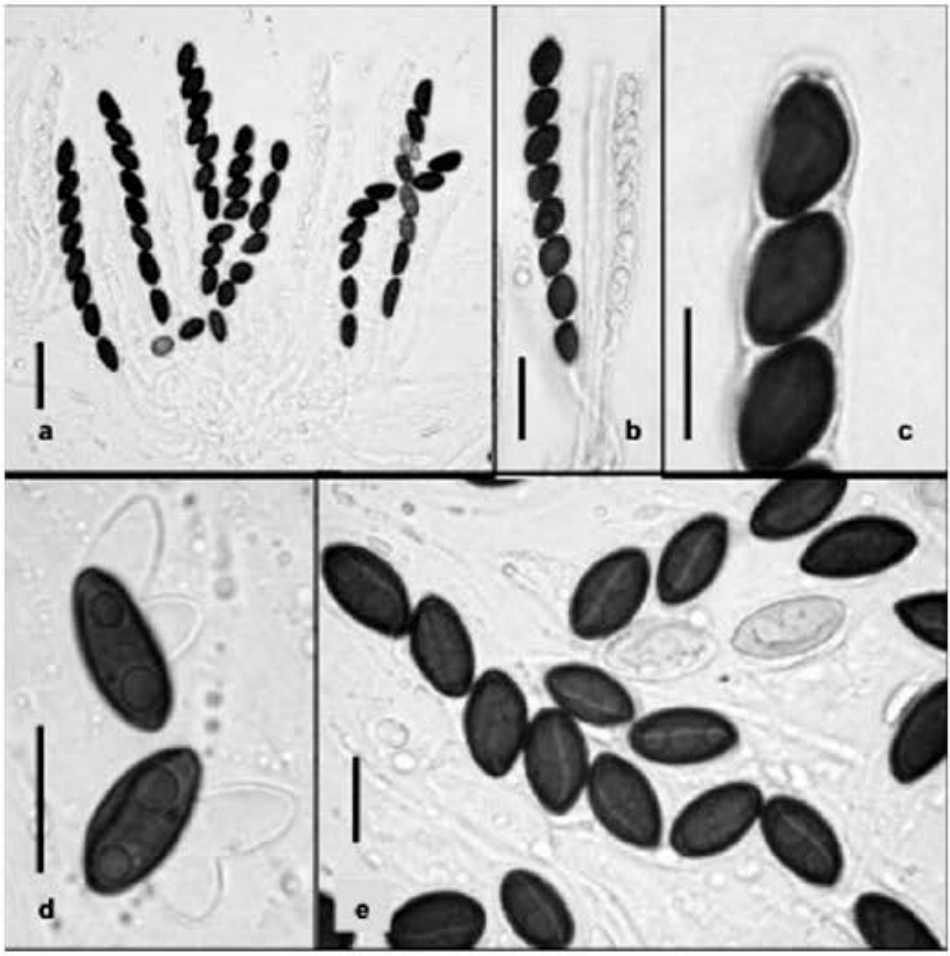

FIG. 3. Microscopic characteristics of *Hypoxylon fuscoides*, from paratype (JF 09347; K). a. Asci in water. b, c. Asci in Melzer's reagent, c showing amyloid apical apparatus. d Ascospores in KOH, showing dehiscent perispore. e. Ascospores in water, showing the sigmoid germ slits. Scale bars: a, b: 20 µm, c, d, e: 10 µm

COMMENTS: *Hypoxylon fuscoides,* already mentioned on a website dedicated to fungal taxonomy (Fournier & Magni 2004) and by Anderson (2008), is not distinguishable from *H. fuscum* in the field. Despite the fact that these species share many morphological features, the new taxon can be readily separated by its reaction in KOH and its smaller ascospores with more acute ends.

Hypoxylon fuscum as currently conceived (Petrini & Müller 1986, Ju & Rogers 1996, Granmo 1999) features a very wide ascospore size range that is not clearly correlated with other morphological, ecological, or chemotaxonomic characters. In the present case, the deviating morphology of ascospore ends appears more significant than the difference in size. The holotype collection has paler pigments in KOH than the material from Northern Ireland, but the ascospores are identical, and it features similar very small gregarious stromata. The cultures are similar to those described for *H. fuscum* by Petrini & Müller (1986) and Ju & Rogers (1996) but have rather stout conidiogenous cells and

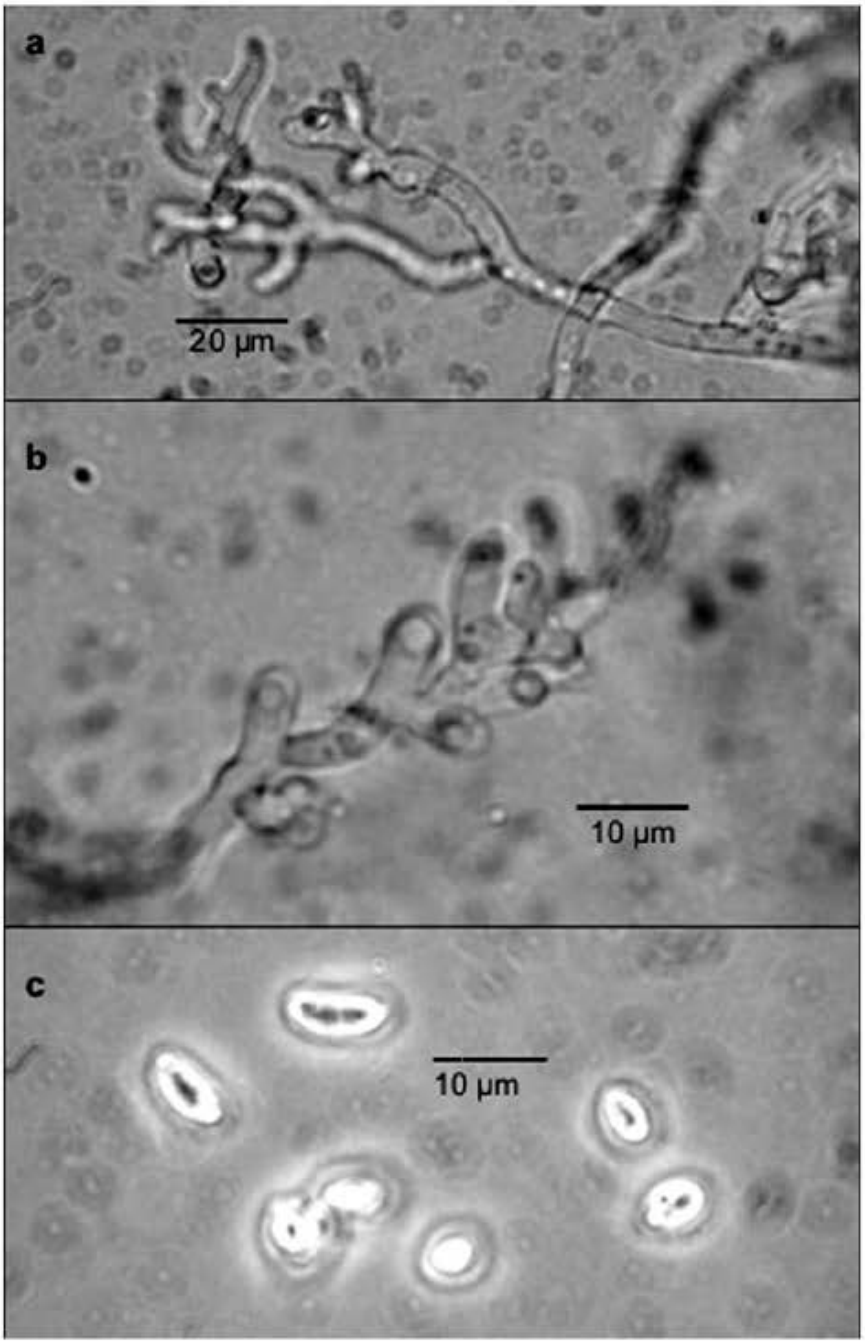

FIG. 4. *Hypoxylon fuscoides*, ex-type strain, from OA culture. a. conidiophores, showing dichotomously branched *Virgariella*-like conidiogenous structures. b. Close-up of conidiophore apex, showing repetitive branching, resulting in stout conidiogenous cells. c. Conidia. Scale is indicated by bars.

slightly larger conidia. In particular, the successive production of numerous small conidiogenous cells from the tip of the same conidiophore is only exceptionally observed in other cultures of *Hypoxylon*, and those of the most frequent morphochemotype of *H. fuscum* from *Corylus* normally produce conidiogenous cells up to 40 µm long. The stromatal HPLC profile also deviates strongly from that observed in numerous collections of *H. fuscum* collected

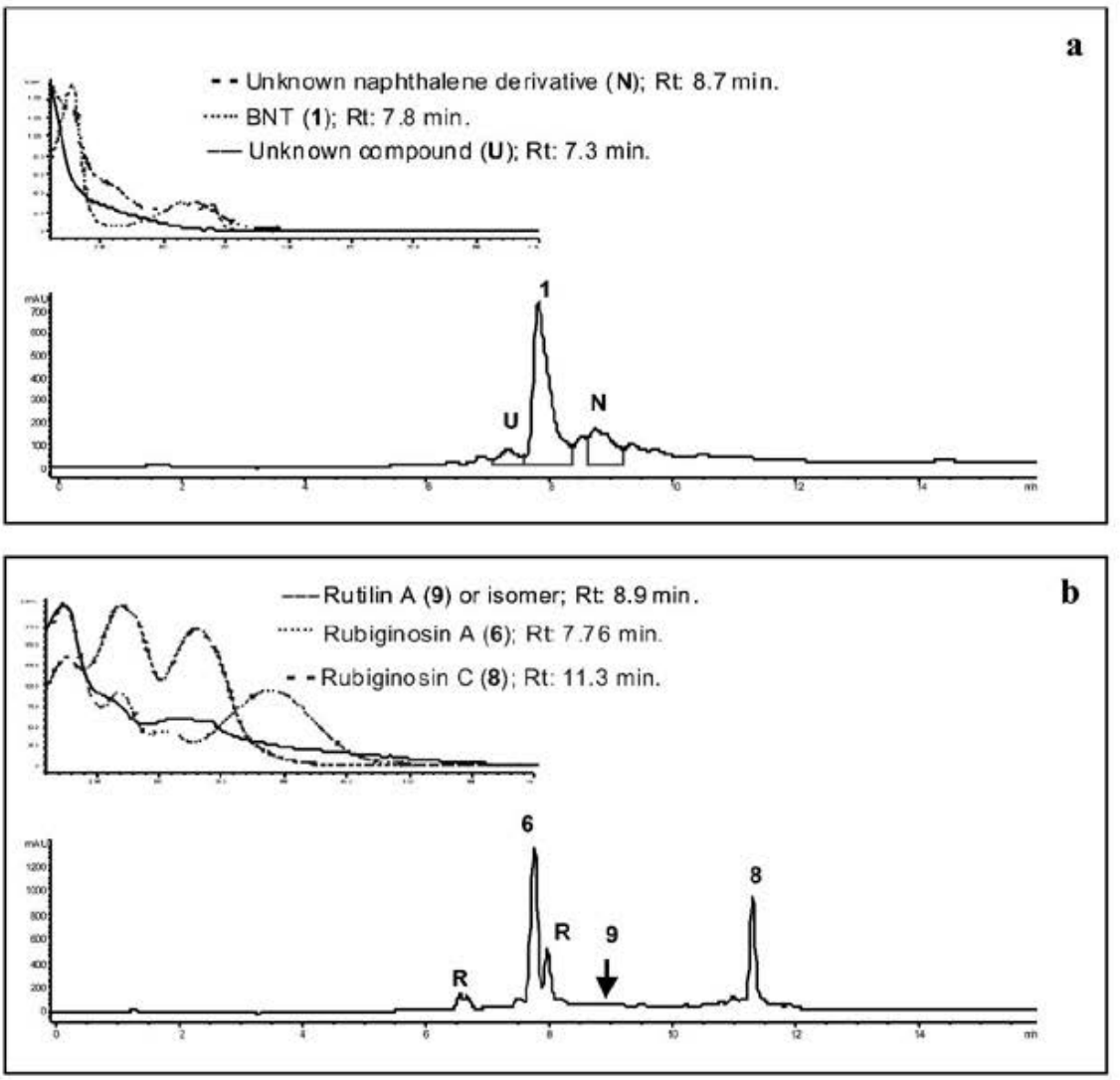

FIG. 5. Stromatal HPLC-UV profiles (210 nm) of holotype specimens of *Hypoxylon fuscoides* (a) and *Hypoxylon lusitanicum* (b). and DAD spectra of major metabolites. In FIG 5a, U indicates an unknown major component lacking a characteristic DAD spectrum, and N indicates an unknown naphthalene with a DAD spectrum similar to BNT (1). Daldinal A and daldinins C and E (10 - 12), the characteristic pigments of *H. fuscum*, were not detected. In FIG. 5b, R indicates further major components of the rubiginosin type, whose spectra are not depicted). For chemical structures of known compounds see FIG. 1.

from *Alnus* and *Salicaceae*, which apparently also lacks daldinins but contains different pigments that also result in olivaceous colors in KOH in our recent study (Stadler et al. 2008).

Rogers et al. (2008) described *H. rosieri* J.D. Rogers & Lar.N. Vassiljeva, another segregate of *H. fuscum* from the USA (Texas), based on a similar purple KOH reaction. Their species differs from *H. fuscoides* in having markedly longer, more slender ascospores (13.5–15 × 5–6 µm). Furthermore, sigmoid ascospore germ slits were not mentioned in their description.

Hypoxylon lusitanicum J. Fourn., M. Stadler & Priou, **sp. nov.** FIGS 6–7

MycoBank MB 516749

A Hypoxylo perforato *differt granulis rufobrunneis in KOH dissolutis et ascis longistipitatis, 158–170 µm longitudine tota, partibus sporiferis 76–91× 7–8 µm, stipitibus 70–80 µm.*

TYPE: PORTUGAL: RIBATEJO Prov., Achete, RIBEIRIHNA, 39° 19' 13" N, 08° 42' 55" W, alt 55 m., on dead blackened wood of *Rhamnus alaternus* (*Rhamnaceae*) in Mediterranean evergreen vegetation, 5.V.2009, J.P. Priou, JF 09125 (HOLOTYPE – LIP; ex-type culture in MUCL52424).

ETYMOLOGY: For Portugal (Lusitania in Latin).

STROMATA (FIG. 6) effused, ellipsoid to elongated, 8–22 mm long × 2.5–8 mm broad × 0.6–0.8 mm thick, at times coalescent, at times with steep, indented black margins; surface pruinose, slightly uneven, Brown Vinaceous (84), with perithecial contours hardly exposed, with a thick layer of olivaceous yellow waxy granules beneath the surface and around the upper half of perithecia, yielding Sienna (8) pigments in 10% KOH; the tissue beneath the perithecia 50–150 µm thick, dull brown, soft-textured, delimited by a black line spreading over the underlying wood. PERITHECIA subglobose to obovoid, 0.5–0.6 mm high × 0.3–0.45 mm diam. OSTIOLES umbilicate, often in a shallow depression, fringed with a disc of white material 70–80 µm diam. ASCI (FIG. 7) cylindrical, long-stipitate, 8-spored, 158–170 µm total length, spore bearing-parts 76–91 µm long × 7–8 µm broad, the stipes 70–80 µm long, with a discoid apical ring 0.8–1 µm high × 2.5–3 µm broad, bluing in Melzer's reagent. Paraphyses not seen. ASCOSPORES (FIG. 7) 11–13.5 × 5–7 µm (M = 11.8 × 5.5 µm, n = 30) ellipsoid-inequilateral with narrowly rounded to acute ends, brown, smooth, with a spore- length straight germ slit; perispore readily dehiscent in 10% KOH, faintly striate. Epispore smooth.

CULTURES AND ANAMORPH: Colonies on YMG and Difco OA covering Petri dish in 2 weeks, at first whitish, becoming umber (9), velvety to felty, azonate, with diffuse margins, with honey (64) pigments diffused beyond colonies; reverse slightly melanizing with age. No conidiogenous structures observed.

SECONDARY METABOLITES: In accordance with the orange pigments in KOH, the stromatal HPLC profile of *H. lusitanicum* (Fig. 5b) revealed the presence of azaphilones, with rubiginosins A (**6**) and C (**8**) being major detectable components. A minor metabolite at Rt 8.9 min was also observed, which probably corresponds with rutilin A (**9**) or another yet unknown dimeric azaphilone of the rutilin type. Neither mitorubrins nor hypomiltin (**2** – **5**) were detected. However, the cultures produced 5-methylmellein (**14**) as major component in YMG medium, indicating a relationship to the *H. fuscum* and *H. rubiginosum* species complexes (cf. Bitzer et al. 2008).

FURTHER SPECIMEN EXAMINED: PORTUGAL: **RIBATEJO** Prov., **Achete**, RIBEIRINHA, *Rhamnus alaternus*, 6.V.2009, mixed with old pulvinate stromata of *Hypoxylon perforatum*, J.P. Priou, JPP 29083.

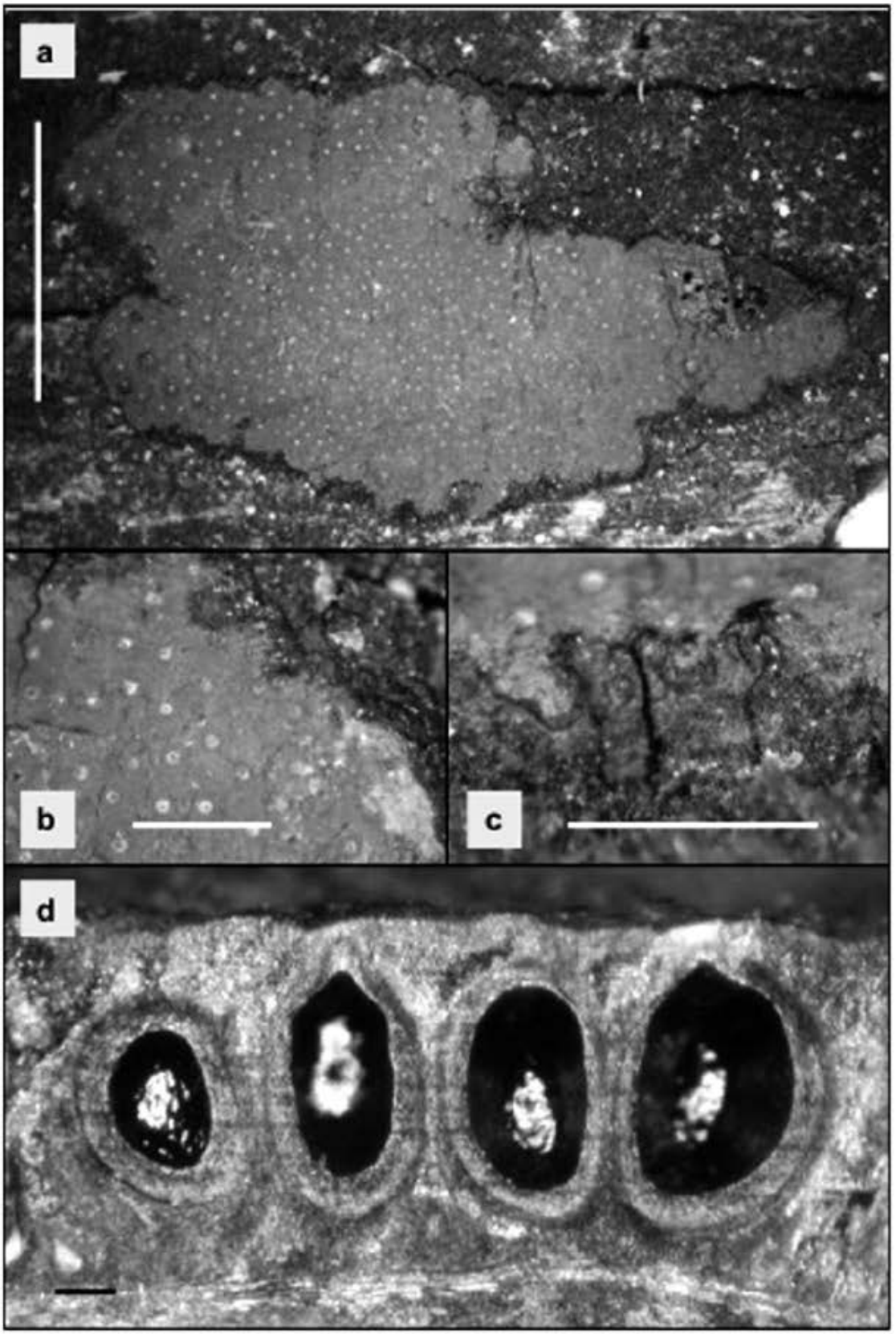

FIG. 6. Stromata of *Hypoxylon lusitanicum*, from holotype (LIP). a. Stromatal habit on the natural substrate. b, e. Close-up of stromatal surface, showing ostioles. c. Close-up of blackened stromatal margin. d. Section through stroma, showing perithecia. Scale bars: a: 5 mm, b, c: 1mm d: 0.1 mm.

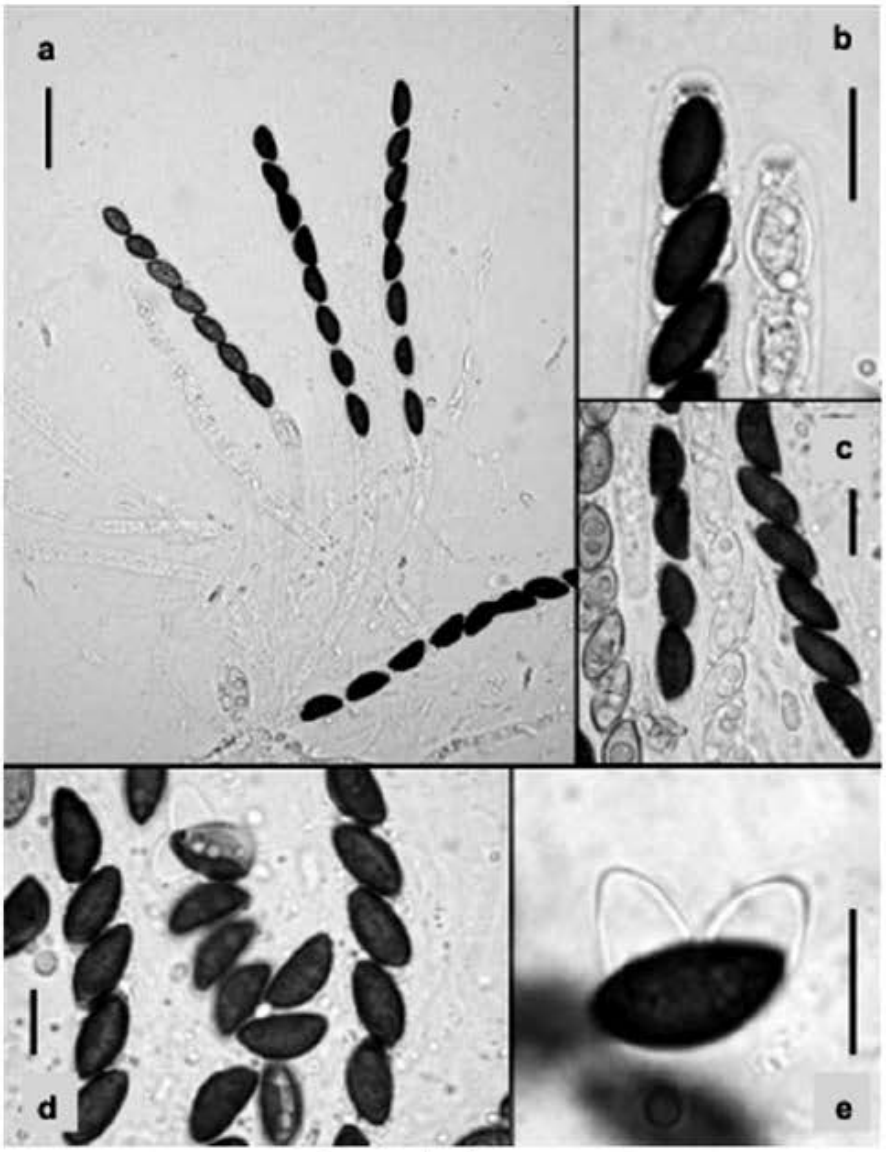

FIG. 7. Microscopic characteristics of *Hypoxylon lusitanicum*, from holotype (LIP). a, Asci in water. b Ascal tip in Melzer's reagent, showing amyloid apical apparatus. c-d Ascospores in water. e Ascospore in KOH, showing dehiscent perispore. Scale bars: a: 20 µm, b, c, d, e: 10 µm.

COMMENTS: *Hypoxylon lusitanicum* appears highly similar to *H. perforatum* with regard to its stromatal morphology (conspicuous white discs around umbilicate ostioles and presence of yellowish granules beneath the stromatal surface. It can be distinguished by its red brown pigments in KOH, larger perithecia, long-stipitate asci, and significantly larger ascospores with more narrowly rounded ends. The red brown pigments are due to the presence of rubiginosins as in *H. rubiginosum* and *H. petriniae*, whereas *H. perforatum* produces hypomiltin instead (cf. Stadler et al. 2004). Both, *H. rubiginosum* and *H. petriniae* have often been confused with *H. perforatum;* hence they might be easily confounded with *H. lusitanicum.* Two recently described taxa from the Canary Islands, *H. canariense* and *H. urriesii* (Stadler et al. 2008), might also

TABLE 1. Diagnostic characters of six species of the *Hypoxylon rubiginosum* complex.

	H. canariense	*H. lusitanicum*	*H. perforatum*	*H. petriniae*	*H. rubiginosum*	*H. urriesii*
SURFACE COLOR	Fulvous(43), Dark Brick (60), or Brown Vinaceous (84)	Brown Vinac. (84)	Dark Brick (60) to Brown Vinac. (84)	Vinaceous Grey (116) to Brown Vinac. (84)	Rust (39) to Dark Brick (60)	Dark Brick (60)
WHITE- FRINGED OSTIOLES	frequent	present	present	frequent	occasional	absent
STROMAL THICKNESS	0.5–0.6 mm	0.6–0.8 mm	0.5–1–(2.5) mm	0.3–0.8 mm	1–1.3(–2) mm	0.3 mm
PERITHECIAL DIAM.	0.3–0.4 mm	0.3–0.45 mm	0.25–0.4 mm	0.25–0.4 mm	0.3–0.65 mm	0.15–0.2 mm
KOH PIGMENTS	Orange(7) to ienna(8)	Sienna (8)	Amber (47)	Orange (7)	Orange (7)	Orange (7)
SECONDARY METABOLITES	mitorubrins, rubiginosins	rubiginosins, rutilin A	hypomiltin	rubiginosins, BNT	mitorubrins, rubiginosins	mitorubrins,r ubiginosins
ASCUS STIPE LENGTH	27–40 µm	70–80 µµ	24–50 µm	37–64 µm	60–98 µm	18–30 µm
AV. ASCOSPORE SIZE	10.4 × 4.8 µm	11.8 × 5.5 µm	10.9 × 4.9 µm	10.7 × 5.1 µm	10.1 × 4.4 µm	12.3 × 5.4 µm
GERM SLIT	straight	straight	straight	straight	straight	sigmoid
PERISPORE (LM)	smooth	faintly striate	smooth	smooth	smooth	smooth
REFERENCE	Stadler et al. 2008	This study	Fournier & Magni 2004	Fournier & Magni 2004	Fournier & Magni 2004	Stadler et al. 2008

be confused in the field with *H. lusitanicum* because of their effused stromata having similar surface colors. *Hypoxylon canariense* mainly differs from *H. lusitanicum* in having short-stipitate asci and smaller ascospores averaging 10.4 × 4.8 µm with a smooth perispore, while *H. urriesii* differs from the new taxon in having much smaller perithecia, short-stipitate asci and slightly larger ascospores averaging 12.3 × 5.4 µm with a sigmoid germ slit and a smooth perispore. Some important diagnostic characters to discriminate these six species are summarized in TABLE 1.

Hypoxylon gibriacense J. Fourn., M. Stadler & Gardiennet, **sp. nov.**

MYCOBANK MB 516750 FIGS 8–9

A Hypoxylon shearii *et* Hypoxylon fraxinophili *differt discis annulatis conspicuis, peritheciis ambientibus. A* Hypoxylon addis *differt in ascosporae parviorae, perisporium conspicuiter striatum praeditae.*

TYPE: FRANCE, CÔTE D'OR, Gevrey-Chambertin, COMBE DE LAVAUX, on moss-covered bark of a fallen branch of *Acer platanoides* (*Aceraceae*), 3.XII.2009, A. Gardiennet, AG 09033 (**HOLOTYPE** – LIP; culture in MUCL 52698).

ETYMOLOGY: from *Gibriacum*, the Latin name of Gevrey, the locality of the type collection .

STROMATA (FIG. 8) corticolous, erumpent through the periderm, glomerate with a narrowly restricted base, containing 12–20 perithecia, scattered to often coalescent, 2–3 mm diam × 1.5–2.5 mm thick, soft-textured; surface Greyish Sepia (106) with a faint olivaceous tone, pruinose, with perithecial contours exposed to strongly exposed; dull yellow granules forming a thin crust beneath the surface and sometimes extending between the perithecia, yielding fugacious Amber (47) then Sienna (8) pigments in 10% KOH (Livid Red (56) under the microscope); subperithecial tissue purplish black, brownish grey at base 1–1.3 mm thick. PERITHECIA ellipsoid to subglobose, 0.5–0.6 mm high × 0.4–0.5 mm diam. OSTIOLES umbilicate, opening at the centre of a paler discoid area ca. 0.2 mm diam delimited by a low rim. ASCI (FIG. 8) unitunicate, cylindrical, 130–140 µm total length, the spore-bearing parts 85–95 µm long × 9–9.5 µm broad, the stipes 40–45 µm long, apex without apical ring, not bluing in Melzer's reagent. Paraphyses filiform, copious. ASCOSPORES (FIG. 9) 11.5–13 × 6–6.8 µm (M = 12.4 × 6.5 µm, n = 30), ellipsoid-inequilateral with narrowly rounded ends, one side flattened to sometimes slightly concave, brown to dark brown, smooth, with spore-length straight germ slit (arrows). Perispore dehiscent in KOH, with fairly conspicuous striae somewhat anastomosing. Epispore smooth.

CULTURES on YMG and OA media covering a 9 cm Petri dish in 2–3 weeks, white, felty to floccose, azonate, with diffuse margins; reverse becoming Honey (64). No conidiophores or other anamorphic structures observed after up to 6 weeks of incubation.

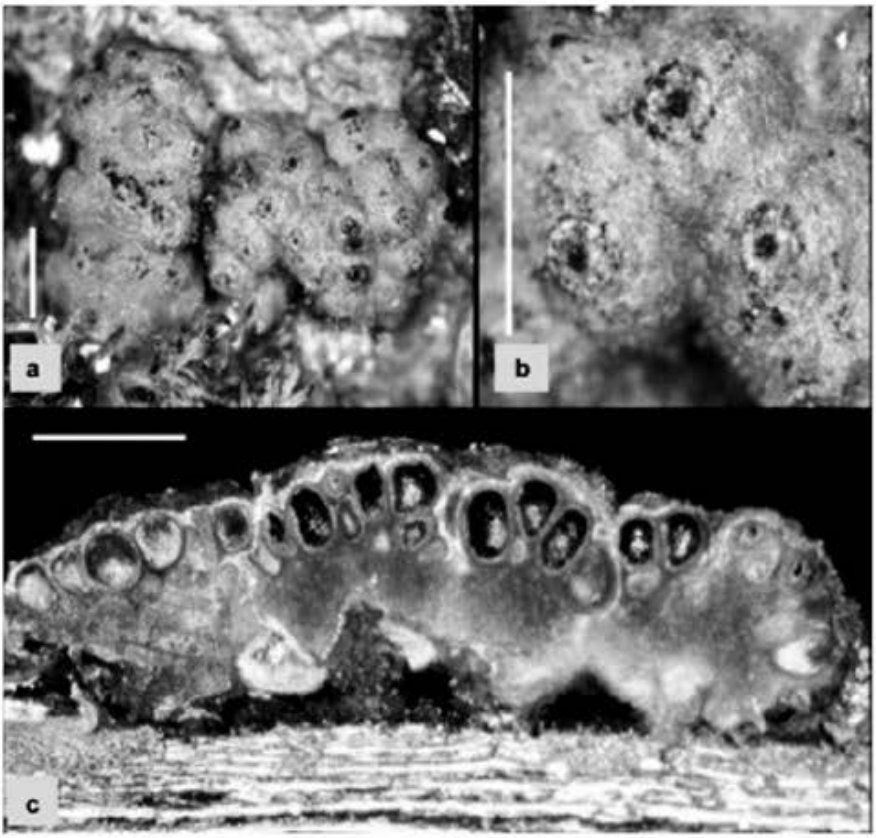

FIG. 8. Stromata of *Hypoxylon gibriacense*, from holotype (LIP). a. Stromatal habit on the natural substrate. b. Close-up of stromatal surface, showing perithecial mounds and ostiolar disks. c. Section through stroma, showing perithecia. Scale bars: a, b, c: 1 mm.

SECONDARY METABOLITES: HPLC of the stromatal MeOH extract of the holotype specimen (FIG. 13) revealed rubiginosin C (**6**) and another major peak that was revealed to be a mixture of BNT (**1**) and hypomiltin (**5**) only by HPLC-MS because the chromatographic method used to separate the components in the crude extract by HPLC-DAD appeared insufficient to discriminate these compounds. The DAD spectrum therefore at first appeared unique because it was actually caused by two components showing different absorption maxima in the UV-visual detection range. The mass spectra derived from this peak, labeled ("**1 + 5**") containing both compounds are included in FIG. 13 for comparison. All these compounds also occur in various other species of the *H. rubiginosum* complex (cf. Stadler et al. 2008). The cultures (FIG. 15) produced mellein (**13**) and several other metabolites, most of which were not yet identified, but 5-methylmellein (**14**) was not observed.

COMMENTS: *Hypoxylon gibriacense* is distinctive in featuring ostiolar discs and in having asci lacking an apical apparatus. Despite the clearly differentiated discs around the ostioles, it is considered best placed in *Hypoxylon* rather than *Annulohypoxylon* based on the soft-textured stromata and ascospores with transversally dehiscent and striate perispores that lack a dorsal thickening

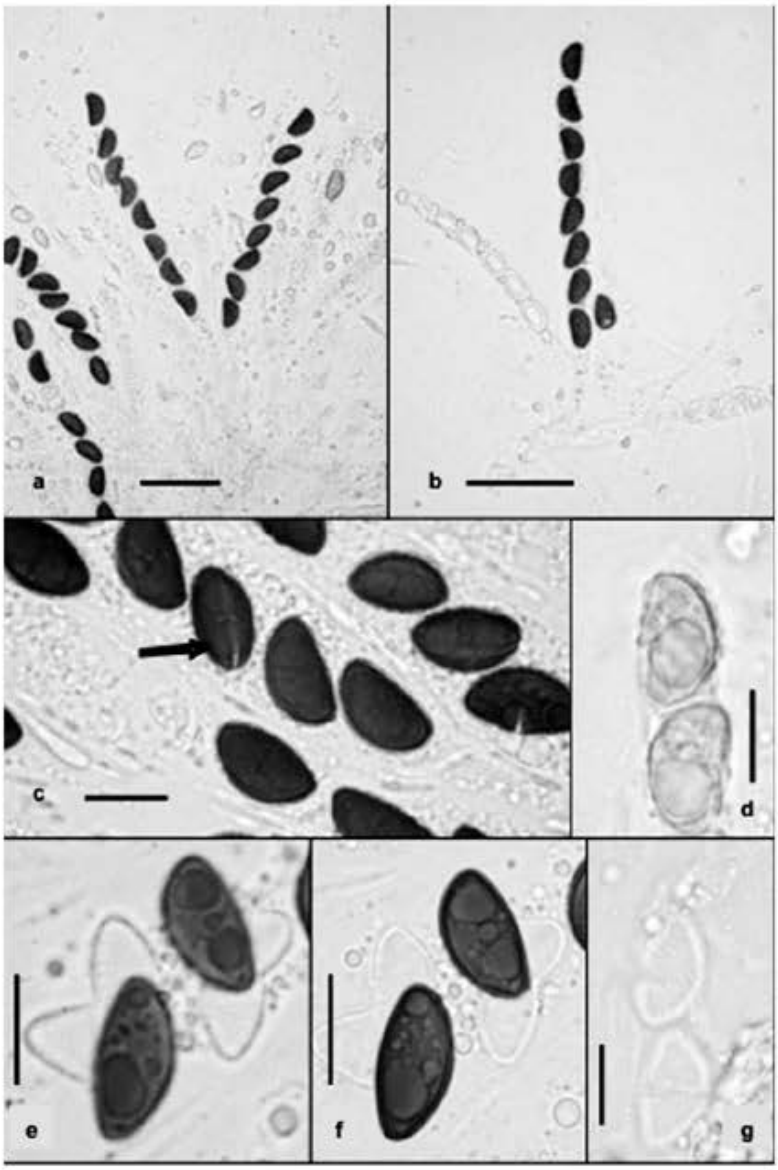

FIG. 9. Microscopic characteristics of *Hypoxylon gibriacense*, from holotype (LIP). a, Asci in chlorazol black. b. ascus in water. c Ascospores in water. d. Ascus tip in Melzer's reagent e, f. Ascospores in KOH at different focuses, showing dehiscent ornamented perispores. g. Free perispores. Scale bars: a b:. 30 µm, c- g: 10 µm

(FIG. 9). The inconspicuous glomerate stromata with conspicuous perithecial elevations and thick subperithecial tissue, the presence of yellow granules beneath the surface yielding red brown pigments in KOH, the lack of ascal apical rings, and the conspicuously striate perispores make a combination of characters not known from any temperate or tropical taxon of *Hypoxylon*.

Of the known European (and Northern temperate) taxa, *H. fraxinophilum* (Pouzar 1972) appears most similar. The stromatal, ascal, and ascospore morphology of this fungus are reminiscent of *H. gibriacense*. As previously shown by Stadler et al. (2004, as "*H. intermedium*"), *H. fraxinophilum* also contains hypomiltin (**5**), but neither rubiginosin C (**6**) nor BNT (**1**) were

detected in its stromata. Furthermore, it differs in its stromata lacking ostiolar disks, and in its host specificity for *Fraxinus*, rather than *Acer*. The new species is, however, remarkably similar to *H. addis* (see below) in having ostiolar discs, similar pigment colors in KOH, and its asci lacking an amyloid apical apparatus. *Hypoxylon gibriacense* and *H. addis* differ in their ascospore dimensions and in the merely faintly striate perispores in *H. addis;* moreover, the stromatal secondary metabolite profiles of the two species differ completely.

Hypoxylon addis J. Fourn., M. Stadler & U. Lindem., **sp. nov.**

MycoBank MB 516751 Figs 10–11

A Hypoxylon shearii *et* Hypoxylon fraxinophili *differt discis annulatis conspicuis, perithecíis ambientibus. A* Hypoxylon gibriacense *differt in ascosporae maiorae.*

Type: ETHIOPIA: Giyon/Wolisso, Negash Lodge, 2000m, +8° 32' 1.73", +37° 58' 52.65", on a corticated dry twig of *Croton sylvaticus* (*Euphorbiaceae*). 3.X.2009, U. Lindemann, JF-09302 (**Holotype**– LIP).

Etymology: Ethiopian "Addis", meaning "new".

Stromata (Fig. 10) corticolous, scattered, glomerate-pulvinate, erumpent through the periderm, 1–3 mm diam × 1–1.2 mm thick, soft-textured; surface Vinaceous Buff (86) to dark Brick (60), pruinose, with perithecial contours exposed to strongly exposed, at times rosellinioid; dull yellow granules beneath the surface and between the perithecia yielding Luteous (12) to Orange (7) pigments in 10% KOH; subperithecial tissue brownish with black streaks, 0.3–0.5 mm thick. Perithecia subglobose, 0.5–0.55 mm diam. Ostioles umbilicate, most often opening at the centre of a raised disc ca. 0.35 mm diam. Asci (Fig. 11) unitunicate, cylindrical, 170–190 µm total length × 9.5–10.5 µm broad, the spore-bearing parts 85–100 µm long, the stipes 70–90 µm long, easily broken, apex without apical ring, not bluing in Melzer's reagent. Paraphyses filiform, copious. Ascospores (Fig. 11) 13–16.5 × 6–7.7 µm (M = 14.6 × 7 µm, n = 20), ellipsoid-inequilateral with narrowly rounded ends, one side flattened to often slightly concave, dark to blackish brown, smooth, with spore-length straight germ slit. Perispore dehiscent in KOH, striate, with striae visible in brightfield microscopy but inconspicuous, epispore smooth.

No cultures obtained. Anamorph not seen.

Secondary metabolites: Surprisingly, the HPLC profile of the stromata of *H. addis* did not reveal any known metabolites of *Hypoxylon* or other *Xylariaceae* that we have characterized or observed in the past. As shown in Fig. 14, the stromatal extract contained a predominant peak with a rather characteristic chromophore. Another, presumably related, minor component showing a highly similar DAD spectrum was observed at a lower Rt. A search in the HPLC library used for dereplication of natural products in crude extracts that represents several thousands of pure compounds (Bitzer et al 2007) revealed

that the prevailing stromatal metabolite of *H. addis* corresponds to lecanoric acid (**16**). The DAD and MS spectra and the Rt of lecanoric acid (**16**) are depicted in FIG. 14.

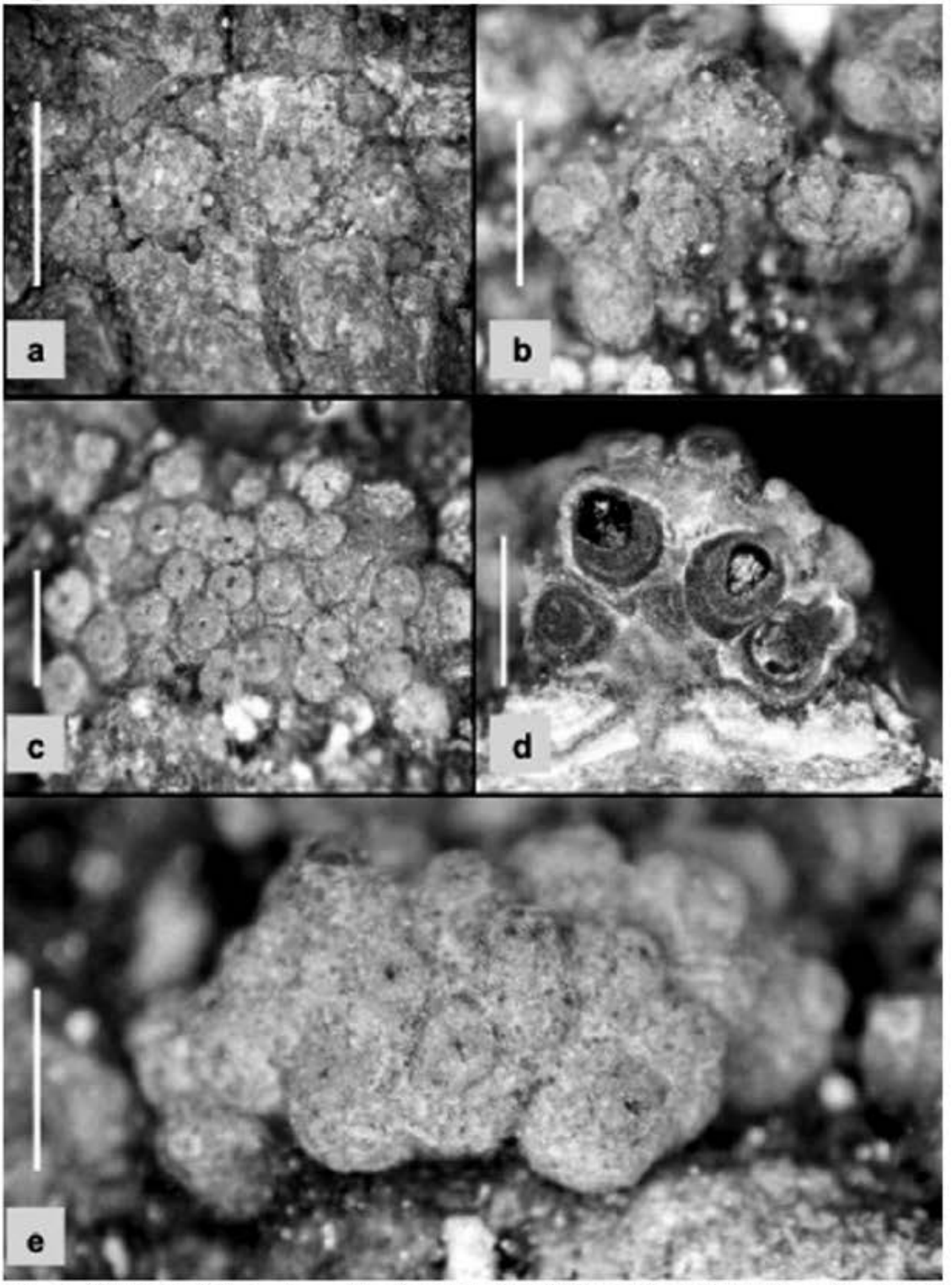

FIG. 10. Stromata of *Hypoxylon addis*, from holotype (LIP). a. Stromatal habit on the natural substrate. b, e. Close-up of stromatal surface, showing rosellinioid perithecial mounds. c. Surface of a glomerate stroma, showing characteristic ostiolar disks. d. Section through stroma, showing perithecia. Scale bars: a. 5 mm, b: 0.5 mm, c, d, e: 1 mm.

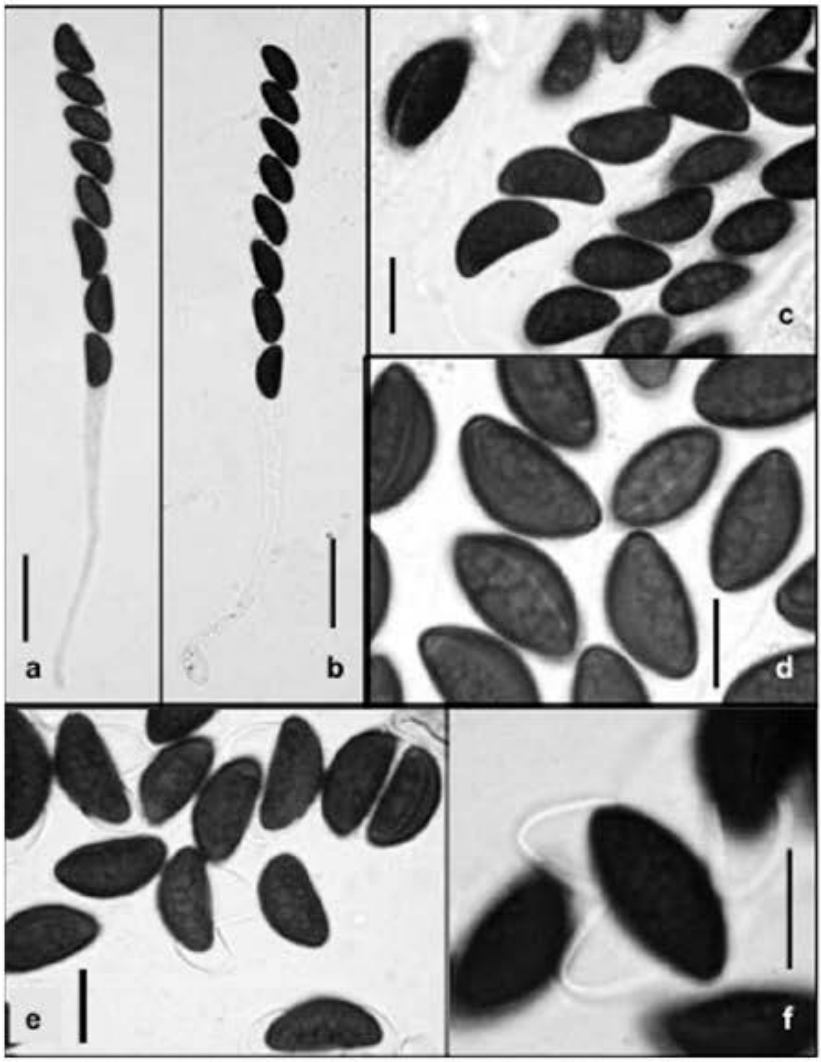

FIG. 11. Microscopic characteristics of *Hypoxylon addis* from holotype (LIP). a, b Asci in chlorazol black. c Ascospores in water. d-f Ascospores in KOH, showing germ slit (d) and dehiscent perispore. Scale bars: a, b: 20 µm, c, d, e, f: 10 µm.

MATERIAL STUDIED FOR COMPARISON (Fig. 12): **USA: LOUISIANA, East Baton Rouge Parish**, corticated wood of *Quercus*, IV.1980, J.D. Rogers & J.P. Jones (WSP 69637 – holotype of *H. shearii*).

COMMENTS: *Hypoxylon addis* is distinctive in its small glomerate stromata with large discoid ostioles and microscopically in its asci lacking an apical ring and rather large, dark-colored ascospores with a faintly striate perispore. The collector stated that he also found this species on a dry twig of *Cordia africana*, but that specimen was moldy and needed to be discarded. From a comparison of teleomorphic characters, *H. shearii* Y.M. Ju & J.D. Rogers (Ju & Rogers 1996) appears most similar with respect to its stromatal and ascospore morphology and the color of its stromatal pigments. The type specimen of *H. shearii* was studied for comparison (FIG. 12) and as previously reported (Stadler et al. 2008), its HPLC profile revealed mitorubrins as well as

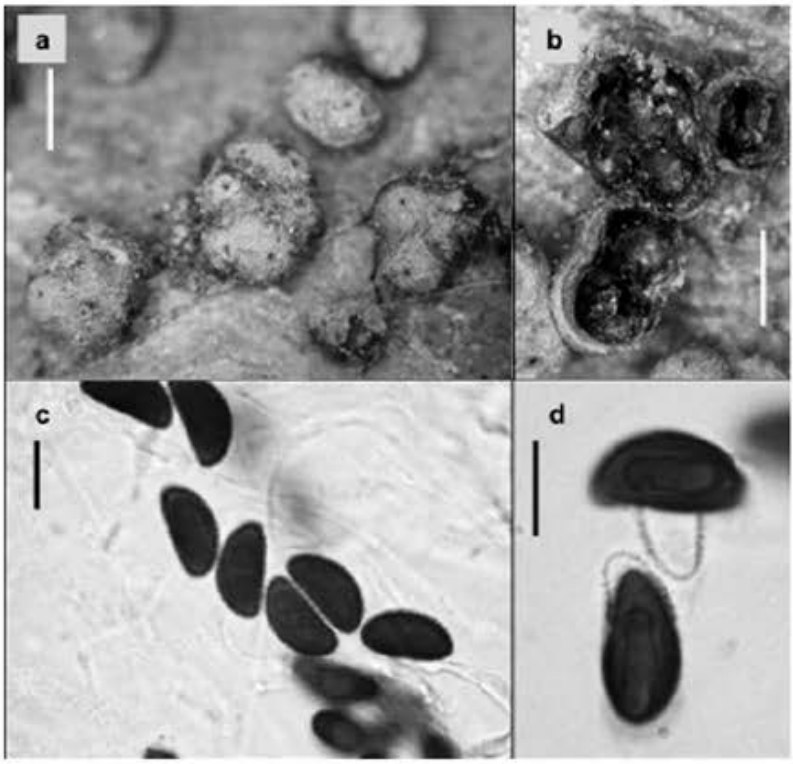

FIG. 12. Morphological characteristics of *Hypoxylon shearii*, from holotype (WSP). a. Stromata. b. Sectioned stromata showing yellow granules and globose perithecia. c. Ascospores in water. d. Ascospores in KOH, showing dehiscent perispore. Scale bars: a,b: 1 mm, c, d: 10 µm.

rubiginosins, all of which are absent in *H. addis*. The new species also differs in having conspicuous raised discs around the ostioles and microscopically in having larger ascospores (13–16.5 × 6–7.7 µm vs. 12–14 × 5.5–6.5 µm in *H. shearii*) with much less conspicuous ornamentation on the perispore. We have not yet studied authentic material of *H. shearii* var. *minor* F. San Martín et al. (1999), which differs from the typical variety by having smaller ascospores, 7–8 × 3.5–4 µm. Interestingly, both varieties of *H. shearii* have been collected thus far exclusively from *Quercus*.

One of the most intriguing features encountered in *H. addis* is the stromatal pigment profile, almost exclusively revealing lecanoric acid. This molecule is widely distributed in lichenized ascomycetes (Huneck 2001 and references cited therein) but has so far not often been encountered in non-lichenized fungi. According to our knowledge, the present study reveals lecanoric acid from a member of the *Xylariaceae* for the first time. Our retrospective analysis of the previously recorded HPLC profiling data in our *Xylariaceae* metabolite library confirms that lecanoric acid has indeed not been detected as major component of any of the previously studied 3500 specimens of *Hypoxylon*, including the majority of currently accepted taxa and their type specimens.

Lecanoric acid is formally derived from condensation of two molecules of orsellinic acid (7), which is widespread in the *H. rubiginosum* complex

as well as in the *H. fragiforme* group (Stadler et al. 2008). All the ubiquitous molecules of the mitorubrin, rubiginosin, and hypomiltin azaphilones contain an orsellinic acid moiety, attached to the azaphilone core molecules by an ester bond. Accordingly, the free orsellinic acid was found in many of the corresponding stromatal extracts of the respective *Hypoxylon* spp. as major component. The azaphilone core moieties were not detected in *H. addis*, although its stromata showed similar pigment colors in KOH as many species of the *H. rubiginosum* complex. Therefore, *H. addis* might represent a rather derived member of *Hypoxylon*, which has early abandoned or never attained azaphilone biosynthesis and developed the specific pathway for lecanoric acid instead, in convergence to the *Lecanorales* and other lichenized taxa of *Ascomycota*. It should be interesting to compare this species using molecular phylogenetic data in order to assess its closest relatives. However, we have so far been unable to obtain viable cultures from the stromata.

Although lichenized ascomycetes have been studied intensively for secondary metabolites for over a century, with many taxa of *Hypoxylon* and allied *Xylariaceae* studied intensively for such compounds in the past decades, there are not many examples for the parallel occurrence of the same compound

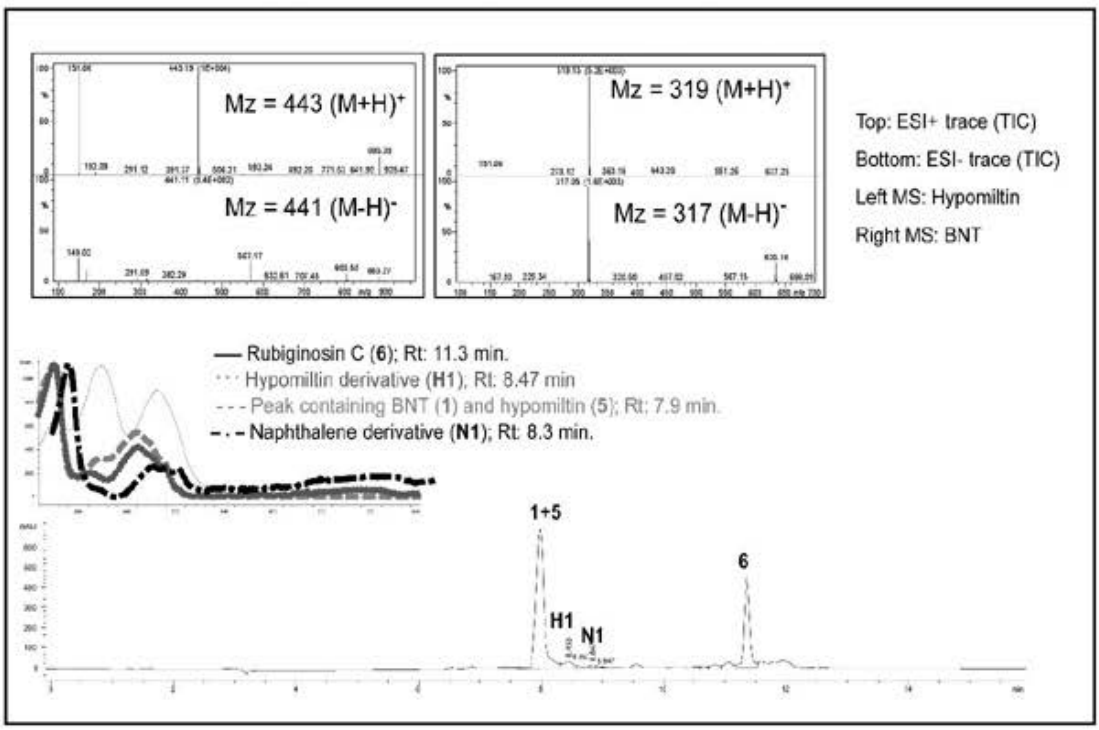

FIG. 13. Stromatal HPLC-UV profile (210 nm) of the stromatal methanol extract derived from the holotype specimen of *Hypoxylon gibriacense*, including DAD and ESI-MS spectra of some major metabolites. Rubiginosin C (6), a peak containing hypomiltin (5) overlaid by BNT (1), and other yet unidentified derivatives of hypomiltin (H1) and BNT (N1) were the major detectable components.

classes in both groups. However, the major stromatal constituents of *H. aeruginosum* J. H. Mill. and other *Xylariaceae* featuring blue or green stromatal surfaces have been recently identified as derivatives of the lichen constituent, lepraric acid (Læssøe et al. 2010).

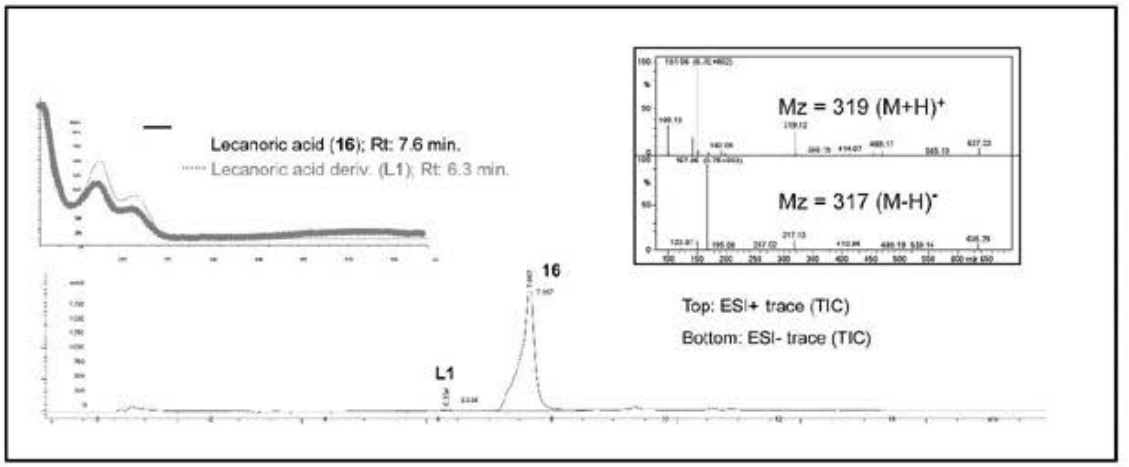

FIG. 14. HPLC-UV profile (210 nm) of the stromatal methanol extract derived from the holotype specimen of *Hypoxylon addis*, including DAD and ESI-MS spectra of some major metabolites. Lecanoric acid **(16)** was clearly the major detectable component, accompanied by a derivative **(L1)**, but no known metabolites of *Hypoxylon* were detected

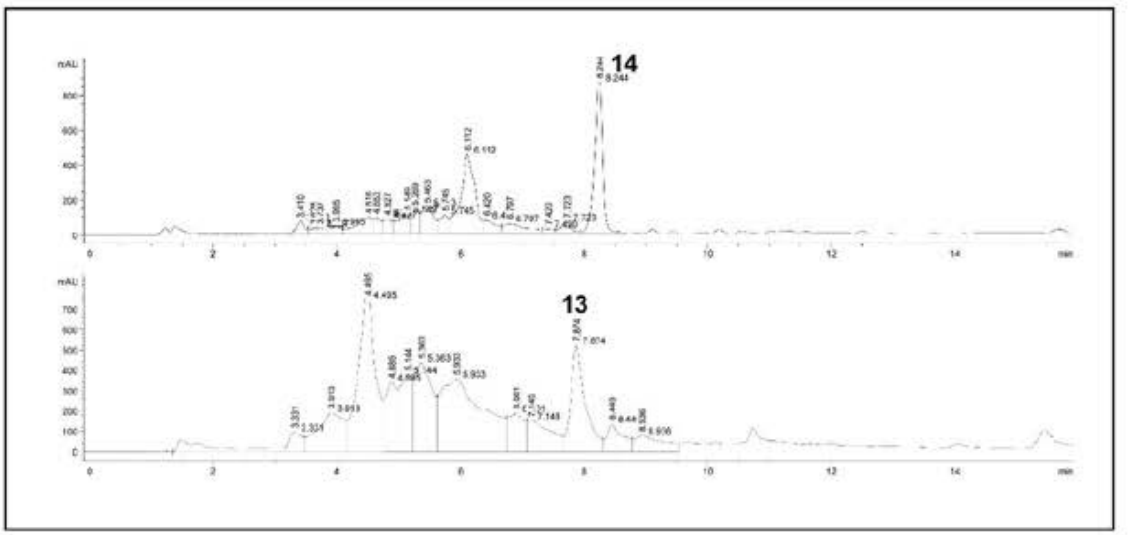

FIG. 15. HPLC-UV profile (210 nm) of the ethyl acetate extracts prepared from YMG cultures of the ex-holotype strains of *Hypoxylon fuscoides* and *H. gibriacense* after 8 days of cultivation, according to Bitzer et al. (2008). The HPLC profile of *H. fuscoides* (above) revealed .5-methylmellein **(14)** as major component, while *H. gibriacense* (below) produced mellein **(13)** and a series of other, mostly unknown compounds. The HPLC profile of *H. lusitanicum* (data not shown) closely resembled that of *H. fuscoides* and, therefore, most other members of the *H. fuscum* /*H. rubiginosum* complexes so far studied.

An updated key to European species of *Hypoxylon*

We found it practical to update our key to the species of *Hypoxylon* that have so far been encountered from regions that politically or geographically belong to Europe. This key is based on the one published by Stadler et al. (2004) but taking new results on the chorology of the species into account. In addition, the key incorporates recently published species (Stadler et al. 2008) as well as those newly described in the present study.

Species of *Annulohypoxylon* (formerly regarded as *Hypoxylon* sect. *Annulata* sensu Ju & Rogers 1996), however, have been expelled from the key published in 2004; for morphological characters and differences to *Hypoxylon*, see Hsieh et al. (2005). To safely identify hypoxyloid specimens with papillate ostioles [*A. cohaerens* (Pers.) Y.M. Ju et al. = *H. cohaerens* (Pers.) Fr.; *A. minutellum* (Sydow & P. Sydow) Y.M. Ju et al. = *H. cohaerens* var. *microsporum* J.D. Rogers & Cand.; *A. multiforme* (Fr.) Y.M. Ju et al. = *H. multiforme*(Fr.) Fr.] and with ostioles encircled by a disk [*A. michelianum* (Ces. & De Not.) Y.M. Ju et al. = *H. michelianum* Ces. & De Not.; *A. stygium* var. *annulatum* (Rehm) Y.M. Ju et al. = *H. stygium* var. *annulatum* (Rehm) Y.M. Ju & J.D. Rogers], a comparison with certain *Annulohypoxylon* species keyed by Stadler et al. (2004) as *Hypoxylon* therefore remains indispensable.

1 Mature stromata carbonaceous, black, without KOH-extractable pigments [but immature stromata orange, with Dark Purple (80) to Dark Vinaceous (82) pigments]. Ascospores 9.5–11.5 × 4–5.5 µm. (USA, France) ..... ***H. submonticulosum*** Y.M. Ju & J.D. Rogers

1 Mature stromata waxy to woody, not carbonaceous, colored other than black and with KOH-extractable pigments 2

2(1) Stromata hemispherical to almost spherical 3

2 Stromata effused to pulvinate 6

3(2) Stromatal surface Vinaceous Grey (116), Sepia (63) or Grayish Sepia (106), KOH-extractable pigments Pure Yellow (14), Greenish Yellow (16) or Citrine (13), ascospores 17–22 × 9–11 µm; on *Fraxinus* ..... ***H. fraxinophilum*** Pouzar

3 Stromatal surface Rust (39), Bay (6), or Dark Brick (60), KOH-extractable pigments orange (7), ascospores averaging less than 15 µm long 4

4(3) Ascal apical ring present, amyloid; widespread 5

4 Ascal apical ring absent; monotypic, not recorded since 1867, ascospores 9–11 × 4.5–5.5 µm ..... ***H. commutatum*** Nitschke

5(4) Mainly on *Fagus*; ascospores 11–13.5 × 5–6.5 µm ..... ***H. fragiforme*** (Pers.: Fr.) J. Kickx f.

5 On other hosts, rarely on *Fagus*; ascospores 7–9 × 3.5–5 µm ..... ***H. howeanum*** Peck

6(2) Stromatal surface with Purple (35) or Vinaceous (57) colors. 7
6 Stromatal surface with Orange (7), Rust (39), Brick (60), or brown colours . . . 17
6 Stromatal surface with a greenish tone, Isabelline (65), without visible colored granules beneath surface but with Fawn (87) to dilute Umber (9) KOH-extractable pigments; ascospores 11–12.5(–13.5) × 6–6.5 µm, ellipsoid-equilateral with straight germ slit, perispore indehiscent in 10% KOH (M.S. & J.F.; unpublished data on specimen in K collected in Poland; identified by Z. Pouzar). . . . . ***H. papillatum*** Ellis & Everh.

7(6) Ascospores averaging more than 20 µm long. 8
7 Ascospores averaging less than 15 µm long 9

8(7) KOH-extractable pigments Pale Vinaceous Grey (115) to Vinaceous Grey (116) in fresh specimens or absent in aged specimens; ascospores 18.5–23 × 8–10 µm with germ slit spore-length . . . . . ***H. vogesiacum*** (Pers.) Sacc.
8 Boreal distribution, frequently on *Salix*, KOH-extractable pigments dense, Greenish Olivaceous (90); ascospores 22–31 × 8.5–11µm with faint germ slit less than spore-length . . . . . ***H. macrosporum*** P. Karst.

9(7) KOH-extractable pigments Livid Purple (81) or absent 10
9 KOH-extractable pigments pigments Orange (7) to Sienna (8). 11
9 KOH-extractable pigments Amber (47), Isabelline (65), Olivaceous (48), Gray Olivaceous (107), Greenish Olivaceous (90), Citrine (13) or otherwise with yellow, green or brown tones. 13

10(9) Stromata effused, 0.4–0.5 mm thick, with KOH-extractable pigments dilute, Livid Purple (81) or absent; ascospores 8–11.5 × 4.5–5 µm with a straight germ slit. Distribution world-wide; major stromatal metabolites: carneic acids (Quang et al. 2006) . . . . . ***H. carneum*** Petch
10 Stromata pulvinate, 0.8–1.4 mm thick, with KOH-extractable pigments Vinaceous Purple (101); ascospores 9.5–12.5 × 5–6 µm with a sigmoid germ slit (France, UK, present study) . . . . . ***H. fuscoides***

11(9) Ascospores 11–13.5 × 5–7 µm, with perispore faintly striate by LM; known from Portugal (present study) . . . . . ***H. lusitanicum***
11 Ascospores 9.5–11.5 × 4.5–6 µm, with perispore smooth by LM 12

12(11) Stromata widely effused with jagged black margins; ascospores 9–11.5 × 5–6 µm; host preference for *Fraxinus*; Temperate Europe and USA (Stadler et al. 2008) . . . . . ***H. petriniae*** M. Stadler & J. Fourn.
12 Stromata less widely effused to effused-pulvinate, with concolorous margins; ascospores 9.5–11.5 × 4.5–5 µm; known from the Canary Islands (Stadler et al. 2008) . . . . . ***H. canariense*** J. Fourn. et al.

13(9) Perithecia obovoid to frequently tubular, up to 1 mm high; stromatal surface with a metallic shine when mature. Recorded from Central and Western Europe and North America (various hosts). Ascospores 9.5–11.5 × 4–4.8 µm . . . . . ***H. macrocarpum*** Pouzar
13 Perithecia spherical to obovoid, not tubular; stromatal surface lacking a metallic shine when mature 14

14(13) Ascospores with straight germ slit 15
14 Ascospores with slightly sigmoid germ slit 16

15(14) Ascospores ellipsoid-inequilateral in lateral view, 9–12 × 4–6 µm, perispore dehiscent in 10% KOH. KOH-extractable pigments Amber (47), Greenish Yellow (16) or Citrine (13) ..... ***H. perforatum*** (Schwein.) Fr.
15 Ascospores ellipsoid, nearly equilateral in lateral view, often pyriform, 12–15 × 5.5–7 µm, perispore indehiscent in 10% KOH. KOH-extractable pigments Olivaceous (48), Greenish Olivaceous (90), Gray olivaceous (127), or Olivaceous Gray (121). So far known from Austria, Germany, Slovakia, and North America. ..... ***H. fuscopurpureum*** (Schwein.) M.A. Curtis

16(14) Stromata with pure yellow (14) to luteous (12) granules and greenish olivaceous (90) KOH-extractable pigments; apparently restricted to *Quercus*, with a boreal distribution; ascospores 10–13.5 × 4–5 µm. So far known from France (Stadler et al. 2004), Scandinavia (Granmo 1999) and USA (Stadler et al. 2008) ..... ***H. porphyreum*** Granmo
16 Stromata with sienna (8) or otherwise orange brown granules and KOH-extractable pigments amber (47), isabelline (65), olivaceous (48), gray olivaceous (107), or greenish olivaceous (90); widespread, preferably on *Betulaceae* and other hosts, but not yet safely recorded from *Quercus*; ascospores 11–16 × 5–8 µm ..... ***H. fuscum*** (Pers.) Fr.

17(6) Young stromata with a bright yellow to orange fimbriate margin; perithecia small, 0.1–0.3 mm diam, seated on a well developed black basal tissue 18
17 Young stromata lacking a bright yellow to orange fimbriate margin 19

18(17) Ascospores 5–7 × 2.5–3.5 µm, ellipsoid-inequilateral in lateral view. So far recorded from Austria, Croatia, Germany (Bitzer et al. 2008). France, Italy, Slovakia (Ripková & Hagara 2003) and Switzerland ..... ***H. ticinense*** L.E. Petrini
18 Ascospores 8–11 × 4–5 µm, ellipsoid-equilateral in lateral view. So far recorded from France and USA ..... ***H. subticinense*** Y.M. Ju & J.D. Rogers

19(17) KOH-extractable pigments yellow or orange 20
19 KOH-extractable pigments with shades of olivaceous brown 33

20(19) Ascal apical ring highly reduced or lacking, inamyloid 21
20 Ascal apical ring present, amyloid 23

21(20) Stromata glomerate with ostioles encircled by a ring; ascospores 11.5–13 × 6–6.8 µm with perispore conspicuously striate by LM (France, present study) ..... ***H. gibriacense***
21 Stromata applanate to pulvinate, with ostioles lacking a ring; ascospores with perispore smooth by LM 22

22(21) Stromata discoid, encircled with a swollen stellate margin, on bark of *Fraxinus*; ascospores 9.5–12 × 5–6 µm. Europe and North America ..... ***H. cercidicola*** (Berk. & M.A. Curtis ex Peck) Y.M. Ju & J.D. Rogers
22 Stromata pulvinate to hemispherical, reported from *Carpinus*, ascospores 9–11 × 4.5–5.5 µm (see also 4) ..... ***H. commutatum*** Nitschke

23(20) Ascospores averaging more than 14 µm long 24
23 Ascospores averaging less than 12 µm long 25

24(23) Stromata pulvinate restricted at base, with rust brown to ochraceous brown granules beneath surface; apparently rare, known only from *Tilia* and *Sorbus*; ascospores 14–17 × 6.5–8 µm, Recorded from Switzerland (Petrini & Müller 1986), Slovakia and Canada (Stadler et al. 2008) ..... ***H. ferrugineum*** G. H. Otth
24 Stromata effused to pulvinate, with blood red granules beneath surface, recorded from various hosts; ascospores 15–18 × 6–7.5 µm ..... ***H. julianii*** L.E. Petrini

25(23) KOH-extractable pigments Amber (47), Greenish Yellow (16) or Citrine (13); ascospores 9.7–11.5 × 4.7–5.3 µm (see also 15) ..... ***H. perforatum*** (Schwein.) Fr.
25 KOH-extractable pigments Orange (7), Sienna (8), Rust (39) or Scarlet (5) ... 26

26(25) Ascospores almost equilateral in lateral view. 27
26 Ascospores inequilateral in lateral view 28

27(26) Ascospores 7–10 × 3–4.5 µm; stromatal surface dark rust (39) to sepia (63), with dark orange granules beneath surface and KOH-extractable pigments fulvous (43) to rust (39); recorded from *Salix* in Northern Europe (Granmo 1999), Belgium (J.F. & M.S., unpublished data), and USA (Ju & Rogers 1996, as unnamed segregate in "Notes to *H. rubiginosum*") ..... ***H. salicicola*** Granmo
27 Ascospores 9.5–12.5 × 4.8–6 µm; stromatal surface vinaceous buff (86), greyish sepia (106) to brown vinaceous (84) with bright yellow granules beneath surface and between perithecia; KOH-extractable pigments hazel (88), sienna (8) to umber (9). Apparently restricted to *Sorbus*, with a boreal distribution (Granmo 2001) ..... ***H. liviae*** Granmo

28(26) Ascospores averaging less than 11 µm long 29
28 Ascospores averaging more than 11 µm long. 31

29(28) Stromata with papillate ostioles. 30
29 Stromata with umbilicate ostioles ..... ***H. rubiginosum*** (Pers.) Fr.

30(29) Stromata erumpent, pulvinate, small, with orange granules beneath surface; known from Europe and USA, restricted to *Populus*; ascospores 8–10 × 3.5–4.5µm ..... ***H. laschii*** Nitschke
30 Stromata superficial, effused to pulvinate, with blood red granules beneath surface; distribution apparently world-wide, without apparent host specificity ascospores 7.5–10 × 4–4.8 µm. ..... ***H. rutilum*** Tul. & C. Tul.

31(28) Perithecia up to 0.2 mm diam; ascospores 11–14.5 × 5–6 µm with slightly sigmoid germ slit; Canary Islands ..... ***H. urriesii*** J. Fourn. & M. Stadler
31 Perithecia 0.3–0.45 mm diam; ascospores with straight germ slit 32

32(31) Ascospores 9.5–11.5 × 4.5–5 µm; known from the Canary Islands (see also 12) ..... ***H. canariense*** J. Fourn. et al.
32 Ascospores 11–13.5 × 5–7 µm; known from Portugal (see also 11) ..... ***H. lusitanicum***

33(18) KOH-extractable pigments Hazel (88), Sienna (8) to Umber (9); perithecia obovoid, up to 0.4 mm high; ascospores dark brown, ellipsoid, nearly equilateral, 9.5–12.5 × 4.8–6 µm; apparently restricted to *Sorbus* (see also **27**) ..... ***H. liviae*** Granmo

33 KOH-extractable pigments isabelline (65), umber (9), or grayish sepia (106); perithecia frequently tubular, up to 1 mm high; ascospores inequilateral and narrower, 9.5–11.5 × 4–4.8 µm (see also 13)..... ***H. macrocarpum*** Pouzar

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New records of graminicolous smut fungi in Ukraine

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Abstract – Four new records of graminicolous smut fungi are reported from Ukraine. Among these species *Tranzscheliella hypodytes* and *Urocystis agrostidis* were found on new host plants, *Ustilago aeluropodis* and *Ustilago trebouxii* are new fungi for Ukraine.

Key words – *Ustilaginomycetes, Poaceae*

Introduction

The smut fungi of Ukraine have not been investigated exhaustively. Studies on these fungi have been carried out intensively in only two regions— Halitzcia, by Polish mycologists (Wróblewski 1912, 1915, 1922; Raciborski 1910, Krupa 1888), and around Kyiv (Zelle 1925, Lavitska 1949, 1978). Other regions of Ukraine are poorly investigated for smut fungi. Southern Ukraine is part of the steppe zone. The true steppe is a unique natural phenomenon that is preserved only in Ukraine and Russia. The protected remnants of the Ukrainian steppe have a high level of endemism in local plant communities. Therefore, this region of the country is promising in terms of discovery of new species of plant pathogenic micromycetes, including smut fungi. Another interesting region of Ukraine is Volhynian Polissia situated in the northwest part of the country. Ancient forests and peat bogs contribute to great floristic diversity in this area. Thus, it is not surprising that the first detailed examination of these fungi in Ukraine provided noteworthy results. In this paper, we examined a collection from Volhynian Polissia containing two specimens of a smut fungus infecting *Melica ciliata* L. and specimens of smut fungi from the steppe region in the southern part of the country.

* corresponding author

Materials and methods

Sori, spore balls, and spores were studied using dried herbarium specimens. For light microscopy (LM), spore balls and spores were dispersed in a droplet of lactophenol on a microscope slide, covered with a cover glass, gently heated to boiling point to rehydrate the spores and eliminate air bubbles, and examined at 400× and 1000× magnification. For scanning electron microscopy (SEM), spores were placed on double-sided adhesive tape, mounted on a specimen stub, sputter-coated with gold, ca. 15 nm, and examined in SEM at 30 kV.

Results and discussion

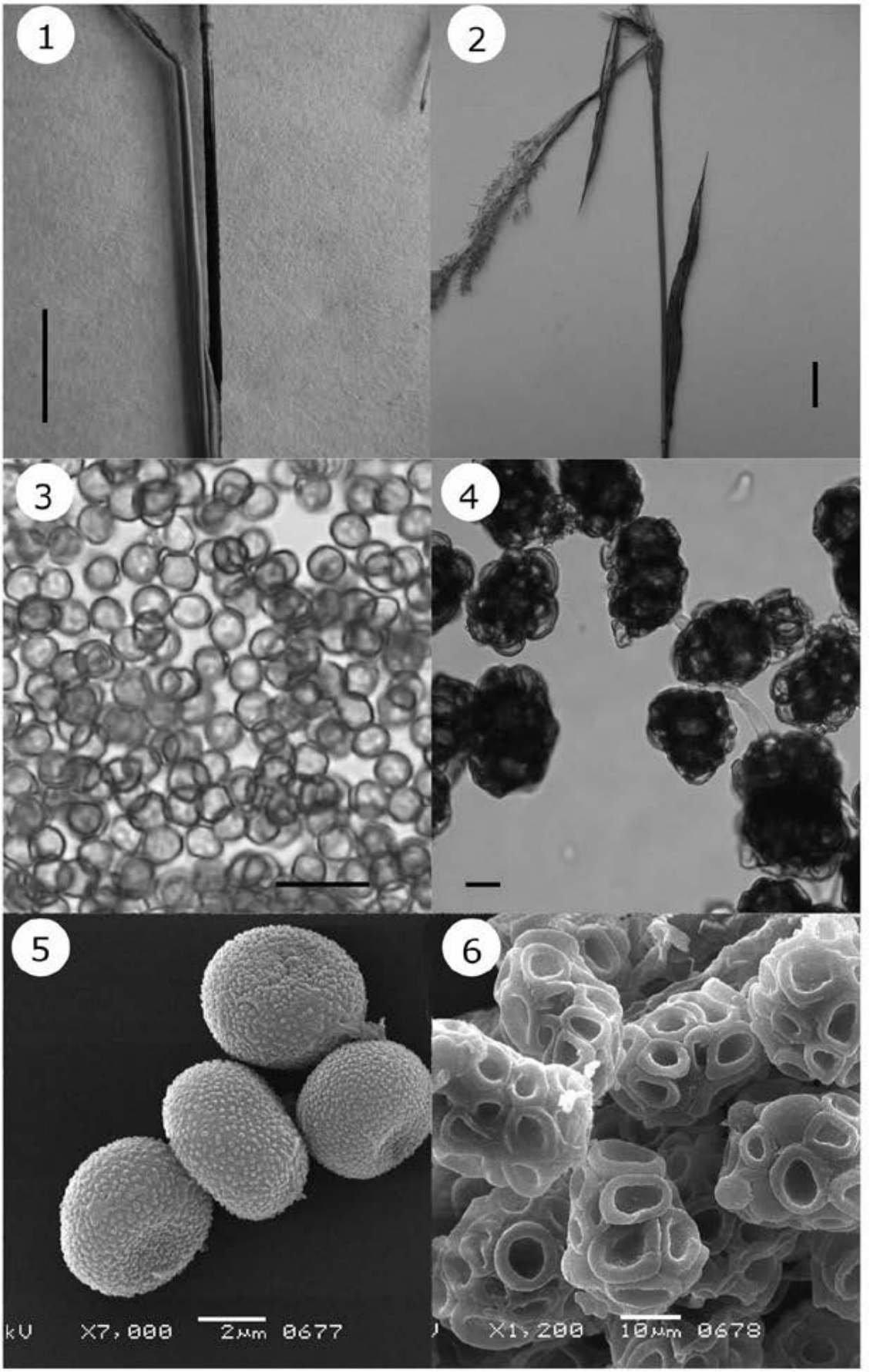
Only 45 species of smut fungi on plants belonging to different grass genera have been reported in Ukraine. The genus *Ustilago* (Pers.) Roussel is represented by 18 species, *Sporisorium* Ehrenb. ex Link by 7 species, the genera *Tilletia* Tul. & C. Tul. and *Urocystis* Rabenh. ex. Fuckel by 6 species each, *Tranzscheliella* Lavrov by 3 species, and *Jamesdicksonia* Thirum. et al., *Macalpinomyces* Langdon & Full., *Moesziomyces* Vánky, *Neovossia* Körn., and *Ustilentyloma* Savile by one species each (Zerova et al. 1971, Savchenko et al. in press). In adjacent countries, for example Poland, 44 species of graminicolous smut fungi were reported (Piątek et al. 2005), and more than 70 species of graminicolous smut fungi were reported in Russia (Karatygin & Azbukina 1989, Azbukina et al. 1995). As a result of our studies on recently collected specimens in the Volhynian Polissia and southern steppe regions of Ukraine we have extended the list of Ukrainian graminicolous smut fungi to include *Urocystis agrostidis*, *Ustilago aeluropodis*, and *U. trebouxii*. Another species, *Tranzscheliella hypodytes*, is reported on a new host plant.

Tranzscheliella hypodytes (Schltdl.) Vánky & McKenzie FIGS. 1, 3, 5

SORI in culms as a black to blackish brown, semi-agglutinated to powdery spore mass surrounding the upper internodes and in the axis of abortive inflorescences. Sori first hidden by a leaf-sheath, then naked. Infection systemic, inflorescences usually sterile. SPORES globose, subglobose to elongated, irregular or slightly to medium compressed, 3.9–5.2 × 4.6–5.7 µm (at the mean 4.6 × 5.2 µm), medium to dark olivaceous brown. Spore wall smooth, ca. 0.5 µm thick, in SEM densely and minutely verruculose on the wall surface, hyaline cap occasionally present.

SPECIMEN EXAMINED — On *Elymus uralensis* subsp. *viridiglumis* (*Poaceae*): Ukraine, Kherson region, Hola Prystan district, Black Sea Biosphere Reserve, 6.VII.2009, K. & M. Savchenko, KW 36370F.

FIGS. 1–6. 1, 3, 5: *Tranzscheliella hypodytes* on *Elymus uralensis* subsp. *viridiglumis*; 1: part of infected plant with sori; 3, 5: spores in LM and SEM. 2, 4, 6: *Urocystis agrostidis* on *Agrostis gigantea* subsp. *maeotica*; 2: infected plant with sori; 4, 6: spore balls in LM and SEM. Bars: 1, 2 = 1 cm; 3, 4, 6 = 10 µm; 5 = 2 µm.


1
2
3
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kV X7,000 2µm 0677
X1,200 10µm 0678

COMMENTS: *Tranzscheliella hypodytes* was collected on a new host plant, *Elymus uralensis* subsp. *viridiglumis* (Nevski) Tzvelev (=*Agropyron lavrenkoanum* Prokudin). This fungus has an extremely broad host range that includes a number of *Elymus* spp., but this is the first report on *E. uralensis*.

Urocystis agrostidis (Lavrov) Zundel FIGS. 2, 4, 6

SORI in leaves as long streaks between the veins, initially lead-colored and covered by the epidermis of the host plant which later ruptures longitudinally and the black powdery mass of spore balls becomes scattered. SPORE BALLS globose, subglobose, 22–50 × 25–50 µm in diameter, composed of 1–4 central spores and a continuous layer of sterile cells. SPORES globose to subglobose, 13–17 × 15–20 µm, olivaceous brown to light brown with a smooth surface. Sterile cells ovoid, subglobose to elongated, 7–15 µm long, pale yellowish to reddish brown.

SPECIMEN EXAMINED — On *Agrostis gigantea* subsp. *maeotica* (*Poaceae*): Ukraine, Kherson region, Hola Prystan district, Black Sea Biosphere Reserve, 4.VII.2009, K. & M. Savchenko, KW 36369F.

COMMENTS: During a trip to the Black Sea Biosphere Reserve (steppe zone, South of Ukraine) in 2009 a smutted specimen of *Agrostis gigantea* subsp. *maeotica* (Klokov) Tzvelev was collected. The fungus was identified as *Urocystis agrostidis*. Until now, no *Urocystis* species on *Agrostis* L. have been reported in Ukraine. This represents a new species of smut fungus for Ukraine and a new host record for the species.

Ustilago aeluropodis (Trotter) Vánky

SORI on the tip of culms replacing the inflorescences, 1–2 cm long, hidden by leaf-sheaths and young leaves, with maturation rupturing to expose the dark brown, powdery spore mass. Peridium, sterile cells, and columellae are lacking. SPORES very variable in shape and size, in certain cases aggregated into loose, ephemeral spore groups, globose, ellipsoidal, 10–17 × 12–18 µm, golden brown to brown, wall 0.8–1.5 µm thick, in LM sparsely to moderately densely, minutely verruculose; in SEM minutely verruculose-echinulate.

SPECIMEN EXAMINED — On *Aeluropus littoralis* (*Poaceae*): Ukraine, Kherson region, Hola Prystan district, Black Sea Biosphere Reserve, 18.VIII.2003, O.Yu. Umanets, KW 36361F.

COMMENTS: During the last ten years phytotrophic micromycetes have been collected by Dr. O. Umanets in the Black Sea Biosphere Reserve (Kherson region, Ukraine). Among the specimens examined, we found several examples of vascular plants infected by smut fungi. Previously we reported *Sporisorium cenchri* (Lagerh.) Vánky as a new record for Ukraine (Savchenko et al., in press). In 2003 Dr. O. Umanets also collected infected plants of *Aeluropus littoralis*

(Gouan) Parl. We have identified the smut as *Ustilago aeluropodis*, another new record for Ukraine. Prior to this record, this species was reported in Europe only from Romania (Vánky 1994).

Ustilago trebouxii Syd. & P. Syd.

Sori in the upper leaves and leaf-sheaths as long, dark to olivaceous brown striae. Spore mass initially covered by the epidermis, exposed with maturation, becoming powdery. Spores subglobose, rarely globose to slightly irregular, 3.5–5 × 4–6 µm, pale olivaceous brown, in LM smooth, in SEM sparsely minutely punctuate-verruculose; verrucae never merged.

Specimens examined — On *Melica ciliata* (*Poaceae*): Ukraine, Volhynian region, Ratne district, near Sviate lake, 1.VIII.2009, K. Savchenko, KW 36854F, 36855F.

Comments: It is not inconceivable that this fungus will be also found in Poland and Byelorussia.

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Bionectria vesiculosa sp. nov. from Yunnan, China

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Abstract — A new species of *Bionectria* on decaying leaves is described from Xishuangbanna in southwestern China. It is distinctive in the brown perithecia, laterally collapsing when dry, a ring of large vesicular cells surrounding the subapical region of the perithecia, clavate asci with an apical ring, and fusiform, smooth-walled ascospores. Morphology and sequence analysis of ITS and 28S nrDNA support its taxonomic position as a new species in *Bionectria*.

Key words — Chelex-100, taxonomy

Introduction

The genus *Bionectria* Speg. (*Bionectriaceae*) is characterized by pale yellowish to orange perithecia that do not change color in 3% KOH or lactic acid, a smooth to warted perithecial wall of 1–3 layers, clavate asci with or without an apical ring, 2-celled ascospores with smooth, spinulose, warted or striate surface, and *Clonostachys* anamorphs. Members of *Bionectria* occur on woody and herbaceous plants or other fungi, and are mainly distributed in tropical and subtropical regions (Rossman et al. 1999, Schroers 2001). In connection with our work on the Chinese fungus flora, an interesting fungus was encountered that has brown perithecia with a ring of large cells at the subapical region. On the basis of the teleomorph morphology and sequence analysis of two nuclear ribosomal genes (nrDNA), its position in *Bionectria* is confirmed; its relationship with other species of the genus is discussed.

Materials & methods

The taxonomic treatments and methods of Rossman et al. (1999) and Schroers (2001) were followed for the morphological study. Water was used as the mounting medium

* Correspondence author

TABLE 1. Sequences analyzed to determine relationships among species in *Bionectria*.

SPECIES	ITS nrDNA		28S nrDNA	
	Collection no.	GenBank no.	Collection no.	GenBank. no.
Bionectria compactiuscula Schroers	CBS 913.97	AF358245	CBS 919.97	AF210690
B. coronata (Juel) Schroers	CBS 696.93	AF210667	CBS 696.93	AF210667
B. epichloe (Speg.) Schroers	CBS 101037	AF210675	CBS 101037	AF210675
B. grammicospora (Ferd. & Winge) Schroers & Samuels	CBS 209.93	AF210678	CBS 209.93	AF210678
B. grammicosporopsis (Samuels) Schroers & Samuels	CBS 115.67	AF210679	CBS 115.67	AF210679
B. levigata Schroers	CBS 948.97	AF210680	CBS 948.97	AF210680
B. ochroleuca (Schwein.) Schroers & Samuels	CBS 194.57	AF358249	CCFC 226708	AY686634
B. pityrodes (Mont.) Schroers	CBS 246.78	AF210673	CBS 102033	AF210672
B. ralfsii (Berk. & Broome) Schroers & Samuels	CBS 102845	AF358253	CBS 129.87	AF210676
B. rossmaniae Schroers	CBS 210.93	AF358227	CBS 211.93	AF210665
B. sesquicillii (Samuels) Schroers	CBS 180.88	AF210666	CBS 180.88	AF210666
B. setosa Schroers	CBS 834.91	AF210670	CBS 834.91	AF210670
B. vesiculosa	HMAS 183151	**HM050304**[a]	HMAS 183151	**HM050302**
B. zelandiae-novae Schroers	CBS 100979	AF358229	CBS 232.80	AF210684
Clonostachys divergens Schroers	CBS 967.73b	AF210677	CBS 967.73b	AF210677
C. miodochialis Schroers	CBS 997.69	AF210674	CBS 997.69	AF210674
C. phyllophila Schroers	CBS 685.96	AF210663	CBS 921.97	AF210664
Hydropisphaera erubescens (Roberge ex Desm.) Rossman & Samuels	HMAS 91779	FJ969800	HMAS 91779	GU075862
Ijuhya paraparilis (Samuels) Rossman & Samuels	HMAS 183506	FJ969801	HMAS 183506	**HM050303**

[a] Numbers in bold indicate the newly submitted sequences.

for microscopic examinations and measurements; and photographs were taken from water or cotton blue mounts (Stevens 1981). Continuous measurements of individual structures are based on 30 units except as otherwise noted. Specimen examined is deposited in the Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences (HMAS).

Chelex-100 was applied to extract genomic DNA from the dehydrated perithecia according to the method by Zhang et al. (2006) with modifications. Fifty perithecia were carefully collected from the substrate with a pair of forceps and rinsed in sterilized water. The perithecia were transferred into a 1.5 ml eppendorf tube, mixed with equal volume of quartz sand, and thoroughly ground with a glass pestle for 10 min. Then 200 µl 10%

w/v Chelex-100 chelating resin (Sigma) was added and mixed for 10 sec on a vortex. The tube was incubated at 56°C for 2 hr, mixed for 10 sec, and then incubated at 99°C for 10 min. After centrifuging at 12000 r/min for 10 min, the supernatant was transferred to another 1.5 ml tube filled with 4/5 volume of 100% pre-cooling isopropanol. The mixture was placed at −20°C overnight, and centrifuged at 12000 r/min for 15 min. After rinsing with 200 µl 75% ethanol, the precipitant was dried at room temperature and dissolved in 30 µl TE or ddH_2O as PCR template.

The ITS1-5.8S-ITS2 (ITS) and 28S regions of the nrDNA were amplified by using the primer pairs, ITS5–ITS4 (White et al. 1990), and LROR–LR5 (Rehner & Samuels 1994, Vilgalys & Hester 1990). The PCR reaction mixture (50 µl) contained 5.0 µl 10× PCR buffer, 3.0 µl $MgCl_2$ (25 mM), 2.5 µl sense primer (10 µM), 2.5 µl antisense primer (10 µM), 1.0 µl dNTP (10 mM each), 2.5 µl DNA template, 0.5 µl Taq polymerase (5.0 U/µl) (Bio Basic Inc.) and 33 µl ddH_2O. Reactions were performed on the 2720 Thermal Cycler (Applied Biosystems) with cycling conditions of denaturation at 95°C for 5 min, followed by 35 cycles of denaturation at 94°C for 30 s, annealing at 52°C (ITS region) and at 55°C (28S region) for 30 s and elongation at 72°C for 60 s, with a final extension step at 72°C for 5 min to complete the reactions. Amplicon was purified with the PCR Product Purification Kit (Biocolor BioScience & Technology Co.) and sequenced with the ABI BigDye Terminator V3.1 Cycle Sequencing Kit (Applied Biosystems) on an ABI 3730XL DNA Sequencer (SinoGenoMax Co. Ltd). The amplifying primers were served as sequencing primers. Final sequences were checked and edited manually by using BioEdit V.7.0.5 (Hall 1999). Sequences of the related species were retrieved from GenBank. Materials studied are listed in TABLE 1.

All sequences were aligned using ClustalX V.1.8 (Thompson et al. 1997), and the alignments were visually adjusted while necessary. A Neighbor-Joining tree was generated using MEGA 4.10 (Tamura et al. 2007) based on combined sequences of ITS and 28S genes with *Hydropisphaera erubescens* and *Ijuhya paraparilis* as outgroup taxa. Kimura 2-parameter was selected as the nucleotide substitution model, and gaps or missing data were pairwise deleted. Bootstrap method was performed with 1000 replicates to test phylogeny branch support.

Results and discussion

Bionectria vesiculosa J. Luo & W.Y. Zhuang, **sp. nov.** FIGS. 1–2

MYCOBANK MB518120

Perithecia subglobosis, 100–155 µm diam; ascis clavatis, 8-sporis, 35–47 × 3.5–7 µm; ascosporis fusiformibus, uniseptatis, 9.5–13 × 1.5–3 µm.

HOLOTYPE: China, Yunnan, Xishuangbanna, on decaying leaves of a dicotyledonous plant, W.-P. Wu & Y. Huang W2728b, 16 X 1999, HMAS 183151.

ETYMOLOGY: The specific epithet refers to the vesicular cells forming a ring on the perithecial apex.

Ascomata on white subiculum, perithecial, solitary or gregarious up to 3 in a group, superficial, subglobose, 110–160 µm high, 100–155 µm diam., laterally collapsing when dry, pale yellow when young, and reddish brown to brown at

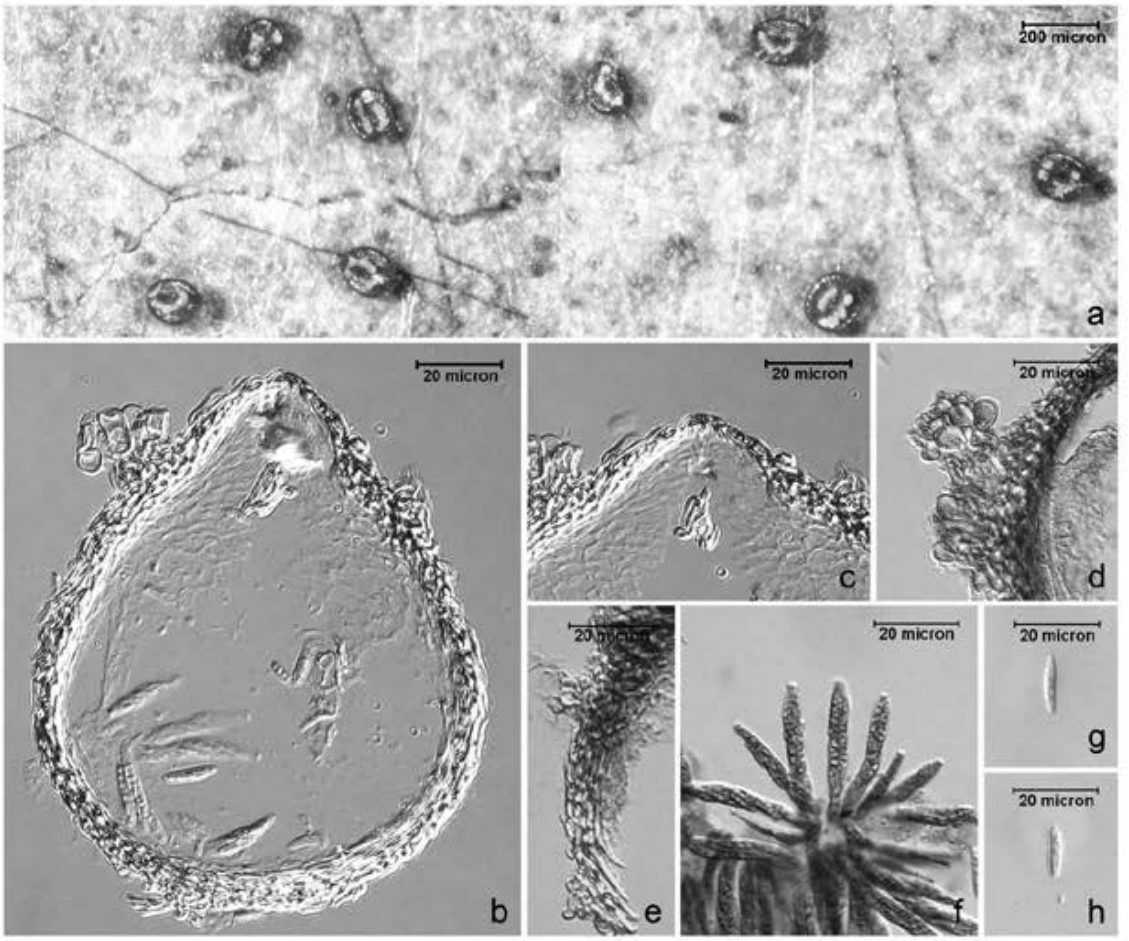

FIG. 1. *Bionectria vesiculosa* (HMAS 183151). a. Ascomata on natural substrate; b. Median section of an ascoma; c. Median section through apical portion of an ascoma; d, e. Structure of ascomatal wall at subapical portion showing vesicular cells; f. Asci with an apical ring; g, h. Ascospore.

maturity, not changing color in 3% KOH or lactic acid, surface smooth, with a ring composed of large cells or a ring of wart-like structures surrounding subapical region; coronate ring 5–26 µm high, pale yellow, cells vesicular, 2–12 × 2–7 µm, cell walls 0.5–1 µm thick. Ascomatal wall 7–15 µm thick, of two layers; outer layer 5–10 µm thick, cells angular, 5–10.5 × 3–5.5 µm, cell walls 0.5–2 µm thick; inner layer 2–6 µm thick, cells flattened, 6–11.5 × 1–3 µm, cell walls 0.5–1.5 µm thick. Asci clavate, 8-spored, with an apical ring, 35–47 × 3.5–7 µm (n = 50). Ascospores fusiform, uniseptate, not constricted at septum, hyaline, smooth, with 6–9 guttules, biseriate, 9.5–13 × 1.5–3 µm (n = 50).

ANAMORPH: Unknown.

NOTES: Morphologically, the perithecial anatomy and negative reactions to KOH and lactic acid of the new species indicate its position in *Bionectria*. Unlike any other species of the genus, a crown-like ring composed of large vesicular cells is present at the subapical region of the perithecia. *Bionectria vesiculosa* is somewhat similar to *B. setosa* in having brown perithecia less than 200 µm in

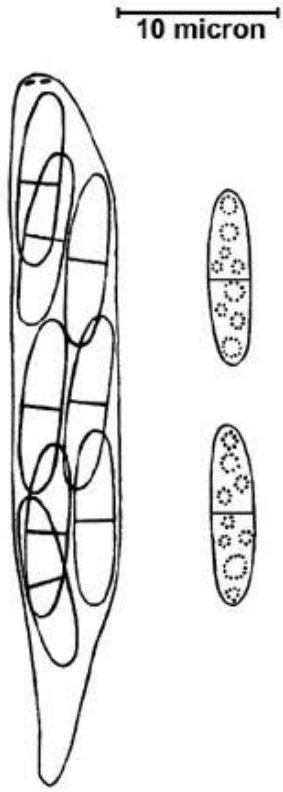

FIG. 2. Ascus and ascospores of *Bionectria vesiculosa* (HMAS 183151).

diam., two-layered perithecial wall, clavate asci with an apical ring, shape, size, septation and surface morphology of ascospores, and leaf-inhabiting. The latter differs in having smooth and thicker perithecial walls 20–30 µm thick and asci 45–53 × 6.5–9 µm (Schroers 2001). The new species also resembles *B. coronata* in the presence of a thin subiculum at the perithecial base, small, subglobose perithecia that are laterally pinched when dry, acute perithecial apex, shape and size of asci, shape, size and surface of ascospores, and foliicolous habit. *Bionectria coronata* differs in having pale yellow to yellowish orange perithecia, one-layered perithecial walls, 15–20 µm thick, with the outermost cell layer connected with a hyphal stroma, undulate setae surrounding the ostiole, asci lacking of an apical apparatus, and unicellular ascospores (Schroers 2001).

Seventeen related species of *Bionectria/Clonostachys* were selected to investigate the phylogenetic position of *B. vesiculosa*. As shown in FIG. 3, all species tested formed one monophyletic clade with 100% bootstrap support, which confirms the placement of the new species in *Bionectria*. The morphologically similar *B. coronata* appears to be only distantly related. *Bionectria pityrodes* and *B. setosa* form a poorly supported subclade with *B. vesiculosa* (FIG. 3). The morphological characteristics of these three species do not show much similarity (Schroers 2001).

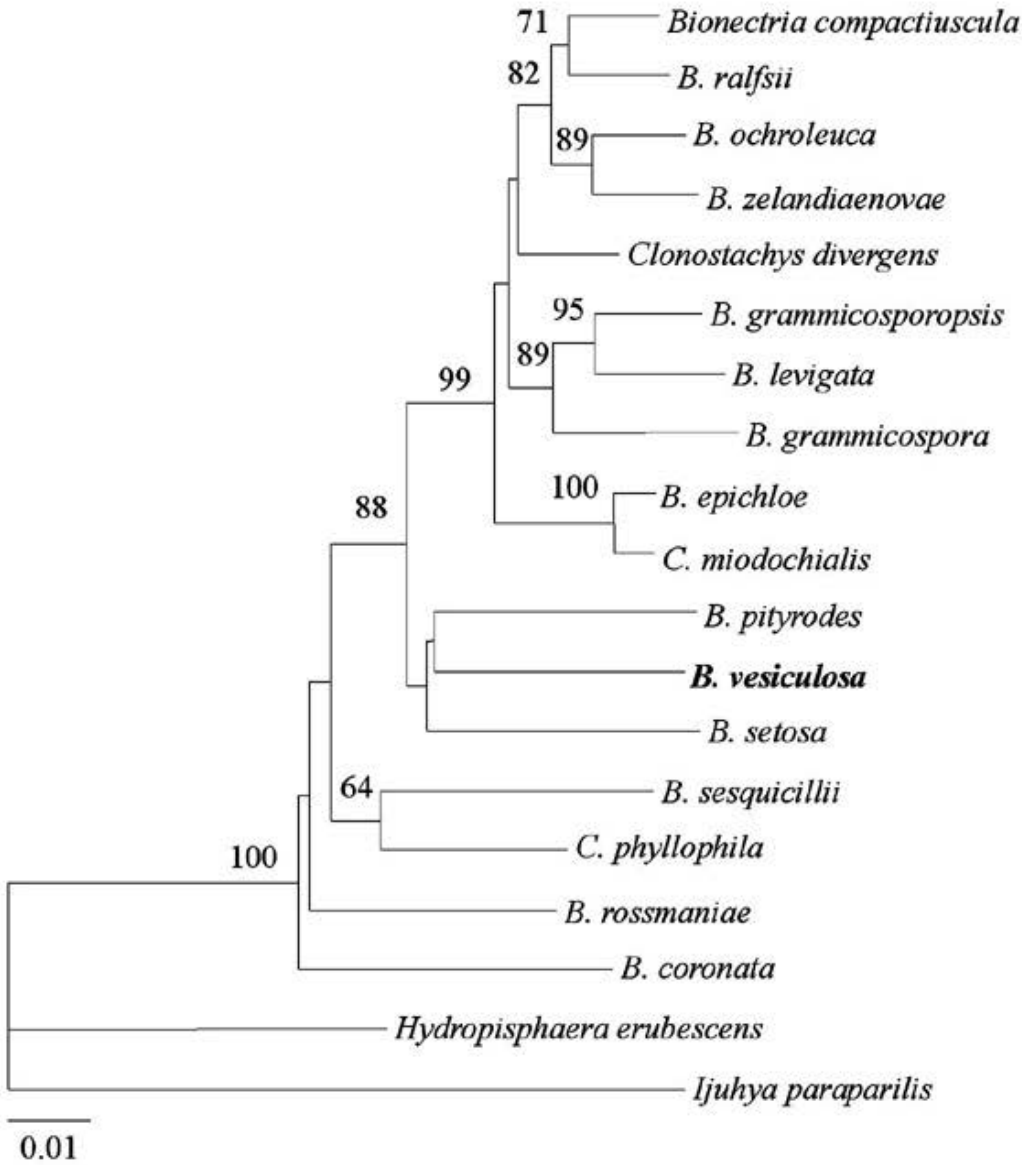

FIG. 3. Neighbour-joining tree based on combined sequences of ITS and 28S nrDNA, showing the relationships among some *Bionectria*/*Clonostachys* species. Bootstrap values ≥ 50% are noted above internodes.

In conclusion, both morphology and DNA sequence analysis support the recognition of *Bionectria vesiculosa* as a new species.

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Checklist of the arbuscular mycorrhizal fungi (*Glomeromycota*) in the Brazilian semiarid

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Abstract — Seventy-nine species of arbuscular mycorrhizal fungi (AMF) are reported for the semiarid Caatinga biome of Northeast Brazil. Data are based primarily on research by L.C. Maia and co-workers during the past 20 years. The full checklist is available at www.mycotaxon.com/resources/weblists.html.

Key words — *Glomeromycetes*, symbiosis, biodiversity, taxonomy

Introduction

Arbuscular mycorrhizal fungi (AMF) form symbiotic association with roots of plants, a mutual connection that may have contributed to the evolution and survival of land-plants and fungi for over 400 million years (Smith & Read 1997).

Thaxter (1922) felt that AMF belonged to the *Endogonaceae*. Based on the symbiotic habit, Morton & Benny (1990) placed all AMF into the new order *Glomales* as a monophyletic group. The AMF are now classified in the phylum *Glomeromycota* (Schüßler et al. 2001) with approximately 220 described species.

Fitter (1990) noted that the fundamental ecological importance of AMF fungi requires research of their diversity in various ecosystems, and in discussing the place of AMF community in a given ecosystem, Sanders et al. (1996) questioned whether there is a relationship between which plants are colonized and what effect AMF have upon both plants and the ecosystem. These questions indicate the need for intensive studies and justify a survey of AMF in different ecosystems.

Most investigations of AMF in Brazil pertain to plant crops and not to natural ecosystems (Maia et al. 2006). The review paper by Trufem (1996) on AMF research within the Amazon, Atlantic Rain Forest, and Cerrado, cited the need for studies in the Caatinga and Pampas, two less studied Brazilian biomes. The Caatinga, which covers more than 800,000 km^2, representing 70% of the Northeast region and ~11% of Brazil (Drummond et al. 2000), is characterized by a hot dry semiarid climate and vegetation with trees and shrubs (many spiny, some xerophytic) in the *Apocynaceae*, *Bromeliaceae*, *Cactaceae*, *Euphorbiaceae*, and *Leguminosae* (Leal et al. 2003). One recent study (Stürmer & Siqueira 2008) lists only 30 AMF species from the Caatinga biome.

The new records contribute additional data about AMF diversity and a more complete list of AMF species from the Brazilian semiarid Caatinga biome.

Material and methods

Data cited originated from the authors as well as from the Web of Science; student theses and scientific proceedings have also been considered. References consulted include Albuquerque 2008; Freitas 2006; Lemos 2008; Gattai 2006; Goto et al. 2009, 2010; Lima et al. 2007; Maia et al. 2006; Mergulhão 2007; Mergulhão et al. 2007; Morais 2007; Pagano et al. 2007; Silva et al. 2007, 2008; and Souza et al. 2007. Gigasporioid-producing AMF species are classified according to Oehl et al. (2008); earlier synonyms are also listed.

Results and discussion

Seventy-nine species were found in the Caatinga, of which seven are new records for Brazil (*Dentiscutata colliculosa, Diversispora spurca, Glomus arborense, G. pallidum, Racocetra intraornata, Scutellospora dipurpurescens, S. pernambucana*) and three (*D. colliculosa, R. intraornata, S. pernambucana*) have been recently described. This brings the number of known Brazilian AMF to 106 species, including the 99 taxa cited by Stürmer & Siqueira (2008).

Compared with this last review (Stürmer & Siqueira 2008), the data presented here increase the number of species known in Brazil, which now represents at least 48.2% of the valid species worldwide. Most families of *Glomeromycota* (except *Geosiphonaceae* and *Pacisporaceae*) are represented in the Caatinga, with the number of species representing 74.5% of those recorded from Brazil and 35.9% of those known worldwide.

The majority of AMF studies in the Caatinga have so far focused on agrosystems (Stürmer & Siqueira 2008). However, despite the low number of inventories in the Caatinga, 57 species were listed from vegetation preserved in the biome, almost equaling the number of species (60) recorded from agrosystems throughout Brazil. This preliminary estimate of the AMF diversity

in the Caatinga suggests that a high diversity will probably be found in the biome in the future, particularly considering the high number of plants and animals also present (Leal et al. 2003).

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A new species of *Spadicoides* from Yunnan, China

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Abstract — *Spadicoides yunnanensis* sp. nov., collected from tropical forests in Yunnan province of China, is described and illustrated from a specimen occurring on dead branches of *Camellia japonica*.

Key words — hyphomycetes, taxonomy

Introduction

The genus *Spadicoides* was established by Hughes (1958) with *S. bina* (Corda) S. Hughes as the type species. Sinclair et al. (1985) amended the generic description to include species with solitary conidia on branched or unbranched conidiophores and suggested that the production of conidia in chains is the sole diagnostic character separating *Diplococcium* Grove from *Spadicoides*. Goh & Hyde (1996) reviewed the genus *Spadicoides* and recognized 21 species in this genus. The genus is characterized by differentiated, single, unbranched or branched conidiophores with polytretic, terminal and intercalary conidiogenous cells producing solitary, terminal and lateral, cuseptate, obovoid to ellipsoid conidia (Ellis 1971; Kuthubutheen & Nawawi 1991). Thus far, 30 species have been accepted in *Spadicoides*, of which four are described from China (Zhou et al. 1999; Ho et al. 2002; Wong et al. 2002; Cai et al. 2004).

Most species of *Spadicoides* are saprobes on rotten leaves or dead branches. A continuing survey of saprobic fungi on dead wood from tropical forest in Yunnan province of China revealed a previously undescribed species, *Spadicoides yunnanensis*. The type specimen is deposited in HSAUP (Herbarium of the Department of Plant Pathology, Shandong Agricultural University) with isotypes in HMAS (Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences).

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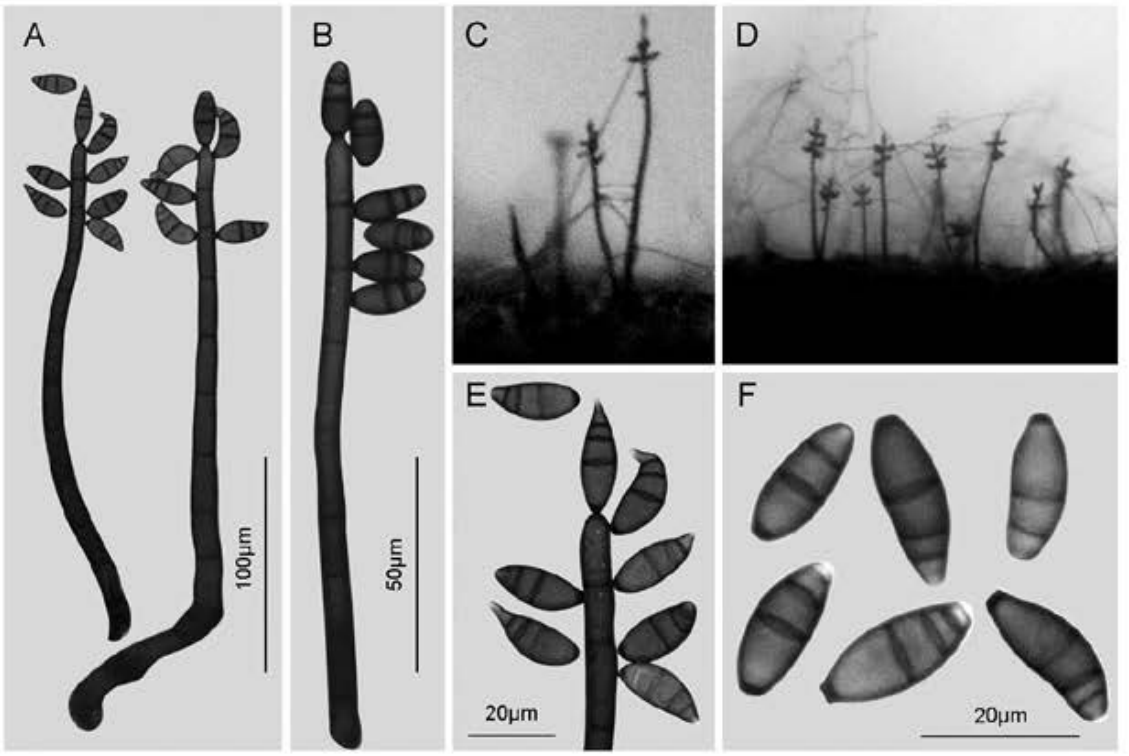

FIG. 1. *Spadicoides yunnanensis*. A–B. Conidiophores with terminal and lateral conidia. C–D. Conidiophores arising from wood. E. Conidiogenous cells showing conidiogenous pores. F. Conidia with 2–3 eusepta.

Taxonomic description

Spadicoides yunnanensis L.G. Ma & X.G. Zhang, **sp. nov.** FIGURE 1

MYCOBANK MB 518363

Coloniae effusae in substrato naturali, atro-brunneae. Mycelium partim superficiale, partim immersum, ex hyphis ramosis, septatis, pallide brunneis, laevibus, 1.5–2.0 μm crassis compositum. Conidiophora macronematosa, mononematosa, singula, simplicia, non ramosa, erecta, cylindrica, recta vel flexuosa, laevia, atro-brunnea, 7–12-septata, 140–290 μm longa, ad basim 10.0–14.5 μm crassa, ad apicem 6.5–8.0 μm crassa. Cellulae conidiogenae polytreticae, in conidiophoris incorporatae, terminales et intercalares, brunnea. Conidia solitaria, acropleurogena, simplicia, obpyriformia vel ovoidea, ad apicem rotundata vel acuta, ad basim truncata, brunnea, interdum cellulae apicalis subhyalina, laevia, crassitunicata, 2–3-euseptata, 18.5–28.0 μm longa, 6.5–10.0 μm crassa. Basi truncata 2.0–3.5 μm lata.

HOLOTYPE: on dead branches of *Camellia japonica* L. (*Theaceae*), the Forbidden Forest of Banna, Yunnan Province, China. Oct. 16. 2008, L.G. Ma, HSAUP H0041 (Isotype HMAS 196882).

ETYMOLOGY: in reference to the province where the type was found

Colonies effuse on natural substratum, dark brown. Mycelium partly superficial, partly immersed, composed of branched, septate, pale brown, smooth-walled hyphae, 1.5–2.0 μm thick. Conidiophores macronematous, mononematous,

single, simple, unbranched, erect, cylindrical, straight or flexuous, smooth, dark brown, 7–12-septate, 140–290 µm long, 10.0–14.5µm wide at the base, 6.5–8.0 µm wide at the apex. Conidiogenous cells polytretic, integrated, terminal and intercalary, brown. Conidia solitary, acropleurogenous, simple, obpyriform to ovoid, apex rounded or acute, base truncate, brown, occasionally apical cell subhyaline, smooth-walled, thick-walled, 2–3-euseptate, 18.5–28.0 µm long, 6.5–10.0 µm wide in the broadest part, 2.0–3.5 µm wide at the truncate base.

The conidia of *S. yunnanensis* resemble those of *S. curvularioides* (Sutton 1978) and *S. xylogena* (Hughes 1958) in having a similar conidial size and number of septa. However, the conidia of *S. curvularioides* are verrucose, pale brown, and cymbiform compared to the smooth, brown, obpyriform to ovoid conidia of *S. yunnanensis*, and the apices of the conidiophores in *S. curvularioides* are geniculate as opposed to those of *S. yunnanensis*, which are not. In addition, *S. yunnanensis* can be separated from *S. xylogena* by its obpyriform to ovoid conidia without banded septa.

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New species of *Monodictys* and *Veronaea* from soil in the Yellow River source area, China

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Abstract—Two new species, *Monodictys macrospora* and *Veronaea latispora* found from wetland soil and Gobi soil in Yellow River source area of China are described, illustrated and compared with similar taxa. The type specimens (dried cultures) and living cultures are deposited in the Herbarium of Shandong Agricultural University Plant Pathology (HSAUP). Isotypes are kept in the Herbarium of Institute of Microbiology, Academia Sinica (HMAS).

Key words—dematiaceous hyphomycetes, taxonomy, soil fungi

Introduction

During an investigation of soil dematiaceous hyphomycetes in Yellow River source area, China, two species in the genera *Monodictys* S. Hughes and *Veronaea* Cif. & Montemart. were discovered. Based on their distinctive morphological characteristics they could not be assigned to any of the described species. They are treated as new species and are compared to the most closely related species, *Monodictys chlamydosporoidea* (Liu & Zhang 2007), *M. arxanensis* (Wu & Zhang 2008), *Veronaea parvispora* (Ellis 1976), and *V. musae* (Ellis 1976).

Taxonomy

Monodictys macrospora H.Q. Pan & T.Y. Zhang, **sp. nov.** FIG. 1

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Coloniae in PCA effusae, atrobrunneae vel atrae. Mycelium maximam parten superficiale et aliquot immersum, ex hyphis modice vel atrobrunneis, levibus, septatis, 5–6.5 µm crassis compositum. Conidiophora micronematica, recta vel curvata, pallide brunnea,

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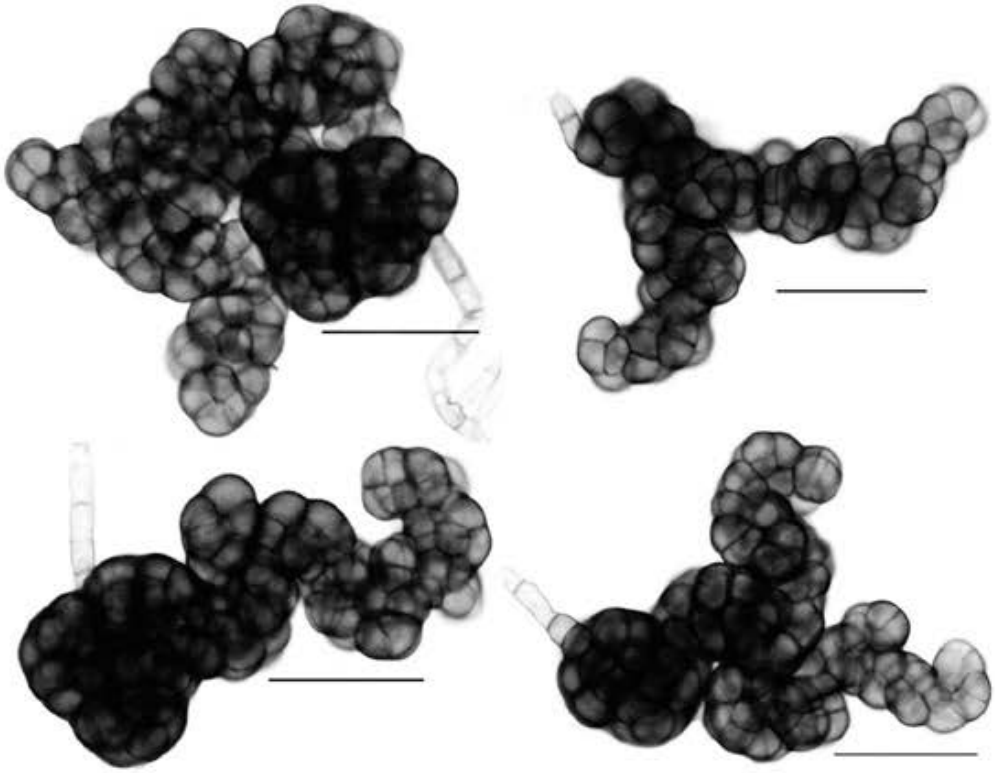

FIG. 1 Conidia and conidiophores of *Monodictys macrospora* (ex holotype; bars = 100 μm)

laevia. Cellulae conidiogenae pallide brunneae, monoblasticae, leaves, determinatae, aliquando inflatae, subglobosae vel cylindricae, 10.5–28.5 μm longae et 6.5–13 μm crassae. Conidia solitaria, acropleurogena, irregularis, ex cellulis globosis numerosis crasse inflatis composite, brunnea vel atrobrunnea, 43–125 × 21–38 μm.

HOLOTYPE: isolated from wetland soil, Madoi County, Qinghai Province, China, 24 Jul. 2007, H.Q. Pan, HSAUP II $_{07}$4068, holotype, HMAS196216, isotype.

ETYMOLOGY: in reference to the large conidia.

Colonies in potato carrot agar medium effuse, dark brown to black. Mycelium mostly superficial. Hyphae moderate brown to dark brown, smooth, septate, branched, 5–6.5 μm wide. Conidiophores micronematous, straight or flexuous, pale brown, smooth. Conidiogenous cells pale brown, monoblastic, smooth, determinate, sometimes inflated, subglobose or cylindrical, 10.5–28.5 μm long, 6.5–13 μm wide. Conidia solitary, acropleurogenous, irregular, comprising numerous globose inflated cells, brown to dark brown, 43–125 × 21–38 μm.

This species is similar to *Monodictys chlamydosporoidea* H.M. Liu & T.Y. Zhang and *Monodictys arxanensis* Y.M. Wu & T.Y. Zhang in conidial morphology. Both *M. chlamydosporoidea* and *M. arxanensis* have smaller conidia; those of *M. chlamydosporoidea* are 23–44 × 17–30 μm and those of *M. arxanensis* are 25–60 × 2–25 μm. These two species also have relatively simple conidia, pale brown colonies, and hyaline conidiophores.

Veronaea latispora H.Q. Pan & T.Y. Zhang, **sp. nov.** FIG. 2

MYCOBANK MB 512622

Coloniae effusae, olivaceae. Conidiophora recta vel leviter curvata, septata, brunnea, laevia, usque ad 90 µm longa, 1.5–2.5 µm crassa, apicem versus cicatricibus conidialibus minutis numerosis praedita. Conidia late obovoidea, subhyalina vel pallide brunnea, laevia, 7.5–9.5 × 3–5 µm.

HOLOTYPE: isolated from Gobi soil, Xunhua County, Qinghai Province, China. 24 Aug 2006, H.Q. Pan, HSAUP II $_{06}$3223, holotype; HMAS196217, isotype.

ETYMOLOGY: in reference to the relatively broad conidia of this species.

Colonies effuse, olivaceous brown. Conidiophores straight or slightly curved, septate, brown, smooth, up to 90 µm long, 1.5–2.5 µm thick, with numerous minute scars at the upper parts. Conidia broadly obovoid, subhyaline to pale brown, smooth, 7.5–9.5 × 3–5 µm.

The most closely related species in conidial morphology to this new taxon are *Veronaea parvispora* M.B. Ellis and *V. musae* M.B. Ellis (Ellis 1976). However, the conidia of *V. parvispora* are much smaller (2–3 × 1.5–2 µm). *Veronaea musae* differs from the new taxon in having narrower conidia (5–10 × 2–3 µm), usually with a minutely papillate base.

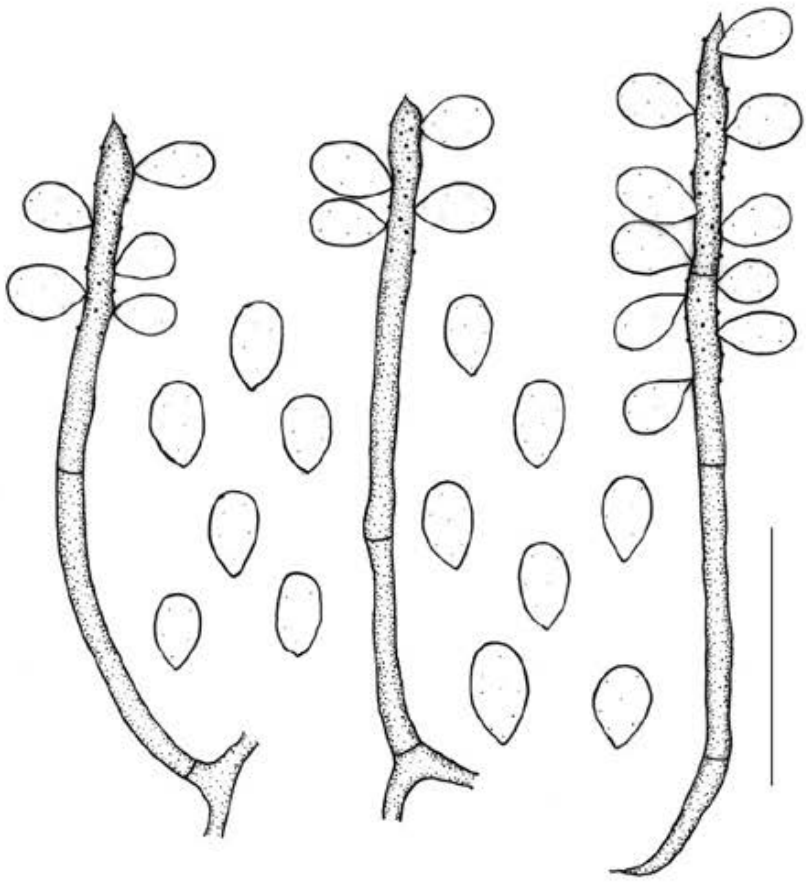

FIG. 2 Conidia and conidiophores of *Veronaea latispora* (ex holotype; bars = 25 µm)

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A new *Trametes* species from Southwest China

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Abstract — A new polypore, *Trametes cystidiolophora* sp. nov., found in Yunnan Province, southwest China, is described and illustrated. The new species is characterized by its pale grayish brown to pale cinnamon-buff pileus with distinctly concentric zones and radial veins, uneven pore surface, cylindrical to more or less allantoid basidiospores (6.6–9.2 × 2.4–3 µm), abundant cystidioles present in the hymenium, and skeleto-binding hyphae that become swollen in KOH.

Key words — *Polyporaceae*, taxonomy, wood-rotting fungi

Introduction

The genus *Trametes* Fr. is characterized by having pileate basidiocarps, a trimitic hyphal system with clamp connections on generative hyphae, hyaline and thin-walled basidiospores that are negative in Melzer's reagent, and causing white rot (Gilbertson & Ryvarden 1986, Ryvarden & Gilbertson 1994, Lindblad & Ryvarden 1999, Núñez & Ryvarden 2001). About 50 species in the genus have been reported in the world (Kirk et al. 2008), including 23 species previously recorded from China (Zhao & Zhang 1991, Teng 1996, Zhao 1998, Dai et al. 2007, Dai 2009, Dai & Yuan 2010).

During the study on wood-decaying fungi from Gaoligongshan Nature Reserve, Yunnan Province, southwest China, a species of *Trametes* was found that could not be identified to any known species. It is described in the present paper as *Trametes cystidiolophora*.

Materials and methods

The studied specimens are deposited in herbaria as cited below. The microscopic procedure follows Dai & Penttilä (2006). Sections were studied at

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magnification up to ×1000 using a Nikon Eclipse E 80i microscope and phase contrast illumination. Drawings were made with the aid of a drawing tube. To present spore size variation, the 5% of measurements excluded from each end of the range are given in parentheses. Abbreviations include IKI = Melzer's reagent, IKI– = negative in Melzer's reagent, KOH = 5% potassium hydroxide, CB = Cotton Blue, CB– = acyanophilous, L = mean spore length (arithmetic average of all spores), W = mean spore width (arithmetic average of all spores), Q = variation in the L/W ratios between the specimens studied, and n = number of spores measured from given number of specimens. Special colour terms follow Anonymous (1969) and Petersen (1996).

Taxonomy

Trametes cystidiolophora B.K. Cui & H.J. Li, **sp. nov.** FIG. 1

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Carpophorum annuum, pileatum, imbricatum; facies pororum bubalina vel reseo-bubalina, pori rotundi vel angulati, 2–3 per mm. Systema hypharum trimiticum, hyphae generatoriae hyalinae, fibulatae, hyphae skeletales contexti 2.8–6.2 µm; sporae hyalinae, cylindricae, IKI–, CB–, 6.6–9.2 × 2.4–3 µm.

TYPE — China. Yunnan Province, Baoshan, Gaoligongshan Nature Reserve, on dead angiosperm tree, 25.X.2009 Cui 8084 (**holotype** in BJFC); Cui 8087 (**isotype** in BJFC).

ETYMOLOGY — *cystidiolophora* (Greek): = "cystidiole-bearing", referring to the abundant cystidioles in the hymenium.

FRUITBODY — Basidiocarps annual, pileate, usually imbricate, without odor or taste when fresh, corky and light in weight when dry. Pileus dimidiate to semicircular, projecting up to 4.2 cm, 7.3 cm wide, 7 mm thick at the base; pileal surface pale grayish brown to pale cinnamon-buff when dry, glabrous, distinctly concentrically zoned and radially veined; margin sharp, wavy or incised in rounded lobes, deflexed with age. Pore surface cream-buff to pinkish buff when dry, slightly shiny; sterile margin white to cream, up to 2.5 mm wide; pores round to angular, 2–3 per mm, dissepiments thin, entire at margin and dentate to hydnoid with age. Context cream, corky, up to 3 mm thick. Tubes cream to cream-buff, corky, up to 4 mm long.

HYPHAL STRUCTURE — Hyphal system trimitic; generative hyphae with clamp connections; skeleto-binding hyphae dominant, thick-walled to subsolid, IKI–, CB–, become swollen in KOH.

CONTEXT — Generative hyphae infrequent, hyaline, thin-walled, moderately branched, 2–3.7 µm in diam; skeletal hyphae dominant, hyaline, slightly thick-walled to subsolid, frequently branched, and the slightly thick-walled skeletal hyphae often collapsed, interwoven, 2.8–6.2 µm in diam; binding hyphae hyaline, thick-walled to almost solid, frequently branched, interwoven, 1.7–3 µm.

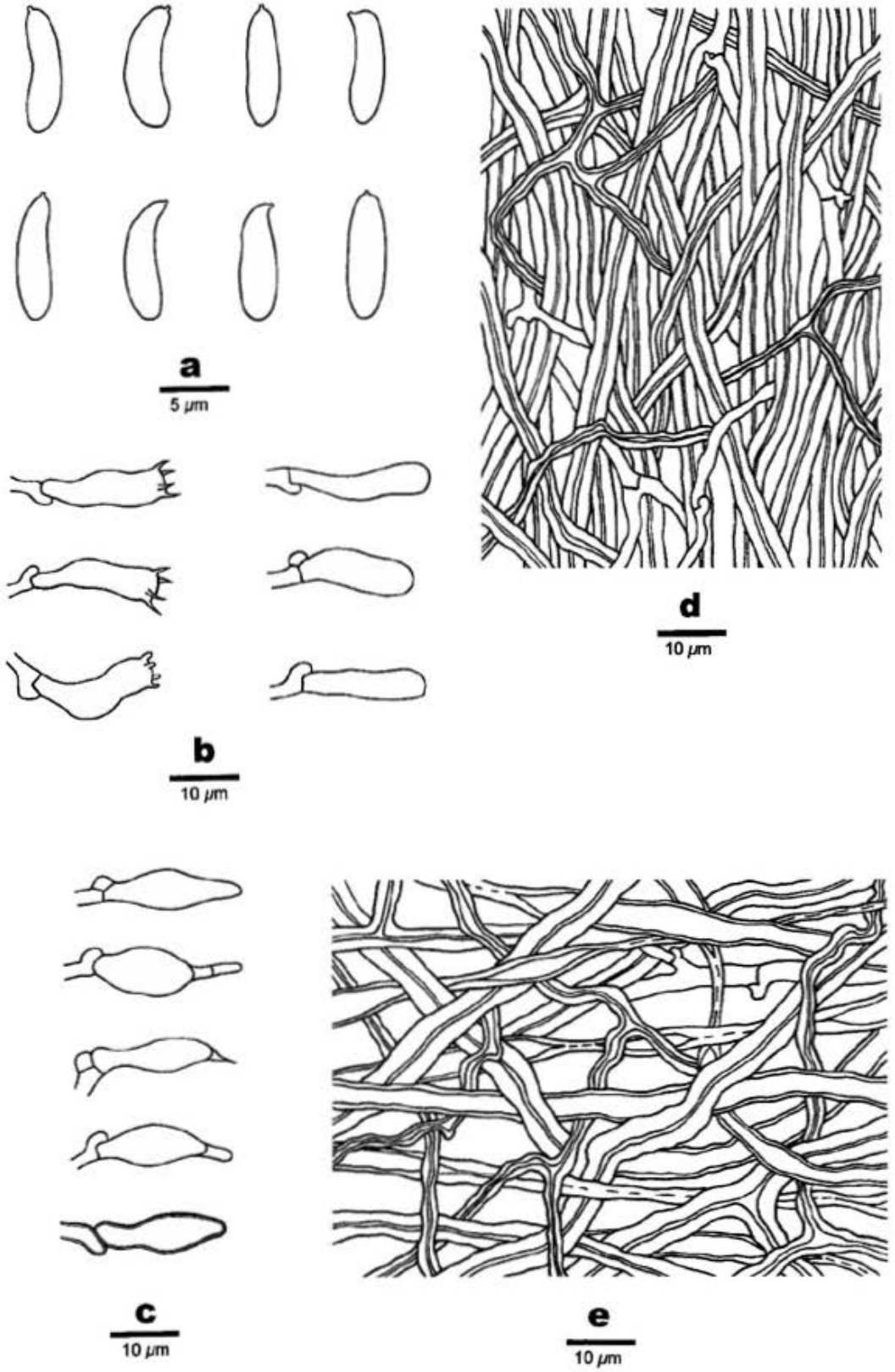

FIG. 1. Microscopic structures of *Trametes cystidiolophora* (drawn from the holotype).
a: Basidiospores. b: Basidia and basidioles. c: Cystidioles.
d: Hyphae from tube trama. e: Hyphae from context.

TUBES — Generative hyphae infrequent, hyaline, thin-walled, frequently branched, 1.7–3 μm in diam; skeletal hyphae dominant, hyaline, thick-walled to subsolid, occasionally branched, interwoven, 2.3–5 μm; binding hyphae hyaline, flexuous, thick-walled to almost solid, frequently branched, interwoven, 1.6–3.1 μm. Cystidia absent, cystidioles abundant in the hymenium, fusoid, hyaline, mostly thin-walled, occasionally slightly thick-walled, some with one or two septa, 16–24 × 4–6 μm; basidia clavate, with four sterigmata and a basal clamp connection, 16–18.2 × 5–7.8 μm; basidioles in shape similar to basidia, but slightly smaller.

SPORES — Basidiospores cylindrical, occasionally slightly curved to more or less allantoid hyaline, thin-walled, smooth, IKI–, CB–, (6–)6.6–9.2(–10) × (2.2–)2.4–3(–3.3) μm, L = 8.1 μm, W = 2.79 μm, Q = 2.78–3.04 (n=60/2).

TYPE OF ROT — White rot.

REMARKS — *Trametes cystidiolophora* is characterized by its pale grayish brown to pale cinnamon-buff pileal surface with distinctly concentric zones and radial veins, uneven pore surface, cylindrical to more or less allantoid basidiospores (6.6–9.2 × 2.4–3 μm), and abundant cystidioles present in the hymenium. Moreover, its skeleto-binding hyphae become swollen in KOH.

Trametes cystidiolophora may be confused with *Fomitopsis palustris* (Berk. & M.A. Curtis) Gilb. & Ryvarden, which produces similar basidiospores, but the two species can be separated by the rot type. *Trametes cystidiolophora* causes a white rot, while *Fomitopsis palustris* causes a brown rot.

Trametes maxima (Mont.) A. David & Rajchenb. is similar to *T. cystidiolophora* by sharing similar uneven pore surface and pore size (2–3 per mm), but *T. maxima* differs in its tomentose to hirsute pileal surface and smaller basidiospores (4.5–5.5 × 2–2.5 μm, Gilbertson & Ryvarden 1986).

Trametes cotonea (Pat. & Har.) Ryvarden, which has similar basidiospores (7–10 × 2.5–3.5 μm) as *T. cystidiolophora*, is usually effused-reflexed, paper thin, and flexible and its pores are smaller (3–4 per mm, Ryvarden & Johansen 1980).

Trametes glabrata (Lloyd) Ryvarden, which shares with *T. cystidiolophora* a glabrous pileus, uneven pore surface, and similar pore size. However, *T. glabrata* has distinctly smaller basidiospores (4–5 × 1–1.5 μm, Ryvarden 1992).

Cystidioles are also present in several other reported species in *Trametes*, such as *T. gibbosa, T. hirsuta, T. ljubarskyi,* and *T. pubescens* (Gilbertson & Ryvarden 1986, Núñez & Ryvarden 2001), but the cystidioles in all these species are infrequent and without septa. The fact that its cystidioles are abundant in the hymenium and that some are septate make *T. cystidiolophora* unique in *Trametes*.

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First description of *Oidium neolycopersici* (*Erysiphaceae*) in France, on a new host plant extinct in the wild

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Abstract —The first description of *Oidium neolycopersici* (*Erysiphaceae*) discovered on a Madeiran plant now extinct in the wild, *Normania triphylla* (*Solanaceae*), is provided. The pathogen was collected from the National Botanical Conservatory of Brest in western France.

Key words — *Erysiphales*, mildew, *Solanales*, Madeira

Normania triphylla Lowe plants (*Solanaceae*) cultivated in the greenhouse at the National Botanical Conservatory of Brest (NBCB) showed signs of powdery mildew. This Madeiran plant is extinct in the wild and currently the only ex situ culture exists at the NBCB. Recently several dense and discontinuous white patches were observed on the leaf upper epidermis of 47% of individuals. These characteristics were easily differentiated from symptoms caused by *Leveillula taurica*, which can readily affect *Solanaceae*, a fungus considered to be the unique agent of powdery mildew on *N. triphylla* in France up to now that causes white powdery masses appearing just under the chlorotic spots that are produced on the adaxial leaf surface.

To determine the morphological characteristics of the pathogen affecting *N. triphylla*, the surface mycelium was removed with adhesive tape and examined under optical microscope. Microscopic observations revealed exclusively solitary ellipsoid conidia (29.3 × 13.5 µm) germinating with one short germ tube terminating in simple apices (FIG. 1A). Conidiophores were straight, with cylindrical foot cells (43.0 × 9.3 µm), sometimes followed by a longer cell and one or two shorter cells (FIG. 1B). Fibrosin bodies and chasmothecia were not observed. Based on these characteristics the fungus was

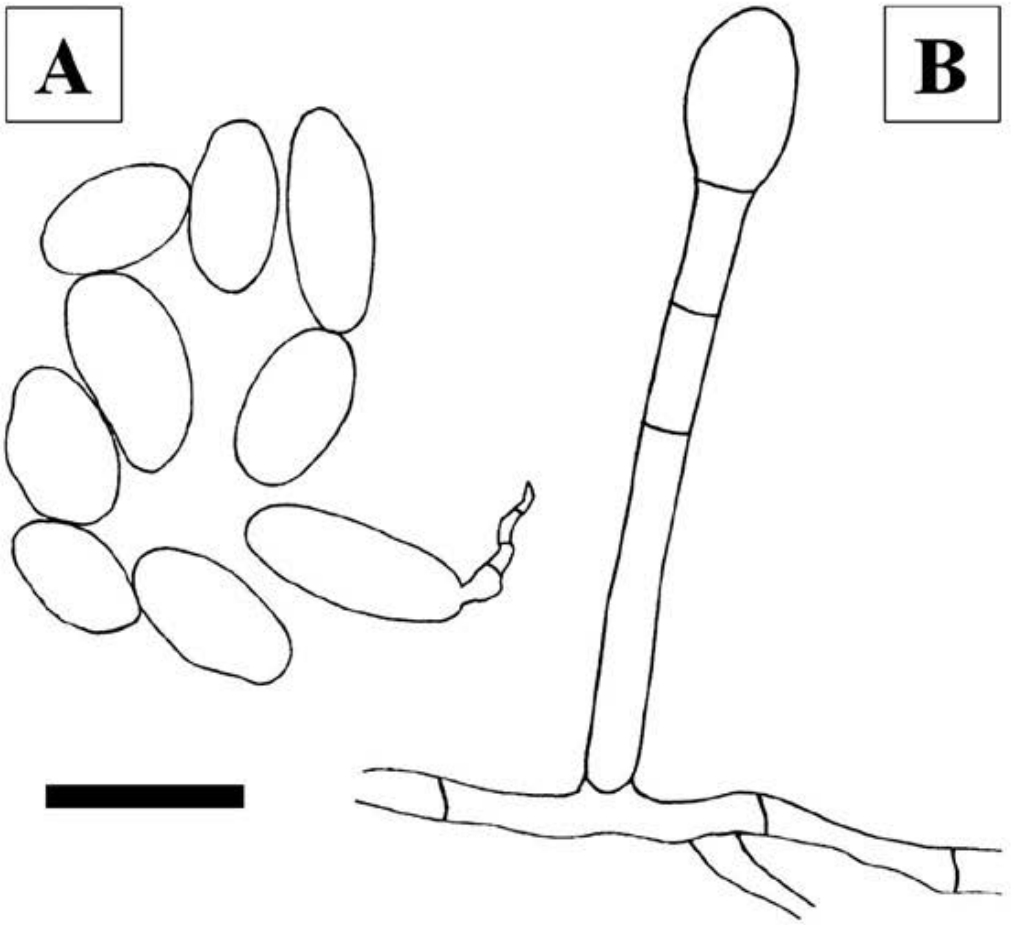

FIG. 1 A–B. Drawings of *Oidium neolycopersici* specimens observed on *Normania triphylla*. A. Free conidia with a germinating conidium. B. Conidium developing singly on conidiophore. Scale bar represents 30 µm.

identified as *Oidium neolycopersici* L. Kiss (Kiss et al. 2001). This species has been reported as occurring on host plants in the *Solanaceae* (*Solanum betaceum* and *S. lycopersicum*) family in Asia (Baiswar et al. 2009; Kiss et al. 2001; Li et al. 2008, Yolageldi et al. 2008), Australia, Tanzania, the French Caribbean (Kiss et al. 2001), North America (Kiss et al. 2001; Kiss et al. 2005), and Europe (Ivic et al. 2009; Kiss et al. 2001). Specimens were identified on tomato in West Europe by sequencing by Kiss et al. (2001) in France (specimen examined: BPI 747013; database accession number: AF229019) and Netherlands (specimen examined: VPRI 20724; database accession number: AF229015).

To confirm the pathogenicity, 15 healthy *N. triphylla* plants were inoculated with conidia from infected plants and then kept in a polypropylene (PP) chamber placed in a greenhouse cabinet at 25 ± 1°C and a 15-h photoperiod for 7 days. The PP chamber was then removed and plants grown in the greenhouse. After 9 days, powdery mildew symptoms appeared on the inoculated leaves of the plants and the morphological characteristics of the reisolated pathogen were the same as those observed on the naturally infected plants.

This is the first report of powdery mildew caused by *O. neolycopersici* on *N. triphylla* in France. This disease has the potential to be extremely virulent (Jones et al. 2001) and may become a problem in ex situ cultures of *N. triphylla*. These cultures are essential because reintroduction attempts, which have failed until now, will help researchers learn how *N. triphylla* might again grow wild in the laurel forest of Madeira.

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Some new pyrenomycetous and loculoascomycetous fungi on the endemic Hawaiian plant *Hibiscadelphus giffardianus*

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Abstract — The fungal associates of the rare tree *Hibiscadelphus giffardianus* were studied. Three of these (*Eutypella giffardiani*, *Thyridaria hawaiiensis*, and *Valsonectria macrospora*) are described and illustrated as new to science.

Key words — *Ascomycota*, Hawai'i, taxonomy

Introduction

Several unknown pyrenomycetous and loculomycetous fungi inhabiting dead branches of *Hibiscadelphus giffardianus* Rock (a Hawaiian endemic in the *Malvaceae*) were collected by J.D. Rogers in 2005; three of these species are described below. The Hawaiian Islands have the very high (90%) degree of endemism associated with an exceptionally diverse flora (Kim et al. 1998). For the mushrooms, 46 of 310 species are endemic Hawaiian taxa (Hemmes & Desjardin 2002). Other fungal groups (*Capnodiales, Chaetothyriales, Coronophorales, Corticiales, Diaporthales, Diversisporales, Dothideales, Erysiphales, Helotiales, Hymenochaetales, Meliolales, Microthyriales, Myriangiales, Phyllachorales, Pleosporales, Uredinales, Xylariales*) also have endemic Hawaiian representatives (Stevens 1925; Petrak 1952, 1953; Goos 1970; Sutton & Hodges 1983; Hodges & Gardner 1984; Hodges 1985; Barr & Hodges 1987; Gardner 1988, 1990, 1996; Goos & Uecker 1992; Koske & Gemma 1995; Gilbertson & Nakasone 2003; Rogers et al. 2003, 2006, 2007, 2008; Scholler & Aime 2006). We are not aware of any other reports of fungi on *Hibiscadelphus*. This paper contributes to a better understanding of the uniqueness of Hawaiian mycobiota.

Materials and methods

Microscopic analyses were carried out using standard techniques. Observations, measurements, and photographs of asci and ascospores were made using Zeiss Primo Star and Leica MZ75 microscopes, G10 and Canon Power Short S40 digital cameras, as well as AxioVision software. Photographs of stromata were taken using a Nikon D40x digital camera. Measurements of asci and ascospores were made in water mounts. Colors follow those of Rayner (1970).

Taxonomic descriptions

Eutypella giffardiani Lar.N. Vassiljeva & J.D. Rogers, **sp. nov.** FIGS. 1A–B

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Stromata cortice erumpentia, valsoidea, gregaria, parte immersa nigro limitata, circular vel ellipsoidea, disco ostiolato nigro, 1–2 mm diam., praedita. Perithecia profunde immersa, monosticha, globosa, 300–350 µm diam.; collis leniter elongatis, sulcatis, 230–250 µm diam. Asci fasciculati, paraphysati, unitunicati, octospori, clavati vel fusoidei, membrana apicem versus incrassata, annulo apicali in liquore iodato Melzeri cyanescente, partibus sporiferis 25–35 × 4.5–5 µm, stipitibus 15–25 µm longitudine. Ascosporae unicellulares, allantoideae, irregulariter biseriatae vel conglobatae, subolivaceae, 6–8 × 1.7–2 µm.

HOLOTYPE: Hawai'i, Island of Hawaii, Hawaii Volcanoes National Park, Kipuka Puaulu (Bird Park), dead branches of *Hibiscadelphus giffardianus*, 3 November 2005, Jack D. Rogers (BISH). **Isotype:** VLA.

STROMATA erumpent through the bark, valsoid, aggregated, bounded internally by a black zone line, circular to elliptical, with ostiolar disc 1–2 mm diam., surface black. PERITHECIA deeply embedded, globose, 300–350 µm diam.; perithecial necks somewhat elongate, sulcate, 230–250 µm diam. ASCI in paraphysate fascicles, unitunicate, eight-spored, clavate or spindle-shaped, with tiny amyloid apical ring, p. sp. 25–35 × 4.5–5 µm, with stipes 15–25 µm long. ASCOSPORES one-celled, overlapping and irregularly biseriate or crowded, allantoid, subolivaceous, 6–8 × 1.7–2 µm.

COMMENTS—Numerous species of *Eutypella* have been described. They are difficult to differentiate, and the identification key by Rappaz (1987) offers the most useful information. Two ranges of ascospore average length (5–8 µm and 7–11 µm), which are repeated many times in the key, characterize large groups in the genus. The specimen from Hawaii falls into the group with smaller size range. The ascospore width correlates well with length, and almost all species with ascospores 5–8 µm long are narrower than 2 µm, whereas species with an ascospore length of 7–11 µm have ascospores wider than 2 µm (most often 2–2.5 µm).

As there are 21 species with an ascospore length of 5–8 µm (Rappaz 1987), it is important to find other differences to distinguish between them. Two species [*E. comosa* (Speg.) Rappaz, *E. leucaenae* Rehm] are rare exceptions that can

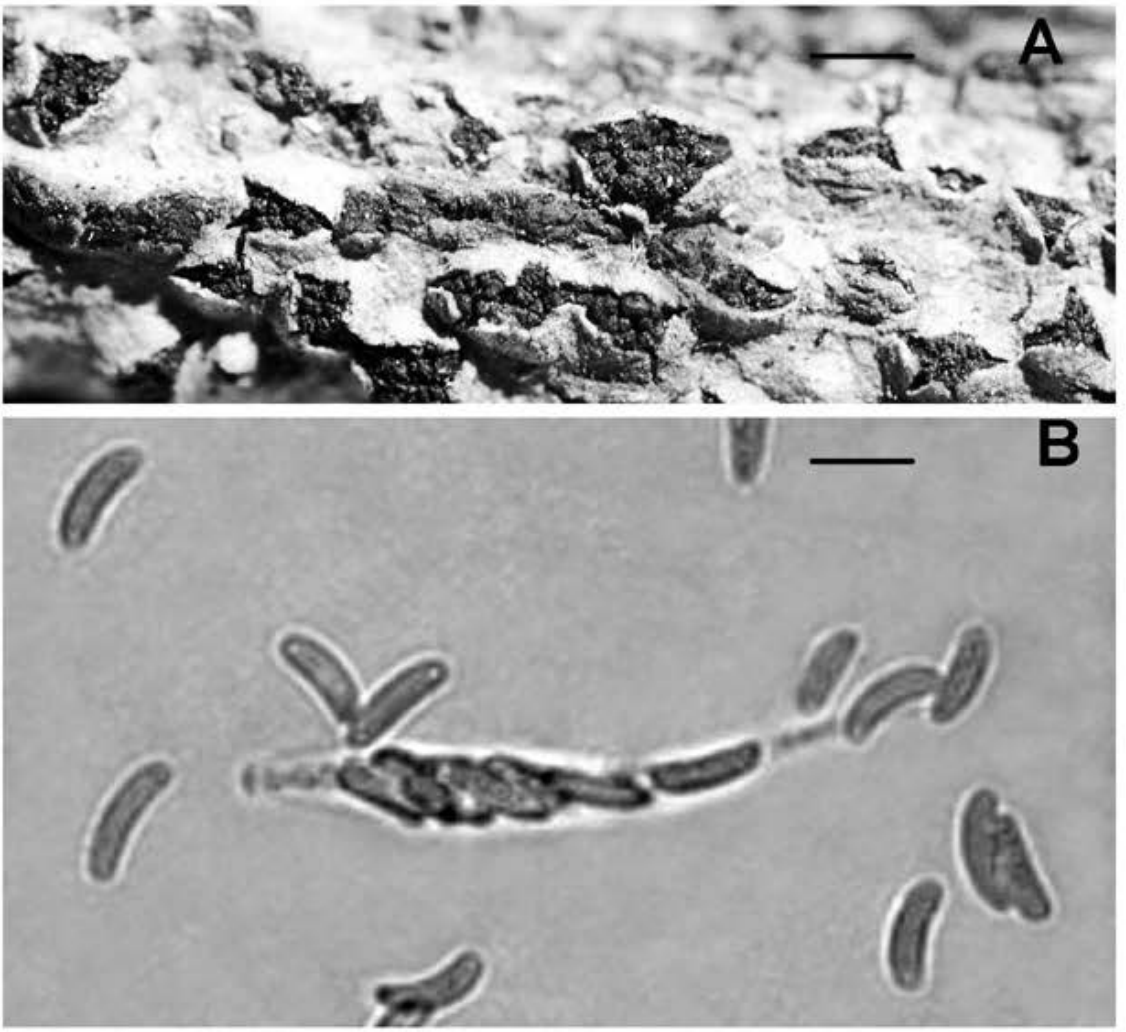

FIG. 1. *Eutypella giffardiani*. A. Stromata. B. Ascus and ascospores. Scale bars: A = 1 mm; B = 6 µm.

be easily separated by ascospores that are more than 2 µm broad, and another species, *E. hunanensis* Rappaz, produces very narrow ascospores less than 1.2 µm wide. Six species [*E. arecae* (Syd. & P. Syd.) Rappaz, *E. bonariensis* Speg., *E. gliricidae* Rehm, *E. prunastri* (Pers.) Sacc., *E. sorbi* (Alb. & Schwein.) Sacc., *E. theobromicola* Wakef.] display a J-negative reaction of the ascal apical ring that contrasts with a J-positive one in the Hawaiian specimen.

Another character differentiating species of *Eutypella* is the size of the ostioles. *Eutypella androssowii* Rehm and *E. tetraploa* (Berk. & M.A. Curtis) Sacc. have ostioles with a diam of 100–150 µm and 100–180 µm, respectively, whereas 200 µm diam ostioles occur in *E. andicola* Speg., *E. atropae* (Mont.) Sacc., and *E. capensis* Rappaz; 150–200 µm diam ostioles are observed in *E. padina* (Nitschke) Nannf. and *E. sarcobati* Ellis & Everh. Ostioles in *E. extensa* (Fr.) Sacc. are 180–220 µm diam, compared to a diameter ~220–250 µm in the Hawaiian specimen. As such, they correspond to *E. alsophila* (Durieu & Mont.) Berk. in the group with the range in ascospore length of 5–8 µm. However,

E. alsophila falls into the group with 400–600 µm diam perithecia, not the group with 200–400 µm diam perithecia.

The Hawaiian specimen belongs to the group with 200–400 µm diam and the combination of the other diagnostic features — ascospore, ostiole, and perithecial sizes and the J-positive apical ring — corresponds to the sole remaining species, *E. kochiana* Rehm. There is no information about ostiolar size in *E. kochiana*, but it has smaller ascospores than the Hawaiian specimen. Although Rappaz's key (step 6) identifies the length ascospore group (5–7.5 µm) where *E. kochiana* appears to belong, the length range of its 4.5–6 µm diam ascospores does not overlap with that in the Hawaiian specimen.

Recently, *E. alsophila, E. arecae, E. comosa, E. gliricidae,* and *E. kochiana* were transferred to the re-instated genus *Peroneutypa* Berl. based on ascus morphology (Carmarán et al. 2006). The asci in this genus were described as urn-shaped but with a truncated apex and wider in the middle where ascospores tend to cluster. The apical portion has a thick wall and very small apical ring and lacks any channel. The asci in *Eutypella giffardiani* from Hawaii have a thick-walled apical region that is penetrated by a narrow channel with cytoplasmic strands connecting the apex with the ascus cytoplasm. This kind of ascus is considered to be typical of true species of *Eutypella* (Carmarán et al. 2006).

After the publication of Rappaz's (1987) monograph, several new species of *Eutypella* were described (Agarwal & Gupta 1988; Rajak et al. 1988; Ananthapadmanaban 1989), some of which form ascospores averaging 5–8 µm long (e.g., *E. pongamiae* G.P. Agarwal & S. Gupta). However, as information about the iodine reaction of the ascal apical ring and ostiole size is lacking, it is difficult to make a proper comparison. *Eutypella ceibae* R.C. Rajak et al. has a comparable ascospore length (4–8 µm), but a width of 2.5–6 µm is indicated (a very unusual range, and data on the ascal apical ring in asci and ostiolar size are also wanting).

Three other species from India — "*E. annonae-squamosae*" A. Pande, "*E. colebrookiae-oppositifoliae*" A. Pande, and *E. rozabaghensis* (Srinivas. & P.G. Sathe) A. Pande, which were originally described in *Quaternaria* Tul. & C. Tul. (Srinivasulu & Sathe 1970, Kale & Kale 1972) and later transferred to *Eutypella* either invalidly (as nom. nov.) or as comb. nov. (Pande 2008) — produce ascospores averaging 7–11 µm long and wider than 3 µm. Therefore, the Hawaiian specimen differs from them.

Thyridaria hawaiiensis Lar.N. Vassiljeva & J.D. Rogers, **sp. nov.** FIGS. 2A–E

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Stromata valsoidea, mollia, cortice erumpentia, disco ectostromatico pulvinato vel hemisphaerico, castaneo, up to 1.5 mm diam. praedita, intus rubiginosa, ligno circa peritheciis nigra. Perithecia globosa, 300–400 µm diam.; ostiolis leniter papillatis, nigris. Asci longe clavati vel cylindrici, sessiles vel short-stipitati, 100–110 × 12–14 µm, juvenilis

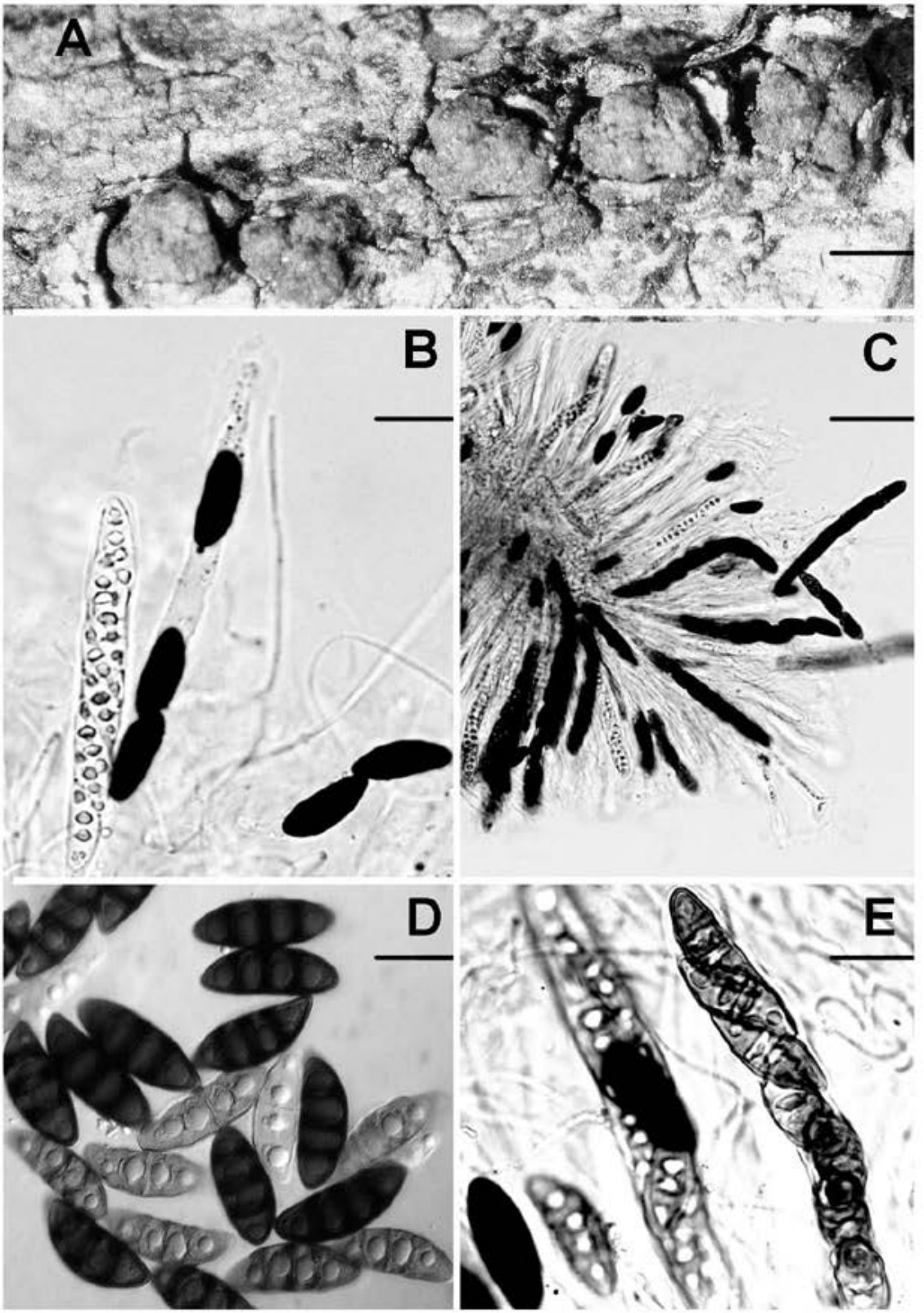

FIG. 2. *Thyridaria hawaiiensis*. A. Stromata. B–C, E. Asci and ascospores. D. Ascospores. Scale bars: A = 1 mm; B = 15 µm; C = 50 µm; D,E = 12 µm.

crasse tunicati; paraphysibus numerosis, hyalinis, longissimis, sinuosis, ca. 1 µm latis. Ascosporae uni- vel biseriatae, ellipsodeae vel fusoideae, rectae, inaequilateralia vel leniter cirvatae, 3-septatae, interdum leniter constrictae, pallide- vel atro-fuscae, etiam opacae, levigatae, (19–)20–25(–27) × 6–9 µm.

HOLOTYPE: Hawai'i, Island of Hawaii, Hawaii Volcanoes National Park, Kipuka Puaulu (Bird Park), dead branches of *Hibiscadelphus giffardianus*, 3 November 2005, Jack D. Rogers (BISH). **Isotypes:** VLA; WSP.

STROMATA valsoid, soft, erumpent from the bark with pulvinate or hemispherical, chestnut (40) ectostromatic 'disc' up to 1.5 mm diam., consisting of confluent and conspicuous tops of perithecial necks with slightly papillate, black ostioles, bay (6) or rust (39) under the surface, black around perithecia deep in the wood. PERITHECIA globose, 300–400 µm diam. ASCI long clavate to cylindrical, sessile, 100–110 × 12–14 µm, thick-walled when young, surrounded by numerous, hyaline, long, sinuous and anastomosing paraphyses about 1 µm wide. ASCOSPORES overlapping uniseriate or irregularly biseriate, ellipsoid-fusoid, straight to inequilateral or slightly curved, 3-septate, not at all or slightly constricted at the septa, light to dark brown, even opaque, smooth, (19–)20–25(–27) × 6–9 µm.

COMMENTS— *Thyridaria hawaiiensis* resembles the type of the genus, (*T. incrustans* Sacc.) in ascospore shape, septation, and size, but the latter has a black, carbonaceous disc that is only covered "with a yellow-green pulverulence or pubescence when young" (Wehmeyer 1941). Also, the brown-black entostroma of *T. incrustans* was said to turn reddish in KOH. The stromata of *T. hawaiiensis* are rusty inside, chestnut-colored on the outside, and do not react to KOH.

An earlier name [i.e., *Thyridaria broussonetiae* (Sacc.) Traverso] exists for *T. incrustans* (Barr 1990), which is characterized by ascospores with verruculose walls and apical pores of the perithecia that are bright yellowish to orange pigmented, but the color of the whole stromata is not reported. The apical pore pigmentation is more similar to that found in some *Byssosphaeria* species that were placed together with *Thyridaria* in the *Melanommatales* (Barr 1990). The smooth ascospores in *T. hawaiiensis* distinguishes it from the verruculose spored *T. broussonetiae*.

Another endemic Hawaiian plant, *Acacia koa* A. Gray, was reported to support a separate *Thyridaria* species, namely *T. koae* Petr. characterized by smaller ascospores—14–21(mostly 18) × 6–9 µm (Petrak 1952).

Valsonectria macrospora J.D. Rogers & Lar.N. Vassiljeva, **sp. nov.** FIGS. 3A–D

MYCOBANK MB 518318

Stromata cortice erumpentia, pulvinata, 1–2 mm diam, gregaria, lignose ubi siccata vel mollia ubi madefacta, extus initio aurantiaca demum castanea, intus aurantaca sine pigmento in KOH. Perithecia 0.2–0.3 mm diam, ambitus distinca vel indistincta,

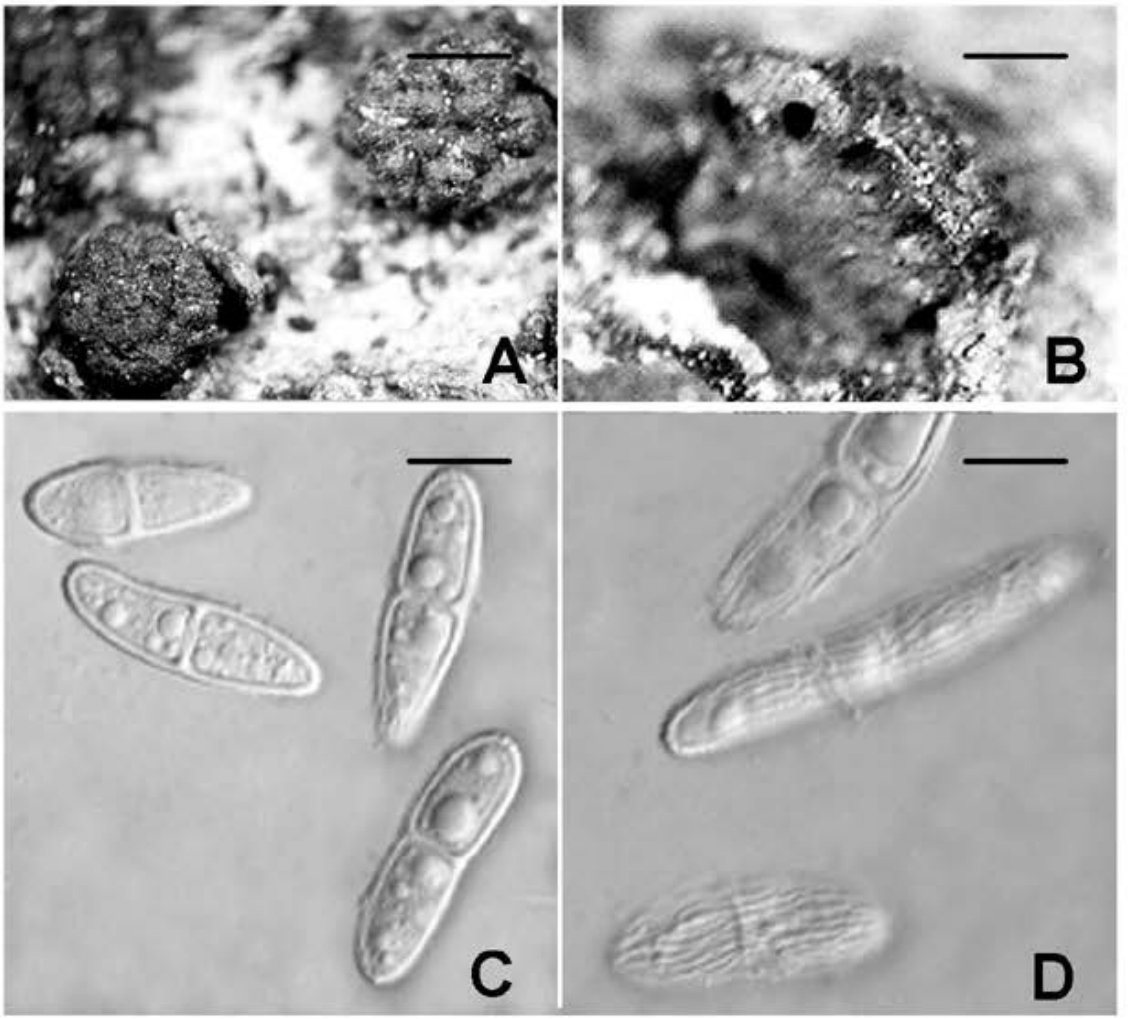

FIG. 3. *Valsonectria macrospora*. A–B. Stromata. C–D. Ascospores. Scale bars: A = 1mm; B = 0.5 mm; C, D = 10 µm.

monosticha. Ostiola papillata, minuta. Asci octospori, ascosporis irreguleriter dispositis, ca. 100 µm longitudine tota, ca. 18 µm crassi, partibus sporiferis ca. 91 µm longitudine, annulo apicali nullo. Asci infrequenter observatis, probliter deliquesentibus. Ascosporae hyalinae,pariter bicellulares, ellipsoideae vel aliquantum inequilaterales, striis longitudinalibus ornatae, 28–31(–46) × 9–12(–15) µm, sine poro vel rima germinationis. Paraphyses vel pseudoparaphyses apparenter nullae.

HOLOTYPE: Hawai'i, Island of Hawaii, Hawaii Volcanoes National Park, Kipuka Puaulu (Bird Park), dead branches of *Hibiscadelphus giffardianus*, 3 November 2005, Jack D. Rogers (BISH).

STROMATA erumpent from bark, pulvinate, 1–2 mm diam, gregarious, woody when dry, soft when wet, surface at first orange (7) becoming chestnut (40), interior orange (7), not releasing a pigment in KOH. PERITHECIA 0.2–0.3 mm diam with contours distinct or obscure, monostichous, ostioles papillate, minute. ASCI eight-spored, the ascospores jumbled, ca. 100 µm total length, 18 µm broad, spore-bearing part ca. 91 µm long, with apex not bluing in Melzer's iodine reagent. Asci infrequently observed, probably deliquescent. ASCOSPORES

hyaline, equally 2-celled, ellipsoid to somewhat inequilateral, ornamented with longitudinal striations, 28–31(–46) × 9–12(–15) µm, without germination pore or slit. Hamathecial elements not seen.

COMMENTS—The material described herein, although abundant, seems overmature. It is included here because the ascospore average is much longer and broader than any other described *Valsonectria* species (Rossman et al. 1999). The striate ornamentation as observed by light microscopy (FIGS. 3D) are, in reality, ribs when seen by SEM. Asci, which are not frequently encountered, appear to be unitunicate and are probably deliquescent. Hamathecial elements appear to be absent, but this might be due to the apparent overmaturity of the material. Our late colleague, Margaret Barr, examined our material and believed it to be a *Valsonectria*. It is noteworthy, however, that several species first described in *Valsonectria* have been transferred to *Valsaria* (Ju et al. 1996; Rossman et al. 1999). It is likewise noteworthy that none of the species of *Valsonectria* recognized by Seifert & Samuels (1997) has a valsoid arrangement of perithecia. Consequently, the name *Valsonectria* actually implies a feature that is not extant.

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New names in the genus *Marasmius*

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Abstract — Illegitimate later homonyms for six well documented species in the genus *Marasmius* are used in recent literature. Consequently, new names are proposed: *M. asiaticus* (≡ *M. distantifolius* Y.S. Tan & Desjardin), *M. canalipes* (≡ *M. sulcatipes* Pat.), *M. leelavathyi* (≡ *M. parvulus* Manim. & Leelav.), *M. lilacinitinctus* [≡ *M. lilacinus* (Coker & Beardslee) Singer], *M. masseei* (≡ *M. aratus* Massee), and *M. neotropicus* (≡ *M. asemus* Singer).

Key words — *Agaricales*, *Basidiomycota*, *Marasmiaceae*, nomenclature

Introduction

In recent literature dealing with the genus *Marasmius* Fr., we have noticed several later homonyms of validly published names. Six later homonyms are used for well-documented species: *Marasmius aratus* (Massee 1914), *M. asemus* (Singer 1989), *M. distantifolius* (Tan et al. 2009), *M. lilacinus* (Singer 1951), *M. parvulus* (Manimohan & Leelavathy 1987), and *M. sulcatipes* (Patouillard 1924). These names are illegitimate according to Art. 53.1 of the International Code of Botanical Nomenclature (McNeill et al. 2006). Therefore, we propose new names for these six species.

Taxonomy

Marasmius asiaticus Mešić & Tkalčec, nom. nov.

MYCOBANK MB 518123

≡ *Marasmius distantifolius* Y.S. Tan & Desjardin, Fungal Diversity 37: 95, 2009, nom. illeg., non (Murrill) Murrill 1915.

ETYMOLOGY: The species is named after the continent on which it was found.

The species belongs to the section *Sicci* Singer. Tan & Desjardin (Tan et al. 2009) described this species based on one collection from Peninsular Malaysia.

Marasmius canalipes Tkalčec & Mešić, nom. nov.

MycoBank MB 516949

= *Marasmius sulcatipes* Pat., Bull. Mus. Natl. Hist. Nat. 30: 526, 1924, nom. illeg., non Murrill 1915.

Etymology: The species is named for the striate surface of its stipe.

The species belongs to the section *Globulares* Kühner. Since it was originally described on the basis of a single collection from Madagascar by Patouillard (1924), it has never been found again. Antonín & Buyck (2006) made an analysis of the holotype, redescribed the micromorphological characters, and compared it with similar species.

Marasmius leelavathyi Manim., Tkalčec & Mešić, nom. nov.

MycoBank MB 518137

= *Marasmius parvulus* Manim. & Leelav., Trans. Brit. Mycol. Soc. 88(3): 422, 1987, nom. illeg., non Berk. & M.A. Curtis 1860.

Etymology: Dedicated to Prof. K. M. Leelavathy, Indian mycologist.

The species belongs to the section *Neosessiles* Singer. Manimohan & Leelavathy (1987) described it based on only one collection from India. Thereafter, it has not been found again (P. Manimohan, pers. comm.).

Marasmius lilacinitinctus Mešić & Tkalčec, nom. nov.

MycoBank MB 518141

= *Collybia lilacina* Coker & Beardslee, J. Elisha Mitchell Sci. Soc. 37(1): 104, 1921.

= *Gymnopus lilacinus* (Coker & Beardslee) Murrill, Mycologia 30(4): 367, 1938.

= *Marasmius lilacinus* (Coker & Beardslee) Singer, Lilloa 22: 326, 1951 ["1949"], nom. illeg., non Henn. 1896.

Etymology: The species is named for its lilac tones on basidiomata.

Coker & Beardslee (1921) described this species in the genus *Collybia* (Fr.) Staude. Singer (1951) transferred it to the genus *Marasmius* where it is classified in section *Globulares*. Halling (1983) redescribed the species and designated a lectotype. It is distributed in the southeastern part of the USA from North Carolina to Florida (Halling 1983).

Marasmius masseei Tkalčec & Mešić, nom. nov.

MycoBank MB 518138

= *Marasmius aratus* Massee, Bull. Misc. Inform. Kew 1914: 358, 1914, nom. illeg., non W.G. Sm. 1873.

Etymology: Dedicated to G. E. Massee, British mycologist.

The species belongs to the section *Sicci*. It was described from Singapore by Massee (1914) and has also been found in Peninsular Malaysia (Tan et al. 2009). For descriptions and comments on similar species, see Corner (1996) and Tan et al. (2009).

Marasmius neotropicus Mešić & Tkalčec, nom. nov.

MycoBank MB 518140

= *Marasmius asemus* Singer, Fieldiana, Bot., 21: 60, 1989, nom. illeg., non (Fr. : Fr.) P. Karst. 1889.

Etymology: The species is named after the Neotropical region where it was originally found.

The species belongs to the section *Sicci*. Singer (1989) described it based on two collections from the same locality in Brazil. There are no other records of the species in the literature.

Acknowledgements

We are grateful to Prof. P. Manimohan (Kerala, India) for useful information and his help with the literature. We would also like to thank Dr. Leticia Montoya (Instituto de Ecología, Xalapa, Mexico) and Dr. Andrew M. Minnis (Systematic Mycology and Microbiology Laboratory, Beltsville, USA) for their critical reviews of the manuscript.

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Macrofungal diversity of Ilgaz Mountain National Park and its environs (Turkey)

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Abstract — The current research is based on macrofungi collected from Ilgaz Mountain National Park and its environs between 2004 and 2008. As a result of field and laboratory studies, 220 taxa belonging to 59 families were identified. Nineteen taxa belong to *Ascomycota* and 201 to *Basidiomycota*. Three — *Bisporella subpallida*, *Tricholoma bufonium*, *Leucogyrophana pseudomollusca* — represent new records for Turkish mycobiota. The complete list is available on: http://www.mycotaxon.com/resources/weblists.html.

Key words — biodiversity, mushrooms, taxonomy

Introduction

Ilgaz Mountain National Park is located in a transitional zone between Central Anatolia and the North-West Black Sea region within the boundaries of Çankırı and Kastamonu provinces of Turkey. The national park, which covers 1089 hectares and is situated in the A4 grid (see Davis 1965), has a great importance in terms of its flora, wildlife, geographical location, and natural landscape (Kuter 2008). Among the 109 bryophyte and 630 higher plant taxa identified within national park boundaries, 64 taxa are only indigenous to Ilgaz Mountain (Abay & Çetin, 2003) (FIG. 1).

The region is typical of mountain ranges within the prepontic zone of northwest Anatolia. Most of the area is covered with conifer forests, although angiosperm forests also exist at lower elevations. Fir (*Abies nordmanniana* subsp. *bornmuelleriana* (Mattf.) Coode & Cullen) is the dominant species, sometimes forming mixed stands with beech (*Fagus orientalis* Lipsky), Scots pine (*Pinus*

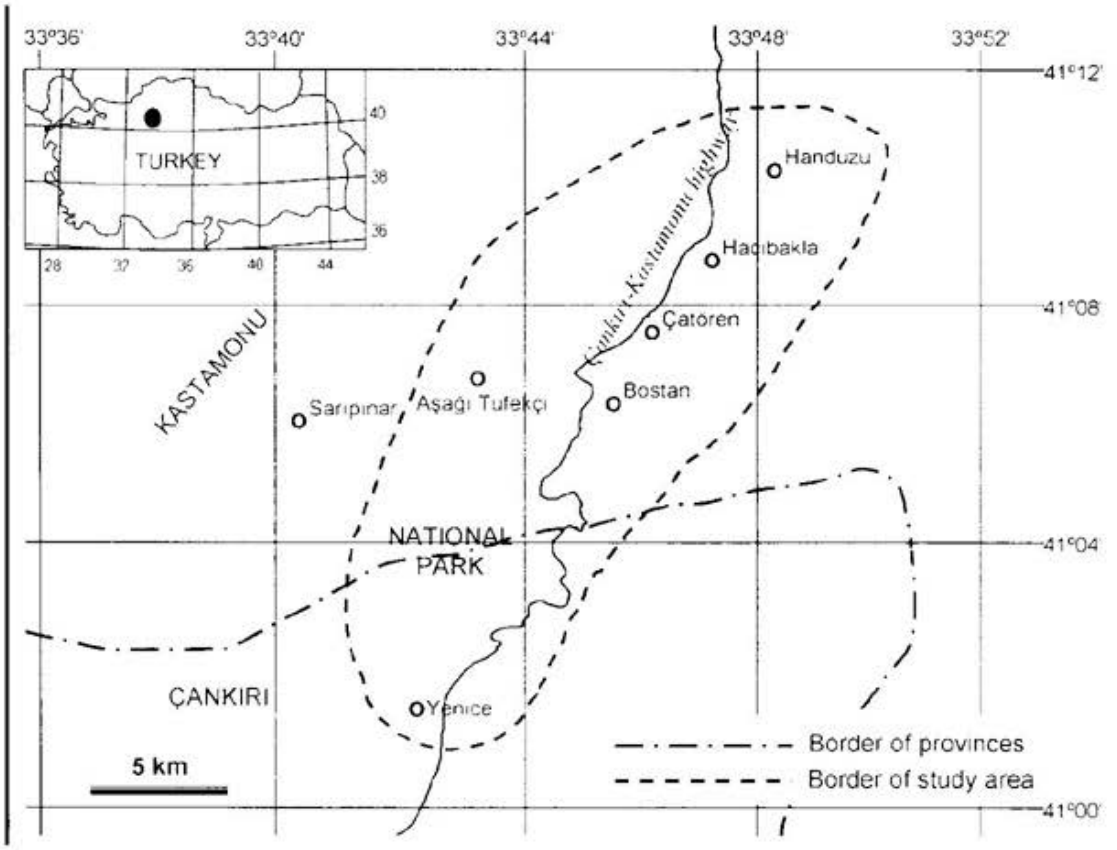

FIGURE 1. Ilgaz Mountain National Park (Turkey).
Macrofungi collecting area

sylvestris L.), and oak (*Quercus petraea* (Matt.) Liebl.). Black pine (*Pinus nigra* J.F. Arnold) and Scots pine are widespread in the western regions of the study area. The southern mountain slopes are influenced by a Mediterranean climate with semi-arid and very cold weather regimes while the northern slopes are under the influence of an oceanic climate (Akman et al. 1983).

Many studies have been conducted on macromycota of Turkey, some of which are still in progress. Sesli & Denchev (2010) cite 1929 macromycete taxa occurring in Turkey based on published research, and Işıloğlu et al. (2010) and Uzun et al. (2010) have contributed additional data. There has not, however, yet been any detailed mycological research devoted to Ilgaz Mountain National Park and its environs.

Materials and methods

The macrofungi samples of this study were collected from 26 localities in Ilgaz Mountain National Park and its environs between 2004 and 2008. Relevant morphological and ecological characters were recorded for the fungi, which were photographed in their natural habitats. In the herbarium, the fungi were further examined and microscopic characters were measured in Melzer's

reagent, 5% KOH, H_2O, and H_2SO_4. References consulted for identification purposes are provided in the complete annotated species list. All specimens are deposited at the herbarium of Ankara University (ANK).

Results

As a result of the present study, 220 taxa were identified and named according to the taxonomic conventions of Cannon & Kirk (2007), Kirk et al. (2008), and Index fungorum (www.speciesfungorum.org: accessed 1 January 2010). Taxa are presented in alphabetical order and are listed together with notes on habitat, geographical position, locality, collection date, and accession numbers (A: Akata).

The checklist contains 220 taxa belonging to 124 genera and 59 families. The taxa represent 19 *Ascomycota* (5 *Helotiales*, 10 *Pezizales*, 4 *Xylariales*) and 201 *Basidiomycota* (119 *Agaricales*, 5 *Auriculariales*, 13 *Boletales*, 4 *Cantharellales*, 3 *Dacrymycetales*, 2 *Geastrales*, 1 *Gloeophyllales*, 3 *Gomphales*, 3 *Hymenochaetales*, 2 *Phallales*, 21 *Polyporales*, 21 *Russulales*, 3 *Thelephorales* and 1 *Tremellales*). Three taxa are new records for Turkey: *Bisporella subpallida* (Rehm) Dennis 1978, *Tricholoma bufonium* (Pers.) Gillet 1874, and *Leucogyrophana pseudomollusca* (Parmasto) Parmasto 1967.

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First records of *Rhizopogon rocabrunae* and *R. pumilionum* (*Boletales*) from Italy

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Abstract — The paper reports a macro- and micromorphological investigation on *Rhizopogon rocabrunae*, a very rare hypogeous macrofungus, recently collected in Liguria (Italy) in two different times and locations. These specimens represent the first authentic record of this species from Italy. According to our microscopic analyses, an older Italian collection, formerly identified as *R. rocabrunae*, must be ascribed to *R. pumilionum*, a species previously never reported from Italy. Notes on closely related species are also provided.

Keywords — *Abies alba*, *Agaricomycetes*, *Rhizopogonaceae*, *Rhizopogon pannosus*, *Suillineae*

Introduction

The genus *Rhizopogon* Fr. encompasses hypogeous ectomycorrhizal fungi primarily associated with members of the *Pinaceae* Lindl. Phylogenetically monophyletic, the genus belongs to the so-called Suilloid radiation or suborder *Suillineae* of the *Boletales* (Grubisha et al. 2001, Binder & Hibbett 2006, Desjardin et al. 2008).

Until now, five species have been reported in Liguria (Northwest Italy), viz. *Rhizopogon luteolus* Fr. 1817, *R. occidentalis* Zeller & C.W. Dodge 1918, *R. rocabrunae*, *R. roseolus* (Corda) Th. Fr. 1909, and *R. villosulus* Zeller 1941. Among the above-mentioned species, *R. rocabrunae* is the least frequent in Liguria, previously reported in Italy on the basis of a single dubious collection (Montecchi & Sarasini 2000) and with few reports from Europe (Martín 1996, Cavet & Lopez 2004). Only two sites are known from Liguria, both located in Ligurian Maritime Alps (Alpi Marittime). One specimen was collected in

Testa d'Alpe forest, in an area dug by wild boars. Testa d'Alpe forest, which extends for 140 hectares from 750 to 1460 m. a.s.l., is the only forest in which the silver fir is considered native in Liguria. The other specimen was observed in an allochthonous silver fir forest, derived from a reforestation.

The paper evaluates the presence of *R. rocabrunae* in Italy based on the study of both the recent Ligurian collections and an older Italian collection (from Lombardia) formerly ascribed to *R. rocabrunae* (Montecchi & Sarasini 2000). Analysis of the old collection was motivated by the fact that Montecchi & Sarasini (2000) illustrated and described specimens with aberrant features for the species and did not mention some microscopic characters that are needed for a correct identification.

Materials and methods

Macroscopic and microscopic characters were described using a stereo microscope (Leica M 205 C) and a compound microscope (Axioscope, Zeiss), respectively. The description of the features is based on fresh and dry specimens (in the latter case after rehydration in water and lactic acid).

Microscopical observations were made from tissues mounted in distilled water, lactic acid plus acid fuchsine, 5% potassium hydroxide, and Melzer's reagent. For basidiospores and other structures at least 30 individuals were measured. The spore sizes are reported using three numbers corresponding to the minimum, average, and maximum values, respectively. The Qm abbreviation designates the average length to width ratio of the spores in side view.

Colour notations reported in brackets were taken from Kornerup & Wanscher (1978), indicated as "M." in front of a colour code. Identification references were Smith & Zeller (1966), Martín (1996), and Montecchi & Sarasini (2000).

All the Ligurian examined material is deposited and kept at GDOR (Herbarium of the Museo Civico di Storia Naturale Giacomo Doria, Mycologia section, Genova, Italy). Herbarium abbreviations follow Thiers (2010).

As concerns the geo-reference, a Garmin (eTrex Summit) Global Position System (GPS) was set to express the locations in WGS-84 coordinates in decimal degrees. The geographical data were mapped on the Official Map of Italian State (I.G.M.I) using GIS software (MapInfo 7.0). The data were also inserted in a database where all Ligurian macrofungi species are recorded.

Taxonomy

Rhizopogon rocabrunae M.P. Martín, Edic. Espec. Soc. Catalana Micol. 5: 95 (1996)

Description of the two collections from Liguria

FIG. 1

BASIDIOMATA globose to subglobose, on average 3 cm in diam. PERIDIUM well developed, 0.3–0.6 mm thick, brown with reddish to orange tinges (M. 6 B 8 C 5),

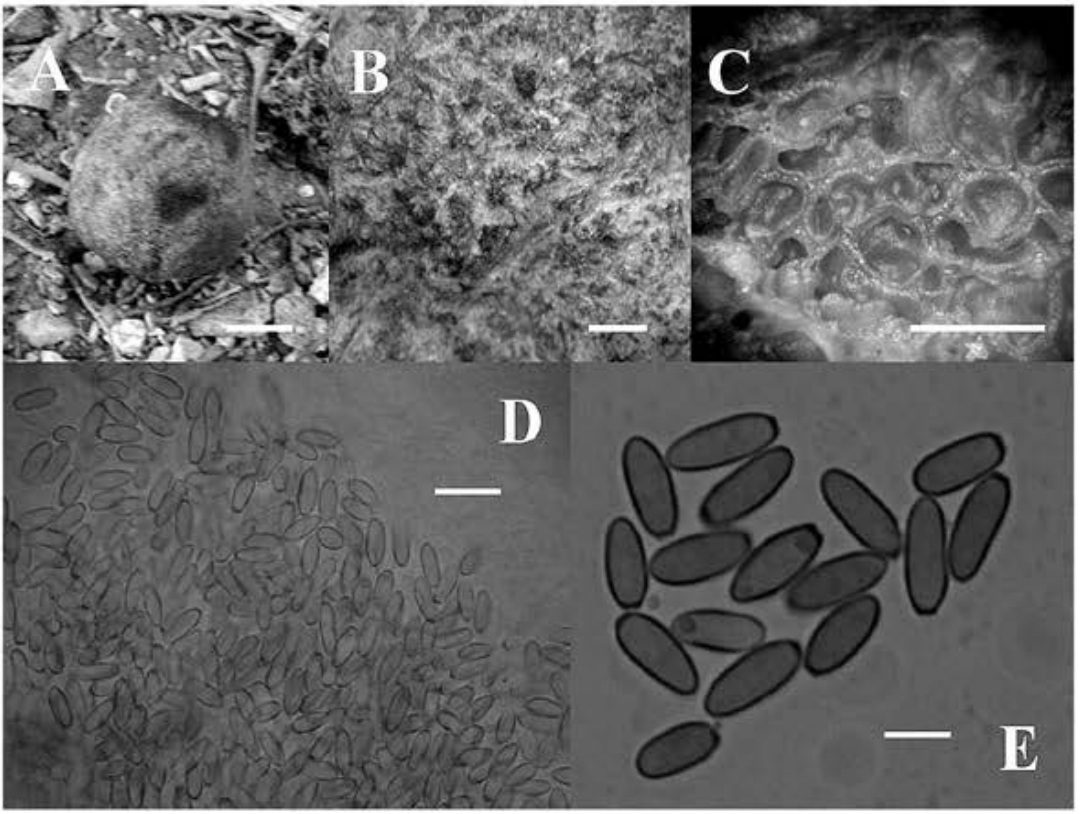

FIGURE 1. *Rhizopogon rocabrunae.*
A. Ripe basidioma. B. Peridium surface. C. Gleba cells. D. E. Basidiospores.
Scale bars: A = 1 cm; B, C = 1 mm; D = 10 µm; E = 5 µm.

with evident, 0.15–0.35 mm thick squamules, at first orange (M. 6 B 8) then brownish to black. RHIZOMORPHS scarce, gray (M. 1 B, C 1) emanating singly from the base. GLEBA firmly spongy with roundish to elliptical cells, 0.2 to 0.6 mm in diam., yellowish to brownish (M. 5 D 7). TRAMAL PLATES often in part gelatinized 100–200 µm thick. SMELL and TASTE indistinct.

PERIDIUM made up of hyaline, septate and thin-walled hyphae, 3–6 µm wide, encrusted with brown-orange pigment, with trend mostly parallel to the outer surface; squamules consisting of a more or less parallel arrangement of hyphae, with extracellular orange pigment. BASIDIA cylindrical, 4–10 spored. BASIDIOSPORES (6.6–)7.5(–9) × (2.3–)2.9(–3.5) µm, Qm = 2.586, elongated, ellipsoidal, smooth, often clearly truncated, transparent yellow to light green (1 A 4, B 4) when ripe, usually pluriguttulate. CLAMP CONNECTIONS absent.

HABITAT – solitary or gregarious under the needle layer of *Abies alba* Mill. Vernal.

MATERIAL EXAMINED: ITALY, Liguria, Foresta Demaniale di Gouta, Testa d'Alpe (IM), 1360 m a.s.l., G.P.S. (wgs 84) long 7.570027° lat 43.945343°, 17/06/2008, leg. M. Zotti, (GDOR 08061701); ITALY, Liguria, Bosco nero, Mendatica (IM) 1350 m. a.s.l., G.P.S. (wgs 84) long 7.733891° lat 44.125178°, 12/06/2008, numerous specimens, leg. G. Baiano (GDOR 08061201).

Description of the Sarasini collection from Lombardia

(cited in Montecchi & Sarasini 2000).

BASIDIOMATA globose to subglobose, on average 1–2,5 cm in diam. PERIDIUM color mostly brown (M. 7 F 6 – M. 6 C 4) with reddish tinges (M. 8 C 6). GLEBA with olivaceous tinges (M. 8 C 2). PERIDIUM made up of hyaline hyphae, with trend mostly parallel in the inner layer, while, in the outer layer at the squamules, consisting unordered parallel arrangement of hyphae. BASIDIOSPORES (6.5–)7.93(–9) × (2.2–)2.76(–3) µm, Qm = 2.87, elongated, ellipsoidal, smooth, not always clearly truncated, transparent yellow to light green (1 A 4, B 4).

HABITAT – solitary or gregarious under the needle layer of *Pinus montana* Mill. In summer.

MATERIAL EXAMINED: ITALY, Lombardia, Valdidentro - Cancano (So), 10/08/1987, consisting of four specimens, leg. Aiana, det. Sarasini (AMB 267)

Discussion

Martín (1996) originally described *R. rocabrunae* from Spain based on two collections found under *Abies alba*. In the last ten years it has been reported from Italy under *Pinus montana* s.l. (Montecchi & Sarasini 2000) and from France in a *Picea alba-Abies alba* wood (Cavet & Lopez 2004).

The two Ligurian collections show features fitting very well the original description of *R. rocabrunae* (Martín 1996). This species is macroscopically characterized by a reddish orange squamulose peridium and microscopically by elongate basidiospores, clearly truncate at the base, and peridial squamules made up of hyphae running parallel to the peridium surface. The squamulose peridium gives the basidiomes a quite distinct and characteristically *Elaphomyces*-like appearance or, as reported by Martín (1996), resembling *Arbutus* berries.

Rhizopogon rocabrunae comes very close to *R. pannosus* Zeller & C.W. Dodge 1918, a North American species (Smith & Zeller 1966) reported also from Spain (Martín 1996) and recently from Switzerland (Kathriner & Mühlebach 2008). The latter species differs in having a more verrucose peridium with more irregular squamules made up of interwoven hyphae running perpendicular to the peridium surface, less gelified hyphae of the tramal plates, wider basidiospores (on average 3.4 µm, Qm = 2.3), different isoenzymatic and PCR-RFLP patterns (Martín 1996, Martín & Sánchez 1996, Moser & Peintner 2000), and an association with *Pinus* spp.

According to Moser & Peintner (2000), *R. pumilionum* (Ade) Bataille 1923 from the Austrian *Pinus montana* forests shares with *R. pannosus* the same structure of the peridial squamules, but it is distinguished by its narrower spores (on average 2.9 µm, Qm = 2.6; Moser et al. 1999, Moser & Peintner 2000). Preliminary studies based on 28S rDNA analysis by Jarosch (2001)

indicate that *R. rocabrunae*, *R. pannosus*, and *R. pumilionum* are closely allied but independent species.

The Sarasini collection from Lombardia labelled *R. rocabrunae* (Montecchi & Sarasini 2000) seems quite anomalous due to the ochraceous-coloured peridium and its association with *Pinus montana*. Microscopical analysis revealed that it is referable to *R. pumilionum* based on peridial squamules made up of tufts of ascending hyphae and on spore size. Additionally, the olivaceous tinged gleba and association with *P. montana* are features typical for this species (Moser & Peintner 2000). Therefore, this collection represents the first record of *R. pumilionum* from Italy.

The two Ligurian specimens represent the first authentic report of *R. rocabrunae* from Italy. Adding to the original Spanish and French collections, our records confirm that *Abies alba* seems to be the preferred ectomycorrhizal partner of *R. rocabrunae*, highlighting, as already pointed out in other *Rhizopogon* species as well as in related genera (e.g. *Suillus*), a rather strict, specific association between the mycobiont and the photosynthetic host in the *Suillineae* (Grubisha et al. 2001, 2002).

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MYCOTAXON

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New species of *Dendryphiopsis* and *Stauriella* from Goa, India

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Abstract – Two new species of hyphomycetes isolated from decaying plant litter collected from Goa, India, are described and illustrated. *Dendryphiopsis goanensis*, found on decaying bark of an unidentified tree, is characterized by mostly polytretic, integrated, discrete, terminal, and intercalary conidiogenous cells. *Stauriella indica*, collected from decaying spathe of coconut tree, is characterized by sub-hyaline, spinulate, staurosporous conidia with 15–20 cells.

Key words – biodiversity, taxonomy

Introduction

During the course of studies on microfungi from forests of Western Ghats in Goa, two hitherto undescribed hyphomycete species, belonging to the genera *Dendryphiopsis* S. Hughes and *Stauriella* Sivichai & E.B.G. Jones, were isolated from fallen and decaying plant litter. Description and illustration of these fungi form the subject matter of this paper.

Taxonomic descriptions

Dendryphiopsis goanensis Pratibha, Raghuk. & Bhat, **sp. nov.** FIGS. 1, 2

MYCOBANK MB 516558

Ad fungos conidiales, hyphomycetes. Coloniae in substrato naturali dispersae, atrobrunneae vel nigrae; mycelium partim superficiale, partim substrato immersum, ex hyphis laevibus, pallide brunneis, ramosis, septatis, 2–2.5 µm latis, compositum. Coloniae in PDA-cultura, viridi-brunneae, lanatus, reverses nigrae, margin serratus, diam. 2.1 cm aetate 10 dierum. Stroma nullus. Conidiophora macronematica, mononematica, singula vel laxe fasciculata, erecta, recta vel leviter flexuosa, ramosa ad apicem, atrobrunnea, multiseptata, 85–230 × 4–6 µm. Cellulae conidiogenae monotreticae et polytreticae, in conidiophoris incorporatae

et discretae, terminales et intercalares, calyciformes, 7.5–13.5 × 4.5–7 µm. Conidia solitaria, cylindrica, utrinque rotandata, atro brunnea, laevia, 3–5-septata, 20–40 × 5–7.5 µm.

HOLOTYPE: On dead and decaying bark of unidentified tree, 13/11/2008, Pratibha J., Mashem, Canacona, Goa, India, Herb. No. HCIO 49724.

Conidial fungi, hyphomycetes. Colonies on natural substrate scattered, dark brown to black. Mycelium partly superficial, partly immersed in the host tissue, composed of smooth, light brown, branched, septate, 2–2.5 µm wide hyphae. Colonies on PDA greenish-brown, wooly, reverse black, margin serrated, attaining a diam. of 2.1 cm in 10 days. Stroma none. Conidiophores macronematous, mononematous, single to loosely fasciculate, erect, straight to slightly flexuous, branched at the apex, dark brown, multiseptate, 85–230 × 4–6 µm. Conidiogenous cells mostly polytretic, sometimes monotretic, integrated, discrete, terminal and intercalary, calyciform, 7.5–13.5 × 4.5–7 µm. Conidia solitary, cylindrical, rounded at both the ends, dark brown, smooth, 3–5-septate, 20–40 × 5–7.5 µm.

NOTES: Hughes (1953) established the genus *Dendryphiopsis* with *D. atra* as type species to accommodate *Dendryphion atrum* Corda. Later Hughes (1958) added two species, *Dendryphiopsis arbuscula* and *D. fascicularis*. Subsequently, two new species have been described in *Dendryphiopsis*, *D. biseptata* (Morgan-Jones et al. 1983), and *D. binsarensis* (Subramanian & Srivastava 1994). Thus, the genus until now has accommodated five species, which are characterized by monotretic, discrete, cylindrical conidiogenous cells and pigmented, thick-walled conidia with two or more transverse septa (TABLE 1). *D. goanensis* differs from earlier described species by having conidiogenous cells that are polytretic, integrated as well as discrete, and terminal as well as intercalary.

TABLE 1: Synopsis of *Dendryphiopsis* spp.

SPECIES	CONIDIOPHORES (µm)	CONIDIOGENOUS CELLS	CONIDIA (µm)
D. arbuscula	240–580 × 10–13	Monotretic, integrated or discrete, terminal, determinate	3–5-septate, 42–64 × 12–14
D. atra	200–400 × 8–11	Monotretic, integrated or discrete, terminal, determinate or percurrent	2–5-septate, 35–65 × 13–20
D. binsarensis	280–520 × 6.5–8	Monotretic, subconical, truncate at apex	4–5-septate, 36–44 × 8–10
D. biseptata	180 long, 8–10 wide	Monotretic, integrated or discrete, cylindrical or narrowly clavate	2-septate, 28–39 × 19–22
D. fascicularis	200–450 × 9–11	Monotretic, integrated or discrete, cylindrical or narrowly clavate	3–8-septate, 48–90 × 5–10
D. goanensis	85–230 × 4–6	Mostly polytretic, sometimes monotretic, terminal or intercalary, integrated or discrete	3–5-septate, 20–40 × 5–7.5

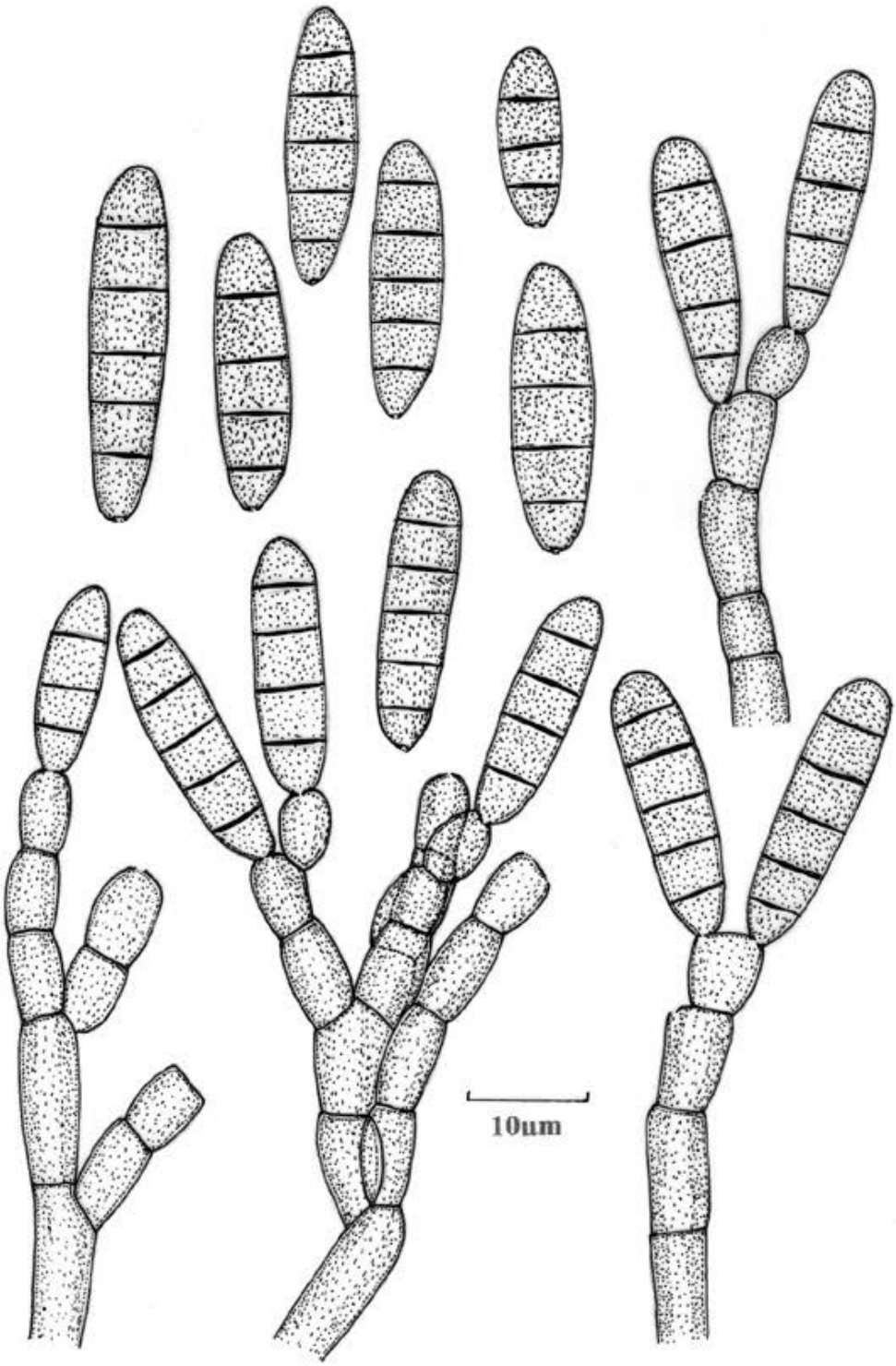

FIG. 1. *Dendryphiopsis goanensis*.
Conidiophores, conidiogenous cells, and conidia

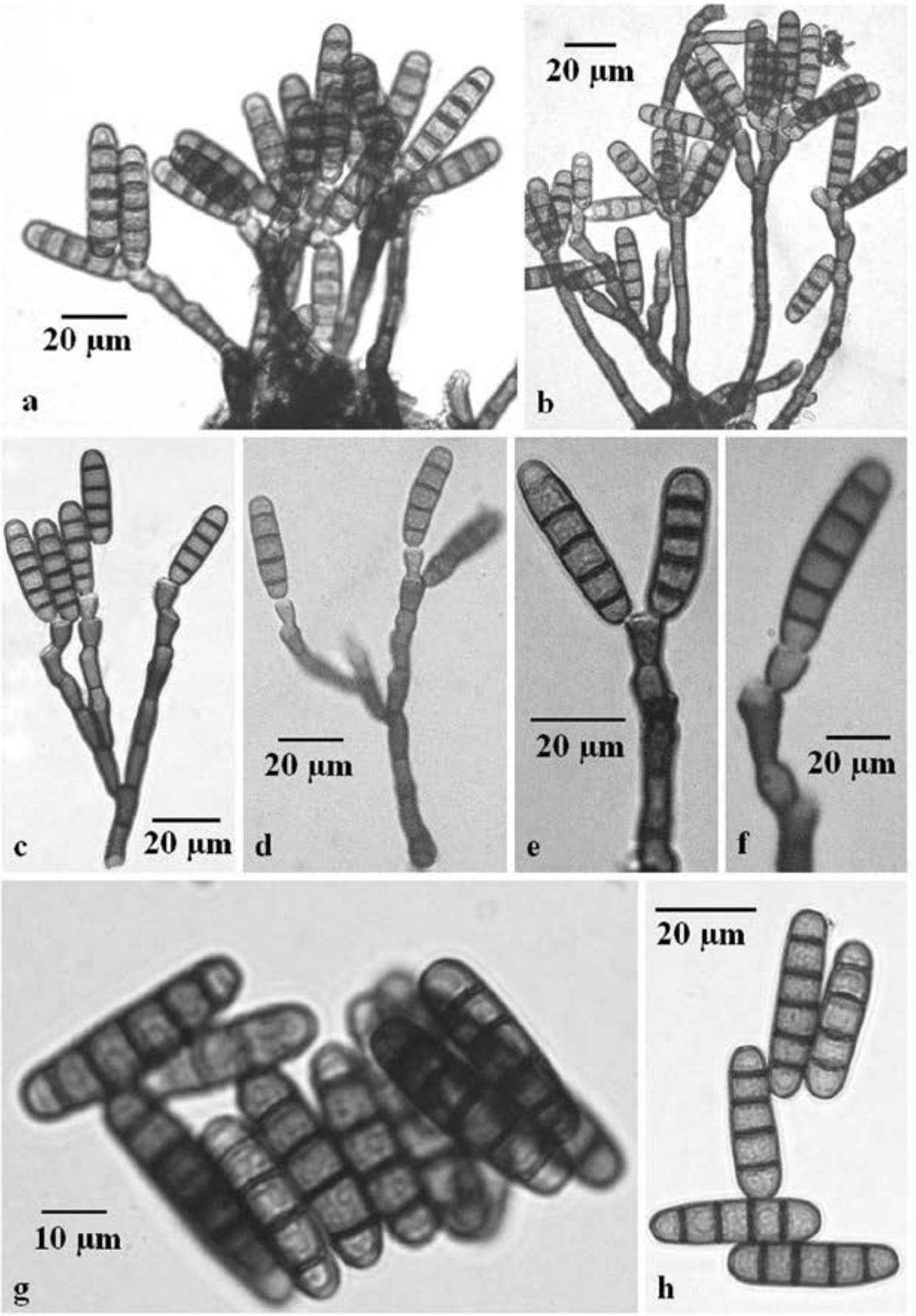

FIG. 2. *Dendryphiopsis goanensis.*
a–f. conidiophores, conidiogenous cells, and conidia; g–h. conidia

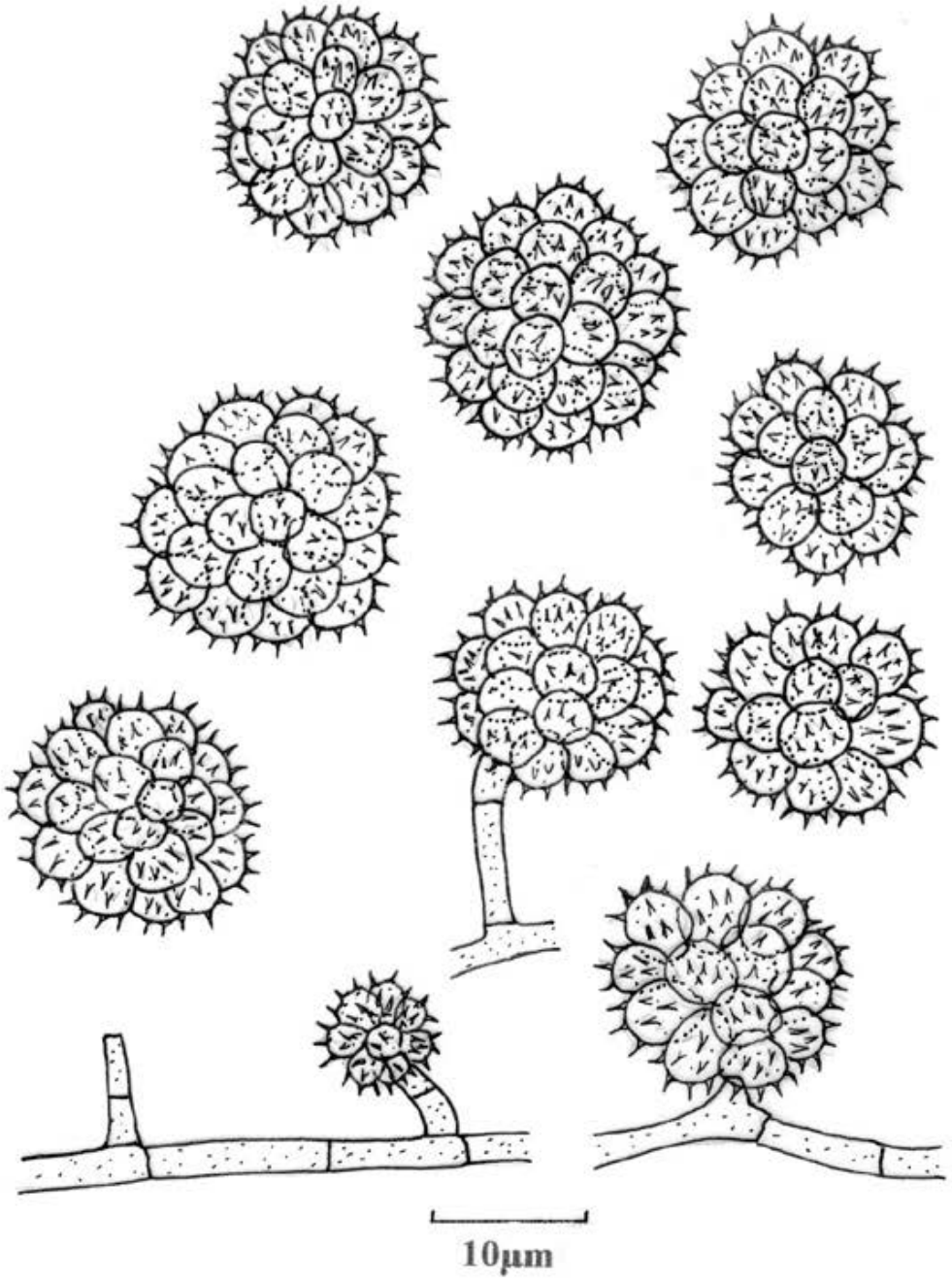

FIG. 3. *Stauriella indica*.
Conidiophores, conidiogenous cells, and conidia

Stauriella indica Pratibha, Raghuk. & Bhat, **sp. nov.** FIGS. 3, 4

MYCOBANK MB 516559

Ad fungos conidiales, hyphomycetes. Coloniae in substrato naturali effusae, candidae; mycelium partim superficiale, partim substrato immersum, ex hyphis laevibus, hyalinis, ramosis, septatis, 2–3 µm latis, compositum. Stroma nullus. Conidiophora semi-macronematica, mononematica, laevia, hyalina. Cellulae conidiogenae monoblasticae, terminales, integratae, hyalinae, usque ad 10 µm longus, lateraliter orientes. Conidia sicca,

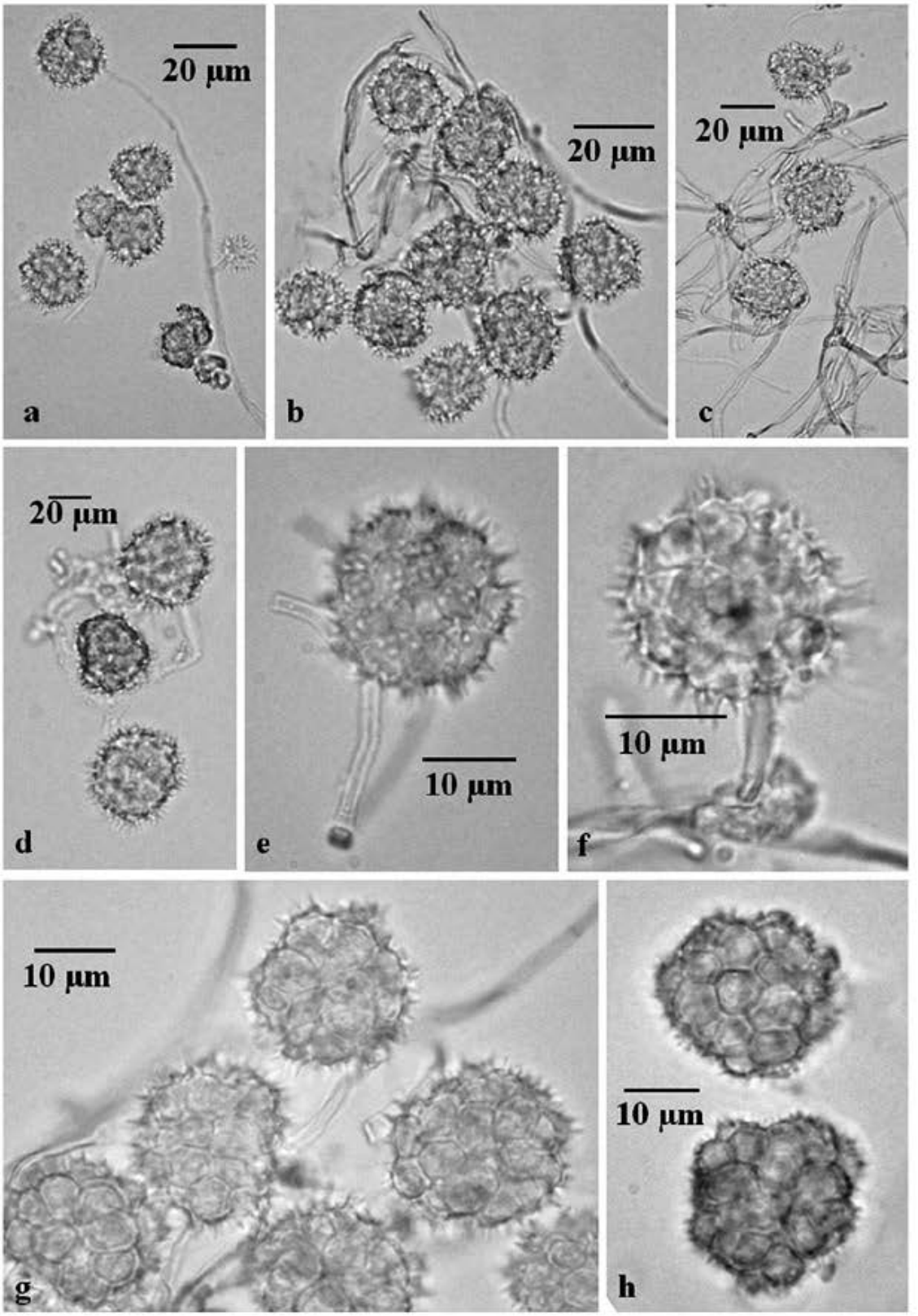

FIG. 4. *Stauriella indica*.
a–g. conidiophores and conidia; h. conidia

solitaria, hyalina vel subhyalina, 17–23.5 µm diam., ex cellula basali et 15–20 cellulis, cum numerosus spines in omnibus cellulis, conformata.

HOLOTYPE: On decaying spathe of *Cocos nucifera*, 17/11/2008, Pratibha J., Mashem, Canacona, Goa, India, Herb. No. HCIO 49725.

Conidial fungi, hyphomycetes. Colonies on natural substrate effuse, dull white. Mycelium partly superficial, partly immersed in the host tissue, composed of smooth, hyaline, branched, septate, 2–3 µm wide hyphae. Stroma none. Conidiophores semi-macronematous, mononematous, smooth, hyaline. Conidiogenous cells monoblastic, terminal, integrated, hyaline, up to 10 µm long, arising laterally from hyphae. Conidia dry, solitary, hyaline to sub-hyaline, 17–23.5 µm in diam., comprising 15–20 cells, each with numerous spines on the surface.

NOTES: Sivichai & Jones (2004) established the genus *Stauriella* with *S. aquatica* as type species to accommodate a fungus with hyaline, multicelled, spinulate conidia. The genus was so far monotypic. *S. indica* differs from the type species with conidia comprising 15–20 cells, each with numerous spines and measuring 17–23.5 µm in diam. The conidia in *S. aquatica* are 4–6 celled, each with 2–6 spines and 10–12.5 µm diam.

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A new species of *Graphis* (lichenized *Ascomycetes*) from South Korea

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Abstract — *Graphis flavopalmicola* is described as a new lichenized fungus from Jeju Island (South Korea). It is characterized by smooth, whitish-gray, UV+ pale yellow thallus (lichexanthone), unbranched to irregularly branched lirellae; completely carbonized exciple, and transversely 5–9-septate ascospores. It differs from the closely related *G. palmicola* chiefly in its chemistry; the latter has no substances and is UV–.

Key words — biodiversity, *Graphidaceae*, lichens, *Ostropales*, taxonomy

Introduction

The lichen genus *Graphis* is characterized by a crustose thallus, rounded to lirellate or rarely pseudostromatic ascomata with carbonized exciples; non-amyloid, functionally unitunicate asci with apical wall thickenings, hyaline, amyloid ascospores with lens shaped lumina, and a trentepohlioid photobiont (Staiger 2002; Lücking 2009). The genus is represented by more than 300 species in the world (Kirk et al. 2008; Lücking et al. 2009). Recent molecular study has confirmed the placement of the genus *Graphis* within family *Graphidaceae* (Mangold et al. 2008).

In South Korea, this genus has so far been investigated to a limited extent with records of only nine species (Kim & Lee 1975; Kim 1976, 1981; Ka et

al. 1997; Park 1982; Hur et al. 2005). During the course of floristic surveys in the extreme southern part of South Korea (Jeju Island), an unknown species of *Graphis* was found growing over bark of *Abies* in open canopy forest. It resembled *G. palmicola* Makhija & Adaw. by having a smooth thallus, a completely carbonized exciple, transversely septate spores, and a similar geographical distribution. In this paper, *G. flavopalmicola* is described as new to science based on this specimen.

Materials and methods

The specimen for this study was collected on Jeju Island, situated in the extreme southern part of South Korea. The material is deposited in the herbarium of the Korean Lichen Research Institute (KoLRI). Description and photographs of external morphology are based on air-dried material observed under a dissecting stereomicroscope (Nikon SMZ645). Sections were made with a razor blade under the stereomicroscope and mounted in lactophenol cotton blue. Anatomical descriptions are based on these preparations under a compound microscope (Nikon Eclipse E200). Ten measurements per apothecial sections were recorded for ascospore dimensions. Iodine test was performed by using Lugol's solution. The chemistry of the specimens was studied with thin layer chromatography (Culberson 1972; Elix et al. 1987; Orange et al. 2001; White & James 1985) using solvents A and C, and high performance liquid chromatography (Yoshimura et al. 1994).

New species

Graphis flavopalmicola Y. Joshi, Lücking & Hur, **sp. nov.** FIG. 1

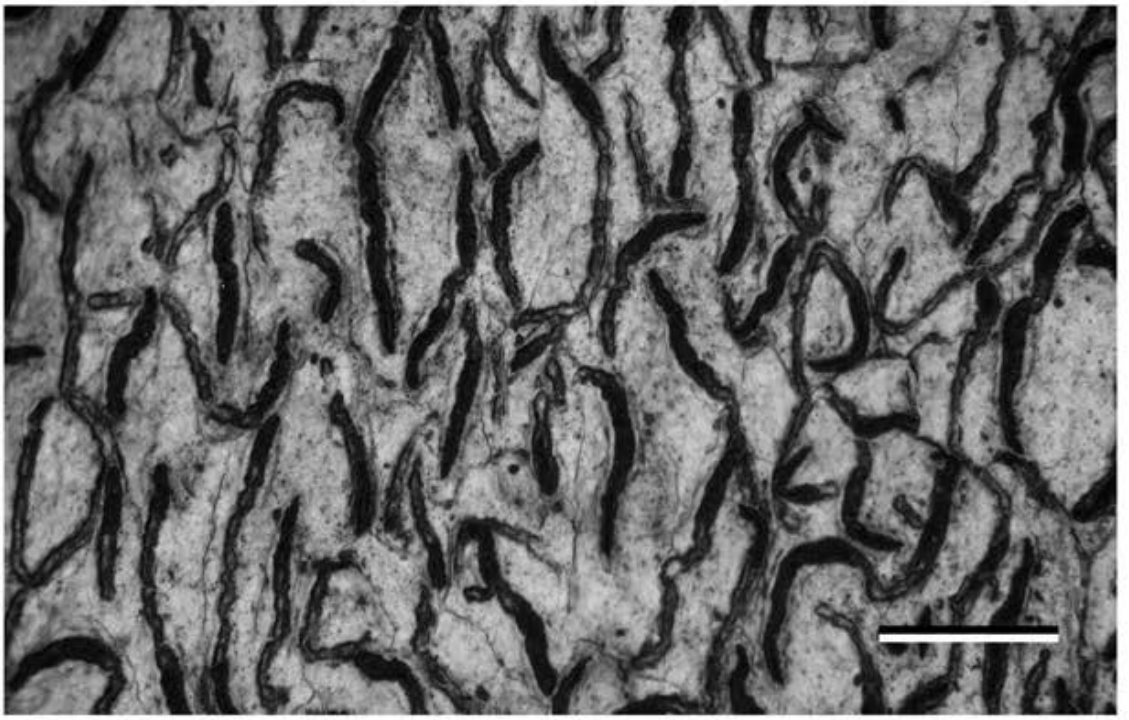
MYCOBANK MB 518424

Thallus crustaceus, epiperidermatis, continuus, tenuis, laevigatus vel ob substratum rugulosus, albus vel glauco-cinereus, opacus, UV+ flavescens. Ascomata lirellina, erumpentes, simplicia vel aniso-dichotomiter vel aniso-trichotomiter ramosa, flexuosa, usque ad 6 mm longa et 0.2 mm lata, apicibus acutus vel obtusus. Discus foramen, nigrus, epruinosus. Labia convergentia. Excipulum in toto carbonaceum. Hymenium non-inspersum. Paraphyses filiformes, simplices, densae, ad apicem modica clavatae et fulvescentes. Asci (4–)8-spori, ascosporae oblong-fusiformes, rectae, ad apicem rotundatae vel angustato-rotundatae, incolores, I+ caeruleo-violaceae, transversalibus 6–10 loculares, 20–25 µm longae et 4–7 µm latae.

TYPE — SOUTH KOREA, Jeju Island, Mt. Halla, N33°21'99.6", E126°32'15.1", alt. 1714 m, on *Abies* bark, 21 April 2009, Jae-Seoun Hur 090149 (**HOLOTYPE**- KoLRI, ISOTYPE- KH).

ETYMOLOGY — The species epithet refers to the UV+ yellow thallus and its resemblance to *G. palmicola*.

DESCRIPTION — THALLUS crustose, epiperidermal, continuous, smooth to ± rugulose, 75–100 µm thick, with hyaline crystals scattered in the thallus, but



Habit of *Graphis flavopalmicola* (holotype). Scale = 4 mm.

mainly in clusters near the exciple; surface white or ash-gray, opaque. SOREDIA absent. PROTHALLUS absent.

APOTHECIA much crowded, lirelliform, erumpent, unbranched to rarely anisotomic dichotomously or trichotomously branched, straight to ± flexuose, 1–6 mm long and 0.1–0.2 mm wide, terminally acute to obtuse. DISC exposed, black, epruinose (*handelii*-morph according to Lücking 2009). THALLINE MARGIN basal to lateral, but reaching the apices in some lirellae. LABIA entire, convergent. EXCIPLE basally closed, completely carbonized, dirty brown in thin sections, thalline margin with hyaline crystals. EPITHECIUM indistinct, brownish, 5–7.5 µm. HYMENIUM hyaline, not inspersed, I–, 75–140 µm high. PARAPHYSES hyaline, filiform, unbranched, dense, 1–1.5 µm thick, moderately clavate and yellowish brown at apices. ASCOSPORES (4–)8 per ascus, hyaline, transversely 5–9 septate, oblong-fusiform, straight, rounded to narrowly rounded at the apices, (19–)20–25(–27) × 4–7 µm.

CHEMISTRY — Spot test reactions: thallus K– or yellowish-brown, C–, KC–, P–, UV+ pale yellow. TLC: lichexanthone. HPLC: unknown products at Rt 2.544 and 2.968.

ECOLOGY AND DISTRIBUTION — The species is so far known from the type locality and was found growing over the bark of *Abies koreana* at an elevation of 1714 m. The subalpine forest is mainly composed of *Abies koreana* community.

REMARKS — *Graphis flavopalmicola* is characterized by smooth to rugulose, whitish-gray, UV+ pale yellow thallus, an exposed, blackish disc, entire labia, completely carbonized exciple, and small, transversely septate ascospores. In morphology of the ascomata and general appearance, the new species is most likely to be confused with *G. palmicola*, *G. assimilis* Nyl., and *G. stipitata* A.W. Archer. *Graphis palmicola* differs in having an UV– thallus. *Graphis assimilis* has larger ascospores [23–40(–54) µm] and produces norstictic acid (without lichexanthone), while *G. stipitata* differs in having a laterally carbonized exciple, slightly smaller ascospores (15–20 µm long), and the presence of norstictic acid in addition to lichexanthone.

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Elucidating the taxonomic rank of *Cladonia subulata* versus *C. rei* (*Cladoniaceae*)

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Abstract — *Cladonia subulata* and *C. rei* are two lichen species apparently closely related from a morphological viewpoint. Since both species also show a high morphological variability, it has been difficult to establish the limit between them, and their taxonomic classification has often been questioned. Nevertheless, they have different lichen substance contents. The present paper aims to clarify the taxonomy of *C. subulata* and *C. rei*. Their morphological, chemical, and anatomical variation is examined and correlated with the molecular data of three gene regions (ITS rDNA, *rpb2* and *ef1α*). The results of the analyses reveal two strongly supported monophyletic clades, correlated with the two taxa. We conclude that *C. subulata* and *C. rei* should be maintained as two different species.

Key Words — *Ascomycota*, secondary chemistry, sibling species, species delimitation

Introduction

The lichens *Cladonia subulata* (L.) F.H. Wigg. and *Cladonia rei* Schaer. can be difficult to distinguish and therefore their taxonomic distinction has recently been questioned, particularly by Spier & Aptroot (2007). Traditionally, they have been regarded as two distinct species in spite of their great morphological similarity. *Cladonia subulata* is even the nomenclatural type species of the large genus *Cladonia* (Ahti 2000). The secondary metabolites, the presence of corticated areas at the base of podetia and the farinose or granular soredia are the main characters used to distinguish those species (Suominen & Ahti 1966, Wirth 1995, Brodo et al. 2001, James 2009).

Paus et al. (1993), who conducted an exhaustive revision of the morphological characters used to differentiate these species, concluded that none of them were sufficient to distinguish the two taxa. Nevertheless, they were attributed

TABLE 1. Specimens included in molecular study and GenBank accession numbers.

Taxon	Code	Chemical	UV	$FeCl_3$	Collection	ITS	*rpb2*	*ef1α*
C. rei	2REI	HSEK	+	+	Canada, Ontario, S L58841	FN868580	HM243200	HM243185
C. rei	3REI	HSEK	+	+	Sweden, Gästrikland, S F52894	FN868581	HM243201	HM243186
C. rei	4REI	HSEK	+	+	Norway, Oslo, BG L86605	FN868582	HM243202	HM243187
C. rei	5REI	HSEK	+	+	Canada, Newfoundland, BG L86394	FN868583	HM243203	HM243188
C. rei	6REI	HSEK	+	+	USA, Minnesota, S F53070	FN868584	HM243204	HM243189
C. rei	7REI	FUM, HSEK	+	+	Spain, Gerona, MACB 92216	FN868585	HM243205	HM243190
C. rei	8REI	FUM, HSEK	+	+	Spain, Barcelona, MACB 100473	FN868586	HM243206	HM243191
C. rei	11REI	HSEK	+	+	Slovakia, Trenčin, BRA 10005	FN868591	-	HM243192
C. rei	12REI	HSEK	-	+	Czech Republic, Central Bohemia, BRA 10044	FN868592	-	-
C. rei	15REI	FUM, HSEK	+	+	Netherlands, Utrecht, Aptroot 68588	FN868590	HM243207	HM243193
C. rei	16REI	HSEK	+	+	Japan, Akita, UPS L170710	FN868593	-	-
C. rei	17REI	FUM, HSEK	+	+	Czech Republic, Karlovy Vary, J. Vondrák 7024	FN868587	HM243208	HM243194
C. rei	18REI	FUM, HSEK	+	+	Czech Republic, South Bohemia, J. Vondrák 7006	FN868588	HM243209	HM243195
C. rei	19REI	FUM, HSEK	+	+	Czech Republic, Karlovy Vary, J. Vondrák 7026	FN868589	-	HM243196
C. subulata	1SUBU	FUM	-	-	Spain, Asturias, MACB 93151	FN868566	HM243210	HM243174
C. subulata	2SUBU	FUM	-	-	Spain, Ávila, MACB 93837	FN868567	HM243211	HM243175
C. subulata	3SUBU	FUM	-	-	Sweden, Gästrikland, S F52879	FN868568	HM243212	HM243176
C. subulata	4SUBU	FUM	-	-	Sweden, Halland, S F90966	FN868569	HM243213	HM243177
C. subulata	5SUBU	FUM	-	-	Spain, Burgos, MACB 97275	FN868570	HM243214	HM243178
C. subulata	6SUBU	FUM	-	-	Spain, Palencia, MACB 95159	FN868577	-	-
C. subulata	7SUBU	FUM	-	-	Spain, La Rioja, MACB 96350	FN868571	HM243215	HM243179
C. subulata	8SUBU	FUM	-	-	Portugal, Trás-os-Montes, MACB 93692	FN868572	HM243216	HM243180
C. subulata	9SUBU	FUM	-	-	Chile, Navarino Island, MACB 92216	FN868578	-	-
C. subulata	12SUBU	FUM	-	-	Slovakia, Moravia, BRA 10048	-	-	HM243181
C. subulata	13SUBU	FUM	-	-	Netherlands, Utrecht, L Spier	FN868573	HM243217	-
C. subulata	15SUBU	FUM	-	-	France, Midi-Pyrénées, L 75293	FN868579	-	-
C. subulata	16SUBU	FUM	-	-	Czech Republic, Central Bohemia, J. Vondrák 6983	FN868574	-	HM243182
C. subulata	18SUBU	FUM	-	-	Denmark, Zealand, J. Vondrák 6967	FN868575	-	HM243183
C. subulata	19SUBU	FUM	-	-	Austria, Upper Austria, FB	FN868576	HM243218	HM243184
C. glauca	1GLAU	SQUA			Spain, Segovia, MACB 96751	FN868594	HM243219	HM243197
C. glauca	3GLAU	BAR, THAM			Spain, Alava, MACB 96090	FN868595	HM243220	HM243198
C. cenotea	1CENO	SQUA			Denmark, Hovedstaden, J. Vondrák 6965	FN868596	HM243221	HM243199

FUM= fumarprotocetraric acid, HSEK= homosekikaic acid, SQUA= squamatic acid, BAR= barbatic acid, THAM = thamnolic acid.

a species rank based on their different habitat preferences. Spier & Aptroot (2007), on the contrary, concluded that as there are not enough characters to maintain the two taxa as independent they represent chemotypes of a single species. Syrek & Kukwa (2008) and James (2009), who have not accepted this viewpoint, retain *C. subulata* and *C. rei* as independent species.

The aim of this study is to resolve the complex *C. subulata-C. rei* and attempt to elucidate whether the complex represents two species or chemotypes of the one and the same species. To this end, three gene regions ITS rDNA, *rpb2* and *ef1*α have been analyzed in combination with morphological and anatomical characters. Recent studies using DNA sequence data have clarified relationships in several lichen species with high morphological similarities (Argüello et al. 2007, Ohmura & Kanda 2004, Amtoft et al. 2008).

Material & methods

Lichen material

A total of 241 specimens of *Cladonia subulata* and 60 of *C. rei* were studied. The samples selected for molecular and morphological study were chosen from several places within the geographical range of these species and are listed in TABLE 1. Some morphologically similar species, such as *C. glauca* Flörke and *C. cenotea* (Ach.) Schaer., were included (Suominen & Ahti 1966, Nourish 1977, Paus 1997, James 2009). *Cladonia cariosa* (Ach.) Spreng. was used as an outgroup because it was basal in the clade where *C. subulata* and *C. rei* were included by Stenroos et al. (2002) in their phylogenetic trees.

Morphological and chemical data

The samples were identified on the basis of morphology and secondary metabolites. The presence/absence of cortex at the base of podetia, presence/absence of squamules, branching type of podetia (type I: branched antler-like; type II: unbranched or forked at the apex), and cup shape of the podetia were studied macroscopically with a stereomicroscope, and the soredial size was measured under the light microscope. Microscopic measurements of the podetial wall thickness were carried out on sections cut with a freezing microtome. Iodine reactions were tested using Lugol's solution after pre-treatment with 10% KOH. In addition, transverse and lengthwise sections at the base of the podetia were made and stained with lactophenol blue solution. The stereome surface was observed by Scanning Electron Microscopy (SEM) in longitudinal sections of the podetia. Statistical analyses were done by STATGRAPHICS 5.1 computer program. The continuous characters normality and homogeneous variance were subject to analysis of variance (ANOVA) in association with the resulting clades of the phylogenetical analyses. Continuous characters that did not fulfill the normality and homogeneous variance were analyzed by Kruskal-Wallis test. The Kolmogorov-Simirnov test was used to check normality and Levence statistic to check the homogeneous variance. Binary characters were subjected to a test of contingency tables based on χ^2 –statistic test.

Chemical composition was checked by thin layer chromatography (TLC) according to the standardized procedures of White & James (1985), with solvent systems A and

B. Moreover, 60 samples were visualized under UV light (TABLE 1), and $FeCl_3$ reaction (alcoholic dissolution to 10%) was checked on 188 specimens (TABLE 1).

DNA extraction and PCR

Total DNA was extracted using DNeasy Plant Mini Kit (Quiagen) following the manufacturer's instructions. The DNA was dissolved in 200 µl of buffer included in the kit. Three genetic regions were selected: ITS rDNA, *rpb2* partial gene, and *ef1α* partial gene. The primers used to amplify the nuclear ITS rDNA were ITS1F (Gardes & Bruns 1993) and ITS4 (White et al. 1990), alternatively 1780-5'F/LSU0012 (Piercey-Normore & DePriest 2001) or ITSCld /ITSClr (Pino-Bodas unpubl. data). The *rpb2* partial gene was amplified using nested PCR. The first PCR was performed with the primer pair RPB2-5F/ RPB2-7cR (Liu et al. 1999); 1 µl of the first amplification served as DNA template for a second reaction using the primers RPB2dRaq (5' GCTGCTAAGTCTACCAT 3') /RPB2rRaq (5' ATCATGCTTGGAATCTC 3') newly designed in this study. The primers used to amplify *ef1α* partial gene were CLEF-3F/CLEF-3R (Yahr et al. 2006). The amplification program for ITS rDNA was: initial denaturation at 94 °C for 5 min; 5 cycles of 94 °C for 30 s, 54 °C for 30 s and 72 °C for 1 min; and 33 cycles of 94 °C for 30 s, 48 °C for 30 s and 72 °C for 1 min; with a final extension at 72 °C for 10 min. The amplification program for *rpb2* was: initial denaturation at 94 °C for 5 min; 40 cycles of 95 °C for 30 s, 52 °C for 30 s and 72 °C for 2 min; with a final extension at 72 °C for 10 min. The amplification program for *ef1α* was: initial denaturation at 94 °C for 5 min; 35 cycles of 95 °C for 30s, 55 °C for 30s and 72 °C for 1 min; with a final extension at 72 °C for 10 min. PCRs were carried out with Ready-to-Go-PCR Beads (GE Healthcare Life Sciences, UK). Amplifications were prepared for a 25 µl final volume. PCR was performed using the MJ Reseach-PTC-200 termocycler (Massachusetts). The PCR products were purified using the QIAquick Kit (QIAGEN, Valencia, California, USA).

DNA sequencing

The primers for sequencing reactions were those used in PCR amplification. The sequencing reactions were done at the Secugen S. L. (CIB, Madrid, Spain) or Macrogen (Korea) sequencing service (www.macrogen.com). Sequencher™ program (Gene Codes Corporation, Inc, Ann Arbor, Michigan, USA) was used to assemble the consensus sequence from the two strands of each isolate.

Sequence alignments and data analysis

The sequences were manually aligned with SE-AL v2.0a11 Carbon (Rambaut 1996) with each region aligned separately. The transitions and transversions were considered for aligning the sequences. The ambiguous positions were removed.

After each gene region was separately analyzed, a matrix combining the three studied gene regions was constructed in which we included only taxa for which sequences of all three gene regions were available. Both individual regions and the combined matrix were analyzed using Maximum Parsimony (MP) and Bayesian Analysis. MP analyses were conducted with PAUP* version 4.0b10 (Swofford 2002) using heuristic search with 500 replicates and TBR Branch-swapping option. Bootstrap analyses were performed with 10.000 replicates, using the fast-step option. MrModeltest (Nylander 2004) was used for selecting the best evolution model (TABLE 2) for each region. Bayesian analyses were

carried out by MrBayes 3.1 (Huelsenbeck & Ronquist 2001). The posterior probabilities were approximated by sampling trees using Markov Chain Monte Carlo (MCMC). The posterior probabilities of each branch were calculated by counting the frequency of trees visited during MCMC analysis. Model parameters were estimated in each analysis for 2.000.000 generations sampled in 12 simultaneous chains and every 100th was saved into a file. Plots of likelihood were examined for each run to determine the number of generations required to reach stationarity (burn-in) by Tracer v.1.0. (http://tree.bio.ed.ac.uk/software/tracer/). Then, the MCMC convergence was evaluated by performing cumulative and sliding window analyses of posterior probability and among-run variability of cumulate and split frequencies using the online application AWTY (Nylander et al. 2008). The initial 2000 trees were discarded. Using the "sumt" command of MrBayes, the 50% majority-rule consensus tree was calculated from 36,000 trees sampled after reaching likelihood convergence to calculate the posterior probabilities of the tree nodes. The statistical congruence among the different regions was tested using ILD test (Farris et al. 1994; Huelsenbeck et al. 1996) carried out with PAUP. A conflict between ITS and *rpb2* and ITS and *ef1α* was found. The incongruities detected among the different data sets appeared in the *C. rei* clade. When incongruities appear among the different data sets, these sets can be analyzed as a whole or separately. This work followed the methodology proposed by Wiens (1998), who advises to separately analyze each data set and to assess the support of each clade; then to carry out a combined analysis of all the data sets, finally deeming as questionable those parts of the tree where incongruities are found.

Results

Phylogenetic analyses

In this work, 80 new sequences have been generated, of which 32 are of ITS rDNA, 22 of *rpb2*, and 26 of *ef1α*. The alignment of the ITS rDNA region contained 582 positions while the *rpb2* and *ef1α* alignments contained 891 and 612, respectively.

The MP analyses based on ITS rDNA region generated 500 equally parsimonious trees of 127 steps. The likelihood parameters of Bayesian analyses are shown in TABLE 2. Both analyses generated topologically similar trees. The majority Bayesian consensus tree (FIG. 1A) shows three strongly supported monophyletic clades. One clade groups all the specimens delimited as *C. subulata*; another clade includes all the samples identified as *C. rei*; and the third clade comprises the samples of *C. glauca* and *C. cenotea*. Within the *C. rei* clade, two strongly supported subclades appear. In both subclades, the specimens come from different geographical origins (TABLE 1).

The MP and Bayesian analyses based on *rpb2* partial gene display a similar topology (FIG. 1B). The MP analysis generated 500 equally parsimonious trees, 162 steps long. The rest of the parameters, together with the likelihood values of the Bayesian analysis are shown in TABLE 2. As in the ITS rDNA analyses, three strongly supported clades appear, one corresponding to *C. subulata*, another to *C. rei* and a third including *C. glauca* and *C. cenotea*. Only one strongly

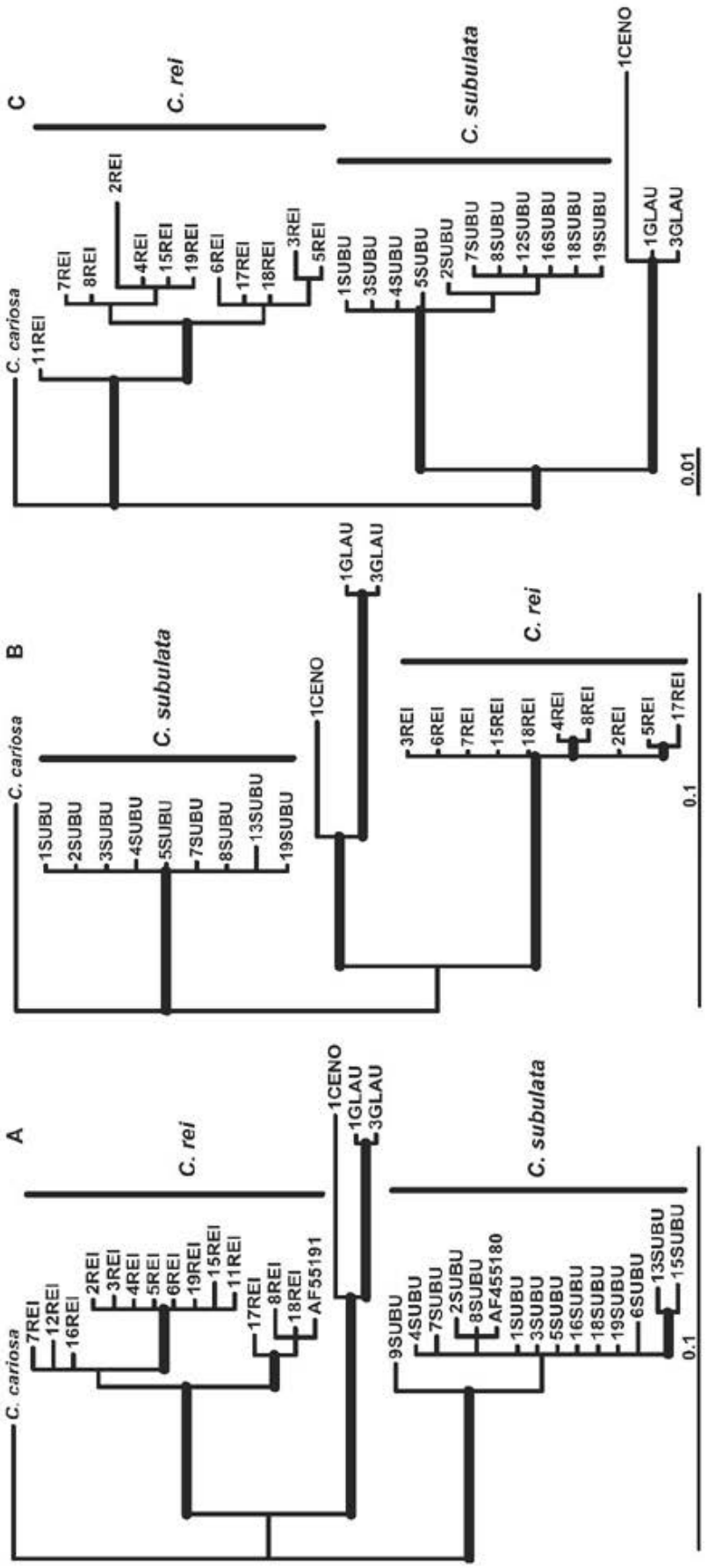

FIG. 1. Phylogeny of *Cladonia subulata* and *Cladonia rei*. The 50% consensus majority-rule tree from Bayesian/MCMC of three separate regions. Bold branches indicate a support of bootstrap ≥ al 70% and posterior probability ≥ 95%. A) ITS rnDNA B) *rpb2* C) *ef1α*.

supported subclade can be distinguished within the *C. rei* clade. However, it does not correspond to any of those appearing in the ITS rDNA analyses. The samples of this subclade have different geographical origins.

The MP analyses based on *ef1α* partial gene generated three equally parsimonious trees of 113 steps. The remaining MP parameters and Bayesian likelihood values are shown in TABLE 2. Analyses corresponding to this *ef1α* region also show three strongly supported monophyletic clades (FIG. 1C). In the *C. subulata* clade, one low-support subclade can be observed. The topologies of the MP and Bayesian consensus trees were not strictly identical. The MP tree shows *C. cenotea* apart from the *C. glauca* samples, while the Bayesian tree does not. The Bayesian analysis was repeated using GTR+I+G model and the result was the same.

TABLE 2. Information on MP analyses, evolutionary model and likelihood parameters of Bayesian analyses.

	PARAMETER	ITS rDNA	rpb2	ef1α	Combined
MP	CI	0.8920	0.8377	0.9292	0.8667
	RI	0.9530	0.9448	0.9815	0.9518
	RC	0.8501	0.7915	0.9120	0.8249
	informative characters	73	98	66	232
Bayesian analyses	Model	SYM+I	SYM+G	SYM+G	GTR+I+G
	-LnL	-1582.984 (0.07398)	-2128.058 (0.02592)	-1527.70 (0.00723)	-5172.63 (0.01232)
	π (A)	-	-	-	0.2601 (0.00008)
	π (C)	-	-	-	0.2519 (0.00008)
	π (G)	-	-	-	0.2415 (0.00008)
	π (T)	-	-	-	0.2465 (0.00007)
	r (A-C)	0.4745 (0.00235)	0.0468 (0.00031)	0.0605 (0.00051)	0.0591 (0.00016)
	r (A-G)	0.2498 (0.00248)	0.2375 (0.00165)	0.2485 (0.00246)	0.2472 (0.00067)
	r (A-T)	0.1474 (0.00130)	0.0873 (0.00055)	0.0808 (0.00073)	0.1150 (0.00028)
	r (C-G)	0.0666 (0.00050)	0.0326 (0.00022)	0.0312 (0.00036)	0.3326 (0.00009)
	r (C-T)	0.4095 (0.00311)	0.5272 (0.00246)	0.5026 (0.00349)	0.4944 (0.00093)
	r (G-T)	0.0566 (0.00046)	0.0684 (0.00044)	0.0760 (0.00080)	0.0608 (0.00017)
	α	-	0.2748 (0.01024)	0.3535 (0.04190)	73.254 (0.00007)
	Pinvar	0.6021 (0.00198)	-	-	0.6233 (0.00795)

Bayesian parameters: mean value (variance)
Models selected by AIC criterion using MrModeltest

The MP analyses based on the combined dataset generated 500 equally parsimonious trees of 405 steps long. The remaining parameters of the MP analyses, together with the likelihood values of the Bayesian analyses are shown in TABLE 2. Both analyses generated topologically similar trees (FIG. 2). Three strongly supported monophyletic clades appear, one corresponding to *C. subulata*, another to *C. rei*, and the third to *C. glauca* and *C. cenotea*.

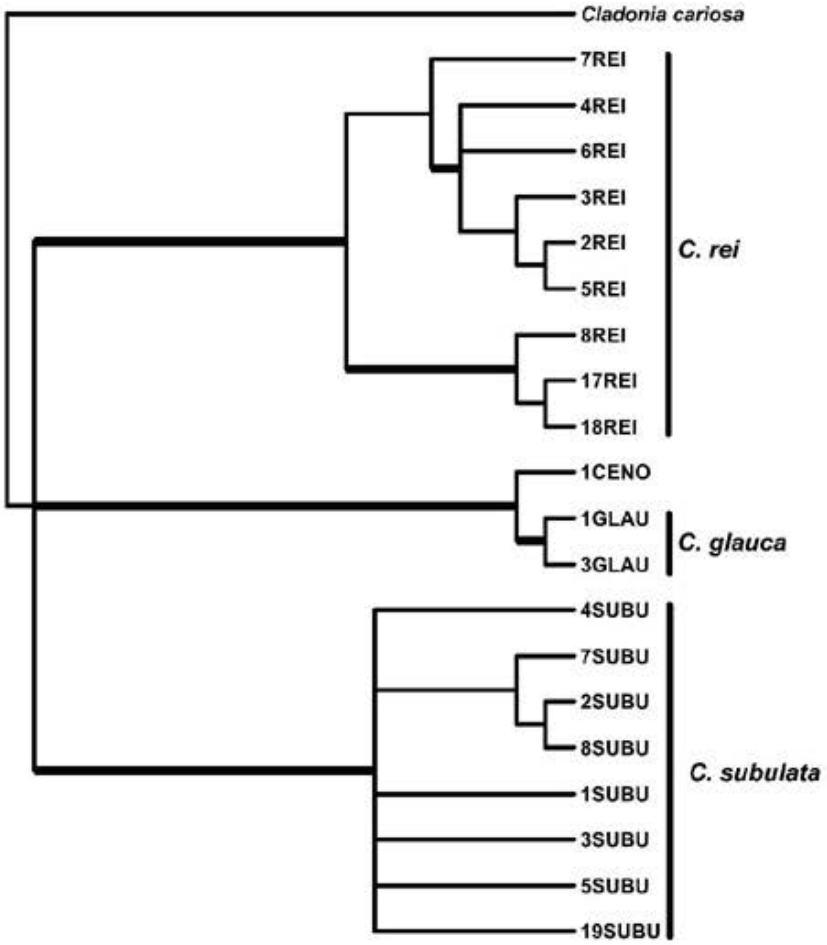

FIG. 2. The 50% consensus majority-rule tree based of combined data set (ITS rnDNA, *rpb2* partial gene and *ef1α* partial gene) from Bayesian/MCMC. The highly supported branches (bootstrap ≥ al 70% and posterior probability ≥ 95%) are indicated in bold.

The ILD-based congruence analysis revealed one conflict between the ITS rDNA + *rpb2* partial gene matrices and another conflict between the ITS rDNA + *ef1α* partial gene matrices. The cause of these incongruities lies in 4 samples of *Cladonia rei* (4REI, 8REI, 17REI and 18REI), which appear in different subclades in the analyses. The three data matrices were combined, however, in accordance with Wiens (1998).

Morphological and chemical analysis

The SEM showed notable differences between the stereome surfaces of *Cladonia subulata* and *C. rei*. In *C. rei*, the internal face of the stereome lacks pores, while *C. subulata* samples display a reticulated stereome with pores (FIG. 3). Furthermore, under the light microscope the transverse and lengthwise podetial sections (FIG. 4) reveal stereome hyphae that are thinner in *C. subulata* (2-3 μm diam.) than in *C. rei* (3.75-5 μm diam.). In both cases, the stereome hyphae are arranged lengthwise along the podetia.

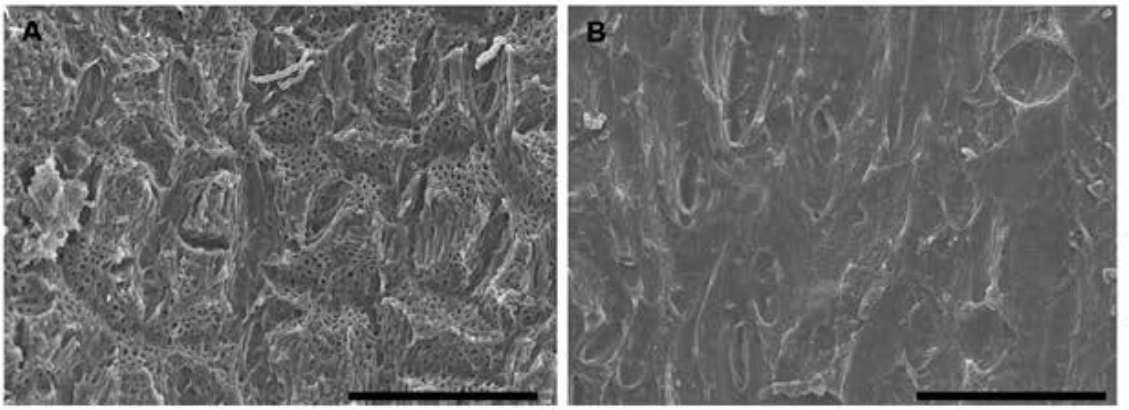

FIG. 3. SEM micrographs of the stereome surface.
A) *Cladonia subulata*. B) *C. rei*. Bar = 100 µm.

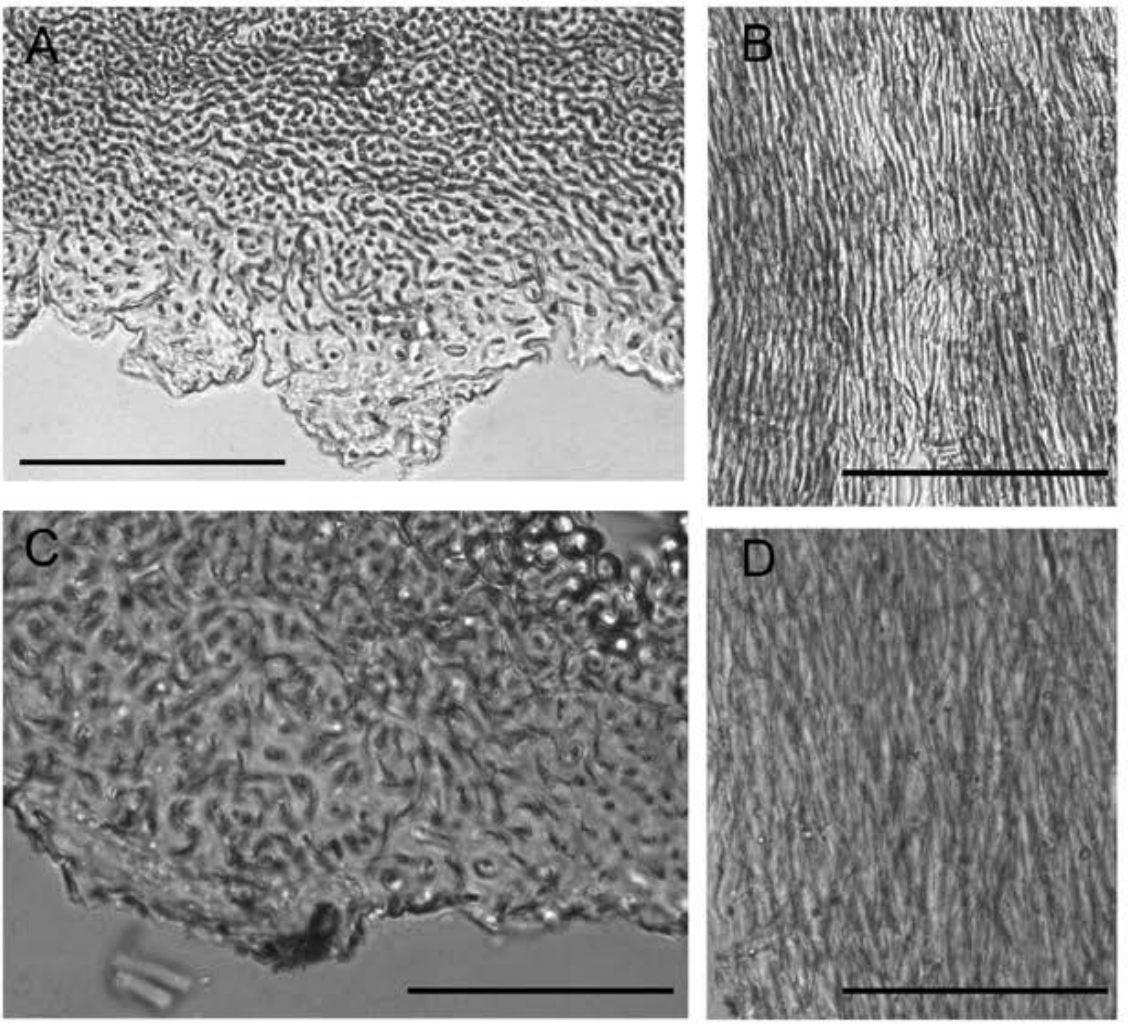

FIG. 4. Microtome sections of stereome under light microscope.
A) Transversal section of *C. subulata*. B) Lengthwise section of *C. subulata*.
C) Transversal section of *C. rei*. D) Lengthwise section of *C. rei*.
Bar = 50 µm.

TABLE 3. Results of the contingency table for *C. subulata* and *C. rei*.

CHARACTER	*p*
Presence/absence of basal squamules	0.035 *
Presence/absence of scyphi	0.13
Presence/absence of basal cortex	0.00008 **
Branching type I/branching type II	0.196

p, significance level (* $p < 0.05$, ** $p < 0.01$).

The contingency table (TABLE 3) shows the correlation between the qualitative morphological characters previously used to distinguish these taxa and the clades implied by the phylogenetic analyses. Significant differences are observed, such as the presence/absence of squamules and the presence of basal cortex on the podetia, while there are no significant differences between both taxa in the podetial branching type. Significant statistical differences were found in the podetial anatomical characters (TABLE 4), with the podetial wall being thicker in *C. rei* than in *C. subulata*, as also the medulla and stereome layers are, with the stereome/medulla ratio higher in *C. subulata*. Also, the soredial granules are significantly larger in *C. rei* than in *C. subulata*.

TABLE 4. Statistical analyses for continuous characters.

CHARACTER	*C. subulata*	*C. rei*	*p*
Soredium size	17.5-80 (125)	(14.5) 20-65 (100)	$4.42e^{-8}$**
Podetium thickness	115-310 (350)	(112.5) 130-400 (707.5)	0.0054**
Medule thickness	47.5-225 (250)	(22.5) 30-227.5 (260)	0.0029**
Stereome thickness	35-145 (187.5)	(14.5) 20-212.5 (400)	0.0000**
stereome/medule ratio	1.36-5.0 (5.70)	(1.22) 1.27-2.63 (3.08)	$6.57e^{-11}$**

The minimum value corresponds to percentile 1 and the maximum to percentile 95. The absolute maximum and minimum values are in brackets.

p, significance level (* $p < 0.05$, ** $p < 0.01$).

TLC analyses revealed that 36 samples of *C. rei* contained homosekikaic acid together with fumarprotocetraric acid, while 24 samples contained only homosekikaic acid. In both cases, homosekikaic acid was accompanied by small amounts of sekikaic acid. Furthermore, in the samples of *C. rei* the accessory substance 4'-O-methylnorhomosekikaic acid was found. Frequently fumarprotocetraric acid is accompanied by protocetraric acid; besides, in 8 of the samples containing fumarprotocetraric acid, also confumarprotocetraric acid was detected. In all *C. subulata* samples fumarprotocetraric acid was present with protocetraric acid. In addition, in 34 of these samples the satellite substance confumarprotocetraric acid occurred.

The UV test, traditionally used to detect the presence of homosekikaic acid, was applied to 60 samples; 87.5% of the samples where TLC detected homosekikaic acid gave a positive fluorescence. On the other hand, 96%

of the samples where TLC detected only fumarprotocetraric acid gave no fluorescence. The $FeCl_3$ test applied to 188 samples gave a positive reaction in 90% of the samples containing homosekikaic acid and was negative in 98% of the specimens containing only fumarprotocetraric acid.

Discussion

Evaluation of characters

SOREDIUM SIZE. Soredium size is one of the main characters used for species differentiation in many *Cladonia* species, as in the complex *C. chlorophaea* (Flörke ex Sommerf.) Spreng.–*C. fimbriata* (L.) Fr. (Hennings 1983). However, in *C. ochrochlora* Flörke the soredium size is variable (Hammer 1993). Statistically significant differences in soredium size were found in *C. subulata* and *C. rei,* with the soredial granules being bigger in *C. rei* (TABLE 4). As several factors (e.g., age, development stage, environmental conditions) probably affect soredium size (Paus et al. 1993), using this character to distinguish these species must be used with caution.

CORTEX AT THE BASE OF PODETIA. Earlier authors have discussed the utility of the podetial cortex to differentiate *C. rei* from *C. subulata*. Paus et al. (1993) and Spier & Aptroot (2007) consider it unreliable, while Syrek & Kukwa (2008) accept it as reliably diagnostic. Although a great many of the *C. rei* specimens studied were corticated, 40.62% of the *C. subulata* podetia also have corticate bases. The presence of this cortex was sometimes difficult to observe because it was covered by soredia and could be detected only by a transversal section of the podetium.

SQUAMULES AT THE BASE OF PODETIA. There are statistically significant differences between the *C. subulata* and *C. rei* clades related to the presence of squamules at the base of podetia (TABLE 4). However, as only 34.69% of *C. rei* podetia have squamules, possession of squamules cannot be used to differentiate these two species. In fact, Evans (1930) differentiated two forms of *C. nemoxyna* (Ach.) Arnold (a synonym of *C. rei*): *C. nemoxyna* f. *fibula* (Ach.) Vainio—lacking podetial squamules—and *C. nemoxyna* f. *phyllocephala* Arn.—with squamulose podetia. The presence/absence of squamules on the podetia is actually a variable character in many *Cladonia* species, e.g., *C. furcata* (Huds.) Schrad. and *C. rangiformis* Hoffm. (Burgaz & Ahti 2009).

MORPHOLOGY OF PODETIA. The presence of antler-like, irregularly branched podetia is one character attributed to *C. subulata* (Brodo 2001, Osyczka 2006, James 2009). In the material used for this paper, however, no significant differences were found between the podetia of *C. subulata* and *C. rei.* It is worth noting that much *C. subulata* material studied here was young and not well developed. Other authors (Paus et al 1993, Spier & Aptroot 2007) consider the

podetia morphology to be of little taxonomic value due to the wide variability (simple, cup-like, irregularly branched) that podetia show.

ANATOMICAL CHARACTERS. Statistically significant differences between *Cladonia subulata* and *C. rei* were found in the thickness of the podetial wall (TABLE 4). Nevertheless, as in soredium size, the thickness of the podetial wall and the thickness of each layer are widely variable in these two taxa, making it difficult to identify the two species based only on these characters. On the other hand, such anatomical features can be used to differentiate other similar taxa such as *C. mediterranea* P.A. Duvign. & Abbayes from *C. mitis* Sandst., *C. ciliata* Stirt. var. *ciliata* from var. *tenuis* (Flörke) Ahti (Burgaz & Martínez 2008), or the species within the *C. gracilis* (L.) Willd. group (Ahti 1980). In some cases, some taxonomic value is attributed to the stereome surface (Ahti 1980), which is different in *C. rei* and in *C. subulata*. Under the stereomicroscope, the reticulated stereome surface of *C. subulata* and the smooth stereome surface of *C. rei* can sometimes be observed. In most cases, however, a SEM is required to observe stereome surfaces, greatly limiting its utility for an everyday identification. Besides, the differing stereome hyphal thicknesses in those species may be responsible for the differences seen on the stereome surface.

COLOR OF THE PODETIA. The color of the podetia of *C. subulata* reportedly varies from whitish-greyish to bright green, up to brownish green, or at least with zones of brownish coloring, while in *C. rei* the podetia vary from brownish green to dirty brown (Suominen & Ahti 1966, Thomson 1968, James 2009); nevertheless color could turn out to be an ambiguous character due to the variation within either species (Paus et al. 1993, Spier & Aptroot 2007). In the present study we found that the podetia of *C. subulata* are often pale green or whitish (though some of them present brownish zones), while in *C. rei* they are green brownish.

CHEMISTRY. Secondary metabolites were confirmed as the only reliable characters to distinguish *C. rei* and *C. subulata*. A negative *p*-phenylenediamine (Pd) reaction is still useful in diagnosing specimens as *C. rei*. But a positive reaction is not reliable (Pišút 1961, Paus et al. 1993, Spier & Aptroot 2007), because many *C. rei* samples contain fumarprotocetraric acid in addition to homosekikaic acid, although Suominen & Ahti (1966) note that the *C. rei* Pd reaction is slow, being yellow at first, while in *C. subulata* it is normally instantly red, due to different fumarprotocetraric acid concentrations. Specimens containing homosekikaic acid do appear white under UV, but our results have shown small errors occur in detecting the presence of homosekikaic acid using the UV test. Nonetheless, we find the UV test useful in differentiating the species in most cases. Homosekikaic acid can also be detected by the ferric chloride test, which produces a violet spot when it is positive (Huneck &

Yoshimura 1996). Although this reaction is not used in the keys, we consider it useful for differentiating *C. rei* from *C. subulata*, and it should be included in the identification keys.

Delimitation of the taxa

Despite the high phenotypic similarity of *C. subulata* and *C. rei*, the phylogenetic analyses of the ITS rDNA, *rpb2* and *ef1α* regions show two strongly supported monophyletic clades. These clades agree with the chemical variability of the *C. subulata-C. rei* complex. All the specimens included in the *C. rei* clade contain homosekikaic acid with fumarprotocetraric acid as a frequent accessory substance, while in the *C. subulata* clade no specimens with homosekikaic acid were found. If the taxa belonged to a single species with two (to three) chemotypes, it should be expected that the chemotypes would appear intermingled, which is not true. Besides, each clade is associated with a different set of morphological characters.

In addition, the two species have obviously different ecological requirements. *Cladonia rei* is a terricolous species growing in open areas with low humus content and subneutrophilous substrate. It may sometimes grow on impoverished soils with high heavy metal content (Hajdúk & Lisická 1999). *Cladonia subulata* grows on humus-rich acidophilous substrates and even in shady areas (Sipman 1977, Paus et al. 1993, Hammer 1995, Syrek & Kukwa 2008). However, both species do occasionally grow on wood or bare rocks (Spier & Aptroot 2007). Both taxa are broadly distributed in Europe, Asia, and North America and have also been found in Australasia. However, *C. rei* has not been reported for South America or the Antarctic, while *C. subulata* grows in Argentina and Chile. In general *C. subulata* has a wider distribution, although absent in warm areas, while *C. rei* is more common in temperate or sub-arid areas, being absent in Arctic and Antarctic zones (Ahti in litt.).

Suominen & Ahti (1966) found that the *C. rei* chemotypes usually did not appear intermingled, suggesting that the chemotypes are genetically, not environmentally, determined. But the incongruities detected among the different data sets within the *C. rei* clade shows that phylogenetic relationships within this clade are not fully resolved (Wiens 1998).

Our results support *C. subulata* and *C. rei* as two independent phylogenetic species. This conclusion is founded on: 1) the genealogic concordance of the three gene regions; 2) the existence of a correlation between clades and morphological characters; and 3) the fact that both species have different habitats. Our data corroborate the results obtained in the phylogenetic study of *Cladonia* by Stenroos et al. (2002) and Dolnik et al. (2010) where *C. subulata* and *C. rei* appear in separate clades. Spier & Aptroot (2007) pointed out that the Canadian specimen of *C. rei* (AF455191) analyzed by Stenroos et al. (2002)

possibly belongs to another taxon than the European ones. Our ITS analysis, which included this sequence, shows it grouping with the other *C. rei* samples.

Cladonia glauca is morphologically similar to *C. rei,* sharing grey brownish podetia and squamules at the podetia base (Brodo et al. 2001, Syrek & Kukwa 2008, James 2009, Burgaz & Ahti 2009). However, they contain different lichen substances representing different biosequential groups. *Cladonia glauca* has squamatic acid or (rarely) thamnolic and barbatic acids (Burgaz et al. 1999, Burgaz & Ahti 2009). In addition, *C. glauca* presents a very peculiar groove along the podetium that distinguishes it from *C. rei*, and it is fully unable to produce cups (scyphi), which occur in mature specimens of *C. rei* and *C. subulata.* Our phylogenetic analyses clearly separate *C. glauca* from *C. rei. Cladonia glauca* seems to be related to *C. cenotea* (in some areas they can be difficult to distinguish), and Stenroos et al. (2002) cite *C. cenotea* as phylogenetically related to *C. crispata* (Ach.) Flot. and *C. subsubulata* Nyl. Nevertheless, further studies including additional taxa are necessary to establish the phylogenetic relationships of *C. glauca.*

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Athelopsis parvispora (*Basidiomycetes*), a new species from India

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Abstract – A new corticioid species, *Athelopsis parvispora*, is described from Manali hills in Himachal Pradesh.

Key words – Kullu, Gulaba, stalked basidia

While conducting the fungal forays in the oak forest in Gulaba area of Manali hills district Kullu of Himachal Pradesh, India, Avneet and Dhingra collected a corticioid specimen on a stump of *Quercus incana*. After detailed macroscopic and microscopic comparisons with descriptions of known species of genus *Athelopsis* (Jülich 1971, Eriksson & Ryvarden 1973, Hjortstam 1991, Kotiranta & Saarenoksa 2005), it was found to be close to *Athelopsis subinconspicua* (Litsch.) Jülich. Characters in common were thin, pellicular basidiocarps with smooth hymenial surface and clavate, basally stalked basidia, but the basidiospores in the newly described species differed in being narrowly ellipsoid and smaller (4.3–4.7 × 1.5–1.9 µm) compared to the more broadly ellipsoid and larger (6.5–8 × 4–4.5 µm) spores in *A. subinconspicua*. This suggests that this new finding represents a species of its own.

Athelopsis parvispora Avneet P. Singh, Dhingra & J. Kaur, **sp. nov.** FIGS 1–4

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Basidiocarpum resupinatum, adnatum, effusum, ad 160 µm crassum, pelliculosum; hymenium laevigatum flavescens; systema hyphale monomiticum; hyphae ad 3.1 µm latae, nodoso-septatae; hyphae basales crassitunicatae, incrustatae; subhymenial hyphae tenuitunicatae, non incrustae; basidia 10.9–16 × 3.0–3.9 µm, clavata, stipitata, 4-sterigmata, ad basin fibuligera; basidiosporae 4.3–4.7 × 1.5–1.9 µm, auguste ellipsoideae, tenuitunicatae.

TYPE: India, Himachal Pradesh: Kullu, Gulaba, on the way to Rohtang, on *Quercus incana* wood, Avneet 3578 (PUN, **holotype**), September 10, 2004.

ETYMOLOGY: The epithet refers to small basidiospores.

Basidiocarps resupinate, adnate, effused, up to 160 µm thick in section, thin, pellicular, almost athelioid; hymenial surface smooth, pale yellowish; margins indeterminately thinning. Hyphal system monomitic; generative hyphae up to 3.1 µm wide, branched, septate, clamped; basal hyphae somewhat thick-walled, encrusted; subhymenial hyphae thin-walled, without encrustation. Basidia 10.9–16 × 3.0–3.9 µm, clavate, basally stalked, 4-sterigmate, with a basal clamp; sterigmata up to 4.3 µm long. Basidiospores 4.3–4.7 × 1.5–1.9 µm, narrowly ellipsoid, thin-walled, smooth, inamyloid, acyanophilous.

FIGS 1–4. *Athelopsis parvispora.*
FIGS 1–3. Microscopic structures: 1. Basidiospores; 2. Basidia; 3. Generative hyphae.
FIG. 4. Basidiocarp showing hymenial surface.

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Helicogonium fusisporum sp. nov., an intrahymenial parasite in *Orbilia eucalypti*

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Abstract — *Helicogonium fusisporum*, an intrahymenial ascomycete that forms its ascogenous hyphae and asci in the hymenium of *Orbilia eucalypti* (= *O. coccinella* s. auct. = *O. alnea*), is illustrated and described as a new species from Lithuania.

Key words — ascomycetes, taxonomy, mycoparasite

Introduction

Species of the genus *Helicogonium* W.L. White live as parasites in hymenia of other fungi where they suppress the formation of the host's meiosporangia. They are considered to originate phylogenetically from *Helotiales* but with a loss of ability to form apothecia (Baral 1999).

These species can hardly be detected other than by accident. Although they are certainly not very rare, it is very difficult to search intentionally for them because their presence in the fruitbodies of their hosts (ascomycetes and basidiomycetes) is generally not obvious by external view, and their occurrence is usually irregular and unpredictable. Probably, *Helicogonium* asci have been repeatedly observed by mycologists who put the material aside because the strange combination of ascus and apothecial characters did not fit any described species.

Most species of *Helicogonium* occur as parasites of various genera in the *Helotiales*, whereas only one species, *H. orbiliarum* Baral & G. Marson, was

formerly known to occur in members of *Orbiliomycetes* (Baral 1999). The new species described here is the second one to be found in hymenia of the genus *Orbilia* Fr. (but a third one is mentioned below). It has so far been detected only once, and in spite of a thorough search in Lithuania over a two-year period in more than 30 collections of *Orbilia*, the second author did not succeed in finding it again. Also, the examination of roughly 4500 specimens of *Orbiliomycetes* by the first author and about 100 specimens by the second author during a period of over 20 years never brought this parasitic species to light.

Material and methods

The type material was studied by both authors in the dead state (the sign † refers to this). Freehand sections made with razor blade and also squashed material were mounted in tap water, 5% aqueous KOH, Lugol's solution (IKI) and aqueous Congo Red (CR) for microscopic examination. Line drawings of microscopical structures were made free-hand directly from the microscope. Photos were obtained with a Nikon Coolpix 4500 digital camera held free-hand on the 10x ocular of a Zeiss Standard 20 microscope. The material is deposited in the Herbaria of the Botanische Staatssammlung München (M) and Institute of Botany, Nature Research Centre, Vilnius (BILAS).

Taxonomic description

Helicogonium fusisporum Baral & Kutorga, **sp. nov.** FIGS 1–2

MYCOBANK 516003

Ascomata nulla. Asci in hymenio hospitis formati, 30–47 × (6–)6.5–7.5(–8) µm in statu emortuo, cylindraceo-clavati, tunica apicali incrassata, inamyloidea, octospori, breviter stipitati, plerumque bifurcati, non uncinati. Ascosporae fasciculatae, oblique biseriati, fusoideae, rectae, (7.5–)9–11(–12) × 2–2.5 µm in statu emortuo, non-septatae, guttulis magnis impletae, ascoconidiis carentes. Habitatio: in apotheciis Orbiliae eucalypti.

TYPE: 55°04'71.7" N, 24°23'74.0" E, Upninkai Forest, Jonava district, Lithuania alt. 122 m., on a xeric still-attached *Quercus robur* branch in apothecia of *Orbilia eucalypti* growing on old ascomata of *Colpoma quercinum*, 2.IX.2004, E. Kutorga (**HOLOTYPE** – M (ex *H.B.8533*); **ISOTYPE** – BILAS *42681*).

ETYMOLOGY: referring to the fusoid ascospores.

DESCRIPTION — ASCOGENOUS HYPHAE penetrating the medullary excipulum and subhymenium of the host, simple-septate. ASCI (†) 30–47 × (6–)6.5–7.5 (–8) µm, cylindric-clavate to clavate, 8-spored; apex slightly to medium conical, with an apical dome 2–3 µm (immature) or 1–2 µm (mature) thick in KOH, inner surface plane or usually distinctly convex, without apical chamber, IKI–, usually not exceeding the paraphyses of host in height (dead state); stalk short to medium long, medium thick, bifurcate (Y to L-shaped), without croziers. ASCOSPORES (†) (7.5–)9–11(–12) × 2–2.5 µm, fusoid to fusiform, with gradually

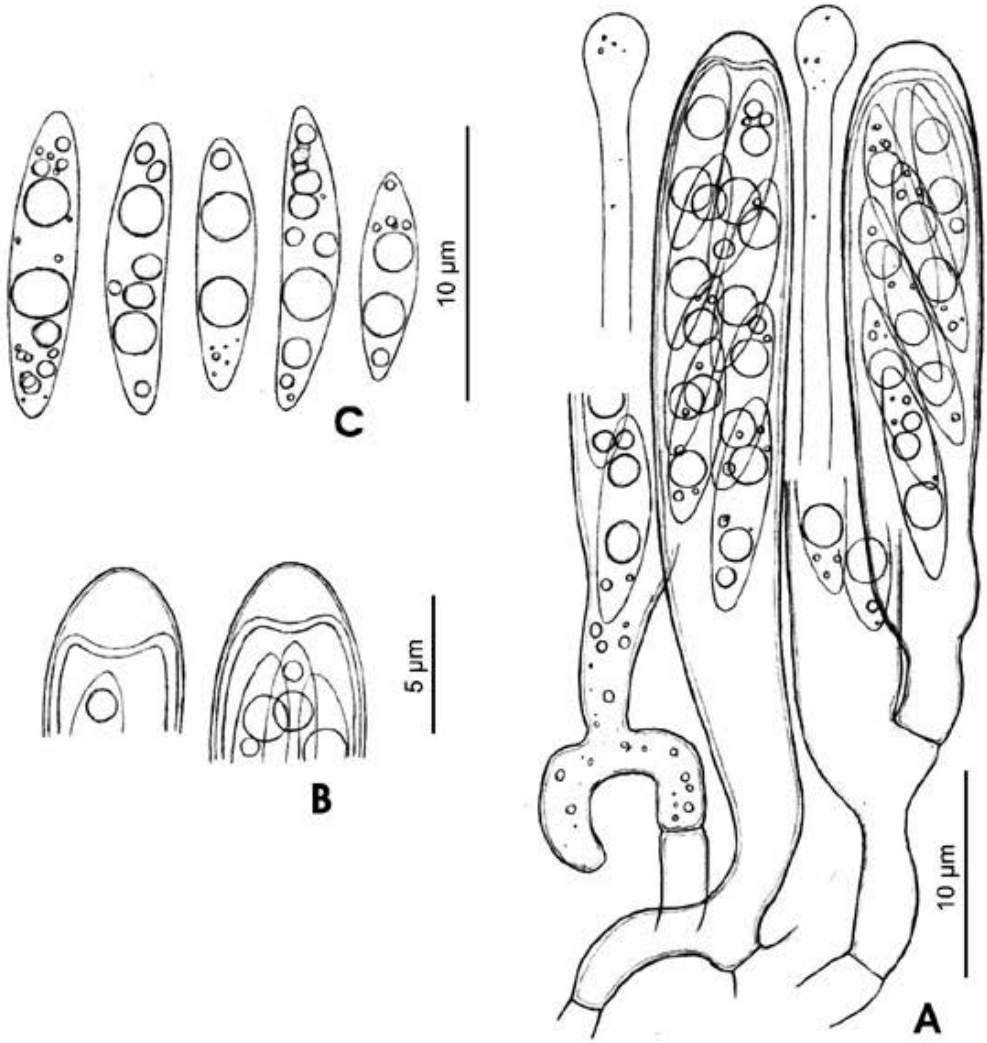

FIG. 1. *Helicogonium fusisporum* (holotype, all in KOH, KOH+IKI or KOH+CR).
A: asci (between paraphyses of *Orbilia eucalypti*),
B: ascus apices, C: ascospores containing lipid bodies (oil drops).

tapered, obtuse to acute ends, homopolar, straight to often slightly inequilateral, non-septate, containing some large and small oil drops (high lipid content).

ANAMORPH not detected. Conidia born on ascospores not observed, either on free spores or on spores within the asci.

ECOLOGY, AND RANGE — mycoparasite in the hymenium of *Orbilia eucalypti* (W. Phillips & Harkn.) Sacc., which grew on decayed ascomata of *Colpoma quercinum* (Pers.) Wallr. on 6–9 mm thick, dead, corticated branches attached to a *Quercus robur* tree, ca. 1.5–2 m above the ground in a ca. 70 year old *Pinus sylvestris* stand with scattered *Betula pendula*, *Picea abies*, and *Quercus robur*. So far only known from type locality.

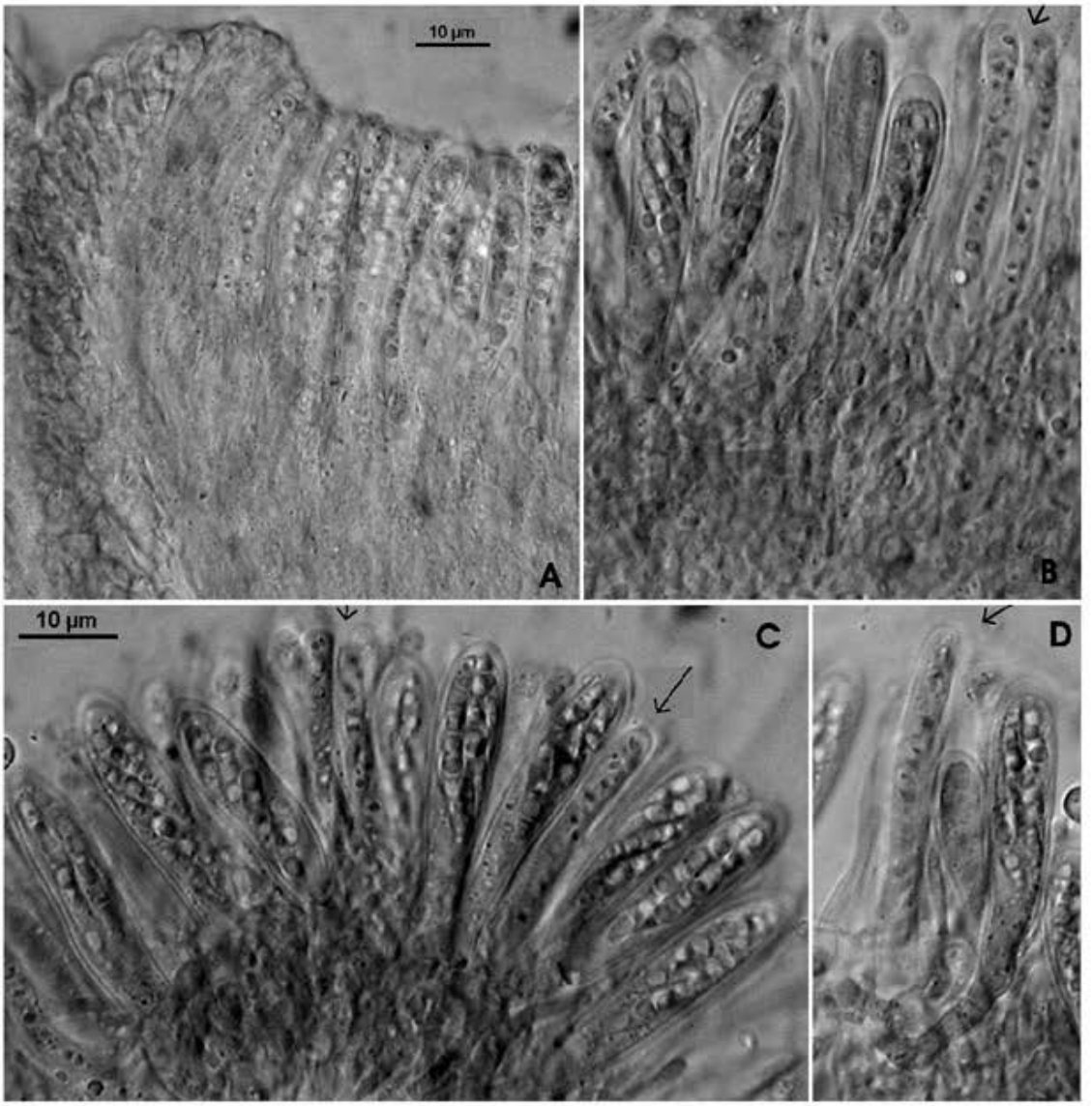

FIG. 2. Asci of *Helicogonium fusisporum* in hymenium of host apothecium (holotype, all in KOH+CR). Arrows: narrow asci of the host *Orbilia eucalypti*.

Discussion

In 2006, apothecia of *Orbilia eucalypti* (= *Orbilia coccinella* s. auct., = *O. alnea* Velen.) were collected again at the same site on very similar *Quercus* branches with old *Colpoma* ascomata, but no asci of this parasite could be detected in the examined apothecia.

Helicogonium fusisporum forms its asci between the paraphyses and asci of the host species *O. eucalypti*. In the apothecia tested, the parasitic asci were present in similar frequency to those of the host. Toward the margin of the apothecia the parasitic asci are fewer. The host asci with their small ellipsoid spores are distinctly narrower than the parasitic asci, while the parasitic asci tend to project more than the host asci (both in the dead state).

Orbilia eucalypti is a common species on attached branches or standing trunks in temperate humid to subtropical semi-humid climates. Its apothecia are desiccation-tolerant for at least 1–2 months, but much less tolerant populations of apparently the same species occur on substrate lying on the moist ground. The occurrence of *Helicogonium fusisporum* and its host on rather thin branches at eye height provides evidence that this parasite also is a desiccation-tolerant fungus. Because the specimen was studied only 1–2.5 years after collecting, no observations of the living organs could be made, therefore its desiccation-tolerance is indirectly inferred.

H. fusisporum resembles in ascospore shape *H. psilachni* Baral, a parasite in the hymenium of *Psilachnum* aff. *chrysostigmum* (Fr.) Raitv., but in *H. psilachni* the spores are shorter, much more clavate, and produce ascoconidia at their broad end while still inside the immature asci. The type species of *Helicogonium*, *H. jacksonii* W.L. White, parasitic in *Corticiaceae*, differs in septate, broader, eguttulate ascospores forming ascoconidia.

Three *Helicogonium* species are presently known to grow parasitically in *Orbilia*. The second, *H. orbiliarum*, is quite common, being so far recorded in seven different species of *Orbilia* (including *O. eucalypti*) as well as in some *Helotiales*, viz. *Calloria* Fr., *Cyathicula* De Not., and *Parorbiliopsis* Spooner & Dennis (Baral 1999). That species is readily recognized by globose to broadly ovoid ascospores containing a few ± small lipid bodies, and the spores form small ellipsoid ascoconidia that, prior to ejection, aggregate in 8 "warted" balls within the living mature asci. A third species, *H.* cf. *hyaloscypharum* Baral, resembles *H. orbiliarum* but differs in more elongate ellipsoid-clavate ascospores producing curved (cashew-shaped) ascoconidia. This species is usually found in hymenia of *Hyaloscypha* Boud. in Europe, although a single known collection from China was detected in an *Orbilia* (*O.* cf. *crenatomarginata* (Höhn.) Sacc. & Trotter (Hongyan Su pers. comm.).

During monographic work on the *Orbiliomycetes*, one of us (H.B.) had the opportunity to revise type materials of *O. coccinella* Fr. in Herb. UPS, as well as such of *O. eucalypti* (W. Phillips & Harkn.) Sacc. in K and *O. alnea* Velen. in PRM. It was found that the type of *O. coccinella* possesses 16-spored asci and cashew-shaped ascospores, which is very different from the current concept of that taxon that includes 8-spored asci and ellipsoid ascospores. *Orbilia eucalypti* was found to be conspecific with *O. alnea* and is, therefore, adopted as the oldest available name for *Orbilia coccinella* s. auct., the taxon with ellipsoid ascospores.

Acknowledgements

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Botanic Gardens at Kew) and Jan Vesterholt (Natural History Museum of Denmark) for reviewing the manuscript.

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Diadema ahmadii (*Pleosporales*), a new ascomycetous species from Pakistan

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Abstract — *Diadema ahmadii* sp. nov. is described, illustrated, and compared with similar taxa. This species was collected from dead branches of *Rosa moschata* in Kaghan Valley, an alpine region in Pakistan. *Diadema ahmadii* is most similar to *D. tetramerum*, the type species of the genus, in that it has asci and ascospores of similar dimensions. However, *D. ahmadii* is distinguished from the latter and other related species by having ascospores with a submedian primary septum.

Key words — bitunicate ascomycetes, *Diademaceae*, *Dothideomycetes*, *Pleosporomycetidae*

Introduction

During the examination of several herbarium specimens of bitunicate ascomycetes in Pakistan, an interesting species with dark and relatively large ascospores was found on dead branches of *Rosa moschata* collected from an alpine region in Pakistan (Batakundi, Kaghan Valley). Owing to the presence of globose to subglobose ascomata without a papillate beak, obclavate to cylindrical asci with fissitunicate dehiscence, and deeply pigmented, 3-septate ascospores, this ascomycete was considered as an undescribed species in the genus *Diadema* Shoemaker & C.E. Babc. The new species is described, illustrated, and compared to other species in this genus.

Materials and methods

Microscopical observations followed methods as described in Tanaka & Harada (2003) and Tanaka et al. (2009) have been followed. To observe the internal structure of ascospores, 5% NaCLO was used to bleach strongly melanized ascospores as described in Eriksson (1989). Ratios indicating ascospore septum

position follow Shoemaker (1984; length of upper hemispore/total length of ascospore). Holotype and isotype specimens were deposited in the herbaria of LAH (SHI Mycological Herbarium, University of the Punjab) and HHUF (Hirosaki University), respectively.

Taxonomy

Diadema ahmadii Kaz. Tanaka & S.H. Iqbal, **sp. nov.** FIGS. 1–15

MYCOBANK MB 513556

Ascomata 240–310 µm alta, 290–500 µm diametro, immersa, erumpentia ad apicem, dispersa vel 2–4 congregata, unilocularia, globosa vel subglobosa, glabrata. Orificinum centrale, planum, non papillatum. Paries ascomatis uniformiter 12–30 crassus. Pseudoparaphyses 2–4 µm latae. Asci (135–)140–185(–193) × 29–42(–44.5) µm, obclavati vel cylindrici, apice rotundati, stipitati, fissitunicati, octospori. Ascosporae 37–44(–47) × 13–16 µm, cum septo primum submedio (0.53), 3-septatae, late fusiformis, crassitunicatae, badiae vel fere nigerae, strato mucoso 2–4 µm lato circumdatae.

HOLOTYPE: **PAKISTAN**. NORTHWESTERN FRONTIER PROVINCE, Lalazar (Batakundi), Kaghan Valley, on dead branches of *Rosa moschata*, 3 September 1967, SHI2007-541, LAH (**holotype**), HHUF 30004 (**isotype**).

ETYMOLOGY: named in honor of Dr. Sultan Ahmad for his outstanding work on Pakistan fungi.

Ascomata 240–310 µm high, 290–500 µm diam, immersed, erumpent at the apex, scattered to 2–4 gregarious, uniloculate, globose to subglobose with flattened base in longitudinal section, glabrous. Opening area central, flat, not papillate; lid not seen. Ascomatal wall of 'textura angularis' in surface view; wall in longitudinal section uniformly 12–30 µm thick at sides, composed of 4–6 layers of polygonal cells (12–25 × 4–13 µm); wall at base composed of rectangular to subglobose cells of 5–12 µm diam; wall around the opening area composed of flattened dark brown cells of 5–8 × 2–5 µm. Pseudoparaphyses numerous, sometimes very sparse, septate, branched and anastomosed, 2–4 µm wide. Asci (135–)140–185(–193) × 29–42(–44.5) µm (mean = 159.3 × 36.6 µm, n = 50), obclavate to cylindrical, rounded at the apex, with a shallow ocular chamber, broadly at below, stipitate, fissitunicate, with 8 biseriate ascospores. Ascospores 37–44(–47) × 13–16 µm (mean = 41.3 × 15.0 µm, n = 70), L/W 2.5–3.1 (mean = 2.8, n = 70), with a primary septum submedian (0.51–0.55; mean = 0.53, n = 70), 3-septate, rarely with an additional septum at the basal cell, broadly fusiform, mostly straight, enlarged at second cell from apex, strongly constricted at primary septum, weakly constricted at other septa,

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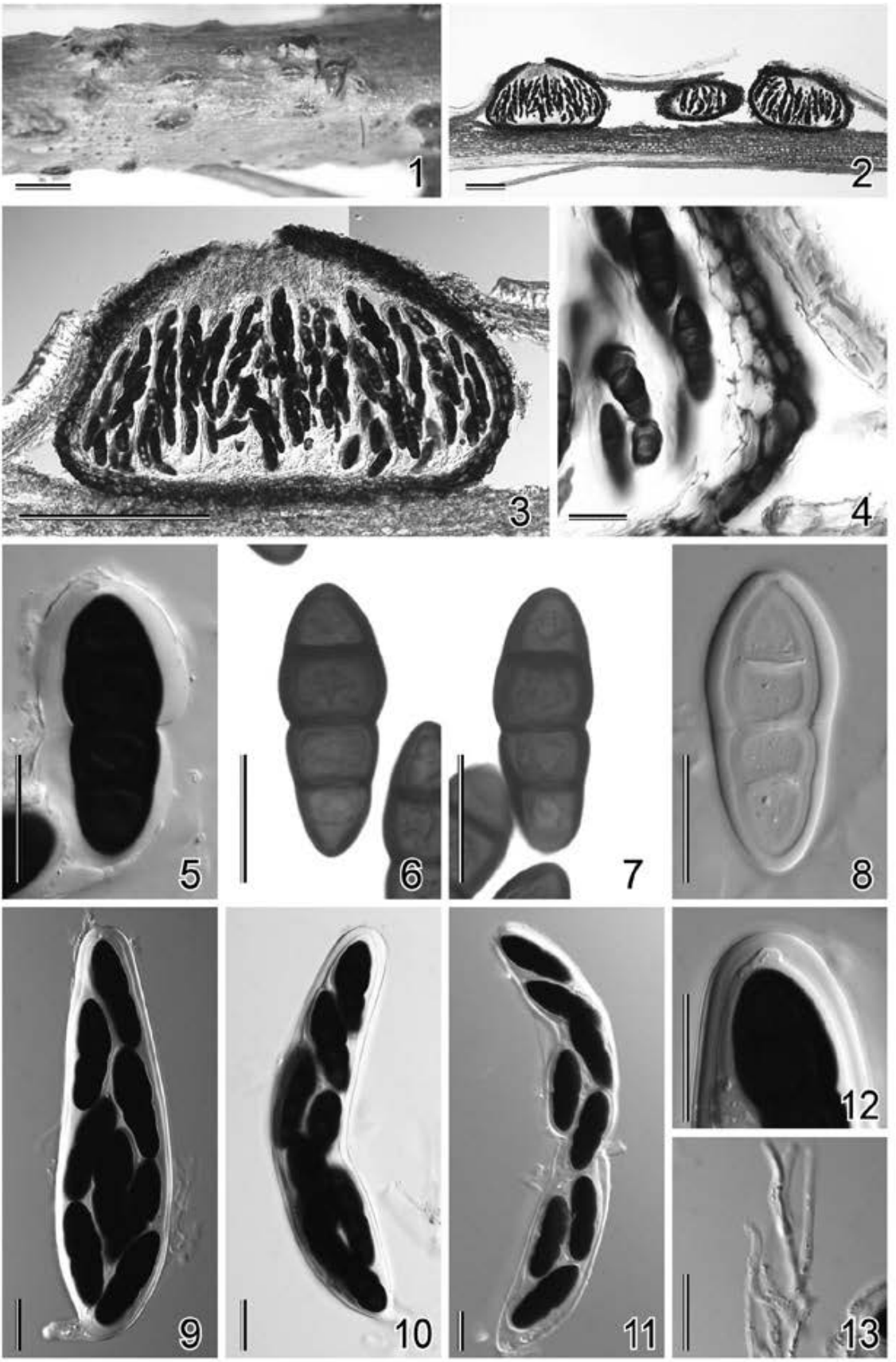
FIGS. 1–13. *Diadema ahmadii*. 1. Ascomata on the host surface. 2–3. Longitudinal section of ascomata. 4. Ascomatal wall in longitudinal section. 5–7. Ascospores in water mount. 8. Ascospore in NaClO, 9–10. Asci. 11. Extending fissitunicate ascus. 12. Apex of ascus. 13. Pseudoparaphyses. Bars: 1 = 1 mm, 2–3 = 200 µm, 4–13 = 20 µm.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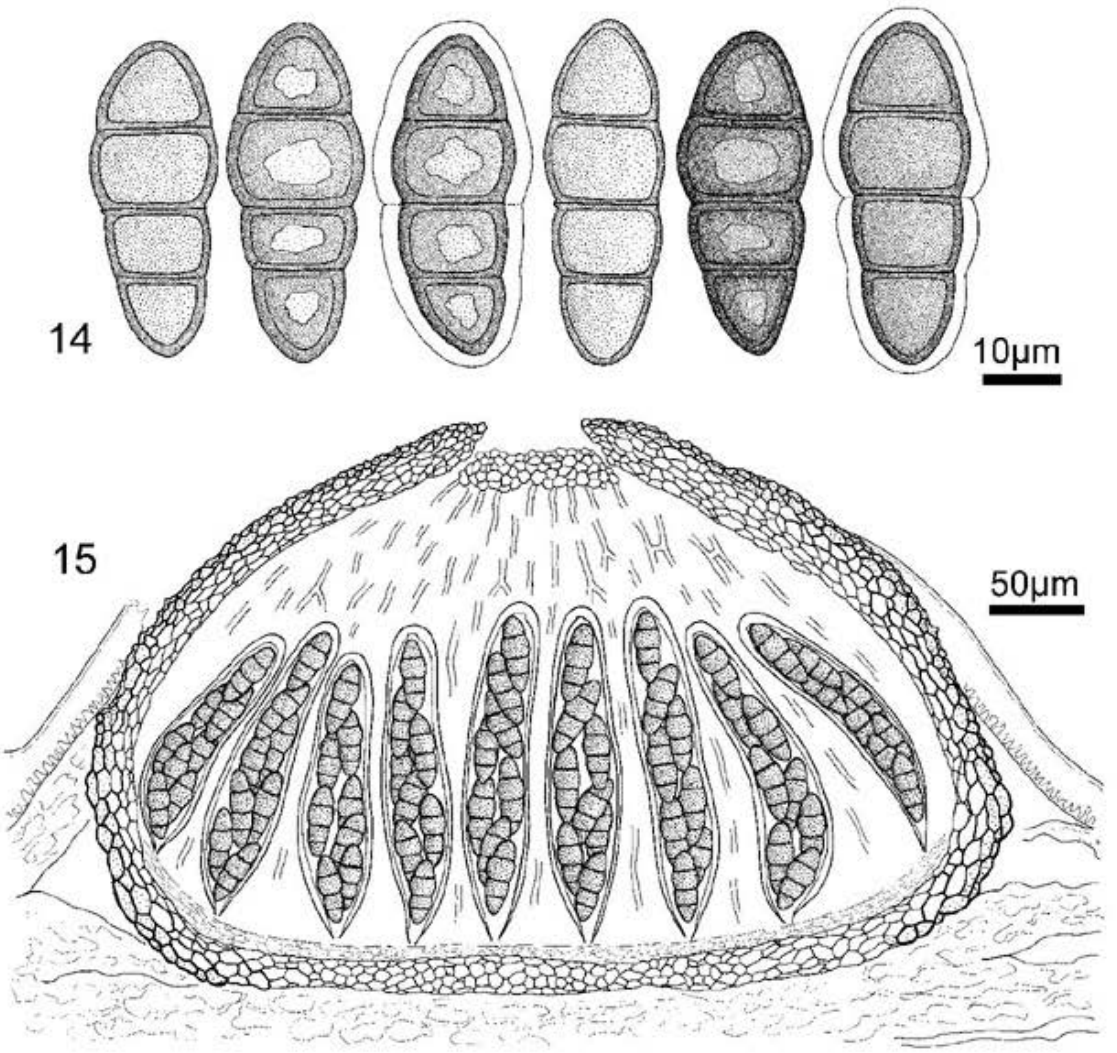

FIGS. 14–15. Line drawings of *Diadema ahmadii*.
14. Ascospores. 15. Ascoma in longitudinal section. Bars: 14 = 10 µm. 15 = 50 µm.

thick-walled (ca. 1–2 µm wide), reddish brown to almost black, smooth, with a sheath. Sheath entire, firm, sharply delimited, 2–4 µm thick, mostly constricted at the side of primary septum.

Discussion

Diadema, an ascomycetous genus typified by *D. tetramerum* Shoemaker & C.E. Babc., is assigned to *Diademaceae*, a family characterized by the presence of a 'lid' or 'cap' in the area of the ascomatal opening (Shoemaker & Babcock 1992). Most members of *Diadema* are known from culms or stems of alpine plants, in particular, those belonging to *Poaceae* or *Rosaceae*, and are reported from India, Pakistan, and USA (Shoemaker & Babcock 1989). The characteristic features of *Diadema* are relatively large, deeply pigmented ascospores and the disc-like

opening system of the ascomata. These morphological ascomycete features are generally regarded as adaptations to severe alpine conditions, such as high UV-radiation and low temperature (Savile 1972, Leuchtmann 1987, Shoemaker & Babcock 1989). *Diadema* was monographed by Shoemaker & Babcock (1989), who accepted 6 species in this genus. Subsequently, one species was added by Huhndorf (1992).

The overall morphological features of *Diadema ahmadii* as well as its alpine habitat in Pakistan agree with the current concept of *Diadema*. However, we could not find a 'lid' or 'cap' at the opening of the ascomatal apex in our material. This cap-like structure is also absent in other species of *Diadema*, such as *D. sieversiae* (Peck) Huhndorf and *D. obtusum* Shoemaker & C.E. Babc. (Shoemaker & Babcock 1987, Huhndorf 1992). The opening area of the ascomata in the Pakistan material was obscure, but the presence of a flattened apex in ascomata that lacked a papillate beak, the wall around the opening area composed of small flattened dark brown cells, and the subtending pseudoparaphyses suggest that the opening system of *D. ahmadii* might be essentially the same as that of other species in *Diadema*.

TABLE 1. Comparison of *Diadema ahmadii* with other species in the genus *Diadema*

TAXA	ASCOSPORES				HOSTS	DISTRIBUTION
	Size (µm)	L/W	PS*	Septa		
D. ahmadii (this study)	37–44(–47) × 13–16	2.8	0.53	3	*Rosaceae*	Pakistan
D. acutum Shoemaker & C.E. Babc. [1]	50–56 × 16–21	2.9	0.50	3	*Poaceae*	India, USA
D. cinctum Shoemaker & C.E. Babc. [1]	33–38 × 13–18	2.3	0.50	3	*Cyperaceae*	India
D. curtum Shoemaker & C.E. Babc. [1]	43–49 × 15–20	2.7	0.50	3	*Biebersteiniaceae*	India
D. hexamerum Shoemaker & C.E. Babc. [1]	40–50 × 15–17	2.6	0.50	5	*Poaceae*	USA
D. obtusum [1]	(40–)46–50(–55) × 19–21	2.3	0.50	3	*Rosaceae*, *Poaceae*	India, Pakistan
D. sieversiae [2] [3]	50–56 × 20–28	–	0.48	3	*Rosaceae*, *Ericaceae*	USA
D. tetramerum [1]	36–50 × 14–20	2.7	0.50	3	*Juncaceae*, *Poaceae*	USA

Data from [1] Shoemaker & Babcock (1989), [2] Shoemaker & Babcock (1987), [3] Huhndorf (1992).
* PS = position of the primary septum (length of upper hemispore/total length of ascospore).

Among the 7 species previously recognized in this genus, *D. ahmadii* superficially resembles *D. tetramerum*, the type species of the genus, in having asci and ascospores of similar dimensions. Like *D. ahmadii*, the species, *D. obtusum* and *D. sieversiae*, have also been recorded on host plants belonging to the family *Rosaceae* in alpine regions. *Diadema ahmadii*, however, can be easily distinguished from all known *Diadema* species owing to the presence of ascospores with submedian primary septum. A synopsis of these differences is shown in TABLE 1.

Acknowledgments

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Ganoderma hoehnelianum has priority over *G. shangsiense*, and *G. williamsianum* over *G. meijiangense*

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Abstract — Some type specimens of *Ganoderma* from tropical and subtropical Asia were studied. The results revealed that *Ganoderma hoehnelianum* and *G. williamsianum* are earlier names for two species of *Ganoderma* originally described from China, *G. shangsiense* and *G. meijiangense*, respectively.

Key words —*Elfvingia*, *Ganodermataceae*, *Polyporales*, taxonomy

Introduction

In China, Zhao & Zhang (2000) considered the genus *Ganoderma* P. Karst. to contain three subgenera and discriminated subgenus *Elfvingia* (P. Karst.) Imazeki from the other two by its non-laccate upper pilear surface, thick cuticle of trichodermic, anamixodermic, or plecodermic composition and uniformly brown, dark brown, or chestnut brown context. In the same paper they recorded twenty species of subgenus *Elfvingia* from this region and ten of them were new to science (Zhao et al. 1984, 1986; Zhao & Zhang 1986, 1987a,b; Zhao 1988a,b). After studying the type specimens of these "new species," we found that *Ganoderma meijiangense* and *G. shangsiense* are synonyms of *G. williamsianum* and *G. hoehnelianum* respectively. Descriptions for these two species were based solely on Chinese collections.

Methods for morphological studies mainly followed those previously described by Wang & Wu (2007). Sections for cuticular observations were

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taken from the pileus, and color of cuticular hyphae was recorded when treated with Melzer's reagent. Basidiospores were mounted in 5% KOH and only spores with a collapsed apex were measured.

Taxonomy

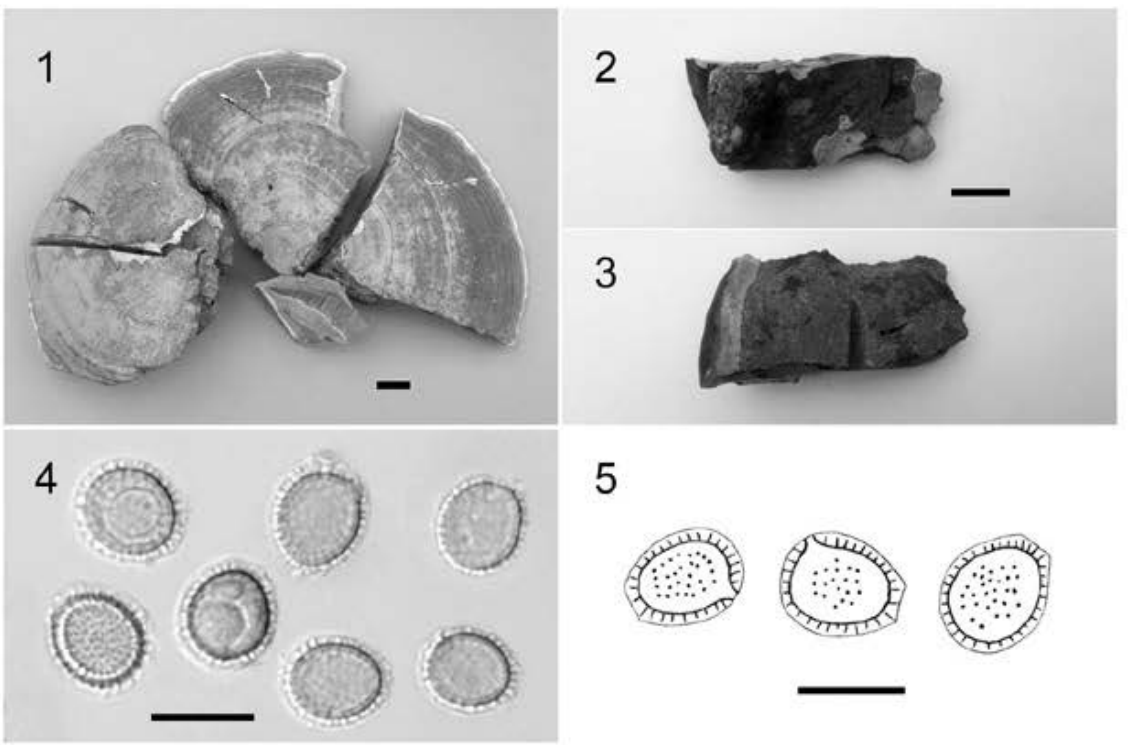
Ganoderma hoehnelianum Bres., Ann. Mycol. 10(5): 502 (1912). FIGS. 1–5

= *Ganoderma shangsiense* J.D. Zhao, Acta Mycol. Sin. 7(1): 17 (1988).

A full description of Chinese *G. hoehnelianum* was given by Wang et al. (2005; as *G. shangsiense*). The description of *G. shangsiense* was based on its holotype (HMAS 29739) and five other Chinese collections (HMAS 29740, 29741, 29742, 73477, 130043).

SPECIMENS EXAMINED—**CHINA. GUANGXI:** Shangsi county, on rotten wood, 5 Nov. 1958, Z.-C. Liang *1652* (HMAS 29741). **HAINAN:** Diaoluoshan, on rotten wood, 29 Sep. 1958, J.-H. Yu *325* (HMAS 29739, **Holotype** of *G. shangsiense*); Diaoluoshan, on dead wood, 25 Sep. 1958, J.-H. Yu *147* (HMAS 29740); Diaoluoshan, on living tree, 4 Oct. 1958, J.-H. Yu *350* (HMAS 29742); Diaoluoshan, on rotten wood of broad-leaved tree, 11 Apr. 1993, J.-P. Lai *1799* (HMAS 73477); Diaoluoshan, on dead wood of *Quercus patelliformis*, 13 Dec. 2003, D.-M. Wang *28* (HMAS 130043). **INDONESIA. JAVA:** Tjibodas, v. Hoehnel (BPI 236008, **Isotype** of *G. hoehnelianum*).

DISTRIBUTION—Indonesia (Bresadola 1912, Ryvarden 1988), China (this study).



FIGS 1–5. *Ganoderma hoehnelianum* (FIGS 1, 4: HMAS 29739; FIGS 2, 3, 5: BPI 236008). FIG 1. Basidiocarps; FIG 2. Upper surface of the basidiocarp fragment; FIG 3. Pore surface of the basidiocarp fragment; FIG 4. Basidiospores; FIG 5. Basidiospores. Bars = 1 cm in FIGS 1 & 2; = 10 μm in FIGS 4 & 5.

NOTES—Only a small pilear fragment remains from the isotype of *G. hoehnelianum* (BPI 236008). However, this portion was enough to recognize the species. The basidiocarp has a dull yellowish brown to blackish brown upper pilear surface; a vividly yellow pore surface, becoming purplish-brown on bruising; duplex context with yellow or bright yellow approaching the cuticle and yellowish brown to brown near the tube layer, with two black crustose layers; pale brown to brown tubes; broadly ovoid to subglobose basidiospores with thick echinulae and only a slightly truncate apex (11.0–12.0 × 8.5–9.5 μm); an anamixodermic cuticle composed of pale yellow, interwoven hyphae. The combined features of context color, basidiospore characteristics, and cuticular composition are the most reliable criteria in recognizing *G. hoehnelianum*. The Chinese collections of *G. shangsiense* bear the same characteristics (Wang et al. 2005).

Ganoderma williamsianum Murrill, Bull. Torrey Bot. Club 34: 478 (1907). FIGS. 6–12

= *Elfvingia williamsiana* (Murrill) Imazeki, Bull. Gov. Forest Exp. St. Tokyo 57: 106 (1952).

= *Ganoderma meijiangense* J.D. Zhao, Acta Mycol. Sin. 7(1): 16 (1988).

BASIDIOMA annual to perennial, mostly sessile, rarely with a stipe-like base, lightweight, corky. PILEUS 3.5–4.7 × 6.5–10.0 cm, reniform, dimidiate, ungulate or irregularly shaped due to imbrication; upper surface reddish brown to purplish black or black, partly strongly laccate, finely but distinctly and concentrically sulcate, slightly to distinctly radially rugose; margin rounded, incurved, concolorous with the pileus. PORE SURFACE dark yellow or bright yellow; tubes up to 1.9 cm long in total, brown or dark brown; pores circular, 5/mm, 100–200 μm diam., dissepiments 45–90(–120) μm thick. CONTEXT up to 1.5 cm thick, yellowish brown to reddish brown, with black crustose layers, corky; generative hyphae 3.0–4.5 μm diam., colorless, thin-walled; skeleto-ligative hyphae 5.5–8.0 μm diam., yellowish brown to reddish brown in KOH, arboriform with short sinuous branches. BASIDIOSPORES (10.5–)11.5–13.2 (–14.5) × (7.5–)8.5–9.5(–11.0) μm (with myxosporium), (9.2–)10.0–11.5 (–12.0) × (6.2–)7.5–8.0(–9.5) μm (without myxosporium), ellipsoid, mostly truncate at apex, brown, with a dark brown eusporium bearing very thick echinulae and longitudinally ridged ornamentations. CUTIS anamixodermic, composed of yellowish brown, dextrinoid, thick-walled hyphae usually with numerous irregular protuberances, and colorless or pale yellow, thin-walled hyphae arising from the yellowish brown hyphae, easily broken and peeled off.

SPECIMENS EXAMINED—CHINA. HAINAN: Hainan Botanical Garden, alt. 300 m, on rotten wood, 31 Oct. 1958, J.-H. Yu & J.-C. Xing *535* (HMAS 27076); Diaoluoshan, on fallen wood, 6 Nov. 1960, J.-H. Yu & R. Liu *2807* (HMAS 31826, **Holotype** of *G. meijiangense*); Diaoluoshan, on rotten wood, 26 Sep. 1958, R.-Y. Zheng et al. *212* (HMAS 26159); Jianfengling, on dead standing tree, 5 May 1960, J.-H. Yu & R. Liu *1262* (HMAS

30879). YUNNAN: Meijiang county, on rotten wood, 19 Apr. 1957, Bailiangshiji (HMAS 29751). PHILIPPINES. LUZON: Lamao River, Jan. 1904, R.S. Williams (BPI 236684, **Isotype** of *G. williamsianum*).

DISTRIBUTION—Phillipines (Murrill 1907, Steyaert 1972), Indonesia (Imazeki 1952, Steyaert 1972), Malaysia (Steyaert 1972), China (this study).

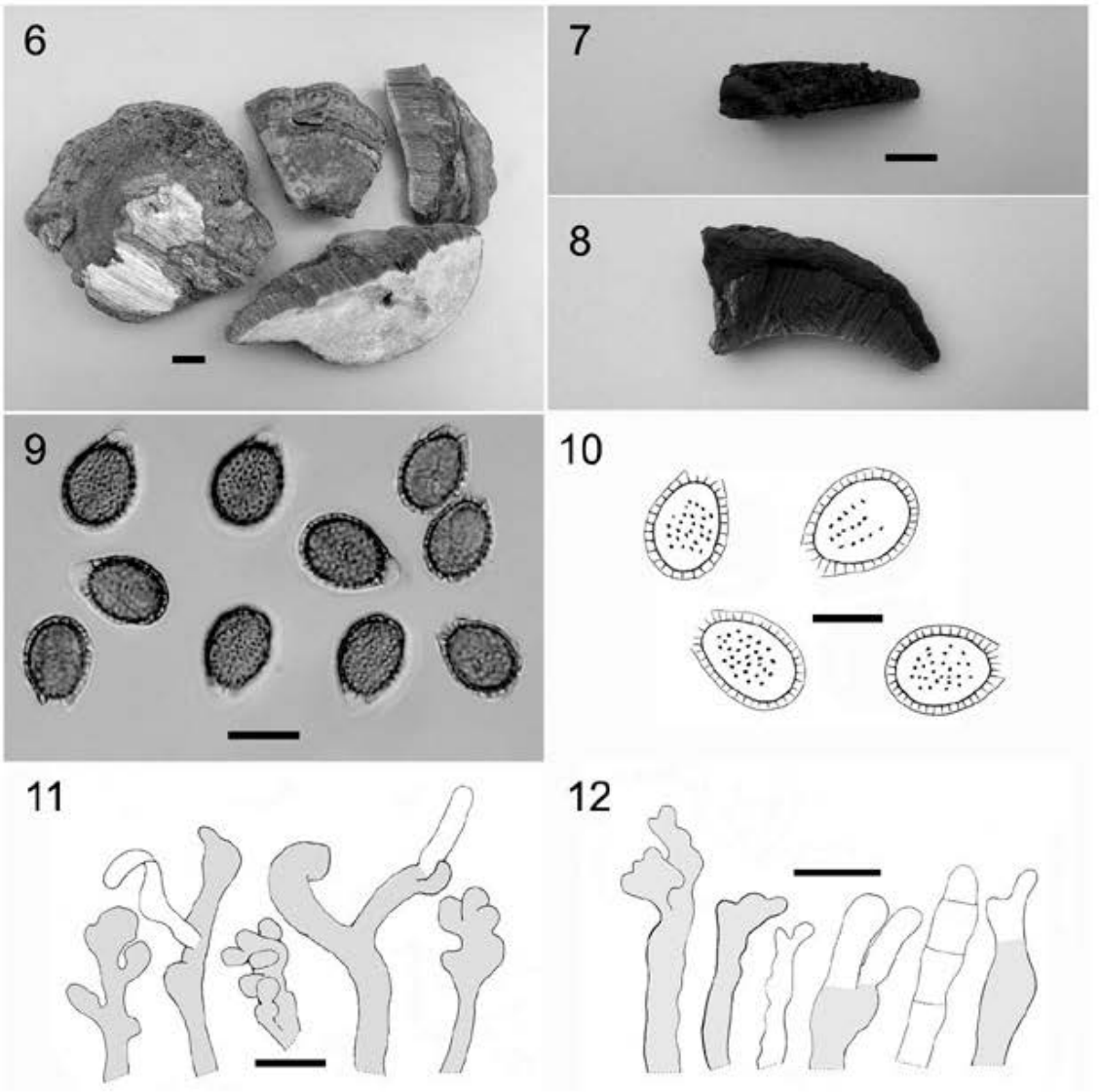
NOTES—The isotype of *G. williamsianum* (BPI 236684) comprises only a slice of a basidiocarp. Based on this material, the main features of *G. williamsianum* can be summarized as follows: strongly laccate, reddish brown pileus; vividly yellow pore surface; reddish brown context becoming yellowish brown near the cuticle, with two black crustose layers; skeleto-ligative hyphae with consistently short branches; pale brown tubes; ellipsoid basidiospores with rather thick echinulae and longitudinally ridged ornamentations (13.5–16.0 × 9.0–10.5 μm); cuticle composed of thin-walled, interwoven hyphae usually with apical protuberances, colorless or pale yellow (inamyloid) or bluish black (amyloid).

Steyaert (1972) emphasized peculiarities of two characters in *Ganoderma williamsianum*. First, the cutis is composed of "hyaline" hyphae only; secondly, hyphae grow in a wavy or zigzag manner. The first feature is merely one transitional form from anamixoderm to characoderm (Corner 1983). The second feature illustrated in Steyaert (1972) and Corner (1983) is from short sinuous branches at the ends of the skeletal hyphal stalk. In addition, *G. williamsianum* is also easily recognized by having a yellow pore surface, dark brown context, and large basidiospores with striped ornamentation.

Ganoderma williamsianum superficially resembles members of the laccate *Ganoderma* group by its macromorphology. Aoshima (1971) misinterpreted the cuticle of this species as a palisadoderm. In reality, *G. williamsianum* has an anamixodermic cuticle and is a member of *Elfvingia* group (Imazeki 1952, Moncalvo & Ryvarden 1997).

Corner (1983) considered that *G. williamsianum* needed to be compared with *G. brownii* (Murrill) Gilb., an American species collected from California. *Ganoderma brownii* is very similar to *G. williamsianum* in color of pore surface (Lowe & Gilbertson 1961, Gilbertson & Ryvarden 1986). However, *G. brownii* can be easily distinguished from *G. williamsianum* by having a dull pileus with a hard, not easily broken crust (Lowe & Gilbertson 1961) formed by hyphae arranged in a trichoderm (Steyaert 1972, Gottlieb & Wright 1999), skeletal hyphae with occasional branching (Gilbertson & Ryvarden 1986), and smaller basidiospores (9–12 × 7–9 μm in Lowe & Gilbertson (1961), 9.5–10.6–12 × 6.5–7.6–8 μm in Steyaert (1972), 11–12 × 7–8 μm in Gilbertson & Ryvarden (1986), (9–)10–11 × 6–7(–8) μm in Gottlieb & Wright (1999)).

Zhao (1988a) stated that *G. williamsianum* is similar to *G. meijiangense* but distinguished from the latter by having dark brown context without any black crustose layer and a distinct cuticular composition. However, these



Figs 6–12. *Ganoderma williamsianum* (Figs 6, 9, 11: HMAS 31826; Figs 7, 8, 10, 12: BPI 236684). Fig 6. Basidiocarps; Fig 7. Upper surface of the basidiocarp fragment; Fig 8. Vertical section of the basidiocarp fragment; Fig 9. Basidiospores; Fig 10. Basidiospores; Fig 11. Cutis hyphae (Pale parts indicating colorless or pale yellow, thin-walled hyphae; Dark parts indicating yellowish brown, thick-walled hyphae); Fig 12. Cutis hyphae (Pale parts indicating colorless or pale yellow, thin-walled hyphae; Dark parts indicating bluish black hyphae). Bars = 1 cm in Figs 6 & 7; = 10 µm in Figs 9–12.

characters used for discrimination by Zhao (1988a) have not been supported in this study. The isotype of *G. williamsianum* BPI 236684 has dark context with black crustose layers, while the holotype of *G. meijiangense* HMAS 31826 has a cuticular composition with colorless or pale yellow, thin-walled hyphal ends. Further, HMAS 31826 has the skeleto-ligative hyphae which are typical for *G. williamsianum*. The Chinese collections of *G. meijiangense* cited above agree well with *G. williamsianum* in morphology except for having slightly smaller basidiospores.

Acknowledgments

We are very grateful to Drs. Nils Hallenberg and Peter Buchanan for reviewing this paper. Thanks are due to the curators of BPI and HMAS for loans of *Ganoderma* specimens. This study is supported by the National Museum of Natural Science and Foundation of the National Museum of Natural Science of ROC, Postdoctoral Fellowship Grant of National Science Council (NSC96-2816-B-178-001), the Natural Science Foundation of Guangdong Province, China (Serial no. 8451007002001904), Science and Technology Planning Project of Guangdong Province, China (2008B020400013, 2009B020304003), and the Foundation of Guangdong Academy of Sciences, China for 2008 Outstanding Young Science and Technology Talents. The senior author also wishes to appreciate the instructions of Dr. Y.-J. Yao during her initial study of *Ganoderma* in China.

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Passalora acericola – a rare cercosporoid species found for the first time in Poland

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Abstract – The rare cercosporoid hyphomycete *Passalora acericola* has been found for the first time in Poland, on *Acer pseudoplatanus*. Previously, this rare species has been found in only three other localities. It is described illustrated and discussed, based on the Polish material.

Key words – anamorphic fungi, hyphomycetes, distribution

Introduction

Passalora Fr. was previously regarded as an anamorph genus of the ascomycetous genus *Mycosphaerella* Johanson (e.g., Braun & Mel'nik 1997, Shin & Kim 2001, Crous & Braun 2003) and belonged to the so-called cercosporoid fungi. *Passalora* is now considered polyphyletic within *Mycosphaerellaceae* and not a genus-specific anamorph of *Mycosphaerella* s. str., which is restricted to species having *Ramularia* anamorphs (Crous et al. 2009). *Passalora*-like fungi are usually phytopathogenic, often causing leaf spots, but they may occasionally also be hyperparasitic or rarely saprobic (Crous & Braun 2003). Fries introduced *Passalora* as a genus in 1849. Braun (1995) discussed in detail the differentiation of *Passalora* and allied genera within the cercosporoid fungi. Recently Crous & Braun (2003) recognized four true cercosporoid genera, viz. *Cercospora* Fresen., *Passalora, Pseudocercospora* Speg., and *Stenella* Syd. and cited several other morphologically similar genera based on molecular sequence analyses and a reassessment of morphological characters.

Passalora acericola is a very rare species known from only three other localities in the world. Liu & Guo (1982) first described the fungus as *Phaeoramularia acericola* X.J. Liu & Y.L. Guo on *Acer truncatum* Bunge in China. Six years later the same authors (Liu & Guo 1988) proposed the combination *Mycovellosiella*

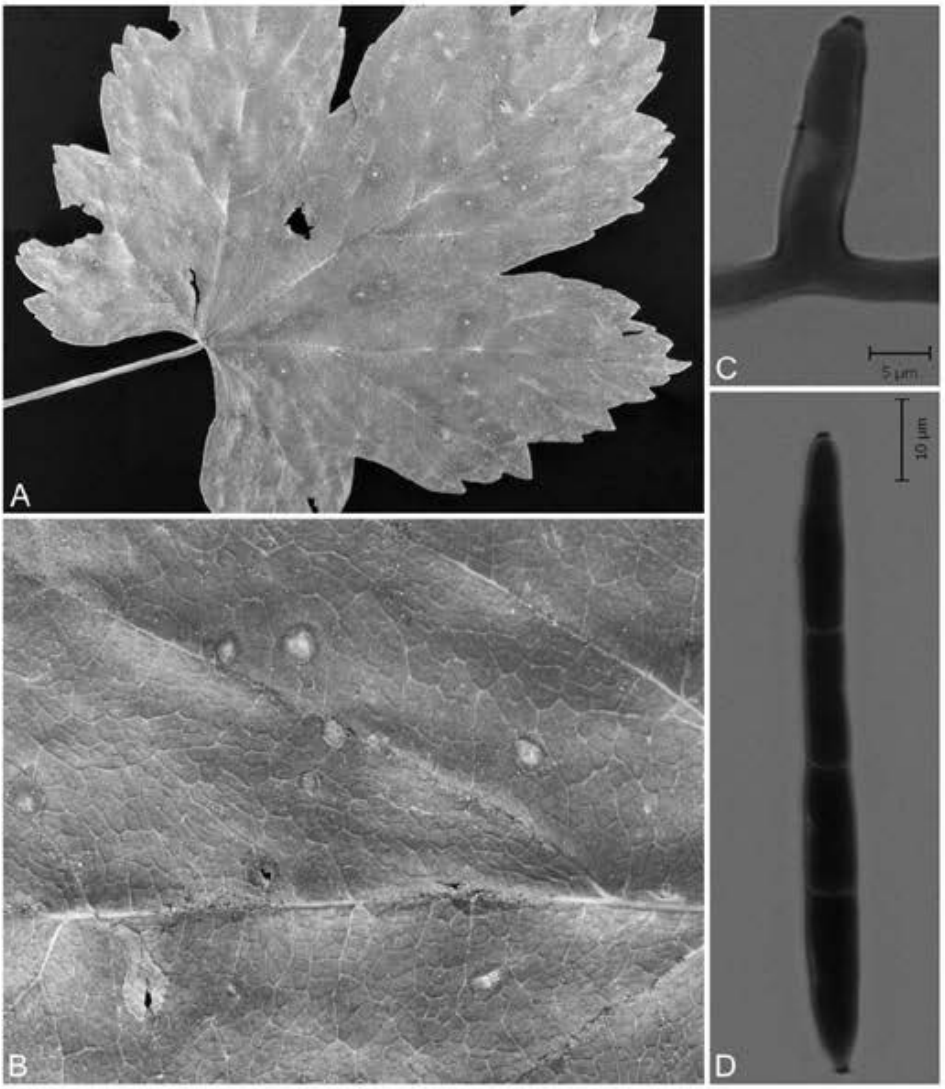

FIG. 1. *Passalora acericola*.
A, B. Leaf spots on *Acer pseudoplatanus*. C, Conidiophore. D. Conidium.

acericola (X.J. Liu & Y.L. Guo) X.J. Liu & Y.L. Guo, which Crous & Braun (2003) transferred to *Passalora* since *Mycovellosiella* was considered a synonym of that genus. This pathogen has also been reported from Italy on *Acer opalus* Mill. and from both Italy and Germany on *A. pseudoplatanus* (Braun & Crous 2005). This fourth record is the first report of *Passalora acericola* from Poland.

Materials and methods

Acer pseudoplatanus (great maple, sycamore) is a native tree in Poland, often found in mountain and upland mixed forests. On lowlands, it is usually cultivated as an ornamental in parks and gardens and along roadsides. In Poland, *A. pseudoplatanus* reaches the northeastern limit of its natural range in Europe. The distinctive brownish lesions were collected from leaves of the tree in June 1989 and originally deposited in

the herbarium as *Cercospora acericola* Woron. After 20 years it was reexamined and redetermined as *Passalora acericola*.

The collected leaves of host plants were air-dried and examined by light microscopy (LM) in lactophenol Cotton Blue. The fungal nomenclature and taxonomy follows Crous & Braun (2003). The specimen examined is deposited in the herbarium of the Department of Botany and Mycology in Lublin (LBL M 8655).

Taxonomy

Passalora acericola (X.J. Liu & Y.L. Guo) U. Braun & Crous, *Mycosphaerella* and its anamorphs 1: 436. 2003. FIGS. 1, 2

Leaf spots amphigenous, scattered, sometimes confluent, circular to subcircular, 1–4 mm in diameter, center grayish white, with wider yellowish brown halo and sometimes with border lines. Conidiophores solitary or 2–6 in fascicles, pale olivaceous-brown, straight or slightly curved, 0-1-septate, indistinct, conidial scars conspicuous, thickened and darkened, 15–42.5 × 4.5–6.5(–7)

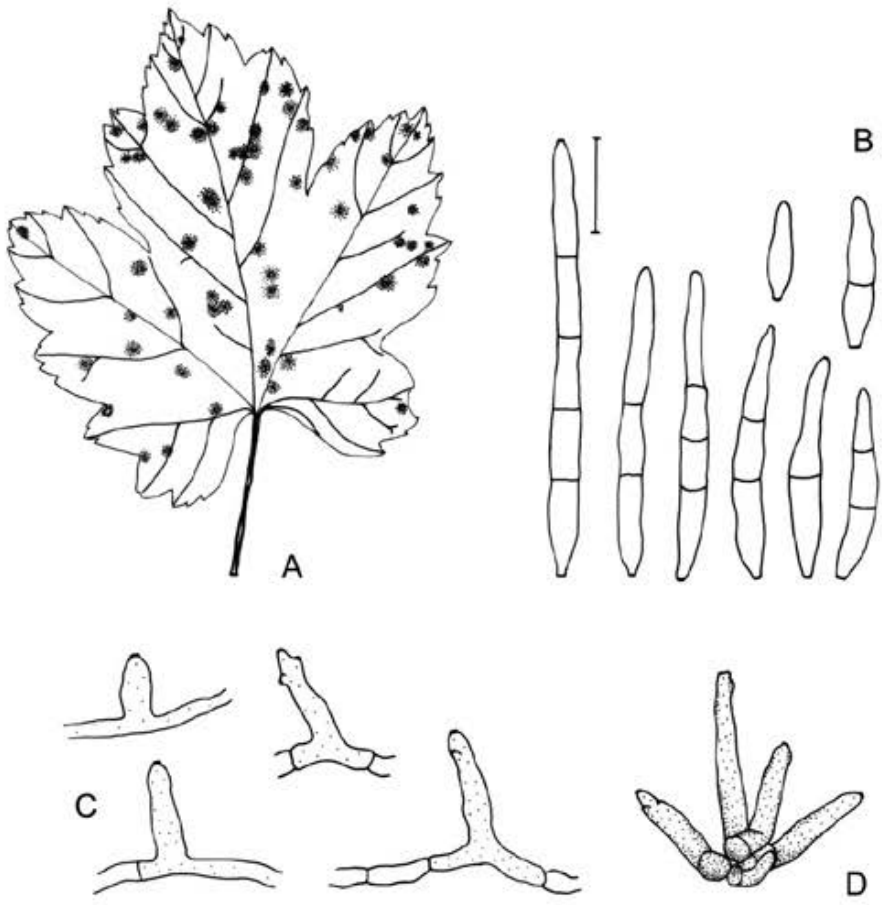

FIG. 2. *Passalora acericola* on *Acer pseudoplatanus*.
A. Leaf spots. B. Conidia. C, D. Conidiophores.
Scale bar = 20 µm. U. Świderska-Burek del.

µm. Conidia hyaline to subhyaline, solitary or occasionally catenate, obclavate to cylindrical, straight to slightly curved, usually 1–4-septate, 35–85 × 3.5–5 µm, hila slightly thickened and darkened.

Specimen examined: POLAND. Wyżyna Lubelska Upland, Lipowiec village near Tyszowce town, on *Acer pseudoplatanus* L., 15 June 1989, W. Mułenko (LBL M 8655).

Several species of cercosporoid fungi have been reported worldwide on hosts of the genus *Acer*, including three species of *Cercospora* (*C. acerigena* U. Braun & Crous, *C. negundinis* Ellis & Everh., *C. saccharini* Liberta & Boewe), one species of *Pseudocercospora* (*Ps. acericola* (Woron.) Y.L. Guo & X.J. Liu), and only a single species of *Passalora* (*P. acericola*) (Crous & Braun 2003). The last species has previously been confused with *Pseudocercospora acericola* (= *Cercospora acericola* Woron.), which is, however, easily distinguishable by its inconspicuous, unthickened, non-pigmented loci (Braun & Crous 2005). The conidiophores in the Polish sample are somewhat wider than in the Chinese original description by Liu & Guo (1982), viz. 15–42 × 4.5–6.5(–7) (versus 15–43.8 × 3.8–6.3 µm), but otherwise it agrees well with the type description.

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Occurrence of *Lentinula raphanica* in Amazonas State, Brazil

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Abstract — *Lentinula raphanica* (*Basidiomycota, Marasmiaceae*) has been found in the Amazonian region of Brazil for the first time. Sequencing of the LSU region of the nuclear ribosomal DNA confirms the identity of the species. Macro- and microscopic descriptions and illustrations are provided, and the American distribution of *Lentinula* species is summarized.

Key words — *Agaricales*, diversity

Introduction

Lentinula Earle had long been considered to be a synonym of the cosmopolitan genus *Lentinus* Fr., but it is now accepted as a distinct genus with significant morphological differences in hyphal structure (Pegler 1983a) and type of wood rot (Redhead & Ginns 1985). Molecular data also confirm the distinction between the genera (Molina et al. 1992, Hibbett & Vilgalys 1993).

The genus comprises only seven morphological species with Asian-Australasian and American distributions. According to Nicholson et al. (1997), *Lentinula edodes* (Berk.) Pegler comprises three phylogenetic species with biological compatibility (Shimomura et al. 1992): *L. edodes*, *L. novae-zelandiae* (G. Stev.) Pegler, and *L. lateritia* (Berk.) Pegler. However, Fukuda et al. (1994) and Hibbett et al. (1998) have identified five distinct molecular groups within the *L. edodes* complex, each specific to a particular geographic region.

The currently recognized American species are *L. boryana* (Berk. & Mont.) Pegler, described from material collected by Blanchet de Laurane in Bahia State,

Brazil; *L. guarapiensis* (Speg.) Pegler, known only from the type collection made by Balansa in Guarapi, Paraguay; and *L. raphanica*, described from Florida, U.S.A, and segregated from specimens previously identified as *L. boryana* or *L. aciculospora* J.L. Mata & R.H. Petersen from Costa Rica.

Lentinula boryana and *L. raphanica* are morphologically very similar. Thon & Royse (1999) first established the separation of these two phylogenetic independent lineages within *L. boryana* after which Hibbett (2001) showed that the lineages represented two phylogenetic species of *Lentinula*. One species ("group VI") had a Central American distribution, and the other ("group VII") had a Coastal-Caribbean-South American distribution. Mata & Petersen (2001) and Mata et al. (2001) formally described these groups as *L. boryana* and *L. raphanica*, respectively.

In Brazil, *L. boryana* has been reported previously for Bahia, the type locality [Berkeley & Cooke 1876, as *Agaricus boryanus*; Dennis 1951, as *Collybia boryana*; Pegler 1983a; Mata & Petersen 2001], Paraná State (Meijer 2001), Rio Grande do Sul State (Rick 1907, as *C. boryana*; Singer 1952a, 1952b, 1953, as *Lentinus puiggarii*), and São Paulo (Grandi et al. 1984, as *Lentinus cubensis*; Pegler 1983b, under *L. puiggarii*; Pegler 1988, 1997). In this paper, we report the first record of *Lentinula raphanica* for Amazonas State, supported by morphological and molecular (nLSU) data. This is the second record for Brazil; the voucher material mentioned by Thon & Royse (1999, ambiguously cited as "sp834, Instituto de Botânica Herbarium, São Paulo, Brazil") was not found there.

Material and methods

Sampling

The studied material was collected at the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas State. The specimens were deposited at the Instituto de Botânica Herbarium, São Paulo, Brazil (SP) and at the Instituto Nacional de Pesquisas da Amazônia Herbarium, Manaus, Brazil (INPA).

Morphological study

Dried material was analyzed microscopically. Sections of basidiomata were first rehydrated with 70% ethanol and then with 5% KOH for 5–10 minutes and observed under a light microscope equipped with a drawing tube.

Molecular study

nLSU rDNA sequences were phylogenetically analyzed to compare the *Lentinula* species from Amazonas, Brazil, with sequences deposited in GenBank (Table 1).

DNA extraction —DNA extraction protocols were adapted from Ferreira & Grattapaglia (1995) using lyophilized mycelium previously ground to a fine powder in liquid nitrogen. The sample was re-suspended in 50 µL TE, incubated at 37°C for 30 min after the addition of RNase A (0.01 mg μL^{-1}), and stored at –20°C.

TABLE 1. Collection data and GenBank accession number of the taxa analyzed.

SPECIES	GENBANK NR.	VOUCHER/ STRAIN	REFERENCE
Gymnopus biformis	AF261336	RV98/32	Moncalvo et al. 2002
G. menehune	AY639423	AWW02-SFSU	Wilson & Desjardin 2005
Lentinula boryana	AF356151	R.G. Thorn 960624/09	Hibbett 2001
	AF356152	R38	Hibbett 2001
L. lateritia	AF356160	RHP3577	Hibbett 2001
	AF356162	TMI1172	Hibbett 2001
L. raphanica	AF356147	DUKE HN2002	Hibbett 2001
	GQ865600	SP394008	This study

PCR AMPLIFICATION — The 5' end of the nLSU rDNA was targeted for amplification. The nLSU region was amplified using the primer set LR16 and LR5 (Moncalvo et al. 2000). PCR reactions containing 2.0 U of Platinum® Taq DNA Polymerase - Brazil (Invitrogen), 0.2 mM of each dNTP, 1.5 mM of $MgCl_2$ and 0.2 µM of each primer in 100 µL were performed in an Eppendorf thermocycler. The program was initiated by a 5-min denaturation step at 94°C, followed by 40 cycles of 40 sec at 94°C, 30 sec at 55°C and 60 sec at 72°C. Polymerization was completed by a 5-min incubation at 72°C. Amplification products were electrophoresed in a 1.5% agarose gel containing 0.1 µg ml^{-1} ethidium bromide. PCR products were then purified using the PureLink PCR Purification Kit (Invitrogen).

DNA SEQUENCING —PCR product was sequenced in both directions using the same amplification primers and the DYEnamic ET Dye Terminator Kit in a MegaBACE 1000 DNA sequencer (GE Healthcare) according to the manufacturer's instructions. The sequence was deposited in GenBank as GQ865600.

DATA ANALYSIS — Initially, a blast search was conducted in GenBank to compare the sequence obtained from the Amazonas material with existing sequence data. Subsequently, phylogenetic analysis was performed using the nLSU sequence determined in this study and five sequences available on GenBank (TABLE 1).

The sequences were analyzed using BioEdit version 7.0.5.3 (Hall 1999) and automatically aligned in Clustal W (Thompson et al. 1994). Parsimony analysis was performed using PAUP* version 4.0b10 (Swofford 2001). The most parsimonious tree was obtained by a heuristic search with 1000 replicates of simple sequence addition, employing the tree-bisection-reconnection (TBR) branch-swapping algorithm. Characters from the extreme 5' and 3' ends of the sequences were deleted from all taxa to obtain individual datasets that had identical start and end positions. Gaps were treated as missing data, all characters were unordered and equally weighted, and multistate taxa were interpreted as uncertainty.

Branch support values were determined using 1000 bootstrap (BS) replicates. Estimated levels of homoplasy and phylogenetic signal (retention and consistency indexes) were determined. Trees were rooted using *Gymnopus biformis* (Peck) Halling and *G. menehune* Desjardin et al. as outgroups.

Results and discussion

Molecular analysis

Eight sequences were aligned — two each from three *Lentinula* taxa, and one per outgroup. The alignment consisted of 1426 characters, including gaps. Prior to analysis, 719 characters were excluded from the 5' and 3' ends of the sequences. Of 707 characters included in the analysis, 654 characters were constant, 10 variable characters were parsimony uninformative, and 43 were parsimony informative.

The heuristic search with 1000 BS replicates resulted in a single most parsimonious tree with the following scores: tree length = 60 steps, consistency index = 0.933, retention index = 0.934.

The most parsimonious tree generated from the nLSU sequence data from *Lentinula* species revealed three clades (FIG. 1) according with species identification. *L. boryana* is the sister species of *L. raphanica* with 75% BS support. Neighbor joining analysis (data not shown) showed the same topology. This result and a two-base pair difference between the Amazonas sequence (GQ865600) and the *L. raphanica* sequence (AF356147, obtained from the same material (DUKE HN2002) used for ITS analysis by Mata et al. 2001) support the Amazonas material as *L. raphanica*.

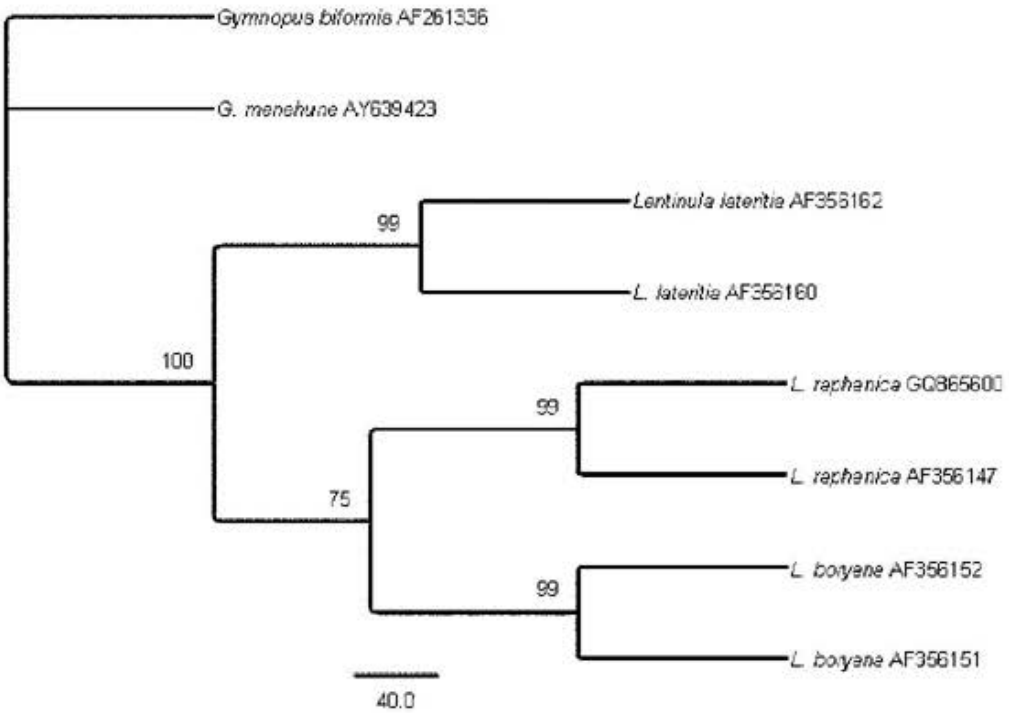

FIGURE 1. MP tree generated by parsimony analysis of partial LSU rDNA sequences. BS values are shown above branches. GenBank accession numbers are shown after each taxon name.

FIGURE 2. *Lentinula raphanica* (INPA230870, SP394008). Bar = 1 cm.

Taxonomy

Lentinula raphanica (Murrill) J.L. Mata & R.H. Petersen, Mycotaxon 79: 228. 2001. FIGS. 2, 3

= *Armillaria raphanica* Murrill, Mycologia 35: 423. 1943.

= *Lentinula raphanica* (Murrill) J.L. Mata & R.H. Petersen, Mycologia 93: 1107. 2001 (superfluous combination).

= *Gymnopus alliaceus* Murrill, Mycologia 35: 425. 1943.

PILEUS 3–6 cm diam., convex at first with an involute margin, then applanate with a depressed center to infundibuliform when fully expanded, glabrous, some slightly viscous, smooth, hygrophanous, white to dirty white, center sometimes cinnamon brown to brownish, sometimes with cinnamon brown patches, fleshy. LAMELLAE free, crowded, white, thin, smooth-edged, with lamellulae. STIPE 40 × 3 mm, central to slightly eccentric, curved, equal to tapering at the base, surface with some floccose fibrillose small scales, dirty white to pinkish, with brownish base, firm. Annulus absent. BASIDIOSPORES not seen. BASIDIA not seen. BASIDIOLES numerous, mostly ventricose, 13–18 × 4–5 µm. PLEUROCYSTIDIA absent. CHEILOCYSTIDIA 21.4–28.5 × 5–7 µm, versiform, contorted, clavate with diverticulate outgrowths, hyaline, thin-walled, clamped at the base. LAMELLAR TRAMA regular, becoming interwoven towards the edge,

hyphae 3–14 µm, hyaline, thin to slightly thick-walled, with clamp connections. CAULOCYSTIDIA 14.2–50 × 2–7 µm, abundant, cylindrical, clavate or flexuous, apex obtuse or with outgrowths, hyaline. Lignicolous, growing on *Bertholletia excelsa* Humb. & Bonpl. (*Lecythidaceae*, castanha da amazônia).

EXAMINED MATERIAL — BRAZIL. AMAZONAS: Manaus, INSTITUTO NACIONAL DE PESQUISAS DA AMAZÔNIA — 04.XII.2007, N.K. Ishikawa s.n. (INPA230870, SP394008; GENBANK GQ865600); 31.VIII.2007, T.A. Silva s.n. (INPA230868, SP394011); 21.XI.2007, T.A. Silva s.n. (INPA230869, SP394010).

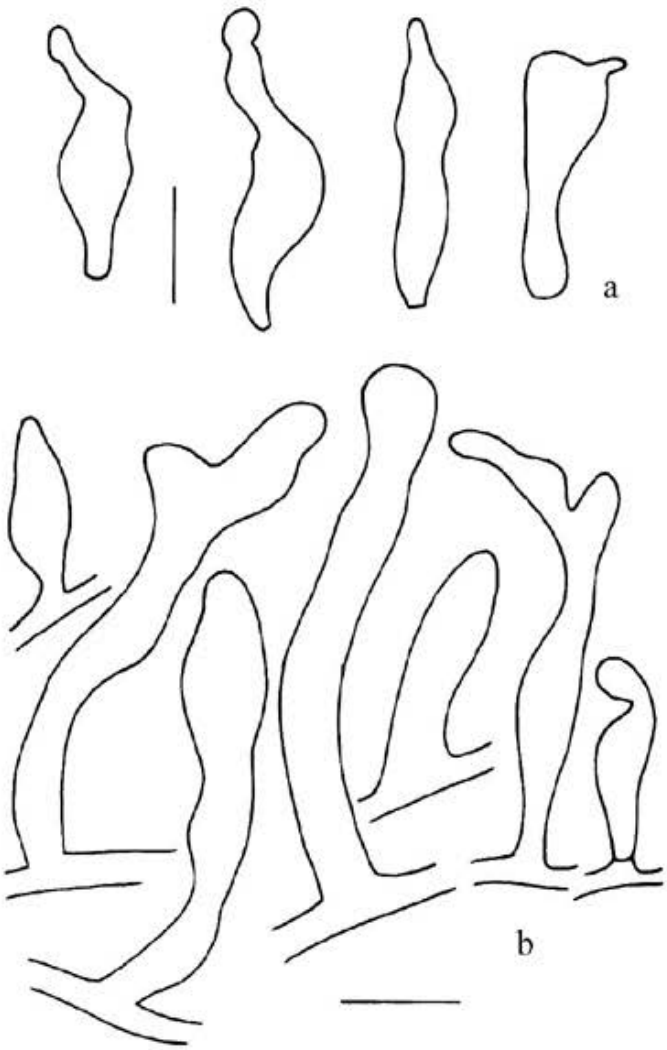

FIGURE 3. *Lentinula raphanica*. a. Cheilocystidia. b. Caulocystidia. (INPA230869, SP394010). Bar = 10 µm.

Except for the lighter pileus colour, the Amazonas specimens fit very well macroscopically with the description by Mata et al. (2001). *Lentinula raphanica* greatly resembles *L. boryana*, differing mainly in the cheilocystidia shape and basidiospore dimensions (Mata et al. 2001). According to Mata et al. (2001), in *L. raphanica* basidiospores "have a narrower shape, more subcylindrical than oblong", measuring 4.8–7.2 × 2.0–3.6 µm, Q = 1.50–3.00, Q_x = 2.16,

while in *L. boryana* they measure 4.8–8.0 × 2.4–4.0 µm, Q = 1.30–2.67, Q_x = 1.91. Unfortunately, the three Amazonas collections examined were sterile, lacking basidia on the lamellae, and the cheilocystidia were very difficult to see. Nevertheless, it was possible to confirm the species identity by matching the caulocystidia shape to those depicted by Mata et al. (2001). In *L. boryana*, the caulocystidia are cylindrical to clavate, while in *L. raphanica*, they are cylindrical, clavate, or flexuous, with an obtuse apex, and knobbed or with outgrowths. This difference in shape seems to be a constant and reliable diagnostic character. A more complete description of this species can be found in Mata et al. (2001) and Mata & Petersen (2001).

FIGURE 4. Geographic distribution of the American species of *Lentinula*.

The geographic distribution of the American species of *Lentinula* is shown in FIG. 4. After Mata & Petersen (2000) and Mata et al. (2001), *L. raphanica* was known from Brazil (probably from São Paulo State), Costa Rica, Puerto Rico, Trinidad, United States of America, and Venezuela; *L. boryana* was known from Brazil, Costa Rica, Cuba, Guadeloupe, Guyana, Mexico and Panama; *L. aciculospora* was known from Costa Rica; and *L. guarapiensis* was known from Paraguay. Subsequently, Vasco-Palacios et al. (2005) have reported *L. raphanica* from Colombia and Piepenbring (2008) has recorded *L. aciculospora* in Panama. Except for *L. guarapiensis*, which should be re-collected at or near its type locality to establish its biological and phylogenetic identity, the remaining species are well defined and probably occur throughout Central and South America. Further explorations will add *Lentinula* collections and may improve understanding of its distribution and diversity in the Americas.

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Pseudocercospora heliconiae sp. nov. causing leaf blight on parakeet flower, *Heliconia psittacorum* (*Heliconiaceae*), in Brazil

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Abstract — The leaf spotting hyphomycete *Pseudocercospora heliconiae* sp. nov., collected on *Heliconia psittacorum* in a commercial nursery in Viçosa, Minas Gerais State, Brazil, is described, illustrated, discussed and compared with allied species.

Key words — cercosporoid, ornamental plant, phytopathology, plant disease, taxonomy, tropical fungi

Introduction

In May 2008, a severe leaf spot disease was observed on *Heliconia psittacorum* L. f. (parakeet flower) in Minas Gerais State, Brazil. A fungus belonging to the genus *Pseudocercospora* Speg., was consistently found associated with the symptoms observed. This important ornamental species is known as an alternative host for *Pseudocercospora fijiensis* (M. Morelet) Deighton (the agent of the black leaf streak of banana) in Brazil, the sole alternative host not belonging to the genus *Musa* L. Morphological studies and pathogenicity tests were conducted to elucidate the disease aetiology. The fungus was proved to be distinct of *P. fijiensis* and other related *Pseudocercospora* spp. on *Musaceae* and proposed as a new species within the genus *Pseudocercospora*. This new species is described, illustrated, and discussed in this paper.

Material and methods

Samples of *H. psittacorum* infected with *P. heliconiae* were collected, photographed (SONY DSC-H9 digital camera), dried in a plant press and deposited at the herbaria VIC and HAL. Under a stereomicroscope, selected structures of the fungus were removed from fresh leaf spots and mounted in glass slides with lactophenol. Observations, measurements and illustrations were carried out by

means of an OLYMPUS BX 50 light microscope fitted with a digital camera (EVOLT E330) and a drawing tube. Wherever possible, 30 measurements were made of the structures mounted. To perform the pathogenicity tests, the fungus was isolated onto PDA, brought into pure culture and grown at 27°C for 20 days. Cultures disks were taken from the border of the colonies and used to inoculate four healthy young and mature leaves of *H. psittacorum* and banana plants (cv. Prata Anã). The inoculated plants were maintained in moist chambers for two days and then transferred to a greenhouse at 25°C. Leaves of both species, on which only PDA plugs were placed, served as control.

Taxonomic description

Pseudocercospora heliconiae Meiriele Silva & O.L. Pereira, **sp. nov.** FIGS 1–6

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Maculae amphigenae, irregulares, necroticae, brunneae, confluentes. Stromata nulla vel minuta. Caespituli saepe hypophylli, atro-brunnei. Conidiophora laxe vel dense fasciculata, pauca vel modice numerosa, per stoma emergentia, recta vel curvata, cylindrica, non ramosa, 22.5–77.5 × 5.0–8.75 µm, medio-brunnea, laevia, 0–2 septata. Cellulae conidiogenae integratae, terminales, laeviae, cicatrices conidiales inconspicuae. Conidia, solitaria, pallide brunnea, cylindrica, recta ad leviter curvata, 52.5–120.5 × 4.5–6.0 µm, apice obtuso, basi truncata, hila non incrassata, non fuscata, 0–5-septata, laevia.

HOLOTYPE: BRAZIL, Minas Gerais, Viçosa, on leaves of *Heliconia psittacorum* L. f. (*Heliconiaceae*), 12 May 2008, O. L. Pereira (VIC 31221). **Isotype:** HAL 2356 F.

ETYMOLOGY: referring to the host genus *Heliconia*.

Leaf spots amphigenous, irregular, necrotic, brownish, confluent, covering large areas of the leaf surfaces. Stromata absent or small. Caespituli mainly hypophyllous, dark brown. Conidiophores in loose to dense, small to moderately large fascicles, straight to curved, cylindrical, unbranched, 22.5–77.5 × 5.5–8.75 µm, 0–2 septate, medium brown, smooth. Conidiogenous cells integrated, terminal, smooth, scars inconspicuous. Conidia solitary cylindrical, straight to slightly curved, 52.5–120.5 × 4.5–6.0 µm, 0–5-septate, pale brown, smooth, apex obtuse, base truncate, hilum neither thickened nor darkened.

COMMENTS — Necrotic symptoms, similar to those originally observed in the field, were detected 10 days after inoculation only on mature leaves of *H. psittacorum*. Inoculated leaves of cv. Prata Anã and uninoculated control leaves, on which only PDA plugs were placed, remained healthy. The fungus was then reisolated, satisfying Koch's Postulates.

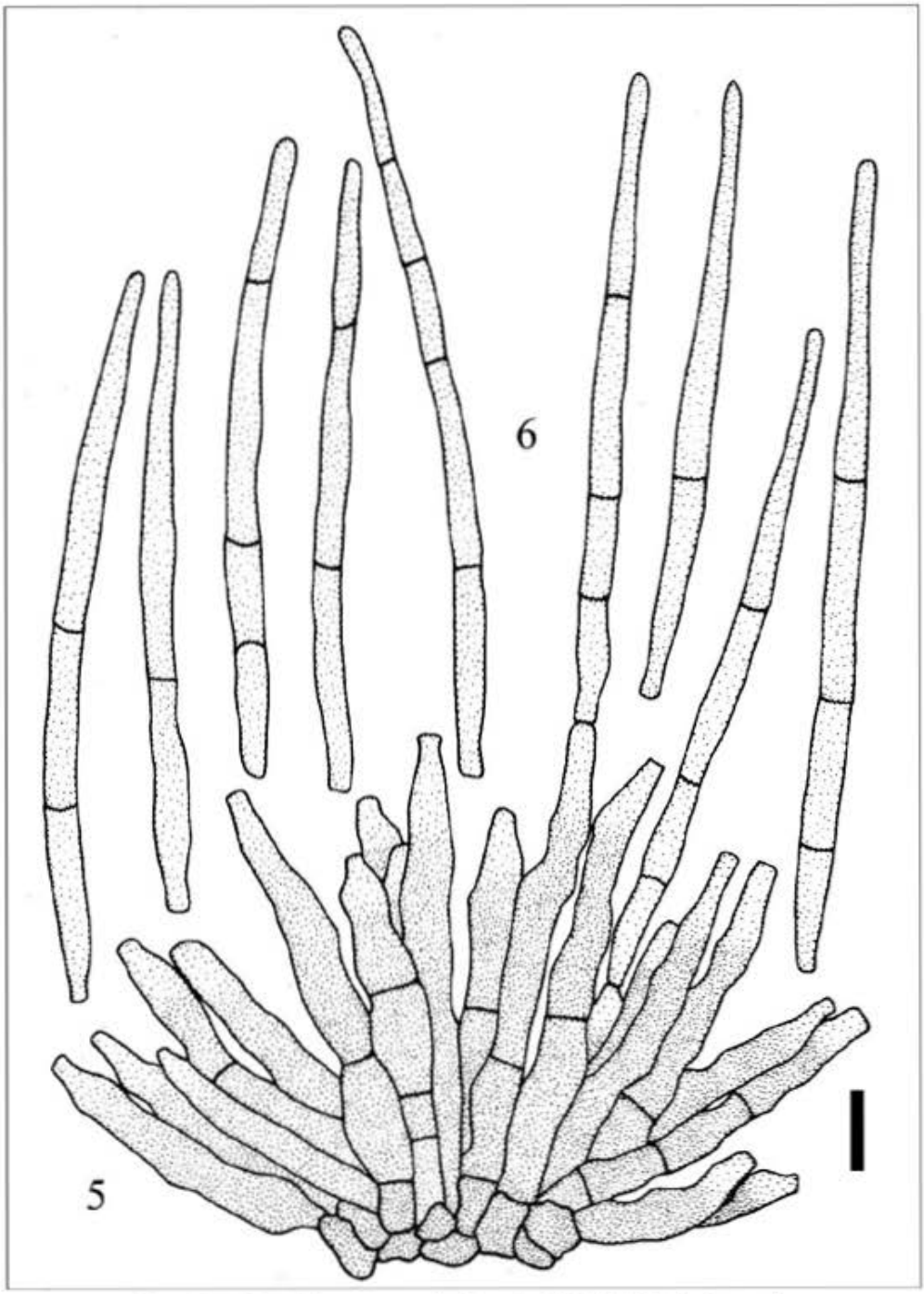
Only two cercosporoid fungi are known to occur on members of the genus *Heliconia* L., viz. *Cercospora heliconiae* Chowdhry et al. reported on *Heliconia caribaea* Lam. in India (Crous & Braun 2003) and *Pseudocercospora fijiensis* reported on *H. psittacorum* in Brazil (Gasparotto et al. 2005). *Cercospora heliconiae* is considered to be a true *Cercospora* s. str., close or identical to

FIGS 1–2. *Pseudocercospora heliconiae*. 1. Leaf blight on *Heliconia psittacorum* from a commercial nursery for cut flower in Viçosa, Minas Gerais, Brazil. 2. Detail of coalescent lesions on leaves.

Cercospora apii Fresen. s. lat. (Crous & Braun 2003). *Pseudocercospora fijiensis*, the causal agent of the black leaf streak of banana, is the sole *Pseudocercospora* reported on the genus *Heliconia*. However, *P. fijiensis* has very diagnostic scars and hila (*Paracercospora*-like, thickened and darkened ultimate rim) (Mulder & Holliday 1974), which were not observed in the samples of *H. psittacorum* from Minas Gerais. Additionally, despite the conidia of *Pseudocercospora heliconiae* resemble those of *P. fijiensis* in color, they are wider and longer.

As *Heliconiaceae* was previously regarded a subfamily within *Musaceae* we compared *P. heliconiae* with nine additional *Pseudocercospora* spp. that have been recorded on *Musaceae*. *Pseudocercospora assamensis* Arzanlou & Crous, *P. indonesiana* Arzanlou & Crous, *P. musae-sapientum* (A.K. Kar & M. Mandal) U. Braun & Mouch., *P. fengshanensis* (T.Y. Lin & J.M. Yen) J.M. Yen & S.K. Sun, *P. musicola* U. Braun, *P. vanieriae* (Chupp & Linder) U. Braun & Crous, *P. musae* (Zimm.) Deighton and *P. eumusae* Crous & Mour., can be distinguished of *P. heliconiae* by having shorter conidia (Chupp 1954, Hsieh & Goh 1990,

FIGS 3–4. *Pseudocercospora heliconiae*. 3. Leaf blight on a severely infected plant leading to leaf death. 4. Detail of blight symptom covering the role leaf surface.



Figs 5–6. *Pseudocercospora heliconiae* (VIC 31221, holotype).
5. Fasciculate conidiophores with inconspicuous conidiogenous cells.
6. Cylindrical conidia with truncate inconspicuous hila.
Scale bar: 10 µm.

Braun et al. 1999, Crous & Mourichon 2002, Arzanlou et al. 2008), while *P. longispora* Arzanlou & Crous has narrower conidia (Arzanlou et al. 2008). Hence, the introduction of a new species is undoubtedly justified.

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First record of *Tulostoma gracilipes* (*Agaricales, Agaricaceae*) for the Americas

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Abstract — *Tulostoma gracilipes* is reported for the first time in the Americas. Since this species was only known in the type locality of South Africa, this record from Mexico represents the second worldwide. Observations of macro- and microscopic characters for the holotype and Sonoran collection are presented. SEM photomicrographs illustrating spore ornamentation are included.

Key words — *Agaricomycetes*, gasteromycetes, chorology, taxonomy

Introduction

Wright (1987) included 138 taxa in the world monograph of *Tulostoma*. Some species such as *T. gracilipes* and *T. portoricense* J.E. Wright were only known in the type locality given in the monograph. *Tulostoma portoricense* was reported for the second time worldwide (Esqueda et al. 1998), from the mycobiota of Sonora, Mexico. Here we report the first record of *T. gracilipes* from North America, also from Sonora; previously, it was known only from Africa.

Twenty-seven taxa of *Tulostoma* have been registered in Sonora, Mexico (Esqueda et al. 2010). Some of them are broadly distributed: *T. fimbriatum* Fr., *T. squamosum* (J.F. Gmel.) Pers., and *T. pulchellum* Sacc. (Esqueda et al. 2004). Other species have a restricted distribution: *T. floridanum* Lloyd, *T. submembranaceum* G. Moreno et al., and *T. mohavei* Lloyd. This last species was found in the Pinacate and Great Altar Desert Biosphere Reserve (Esqueda et al. 2006).

Tulostoma gracilipes was collected in a protected natural area of Sonora: the Sierra de Mazatán, which is located in central region of Sonora and belongs to the Sonoran Desert Province (28°58'–29°30'N, 109°59'–110°33'W; INEGI 2009). According to the Commission for the Knowledge and Use of Biodiversity in Mexico (CONABIO), this area is an "island" of temperate biodiversity surrounded by the arid landscape of the Sonoran Desert (Arriaga 2000). The predominant vegetation type is subtropical scrub, with oak forest in the highest areas, and semiarid plains with mesquite scrub. This is the first report of a fungus for the Sierra de Mazatán.

Materials and methods

The specimen has been deposited in the macromycetes collection of the Centro de Estudios Superiores del Estado de Sonora (CESUES). Observations of microscopic characters (e.g., spore dimension, including ornamentation) were made using a light microscope to observe material mounted in Hoyer's medium. For ultrastructural studies (e.g., spore ornamentation characteristics), the sample was prepared according to the critical-point-drying method outlined in Moreno et al. (1995) and examined with a Zeiss DSM-950 scanning electron microscope.

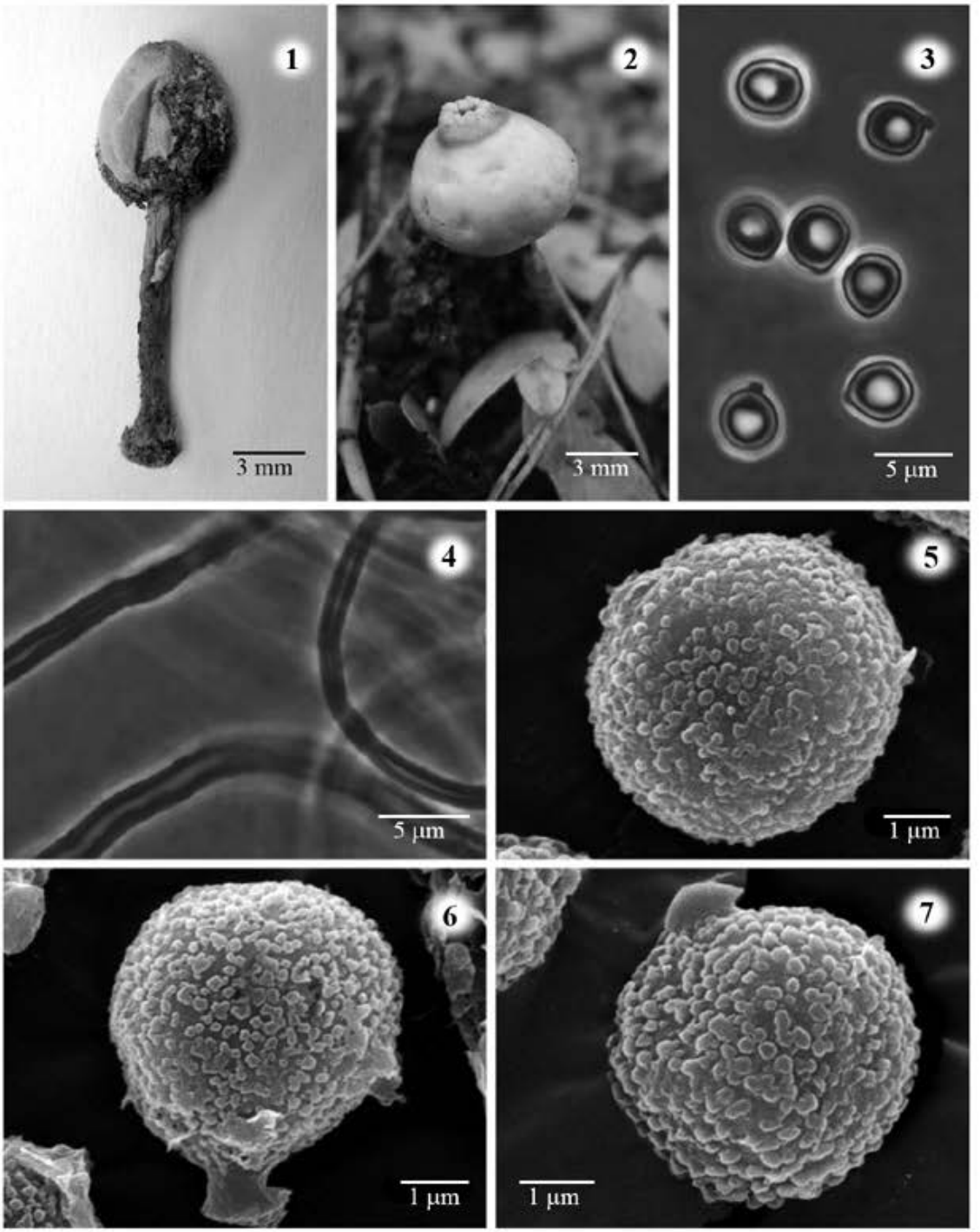
Taxonomy

Tulostoma gracilipes J.E. Wright, Biblthca Mycol. 113: 125 (1987)

SPECIMENS EXAMINED — **MÉXICO. SONORA: Municipality of Ures**, leg. C. Piña & A. Gutierrez, 18.XII.2008, CESUES 9100. **SOUTH AFRICA. NORTHERN CAPE: Lokenburg**, leg. J.P.H. Acocks 18.934, 18.VIII.1956, PREM 41.614, **Holotype.**

Spore sac 8 × 7 mm. Exoperidium membranous, cream coloured within and dirty cream outside covered by soil grains, persistent mainly at spore sac base (FIG. 1). Endoperidium glabrous, little velvet surface under stereoscopic microscope, white isabelline. Stoma fibrillose-fimbriate, opening less than 1 mm diam., scarcely projecting lip ca. 0.5 mm wide, with a denticulate aspect, surrounded by an easily seen brownish spore deposit simulating a coloured peristome (FIG. 2). Socket shallow, membranous with irregular margins, close to stem. Gleba ochraceous. Stem gracile, yellowish to light brown, longitudinally substriate, 14 × 2 mm, ending basally in a mycelial bulb (FIG. 1).

Spores 3.6–4.9 × 3.1–4.6 µm, yellowish, smooth under LM (Fig. 3), globose, subglobose to ellipsoid, guttulate, thick-walled, hilar appendage 0.5 × 1 µm. Capillitium (Fig. 4) of 1.7–3.8 µm diam., 0.5–1.5 µm thick wall, lumen visible to solid, flexuose, scantily septate and branched, wall conspicuously encrusted with inorganic matter particles. Under SEM spores are verrucose, with small and densely crowded verrucae (FIGS. 5–7) that are occasionally joined.



FIGS. 1–7. *Tulostoma gracilipes* (CESUES 9100):
1. Basidiome. 2. Spore sac detail. 3. Spores under LM. 4. Capillitium under LM.
5–7. Spores under SEM.

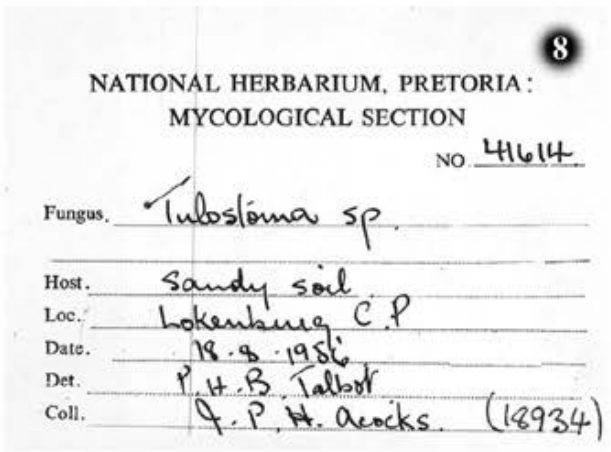
HABITAT — Sandy soils, mesquite vegetation, under *Phaulothamnus spinescens* A. Gray (*Achatocarpaceae*) among litter, during autumn.

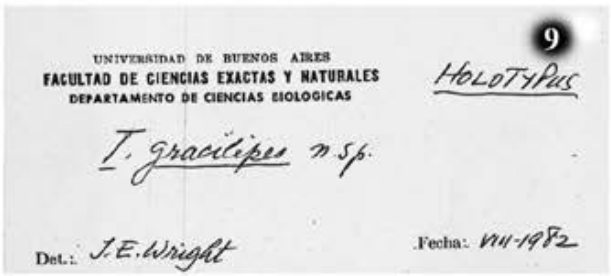
OBSERVATIONS — The Sonoran material was compared with the type collection of *T. gracilipes* kept in Pretoria (PREM) (FIGS. 8–9), which allowed us to confirm our determination. The two basidiomes examined in that type (FIG. 10) had very fragmented stems, but their bases are in good condition. According to the remains, the stems were slender, ca. 1 mm diam., but it was impossible to determine length. In his original description, Wright (1987) describes the stems as up to 25 mm long, which fits well with the illustration included in the monograph (pl. XLIV: 5). He also described the stems as "gracile", a feature reflected in the name of the species. A notable bulbiform thickening (5.5 mm) is also observed at the base of one stem in the type. Stipe bases of both basidiomes are covered by fragile mycelial remains that agglomerate sand grains.

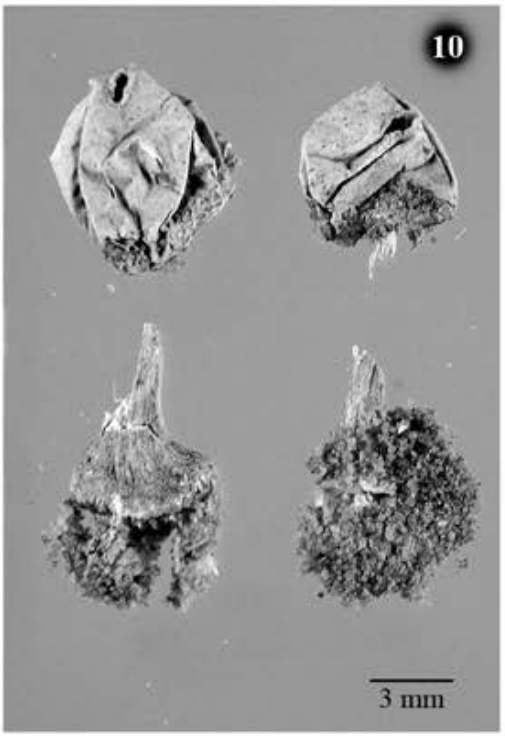
The spore sacs are small (6–7 mm diam.) and well preserved. The endoperidial surface is slightly velvety. Other remarkable features in the type collection are those of the stoma and exoperidium. The stoma is fibrillose-fimbriate, slightly projecting as a denticulate lip, concolorous. The exoperidium persisting on the base of spore sacs is typically membranous, and externally covered by a hyphal layer mixed with sand grains. Spores 4–5.5 µm diam., globose to irregular, yellowish, subsmooth to slightly asperulate under LM. Under SEM spore ornamentation consists of numerous low verrucae, sometimes slightly flattened (FIGS. 11–14). Capillitium 4–13 µm diam., uncoloured, thick walled up to 2–3 µm, leaving an irregular lumen, and with scarce uncoloured septa due to their disarticulation.

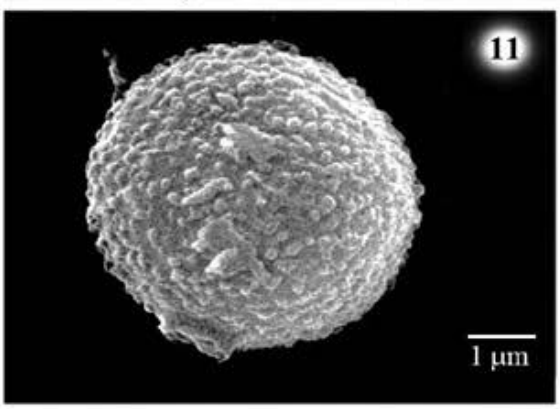
Tulostoma parvissimum Long & S. Ahmad is closely related but shows an almost indefinite fibrillose stoma and asperulate spores (LM) with larger verrucae. The similar *T. berteroanum* (Lév.) Sacc. has a mouth that is mammose-scutellate to fibrillose when mature and basidiospores with conspicuously larger verrucae under SEM. With small basidiomes and almost identical spores even under the SEM, *T. herteri* Lohwag & Swoboda is a very similar species, which, however, differs notably from *T. gracilipes* in its mammose stoma and hyphal exoperidium (Dios et al. 2004). We could also consider the similarity of the spores of *T. pulchellum* (which also has a membranous exoperidium), but its verrucae are usually more flattened and sometimes united in short crests. Besides, *T. pulchellum* shows mammose-scutellate stoma and more robust basidiomes.

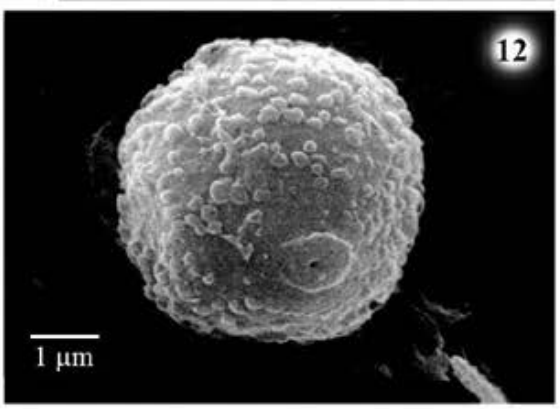
In conclusion, *T. gracilipes* is easily recognized by the combination of the following characters: fibrillose-fimbriate to denticulate stoma, membranous exoperidium, spores that are subsmooth under LM and verrucose under SEM, and a basidiome that is minute. This second world record of *T. gracilipes* allows us to extend significantly the distribution area of the species.

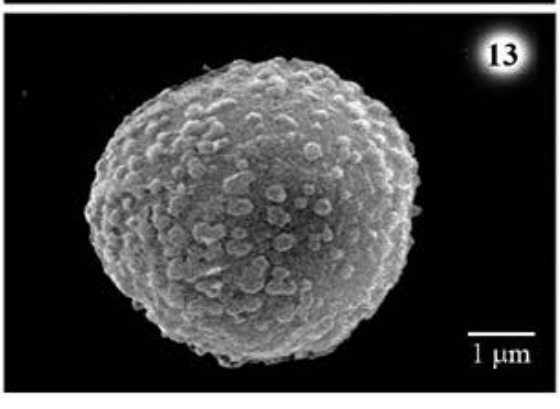


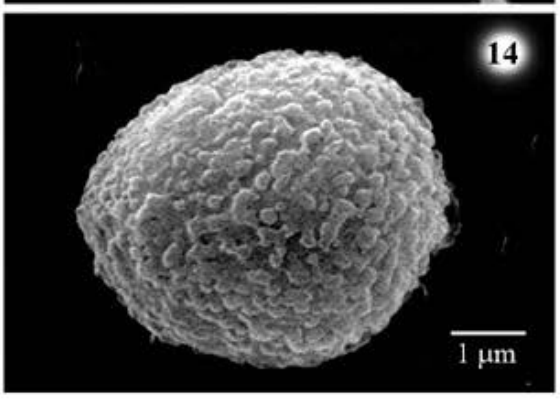












FIGS. 8–14. Holotype of *Tulostoma gracilipes*:
8–9. Labels. 10. Basidiome. 11–14. Spores under SEM.

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Chondrogaster pachysporus in a *Eucalyptus* plantation of southern Brazil

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Abstract — *Chondrogaster pachysporus* is reported for the first time in Brazil. It is similar to *C. angustisporus*, also known from southern Brazil, but differs in the size and ornamentation of the basidiospores and in the presence of monosporic basidia. The hypogeous sequestrate specimens were collected in a *Eucalyptus saligna* plantation. Descriptions, photographs, and line drawings of the specimens are presented.

Key words — ectomycorrhiza, false-truffle, *Hysterangiales*, *Mesophelliaceae*

Introduction

Chondrogaster Maire is a genus of sequestrate fungi characterized by enclosed hypogeous basidiomata that bear a loculate gleba composed of tramal plates where basidia and basidiospores are produced (Castellano et al. 1989). The genus is closely related to *Hysterangium* Vittad., from which it was segregated and differs in the lack of a distinct columella and presence of a mycelial mass covering the whole basidioma (Giachini et al. 2000). Both currently known species are associated with *Eucalyptus* and possibly native to Australia but have spread to many areas where *Eucalyptus* plantations have been established for forestry purposes.

Chondrogaster angustisporus Giachini et al., originally described from Australia, Uruguay, and southern Brazil (Giachini et al. 2000), is possibly the only South American record of the genus. *Chondrogaster pachysporus*, the type

species, is so far known from the Mediterranean zone (Europe and Africa), North America, and Australia (Lago & Castro 2004). Recent studies on the biology and taxonomy of sequestrate fungi in Brazil and neighboring countries are scarce and limited to a few local revisions from Brazil (Giachini et al. 2000, Cortez et al. 2008) and Argentina (Nouhra et al. 2005, 2008). In this paper, we report the occurrence of *C. pachysporus* in southern Brazil.

Materials and methods

Fieldwork was conducted in a *Eucalyptus saligna* Sm. plantation at the Experimental Forestry Station (FEPAGRO), in the municipality of Santa Maria, central region of Rio Grande do Sul State, southern Brazil (29°45' S, 53°43'W). The site comprises 280 ha for cultivation of native trees as *Apuleia leiocarpa* (*Caesalpiniaceae*), *Senna multijuga* (*Caesalpiniaceae*), and *Tabebuia* spp. (*Bignoniaceaae*), and exotics as *Hovenia dulcis* (*Rhamnaceae*), *Platanus×acerifolia* (*Platanaceae*), *Pinus* (*Pinaceae*), and *Eucalyptus* spp. (*Myrtaceae*). Soil is of the Hapludult type, which is deep, imperfectly drained and with low natural fertility (Abrão et al. 1988, Streck et al. 2008). Climate is subtropical humid (Cfa) according to Köppen's system, with mean temperature values for the warmest month higher than 22°C (Menegat 1998). Annual rainfall is about 1769 mm, with rains well distributed throughout the year (Schumacher et al. 2008).

Fresh basidiomata were collected and photographed in situ, then analyzed macro- and microscopically following Brundrett et al. (1996) and Castellano et al. (2004). Color names and codes follow Kornerup & Wanscher (1978). Microscopic analysis of the basidiomata comprised 30 measurements of each microstructure (basidiospores, basidia, and hyphae), which were drawn under a light camera. Specimens are deposited in the herbaria of Department of Biology, "Universidade Federal de Santa Maria" (SMDB) and the Institute of Biosciences, "Universidade Federal do Rio Grande do Sul" (ICN).

Taxonomy

Chondrogaster pachysporus Maire, Bull. Soc. Mycol. Fr. 40: 312, 1925. FIG. 1–8

BASIDIOMATA hypogeous, 8–23 mm in width, 7–11 mm high, depressed globose to subglobose, aggregated in clusters within a common mycelium. PERIDIUM <1 mm thick, greyish beige (4C2) when fresh, dull red (9C4) when bruised, glabrous or covered by scattered to numerous rhizomorphs. GLEBA composed by non-gelatinized, radially arranged locules, greyish green (28C3) to dull green (29D3) at younger stages, to finally olive (1F5) or blackish at maturity. RHIZOMORPHS white, numerous, arising from several points of attachment in the basidiomata surface. COLUMELLA absent.

BASIDIOSPORES 12.5–16.5 × 6–9 µm (ornamentation excluded), subfusoid, ellipsoid to broad ellipsoid, apex and base tapered, some with a shortly mucronate apex; sterigmal attachment persistent at maturity; in KOH, they are hyaline when young to finally pale yellowish brown at maturity; wall smooth

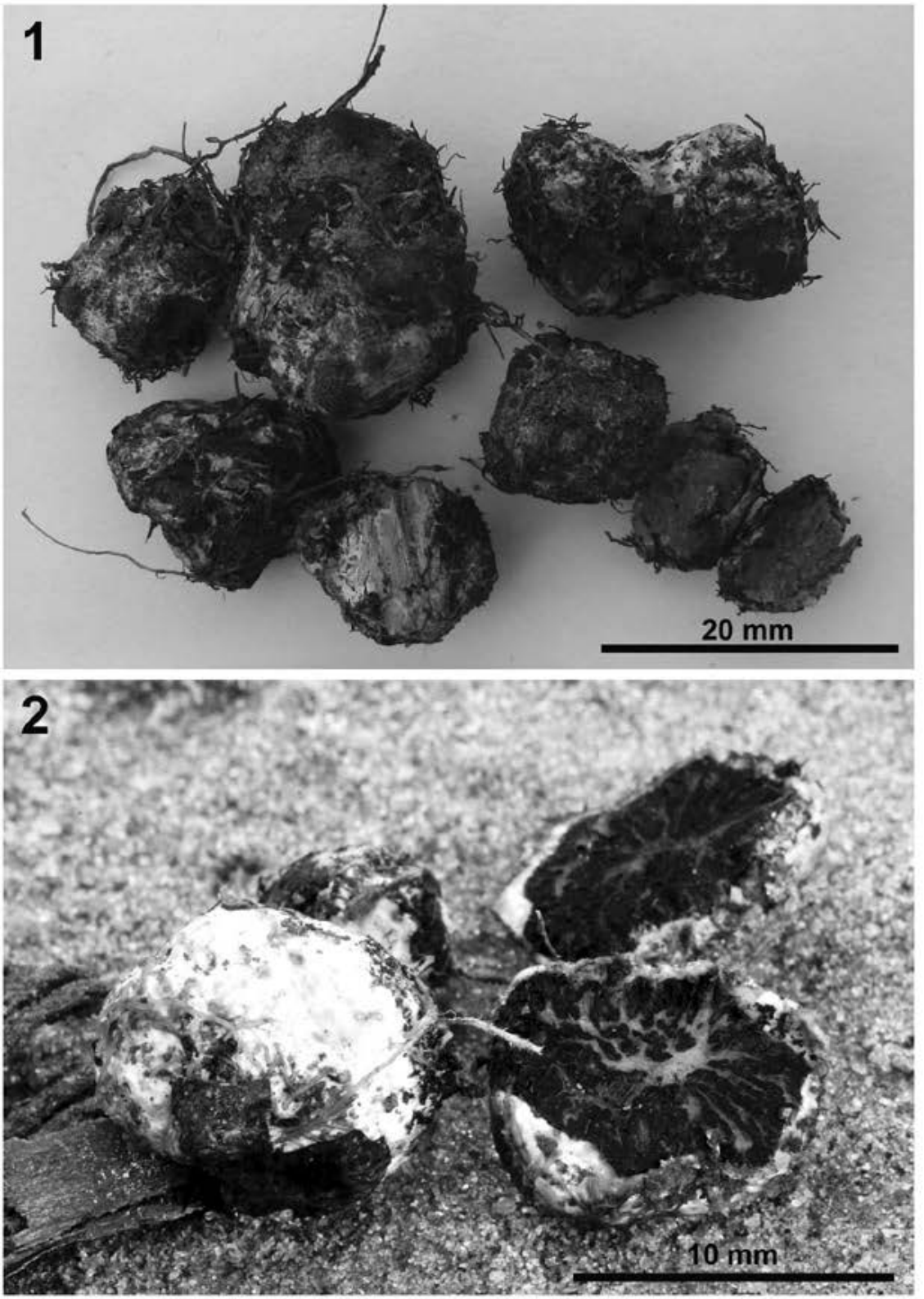

FIG. 1-2. Basidiomata of *Chondrogaster pachysporus*. (1. Sulzbacher-192; 2. Sulzbacher-196)

when young, becoming irregularly reticulate at maturity and of variable diameter (<3 µm).

BASIDIA monosporic, 31–52 × 4–16.5 µm, hyaline, subcylindrical, with constricted base and apex, clamp connections common, collapsed in mature specimens. PERIDIUM separable from the gleba, 2-layered: a) external layer formed by yellowish brown, thick-walled, clamped hyphae (4.2–11 µm diam.) mixed with abundant soil particles; b) internal layer composed by hyaline, smooth and thin-walled hyphae, compactly interwoven, filamentous to subglobose 4–27.5 µm diam. TRAMA 30–100 µm thick, not gelatinized in young basidiomata, becoming gelatinized in mature specimens, constituted of hyaline, smooth, thin-walled, and compactly interwoven hyphae, 3.2–5.5 µm diam., clamp connections rare.

DISTRIBUTION: Australia and United States (Bougher & Lebel 2001), North Africa (Lago & Castro 2004), Spain (Lago & Castro 2004, Moreno-Arroyo et al. 2005), Portugal (Calonge & Vidal 2000), France and Italy (Lago & Castro 2004). Probably widespread with eucalypt trees.

SPECIMEN EXAMINED: **BRAZIL.** Rio Grande do Sul: Santa Maria, Boca do Monte District, Estação Experimental de Silvicultura-FEPAGRO, 21 April 2009, *leg. M.A. Sulzbacher 191* (SMDB 12.920); *ibid.*, 06 May 2009, *leg. M.A. Sulzbacher 192* (SMDB 12.921); *ibid.*, 10 July 2009, *leg. M.A. Sulzbacher 196* (SMDB 12.922; ICN 154459).

COMMENTS — The genus *Chondrogaster* was considered in the past as a member of the *Melanogastraceae* E. Fisch. (Zeller 1949), *Hysterangiaceae* E. Fisch. (Bougher & Lebel 2001), and *Chondrogastraceae* Locq. (Giachini et. al. 2000). However, molecular phylogenetic analysis places the genus is currently placed in the *Mesophelliaceae* Jülich of the *Hysterangiales* K. Hosaka & Castellano (Hosaka et al. 2006).

Chondrogaster pachysporus, originally described by Maire from Mauritania (Africa), constitutes the type species of the genus, which until recently was considered monotypic (Giachini et al. 2000). Although it is associated with widely cultivated *Eucalyptus* spp. in the world, this species has been poorly documented, probably due to its underground cryptic habit, as most mycologists pay little attention to hypogeous fungi.

As far as we know, this is the first record in South America. *Chondrogaster angustisporus*, which has been reported from southern Brazil, Australia, and Uruguay (Giachini et al. 2000), differs from *C. pachysporus* in the narrower basidiospores (10–15 × 4–5 µm) covered by a less coarse ornamentation and the presence of mostly bisporic basidia within the glebal locules (Lago & Castro 2004). In contrast to our specimens, which were collected under *E. saligna*, *C. angustisporus* has been found under *E. dunnii* Maiden in southern Brazil as well as several other *Eucalyptus* species in Australia (Giachini et al. 2000).

Lupatini et al. (2008) characterized southern Brazilian strains of *C. angustisporus* through mycorrhizal morphotyping and ITS (rRNA) sequences. Their

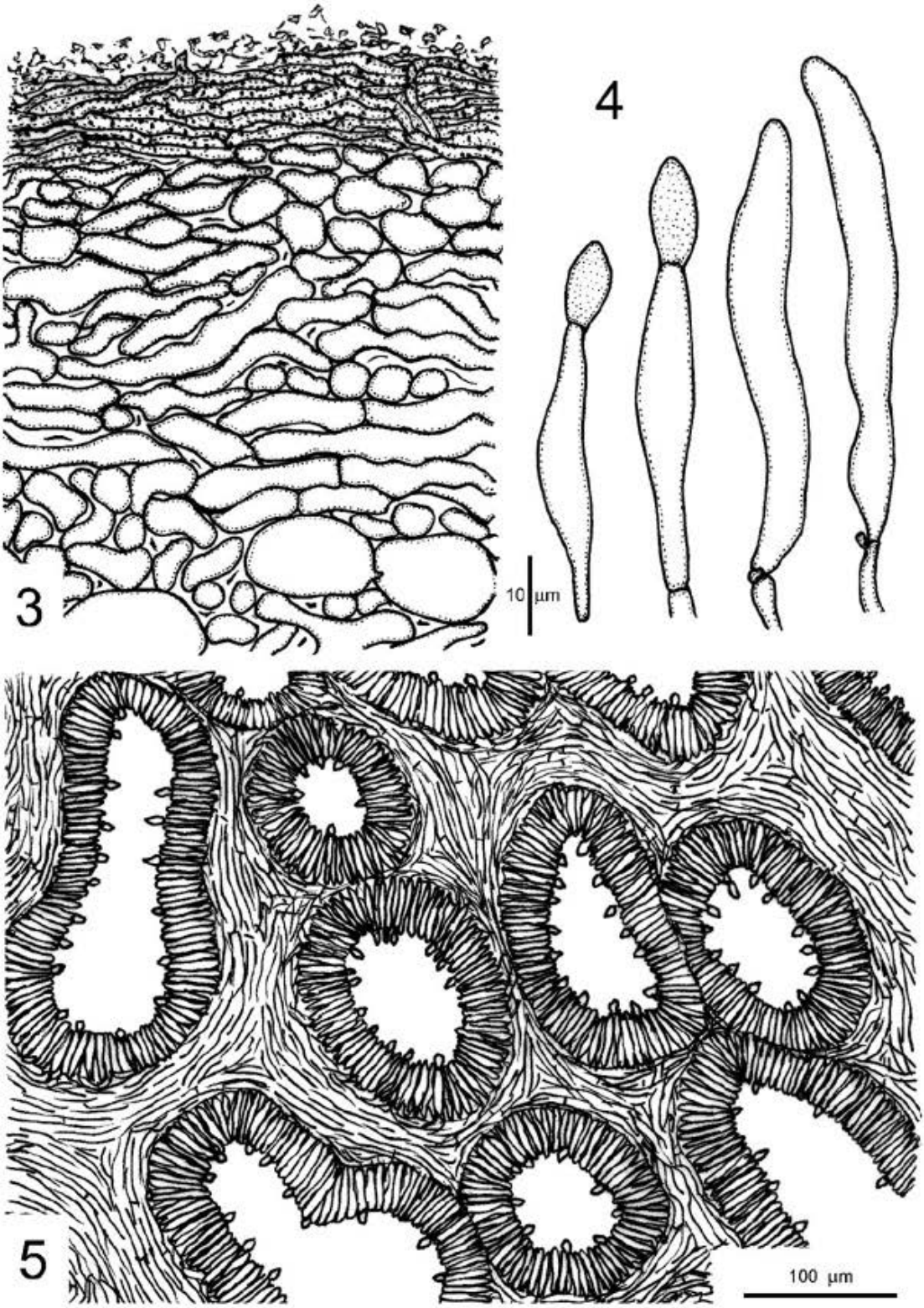

FIG. 3-5. *Chondrogaster pachysporus*. 3. Peridium. 4. Basidia. 5. Gleba structure.

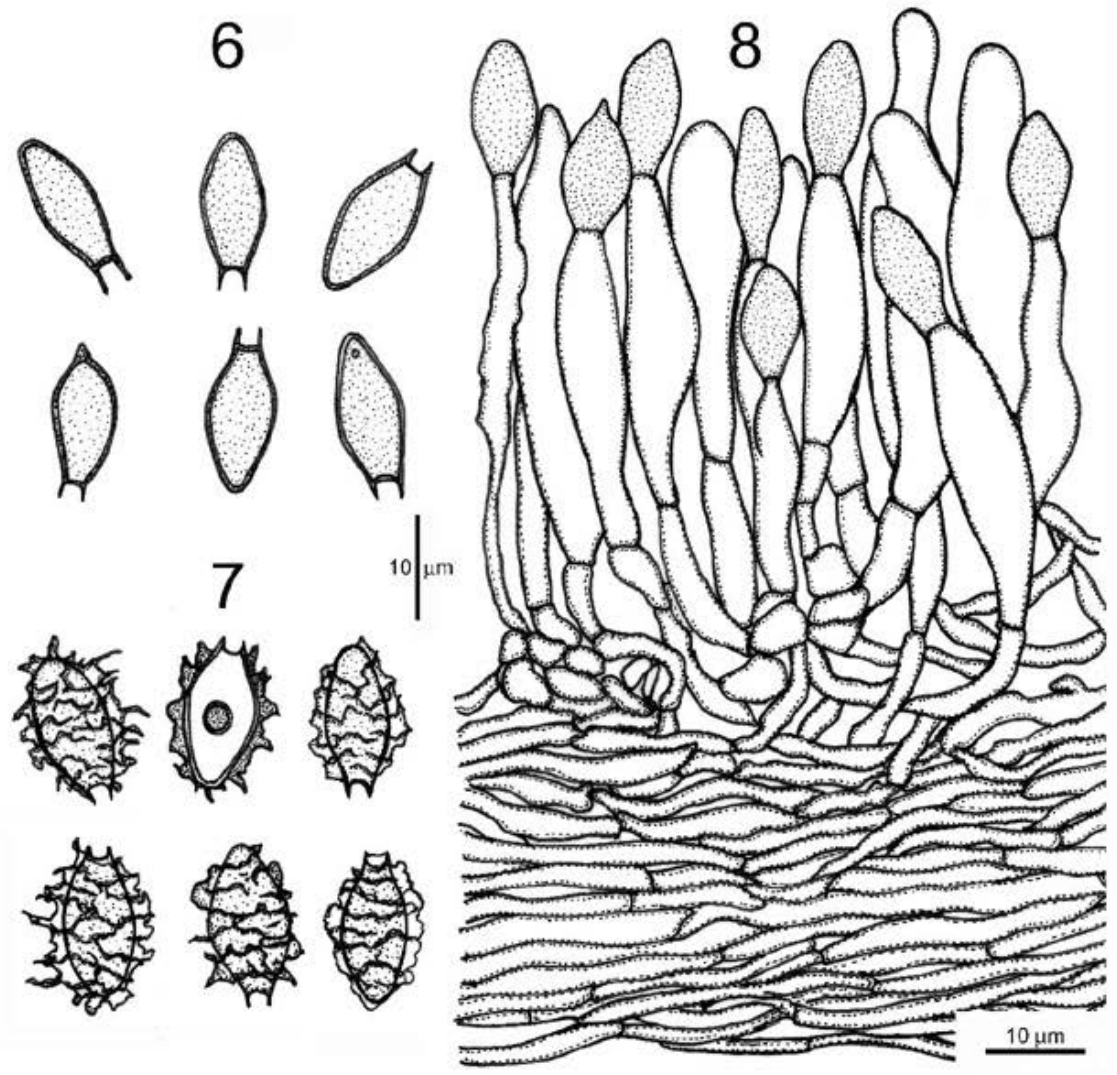

FIG. 6-8. *Chondrogaster pachysporus.*
6. Immature basidiospores. 7. Mature basidiospores. 8 Detail of the hymenium and trama.

results supported strong relationships among other taxa in the gomphoid-phalloid clade (e.g. *Gautieria*, *Gloeocantharellus*, *Gomphus*, *Hysterangium*, *Ramaria*, and *Sphaerobolus*). In two recent molecular phylogeographic studies of *Hysterangiales*, *Andebbia pachythrix* (Cooke & Massee) Trappe et al. clustered with *C. angustisporus* and *C. pachysporus*, suggesting a close relationship between them (Hosaka et al. 2006, 2008).

The present report from southern Brazil considerably extends the known world distribution of *C. pachysporus*. The new record arises from ongoing investigations of hypogeous fungi associated with *Eucalyptus* in the state of Rio Grande do Sul. As this research progresses, we hope to provide additional data on their diversity and biology.

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Neobulgaria alba sp. nov. and its *Phialophora*-like anamorph in native forests and kiwifruit orchards in New Zealand

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Abstract – Surveys of fungi associated with stained vascular tissue in kiwifruit vines in New Zealand have consistently revealed *Phialophora*-like fungi. Phylogenetic analyses based on DNA sequences have shown most of these to be *Leotiomycetes*. The teleomorph of the most common species isolated from stained kiwifruit wood has been found on fallen wood in native forests, and it is described here as *Neobulgaria alba* sp. nov. Other species isolated from kiwifruit wood matched *Cadophora* and *Mollisia* spp. reported from similar symptoms from kiwifruit and other hosts in other countries.

Key words – vascular staining, pathogen, *Actinidia deliciosa*, phylogeny, *Phaeoacremonium*

Introduction

Discoloured and decayed wood is common in the trunks of kiwifruit (*Actinidia deliciosa*) vines more than about 10 years old. The stained wood symptom is similar to that recorded in Italy where a number of fungi including *Phaeoacremonium* spp. and *Phialophora* spp. were isolated from diseased trunks (Di Marco et al. 2000). Surveys in New Zealand of fungi associated with these symptoms revealed several common *Phialophora*-like spp. (e.g. Manning et al. 2003, Manning & Currie 2007). Subsequent DNA sequencing showed them to represent *Leotiomycetes*, several matching described or known *Cadophora* spp. (unpubl. data).

Gams (2000) proposed using the genus *Cadophora* to accommodate some of the leotiomycete-related *Phialophora* spp. and Harrington & McNew (2003) clarified the taxonomy of these species. Based on ITS sequences, New Zealand isolates from kiwifruit wood match *Cadophora luteoolivacea* (e.g. Genbank accession HM116748), *Mollisia dextrinospora* (e.g. Genbank accession HM116746), and an apparently unnamed clade that includes "*Cadophora melinii*" sensu Prodi et al. (2008) but is genetically distinct from the ex holotype isolate of *C. melinii* (e.g. Genbank accession HM116752). This last species has been reported from wood and roots of various trees from Europe as Dark Septate Endophyte ITS Haplotype III in Grünig & Sieber (2005; Genbank accession number AY664502) and as *Phialophora malorum* aggregate in Lygis et al. (2005; Genbank accession number AY787725).

Phialophora-like anamorphs are spread throughout the *Leotiomycetes*. Examples discussed by Gams (1980) included representatives from the families *Helotiaceae*, *Dermateaceae*, *Hyaloscyphaceae*, and *Sclerotiniaceae*. Later authors have linked the *Phialophora*-like genera *Catenulifera* and *Phialocephala* to the leotiomycete genera *Hyphodiscus* (Hosoya 2002, Untereiner et al. 2006) and *Mollisia* (Grünig et al. 2009) respectively.

In this paper we report a *Phialophora*-like leotiomycete anamorph associated with a new *Neobulgaria* sp. The anamorph has been found in cultures grown from ascospores from apothecia collected in native forests and it is also commonly isolated into culture from diseased kiwifruit wood.

Methods

A survey of kiwifruit (*Actinidia deliciosa*) in 38 orchard blocks in South Auckland/Waikato (15), Bay of Plenty (15), Hawkes Bay (2), Nelson/Golden Bay (4), and Kerikeri (2) was carried out between 2002 and 2007. Samples of wood from symptomatic and non-symptomatic trunks were taken using a 4 mm diam core borer and small pieces of wood from these placed on Difco potato dextrose agar plates (PDA) with streptomycin and penicillin G added. The fungi isolated were grouped on the basis of cultural appearance and micro-morphology. Representative isolates were stored as a working collection in 10% glycerol at −80°C and later placed in permanent storage in liquid nitrogen in the ICMP culture collection, Landcare Research, Auckland. DNA sequences were generated from these isolates following the methods below.

Apothecia were collected during a survey of wood rotting fungi in native forests (Paulus et al. 2006). While the collections were still fresh, ascospores were shot from living apothecia onto agar plates; germinating ascospores were transferred to new plates, and following adequate growth, cultures were placed in permanent storage in liquid nitrogen in the ICMP culture collection. Collections were dried and deposited in the New Zealand Fungal Herbarium (PDD). Macroscopic appearance was described from field notes and from dried herbarium material, and microscopic features described following rehydration of herbarium material in 3% KOH with Meltzer's reagent added.

TABLE 1. Collections used to generate DNA sequences for FIG. 2 in addition to those from Wang et al. (2006b), with Genbank accession numbers.

SPECIES*	VOUCHER[a]	SSU, ITS, LSU rDNA	NOTES
**Cadophora luteoolivacea*	ICMP 18096	HM116765, HM116748, HM116760	ICMP 17109, 18084, 18085, 18097, 18098, 18099 from *Vitis vinifera* wood and ICMP 18092 from *Actinidia deliciosa* wood have matching SSU, ITS, and LSU sequences
Hyphodiscus hymeniophilus	MUCL 40275	DQ227258, DQ227258, DQ227258	
Hyphodiscus hymeniophilus	CBS 529.87	—, GU727555, GU727555	
**Mollisia dextrinospora*	ICMP 18083	HM116762, HM116746, HM116757	ICMP 17107, 17108, 17110, 17111, 17112 from *Actinidia deliciosa* wood have matching ITS sequences (other genes not sampled)
**Neobulgaria alba*	ICMP 18072	HM116761, HM116745, HM116756	ICMP 17113, 17114, 17115, 18073, 18074, 18075, 18076, 18077, 18078, 18079, 18080, from *Actinidia deliciosa* wood have matching SSU, ITS, and LSU sequences
**Neobulgaria alba*	ICMP 18394, culture from Holotype	HM116781, HM116783, HM116782	ICMP 18395 from fallen wood in native forest has matching SSU, ITS, and LSU sequences
Neobulgaria pura	CUP 063609	DQ257364, DQ257366, DQ257365	
Phaeomollisia piceae	UAMH 10851	EU434866, EU434836, —	

* Indicates sequences generated as part of this study.

[a] CUP; Cornell Plant Pathology Herbarium, Cornell University, Ithaca, USA. CBS; Centraalbureau voor Schimmelcultures, Utrecht, The Netherlands. ICMP; International Collection of Microorganisms from Plants, Landcare Research, Auckland, New Zealand. MUCL; Industrial Fungi & Yeasts Collection, Belgian Co-ordinated Collections of Micro-organisms, Belgium. UAMH; University of Alberta Microfungus Collection and Herbarium, Alberta, Canada.

Apothecia were sectioned at about 10 µm thickness using a freezing microtome, and sections were mounted in lactic acid.

DNA was extracted from mycelium from cultures grown from both apothecia and stained wood using REDExtract-N-Amp Plant PCR Kits (Sigma, USA), following manufacturer's instructions. ITS sequences were obtained following the methods of Johnston & Park (2005). Amplification primers for ITS were ITS1 and ITS4 (White et al. 1990); for small subunit ribosomal DNA were NS1 and NS6 (White et al. 1990), and

for the large subunit ribosomal DNA were LROR and LR5 (Bunyard et al. 1994, Vilgalys & Hester 1990). The sequences newly generated for this paper (TABLE 1) have been deposited in Genbank.

DNA sequences were aligned using Clustal X (Larkin et al. 2007), then checked and edited manually. A Bayesian tree was estimated in MrBayes 3.1.2 (Huelsenbeck & Ronquist 2001, Ronquist & Huelsenbeck 2003) with gaps treated as missing data, using a partitioned model, where each portion of the rDNA was assigned a model selected using the AIC method in MrModelTest 2.3 (Nylander 2004). The model selected for the 18S and 28S rDNA was GTR+I+Γ and for the 5.8S rDNA was SYM+I+Γ. The data set was run with 2 chains for 10 million generations, trees sampled every 1000 generations with a burn-in of 10%. Bayesian posterior probabilities were obtained from 50% majority rule consensus trees. In addition to the species recorded from New Zealand, taxa for the analysis were selected from Wang et al. (2006b) to represent genetic diversity across the *Helotiales*, plus the *Phialophora*-like species cited in Untereiner et al. (2006) and Grünig et al. (2009).

Neobulgaria alba P.R. Johnst., D.C. Park & M.A. Manning, **sp. nov.** FIG. 1

MYCOBANK MB 518281; GENBANK HM116781, HM116782, HM116783.

Ab Neobulgaria pura *ascsoporis (5–)5.5–6.5 × 3–3.5(–4) µm, apotheciis brunneis differens.*

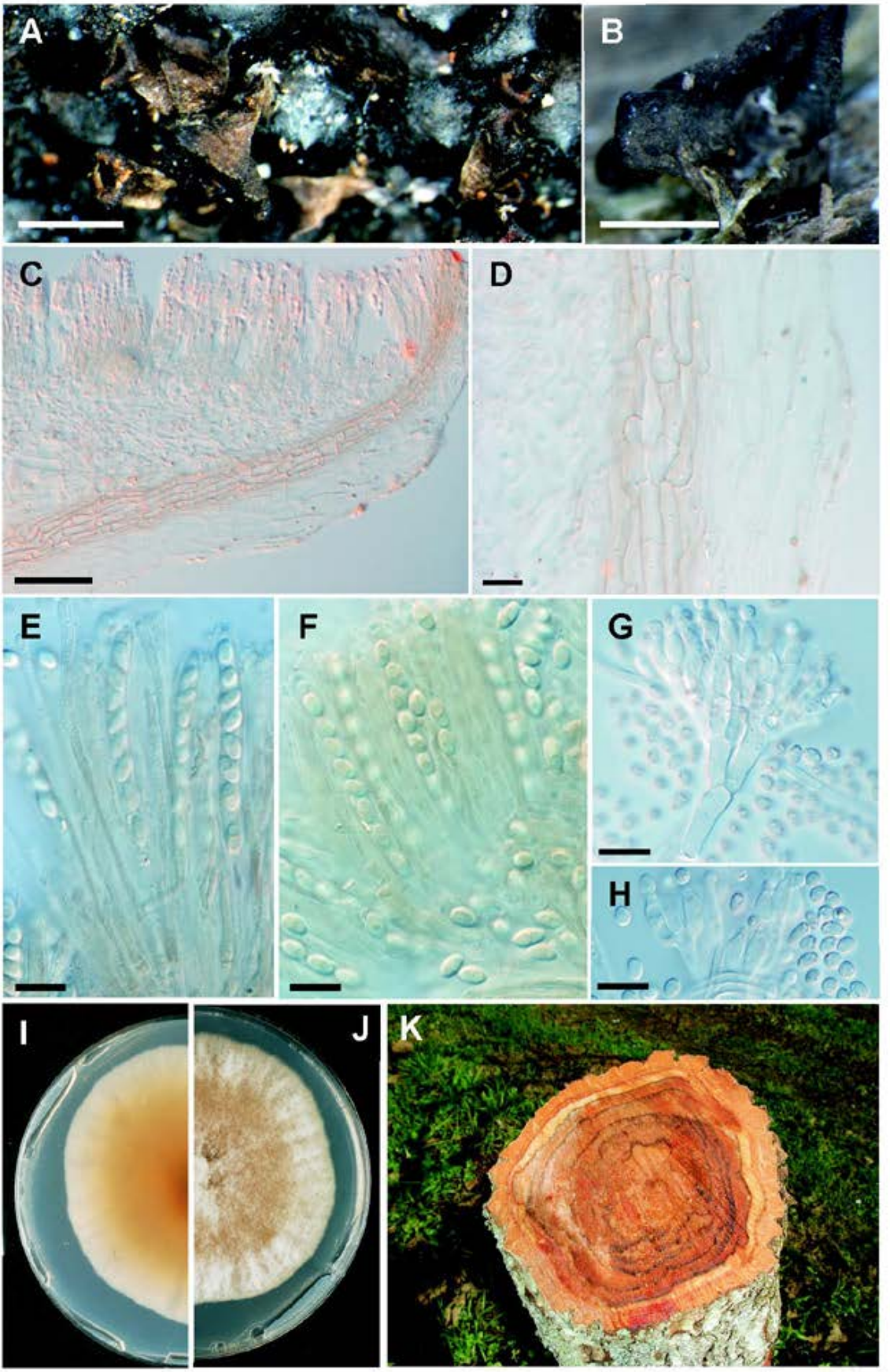
TYPIFICATION: New Zealand, vic. Ruatahuna, Tarapounamu, ridge towards Mangapae on western side of road, on fallen decorticated wood intermixed with *Rosellinia* ascomata, P.R. Johnston (D2022) & B.C. Paulus, 13 Dec 2006, (**Holotype:** PDD 91753; culture grown from holotype, ICMP 18394).

ETYMOLOGY: *alba*, refers to the colour of the colonies on agar isolation plates, paler than most of the other fungi commonly isolated from discoloured vascular tissue.

Apothecia forming on decorticated wood; up to 3 mm diam., substipitate, dull, dark brown, glabrous; when dry receptacle dark brown, hymenium greyish-brown, stipe distinctively flattened. Ectal excipulum with 2 layers; outer layer 35–40 µm thick, comprising hyphae 1.5–2 µm diam. widely spaced in hyaline gel, oriented more or less parallel to receptacle surface; inner layer 30–35 µm thick comprising more or less parallel rows of broad-cylindric cells 5–7 µm diam. with walls thin, pale brown, nongelatinous. Medullary excipulum comprising a textura intricata of hyaline hyphae 2 µm diam. irregularly oriented and tangled within a hyaline gelatinous matrix. Subhymenium textura

FIG. 1. *Neobulgaria alba* (A, C–F, PDD 91753, holotype; B, PDD 91754; G–J, ICMP 19075). A–B. Apothecia (dry). C. Apothecium in vertical section. D. Apothecium in vertical section, detail of inner and outer ectal excipulum layers with hyphae regularly oriented, and medullary excipulum with hyphae irregularly oriented. E. Paraphyses and asci. F. Asci and ascospores. G. Conidiophores and conidiogenous cells from PDA cultures. H. Conidiogenous cells and conidia from PDA cultures. I. Bottom of 20-day-old colony on PDA. J. Top of 20-day-old colony on PDA. K. Stained kiwifruit wood from which *Neobulgaria alba* was isolated.

Scale bars; A–B = 1 mm; C = 50 µm; D–H = 10 µm.


A
B
C
D
E
F
G
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K

intricata, nongelatinous, comprising hyphae with pale brown cell contents. Paraphyses 2–2.5 µm diam., undifferentiated at apex, about same length as asci. Asci 70–110 × 5–6 µm, cylindric, tapering slightly to the subtruncate apex, wall thickened at apex, amyloid plug in the inner half of the wall, more intensely blue to the inside of the wall, 8-spored, uniseriate. Ascospores (5–)5.5–6.5 × 3–3.5(–4) µm, broad-elliptic, symmetrical in both planes, 0-septate, hyaline.

Anamorph in culture. Cultures on Difco PDA 60–70 mm after 20 days, aerial mycelium white, fine, cottony, quite sparse, pale brown agar surface visible through the mycelium. Culture pale yellow-brown in reverse, paler towards the more or less entire margin. Numerous small drops of more or less colourless conidial ooze scattered across surface of colony. Conidiophores penicillate, hyaline, cylindric basal cell 10–15 × 3–5 µm, with 3–4 levels of 2–3 times branching, cylindric cells arising from the basal cell, ending in a terminal conidiogenous cell. Conidiogenous cells 6–8 × 2.5–3.5 µm, more or less cylindric, tapering near apex, with single, apical conidiogenous locus, wall thickened at conidiogenous locus and with flaring collarette. Conidia hyaline, broadly ovate to subglobose, 4.5–5 × 3–3.5 µm.

ADDITIONAL SPECIMENS EXAMINED — New Zealand: Gisborne: vic. Ruatahuna, Te Waiiti, on fallen decorticated wood, P.R. Johnston (D2031) & B.C. Paulus, 4 Dec 2006, (PDD 91754, ICMP 18395). Buller: vic. Reeefton, Maimai Creek, on decorticated wood in running water, P.R. Johnston (D1377), 4 Oct 1998 (PDD 70861). Auckland: Waiuku, on *Actinidia deliciosa* 'Hayward', swollen trunks of living vines, M.A. Manning (MM42), 21 Mar 2002 (ICMP 18072); Waiuku, on *Actinidia deliciosa* 'Hayward', swollen trunks of living vines, M.A. Manning (MM43), 19 Mar 2002 (ICMP 18073); Waiuku, on *Actinidia deliciosa* 'Hayward', swollen trunks of living vines, M.A. Manning (MM44), 15 Mar 2002 (ICMP 18074); South Auckland, on *Actinidia deliciosa* 'Hayward', swollen trunks of living vines, M.A. Manning (MM48), 22 Mar 2002 (ICMP 18077); South Auckland, on *Actinidia deliciosa* 'Hayward', swollen trunks of living vines, M.A. Manning (MM49), 22 Mar 2002 (ICMP 18077); Patamahoe, on *Actinidia deliciosa* 'Hayward', swollen trunks of living vines, M.A. Manning (MM421), 22 Mar 2002 (ICMP 18077). Nelson, on *Actinidia deliciosa* 'Hayward', swollen trunks of living vines, M.A. Manning (MM101), 8 Dec 2004 (ICMP 18080). Waikato, Pukekawa, on *Actinidia deliciosa* 'Hayward', swollen trunks of living vines, M.A. Manning (MM46), 19 Mar 2002 (ICMP 18075); Pukekawa, on *Actinidia deliciosa* 'Hayward', swollen trunks of living vines, M.A. Manning (MM47), 19 Mar 2002 (ICMP 18076). Bay of Plenty: Te Puke, on *Actinidia deliciosa* 'Hayward' trunk decay, M.A. Manning (MM468), 13 Jul 2006 (ICMP 17114); Tauranga, on *Actinidia deliciosa* 'Hayward' trunk decay, M.A. Manning (MM493), 23 Mar 2007 (ICMP 17115); Te Puke, on *Actinidia deliciosa* 'Hayward' trunk decay, M.A. Manning (MM494), 20 Mar 2007 (ICMP 17113).

NOTES —Eleven species have been described in *Neobulgaria* (Index Fungorum 2010) — *N. caliciformis* Killerm., *N. faginea* (Peck) Raitv., *N. foliacea* (Bres.) Dennis, *N. lilacina* (Wulfen) Dennis, *N. margaritoidea* Killerm., *N. orientalis* Raitv. & Bogacheva, *N. parvata* V.P. Tewari & Ram N. Singh, *N. premnophila* Roll-Hansen & H. Roll-Hansen, *N. pura* (Pers.) Petr., *N. rupicola* V.P. Tewari

& Ram N. Singh, and *N. undata* (W.G. Sm.) Spooner & Y.J. Yao. The decision to describe *N. alba* as new is based in part on its genetic distinctness from collections putatively representing three north-temperate species, *N. pura* (DQ257364), *N. foliacea* (NPU45443), and *N. premnophila* (NPU45445), and in part on its geographic range. The 18S rDNA sequences of the three Northern Hemisphere collections differ from each other by 1–2 bases, whereas *N. alba* is 8 base pairs different.

Based on published descriptions, all of the described species differ from *N. alba* variously in ascospore size and septation, apothecial shape and size, and pigmentation in culture (Dennis 1956, 1971, Killerman 1929, Lizoň et al. 1998, Raitviir & Bogacheva 2007, Roll-Hansen & Roll-Hansen 1979, Seaver 1961, Tewari & Singh 1975). From the illustrations of Tewari & Singh (1975), *N. rupicola* appears to have the apothecial anatomy of *Ascocoryne*. From the description provided by Dennis (1954), based in part on material collected in tropical America, *N. alba* is very similar to *Ombrophila microspora* (Ellis & Everh.) Sacc. & P. Syd. However, Dennis (1954) described the asci of *O. microspora* as being barely thickened at the apex and as having an indistinct amyloid reaction. Lizoň et al. (1998) regarded *O. microspora* as a synonym of *N. pura*, a good illustration that species limits within the genus remain confused. Genetic studies on authentically identified specimens are needed to resolve the relationships between species of this genus, and of those that have been placed in *Ombrophila*.

Discussion

Common in living wood of mature kiwifruit vines but found also in native forests, the genetically distinct *Neobulgaria alba* is assumed to be a native New Zealand species that has moved from natural to human habitats. Data from Johnston (2010) show that many putatively native species of fungi have moved into modified habitats and formed associations with exotic host plants. Although represented by only three collections from native forests, this macroscopically insignificant fungus is assumed to be widespread in New Zealand forests. Its occurrence on kiwifruit suggests that it will have a naturally wide host range. Its biology in native forests is likely to be similar to that in kiwifruit orchards — as well as being apparently saprobic on fallen wood it will probably be found also in association with discoloured wood of living trees.

In New Zealand kiwifruit orchards *N. alba* has been found almost exclusively in association with swollen trunks and stained wood, with only one isolate from symptomless wood (Manning et al. 2003). Following inoculation of healthy wood of kiwifruit with *N. alba*, the fungus was subsequently re-isolated 8 months later from stained tissue surrounding the point of inoculation (unpublished data, M.A. Manning). Less commonly isolated from the same symptoms

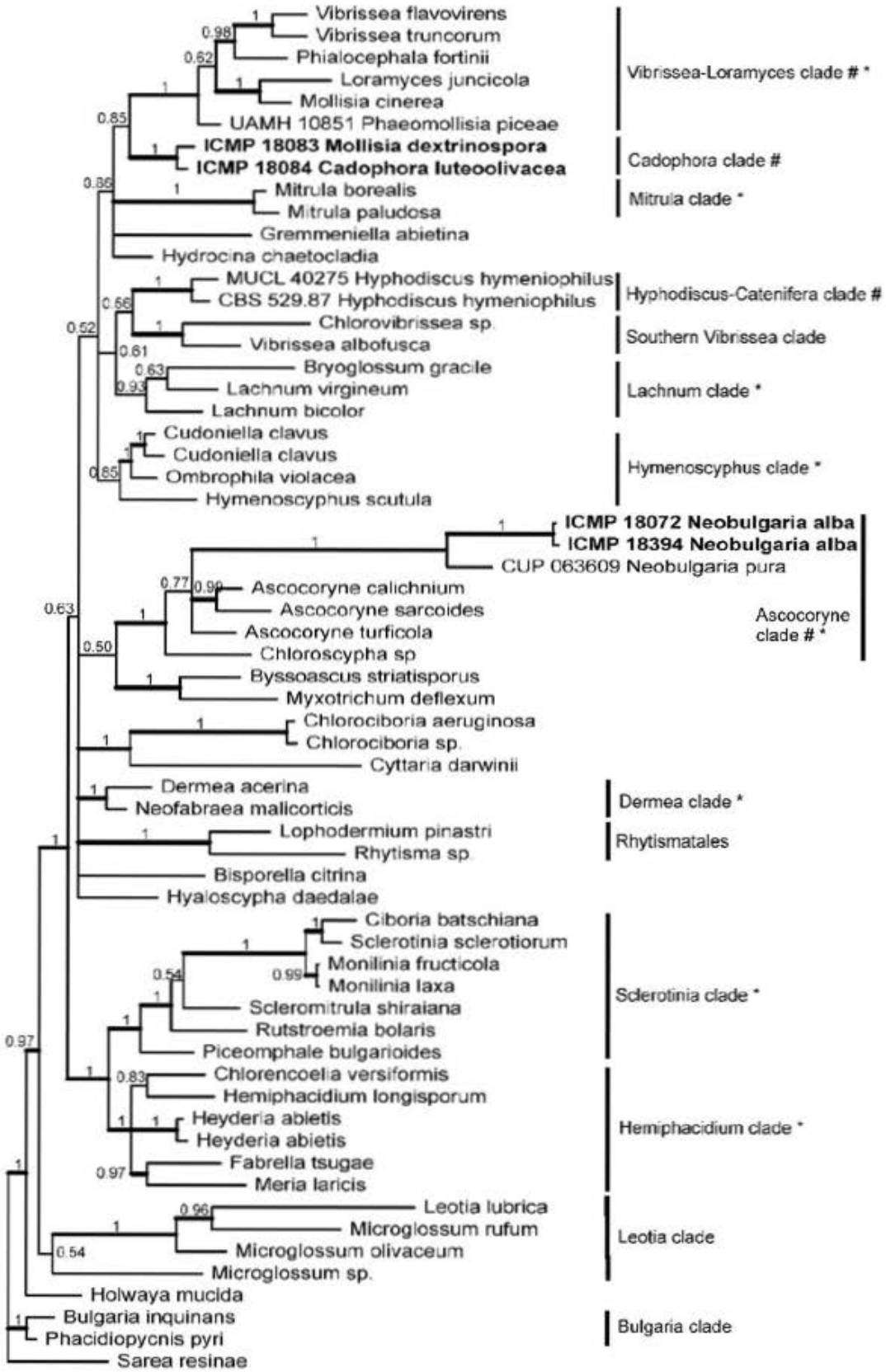
were putatively novel *Phaeoacremonium* spp. (e.g. ICMP 18093, Genbank HM116770, HM116776; ICMP 18094, Genbank HM116771, HM116777) and *Cadophora* spp. (FIG. 2 and TABLE 1). *Cadophora* and *Phaeoacremonium* spp. have been isolated from similarly discoloured wood in Italy, and pathogenicity tests again showed that they caused the symptoms (Di Marco et al. 2008). Field observations suggest that these fungi are unlikely to cause stem death, but they do impact on fruit yield. Fresh weight of fruit from New Zealand vines with disease symptoms averaged 12.6 g less than those from apparently healthy vines (Manning & Currie 2007).

The fungus from New Zealand kiwifruit has in the past been referred informally to "*Phialophora alba*" (e.g. Manning et al. 2003, Prodi et al. 2008). *Phialophora alba* was described from diseased wood by van Beyma (1943). He described a fungus with subglobose conidia, 3–4 × 2.7 µm, similar in size to *Neobulgaria alba*, but the ITS sequence from the type specimen (CBS 112.43, Genbank accession number HM116755) showed it to represent a *Paecilomyces* sp.

The genus *Neobulgaria* is characterised by the excipulum having a layer of non-gelatinous, cylindric cells sandwiched between gelatinous tissue to both the inside and outside. The outer gelatinous layer comprises narrow hyphae in a thick gel matrix, oriented more or less parallel to the receptacle surface, whereas the inner layer has hyphae irregular in orientation and less widely spaced in gel. Some species placed in *Ombrophila* have the same excipular structure (e.g. *O. microspora* as illustrated by Dennis 1954) and several authors have discussed the possibility that the two genera may be synonyms (e.g. Carpenter 1981, Dennis 1956, Verkley 1992). Baral & Krieglsteiner (1985) placed the genera in synonymy, recombining the type species of *Neobulgaria* in *Ombrophila*. However, the only genetic data available for the two genera indicate that they should be retained as distinct. *Ombrophila* belongs with some *Hymenoscyphus* spp. in what Wang et al. (2006a, b) suggested could represent a 'core' *Helotiaceae* sensu stricto clade, while *Neobulgaria* forms an unnamed clade with other genera with highly gelatinised excipular tissues, including *Ascocoryne* and *Chloroscypha*. Additional *Neobulgaria* sequences generated as part of this study support its position close to *Ascocoryne*.

Phylogenetic relationships of leotiomycete fungi with *Phialophora*-like anamorphs remain poorly resolved (FIG. 2). As suggested by Grünig et al.

FIG. 2. 50% majority-rule consensus phylogenetic tree based on Bayesian analysis of 18S rDNA, 5.8S rDNA, and 28S rDNA regions. Details of taxa with voucher numbers before the names are provided in Table 1, all other taxa are from Wang et al. (2006b). Bayesian posterior probabilities are shown above the edges, and those greater than 95% are indicated with bold lines. Informal clade names marked with * follow Wang et al. (2006a) and those marked with # are clades containing wood-staining fungi discussed in this paper. *Sarea resinae*, basal to the monophyletic *Leotiomycetes* in Wang et al. (2006b) was selected as the outgroup.


Vibrissea flavovirens
Vibrissea truncorum
Phialocephala fortinii
Loramyces juncicola
Mollisia cinerea
UAMH 10851 Phaeomollisia piceae
Vibrissea-Loramyces clade # *
ICMP 18083 Mollisia dextrinospora
ICMP 18084 Cadophora luteoolivacea
Cadophora clade #
Mitrula borealis
Mitrula paludosa
Mitrula clade *
Gremmeniella abietina
Hydrocina chaetocladia
MUCL 40275 Hyphodiscus hymeniophilus
CBS 529.87 Hyphodiscus hymeniophilus
Hyphodiscus-Catenifera clade #
Chlorovibrissea sp.
Vibrissea albofusca
Southern Vibrissea clade
Bryoglossum gracile
Lachnum virgineum
Lachnum bicolor
Lachnum clade *
Cudoniella clavus
Cudoniella clavus
Ombrophila violacea
Hymenoscyphus scutula
Hymenoscyphus clade *
ICMP 18072 Neobulgaria alba
ICMP 18394 Neobulgaria alba
CUP 063609 Neobulgaria pura
Ascocoryne calichnium
Ascocoryne sarcoides
Ascocoryne turficola
Ascocoryne clade # *
Chloroscypha sp
Byssoascus striatisporus
Myxotrichum deflexum
Chlorociboria aeruginosa
Chlorociboria sp.
Cyttaria darwinii
Dermea acerina
Neofabraea malicorticis
Dermea clade *
Lophodermium pinastri
Rhytisma sp.
Rhytismatales
Bisporella citrina
Hyaloscypha daedalae
Ciboria batschiana
Sclerotinia sclerotiorum
Monilinia fructicola
Monilinia laxa
Scleromitrula shiraiana
Rutstroemia bolaris
Piceomphale bulgarioides
Sclerotinia clade *
Chlorencoelia versiformis
Hemiphacidium longisporum
Heyderia abietis
Heyderia abietis
Fabrella tsugae
Meria laricis
Hemiphacidium clade *
Leotia lubrica
Microglossum rufum
Microglossum olivaceum
Microglossum sp.
Leotia clade
Holwaya mucida
Bulgaria inquinans
Phacidiopycnis pyri
Sarea resinae
Bulgaria clade

(2009), *Phialocephala*, *Acephala*, and their newly described genus *Phaeomollisia*, belong in the *Vibrissea-Loramyces* clade of Wang et al. (2006a). In our analyses, *Cadophora* forms a poorly supported sister relationship with the *Vibrissea-Loramyces* clade, and the position of *Hyphodiscus* remains unresolved amongst a group of the Wang et al. (2006a) clades including the *Vibrissea-Loramyces*, *Mitrula*, *Hymenoscyphus*, and *Lachnum* clades (FIG. 2).

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We thank Roger Shivas (Agri-Science Queensland, Indooroopilly) and Margaret Dick (Scion, Rotorua) for pre-submission reviews. This work was funded by the New Zealand Foundation for Research, Science and Technology through the Low Impact Disease Control programme (Contract CO6X0810) and the Defining New Zealand's Land Biota OBI.

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Chaetospermum setosum sp. nov. from the Western Ghats, India

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Abstract – A new species of *Chaetospermum*, *Ch. setosum*, is described based on the presence of conidiomatal setae and differences in conidial size and shape. This species occurs on *Mangifera indica* (*Anacardiaceae*) collected from Bhima Shankar forests in the Western Ghats of Maharashtra, India. The presence of conidiomatal setae is a unique character that differentiates this species from related taxa.

Key words – anamorphic fungi, *Efibulobasidium*, *Sebacinales*

Introduction

During July 2009 a survey was conducted to explore the microfungal diversity in the natural forests of Bhima Shankar situated in the northern part of the Western Ghats, India, at 19°40'00"–19°42'09"N 73°29'16"–73°38'06"E with an altitude of 945 msl. The forest types are mainly evergreen and semi-evergreen with rainfall up to 6000 mm per annum (Janardhanan 1966). An unusual *Chaetospermum* species was found on fallen leaves of *Mangifera indica*. The presence of gelatinous conidiomata, holoblastic sympodial conidiogenesis, and cylindrical, non-septate conidia with tubular appendages are the distinguishing features of the genus *Chaetospermum* (Sutton 1980; Nag Raj 1993). Species of *Chaetospermum* are recorded worldwide as common saprophytes isolated from freshwater and litter. Sequences of two species of *Chaetospermum* suggest that members of this genus are basidiomycetes in the order *Sebacinales* (Rungjindamai et al. 2008). The anamorph-teleomorph relationship between

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Chaetospermum and a known species of *Sebacinales*, *Efibulobasidium albescens* (Sacc. & Malbr.) K. Wells, was suggested by Wells & Bandoni (2001) and confirmed recently by Kirschner & Oberwinkler (2009). *Chaetospermum setosum*, which differs from the other five species described in that genus based on the presence of conidiomatal setae, cylindrical or V- and Y-shaped conidia, and number of polar appendages, is described as new to science.

Materials and methods

Conidiomata of the fungus were isolated from the lower surface of fallen leaves and observed under a Nikon Binocular stereo microscope (Model SMZ – 1500 with Digi-CAM, Japan). The serial dilution method was used to isolate this fungus (Pramer & Schmidt 1965) and the hyphal elements from the growing margin of the pure colonies developing from single spores were transferred to new Potato Dextrose Agar plates (PDA). For morphotaxonomic studies and photomicrographs an Olympus CX-41 (Japan) microscope was used. Conidia, setae, and conidiophores were measured using an ocular micrometer. The growth patterns of the colonies were also studied on different culture media viz. Czapek Yeast Autolysate Agar (CYA), Malt Extract Agar (MEA), Potato Carrot Agar (PCA), and PDA (Himedia Mumbai, India). Development was also observed on modified 2% agar media (2 g crushed autoclaved mango leaves mixed in 2% agar). The specimens were deposited in Ajrekar Mycological Herbarium (AMH) and the culture was accessioned and preserved in National Fungal Culture Collection of India (WDCM-932), Agharkar Research Institute, Pune, India.

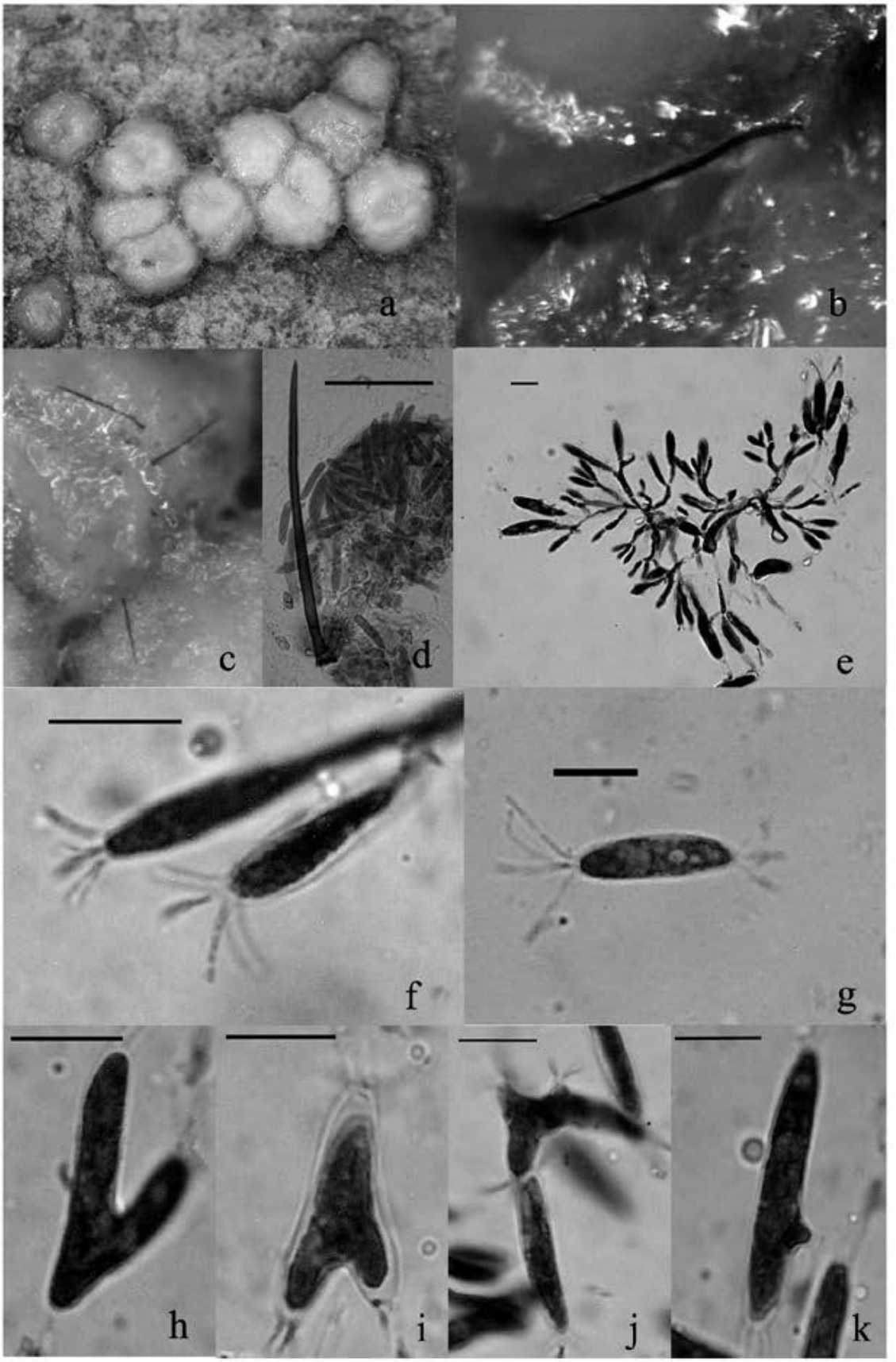
Taxonomic description

Chaetospermum setosum Rajeshkumar, S.K. Singh & P.N. Singh, **sp. nov.**

MycoBank MB 515508 Plates 1, 2

Foliicola. Conidiomata pycnidioidea, 300–750 µm diam., subepidermalia, primum immersa, postremo erumpentia, gelatinosa, nivea ad cremea ubi humida, palllide brunnea ad atrobrunnea ubi sicca. Setae marginales 120–132 µm longae, 5 µm latae ad basim, pallidae ad atrobrunneae, gradatim contractae versus apicem, acuminatae, crassitunicatae, solitariae vel binatim, 1–2-septatae ad basim. Conidiophora ramosa, hyalina, laevia. Cellulae conidiogenae cylindracae, holoblasticae, sympodiales, conidia maximam partem terminalia interdum lateralia, 1–4 in fasciculis. Conidia unicellularia, cylindracea vel variabilia in forma, recta vel curva, hyalina, laevia, guttulata, apice obtusa, 17–29(–40) × 4.4–7 µm. Appendices polares, nonramosae, tubulares, 2–5, praeciupue 3–4, 7.5–12.5 µm longae.

Plate 1. *Chaetospermum setosum* (holotype). a. Habit. b–c. Conidiomatal setae. d. Conidiomatal setae and conidia. e. Conidiophores branching and conidiogenous cells. f. Conidial development g. Mature conidia with appendages. h–k. Branched and irregularly shaped conidia with appendages. Bars: d = 50 µm; e–k = 10 µm.


a
b
c
d
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ETYMOLOGY: from Latin *setosus* referring to the conidiomatal setae present in this species.

HOLOTYPE: India, Bhima Shankar, Western Ghats, Maharashtra, on fallen leaves of *Mangifera indica* L. (*Anacardiaceae*) 30 Nov 2009, K.C. Rajeshkumar, AMH 9299. (Ex-type culture NFCCI 1912.)

Foliicolous. Conidiomata pycnidial, 300–750 µm diam., initially immersed, subepidermal, ultimately erumpent, opening by an irregular split in apical wall, gelatinous, pearl white to creamish when moist, pale brown to dark brown when dry, scattered to gregarious, confluent. Setae marginal, 120–132 µm long, 5 µm wide at the base, pale to dark brown, gradually tapering towards the pointed apex, wall thickened, solitary or in pairs, one to two septate at base. Conidiophores arising from innermost wall of conidiomata, branched, hyaline, smooth. Conidiogenous cells cylindrical, holoblastic, sympodial, conidia mostly terminal, sometimes lateral, 1–4 in clusters. Conidia unicellular, cylindrical or variable in shape, sometimes branched, each branch bearing appendages, straight or curved, hyaline, guttulate, smooth-walled, apex obtuse, 17–29 (–40) × 4.5–7 µm (mean 24.2 × 5.3 µm), length-width ratio 4.6:1; appendages polar, unbranched, tubular, 2–5 at each end, usually 3–4, 7.5–12.5 µm long.

TELEOMORPH: Unknown; no sexual state or fungus resembling *Efibulobasidium* was present near the specimen.

Colonies on PDA slowly growing, 15 mm diam. after 7 days and 25 mm diam after 15 days, white, dull white to pale creamish white, with slight ridges and furrows, smooth, flat, margin irregular, aerial mycelium scanty, reverse creamish or dull white. Colonies on MEA slowly growing, 10 mm diam. after 7 days, white, velutinous, smooth, margin irregular, reverse white to off-white. Colonies on PCA fast growing, 60 mm diam. after 7 days, white or off-white, mycelium immersed forming a film over media, flat, margin regular, colonies rounded, reverse white to off-white. Colonies on CYA fast growing, 65 mm diam. after 7 days, creamish white, mycelium immersed forming thin flat colonies, margin regular, reverse white to off-white. Sporulation and conidium morphology on these media were similar to those in nature, but setae were not found.

Sterile seta-like structures developed from the conidiomata in culture grown on modified 2% agar media with crushed autoclaved mango leaves. The sterile hyphae were hyaline or hyaline with dark brown pigmented areas scattered on it, thin-walled, wavy, with a broader base and blunt tip arising from the margins of the gelatinous conidiomata. Sporulation on this medium was poor.

Discussion

Saccardo (1892) established the genus *Chaetospermum* Sacc. based on *Tubercularia chaetospora* Pat. (Patouillard 1888), now *Ch. chaetosporum* (Pat.)

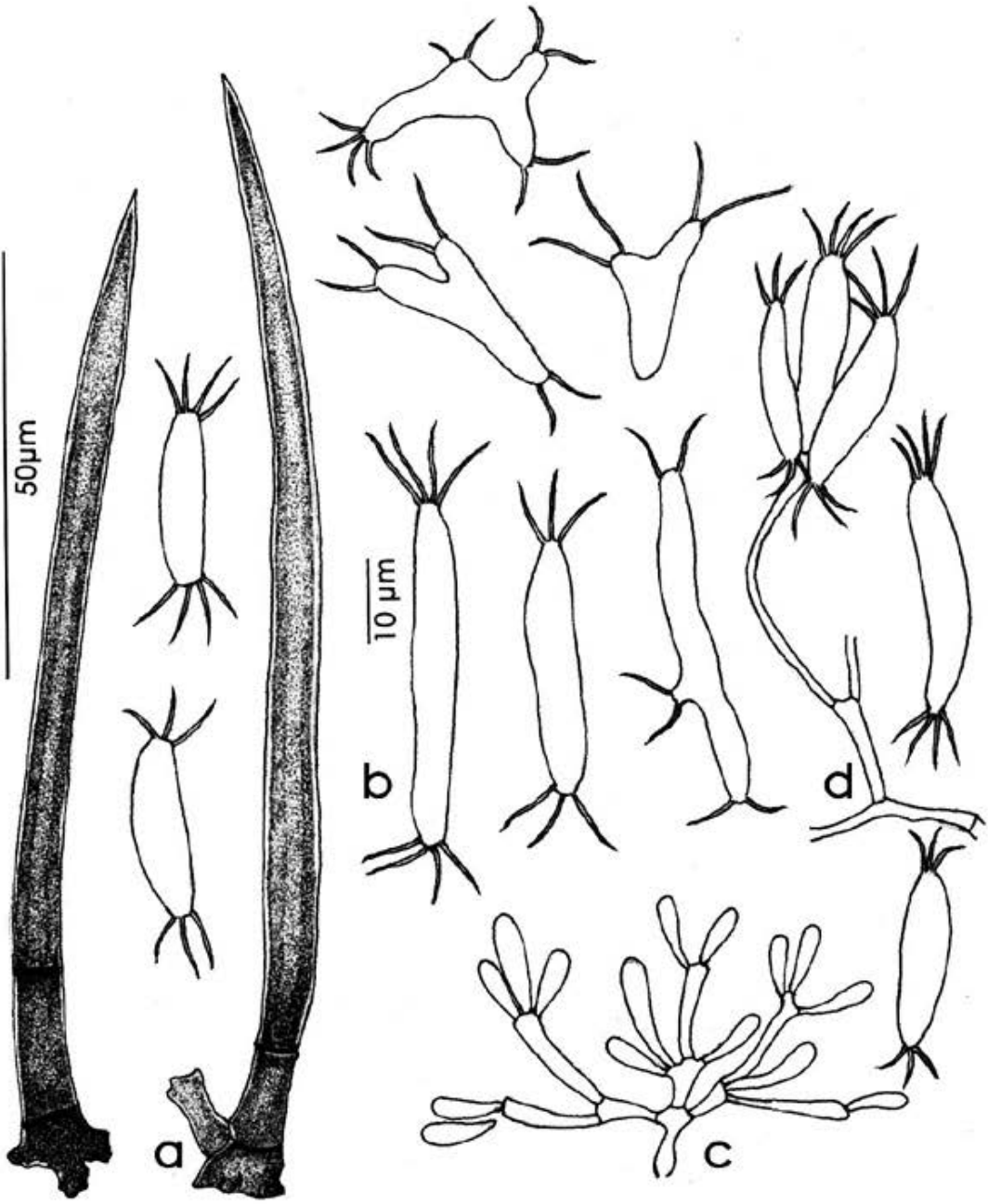

PLATE 2. *Chaetospermum setosum* (holotype).
a. Conidiomatal setae. b. Mature conidia with appendages. c. Conidiophores branching and conidiogenous cells. d. Conidiophores and terminal clusters of conidia.
Bars: a = 50 µm; b–d = 10 µm.

A.L. Sm. & Ramsb. (Smith & Ramsbottom 1914). Saccardo (1892) published a superfluous new name for the type, *Ch. tubercularioides* Sacc., nom. nov., nom. illegit.; this is clearly a homotypic synonym, and not heterotypic as Nag Raj (1993) mistakenly indicated. Nag Raj (1993), who provided the most recent account of the genus *Chaetospermum,* accepted four species: *Ch. chaetosporum, Ch. artocarpi* (Nag Raj) Nag Raj, *Ch. camelliae* Agnihothr., and *Ch. gossypinum*

(G.F. Atk.) Nag Raj. He separated these species based on conidial length-width ratio, conidial width, and the position of appendages. He also clarified that conidial appendages in all the taxa in this genus are tubular. Previously, Sutton (1980) had accepted three species of *Chaetospermum* viz., *Ch. carneum* Tassi, *Ch. chaetosporum* and *Ch. gelatinosum* Petch (1917); however, Nag Raj (1993) placed *Ch. gelatinosum* in synonymy with *Mastigonema gelatinosum* (Berk. & Broome) Nag Raj and, following an examination of the type specimen, considered *Ch. carneum* a nomen dubium. Talde (1981) described *Chaetospermum indicum* Talde from India. The type specimen is missing in AMH and not available for re-examination. The description and illustration of *Ch. indicum* suggest that this species is identical with the type species, *Ch. chaetosporum*. Thus, *Ch. indicum* is treated here as a synonym of *Ch. chaetosporum*.

In the present study *Chaetospermum setosum* is proposed as a new species based on its unique morphological characteristics including the presence of conidiomatal setae, variously shaped conidia, and number and origin of the conidial appendages. The presence of conidiomatal setae has not been previously described in *Chaetospermum*. The conidial appendages are polar in *Ch. artocarpi* (as in *Ch. setosum*) but are circumpolar to sub-polar or lateral in the other two species. Although the presence of polar appendages in *Ch. setosum* suggests an affinity with *Ch. artocarpi*, they are more variable, with as many as 5 appendages sometimes present.

Infundibura adhaerens Nag Raj & W.B. Kendr. (anamorph of *Helicogloea angustispora* L.S. Olive) is another basidiomycetous anamorph that produces sterile seta-like structures in nature as well as culture. Different authors (Nag Raj & Kendrick 1981; Matsushima 1996; Wu et al. 1997) have given different descriptions for sterile hyphae (setae) in this species. Kirschner (2004), who describes them as hyaline, aseptate, and thick-walled, notes that these differences may be due to intraspecific variation, environmental influences, or aging. *Chaetospermum setosum* also produces setae in nature and sterile hyphae (setae) in culture. In nature the setae are dark brown, erect, with pointed tips, but in culture hyaline or hyaline with dark brown pigmented areas, thin-walled, wavy, and bluntly tipped. This observation indicates that setal characteristics depend on environmental factors and culture conditions.

Key to species of *Chaetospermum*

1. Conidiomata with marginal setae; conidia cylindrical to V- or Y-shaped, appendages polar, 2–5 at each end. ..... *Ch. setosum*
1. Conidiomata without setae; conidia ellipsoidal to cylindrical 2
2. Appendages polar, 3, rarely 2, appendages on each conidium; conidia 18–26 × 4.5–5.5 µm ..... *Ch. artocarpi*
2. Appendages circumpolar to subpolar or lateral 3

3. Appendages circumpolar to subpolar; conidia 26–41 × 8–12 µm ..... *Ch. chaetosporum*
3. Appendages subpolar or lateral; conidia less than 8 µm wide 4
4. Appendages 9–20 µm long; conidial length-width ratio 5.5:1 ..... *Ch. camelliae*
4. Appendages 18–20 µm long; conidial length-width ratio 6.3:1 ... *Ch. gossypinum*

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Phialophora sessilis, a species causing flyspeck signs on bamboo in China

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Abstract —*Phialophora sessilis* is reported and redescribed from China. It is distinguished from the other known species in the genus by reduced, flaring phialidic collarettes and clusters of single-celled conidia. ITS sequence analysis of four strains from Xianning, Hubei, China, attributed to the species shows it to be clearly distinct.

Key words —phialide, taxonomy, genetic analysis, sooty blotch, *Gramineae*

Introduction

The genus *Phialophora,* which was introduced by Medlar for *P. verrucosa* Medlar isolated from a human skin lesion (Medlar 1915), is currently regarded as a member of *Herpotrichiellaceae* (Haase et al. 1999). It is a little-differentiated genus of more or less pigmented, phialidic hyphomycetes (Hoog et al. 2000). With the addition of numerous species, the genus has become grossly polyphyletic, although some taxa have already been segregated from *Phialophora* into *Cadophora* (*Helotiales*), *Harpophora* (*Magnaporthaceae*), *Lecythophora* (*Coniochaetaceae*) and *Phaeoacremonium* (*Togniniaceae*) (Kirk et al. 2008).

Most *Phialophora* species are common saprobes in soil, wood pulp, and other plant material. Others are more specialized plant pathogens, and human pathogenicity is known for a few species (Gams 2000). *Phialophora sessilis* was first reported by Hoog et al. (1999) from *Picea abies* resin in the Netherlands

*Corresponding author.

and described in a comparative study of 34 strains belonging to the *Phialophora verrucosa* complex. Additional strains of *Ph. sessilis* originated from forest soils in Sweden, the lichen *Peltigera polydactyla* (Hoog et al. 1999), and marble powder in Italy (Caretta et al. 2006). Important phenetic characteristics of *Ph. sessilis* are dark, slow growing colonies, conspicuous collarettes that are darker than the rest of the phialide and inserted laterally on undifferentiated hyphae, and conidia sometimes inflating and then frequently bearing phialidic collarettes (Caretta et al. 2006).

During a recent survey of host plants for flyspeck fungi in China, two bamboo species were found to be hosts of flyspeck related with *Phialophora sessilis*.

Materials and methods

Fungal strains

Four strains were isolated from the culms of two different hosts; isolates ZJ81-D5 and ZJ81-D7 were from *Phyllostachys meyeri*, and ZJ88-B3 and ZJ88-B8 were from *Yushania falcatiaurita*. Representative dried culture and plant specimens were deposited in the Fungal Herbarium of Northwest A&F University (HMUABO), Yangling, Shaanxi Province, China.

Isolates

Individual sclerotium-like bodies (Batzer et al. 2005), growing in clusters on bamboo culms, were transferred to slants containing potato dextrose agar (200 g peeled potato, 20 g dextrose, 10 g agar in 1 L water; PDA) and cultured at 22 ± 1°C in the dark (Sun et al. 2003). Axenic cultures from slants were transferred to new PDA plates, a sterile cover slip was partially inserted into the agar adjacent to the colony and angled away from the colony at approximately 60 degrees to the agar surface in order to enable the fungus to grow onto the cover slip. Measurements of fungal structures were conducted based on isolates growing on cover slips. Colony descriptions were made after 1 month of growth on PDA plates at 22 ± 1°C in darkness.

DNA extraction, PCR, and sequencing

The protocol of Barnes et al. (2001) was followed to extract genomic DNA from fungal mycelium growing on PDA slants. The primers ITS1-F (Gardes & Bruns 1993) and ITS4 (White et al. 1990) were used to amplify part of the nuclear ribosomal RNA (nrRNA) operon spanning the 3' end of the 18S rRNA gene, the first internal transcribed spacer (ITS1), the 5.8S rRNA gene, the second ITS region (ITS2) and the 5' end of the 28S rRNA gene. The PCR reaction mixture, consisting of 1 unit Taq polymerase, 1× PCR buffer, 2 mM $MgCl_2$, 0.2 mM of each dNTP, 0.4 µM of each primer, and 2 µL template DNA, was made up to a total volume of 25 µL with sterile water. Reactions were performed on a Bio-Rad PCR System PTC-200TM and the cycling conditions were an initial denaturation at 94°C for 3 minutes followed by 35 cycles of denaturation at 94°C for 30 seconds, annealing at 52°C for 30 seconds, extension at 72°C for 30 seconds, and a final 10-minute extension step at 72°C. Purifying and automated sequencing with the

primer ITS4/ ITS1-F of the PCR product was performed at Organism Technology Co., Shanghai, China.

Sequence alignment and phylogenetic analyses

The ITS nucleotide sequences generated in this study were added to sequences of six species of *Phialophora* obtained from GenBank (www.ncbi.nlm.nih.gov) (Table 1). After importing into BioEdit 5.0.9.1 (Hall 1999), all sequences were pruned to include the complete sequences of ITS1, the 5.8S rDNA gene, and ITS2 to aid alignment. Preliminary alignments of the ITS sequences were conducted using CLUSTAL-X (Thompson et al. 1997), with manual adjustment using BioEdit for visual improvement where necessary.

Table 1. Sequences used in the phylogenetic analysis

Species	GenBank	Reference
Cadophora gregata	AY249070	Harrington & McNew 2003
	AY249071	Harrington & McNew 2003
	U66727	Chen et al. 1996
	U66728	Chen et al. 1996
	U66729	Chen et al. 1996
Cadophora malorum	DQ317328	Arenz et al. 2006
	AF083201	McKemy et al. 2005
	AF083202	McKemy et al. 2005
Phialophora americana	EU514694	Untereiner et al. 2008
	EU514695	Untereiner et al. 2008
	AF050259	Untereiner & Naveau 1999
	AF050260	Untereiner & Naveau 1999
Phialophora europaea	FJ489612	Li et al. 2008
	EF551553	Zeng & Hoog 2008
	EU514698	Untereiner et al. 2008
Phialophora sessilis	AY857542	Prenafeta-Boldu et al. 2006
	AY857541	Prenafeta-Boldu et al. 2006
	DQ363414	Feldmann et al. 2006
	FJ438386	Diaz et al. 2010
Phialophora verrucosa	DQ404353	Prodi et al. 2008
	EU514701	Untereiner et al. 2008
	AF050282	Untereiner & Naveau 1999
	AF050281	Untereiner & Naveau 1999
Pyrenopeziza revincta	AJ430224	Vralstad et al. 2002
ZJ81-D5	GU981734	This paper
ZJ81-D7	GU981735	This paper
ZJ88-B3	GU981736	This paper
ZJ88-B8	GU981737	This paper

Maximum parsimony (MP) analysis was carried out using PAUP 4.0b10 (Swofford 2001). Heuristic searches were conducted with a 1000 random taxa addition and tree bisection-reconnection (TBR) as the branch-swapping algorithm. All characters were unordered and of equal weight and gaps were treated as missing data. Branches of zero length were collapsed and all multiple, equally parsimonious trees were saved. Measures calculated for parsimony included tree length, consistency index, retention index, and rescaled consistency index (TL, CI, RI and RC, respectively). To assess the robustness of clades and internal branches, a strict consensus of the most parsimonious trees was generated and a bootstrap analysis of 1000 replications was performed. The outgroup was *Pyrenopeziza revincta*.

Results

DNA phylogeny

Four isolates (ZJ81-D5, ZJ81-D7, ZJ88-B3, ZJ88-B8) were obtained from bamboo. The sequences were deposited in GenBank (ZJ81-D5 = GU981734, ZJ81-D7 = GU981735, ZJ88-B3 = GU981736, ZJ88-B8 = GU981737). Sequences for the ribosomal DNA ITS region (ITS1, 5.8S rDNA gene, ITS2) for each isolate, and related sequence data from GenBank, were used to construct a strict consensus tree with tree length (TL) = 431, consistency index (CI) = 0.8770, retention index (RI) = 0.9671, and rescaled consistency index (RC) = 0.8482 (Fig. 1). Two major clades were resolved in the MP trees. One clade, with 100% bootstrap support, contained two species, *Cadophora gregata* and *C. malorum*. The other major clade (100% bootstrap) consisted of four subclades containing isolates of *P. sessilis*, *P. europaea*, *P. americana*, and *P. verrucosa*. Our four isolates — ZJ81-D5, ZJ81-D7, ZJ88-B3, ZJ88-B8 — clustered together with *P. sessilis* with a 100% bootstrap value, indicating that they probably represent the same species.

Taxonomy

Description (Fig. 2): Hyphae initially somewhat torulose, later regularly tubular. Expanding hyphae 1.2–2.7 µm wide, smooth-walled; hyphal cells sometimes inflated to 3.8–7.5 µm wide. Phialides mostly intercalary. Collarettes distinct from the rest of the phialide, mostly sessile on undifferentiated hyphae, scattered and independent from placement of septa, triangular to funnel-shaped, up to 1.5 µm long and about 1.5 µm wide at the often somewhat flaring opening. Conidia subhyaline, smooth-walled, obovoidal to ellipsoidal, 3.0–7.3 × 2.0–4.5 µm. Conidia in slimy heads, 5.3–8.2 × 6.5–8.4 µm. Chlamydospores absent.

Specimens examined: On *Phyllostachys meyeri* McClure (*Gramineae*): China, Hubei, Xianning, Qianshan National Forest Park, 29°48'N 114°96'E, alt. 46 m, 16 Oct. 2008, J.L. Zhuang & H.L. Yang, HMUABO 20581 (with dried culture), culture ZJ81-D5 and ZJ81-

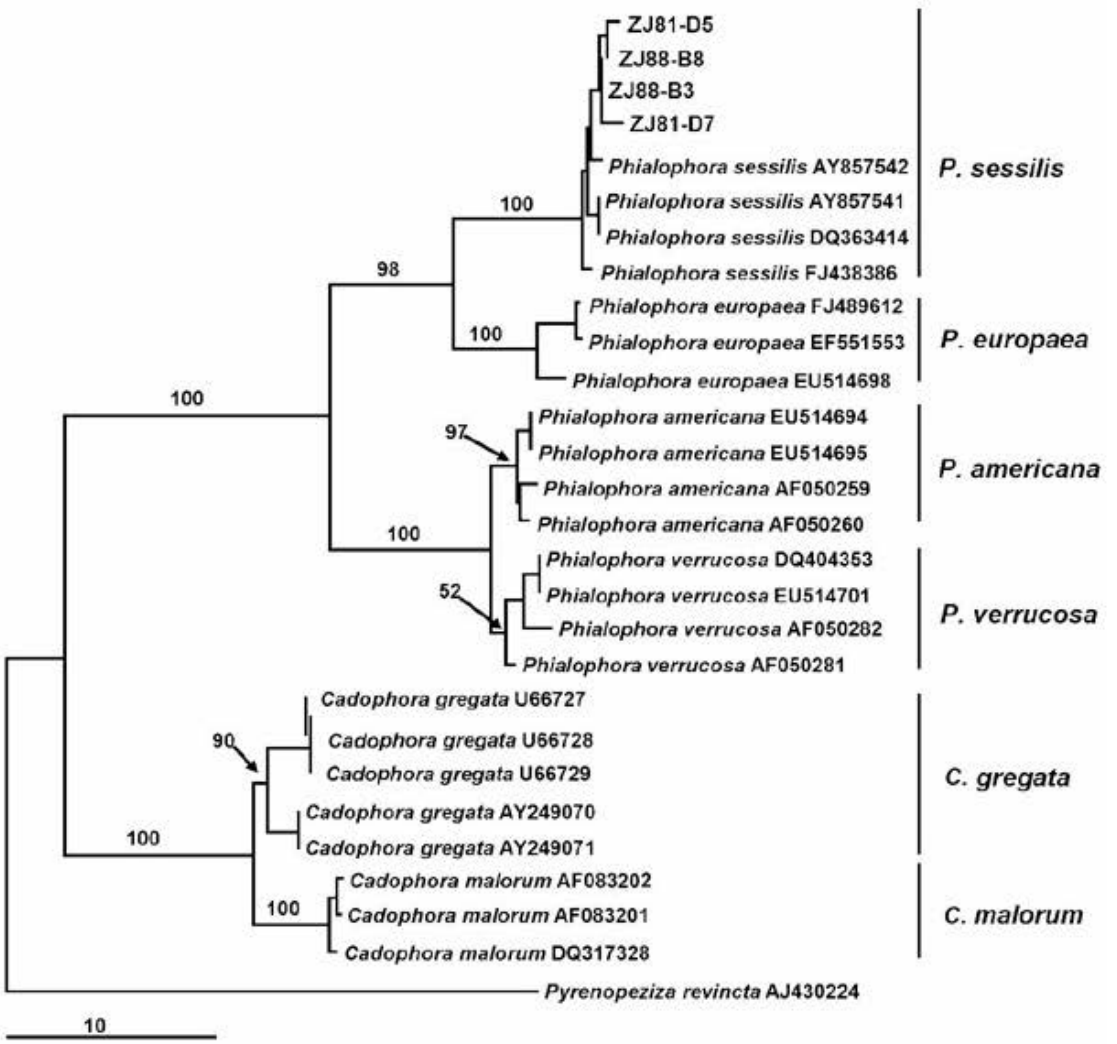

FIG. 1 The parsimony tree (TL = 431, CI = 0.8770, RI = 0.9671, RC = 0.8482) derived from a heuristic search option in PAUP version 4.0b10 with 1000 randomizations of sequence input orders and 1000 bootstrap replications using the data set of ITS1, 5.8S and ITS2. Bootstrap values higher than 50% are indicated above or below the tree branches. The tree was rooted to *Pyrenopeziza revincta*.

D7; on *Yushania falcatiaurita* Hsueh & T.P. Yi (*Gramineae*): China, Hubei, Xianning, Qianshan National Forest Park, 29°48'N 114°96'E, alt. 53 m, 16 Oct. 2008, J.L. Zhuang & H.L. Yang, HMUABO 20588 (with dried culture), culture ZJ88-B3 and ZJ88-B8.

CULTURAL CHARACTERISTICS: Colony diameter after 1 month on PDA at 22 ± 1°C reached 20 mm with even margins and rough, farinose aerial hyphae; colony centers were purplish gray and outer zones olivaceous black. On OA similar, colony reaching 23 mm diameter, flat, spreading, with sparse aerial mycelium, surface olivaceous black, but colony color lighter.

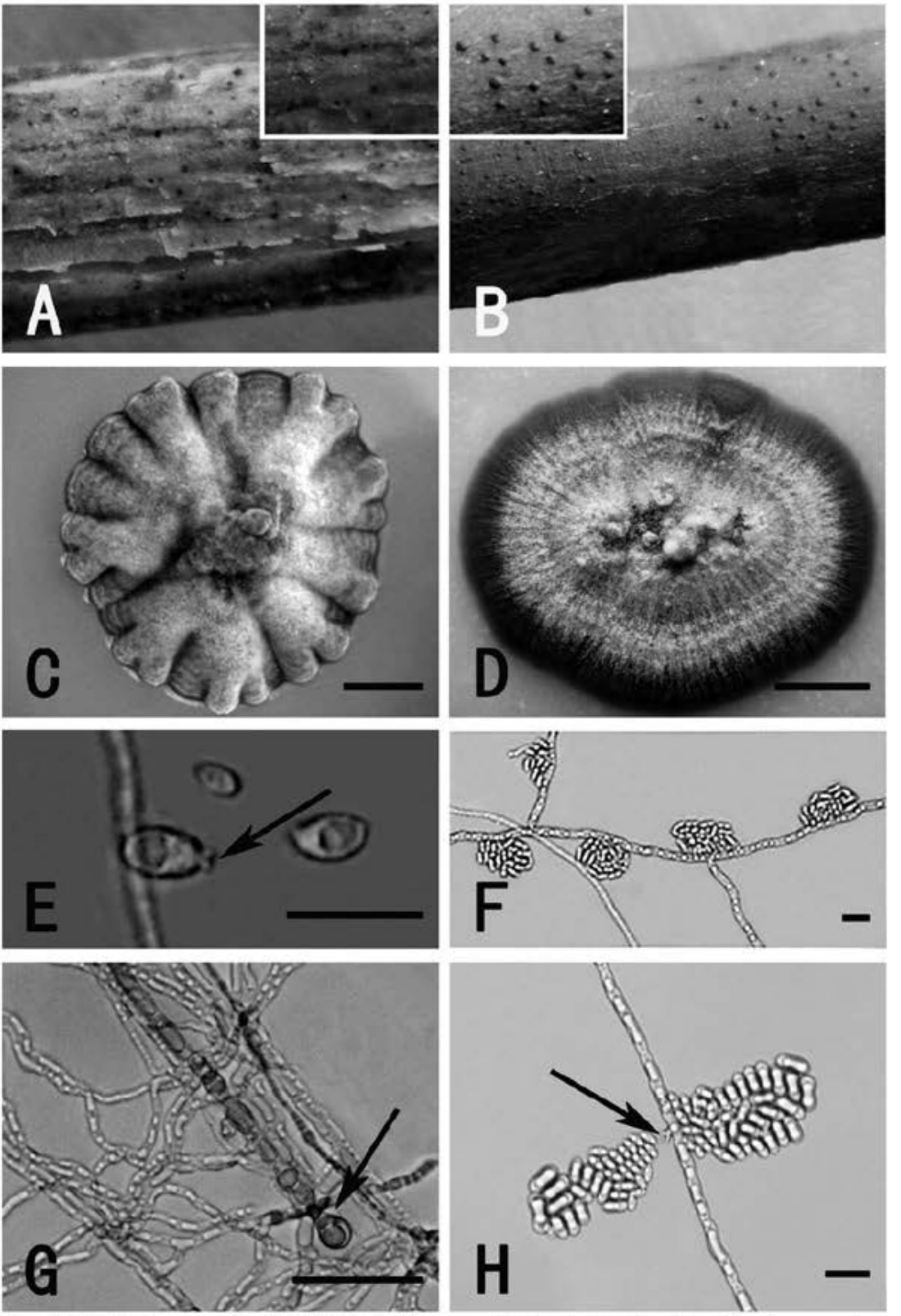

FIG. 2 *Phialophora sessilis* (ZJ81-D5). A. Signs on *Yushania falcatiaurita* with close-up view. B. Signs on *Phyllostachys meyeri* with close-up view. C. Colony on PDA after 30 days. D. Colony on OA after 30 days. E. Conidia with open collarette (arrow). F. Conidia and hyphae. G. Inflated hyphal cells (arrow). H. Phialide (arrow) bearing conidia. Bars (C–D) = 0.5 cm. Bars (E–H) = 10 μm.

HOST CHARACTERISTICS: On *Yushania falcatiaurita*, no visible mycelial mat with shiny, black, flattened sclerotium-like bodies, round to irregular (130–470 μm diam), scattered distribution over the entire surface of the culm, densely arranged 3–8/mm^2 (FIG. 2A). On *Phyllostachys meyeri* similar, but sclerotium-like bodies were larger (430–680 μm diam), sparse, gathered in clusters on the culm, densely arranged 0.5–1.5/mm^2 (FIG. 2B). The flyspeck on bamboo did not damage the plants, but greatly reduced their ornamental and retail value. As a result, these fungi can cause significant economic losses to producers of these plants.

Discussion

Our four isolates are morphologically similar to *Phialophora sessilis* de Hoog, and despite minor differences, identity with this species was well supported by the ITS data. The same fungus caused somewhat different signs on each hosts. This phenomenon occurs in other so-called flyspeck species as well, for example, *Dissoconium mali* produced colonies with flyspeck morphology on persimmon fruit (Sun et al. 2008), but colonies with sooty blotch morphology (dark mycelial matrix) on apple fruit (Zhang 2007). It is possible that host-based morphological plasticity may also occur in other fungi in the sooty blotch and flyspeck complex.

Based on the ITS sequence analysis and morphological comparison, we identified the four isolates as *Phialophora sessilis,* which represents a new record for China. This study is also the first report of *P. sessilis* from bamboo.

Acknowledgments

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Two new anamorphic fungi from Cuba: *Endophragmiella profusa* sp. nov. and *Repetoblastiella olivacea* gen. & sp. nov.

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Abstract — *Endophragmiella profusa* sp. nov., on submerged decaying leaves of *Bucida palustris* and on bark of decaying nuts of *Couroupita guianensis*, and *Repetoblastiella olivacea* anam. gen. & sp. nov., on bark of decaying nuts of *Couroupita guianensis* from tropical forests in Cuba, are described and illustrated. *Endophragmiella profusa* is distinguished by obovoid, clavate, pyriform to slightly turbinate, 3–5-septate, mostly 5-septate, dark brown, and smooth conidia. *Repetoblastiella olivacea* is characterized by inconspicuous conidiophores and monoblastic, determinate conidiogenous cells that bear cylindrical, multi-septate, olivaceous to pale olivaceous brown conidia—repeatedly blastocatenate and forming several irregular chains from several indeterminate cells across the length of the conidial body.

Key words — freshwater fungi, hyphomycetes, systematics

Introduction

Over thirty anamorphic fungi were collected in Cuba during two mycological surveys of microfungi from tropical plant material (mainly *Bucida palustris*

leaf litter and bark of decaying nuts of *Couroupita guianensis*), in several undisturbed forests of Camagüey and Ciudad de La Habana provinces. Among them, two conspicuous fungi appeared to be new to science and therefore they are described and illustrated here.

Materials and methods

Samples of submerged plant material were collected during expeditions in 1999 to "Los Cangilones" pool along the Maximo River (Camagüey), and in 2001 to a forest in Santiago de Las Vegas (Ciudad de La Habana). Individual collections were placed in paper bags and taken to the laboratory as described by Castañeda (2005). They were incubated in Petri dishes at 25°C placed in a moist chamber composed of plastic containers (50 L capacity) with 200 ml of sterile water plus 2 ml of glycerol, and examined at regular intervals for the presence of microfungi. Mounts were prepared using polyvinyl alcohol-glycerol (8.0 g in 100 ml of water, plus 5 ml of glycerol). Measurements were made at a magnification of × 1000. Micrographs were obtained with a Zeiss Axioskop 40 microscope.

Taxonomy

Endophragmiella profusa R.F. Castañeda, M. Stadler & Gené, **sp. nov.** FIG. 1

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Coloniae in substrato naturali effusae, pilosae, profusae, atrobrunneae, amphigenae. Conidiophora conspicua, mononemata, simplicia, erecta, recta, cylindrica, 3–7-septata, levia, brunnea, apice versus pallidiora vel subhyalina, 45–170 longa, plus minusve radiatim lobata ad basim, 5–10 µm lata, plerumque simplicia, interdum ad apicem ramosa cum ramis sessilibus, conidiophoris secundariis mutata. Cellulae conidiogenae hologenosae, loco fertili uno quaeque indutae, terminales, indeterminatae, cum 2–8 proliferationibus percurrentibus, 9–24 × 2.0–3.5 µm, pallide brunneae vel subhyalinae; in conidiophoris incorporatae. Secedentia conidiorum rhexolytica. Conidia solitaria, obovoidea, clavata, pyriformia usque ad turbinata, rotundata ad apicem, conico-truncata ad basim, (2–)3–5-septata, plerumque 5-septata, 22–35 × 7–9 µm; sicca, laevia, atrobrunnea, sed cum cellulis basalibus dilute brunneis vel subhyalinis, 5–10 × 4–7 µm; ad basim reliquiis ab partem superiorem cellulae conidiogenae, fimbriata, 1.5–4.0(–8.0) µm longis praedita. Teleomorphosis ignota.

Type: CUBA. Camagüey: Los cangilones pool along the Maximo river, 21°35'N; 77°42'W, on submerged decaying leaves of *Bucida palustris* Borhidi & O. Muñiz (*Combretaceae*), 7.II.1999. R.F. Castañeda & J. Cano (**Holotype:** MUCL 41853).

Etymology: Latin, *profusa*, meaning extended, spread out, and referring to the colony.

Colonies on the natural substratum effuse, hairy, profuse, amphigenous, dark-brown. Mycelium superficial and immersed, composed of septate, branched, smooth-walled, brown hyphae, 1–2 µm diam. Conidiophores macronematous, mononematous, simple or rarely with a branch near the apex, erect, straight,

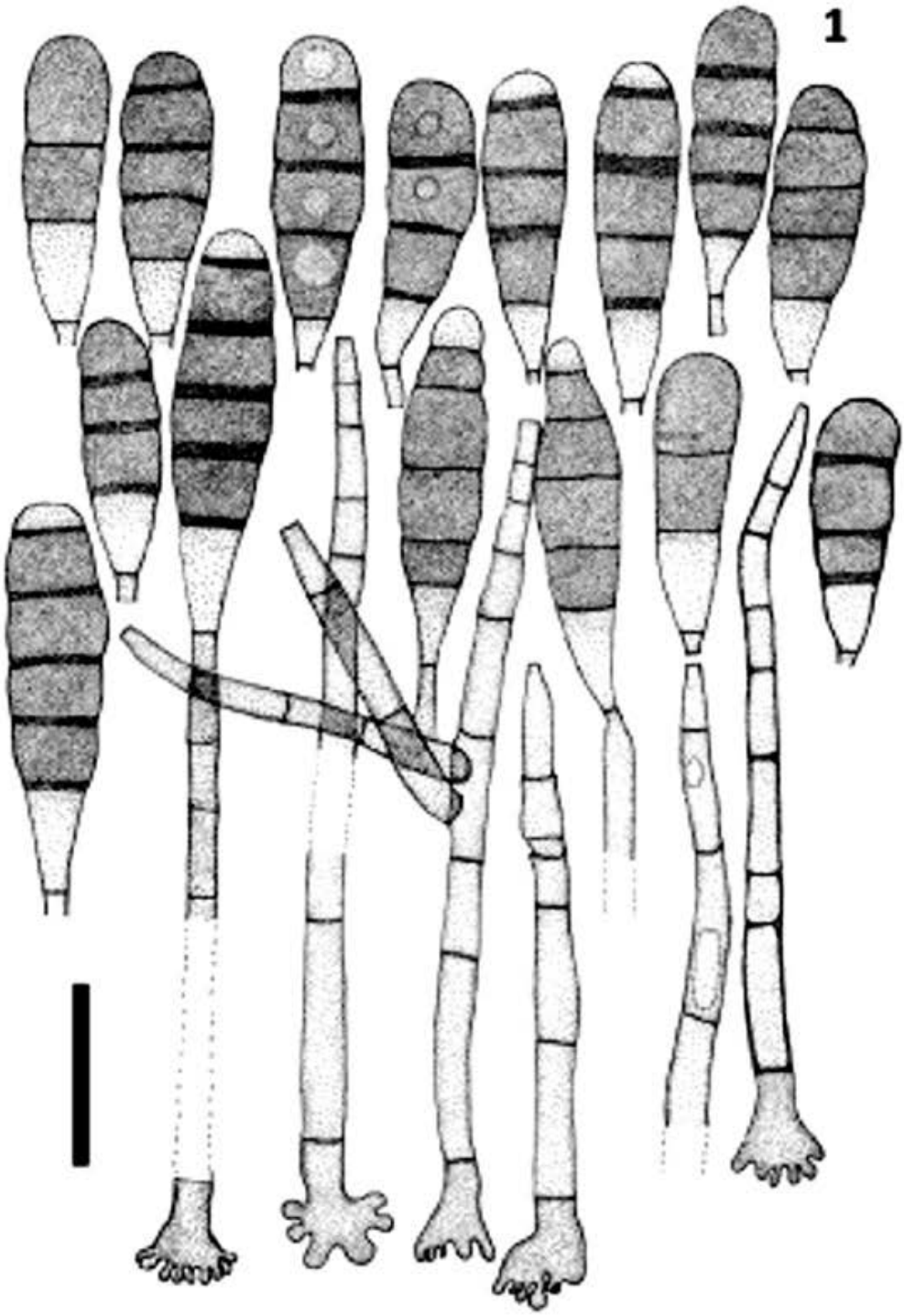

FIG. 1. *Endophragmiella profusa*, drawings from holotype (MUCL 41853). Conidiophores, conidiogenous cells, and conidia. Scale bar = 10 µm.

cylindrical, 3–7-septate, smooth, 45–170 µm tall, basal cell radially lobed, 5–10 µm wide, brown at the base, pale brown towards the apex. CONIDIOGENOUS CELLS monoblastic, integrated, terminal, cylindrical, indeterminate, pale brown, with 2–8 enteroblastic percurrent proliferations, 9–24 × 2.0–3.5 µm.

Conidial secession rhexolytic. CONIDIA solitary, acrogenous, obovoid, clavate, pyriform to turbinate, rounded at the apex, conical-truncate at the base, (2–)3–5-septate, mostly 5-septate, 22–35 × 7–9 µm, dry, smooth-walled, dark brown, with the basal cell pale brown or subhyaline, 5–10 × 4–7 µm, fimbriate, with a conspicuous basal fringe, 1.5–4.0(–8.0) µm long. Teleomorph unknown.

ADDITIONAL SPECIMENS EXAMINED: **CUBA. CIUDAD DE LA HABANA:** SANTIAGO DE LAS VEGAS, 22°58' N; 82°20' W, on bark of decaying nuts of *Couroupita guianensis* Aubl. (*Lecythidaceae*), 2.VII.2001. R.F. Castañeda, INIFAT C01/54-4.

NOTES. The genus *Endophragmiella* was erected by Sutton (1973) for *E. pallescens* B. Sutton, the type species, and is distinguished by macronematous, mononematous conidiophores usually unbranched or rarely with a few branches and conidiogenous cells with repeatedly conspicuous enteroblastic percurrent proliferations. Conidial secession is rhexolytic and the conidia mostly bear a very pale pigmented portion of the conidiogenous cell or basal frill (Hughes 1979, Kirk 1985, Wu & Zhuang 2005). *Endophragmiella profusa* slightly resembles *E. tenuis* R.F. Castañeda (Castañeda 1987), but the latter has clavate, obtuse to rounded apex, 37–50 × 5–6.5 µm, brown, (3–6)-septate, mostly 4-septate conidia with pale brown ends.

Repetoblastiella R.F. Castañeda, Minter & M. Stadler, **anam. gen. nov.**

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Fungus anamorphicus. COLONIAE in substrato naturali pilosae, caespitosae vel funiculosae usque ad arachnoides, effusae, atrovirides, olivaceae vel brunneae. Mycelium partim superficiale et partim in substrato immersum. CONIDIOPHORA micronematosa, mononematosa, simplicia vel ramosa, septata, brunnea vel olivacea, levia vel verrucosa, interdum ad cellulam conidiogenam reducta. CELLULAE CONIDIOGENAE monoblasticae, terminales, determinatae, nonnunquam polyblasticae sympodiales. CONIDIORUM SECESSIO schizolytica. CONIDIA blasto-catenulata, cylindrica, oblonga usque ad longa bacilliformia, multiseptata, olivacea vel brunnea, laevia vel verrucosa; conidia quaeque quaque in cellula facilitatem induta nova producere conidia in catenis.

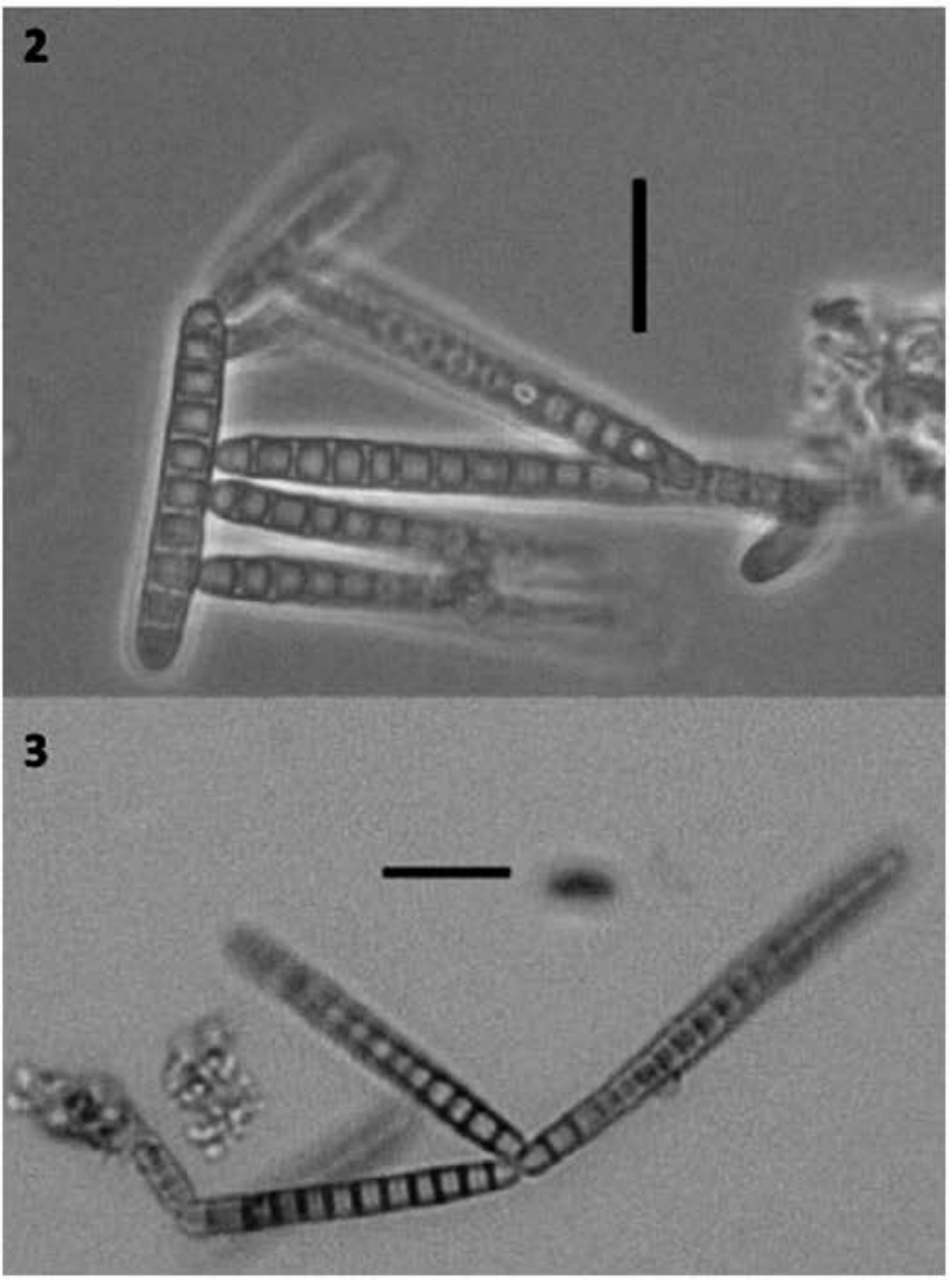
ETYMOLOGY: Latin, *repetite*, meaning repeatedly; *blastiella* referring to the blastic mode of conidium ontogeny.

SPECIES TYPICA: *Repetoblastiella olivacea* R.F. Castañeda, Minter & M. Stadler

Anamorphic fungi. COLONIES on the natural substratum hairy, caespitose, funiculose to arachnoid, effuse, dark green, olivaceous or brown. Mycelium superficial and immersed. CONIDIOPHORES micronematous, mononematous, simple or branched, septate, brown or olivaceous, smooth or verrucose, sometimes reduced to a single conidiogenous cell. CONIDIOGENOUS CELLS monoblastic, terminal, determinate; sometimes polyblastic with sympodial proliferations. CONIDIAL SECESSION schizolytic. CONIDIA cylindrical, oblong to bacilliform, multi-septate, olivaceous to pale olivaceous-brown or brown, repeatedly and randomly blastocatenate, forming several irregular chains from

several indeterminate cells across the length of the conidial body. Teleomorph unknown.

NOTES. Several previously described anamorphic genera commonly found in aquatic habitats form somewhat branched or blastocatenulate conidia which originate in a predictable fashion from identifiable cells of the conidial body, and the conidial chains are more or less predictable and stable for each species. Most of these fungi, such as *Dendrospora* Ingold and *Varicosporium* W. Kegel,



FIGS 2–3. *Repetoblastiella olivacea*, photographs from holotype (INIFAT C00/36–3). Conidiogenous cell and conidia forming repeatedly and randomly chains. Scale bars = 10 µm.

lack pigmentation. *Catenulostroma* Crous & U. Braun, *Lylea* Morgan-Jones, *Trimmatostroma* Corda, and *Xylomyces* Goos et al. have also micronematous or undifferentiated conidiophores, and conidia are formed in branched chains, sometimes from several cells across the body of each "ramoconidium" similarly to *Repetoblastiella*. In *Catenulostroma*, however, conidiogenous cells are holoblastic-thalloblastic, meristematic and conidial chains are basipetal, *Lylea* has distoseptate conidia forming chains from apical and subapical cells of each ramoconidium, and *Trimmatostroma* has thalloblastic conidial ontogeny with evident disarticulation during conidial secession and often dictyoseptate conidia. The conidial chains in *Xylomyces* show restricted growth in relation to the anastomosing process of the assimilative hyphae, but secondary and tertiary conidia originate only from one cell of the parent conidium. The conidial development in the present genus is enigmatic in the remarkable ability of each conidium cell to produce another conidium, resulting in colonies that are visually complex and net-like in appearance.

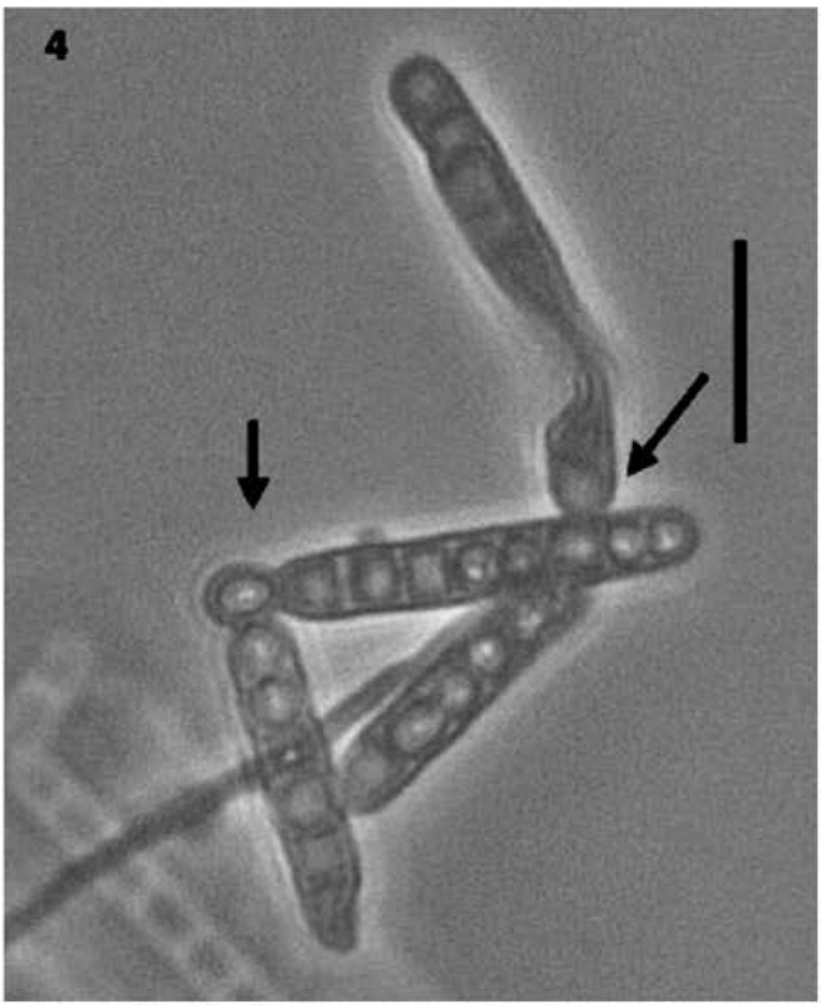


FIG. 4. *Repetoblastiella olivacea*, photograph from holotype (INIFAT C00/36-3). Blastocatenulate conidia. Scale bar = 10 µm.

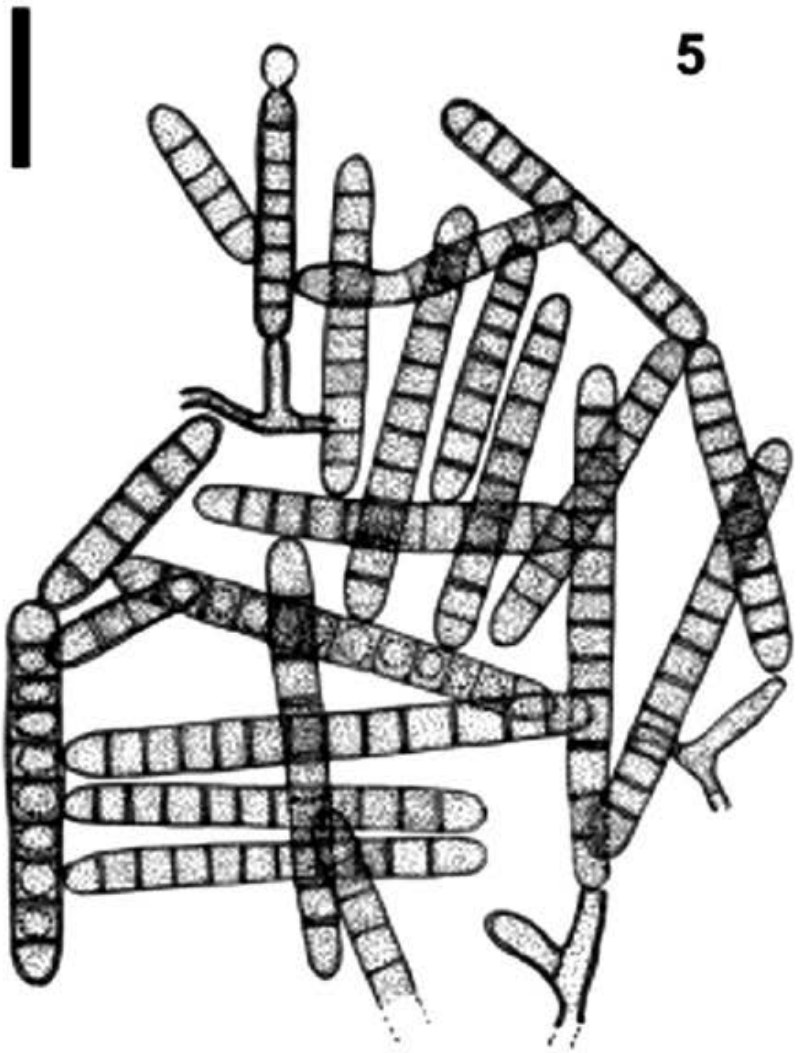


FIG. 5. *Repetoblastiella olivacea*, drawings from holotype (INIFAT C00/36–3). Conidiogenous cells and blastocatenulate conidia. Scale bar = 10 µm.

Repetoblastiella olivacea R.F. Castañeda, Minter & M. Stadler, **anam. sp. nov.**

MYCOBANK MB 518343 FIGS. 2–5

COLONIAE in substrato naturali pilosae, funiculosae, effusae, olivaceae. Mycelium partim superficiale et partim in substrato immersum. Hyphae septatae, ramosae, leves, dilute brunneae, 1–2 µm diam. CONIDIOPHORA micronematosa, mononematosa, simplicia, septata, brunnea vel olivacea, levia plerumque ad cellulam conidiogenam reducta. CELLULAE CONIDIOGENAE monoblasticae, terminales, determinatae, 5–10 × 3–6 µm, nonnunquam polyblasticae sympodiales. CONIDIORUM SECESSIO schizolytica. CONIDIA blastocatenulata, cylindrica, oblonga usque ad longa-bacilliformia (2–)8–9(–16)-septata, levia, olivacea, atroviridia in massa, sicca, (15–)25–10(–50) × 3–7 µm; conidia quaeque quaque in cellula facilitatem induta nova producere conidia in catenis.

TYPE SPECIMEN: **CUBA. CIUDAD DE LA HABANA:** SANTIAGO DE LAS VEGAS, 22°58' N; 82°20' W, on bark of decaying nuts of *Couroupita guianensis* Aubl. (*Lecythidaceae*), 7.IV.2000. R.F. Castañeda, (**Holotype:** INIFAT C00/36–3).

COLONIES on the natural substratum hairy, funiculose, effuse, dark green, olivaceous, or brown. Mycelium superficial and immersed. Hyphae septate, branched, smooth, pale brown, 1–2 µm diam. CONIDIOPHORES micronematous, mononematous, simple or branched, septate, brown or olivaceous, smooth, sometimes reduced to a single conidiogenous cell. CONIDIOGENOUS CELLS monoblastic, terminal, determinate; sometimes polyblastic with sympodial proliferations, 5–10 × 3–6 µm. CONIDIAL SECESSION schizolytic. CONIDIA cylindrical, oblong to bacilliform, (2–)8–9(–16)-septate, olivaceous to pale olivaceous-brown or brown, (15–)25–10(–50) × 3–7 µm, repeatedly and randomly blastocatenate, forming several irregular chains from several indeterminate cells across the length of the conidial body. Teleomorph unknown.

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Phaeocollybia purpurea (*Cortinariaceae*), a new species from Wuyishan, China

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Abstract — A new species in *Phaeocollybia*, *P. purpurea*, is described in this paper based on collections from Wuyishan, Fujian Province, China. The new taxon is distinct within the genus for its persistently purple basidiomata, non-viscid pileus, and small basidiospores. The morphological characters used to distinguish the new species from its related species are also provided and discussed in this paper.

Key words —taxonomy, morphology, *Agaricales*, *Hymenogastraceae*

Introduction

Phaeocollybia R. Heim is an agaric genus, characterized by its umbonate pileus, subterranean pseudorhiza, brown ornamented basidiospores, and the presence of tibiiform diverticula (Smith 1957, Horak 1977, Redhead & Malloch 1986, Norvell 1998, 2000). The genus is widely distributed in moist temperate (Smith 1957, Horak 1977, Redhead & Malloch 1986, Rees & Wood 1996, Norvell 2000) and tropical zones (Singer 1970, Horak 1980, Horak & Halling 1991, Halling & Horak 2008). However, the ecological status of *Phaeocollybia* still remains uncertain. Smith (1957) inferred that the genus might contain both saprobes and mycorrhiza-formers, while Singer (1986) considered that members of the genus were not obligatorily ectomycorrhzial. Norvell (1998) presented evidence for consideration of *Phaeocollybia* as a mycorrhizal genus.

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Phaeocollybia is commonly placed in *Cortinariaceae* (Singer 1986, Kirk et al. 2008, Norvell & Exeter 2009) while Matheny et al. (2006) proposed a molecular-based classification placing the genus in *Hymenogastraceae*, for which further molecular research may provide more evidence. Of the 96 names published in *Phaeocollybia* (CABI 2010), ~50 species are currently accepted by Kirk et al. (2008). *Phaeocollybia* species have been mostly documented from North America and Mexico (Smith 1957, Singer 1970, Smith & Trappe 1972, Horak 1977, Redhead & Malloch 1986, Guzmán et al. 1987, Bandala et al. 1989, 1996, Norvell 2000, 2002, 2004, Norvell & Redhead 2000, Redhead & Norvell 2004, Norvell & Exeter 2007, Halling & Horak 2008), with some from Europe (Pearson 1952, Horak 1977), Asia (Horak 1974, 1977, 1980), South America (Singer 1970, Horak 1977, Horak & Halling 1991), and Oceania (Horak 1973, 1977, Rees & Wood 1996).

The first *Phaeocollybia* species described from China was *P. similis* (Bres.) Singer, based on a collection from Yunnan (Horak 1977). Later, more species were found in China, including a new species, *P. sparsilamellae* P.G. Liu (Liu 1995). Currently, there are 10 species of the genus reported from China (Bi et al. 1994, Deng et al. 2005, Yuan & Sun 1995, Wen et al. 2001, Liu & Qian 2002, Fan 2009).

During a recent expedition to Wuyishan, Fujian Province, China, an undescribed *Phaeocollybia* species was found. A full description of the new taxon is provided in this paper.

Materials and methods

The fresh basidiomata were photographed after collected from the field in the summer of 2009 and the macro-morphological characters were recorded in detail before drying in an oven at around 45°C. Color names were taken from Ridgway (1912). A 20% KOH solution was used on fresh pileus and stipe surfaces, lamella, and context for chemical reaction. Observation of the reactions was performed under ultraviolet light at a wave length of 360 nm. The specimens are housed in the Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences (also as Herbarium Mycologicum Academiae Sinicae, HMAS). Descriptions and line drawings of the micromorphological characters were based on dried collections. Thin sections were prepared by hand with a razor blade. The sections of dried basidiomata were mounted in 5% KOH solution. Basidiospores, basidia, tramal hyphae, context, and cutis of pileus and stipe were measured using an ocular micrometer. At least 30 basidiospores and 20 basidia of each mature collection were measured. The microscopic structures were drawn with the aid of a camera lucida.

FIG. 1. Basidiomata of *Phaeocollybia purpurea* (HMAS 250001, holotype).

Taxonomy

Phaeocollybia purpurea T.Z. Wei, S.Z. Fu, P.P. Qu & Y.J. Yao, **sp. nov.** FIGS 1–2.
MYCOBANK MB 518112

Pileus 2.0–6.0 cm latus, primo conicus, dein umbonato-applanatus, superficie primo obscuro-violaceus, atro-griseo-purpureus vel brunneo-purpureus, dein brunneus vel purpurate ferrugineo-brunneus, glaber, sericeus, nonviscidus. Lamellae adnatae, confertae, ad 4 mm latae, primo pallide violaceo-griseae, dein violaceo-griseae vel griseo-violaceae, demum brunneo-purpureae interdum maturitate ferruginescenter suffusae. Stipes centralis, 2.0–5.5 × 0.3–0.6 cm, cylindraceus, superficie atro-purpureo-griseus vel atro-griseo-violaceus, glaber, sericeus, fistulosus. Pseudorhiza ad 8.0 cm longa, concolor. Basidiosporae 3.5–5.0 × 3.0–4.0 µm, ovoideae vel ellipsoideae, brunneolae vel ferrugineo-brunneae, leviter verrucosae. Basidia 18.0–24 × 5.0–6.0 µm, clavata, tetraspora.

TYPE—CHINA, Fujian Province, Wuyishan National Nature Reserve, in broad leaved forest, 27°44.935'N, 117°40.652'E, alt. 715 m, 18 June 2009, T.-Z. Wei 300, **Holotype** HMAS 250001; Isotype K(M) 166177.

ETYMOLOGY—*purpurea*, from the Latin for 'purple', referring to the color of the basidiomata.

BASIDIOMATA scattered to gregarious. PILEUS 2.0–6.0 cm diam., conical at first, then convex, finally expanding to applanate with a bluntly pointed umbo; margin decurrent at first and then straight; surface dull violet (Dusky violet), dark grayish purple (Dull Dusky Purple) to brownish purple (Deep Livid Purple) when young, changing to brown (Liver Brown) or rust-brown (Hay's Russet) with distinct purplish tint, center more or less darker; smooth, glabrous, silky, hygrophanous, neither viscid nor lubricous when moist, opaque. CONTEXT up to 4.0 mm thick at center, fleshy, purple close to pileus cuticle, elsewhere pale gray with purplish tint. LAMELLAE adnate, up to 4.0 mm broad, ventricose, crowded,

with lamellulae; pale violet gray (Pale Violet Gray) when young, then violet-gray (Deep Violet Gray) to grayish violet (Dark Grayish Blue-Violet), brownish purple (Dark Livid Purple) with rust tint when mature; edge pallid, uneven in age. STIPE central, above-ground part 2.0–5.5 × 0.3–0.6 cm, cylindrical, with subterranean pseudorhiza; surface dark purplish gray (Vinaceous-Slate) to dark grayish violet (Dark Grayish Blue-Violet), occasionally tinted rust from basidiospores, smooth, glabrous, silky; hollow, with concolorous cortex; cortex 1.0–1.5 mm thick, brittle, cartilaginous. PSEUDORHIZA up to 8.0 cm long, rhizomorphic, cylindrical and hollow above, tapering below and solid, concolorous with stipe surface or slightly darker; cortex 1.5–2.0 mm thick, cartilaginous. VEIL REMNANTS not observed. BASIDIOSPORE DEPOSIT brownish rusty.

BASIDIOSPORES 3.5–5.0 × 3.0–4.0 µm, ellipsoid ovoid to ellipsoid with eccentric apiculus and bluntly round to pointed apical callus in profile, brownish to rusty brown, finely punctate to verruculose, thick-walled, inamyloid. BASIDIA 18.0–24×5.0–6.0µm, clavate, 4-spored, with long (up to 6µm) sterigmata, hyaline to subhyaline, thin-walled, basally clamped. LAMELLA EDGE heterogeneous, crowded with abundant cheilocystidia and few basidia. CHEILOCYSTIDIA abundant, 20–29(–40) × (2.3–)3.5–5.0 µm, clavate to ampullaceous, usually with a mucronato-capitate apex atop a short narrow refractive neck, hyaline, thin-walled. PLEUROCYSTIDIA none found. HYMENOPHORAL TRAMA 60–120 µm wide, regular, of thin-walled hyphae; hyphae 4.0–12.0 µm diam., hyaline, rare yellowish, thin-walled. SUBHYMENIAL LAYER 3.0–6.0 µm wide, of repent branched hyphae; hyphae 2.0–3.5 µm diam, thin-walled, hyaline to subhyaline. PILEIPELLIS bilamellate, compact, yellowish brown, of thick-walled gelatinized hyphae gel-encrusted with yellow-brown pigments often concentrating at septa; suprapellis 20-50 µm wide, hyphae 2.5–5.0 µm diam.; subpellis 80–150 µm wide, hyphae 5.0–15.0 µm diam, most elements thick-walled. PILEAL TRAMA of branched hyphae, hyphae normally 4.0–8.0 µm diam., sometimes inflating to 16 µm diam., thin-walled, hyaline to brownish, rarely with purplish content when observed in water. STIPITIPELLIS of longitudinally parellel hyphae, hyphae 1.5–4.0 µm diam., thick-walled, pale brown. STIPE TRAMA bilamellate, vessel hyphae longitudinally parallel, hyphae 5.0–20 µm diam., thick-walled (up to 3 µm wide); inner surface of longitudinally subparellel hyphae, hyphae 1.5–4.0 µm diam., thin-walled, hyaline, rare subhyaline. PSEUDORHIZA strongly sarcodimitic with thick-walled vessel hyphae predominant. TIBIIFORM DIVERTICULA thin-walled, hyaline, up to 12.0 µm long, 0.5–1.0 µm diam., abundant on pseudorhizal pellis and basal mycelium, subcylindrical and with globose apex, with no septum between base and hypha. CLAMP CONNECTIONS abundant in stipe trama, less frequent but present at basidial bases, cheilocystidia, pileipellis, and stipitipellis.

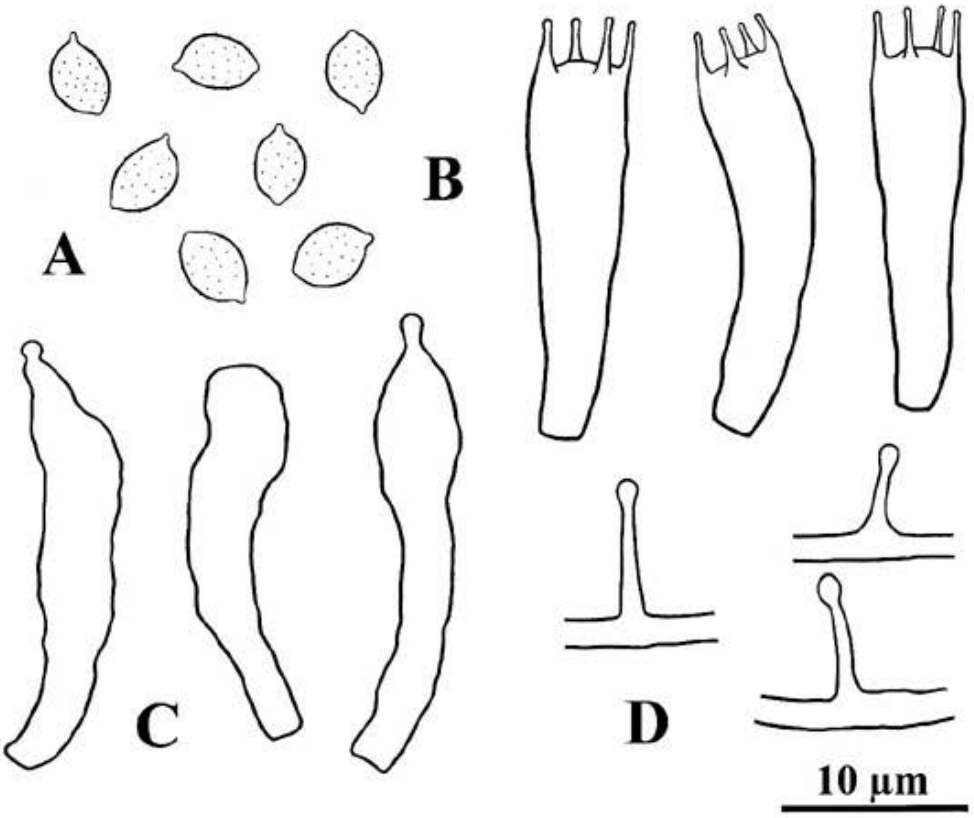

FIG. 2. *Phaeocollybia purpurea* (HMAS 250001, holotype).
A. basidiospores; B. basidia; C. cheilocystidia; D. tibiiform diverticula.

CHEMICAL REACTION with 20% KOH blackening at all parts. FLUORESCENCE REACTION UNDER ULTRAVIOLET LIGHT bright yellow in lamellae, pale yellow with purplish tint in context, violet-purple in all other parts. TASTE of context mild. ODOR of context indistinct.

HABITAT—on ground in forest dominated by broadleaf species and mixed with a few conifers, near *Quercus* sp. and *Cunninghamia* sp.

ADDITIONAL SPECIMEN EXAMINED – CHINA, Fujian Province, Wuyishan National Nature Reserve, in broad-leaved forest, 27°44.935'N, 117°40.652'E, alt. 715 m, 22 June 2009, Wei T.-Z. 595, HMAS 250002.

The two collections examined here are placed in *Phaeocollybia* based on their pileal umbo, cartilaginous stipe, long pseudorhiza, brown verrucose basidiospores, and tibiiform diverticula. The newly described *P. purpurea* is mainly distinguished from other taxa in the genus by its violet to purple basidiomata. Four other *Phaeocollybia* species — *P. amygdalospora* Bandala & E. Horak (Bandala et al. 1996), *P. parvispora* Corner & E. Horak (Horak 1977), *P. pseudolugubris* Bandala & E. Horak (Bandala et al. 1996), *P. singularis* E. Horak & Halling (Horak & Halling 1991) — produce similar basidiomata

with lilac, purple or violaceous tints all-over when young. However, the violet to purple colors persist in the new species whereas the violet tones are lost over time in the four species cited above. Further, *P. purpurea* is separated from *P. amygdalospora*, *P. pseudolugubris*, and *P. singularis* by its non-viscid pileus when moist and it smooth glabrous pileus lacks the appressed squamules typical of *P. parvispora*.

Microscopically, its small basidiospore size (3.0–5.0 × 3.0–4.0 µm) clearly separates *P. purpurea* from *P. amygdalospora* (6.0–9.0 × 4.0–5.0 µm, Bandala et al. 1996), *P. pseudolugubris* (8.0–10.0 × 4.0–5.0 µm, Bandala et al. 1996), and *P. singularis* (8.0–9.5 × 4.5–5.0 µm, Horak & Halling 1991), all of which have amygdaliform to limoniform shaped spores. *Phaeocollybia parvispora* also has small ellipsoid basidiospores (3.4–4.5 × 2.5–3.0 µm, Horak 1977), but they are considerably narrower than those of the new species.

Two other species, *P. arduennensis* Bon and *P. bicolor* E. Horak, produce similar cheilocystidia, clamps, and small spores. In addition, the brown pileus of *P. arduennensis* has a purplish tinge, and the lamellae of *P. bicolor* are lilac at first. However, the ochreous orange lamellae of *P. arduennensis* (Bon 1992) contrast with the violet to brownish purple lamellae in *P. purpurea*, while *P. bicolor* is distinguished by an avellaneous to light brown pileus and the absence of a pseudorhiza (Horak 1977).

DNA sequences derived from the nuclear ribosomal DNA internally transcribed spacer region (nrDNA-ITS) from our laboratory specimens and compared with sequences now on deposit in Genbank support *P. purpurea* as a distinct species in *Phaeocollybia* that clusters with *P. ratticauda* E. Horak (AF501568.1: voucher BRV 99/11) in the same terminal clade but with relatively long branches (unpublished data). *Phaeocollybia ratticauda* resembles *P. purpurea* in lilac coloration (lamellae and stipe) and small basidiospores (5.0–6.0 × 3.5–4.0 µm). However, its dark brown to liver brown pileus (Horak 1973) differentiates *P. ratticauda* from *P. purpurea*. The results of our DNA sequence analyses of *Phaeocollybia* species will be published elsewhere.

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Contributions to the lichen flora of the Hengduan Mountains, China 1. Genus *Pseudephebe* (lichenized *Ascomycota, Parmeliaceae*)

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Abstract — *Pseudephebe pubescens* is reported, described and illustrated from the Chinese Hengduan Mountains region. It is characterized by its slender and isotomic-dichotomous branched filaments forming tiny cushions, a cortex of longitudinally oriented hyphae that become prosoplectenchymatous at the surface, medullary hyphae that are not ornamented, and the absence of lichen substances. It grows on arctic-alpine rock.

Key words — alpine lichens, Sichuan, taxonomy, thallus anatomy, Xizang

Introduction

The Hengduan Mountains are part of the Himalayas located in southern China, including western Sichuan, northwestern Yunnan, and southern Xizang (Tibet). This mountain range has an area of ca. 364,000 km^2. The region has one of the highest biodiversities of lichens in the world. In recent decades, many interesting lichens were found in the region (McCune et al. 2003, Jørgensen 2003, Obermayer 1997, 2001, 2003, 2004; Wang et al. 2001, 2003, 2005; Xiao et al. 2006, Niu et al. 2007, 2008). Although we began our taxonomic work under the series entitled "Taxonomic study on the lichen genus *Bryoria* (lichenized *Ascomycota, Parmeliaceae*) from the Sino-Himalayas" (Wang et al. 2006), we prefer to title the new series as in the present paper, because the Hengduan Mountains form a more distinct biogeographical region than the Sino-Himalayas. In this paper, the genus *Pseudephebe* is reported from the Hengduan Mountains as new for China.

Materials and methods

The four specimens were collected in W-Sichuan and S-Xizang between 2001 and 2007. The collections were annotated and photographed in the field. Descriptions of external morphology were based on air-dried materials observed under a dissecting stereomicroscope. Sections were made with a razor blade under the stereomicroscope, and mounted in GAW (glycerol: ethanol: water=1:1:1). SEM micrographs were obtained with the scanning electron microscope JEOL JSM-5410 LV of National Instrumentation Center for Environmental Management, Seoul National University. Thin-layer chromatography (TLC) was performed to identify lichen chemical compounds with three developing solvent systems (Culberson 1972). The specimens used in this study are deposited in the Cryptogamic Herbarium, Kunming Institute of Botany, Academia Sinica (KUN).

Taxonomy

Pseudephebe M. Choisy, Icon. Lich. Univ. ser. 2, fasc. 1: [sine pag.] (1930).

TYPE SPECIES: *Pseudephebe pubescens*

Thallus fruticose, appressed to the substrate; branching isotomic-dichotomous, the branches terete but tending to become dorsiventrally compressed in one species, even or uneven, brown to black, dull to shiny; cortex of longitudinally oriented hyphae which become prosoplectenchymatous at the surface; medullary hyphae not ornamented. Apothecia lateral; thalloid margin concolorous with the thallus, sometimes ciliate, asci clavate; spores 8, ellipsoid, hyaline, simple, 7–12 x 6–8 µm. Pycnidia common. Lichen products absent.

Only two species of this genus are known worldwide (Brodo & Hawksworth 1977, Nash et al 2002: 409-411).

Pseudephebe pubescens (L.) M. Choisy, Icon. Lich. Univ., ser. 2, 1: [sine pag.] (1930). FIGS. 1–3

≡ *Lichen pubescens* L., Sp. Pl. 2: 1155 (1753).

≡ *Alectoria pubescens* (L.) R. Howe, Classif. Usneac. Amer.: 23 (1912).

Thallus fruticose, decumbent to subpendulous, forming small cushions, loosely adnate, more or less circular c. 2–12 cm diam., brown to blackish brown, smooth, dull to slightly shining; main branches slender, cylindrical, uneven, 0.1–0.2 mm diam., 0.05–0.1mm near the tips; branching frequent, isotomic-dichotomous, not flattened; sometimes with circular pits presented on the surface (FIG. 2); true lateral spinules, soredia, isidia and pseudocyphellae absent; Cortex 50 µm thick, 2-layered, with rectangular to irregular and knobby cells at the surface; medulla white, medullary hyphae not ornamented (FIG. 3). Apothecia not seen. Pycnidia common on tubercles, especially near the axils

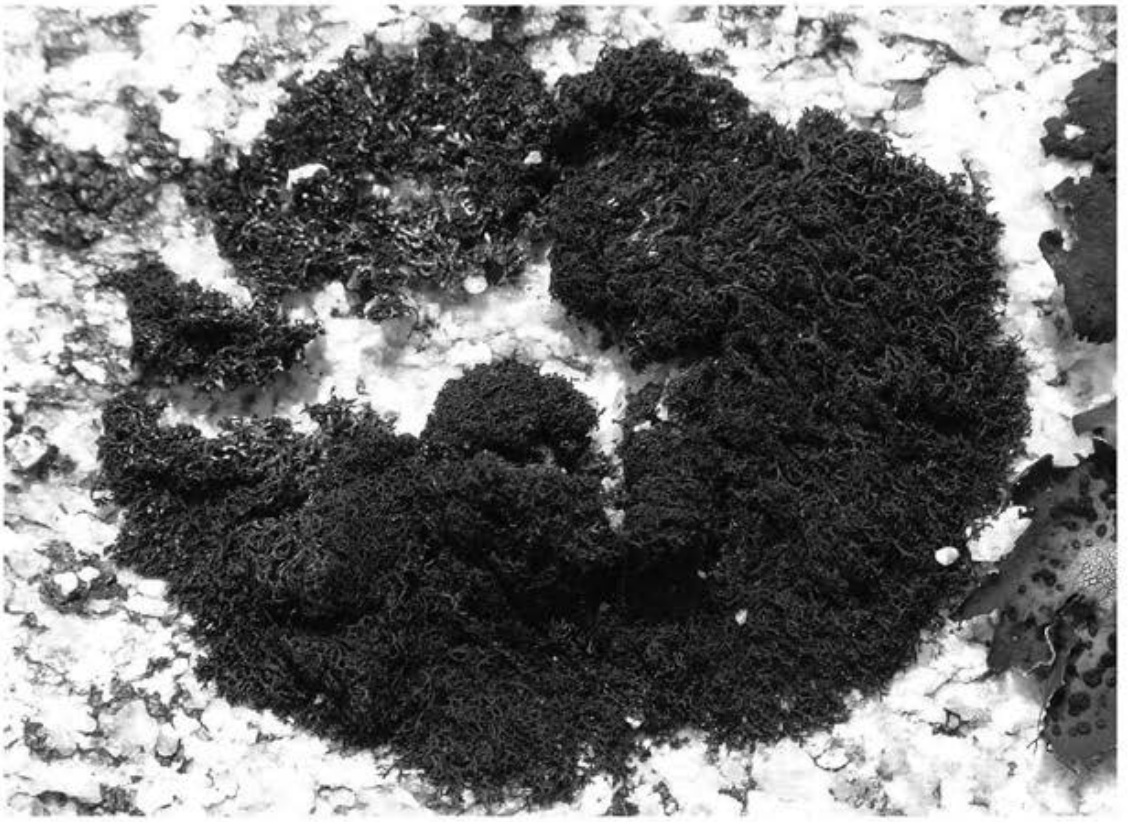

FIG. 1. Habit of *Pseudephebe pubescens* in its natural habitat in Sichuan, China (photograph by Wang, 5 June 2006, voucher: Wang Li-song 06-26090).

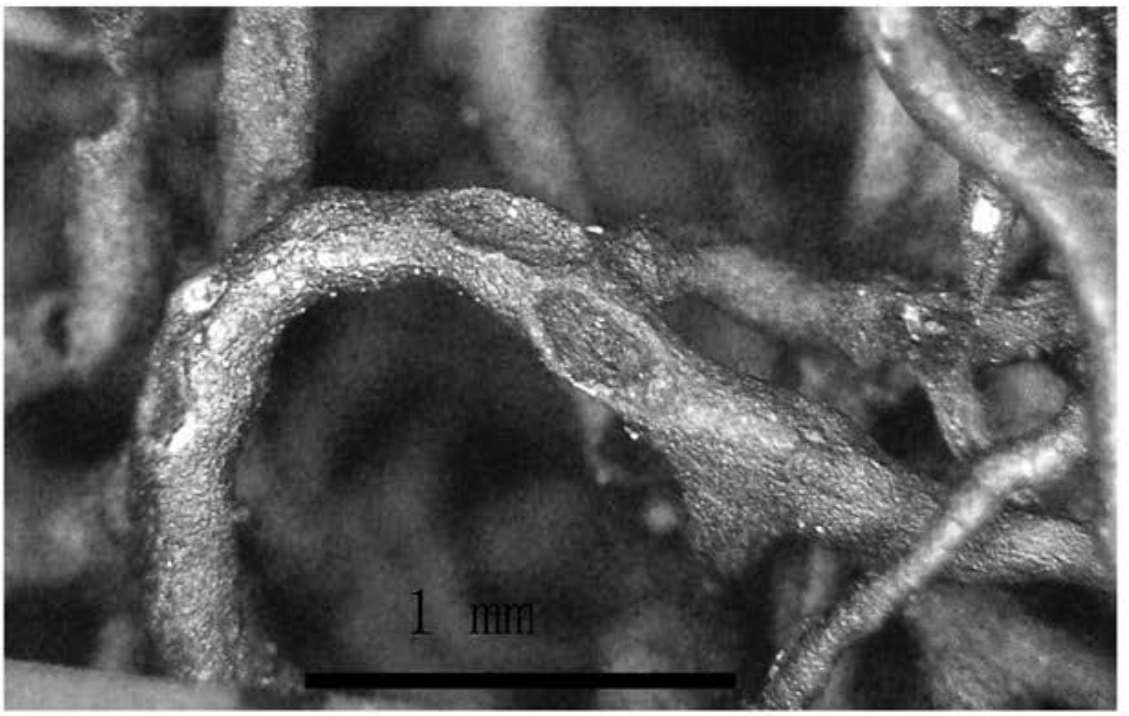

FIG. 2. Close-up of the thallus of *Pseudephebe pubescens*, showing uneven main branch sometimes with circular pits on the surface of the cortex (under the dissecting stereomicroscope; Wang Li-song 06-26090).

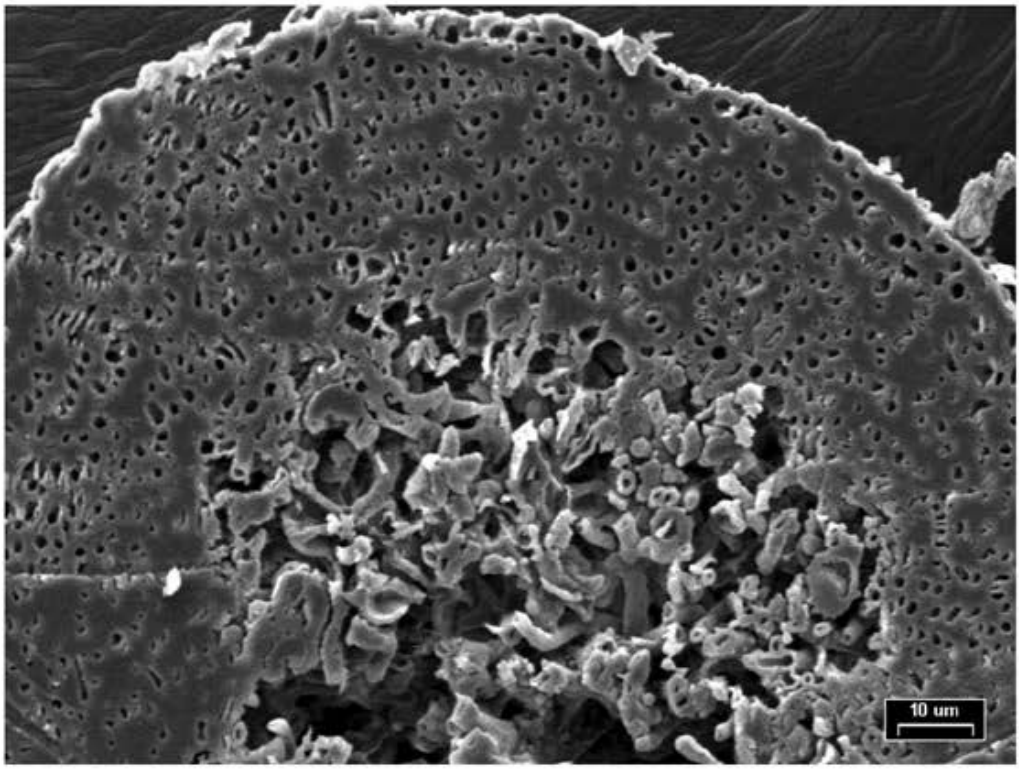

FIG. 3. Cross section of the main branch of *Pseudephebe pubescens* under SEM (Wang Li-song 83-2152a).

and bases, dark brown to black, 0.5–0.7 mm diam., conidia bifusiform, 6–7.5 x 1–2 µm, colorless. Photobiont: green algae. Cortex and medulla: K–, C–, KC–, P–; no lichen substances detected by TLC.

HABITAT AND ECOLOGY —Thallus loosely attached on siliceous rock surfaces, forming small cushions (FIG.1). All collections were from the alpine zone, between 4330 and 5070 m elevations in the Hengduan Mountains. Associated species included *Umbilicaria indica*, *Ophioparma ventosa*, *Rhizoplaca chrysoleuca* and *Rhizocarpon* spp.

DISTRIBUTION —*Pseudephebe pubescens* is widely distributed. It is found in Europe (Hawksworth 1972), North America (Brodo & Hawksworth 1977), California (Nash et al. 2002: 409-411), the Alaskan arctic slope (Thomson 1979: 240-241), Japan (Kurokawa et al. 1968, 1981), and the southern hemisphere (Brodo & Hawksworth 1977). It is new to China (FIG. 4).

SPECIMENS EXAMINED—**CHINA. Sichuan** Prov., Kingding County, Zheduoshan Mt., 30° 04' N, 101° 48' E, 4200–4330 m, on rock, Wang Li-song 06-26090, 07-29009; Muli County, Sanqu village, 4400 m, on rock, Wang Li-song 83-2152a; **Xizang** (Tibet) Prov., Naidong County, 28° 37' N, 92° 13' E, 5070 m, on rock, Wang Li-song 07-28595 (FIG. 4). Additional specimens examined: numerous North American specimens and Finland: Lapponia enontekiensis(le). Enontekio, Hetta, Jyppyra, ad rupem in summon monte. 21 VII 1957, Coll. A. J. Huuskonen (no number).

COMMENTS —The main branches are wider (0.2–0.5 mm diam.) in specimens from the Alaskan arctic slope (Thomson 1979: 240-241) than in the Chinese materials, where they are only 0.2 mm in diam.

This species differs from *Pseudephebe minuscula* (Nyl. ex Arnold) Brodo & D. Hawksw. in that the latter has somewhat flattened branches and shorter internodes (Brodo & Hawksworth 1977). The two species do, however, tend to integrate. Although the Chinese specimens are somewhat smaller and have shorter internodes than typical *P. pubescens*, the absence of distinctly flattened branches indicates *P. pubescens*.

In North America *P. minuscula* tends to have a more continental distribution than *P. pubescens* (Brodo & Hawksworth 1977). Although the climate of the Hengduan Mountains has no close analog in North America, the Hengduan Mountain region is influenced by both continental and maritime air masses, offering a wide range of habitats for alpine lichens. The abundance of cyanolichens at lower elevations in some parts of the Hengduan Mountains suggests a suboceanic climate.

The genus *Pseudephebe* is close to the genus *Bryoria* Brodo & D. Hawksw., which also contains fruticose alpine species found on rocks from the Hengduan Mountain region. For example, *Bryoria nitidula* and *B. tenuis* are similar to *Pseudephebe* in having a dark brown to blackish thallus and medullary hyphae that are not ornamented. However, the alpine *Bryoria* species on rock are

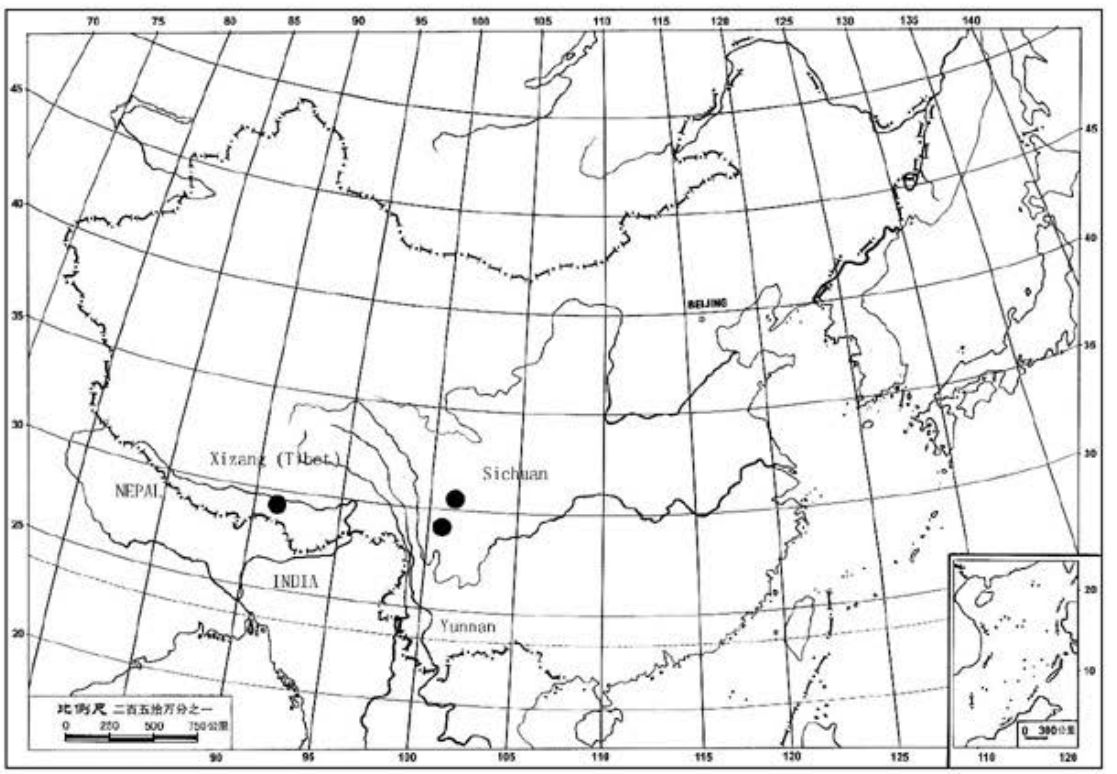

FIG. 4. Distribution of *Pseudephebe pubescens* in China.

usually larger (branches >3 cm long), have an erect to caespitose thallus and often have pseudocyphellae. Furthermore, they usually contain the substances atranorin or fumarprotocetraric acid.

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Myxomycete diversity from arid and semiarid zones of the Canary Islands (Spain)

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Abstract — A study of the myxomycetes recovered from the arid, semiarid, and dry zones of the Canary Islands is presented herein. A total of sixty-three species, most growing on succulent plants, is reported. *Physarum bethelii, P. confertum,* and *Stemonitis herbatica* are cited for the first time from the Canaries, with additional new records from each island. The importance of the endemic plants such as *Euphorbia canariensis* as substrates for myxomycetes is analyzed. As reported from other arid zones of the world species belonging to the orders *Physarales* and *Trichiales* dominate. *Badhamia melanospora*, commonly recorded from the deserts of America, was the most frequently recovered species from the Canaries. The parallel between the myxobiotas of the dry areas of the Americas and the Canary Islands is also discussed. The complete study and catalogue is available at http://www.mycotaxon.com/resources/weblist.html.

Key words — biodiversity inventory, Macaronesian bioregion, thermophilous habitats, xerophytic substrates

Introduction

The study of myxomycetes from the arid lands of the world is a subject of recent interest (Lado et al. 1999, 2009; Mosquera et al. 2000a,b, 2003; Wrigley de Basanta et al. 2008, 2009). Cacti and other succulent plants have been found to support a characteristic succulenticolous species assemblage (Lado et al. 1999). Inventories of the myxomycetes from some deserts, especially from the Americas and other regions of the world, have been published in the last decades (Blackwell & Gilbertson 1980; Novozhilov et al. 2006; Lado et al. 2007a,b; Estrada-Torres et al. 2009) but information about the myxomycetes of insular arid lands is very scarce (Eliasson 1971, 1991, 2004).

The Canary Islands are a group of islands of volcanic origin located in the Atlantic Ocean, between 27°40'–29°30'N latitude and 13°25'–18°10'W

longitude, approximately 100–500 km from the west African coast and the Sahara desert and on about the same latitude as Florida (USA). The Archipelago is composed of seven major islands (Hierro, La Palma, Gomera, Tenerife, Gran Canaria, Fuerteventura, Lanzarote) and a few smaller ones. Due to their volcanic nature the relief is very abrupt, and the elevation ranges from sea level to 3718 m, on Tenerife Island. The considerable elevation gradient produces substantial environmental variation with respect to temperature and moisture across the islands.

The vegetation of the Canary Islands is highly stratified due to the influence of climatic factors, altitude, and exposure. From a bioclimatic point of view, there are six ombrotypes in the Canaries (hyperarid, arid, semiarid, dry, subhumid, humid). From sea level to 200-400 m on their northern slopes and up to 600-1000 m on the southern side, there is an arid-semiarid-dry climate, characterized by high temperatures (18°-22°C) and low annual precipitation (50-350 mm). The vegetation of these zones represents a characteristic xerophytic scrubland (called "cardonal-tabaibal" in Spanish) with succulent plants and occasional aphyllous or spiny shrubs dominated by *Euphorbia* spp. with a high proportion of endemic plants (> 50%). Above the *Euphorbia* communities there are woodland and forest belts, followed by dry xerophytic summit vegetation represented only in the highest islands.

In several places the natural vegetation was replaced by cultivated plots, and many exotic species such as *Opuntia* spp. and *Agave* spp., were introduced. Presently these disturbed formations form part of the Canary landscape. These are the anthropic plant communities.

The overall aim of our investigation was to study the myxomycetes associated with arid, semiarid, and dry zones. As a result, most of the sampled stations were located in the lower elevations of the islands, between sea level and 500 m.

Material and methods

During eleven years (1994–2005) 72 localities were sampled at lower elevations (generally below 500 m) across seven of the Canary Islands. Microscopic measurements were made from material directly mounted in Hoyer's medium. An Olympus BH-2 and a Zeiss Jenemad-2 achromatic phase contrast microscope were used in the identification of the specimens. The specimens have been deposited in TFC Mic, and MA-Fungi herbaria. Nomenclature largely follows that of Lado (2001).

Results

A total of 63 species of myxomycetes were recovered, of which *Physarum bethelii* T.Macbr. ex G.Lister, *P. confertum* T.Macbr., and *Stemonitis herbatica*

Peck are reported for the first time from the Canaries. The taxa recovered were distributed across 21 genera, among which *Physarum* has the greatest representation with 15 species, followed by *Didymium* (12 species), and *Arcyria* (7). As reported from other arid zones of the world the species belonging to the order *Physarales* and *Trichiales* dominate. *Badhamia melanospora*, commonly recorded from the deserts of America, was the most frequently recovered species from the Canaries.

The analysis of the substrates was based on a total of 463 samples, collected from 34 vascular plant species, of which 14 are characterized by succulent biotypes, 19 are woody, and 1 herbaceous. The greatest number of myxomycete species (51) was collected from succulent plants. Of these 32 could be characterized as strictly succulenticolous, since they were only observed from this type of substrate, whereas the remaining species appeared on woody remains and/or leaf litter. *Euphorbia canariensis* was found to be the most productive substrate with respect to species richness among the endemic succulent species with a total of 117 collections distributed across 27 species of myxomycetes. *Opuntia maxima* was the most productive substrate among the introduced succulent species, with 138 samples belonging to 23 species of myxomycetes.

This study was carried out in the same way as research on the myxomycetes of arid lands in Mexico (Estrada-Torres et al. 2009). Some of the results have been similar and have resulted in several taxa new to science (e.g. *Cribraria zonatispora, Trichia agaves, Licea succulenticola,* and *Didymium wildpretii*) having been described based on material from both areas. Several centuries ago succulent plants and cacti from America were introduced to the Canary Islands to see whether they could become acclimated and be cultivated in Europe. Therefore, the similarity in the myxobiota of these areas could potentially have been influenced, as has been suggested previously (Lado et al. 2007b), by the introduction of these plants.

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A new species of *Ijuhya*, *I. antillana*, from the French West Indies

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Abstract — A detailed description of *Ijuhya antillana* sp. nov. is presented based on two collections on dead inflorescences of *Heliconia caribaea* in Guadeloupe and Martinique. The *Acremonium*-like anamorph has been obtained in culture. A key to the species of *Ijuhya* with fasciculate hairs is presented.

Key words —*Ascomycota, Bionectriaceae, Heliconiaceae*

Introduction

During the course of a research program on the fungal diversity of Lesser Antilles, conducted by Prof. R. Courtecuisse under the auspices of Société Mycologique de France with the funding from ONF (French Forest Office) and DREAL (Martinique delegation of French Environment ministery), interesting collections of *Hypocreales* have been made in different localities and ecological situations in Martinique and Guadeloupe. A species first collected in August 2007 in Martinique represents a new taxon of the genus *Ijuhya*. Later, a second specimen of the same species from Guadeloupe was cultured from single ascospores that produced an asexual state *Acremonium*-like. A description and illustrations of this new species are presented here.

Materials & methods

Specimens were examined using the methods described by Rossman et al, (1999). Microscopic observations and measurements were made in water and ascospore ornamentation was observed in lactic cotton blue.

Taxonomy

Ijuhya antillana Lechat & Courtec., **sp. nov.** FIGS. 1

MYCOBANK MB 516744

Ascomata subglobosa, apice applanata, 160–230 µm diametro, subhyalina vel aurantia, corona subapicalis pilis agglutinatis hyalinis vel aurantia, crasse-tunicatis, flexuosis composita, colore in KOH non mutanda. Asci 60–75 × 6.5 µm, octospori, unitunicati, inamyloidei. Ascosporae fusiformes vel ellipsoideae, (10.5–)11–13(–14) × 2.5–3.5 µm, uniseptatae, sublaeves. Status asexualis: Acremonii similis

HOLOTYPE: French West Indies, Martinique, Morne Rouge, la Propreté, 29 Aug. 2007, on dead inflorescence of *Heliconia caribaea* (*Heliconiaceae*), Christian Lechat CLL7321 (LIP); ex-type culture CBS 122797.

ETYMOLOGY: The epithet refers to The Lesser Antilles, the region where this species was collected twice.

ASCOMATA gregarious, solitary or crowded in groups of 2–3, superficial, subglobose, apex flattened with a minute papilla, 120–160 µm high × 160–230 µm diam (^{m} = 145 × 210 µm, n = 15), white when immature, later dark orange to brownish-orange, collapsing cupulate when dry, not changing colour in 3–5% KOH or lactic acid. Perithecial wall abundantly covered by flexuous hyphae 2.5–3 µm diam developing from ascomatal base, apex surrounded by thick-walled hairs except on papilla, hairs 100–160 µm long, 2.5–3 µm wide, pale yellowish to brownish-orange when dry, cylindrical, slightly flexuous, thick-walled, wall 0.7–1 µm thick, rounded at tip, septate, arising from cells of ascomatal wall, fasciculate, agglutinated into triangular teeth 100–160 µm long × 20–30 µm wide at base, arranged in a stellate fringe around upper margin of perithecia.

PERITHECIAL WALL 20–30 µm thick, composed of two regions: outer region 12–20 µm wide, of 3–5 layers of globose to elongate cells 3–10 × 3–4.5 µm with yellow wall; inner region 6–10 µm wide, of elongate, flattened, hyaline cells 5–10 × 1.5–3 µm.

ASCI 60–75 × 6–8.5 µm (^{m} = 71.5 × 8 µm, n = 20), clavate to fusoid, apex flattened, without ring, with 8 obliquely uniseriate or irregularly biseriate ascospores. No interthecial elements seen.

ASCOSPORES (10.5–)11–13(–14) × 2.5–3.5µm (^{m} = 12.7 × 3.2 µm, n = 30), hyaline, fusoid-ellipsoidal, straight, equally 2-celled, not constricted at septum, punctate-striate with 2 drops in each cell.

ANAMORPH: *Acremonium*-like

CULTURAL CHARACTERISTICS: After one week at 25°C on Difco PDA containing 5 mg/L streptomycin, colony 3–4 cm diam, mycelium white, producing an abundant *Acremonium*-like culture in center of colony, composed of

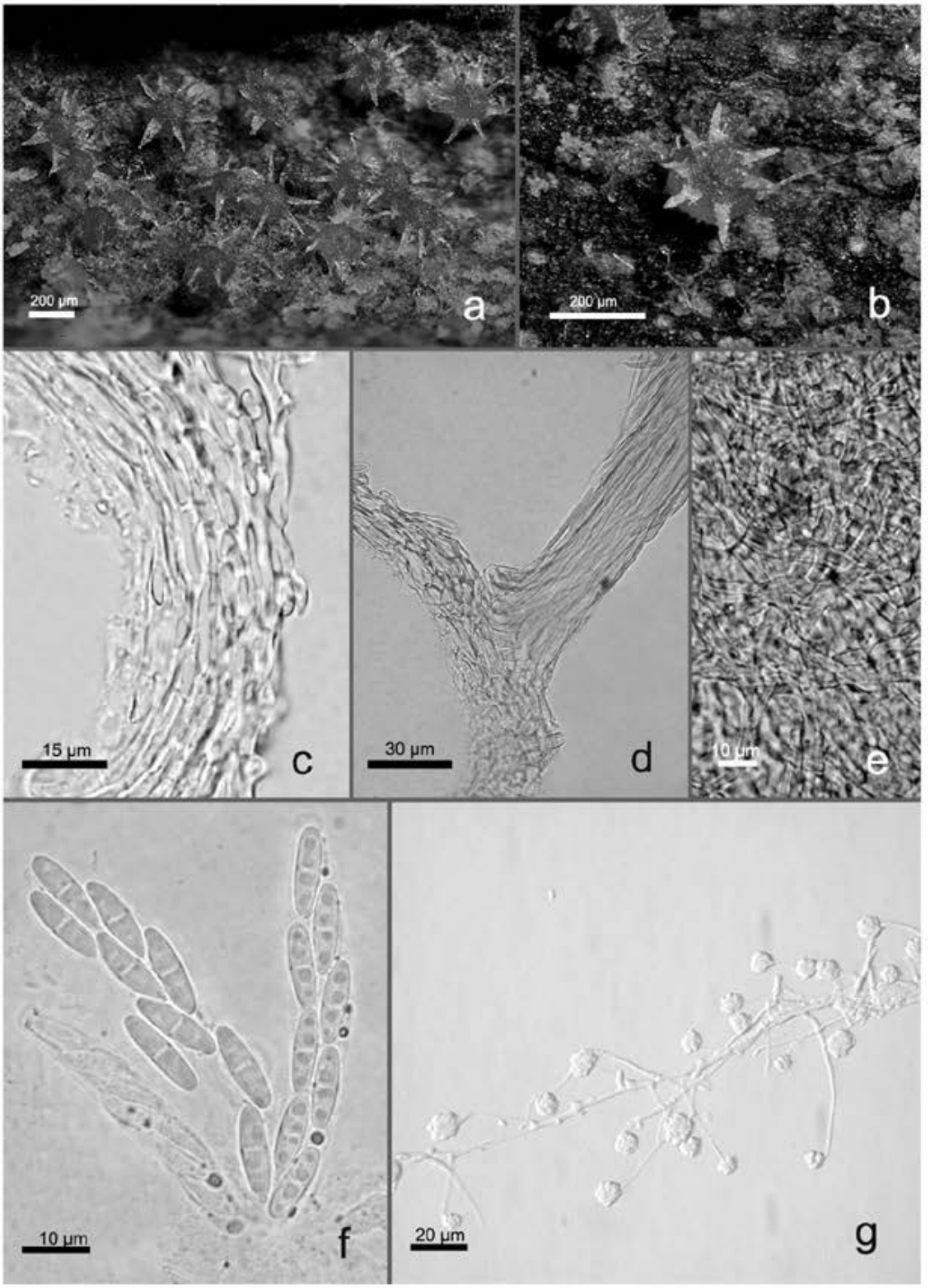

FIG. 1. *Ijuhya antillana*. a. Ascomata b. Single ascoma. c. Median section of perithecium. d. Fasciculate hairs. e. Hyphae covering ascomatal surface. f. Asci. g. *Acremonium*-like anamorph in culture. Additional photos at http://www.ascofrance.fr.\

monophialidic conidiophores, 28–60 µm long, 2–3 µm diam, arising from smooth hyphae 2–3 µm diam, producing ellipsoidal conidia (4.5–)5–7(–8) × 1.8–3 µm (^{m} = 6.4 × 2.4 µm, n = 30), hyaline, smooth, non-septate, with a basal abscission scar.

ADDITIONAL SPECIMEN EXAMINED: French West Indies, Guadeloupe, Petit Bourg, sentier de la Chute de Moreau, 14 Aug. 2008, on dead inflorescence of *Heliconia caribaea*, Christian Lechat CLL8321 (LIP).

Discussion

Ijuhya antillana is placed in the genus *Ijuhya* Starbäck based on the ascomata not changing color in 3% KOH or lactic acid, fasciculate hairs around the perithecial apex, striate ascospores, ascomatal wall of small, thick-walled cells and *Acremonium*-like anamorphs as defined by Rossman et al. (1999).

This species is related to several known species of *Ijuhya,* which have a stellate crown of fasciculate, agglutinated hairs around the perithecial apex, such as *I. chilensis* (Speg.) Rossman & Samuels (Rossman et al. 1999), *I. dentifera* (Samuels) Rossman & Samuels (Samuels 1976 as *Nectria dentifera*), *I. equiseti-hiemalis* Lechat & Baral (Lechat & Baral 2008), *I. peristomialis* (Berk. & Broome.) Rossman & Samuels (Rossman et al. 1999), and *I. parilis* (Syd.) Rossman & Samuels (Samuels 1988). The new species differs from these in size and ornamentation of ascospores and/or length of fasciculate hairs.

Key to species of *Ijuhya* with fasciculate hairs

1. Hairs 200–300 µm long; ascospores (24–) 30–60(–110) × 4–7(–8) µm, striate; ascomata pale yellow ..... ***I. peristomialis***
1. Hairs averaging less than 200 µm long 2
2. Ascospores averaging less than 12 µm long 3
2. Ascospores averaging more than 12 µm long 4
3. Ascospores (8.5–)9.5–11.5(–12.5) × 2.8–3.2(–3.5) µm, striate; ascomata brownish-orange, hairs 28–80 × 2–2.5(–3) µm ..... ***I. equiseti-hiemalis***
3. Ascospores 6–8(–9) × 3–4 µm, spinulose; ascomata orange-yellow, hairs 150–200 × 3–4 µm ..... ***I. dentifera***
4. Ascospores striate 5
4. Ascospores spinulose 14.5–20 × (2.5–)3–5(–5.4) µm, ascomata brownish-orange, hairs 30–50 µm long ..... ***I. parilis***
5. Ascospores (10.5–)11–13(–14) × 2.5–3.5 µm; ascomata dark orange, hairs 100–160 µm × 2.5–3 µm ..... ***I. antillana***
5. Ascospores (19–)21–28 × 3.5–4.5 µm; ascomata dull orange, hairs up to 100 µm long ..... ***I. chilensis***

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Status of some poorly known lichen species from the genus *Lecanora* (lichenized *Ascomycota*) in Poland

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Abstract — Taxonomic and chorological notes on four *Lecanora* species, misidentified or poorly known in Poland, are presented. *L. aitema* is reported from Poland for the first time; its status and previous reports in the country are discussed. *L. phaeostigma*, practically known only from historical publications, appears to be quite frequent in the Polish Carpathians. The current status of poorly known *L. ramulicola* is presented here based on revised literature and herbarium data. No specimen of *L. cadubriae* has been confirmed in Polish collections and all reports of this species from Poland, in fact, refer to *L. ramulicola*. Because of the misidentifications and nomenclatural confusion, *L. cadubriae* should be excluded from the list of Polish lichens. The taxonomy, nomenclatural remarks, chemistry, habitat requirements, and distribution of all taxa are discussed.

Key words — lichenized fungi, fungal diversity, chorology

Introduction

The lichenized fungi *Lecanora ramulicola* and *L. phaeostigma* have been generally considered rare in Poland. However, intensive field studies carried out by the first and third authors in large coniferous forests located in the Western Carpathians and the northern part of Poland revealed them to be quite common in this country. Moreover, detailed studies of herbarium materials referring to the *Lecanora symmicta*-group from the five biggest Polish collections show

that they had been collected in the past quite frequently but, for nomenclatural or taxonomic reasons, had never been published. In order to clarify this issue we initially focused only on these two species. During the study, however, we also found *L. aitema*, which has never been reported from Poland. In addition, we were interested in the possible occurrence of true *L. cadubriae* in this country, something that was unclear because of nomenclatural confusion; it was formerly synonymized in the Polish literature with both *L. ramulicola* and *L. phaeostigma*. Thus, here we elucidate the current status of *L. aitema*, *L. cadubriae*, *L. phaeostigma*, and *L. ramulicola* in Poland.

Materials & methods

The studied material originated from the following Polish herbaria: GPN, KRA, KRAM, KRAP, and UGDA. The morphology and anatomy of the specimens were examined using standard microscopic techniques. Secondary substances were analyzed by TLC (in solvents A, B, and C) according to the methods of Orange et al. (2001). Unknown fatty acids observed in *Lecanora ramulicola* samples were compared with angardianic/roccellic acid (extracted from *Lepraria caerulescens* (Hue) Botnen & Øvstedal), jackinic/rangiformic and norjackinic/norrangiformic acids (extracted from *Cladonia rangiformis* Hoffm. and *Lepraria jackii* Tønsberg). The localities are listed and mapped in the modified ATPOL grid square system (Cieśliński & Fałtynowicz 1993, see also Kukwa et al. 2002). The following abbreviations are used in the citation of localities: NP – National Park; fd. – forest district; fs. – forest section; vill. – village; vall. – valley; sl. – slope.

The species

Lecanora aitema (Ach.) Hepp PLATE 1A

SPECIMENS EXAMINED — POLAND, Carpathians: [Gd-17] – Pasmo Babiogórskie range, Krowiarki pass, alt. ca 1020 m, on horizontal surface of spruce snag, 22.06.1965, Nowak (KRAM-L–15917); [Gd-27] – Pasmo Babiogórskie range, Polica range, Zubrzyca Górna vill., Syhlec vall., alt. ca 900 m, on decaying stump, 23.06.1965, Nowak (KRAM-L–17168); [Ge-12] – Beskid Wyspowy Mts., Mogielica Mt., alt. ca 1170 m, on wood of decaying spruce stump, 06.08.1966, Nowak (KRAM-L–4630); [Ge-21] – Gorce Mts., N sl. of Czoło Mt., alt. 1200 m, on horizontal surface of *Picea abies* snag in well-lit place within upper mountain spruce forest, 30.07.1967, Glanc (KRAM-L–29696).

Lecanora aitema has not yet been reported from Poland, perhaps due to its unclear taxonomic status. Specimens of *L. aitema* were frequently considered to represent darker forms of *L. symmicta*, since these taxa differ essentially by apothecial pigmentation alone. The taxonomic status of *L. aitema* needs molecular resolution, but currently more and more lichenologists treat this taxon as a separate species (see below). A revision of some Polish collections of

'*L. symmicta*' shows that several of them have almost exclusively dark, blackish-grey, blackish-brown, convex to subglobose apothecia (PLATE 1A) and a slightly greenish thallus containing usnic acid and zeorin. The anatomical characters of the apothecia agree well with those described by Wirth (1995) for *L. symmicta* var. *aitema* and by Edwards et al. (2009) for *L. aitema*. We therefore decided to report *L. aitema* as new for Poland. Some Polish specimens originally labeled *L. symmicta* var. *aitema* are, in fact, *L. ramulicola*. It is interesting that we found only old specimens of *L. aitema* in the herbarium collections of *L. symmicta;* recent collections have not been made despite intensive field studies.

CHEMISTRY — Usnic acid, zeorin.

ECOLOGY AND DISTRIBUTION IN POLAND — The old collections show that *L. aitema* occurs on hard wood of conifers, mostly on horizontal surfaces of spruce stumps within upper mountain spruce forests in the Carpathians. This corresponds well with known ecological preferences of the species mentioned by Edwards et al. (2009). Accompanying species include: *Cladonia* spp., *Biatora pullata*, *Lecanora* sp., *Micarea denigrata*, *Parmeliopsis ambigua*, and *Xylographa parallela*.

WORLD DISTRIBUTION — The precise distribution of this species is not known since its taxonomic position at the species level has sometimes been questioned (see, e.g., Nimis 1993). Often, this taxon has been treated as *Lecanora symmicta* var. *aitema* (Ach.) Th. Fr., *L. symmicta* var. *saepincola* (Ach.) Nyl., or *L. aitema*. *Lecanora aitema* has been synonymized with *L. symmicta* (Ach.) Ach. and, under the latter name, it was mentioned in several national and regional checklists (Wirth 1995, Pišút et al. 1996, Ciurchea 1998, Hafellner & Türk 2001, Bielczyk 2003, Fałtynowicz 2003, Clerc 2004, Mayrhofer et al. 2005, Kossowska 2006). The name *L. symmicta* var. *aitema* has also been incorrectly used for *L. ramulicola*. For these reasons, a re-examination of *L. symmicta* s. l. collections is required to uncover the real global distribution of *L. aitema*.

Distributional data presented here include only reports of *L. aitema* or *L. symmicta* var. *aitema*, as these most probably refer to this taxon. As suggested by Nimis (1993), *L. aitema* appears to be widespread, at least in boreal and montane European regions. Indeed, it is reported from Greenland (Alstrup et al. 2009), the Czech Republic (Liška et al. 2008), Denmark (Søchting et al. 2007), Germany (Scholz 2000, Kanz et al. 2005, Dolnik & Neumann 2009), Great Britain (Smith et al. 2009), Ireland (Seaward 1994), Italy (Nimis 1993), the Netherlands (Aptroot et al. 2004), Fennoscandia (Santesson et al. 2004), and the European part of Russia (Hermansson et al. 1998). Esslinger (2009) has also reported *L. aitema* for North America.

Lecanora cadubriae (A. Massal.) Hedl. PLATE 1B

EXSICCATAE EXAMINED — Lichenes Alpinum 287: AUSTRIA, Steiermark, Schladminger Tauern, alt. ca 1350 m, an *Larix decidua*, 09.07.1973, Poelt (KRAM-L-25797); 318: Austria, Kärnten, Tauren, Kreuzeck-Gruppe, alt. ca 1850 m, an Stämmen von *Larix decidua* am Waldrand, 15.07.1978, Wirth & Hertel (KRAM-L-25827); 376: ITALY, Sudtirol: Zillertaler Alpen, Riesenferner-Gruppe, alt. 1850 m, an der Stamm-Basis einzeln am Hang stehender *Larix decidua*, 18.10.1979, Hertel (KRAM-L-25888); Rabenhorst, Lichenes europaei 731 & Massal. Lich. Ital. exs. N. 332!: Italy, Riva, sulla corteccia dei

Larici in varie localita, 1864, Abbé Carestia (KRA-17702); Lichenes Slovakiae Exsiccati 35: SLOVAKIA, Liptovské Tatry, ad corticem Laricis deciduae in monte Klinovate, alt. ca 1300 m, 10.08.1963, Vězda (KRAM-L-25902).

In the Polish literature (Bielczyk 2003), '*Lecanora cadubriae*' was synonymized under the illegitimate name *Lecidea ramulicola* H. Magn. published in 1952 (see Printzen & May 2002). The name '*Lecanora phaeostigma*' was also erroneously used as a synonym of *L. cadubriae* (Fałtynowicz 2003, Kossowska 2006) and it is probable that some published Polish reports of *L. cadubriae* refer to *L. phaeostigma*. However, most of the reported Polish samples of '*L. cadubriae*' appear to represent morphological forms of *L. ramulicola* with less developed apothecia than usual and a thick, cracked thallus (see under *L. ramulicola*). The characteristic secondary substances for *L. cadubriae* have not been detected in any available Polish specimen originally filed under this name. Thus its real occurrence in Poland is questionable. *Lecanora cadubriae* has been collected many times close to Poland in the Slovak Tatra Mts. (Lisická 2005). Considering this and other reports from Central Europe (e.g., Kanz et al. 2005, Liška et al. 2008) the Polish Tatra Mts. is the most probable area to discover the species for the national lichen biota.

CHEMISTRY — P+ orange, K+ yellow turning to orange; TLC: norstictic acid (major), ±stictic and ±salazanic acids (accessory substances).

WORLD DISTRIBUTION — The general distribution of *Lecanora cadubriae* extends from the boreal zone (including North America and Greenland) to the montane areas of Europe (Nimis 1993, Thomson 1997, Alstrup et al. 2009, Smith et al. 2009). The species appears in numerous European checklists and catalogues, being sparsely recorded inter alia from: the British Isles (Smith et al. 2009), the Nordic (Søchting & Alstrup 2002, Santesson et al. 2004) and the Baltic countries (Randlane & Saag 1999, Jüriado et al. 2003), Central Europe (Scholz 2000, Hafellner & Türk 2001, Kanz et al. 2005, Lisická 2005, Liška et al. 2008), the Balkans (Mayrhofer et al. 2005, Knezevic & Mayrhofer 2009) and the alpine regions of Italy and Slovenia (Nimis 1993, Suppan & Mayrhofer 2002). Furthermore, outside Europe and North America, the species was reported from Syria (John et al. 2004).

It seems that the lichen is rare but rather widespread in the Northern Hemisphere. It should be taken into account, however, that the name '*Lecanora ramulicola*' has sometimes been treated erroneously as a synonym of *L. cadubriae* and that some records of *L. cadubriae* refer, in fact, to *L. ramulicola*.

Lecanora phaeostigma (Körb.) Almb. PLATE 1C

SELECTED SPECIMENS EXAMINED — (if not otherwise stated, on wood of *Picea abies* within upper mountain spruce forest). POLAND, Carpathians: [Gd-16] – Western Beskidy Mts., Babia Góra Massif, Babia Góra NP, fs. no. 21A, 49°35'04.6"N / 19°32'15.3"E, alt. 1160 m, 03.07.2009, Czarnota 6156 (GPN); [Gd-17] – Babia Góra Massif, Babia Góra NP, fs. no. 18a, SE sl. of Sokolica Mt., 49°35'12.3"N / 19°34'07.8"E, alt. 1230 m, 08.06.2009, Czarnota 6044 (GPN); ibid., fs. no. 25, S sl. of Sokolica Mt., 49°35'02.3"N / 19°33'56.3"E, alt. 1265 m, 01.07.2009, Czarnota 6093 (GPN); [Gd-26] – Babia Góra Massif, Babia Góra NP, fs. no. 26h, S sl. of Kępa Mt., 49°34'07.7"N / 19°33'01.9"E, alt.

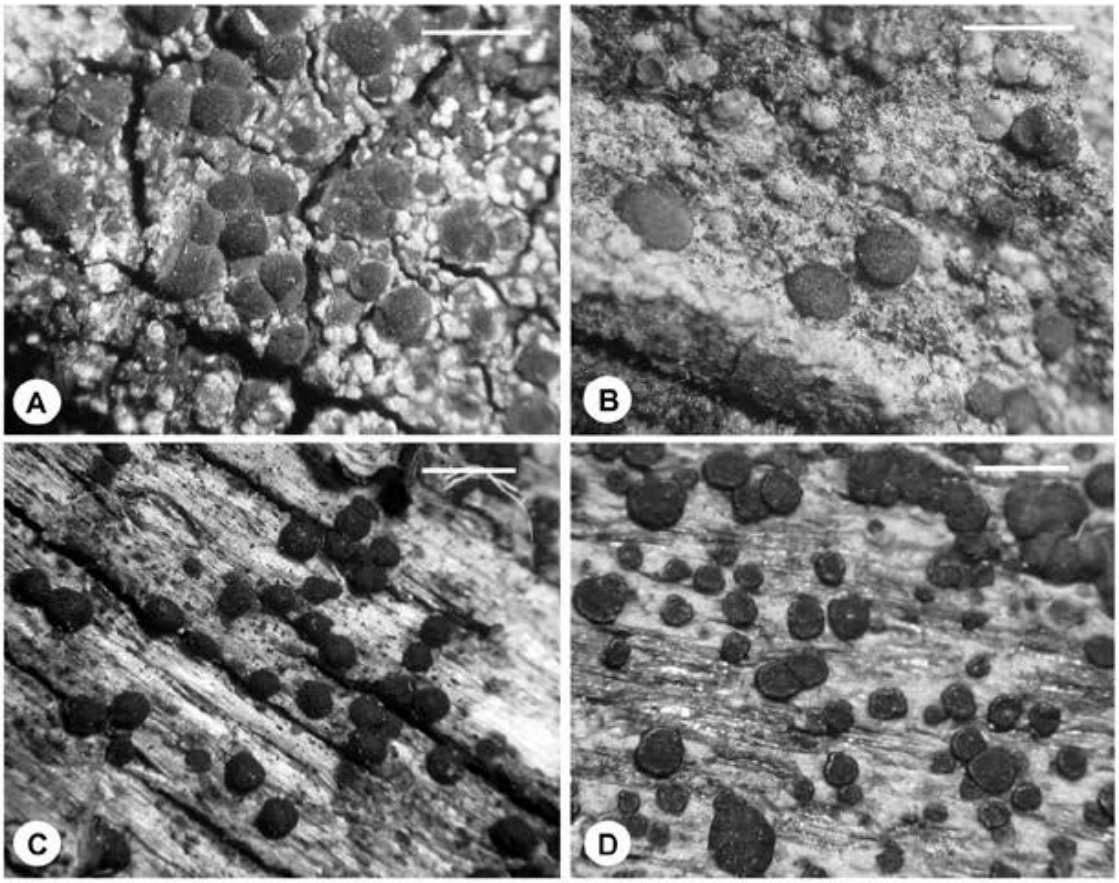

PLATE 1. Habits of discussed *Lecanora* species. A – *L. aitema* (KRAM-L-17168); B – *L. cadubriae* (KRA-17702); C – *L. phaeostigma* (GPN 6069); D – *L. ramulicola* (GPN 5771). Scale bars = 1 mm.

1365 m, 17.07.2009, Czarnota 6069 (GPN); [Gd-27] – Babia Góra Massif, Babia Góra NP, fs. no. 26h, S sl. of Kępa Mt., 49°34'07.8"N / 19°33'12.8"E, alt. 1290 m, 17.07.2009, Czarnota 6079 (GPN); [Ge-11] – Western Beskidy Mts., Gorce Mts., Gorce NP, W sl. of Gorc Kamienicki Mt. near Spaleniec stream, alt. 820 m, 27.03.2002, Czarnota 2754 (GPN); [Ge-20] – Gorce Mts., vall. of Lepietnica stream, W of Długie Młaki glade, alt. 1160 m, 12.09.1966, Glanc (GPN/5368; Ex KRAM-L–39562) and on bark of *Picea abies*, 12.09.1966, Glanc (KRAM-L–39186, as *Lecidea cadubriae*); ibid., Bukowina, Dolina Robowa vall., alt. 715 m, on bark of *Picea abies* within *Abieti-Piceetum*, 21.07.1965, Glanc (KRAM-L–39187, as *Lecidea cadubriae*); [Ge-21] – Gorce Mts., Gorce NP, fs. no. 136a, Dolina Kamienicy vall. above Mały Borek region, 49°33.619'N / 20°09.098'E, alt. 980 m, within *Abieti-Piceetum*, 06.09.2008, Czarnota 5723 (GPN); ibid., N sl. of Turbacz Mt. below the top, alt. 1280 m, 25.05.2001, Czarnota 5369 (GPN); ibid., W sl. of Mostownica range, alt. 1220 m, 23.07.2007, Czarnota 5458b (GPN); ibid., fs. no. 35d, E sl. of Czoło Mt., 49°33.160'N / 20°07.325'E, alt. 1200 m, 14.10.2008, Czarnota 5797 (GPN); [Ge-60] – Tatra Mts., High Tatra Mts., Tatra NP, NW sl. of Żabia Grań Mt. near the border Pl-Sk, alt. 1500 m, 09.07.2002, Czarnota 2874 (GPN, as *Lecidea hypopta*).

There are practically only historical records of *Lecanora phaeostigma* within Poland (Körber 1855, Stein 1879, Eitner 1901). These records accepted here are based only on the original and detailed descriptions included in Körber's and Stein's works. Stein included *Biatora phaeostigma* Körb., a basionym of

L. phaeostigma, as a synonym of *B. obscurella* (Sommerf.) Arnold. According to Zahlbruckner (1925), *B. obscurella* was based on *Lecidea pellucida* var. *obscurella* Sommerf. described in 1826 and raised to the species level as *Lecidea obscurella* (Sommerf.) Nyl. by Nylander in 1866. Hedlund (1892) mentioned this species as *Lecanora obscurella* (Sommerf.) Hedl. [nom. illegit. as a later homonym of *Lecanora obscurella* (J. Lahm.) Nyl. 1878], but surprisingly *Biatora obscurella* has recently been included in the synonymy of *Biatora tetramera* (De Not.) Coppins (Index Fungorum 2010), a species that is not congeneric with *Lecanora phaeostigma* in a current sense. In fact, the nomenclature of the taxa, not to mention the taxonomy, is highly complicated and warrants a separate study.

CHEMISTRY — 2-methylene-3-carboxy-18-hydroxynonadecanoic acid.

ECOLOGY AND DISTRIBUTION IN POLAND — *L. phaeostigma* grows frequently on hard wood of decorticate *Picea abies* trunks and, rarely, on the bark of usually dead spruces within upper montane spruce forest (*Plagiothecio-Piceetum*) and montane spruce-fir forest (*Abieti-Piceetum*) at altitudes between 820–1500 m. It prefers semi-shaded parts of trunks but tolerates well-lit localities within extensive insect damaged stands. Accompanying species usually include *Calicium abietinum, C. glaucellum, C. trabinellum, Fuscidea pusilla, Lecanora ramulicola, L. subintricata, Lecidea leprarioides, Parmeliopsis ambigua, Pycnora sorophora*, and *Strangospora moriformis*.

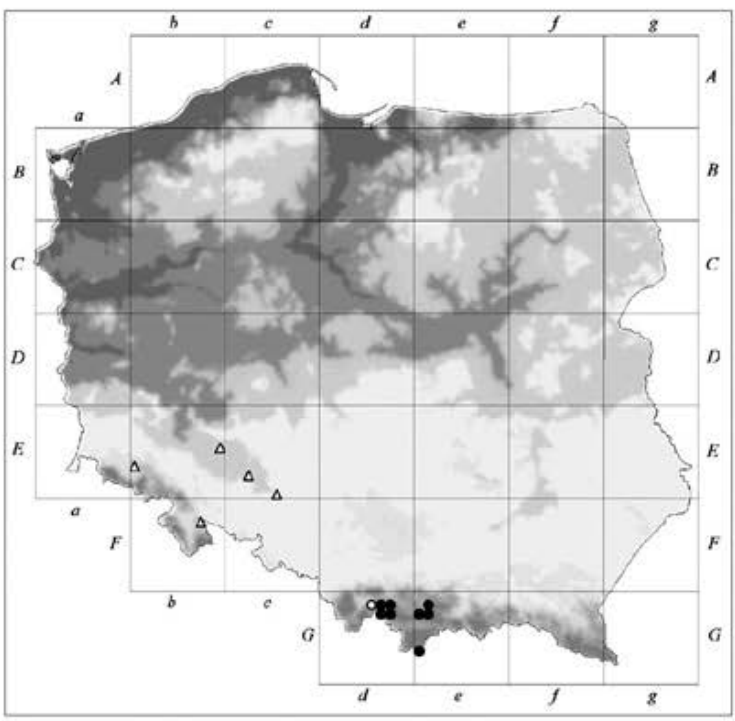

PLATE 2. Known distribution of *Lecanora phaeostigma* in Poland given in ATPOL grid square system (100×100 km): △ – historical data; ○ – recent record; ● – new findings.

The name of *Lecanora phaeostigma* has been reported recently from Poland only twice – from a locality in the Western Beskidy Mts. (Nowak 1998) and from the Polish Eastern Carpathians in the Low Bieszczady Mts. (Kiszka & Kościelniak 1998). Unfortunately, there are neither detailed localities nor any ecological data given in the latter report. Moreover, the species was omitted in later lists compiled for that region (Kościelniak & Kiszka 2003, Kościelniak 2004), from which it has not been reported since 2004. The occurrence of *L. phaeostigma*, however, is possible in the Polish Bieszczady Mts. since it is known in the Ukrainian part of the Eastern Carpathians (Kondratyuk et al. 1998). PLATE 2 shows the known distribution of the species including the old reports cited above.

WORLD DISTRIBUTION — *L. phaeostigma* is regarded as a rare but rather widespread species in Europe. It was reported throughout the continent from Fennoscandia, Western Russia, and Estonia (Randlane & Saag 1999, Jüriado et al. 2003, Santesson et al. 2004, Urbanavichus et al. 2008), Romania and Bulgaria (Ciurchea 1998, Mayrhofer et al. 2005), Germany, Austria, and Switzerland (Scholz 2000, Hafellner & Türk 2001, Clerc 2004, Kanz et al. 2005, Pfefferkorn-Dellali & Türk 2005), and France and Italy (Clauzade & Roux 1985, Nimis 1993). Close to Poland it is found in the Czech Republic and Ukraine (Kondratyuk et al. 1996, Kondratyuk et al. 2003, Liška et al. 2008). Outside Europe, the species was recorded from Mongolia (Biazrov 2009).

Lecanora ramulicola (H. Magn.) Printzen & P.F. May PLATE 1D

= *Lecidea saepincola* var. *ramulicola* H. Magn.

= *Lecidea ramulicola* (H. Magn.) Hillm.

SELECTED SPECIMENS EXAMINED — (if not otherwise stated, on wood or bark of conifers: *Pinus sylvestris* or *Picea abies*). POLAND: [Ac-35] – Wybrzeże Słowińskie coast, Szklana Huta fd., fs. no. 164b, 2.5 km E of Lubiatowo vill., on dead twigs of *Betula pendula*, 18.09.2000, Kowalewska (UGDA-L– 15484); ibid., fs. no. 109f, 3 km NE of Lubiatowo vill., on *Betula pendula*, 9.10.2000, Kowalewska (UGDA-L–15488); [Ac-36] – Wybrzeże Słowińskie coast, Białogóra nature reserve, 27.07.1982, Fałtynowicz (UGDA-L–1461); Białogóra fd., fs. no. 25g, 1 km NW of Białogóra vill., on *Betula pendula*, 10.10.2000, Kowalewska (UGDA-L–15490); ibid. fs. no. 29b, 2 km NW of Białogóra vill., on *Betula pendula*, 25.08.2000, Kowalewska (UGDA-L–15481); ibid., fs. no. 91g, 3 km W of Białogóra vill., on dead twigs of *Betula pendula*, 12.10.2000, Kowalewska (UGDA-L–15493); [Ac-38] – Wybrzeże Słowińskie coast, peat-bog Bielawskie Błoto, 30.09.1981, Fałtynowicz (UGDA-L–1401, as *L. symmicta*); [Ac-41] – Wybrzeże Słowińskie coast, Słowiński NP, Radek near Czołpino, 30.08.1988, Fałtynowicz (UGDA-L–3978, KRAM-L–22458, both as *L. symmicta*); [Ac-61] – Wysoczyzna Damnicka plateau, 1-2 km SE of Damnica vill., 20.11.1987, Fałtynowicz & Miądlikowska (UGDA-L–3752, as *L. symmicta*); [Bc-16] – Pojezierze Południowopomorskie lakeland, Bory Tucholskie forest, peat-bog near Drzędno Lake, 54°03'46"N / 18°00'34"E, 29.07.1983, Fałtynowicz (UGDA-L–1705, as *L. symmicta*); [Bc-25] – Bory Tucholskie forest, Grzybowski Młyn fd., fs. no. 365b, 2.5 km NE of Szludron village, 15.09.2002, Kowalewska (UGDA-L–15503); ibid., 1 km NW of Szludron village, 19.06.2002, Kowalewska (UGDA-L–15500); ibid., 0.5 km SW of Loryniec vill., 15.09.2002, Kowalewska (UGDA-L–15506); [Bc-26] – Bory Tucholskie forest, Lipa vill. at E shore of Wdzydze Lake, 53°59'24"N / 17°56'25"E, 13.09.2006,

Czarnota 5132 (GPN); [Bc-31] – Równina Charzykowska plain, „Niedźwiady" peat-bog nature reserve near Lipczynek vill., 26.07.1987, Fałtynowicz (KRAM-L–21769, UGDA-L–3108, both as *L. symmicta*); [Bc-65] – Bory Tucholskie forest, Biała fd., fs. no. 129, 16.08.2002, Czarnota 3077 (GPN); [Cg-64] – Nizina Północnopodlaska lowland, Równina Bielska plain, Białowieża Primeval forest, Hajnówka fd., fs. no. 572, 11.08.2002, Czarnota 3021 (GPN); [Fd-47] – Wyżyna Krakowsko-Częstochowska upland, Wyżyna Olkuska upland, Skalskie near Olkusz town, 06.04.1956, Nowak (KRAM-L–2556, as *Lecidea ramulosa*); [Fd-48] – Wyżyna Olkuska upland, Ojców vill., 01.05.1956, Nowak (KRAM-L–2446, as *Lecidea ramulicola*); [Fd-66] – Kotlina Oświęcimska depression, Rozkochów on Wisła River, 31.03.1960, Nowak (KRAM-L–6855, as *Lecidea ramulicola*); [Fd-93] – Western Carpathians, Western Beskidy Mts., Beskid Mały Mts., Przegibek pass, alt. ca 660 m, 23.08.1960, Nowak (KRAM-L–7583, as *Lecidea ramulicola*); [Fd-96] – Beskid Mały Mts., Łysa Góra Mt., alt. ca 510 m, close to the hiking track from Wadowice to Leskowiec, 19.04.1961, Nowak (KRAM-L–7065, as *Lecidea ramulicola*); [Fe-96] – Western Carpathians, Pogórze Rożnowskie foothills, Górowa vill., alt. 420 m, 11.09.1970, Kozik (KRAP, dupl. in KRA, as *L. cadubriae*); [Ff-03] – Kotlina Sandomierska basin, Puszcza Sandomierska forest, fs. no. 187, between Grębów and Stalowa Wola town, 07.09.1982, Kiszka (KRAP, as *Lecidea ramulicola*); [Ff-13] – Puszcza Sandomierska forest, Krawce fd., fs. no. 91, 28.09.1982, Kiszka (KRAP, as *Lecidea ramulicola*); [Fg-22] – Kotlina Sandomierska basin, Puszcza Solska forest, near Huta Różaniecka vill., 28.07.1984, Kiszka & Piórecki (KRAM-L, as *Lecidea ramulicola*); [Fg-23] – East Roztocze, Puszcza Solska forest, near Narol town, 20.07.1984, Kiszka (KRAM-L, as *Lecidea ramulicola*); [Gd-16] – Western Beskidy Mts., Beskid Żywiecki Mts., Babia Góra Massif, Babia Góra NP, Mała Babia Góra Mt., alt. 1460 m, 10.08.2001, Węgrzyn 379 (KRA, as *L. symmicta*); ibid., Babia Góra NP, fs. no. 24a, 49°35'10.5"N / 19°30'52.3"E, alt. 1230 m, 02.07.2009, Czarnota 6130 (GPN); [Gd-17] – Babia Góra Massif, Babia Góra NP, Sokolica Mt., alt. 1300 m, 30.08.2000, Węgrzyn 192 (KRA, as *L. symmicta*); ibid., fs. no. 25a, 49°35'01.0"N / 19°33'54.6"E, alt. 1265 m, 01.07.2009, Czarnota 6102 (GPN); ibid., fs. no. 18b, NE sl. of Sokolica Mt., 49°35'19.5"N / 19°33'39.9"E, 10.06.2009, Czarnota 5999 (GPN); Beskid Żywiecki Mts., Polica Mt., alt. ca 1300 m, 8.07.1965, Nowak (KRAM-L–15145, as *L. symmicta*); [Gd-58] – Tatra Mts., West Tatra Mts., Wielkie Koryciska, alt. ca 1000 m, 19.06.1998, Bielczyk (KRAM-L–44435, as *L. symmicta*); [Gd-59] – Obniżenie Orawsko-Podhalańskie depression, Rów Podtatrzański depression, Dolina Lejowa vall., Polana Biały glade, 49°17'02"N / 19°50'48"E, alt. 900 m, 17.07.2004, Śliwa 3257 (KRAM-L–54579, as *L. symmicta*); [Ge-11] – Western Beskidy Mts., Gorce Mts., Gorce NP, N sl. of Kudłoń Mt., alt. 1130 m, 24.08.1967, Glanc (KRAM-L–48422, as *L. symmicta*); ibid., vall. of Turbacz stream below Turbaczyk Mt., alt. 870 m, 04.11.1994, Czarnota 684 (GPN, as *L. cadubriae*); ibid., W sl. of Kudłoń Mt. close to Pustak glade, 49°33'14"N / 20°10'13"E, alt. 1200 m, 11.07.2008, Czarnota 5371 (GPN); ibid., vall. of Rosocha stream, alt. 780 m, 05.12.1994, Czarnota 672 (GPN, as. *L. symmicta*); [Ge-20] – Gorce Mts., by hiking track from Turbacz Mt. to Nowy Targ-Kowaniec, 12.09.1964, Glanc (KRAM-L–28344, as *Lecidea helvola*); [Ge-21] – Gorce Mts., Gorce NP, Dolina Łopusznej vall., below Gabrowska glade, alt. 1240 m, 27.08.1968, Glanc (KRAM-L–40264, as *L. symmicta*); ibid., fs. no. 136c, vall. of Kamienica stream below Jaworzyna glade, 49°33.415'N / 20°09.244'E, alt. 1075 m, 09.09.2008, Czarnota 5638 (GPN); ibid., fs. no. 35a, W sl. of Mostownica Mt., 49°33.302'N / 20°07.318'E, alt. 990 m, 08.10.2008, Czarnota 5818 (GPN); ibid., fs. no. 184b, W of Gabrowska glade, 49°32.624'N / 20°08.402'E, alt. 1240 m, 29.08.2008, Czarnota 5762 (GPN); [Ge-60] – High Tatra Mts., Tatra NP, N ridge of Żabia Grań Mt. on the border of Pl-Sk, alt. 1570 m, 09.07.2002, Czarnota 2921 (GPN);

ibid., ridge of Siedem Granatów Mt., 49°12'39.6"N / 20°05'25.0"E, alt. 1600 m, mountain stone pine and spruce forest, on *Pinus cembra*, 15.07.2006, Węgrzyn 3195 (KRA).

There are few literature records of *L. ramulicola* in Poland (Hillmann & Grummann 1957, Nowotarska 1976, Kozik 1977, Kiszka 1979, 1981a, b; Cieśliński et al. 1982 – all reported as *Lecidea ramulicola*; Printzen & May 2002, Kiszka 2008, Kubiak 2008 – reported as *Lecanora ramulicola*). Moreover, Nowak & Tobolewski (1975) mentioned that the species then occurred in the lowland and Carpathian foothills but did not include any detailed localities. Due to the nomenclatural and taxonomic confusion concerning this taxon between 1982 and 2002, there was a twenty-year-old gap in any information on *L. ramulicola* in Poland. Kiszka (1993) reflected that situation in Polish lichenology when he included *Lecidea ramulicola* as a synonym of *Lecanora cadubriae*. Since 1993, specimens of *L. ramulicola* have been usually cited in Polish literature exclusively (and erroneously) as *L. cadubriae* (e.g., Kiszka 1998, Kiszka & Grodzińska 2004). During our revision we found many specimens of *L. ramulicola* labeled as *L. cadubriae*. Some were originally labeled correctly as *Lecidea ramulicola* but later were annotated as *L. cadubriae* and thus never published. Although Printzen & May (2002) finally resolved the nomenclatural problems surrounding these species, distributional data of *Lecanora ramulicola* in Poland remained hidden under '*L. cadubriae*' (e.g., Bielczyk 2003), a species that probably has never been collected in Poland (see under *L. cadubriae*). Our revision showed also that *Lecanora ramulicola* was often misidentified as *Lecanora symmicta* (including *L. symmicta* var. *aitema*).

Taxonomical remarks — Darker forms of *Lecanora ramulicola* resemble *L. aitema* because of the similar apothecial pigmentation. The biatorine apothecia of *L. ramulicola*, however, are usually distinctly marginate, ±glossy and often concave when immature (Plate 1D). Moreover, the taxa are chemically distinct. According to Printzen & May (2002), *L. ramulicola* produces atranorin as a major compound together with one unknown substance. Some paler, mature, immarginate forms of *L. ramulicola* often resemble *L. symmicta*, but these species differ in the colour of thallus: distinctly ash-grey in *L. ramulicola* (because of the predominance of atranorin) and slightly yellowish green in *L. symmicta* (because of abundant usnic acid). In addition, the areoles of *L. ramulicola* are usually more coherent.

Printzen & May (2002) present an excellent description, and they discuss the affinities and differences between other taxa in the *Lecanora symmicta*-group (forming biatorine, mature apothecia and containing usnic acid as a major compound).

Chemistry — Atranorin, ±usnic acid, 1 or rarely 2 unidentified fatty acids. Most of the analyzed specimens contain usnic acid, but often, only small

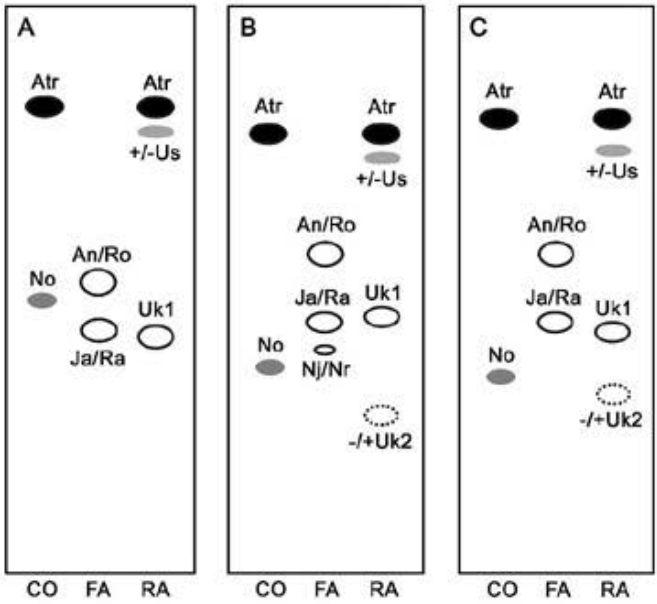

PLATE 3. Schematic diagram of chromatograms showing substances detected in *Lecanora ramulicola*, in solvent systems A, B, and C. CO – control; FA – selected fatty acids; RA – *L. ramulicola*. Compounds: An/Ro – angardianic/roccellic acid; Atr – atranorin; Ja/Ra – jackinic/rangiformic acid; Nj/Nr – norjackinic/norrangiformic acid; No – norstictic acid; Uk1 and Uk2 – unknown fatty acids; Us – usnic acid.

amounts of this substance were detected. Unknown fatty acids differ from substances mentioned in the Material and methods section (see PLATE 3). The first fatty acid (Rf classes A3-4, B4, and C4-5) is always produced whereas the second fatty acid (Rf classes A not detected, B2-3, C3) occurs sporadically. Only a dozen of the examined specimens contained trace amounts of this satellite substance.

ECOLOGY AND DISTRIBUTION IN POLAND — *Lecanora ramulicola* is widespread in Poland from the Baltic coast (Printzen & May 2002) to the Tatra Mts., and from close to sea level to the upper timberline at an altitude of 1500 m. Most of its known localities, however, lie to the south in the Western Carpathians. It usually grows there on the hard wood of branches and decorticate trunks of *Picea abies* within the upper montane spruce forest *Plagiothecio-Piceetum* or, more rarely, in the Carpathian beech forest of the lower montane belt. A few collections have also been made from the bark of conifers (e.g., *Picea abies, Pinus sylvestris, Abies alba*). It prefers well-lit places within dead stands destroyed by bark beetles and open localities at the edges of forest gaps. Large lowland pine forests are also favoured habitats. There, *L. ramulicola* grows both on bark and wood of *Pinus sylvestris* and frequently on the dead twigs of *Betula pendula*.

The known distribution of *L. ramulicola* in Poland is shown in PLATE 4. Localities from Upper Silesia mentioned by Kiszka (1993) for *Lecanora cadubriae*

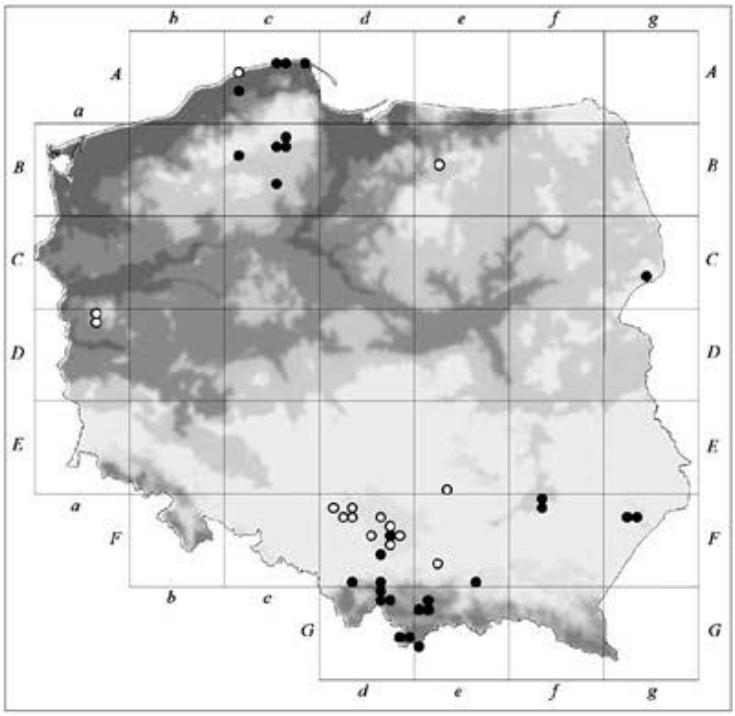

PLATE 4. Known distribution of *Lecanora ramulicola* in Poland given in ATPOL grid square system (100×100 km): ○ – previously reported localities; ● – new findings.

have been included here without taxonomic revision, since the specimens clearly refer to *Lecidea ramulicola*. Anyway, revision of those materials was impossible because the collection was unavailable in KRAP.

WORLD DISTRIBUTION — *L. ramulicola* was an overlooked lichen in the past and its general distribution is not yet well known. Printzen & May (2002) reported it from some central European countries (the Czech Republic, Poland, Germany) and North America (Canada and the U.S.A.). Later the species was reported from the Slovak part of the Tatra Mts. (Lisická 2005), the Iberian Peninsula (Pérez-Ortega & Printzen 2007), Western Russia (Kuznetsova et al. 2007) and some additional localities in Germany (Kanz et al. 2005, Dolnik & Neumann 2009).

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The epitypification of *Ophiostoma minutum*, now *Ceratocystiopsis minuta*

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Abstract — Siemaszko's (1939) illustrations and figure legends for *Ophiostoma minutum* are designated herein as the lectotype for *Ceratocystiopsis minuta*, and a strain UAMH 11218 [= WIN(M) 1532, = R. Jankowiak 705] isolated from perithecia in galleries of *Ips typographus* in stems of *Picea abies*, from Biebrzanski National Park (Polish: Biebrzański Park Narodowy), Werklye Protection Range, grown and dried on wood chips, is then designated as the epitype and deposited in UAMH. This specimen will serve as a reference in future studies on species of *Ceratocystiopsis* that use modern morphological, chemotaxonomic, and molecular approaches. Morphological details are also presented for the epitype material.

Key words — nomenclature, ophiostomatoid fungi, species delimitation

Introduction

The genus *Ceratocystiopsis* H.P. Upadhyay & W.B. Kendr., based on *Ceratocystiopsis minuta* (≡ *Ophiostoma minutum*), was erected to accommodate ophiostomatoid fungi that have short perithecial necks and falcate ascospores (Upadhyay & Kendrick 1975). Siemaszko (1939) did not mention a conidial state for his fungus, and none of his material is extant. However Upadhyay (1981) indicated the anamorph of this species is a *Hyalorhinocladiella* H.P. Upadhyay & W.B. Kendr. Additional significant papers in the history of the erection of *Ceratocystiopsis* are those of Davidson (1942) and Mathiesen (1951).

Davidson (1942) took up Siemaszko's name as "*Ceratostomella (Ophiostoma) minutum* Siem." for several isolates he obtained from stained sapwood and grubs of *Monochamus titillator* (Fabr.) infesting a single dead pine near the District of Columbia, U.S.A. And while fertile perithecia were produced by his isolates, cultures he started from single ascospores were sterile; no perithecia were formed. He also recorded that this fungus produced a "cephalosporium-

like" conidial state, but that the perithecia it produced were smaller than those measured by Siemaszko.

Next Mathiesen (1951) provided an amended description for *O. minutum*, based on a number of the collections from both spruce and pine trees that had beetle galleries in them of one of four different bark beetles; perithecia were found regularly amongst the frass in the galleries. She noted some differences in that several of her measurements fell between those recorded by Siemaszko and Davidson. She also provided a detailed description of what she, too, called a "cephalosporium-like" conidial state, but her figures illustrate more complex fruiting structures than do those of Davidson.

Upadhyay's (1981) treatment of the fungus, by then known as *Ceratocystiopsis minuta*, was based entirely on North American material, for he did not record a single off-shore specimen as having been examined. Yet while Davidson reported the perithecial necks were 45–90 µm in length, Upadhyay stated they were 45–150 µm long. He also assigned the conidial state to the genus *Hyalorhinocladiella*, even though *Hyalorhinocladiella minutibicolor*, the type species of that anamorphic genus, does not resemble the conidial state of *Ceratocystiopsis minuta* as figured by Mathiesen (1951). [The original spelling of the specific epithet "*minuta-bicolor*" has been corrected throughout in accordance with Articles 60.8 and 60.9 of the ICBN (McNeill et al. 2006).]

Historically, the genus *Ceratocystiopsis* was not accepted by Wingfield et al. (1988), Hausner et al. (1993), or Van Wyk & Wingfield (1993); indeed Hausner et al. (1993) formally reduced it to synonymy with *Ophiostoma*. Subsequently, Zipfel et al. (2006), who discussed the taxonomic placement of the falcate-ascospored, short-necked, ophiostomatoid fungi, re-instated the genus name *Ceratocystiopsis*. They placed eleven species in the genus, but addressed only briefly the taxonomic and phylogenetic inconsistencies that existed amongst the species, and it now appears likely that the specimen they selected to represent *Ceratocystiopsis minuta* in their study was an unfortunate choice; it was not explained. They also listed, with brief notes, eleven other species that might be linked in some way to accepted members of this genus.

Recently Plattner et al. (2009) reviewed the taxonomic and phylogenetic inconsistencies that surround strains and isolates of this species studied previously by various authors, and attempted to resolve them using a molecular-based approach. They made much progress, but the final result did not allow convincing conclusions to be drawn, although the extent of genetic diversity they uncovered within the complex showed clearly that several phylogenetic species have been combined under the name *Ceratocystiopsis minuta*. Unfortunately however, because neither herbarium material nor a viable culture exists that can be linked to Siemaszko's (1939) original description of the basionym *Ophiostoma minutum*, they could make no further progress. Thus there is still no true nomenclatural type to serve as a reference for current workers.

Plattner et al. (2009) considered designating a neotype (new nomenclatural type) for *O. minutum* but were unable to do so because none of the cultures they considered to be appropriate candidate strains-these were from Poland-produced fully mature perithecia. However, using a modified culture technique and one of Plattner et al.'s designated candidate strains, R.J. 705 (UM 1532), we have obtained a very substantial number of mature perithecia on both wood chips and agar surfaces, but neotypification is not the appropriate course.

Along with his formal Latin description, Siemaszko provided photographs of two separate perithecia (possibly separate photographs of the same perithecium at different magnifications), a photograph of a bark sample with beetle galleries filled throughout with frass in which perithecia can be seen, and a line drawing of 22 ascospores showing their shape as enclosed within their mucilaginous sheaths. All these illustrations are referenced with his description and are certainly part of the material upon which the Latin description validating the name was based. Thus lectotypification based on these elements, followed by designation of an epitype, will serve to define this name.

Materials and methods

Air-dried (20°C) wood chips were obtained from the face of the outer sapwood next to the inner bark of laboratory air-dried discs that had been cut from the stem of a healthy specimen of both *Picea glauca* (Moench) Voss and *Pinus sylvestris* L.; the chips, which ranged from 3.5–5 mm long, 1.5–2 mm wide, and up to 1 mm thick, were placed in a clean 600 ml beaker and flooded with enough of a solution containing 20 g malt extract, 1 g of yeast extract, and 0.02 g of thiamine hydrochloride per L distilled water to ensure the chips would be still fully covered when they became saturated. Next the beaker was placed in a sealed Nalgene Vacuum desiccator (Fisher Scientific, Fair Lawn, NJ), and the latter was then evacuated and allowed to stand overnight. The next day, after adding nutrient solution to ensure the chips were covered, the beaker was sealed with aluminum foil and autoclaved for one hour at 121°C. The stimulatory effect of thiamine on perithecial production has long been known (Barnett & Lilly 1947; Hawker 1957), and it has been used recently for this purpose with other ophiostomatoid fungi (van Wyk et al. 2004, 2006).

When cooled, in a sterile chamber the chips were aseptically placed flat on the medium surface of sterile Petri dishes; in the latter the medium had the same composition as the above nutrient solution, but with solidifying agar added at 20 g/L. Two separate inoculation series were undertaken; one used pine chips, the other spruce. Depending on the size of the chips, two to four were placed in each plate. Plates were then inoculated using 1 mm square blocks of mycelium cut aseptically from colony margins of stock plates of isolate RJ705. One block, mycelium face down, was placed immediately adjacent to each wood chip in a plate, and the plates were then incubated in the dark at 20°C for up to 60 days. In total, forty plates were inoculated: 18 with spruce chips (total 54) and 22 with pine chips (total 65).

Although *Ceratocystiopsis minuta* has been reported to occur on *Abies*, *Larix*, *Picea*, and *Pinus* spp. in association with a variety of bark beetle species, we used pine and spruce chips in our trials because spruce was the host recorded by Siemaszko (1939). Mathiesen (1951: 205), who recorded this species from both spruce and pine, observed that it occurred most commonly on pine, "meist auf Kiefer, weniger oft auf Fichte".

Six agar plates containing only the amended malt extract agar plus thiamine hydrochloride were also inoculated centrally with single blocks of mycelium to serve as controls. Morphological structures were mounted in 85% lactic acid (Fisher Scientific, Fair Lawn, N.J.), and processed for observation according to Hausner et al. (2003). For photography we used Melzer's Reagent (Kohn & Korf 1975) to contrast the spore bodies with their surrounding sheaths.

Results

As our purpose was to obtain appropriate material to serve as an epitype for *Ceratocystiopsis minuta*, only incidental cultural characteristics were recorded. Mycelium growth was slow, as Davidson (1942) and Mathiesen (1951) both noted with their isolates.

By day 10, the mycelium had grown onto the pine-wood chip surfaces, but less abundantly than onto the adjacent agar. On the agar surface it was white initially, but later became pale grey around the inoculation blocks; on wood, the mycelium remained white, and by this time small, pale grey, spherical bodies were present on both the wood and agar. Over the next 50 days many more spherical bodies formed in irregular patches on the mycelium on both the wood and agar surfaces, and a surprisingly large number of them matured into fertile perithecia.

Although initially the developing perithecial necks were darker than the perithecial bases, this slight "bicolored" condition disappeared as the perithecia continued to mature and was never as pronounced as that seen in perithecia of *Ceratocystiopsis minutibicolor* (R.W. Davidson) H.P. Upadhyay & W.B. Kendr. (Upadhyay & Kendrick 1975).

By day 20 there were abundant maturing/matured perithecia in localized patches on the agar and numerous more dispersed perithecia on the wood-chip surfaces. And by then the majority of the perithecia had become uniformly dark colored, and spore tendrils/droplets were seen at many neck apices (Fig. 1 A – E).

Over the next 40 days increasing numbers of mature perithecia formed, particularly on the wood chips, and at day 60 the plates were dried at 20 C in a drying oven, and stored for further study.

Although both Scots pine and white spruce chips were used in parallel inoculation trials, mature fertile perithecia formed only in the culture plates containing pine chips.

Nomenclature

Ceratocystiopsis minuta (Siemaszko) H.P. Upadhyay & W.B. Kendr., Mycologia 67(4): 800. 1975 FIGS 1A–E, 2

≡ *Ophiostoma minutum* Siemaszko, Plant Polonica 7: 23. 1939

≡ *Ceratocystis minuta* (Siemaszko) J. Hunt, Lloydia 19: 49. 1956

≡ *Ceratostomella minuta* (Siemaszko) R.W. Davidson, Mycologia 34: 655. 1942

Lectotypification

The status of the genus *Ceratocystiopsis* H.P. Upadhyay & W.B. Kendr. is in doubt because no holotype specimen exists for the species upon which it was based, i.e. *Ceratocystiopsis minuta* (≡ *Ophiostoma minutum*); indeed none of Siemaszko's herbarium material is now extant. However, in accord with Article 9.2 of the ICBN (McNeill et al. 2006), Siemaszko's (1939) illustrations typify his description.

LECTOTYPUS (designated here): Siemaszko's Planta Polonica 7: plate III: 10, 11, 12; fig. 1B. 1939.

Siemaszko (1939) did not refer to any specific collection but merely the tree host species and beetle with which the fungus is associated in a specific geographical area. Plate III: 10 and 12 are photographs of two perithecia, 11 perithecia in beetle galleries, and Fig. 1B shows line drawings of ascospores.

Epitypification

From the foregoing, the concept of *Ceratocystiopsis minuta* is now technically fixed, but Siemaszko's illustrations and description cannot possibly accommodate the needs of mycologists employing more modern morphological techniques or of those currently using chemotaxonomic and molecular methods to unravel relationships amongst various widespread populations of fungi such as *Ceratocystiopsis minuta*. Therefore we have chosen to designate an epitype.

EPITYPUS (designated here): UAMH 11218 (= a dried culture of WIN(M) 1532 = R. Jankowiak 705). ISOEPITYPE BPI 880579 (= R.Jankowiak(R.J. 705)/1532).

The strain was isolated from perithecia in galleries of *Ips typographus* (L.) in stems of *Picea abies* (L.) H. Karst., Biebrzanski National Park (Polish: Biebrzański Park Narodowy), Werklye Protection Range, Northeastern Poland, R. Jankowiak, date not given, and grown and dried by us on wood chips on agar.

Description of the epitype

Perithecia on wood and agar form initially as pale grey, spherical bodies with a lighter coloured central area from which the neck develops. Young necks initially darker than the perithecial base, bicolored phase gradually disappears with maturity; the upper portion of the base darkens first, the

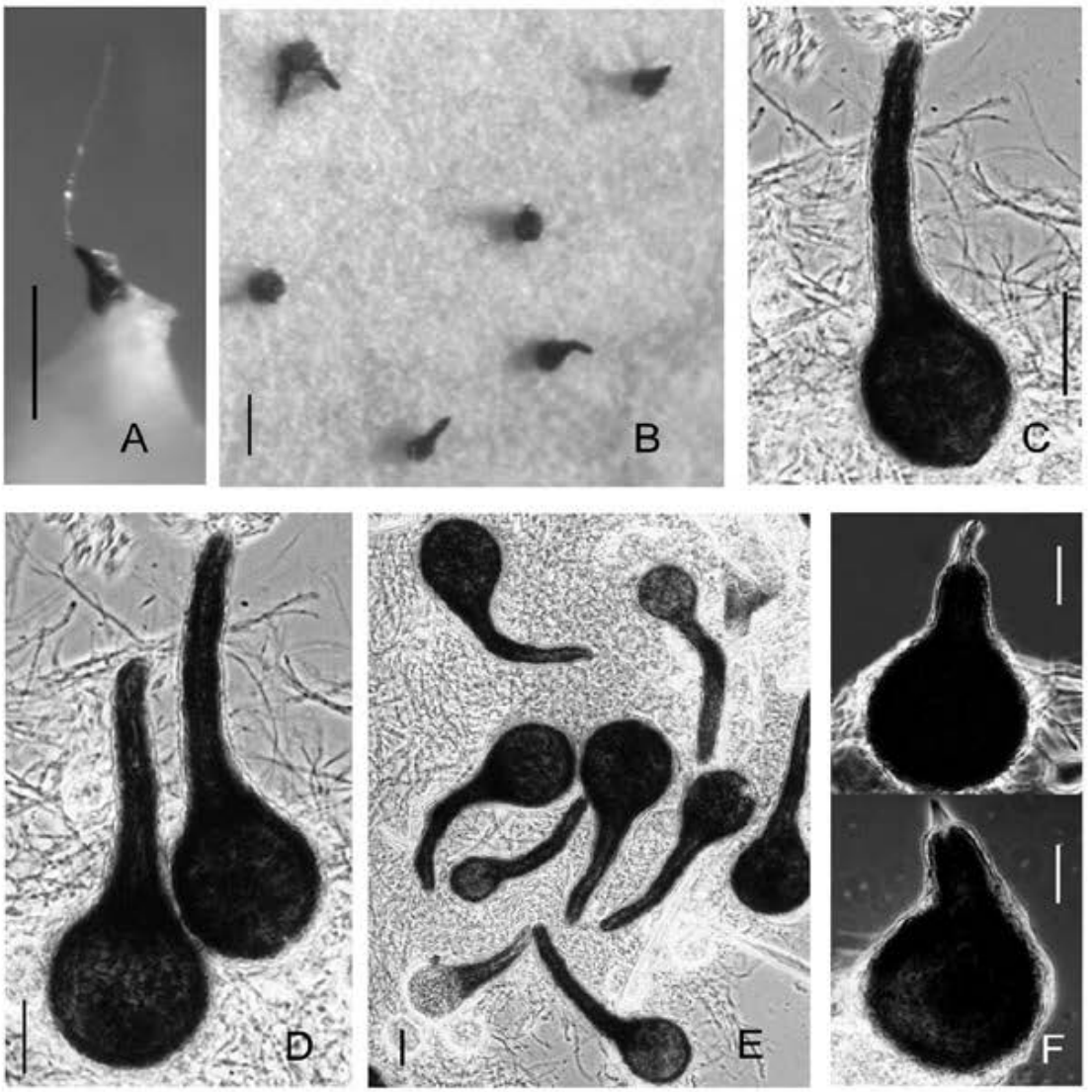

FIG. 1: A–E. *Ceratocystiopsis minuta* epitype UAMH 11218 [WIN(M) 1532]. A. A single perithecium, with an extruded spore tendril, on hyphal elements. B. Mature perithecia on the mycelium surface. C–E. Maturing and mature perithecia. Note the color variations in the young perithecia in E, and the extruded ascospores in D. F. *Ceratocystiopsis minuta* CBS 116795 [WIN(M) 1511]. Perithecia produced by this isolate in culture on wood; show the significant morphological differences apparent between the appearance of these perithecia and those produced by UAMH 11218. Scale bars: A and B = 250 µm; C–F = 30 µm.

darkening spreading downwards over time. Mature perithecial bases globose to obpyriform, surface smooth to slightly irregular, very rarely with short brown hairs, dark-brown to black in color; base width 37.5–87.5 (sd = 59.41 ± 13.17) µm, base height 37.5–97.5 (sd = 58.7 ± 14.58) µm. Perithecial necks with smooth to irregular surfaces, 20–45 (sd = 28.89 ± 6.8) µm wide at the base, tapering to 7.5–17.5 (sd = 13.8 ± 4.98) µm and narrowest at the apex; 70–175 (sd = 113.4 ± 17.98) µm long, ostiolar hyphae not included. Ostiolar hyphae up to 12 µm long); 1.5 µm wide at the base and tapering to a slightly blunted point; hyaline

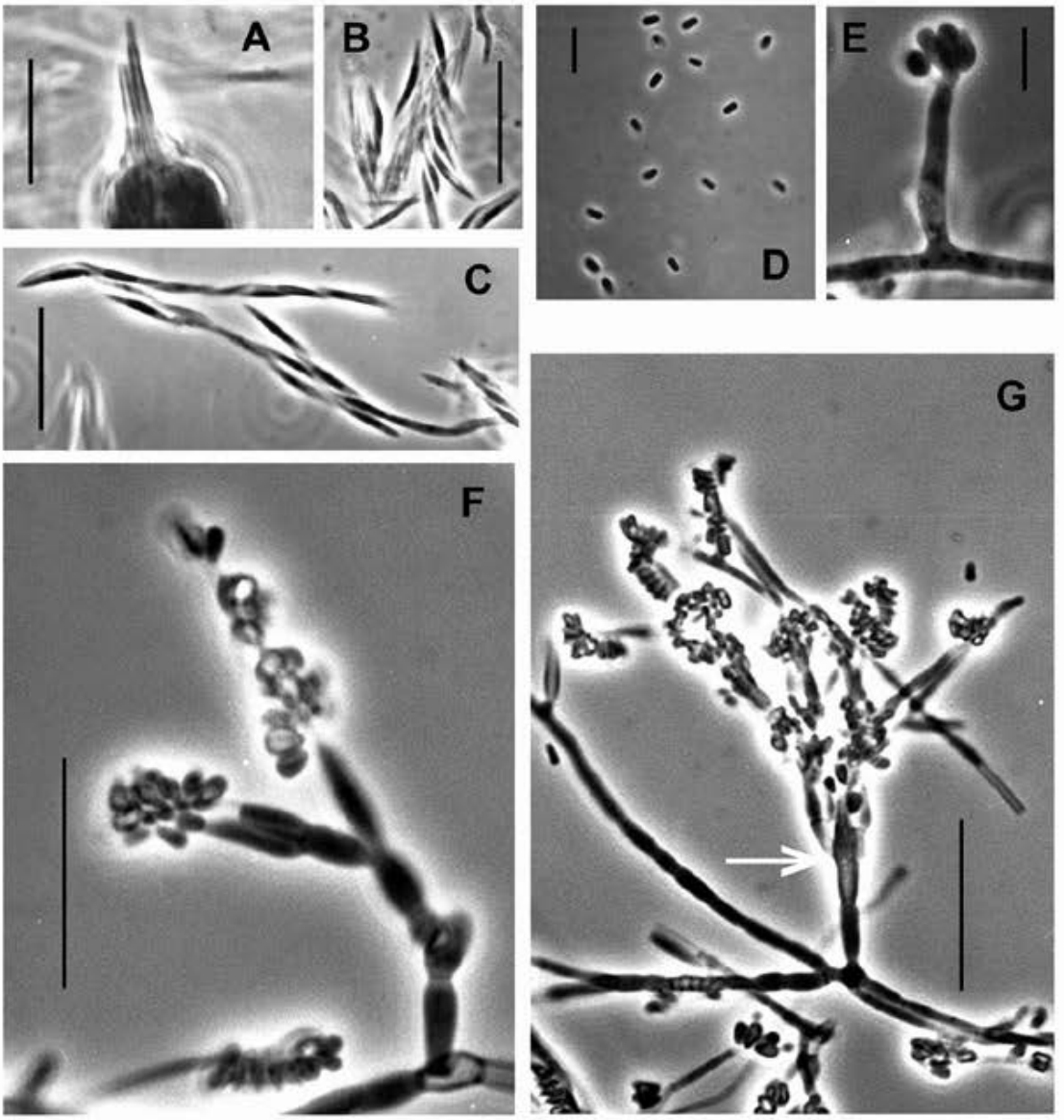

FIG. 2: *Ceratocystis minuta* epitype UAMH 11218. A. Neck apex of a mature perithecium with ostiolar hyphae. B and C. Ascospores stained with Melzer's reagent. D. Conidia. E. Simple conidiophore with adhering conidia. F. Branched conidiophore. G. Complex (macronematous) branching conidiophore; whorled branches origin is denoted by arrow. Scale bars: A, B and C = 20 µm; D and E = 10 µm; F and G = 30 µm.

and convergent. Asci deliquesce rapidly and are seen rarely in mounting media; the free ascospores are usually extruded in long tendrils from the ostiole, but sometimes they collapse into mucilaginous droplets). Ascospores with sheath appear falcate, 10–13 (sd = 11.4 ± 1.18) µm long and widest, 1–2 (sd = 1.38 ± 0.48) µm, at their mid-point, tapering sharply to their tips. Ascospores without the sheath rarely seen.

Mycelium on agar white initially, becoming pale grey centrally and in infrequent patches with maturity. Aerial mycelium sparse, producing two types

of conidiophores. First type short, simple, randomly produced, with droplets containing numerous conidia at apices. Second type arise as short hyphal elements that continue to grow producing verticillate to irregular lateral and secondary branches. Conidiogenous cells appearing holoblastic, terminal, and percurrent. Conidia produced in slime drops, one-celled; oblong to slightly tapered with rounded ends, oval; small, 2–4 (sd = 3.34 ± 0.59) µm long and 1–2 (sd = 1.38 ± 0.48) µm wide hyaline and smooth.

We do not accept the synonymization of *Ceratocystis dolominuta* H.D. Griffin (Griffin 1968) with *Ceratocystiopsis minuta* (Upadhyay 1981). We concur with Griffin and Olchowecki & Reid (1974) that its consistently shorter ascospores separate it from *Ceratocystiopsis minuta*.

Discussion

Ideally a designated epitype would be based on an isolate from the Białowieski Park Narodowy (Białowieski National Park) area of eastern Poland, as this is where Siemaszko (1939) made his collections. Therefore, Plattner et al. (2009) sequenced three strains isolated from hosts in that area by T. Kirisits in June, 2002; specifically CBS 116795, 116796 and 116963. Of these, only strain 116795, closely allied to 116963 in their tree, fruited in culture, but it did not fit well with either Siemaszko's protologue for *Ophiostoma minutum*, or the latter as amended by Mathiesen (1951); 116796 did not fruit either and grouped with four other Polish strains and one Japanese strain in a different clade of Plattner et al.'s tree (2009). None of these four latter Polish isolates were from Białowieża, but three were from northeastern Poland, between 150 and 210 miles north northeast of that locality. Plattner et al. (2009: 884) noted that one of these "... , R.J. 705, which produced what appeared to be mature perithecia but no ascospores, showed an imperfect state almost identical to that described by Mathiesen (1951) and Davidson (1942)" would be a candidate for neotypification if it had produced ascospores. It is this strain we used for epitypification.

In Europe, *Ceratocystiopsis minuta* is associated commonly with a wide range of bark beetles on more than one host tree species (Kirisits 2004). In some cases there is a common association between the bark beetle and this fungus, e.g. *Ips typographus* and *Ceratocystiopsis minuta* on *P. abies* in certain areas of France (Viri & Lieutier 2004), but in other geographical areas the association is rare. For example, during a study of the fungi associated with *Tomicus piniperda* (L.) attacking *P. sylvestris* at eight locations in Poland, Jankowiak (2006) found it at only one of the locations sampled, and then only at very low levels. Clearly, *Ceratocystiopsis minuta* is beetle-vectored, although with more than one species (Kirisits 2004).

Plattner et al. (2009) concluded that the name *Ceratocystiopsis minuta* referred to several phylogenetic species, and that different species misidentified as *Ceratocystiopsis minuta* might be present in different geographical locations. Our results indicate that populations of these putative different phylogenetic species may coexist within fairly restricted geographical areas; based on combined morphological and molecular criteria, this appears to be the case in northeastern Poland.

The molecular analysis in Plattner et al.'s tree (2009; FIG. 1) suggests that two distinct populations of *Ceratocystiopsis minuta* exist in eastern Poland. Isolate R.J. 705, which we have designated as epitype, is representative of one of these populations, while CBS 116795 belongs to the other. Their molecular distinctness is confirmed by the morphological differences that we observed between these two isolates (TABLE 1, FIGS. 1 A–F).

TABLE 1. Comparison of perithecial and ascospore measurements for *Ceratocystiopsis minuta* strains R.J. 705 and CBS 116795.

ISOLATE	R.J. 705	CBS 116795
PERITHECIUM (µm)		
Base width	37.5–87.5; sd = 59.41 ± 13.7	52.5–100; sd = 78.44 ± 13.03
Base height	37.5–97.5; sd = 58.7 ± 14.58	57.5–100; sd = 77.39 ± 12.58
Neck length	70–175; sd = 113.4 ± 17.98	30.0–75; sd = 49.8 ± 12.65
Neck base width	20–45; sd = 28.89 ± 6.8	20–35(–37.5); sd = 26.81 ±5.0
Neck tip width	7.5–17.5; sd = 13.8 ± 4.98	(15–)17.5–25; sd = 20.56 ± 2.34
Ostiolar hyphae	up to 12. 4 in length	up to 12.5 in length
ASCOSPORES (µm)		
Length	10–13; sd = 11.4 ±1.18	9–15; sd = 10.86 ± 1.34
Width	1–2; sd = 1.19 ± 0.29	1–2; sd = 1.14 ± 0.26
CONIDIOPHORE TYPE	macronematous & micronematous	micronematous

Although not precisely the same, another unusual situation is evident in reports of *Ceratocystiopsis minuta* from Japan. Plattner et al. (2009) noted that Japanese strains of this fungus from two different tree species, *Picea jezoensis* (Siebold & Zucc.) Carrière (Yamaoka et al. 1997) and *Larix kaempferi* (Lamb.) Carrière (Yamaoka et al. 1998) shared a common phylogenetic ancestor, although they were placed in two distinct monophyletic groups (clades). These two isolates, JCM 9367 (YCC-139) from *P. jezoensis* and JCM 9816 (YCC-294) from *L. kaempferi*, are similarly morphologically distinct from each other in both their perithecial appearance and the nature of their anamorphs (Yamaoka et al. 1997, Figs. 1–5; Yamaoka et al. 1998, Figs. 2–5), as isolate R.J. 705 is from CBS 116795. Also, JCM 9367 (YCC-139), is placed in the same clade as R.J. 705

in Plattner et al.(2009, Fig.1), and resembles the latter isolate in morphological features, i.e. perithecial neck shape and conidiophore complexity.

Upadhyay & Kendrick (1975) erected the genus *Hyalorhinocladiella*, based on *Hyalorhinocladiella minutibicolor*, to accommodate the anamorph of *Ceratocystiopsis minutibicolor*. While their description and photographs do represent accurately the conidial state of *Ceratocystiopsis minutibicolor* as described by Davidson (1966), their concept of *Hyalorhinocladiella* does not fit the anamorph of *Ceratocystiopsis minuta* as defined herein.

Benade et al. (1996) emended the description of conidiogenesis in *Ceratocystiopsis minutibicolor* to percurrent and sympodial extensions of the conidiogenous cell, but did not indicate whether the conidiophores could be more complex than the simple hyphal elements described and/or figured by Davidson (1966) or Upadhyay & Kendrick (1975).

Our photographs of isolate R.J. 705, plus those of isolate YC-139 (Yamaoka et al. 1997) and the drawings of Mathiesen (1951) of *Ceratocystiopsis minuta* all show that this species, as epitypified herein, most commonly produces quite complex conidiophores; the simple *Hyalorhinocladiella*-like structures are less abundant.

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Tylopilus oradivensis sp. nov.: a newly described member of the *Tylopilus balloui* complex from Costa Rica

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Abstract — Surveys of macrofungi associated with neotropical *Quercus* forests in Costa Rica resulted in the discovery of a *Tylopilus* species similar to *T. balloui* in appearance but exhibiting differences in typical basidiome size, basidiome coloration, basidiospore size and shape, typical pleurocystidial shape, and DNA sequence characters. Molecular data suggest that *T. oradivensis* and *T. balloui* share a relatively recent common ancestor and lend support to the hypothesis of a biogeographic connection between oak forests of the eastern United States and Central America. The orthographic correction of the epithet *ballouii* to *balloui* is hereby made in accordance with the International Code of Botanical Nomenclature.

Key words — *Boletaceae*, *Boletineae*, boletes, ectomycorrhizal fungi, *Rubinoboletus*

Introduction

Since the mid-1990s, a concerted effort to document macrofungal diversity in Costa Rican montane *Quercus* forests has yielded descriptions of previously unknown boletes and field data valuable for assessing biogeographic patterns in ectomycorrhizal fungi (Amtoft et al. 2002; Halling 1999, 2001; Halling & Mata 2004; Halling et al. 2004; Halling & Mueller 2002, 2003, 2005; Mueller & Halling 1995; Osmundson et al. 2007). Subsequent field and laboratory studies of Australian and Southeast Asian boletes have revealed a number of taxa morphologically similar to the distinctive North American species *Tylopilus balloui* (Peck) Singer but differing in several morphological as well as molecular

characters — these data suggest that the name *T. balloui* as commonly ascribed to field and herbarium collections represents a species complex rather than a single widespread species (Halling et al. 2008), an observation consistent with those of Watling (Watling 2001; Watling & Gregory 1988). A closer examination of Costa Rican collections from Cartago and San José provinces led to the discovery of a taxon morphologically and genetically distinct from *T. balloui*, which we here describe as *Tylopilus oradivensis*.

Materials and methods

Macromorphological descriptions were made from fresh basidiomes. Alphanumerical color designations correspond to Kornerup & Wanscher (1967), and are noted as combinations of plate, column, and row numbers (e.g., 8A5). Micromorphological examinations were performed using air-dried tissue from field collections or herbarium specimens. Preparation of hand sections for observation of micromorphological characters and use of descriptive terms follow Largent et al. (1977). Basidiospore measurements are presented as *(k–)m–n(–p)*, where *k* is the smallest observed value, *p* is the largest observed value, m is the 5th percentile value, and n is the 95th percentile value (Tulloss & Lindgren 2005). Length-to-width ratio (Q) of the basidiospores is presented in the same manner. Mean length (L_m), width (W_m) and length-to-width ratio (Q_m) are presented with their standard deviations (sd). Voucher specimens were deposited in the herbaria of the New York Botanical Garden (NY) or the Field Museum (F), with duplicate collections deposited in the herbarium of the University of Costa Rica (USJ) (acronyms from Thiers 2010).

A comparison of nuclear ribosomal large subunit (nrLSU) DNA sequences between Costa Rican collections and United States *T. balloui* accessions was made using data from Halling et al. (2008). Sequences were downloaded from GenBank (accession numbers EU430731 (CR), EU430732 (CR), EU430734 (USA), and EU430737 (USA)) and aligned using MAFFT (Katoh et al. 2005). Alignments were trimmed at the 5' and 3' ends (<10 bp per end) in order to eliminate terminal gaps using MacClade 4.08 (Maddison & Maddison 2001), and the alignment was examined manually.

Taxonomic description

Tylopilus oradivensis Osmundson & Halling, **sp. nov.** FIGS. 1, 2

MYCOBANK: 516651

Aspectu similis Tylopilo balloui, *sed pileo e stipite aurantiaco-rubro magi, basidiomatibus minori, basidiosporis longioribus e subfusiformibus ad fusiformibus vel formibus capsicorum jalapensis revocans.*

HOLOTYPE: R.E. Halling 7562 (NY 136973), 28 May 1996, approximately 4.5 km east of km 31 of Interamerican Highway, Palo Verde, El Guarco, Cartago, Costa Rica, elev. 1600 m.

ETYMOLOGY: The epithet oradivensis (ora = coast; dives = rich, -ensis = suffix indicating origin or place) refers to Costa Rica as the origin of the type collection.

ICONES: Halling & Mueller (2005: 72, as *Tylopilus ballouii*).

MACROCHARACTERS — PILEUS 3–5.5(–6) cm broad, convex to plano-convex, dry, matted subtomentose or tomentose, garnet brown (9D8) to orange red (8B7), capsicum red, tomato red or English red (8C7 to 8A-E8); margin inrolled, sterile. CONTEXT white to cream (4A3), unchanging. ODOR not distinctive. TASTE mild. TUBES adnate, up to 6 mm deep, yellowish white (4A2) or paler. PORES concolorous with tubes, staining light yellowish brown or pale brown when bruised. STIPE 5–7 cm long, 0.8–1 cm thick, nearly equal or tapering toward base, glabrous or finely to heavily pruinose, concolorous with pileus or sometimes paler near a pale salmon (6A-B5-4) or white with orange (6A-B8-7) patches, becoming sordid pale; base white or pale cream-colored, developing pale yellow or pale brown stains from handling. Obscure coarse reticulum at apex (as viewed under hand lens) observed in one collection.

MICROCHARACTERS — BASIDIOSPORES (7.6–)8.2–12(–13.6) × (2.6–)3-4(–4.4) µm (L_m = 9.74, sd = 1.13; W_m = 3.47, sd = 0.36; Q = (2.1–)2.23–3.5(–4.57); Q_m = 2.83, sd = 0.39), subfusiform, fusiform or jalapeño pepper-shaped, longitudinal axis often sigmoid; thin-walled, hyaline or pale yellow in 3% KOH; uniguttulate, but droplet often irregular and with the appearance of being the product of fusion of two or more individual droplets, inamyloid, pale cinnamon brown in deposit. BASIDIA clavate, 4-sterigmate, hyaline. PLEUROCYSTIDIA of the pseudocystidia type; thin-walled, narrow, subclavate or ventricose-rostrate, 40–76(–90) × 8–15(–18) µm; one collection (REH 7562) with larger (92–110 × 20–38 µm), ventricose-rostrate cystidia present; contents granular and golden brown in 3% KOH, exhibiting a positive reaction with acidic fuchsin. CHEILOCYSTIDIA clavate, strangulated, or isomorphic with pleurocystidia, with contents similar to pleurocystidia. PILEIPELLIS a loose trichoderm or mixtocutis, hyphae 4–7 µm broad, thin-walled, hyaline; end cells cylindrical, occasionally apically constricted, with yellow-orange uniform contents that are oily in appearance, exhibiting positive acid fuchsin reaction. PILEAL TRAMA of interwoven cylindrical, thin-walled, smooth hyphae. HYMENOPHORAL TRAMA boletoid, bilateral; hyphae 5.6–9.6 µm broad; lateral stratum elements parallel or slightly divergent; mediostratum hyaline to pale orange-brown, darker than lateral stratum especially when young. STIPITIPELLIS a broken hymeniform layer or with closely spaced fascicles of end cells; end cells subclavate or clavate; hyaline; larger ventricose-rostrate caulocystidia occasionally present in some samples. CAULOCYSTIDIA 48–66 × 8–14(–17) µm, clavate or ventricose-rostrate, thin-walled, hyaline or with orange-brown contents in KOH. CLAMP CONNECTIONS absent.

ECOLOGY, RANGE, AND DISTRIBUTION — Scattered to gregarious, associated with *Quercus* in montane forests (observed at elevations of 1600–1850 m) of the Talamanca Mountains, Costa Rica.

FIG. 1. Basidiomata of *Tylopilus oradivensis*, R.E. Halling 7562 (NY).

ADDITIONAL SPECIMENS EXAMINED — **COSTA RICA. CARTAGO:** El Guarco. PALO VERDE, approximately 4.5 km east of km 31 of Interamerican Highway, elev. 1600 m, 24 June 2000, R.E. Halling (*Halling 7920*) (NY); 1 June 2001, R.E. Halling (*Halling 8087*) (NY); ESTRELLA, approximately 5 km east of km 31 of Interamerican Highway, elev. 1685 m, 21 July 1993, R.E. Halling (*Halling 7044*) (NY); 15 November 1993, R.E. Halling (*Halling 7170*) (NY); 31 May 1994, R.E. Halling (*Halling 7214*) (NY); 14 June 1996, R.E. Halling (*Halling 7681*) (NY); 1999, G.M. Mueller (*Mueller 4853*) (F); 13 June 2001, R.E. Halling (*Halling 8187*) (NY). **SAN JOSÉ:** CASAMATA, approximately 1 km west of Interamerican Highway at Casamata on road to San Cristobal Norte, elev. 1850 m, 18 October 1994, R.E. Halling (*Halling 7380*) (NY).

COMMENTS — Both macro- and micromorphologically, *T. oradivensis* bears a close resemblance to *T. balloui*, described from the northeastern United States. The latter is here orthographically corrected from the originally published epithet *ballouii* in accordance with article 60.11 of the International Code of Botanical Nomenclature (2006 Vienna Code), as well as from the incorrect epithet *balonii* as published by Saccardo (1925). The correct orthography appears in Heinemann & Rammeloo (1983), although the original spelling "ballouii" remains in nearly universal use. *Tylopilus oradivensis* and *T. balloui* are both characterized by having a pale hymenophore, pileus and stipe coloration in shades of orange, short (compared to many other boletes) basidiospores that are hyaline or pale yellow in 3% KOH, and the presence of an oily orange pigment in the hyphae of the pileipellis. However, the newly described taxon differs from *T. balloui* in

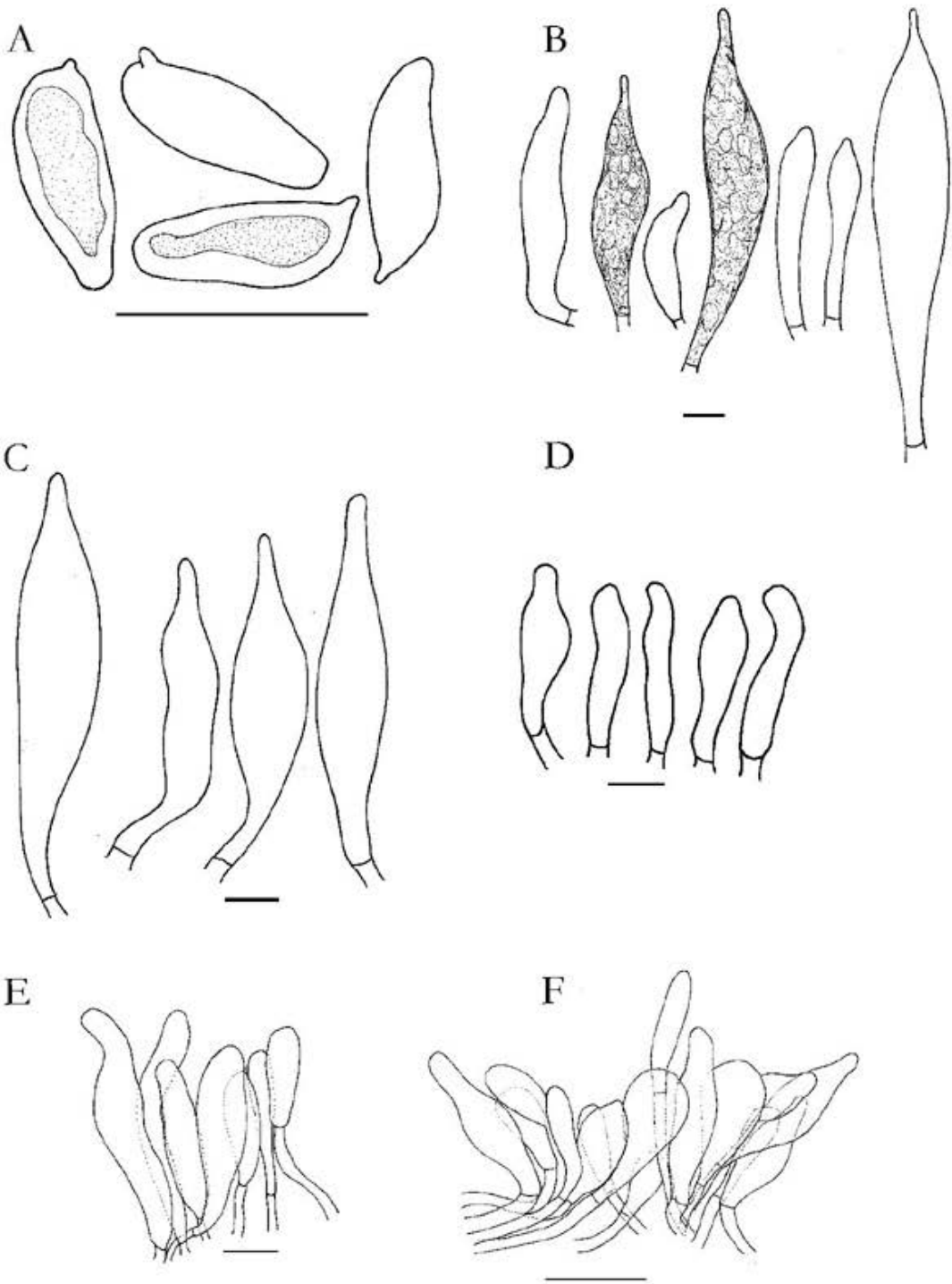

FIG. 2. Micromorphological features of *Tylopilus oradivensis*.
a. Basidiospores (R.E. Halling 7562, HOLOTYPE). b. Pleurocystidia (R.E. Halling 7562, HOLOTYPE).
c. Pleurocystidia (G.M. Mueller 4853). d. Cheilocystidia (R.E. Halling 7562, HOLOTYPE).
e. Stipitipellis (R.E. Halling 7562, HOLOTYPE). f. Stipitipellis (R.E. Halling 7170).
Scale bars: 10 µm.

several respects. The original description of *T. balloui* by Peck (1912, as *Boletus ballouii*) describes a species with a bright orange to orange-brown pileus 5–12 cm broad, stipe 2.5–12 cm long and 0.7–1.5 cm thick, and basidiospores 8–10 × 4–5 µm that are clearly ellipsoid in Peck's original illustration. The Costa Rican material has smaller basidiomes (pileus <5.5(–6) cm), a reddish orange to nearly red (rather than bright orange) pileus (see comparison at http://www.nybg.org/bsci/res/hall/oradivensis.html), larger and differently shaped basidiospores, and pleurocystidia that are generally slightly narrower and longer than those in *T. balloui*. The end cells in the pileipellis are often tapered in *T. balloui*, but not in *T. oradivensis*. Although both Peck's description and the description of *T. balloui* by Singer (1947) note a range of spore dimensions that overlaps with that of *T. oradivensis* (dimensions recorded as 7.5–11 × 3.7–4.8 µm by Singer), both Peck's illustration and Singer's description strongly indicate that shorter, ellipsoid basidiospores are the normal condition. Wolfe's (1981) type study reports a range of basidiospore dimensions of 5–10.5 × 4–5 µm, with a mean of 6.5 × 4 µm. We have examined a large number of collections of *T. balloui* from the eastern, midwestern, and southern United States — including a collection made by Ballou (*W.H. Ballou s.n.*, accession 45249, NY), who provided a number of the collections of this taxon originally sent to Peck — and we have noted pileus dimensions of 4–9 cm, stipe 3–10 × 1–2.5 cm, and broadly ellipsoid basidiospores 6.4–8.4(–8.8) × (3.2–)3.6–4.4 µm. Where larger basidiospores occur, they are rare and differently shaped (more ellipsoid) than those of *T. oradivensis*.

Nuclear ribosomal large subunit sequences differed between *T. oradivensis* and United States *T. balloui* in 23 of the 1421 nucleotide positions compared (98.4% sequence identity), with sequence differences comprised of 12 transitions, 2 transversions and 9 indel positions (five indels of 1, 1, 1, 2, and 4 bp). Sequences were invariable between the two collections within each species. While within-taxon sampling is too sparse to allow drawing conclusions regarding the genetic limits of the two taxa, these limited data nonetheless support the conclusion drawn from morphological analyses; i.e., that the two taxa are closely related yet distinct.

Both *Tylopilus oradivensis* and *T. balloui* would be placed in *Rubinoboletus* by some authors (Heinemann & Rammeloo 1983). However, *T. balloui* bears little morphological resemblance to the type species of *Rubinoboletus* (*R. rubinus* (W.G. Sm.) Pilát & Dermek, basionym *Boletus rubinus* W.G. Sm.) outside of having short, elliptical basidiospores. Singer (1947), in transferring *T. balloui* from *Gyrodon* (*G. balloui* (Peck) Snell) to *Tylopilus*, wrote: "The short spores do, in fact, occur in almost all groups of boletes and are not characteristic for *Gyrodon* alone." The same argument can — and we believe should — be applied

to placement of *T. balloui* within *Rubinoboletus*. *Tylopilus balloui* and its close relatives (including *T. oradivensis*) are indeed somewhat enigmatic among *Tylopilus* species; however, they are united with other species in the genus by several morphological characters including a pale hymenophore and hymenial pseudocystidia with dark yellow to brown pigmented contents (as observed in KOH mounts). Phylogenetic placement within a core *Tylopilus* clade is indicated by the nucLSU analysis of Binder & Hibbett (2006), and in our analyses using multiple loci (Osmundson et al. manuscript in prep.).

Consistent with the high sequence similarity observed between *T. oradivensis* and *T. balloui*, a previous phylogenetic analysis of nrDNA sequences for a broad geographic sample of *T. balloui* s.l. (Halling et al. 2008) indicated that the two species share a relatively recent common ancestor and lends support to the hypothesis of a biogeographic connection between oak forests of the eastern United States and Central America. As was hypothesized in the case of the species pair *T. chromapes* (*Leccinum chromapes*) and *T. cartagoensis* (*L. cartagoense*) (Wolfe & Bougher 1993), the close similarity between *T. oradivensis* and *T. balloui* would be consistent with a history of postglacial southward migration followed by morphological (and molecular) differentiation.

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Strelitziana africana newly recorded from China

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Abstract — We document the first report of *Strelitziana africana* from China. This fungus was isolated from stems of *Dioscorea cirrhosa* and *Sabia parviflora* collected from Nanning, Guangxi Province. *Strelitziana africana* can produce flyspeck signs on inoculated apple fruit and is distinguished from the other known species in the genus by morphological characters and phylogenetic analysis based on ITS sequences.

Key words — biodiversity, *Dioscoreaceae*, *Sabiaceae*, reservoir hosts, sooty blotch

Introduction

Sooty blotch and flyspeck (SBFS), a disease complex comprising more than 60 putative species of fungi, colonizes the waxy cuticle of many plants in humid production regions worldwide, inciting cosmetic damage that causes significant economic losses (Batzer et al. 2005). The common name "flyspeck" refers to species in the SBFS complex whose morphology on fruit surfaces consists of clusters of black dots lacking a mycelial matrix. Colby (1920) reported that flyspeck was caused by *Leptothyrium pomi* (Mont. & Fr.) Sacc. Von Arx (1959) synonymized 14 species, including *Leptothyrium pomi*, under *Schizothyrium pomi* (Mont. & Fr.) Arx, the currently accepted name for this taxon. Arzanlou & Crous (2006) reported *Strelitziana africana* Arzanlou & Crous from leaf speckle symptoms of *Strelitzia* in South Africa. The genus *Strelitziana* Arzanlou & Crous was named after the host genus from which it was collected and shown to be a member of the *Chaetothyriales*. We have identified two isolates that

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are described as the first record of *Strelitziana africana* from China based on morphological comparison and their phylogenetic relationships, as shown by analysis of sequence data of the internal transcribed spacer (ITS) of the rRNA repeat (Harrington & Rizzo 1999).

The species *Dioscorea cirrhosa* and *Sabia parviflora* are economically important medicinal plants in China because their stems and leaves are used as ingredients in Chinese traditional medicine. Recently, during a survey of alternate host plants for flyspeck fungi in China, these medicinal plants were found to be reservoir hosts of flyspeck fungi, including *Strelitziana africana*.

Materials and methods

Isolates. Individual sclerotium-like bodies (Batzer et al. 2005), growing in clusters on culms, were transferred to slants containing potato-dextrose agar (200 g peeled potato, 20 g dextrose, 10 g agar in 1 L water; PDA) and cultured at 22 ± 1°C in darkness (Sun et al. 2003). Colony descriptions were made after 1 month of growth on oatmeal agar (3%; 30 g oatmeal, 10 g agar in 1 L water; OA) plates at 22 ± 1°C in darkness. After 1-month-old axenic cultures were transferred to new OA plates, a sterile cover slip was partially inserted into the agar adjacent to the colony and angled away from the colony at approximately 60 degrees to the agar surface in order to enable the fungus to grow onto the cover slip. Measurements of fungal structures were conducted based on isolates growing on cover slips.

DNA sequencing. Template DNA was extracted from the fungal mycelium according to the method of Barnes et al. (2001), and primer pairs used for amplification and sequencing of the ITS region were ITS1-F (Gardes & Bruns 1993) and ITS4 (White et al. 1990). Amplification was completed with the following cycling parameters: initial denaturation at 94°C for 3 min followed by 35 cycles of denaturation at 94°C for 30 s, annealing at 52°C for 30 s, and extension at 72°C for 30 s and a final extension of 72°C for 10 min. The PCR products were sequenced by Organism Technology Co., Ltd., Shanghai, China.

The ITS nucleotide sequences generated in this study were added to sequences downloaded from GenBank (Table 1) that had high similarity according to a BLAST search (National Center for Biotechnology Information's nucleotide blast program). Preliminary alignments were performed using CLUSTAL-X (Thompson et al. 1997). The alignments were imported into BioEdit v. 5.0.9.1 (Hall 1999) and manually adjusted. Phylogenetic analysis of aligned DNA sequences was performed with PAUP v. 4.0b10 for 32-bit Microsoft Windows (Swofford 2001). Heuristic searches were performed with 1000 random sequence additions. Clade stability was evaluated by 1000 bootstrap replications. Other measures for parsimony, including tree length, consistency index, retention index, and rescaled consistency index (CI, RI and RC, respectively), were also calculated. *Curvularia affinis* was used as the outgroup taxon.

Koch's postulates. After the two isolates in this paper were grown on OA for 1 month, a piece of the colony was picked up into an 1.5 ml Eppendorf tube and blended with 1.0 ml sterile deionized water for 1 minute. This suspension of mycelial fragments

TABLE 1. Sequences used in the phylogenetic analysis

SPECIES	GENBANK	REFERENCE
GX01	GQ850385	This paper
GX02	GQ850386	This paper
Capronia acutiseta	AF050241	Untereiner & Naveau 1999
Capronia pulcherrima	AF050256	Untereiner & Naveau 1999
Cladophialophora devriesii	AB091212	Abliz et al. 2003
Cladophialophora sp.	EU137326	De Hoog et al. 2007
Curvularia affinis	EF187909	Di Maiuta & Schwarzentruber 2007
Mycosphaerella vietnamensis	DQ632675	Burgess et al. 2007
	DQ632678	Burgess et al. 2007
Pseudocercospora syzygiicola	AF309600	Crous et al. 2000
Pseudocercospora sp.	DQ303082	Crous et al. 2006
Rhinocladiella anceps	AY163559	De Hoog et al. 2003
	DQ826740	De Hoog et al. 2003
Rhinocladiella atrovirens	AY163558	De Hoog et al. 2003
Rhinocladiella basitona	AY163561	De Hoog et al. 2003
Rhinocladiella similis	AY857529	Prenafeta-Boldu et al. 2006
Strelitziana africana	DQ885895	Arzanlou & Crous 2006
Strelitziana australiensis	GQ303295	Cheewangkoon et al. 2009

and conidia was used within 2 hours. Three mature, non-wounded apples were chosen for each isolate, surface-sterilized with 75% ethanol and allowed to dry completely, then swabbed with suspension of one isolate per apple. Two control apples were surface-sterilized and swabbed with sterile deionized water only. All the inoculated apples were incubated in a moist chamber at 22 ± 1°C.

Results

DNA phylogeny

A multiple alignment of the rDNA-ITS was generated with 18 sequences obtained from GenBank plus the sequences of isolates GX01 and GX02 (GX01 = GQ850385, GX02 = GQ850386). From a MP tree with a length of 750 bp (CI = 0.7080, RI = 0.7830, RC = 0.5512), two major clades were resolved (FIG. 1). One clade, with 100% bootstrap support, contained three species in *Mycosphaerella* and *Pseudocercospora*. The other major clade had a bootstrap value of 93%. The *Strelitziana* species grouped in a well-supported subclade (100%). Our isolates and a *Strelitziana africana* isolate from *Strelitzia* that was identified by Arzanlou & Crous (2006) fell within a single clade with 100% bootstrap support, indicating that they might represent the same species.

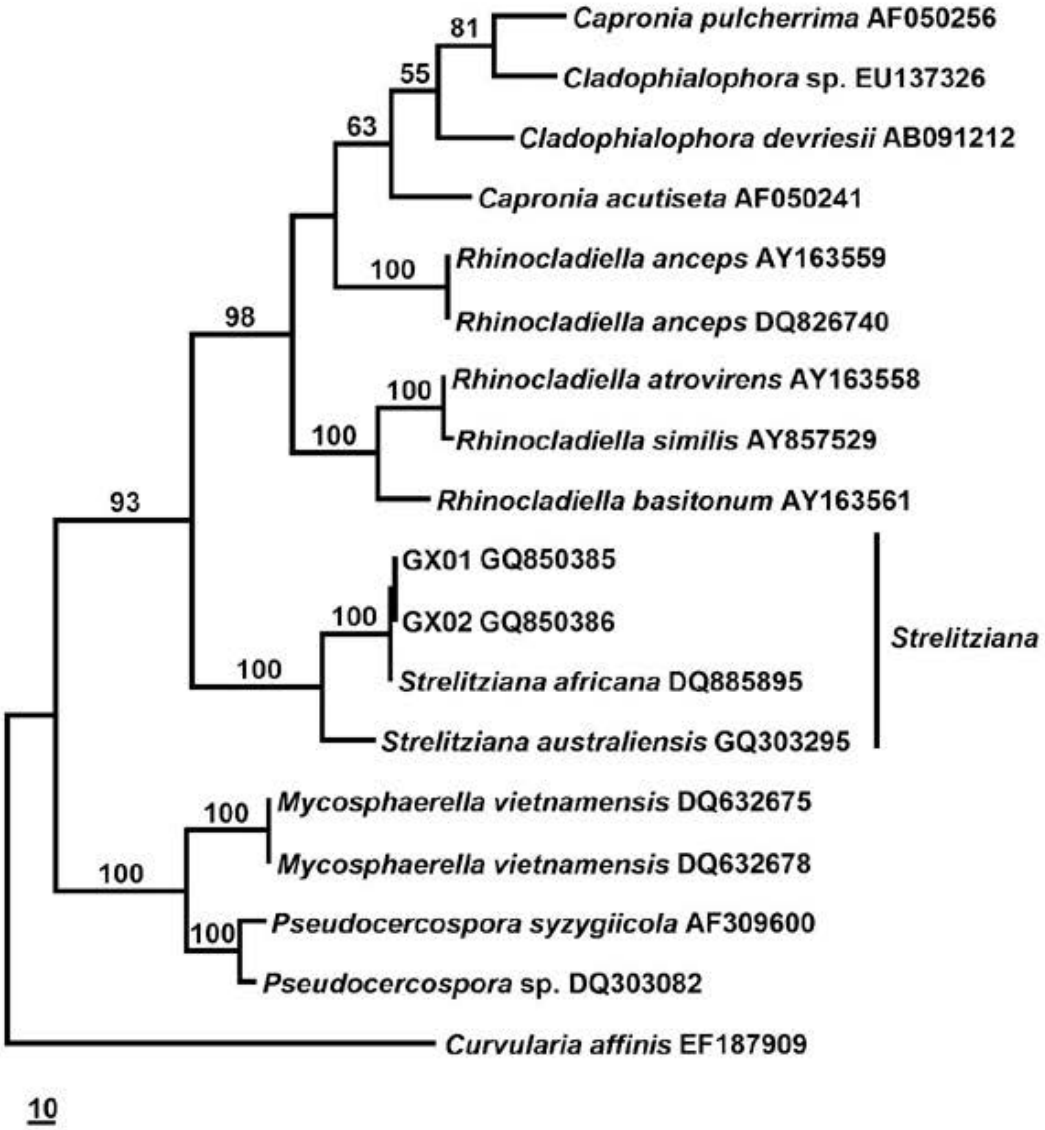

FIG. 1 The parsimony tree (TL = 750, CI = 0.7080, RI = 0.7830, RC = 0.5512) derived from a heuristic search option in PAUP v. 4.0b10 with 1000 randomizations of sequence input orders and 1000 bootstrap replications using the data set of ITS1, 5.8S and ITS2. Bootstrap values higher than 50% are indicated above the tree branches. The tree was rooted to *Curvularia affinis*.

Taxonomy

DESCRIPTION: Mycelium superficial, consisting of smooth, septate, branched hyphae, 2–3 µm wide. Conidiophores erect, solitary, arising from aerial and submerged mycelium, subcylindrical, straight to geniculous-sinuous, pale brown, concolorous with hyphae, smooth, 0–4-septate, 3–20(–50) × 1.5–4.5 µm. Conidiogenous cells terminal, integrated, rejuvenating percurrently, proliferating apically via several short, conspicuous denticles, conidiogenesis rhexolytic. Conidia pale brown, smooth, long obclavate, widest in middle of

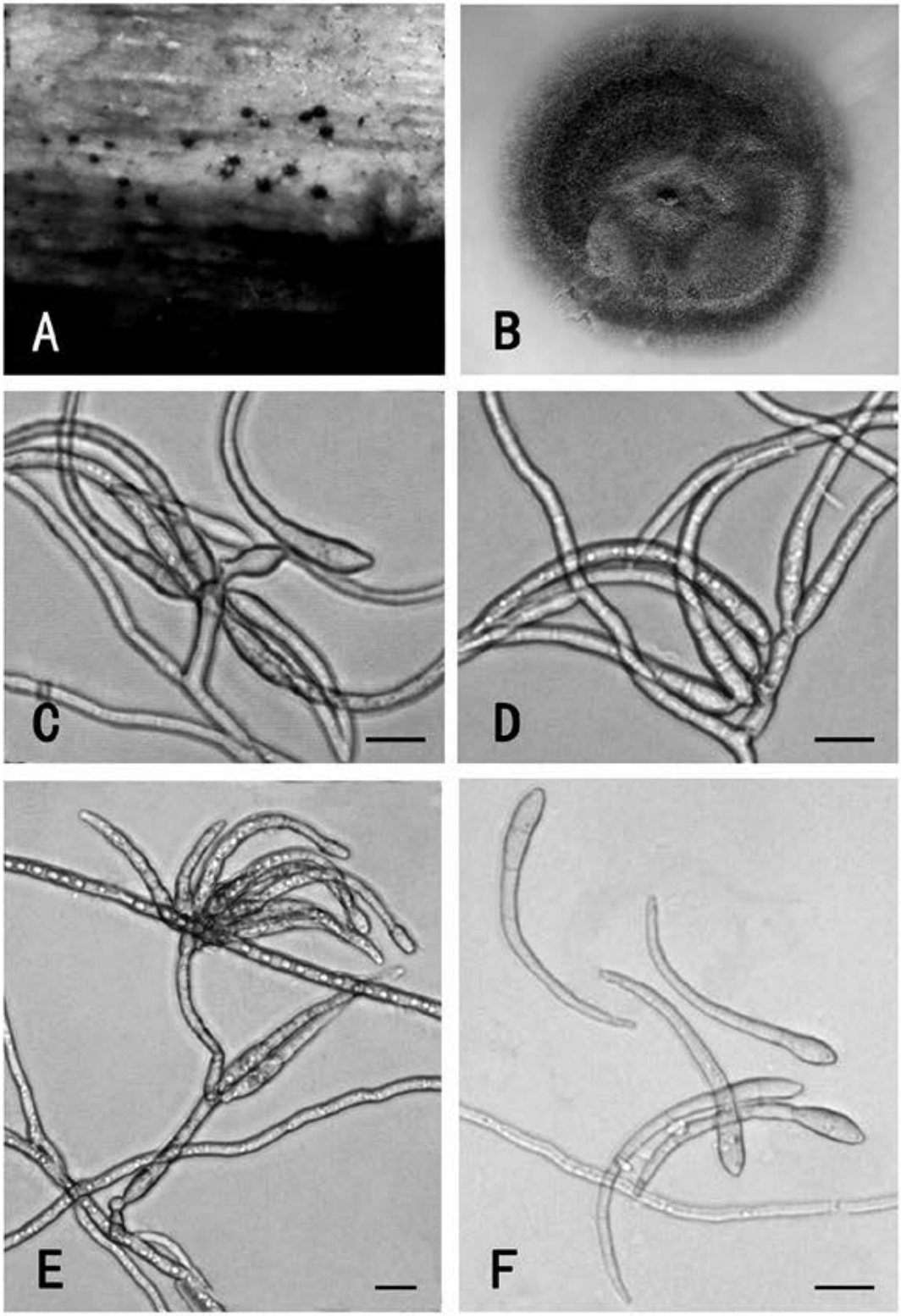

FIG. 2 *Strelitziana africana* GX01. A. Signs on *Dioscorea cirrhosa*. B. Colony on oatmeal agar after 30 days. C–D. Conidia, conidiogenous cells and hyphae. E. Conidiogenous cell giving rise to conidia, and microcyclic conidia. F. Conidia. Bars (C–F) =10 μm.

basal cell, tapering to a subobtusely rounded apex and obconically subtruncate base with minute marginal frill, 1 µm wide, (12–)35–70(–100) × 2.5–5 µm, 3–10(–21)-septate, microcyclic conidiation observed in culture (Fig. 2).

Specimens examined: On *Dioscorea cirrhosa* Lour. (*Dioscoreaceae*), China: Guangxi, Nanning, Guangxi Medicinal Botanical Garden, 22°51'N 108°19'E, alt. 72 m, 23 Sep. 2008, J.L. Zhuang & H.L. Yang, HMUABO (the Fungal Herbarium of Northwest A&F University) 822516 (with dried culture), culture GX01. On *Sabia parviflora* Wall. (*Sabiaceae*), China: Guangxi, Nanning, Guangxi Medicinal Botanical Garden, 22°51'N 108°19'E, alt. 76 m, 23 Sep. 2008, J.L. Zhuang & H.L. Yang, HMUABO 822517 (with dried culture), culture GX02.

Cultural characteristics: The colony diameter after 1 month on PDA at 22 ± 1°C reached 28 mm with even margins and smooth, felty aerial hyphae; colony centers were purplish gray and outer zones pale white. On OA the colony was flat, spreading, with sparse aerial mycelium, reaching 33 mm diam after 1 month at 22 ± 1°C, surface olivaceous, colonies fertile.

Host characteristics: On stems, the fungus produced dark, shiny, round to oval, slightly protuberant sclerotium-like bodies (Fig. 2A). The flyspeck on stems did not damage the plants, but greatly reduced their ornamental and retail value. As a result, these fungi can cause significant economic losses to producers of these medicinal plants.

Koch's postulates: The inoculated apples were examined after incubating for 1 month. All inoculated apples with the two isolates exhibited flyspeck signs similar to that on the original plant stems, although with a sparser density of the sclerotium-like bodies. Control apples did not show any flyspeck signs.

Discussion

Based on phylogenetic analysis of the ITS region and morphological characters of the anamorph, we identified the two isolates as *Strelitziana africana*. This species was described from *Strelitzia* (Arzanlou & Crous 2006) and was previously known only from that host. This study is the first report of *S. africana* from medicinal plants. Currently there are only two species in *Strelitziana*, and no potential teleomorph connection is known. *Strelitziana africana*, the type species of this genus, has rhexolytic conidiation and conidial dimensions similar to *S. australiensis* Cheewangkoon & Crous (Cheewangkoon et al. 2009). However, *S. africana* lacks an apical mucilaginous appendage and chlamydospores and has obclavate conidia, making it easy to distinguish from *S. australiensis*.

Morphologically, our two isolates are similar to *Strelitziana africana*, though our isolates produced longer conidia and conidiophores ((12–)35–70(–100) µm, 3–20(–50) µm) than *S. africana* ((18–)50–70(–95) µm, 3–15(–40) µm). Furthermore, conidiophores and conidia of the Chinese isolates produced

more septa (0–4 in conidiophores, 3–10(–21) in conidia for these isolates, vs. 0–1(–5) in conidiophores, and 3–5(–10) in conidia of ex-type strains of *S. africana*). In ITS sequence analysis, our isolates and *S. africana* isolates from *Strelitzia* identified by Arzanlou & Crous (2006) fell within a single clade with 100% bootstrap support.

The results of Koch's postulates show that: 1) the fungi from medicinal plant can produce flyspeck signs on apple fruit; 2) medicinal plants may therefore act as reservoir hosts, providing inoculum for SBFS infestations on apple. Based on the ITS sequence analysis and morphological comparison, we identified the isolates as *Strelitziana africana*, which represent a new record for China.

Acknowledgments

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Book reviews and notices

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Introduction

A variety of topics forms the subject of the books reviewed in this instalment from updated versions of books on ascomycetes, Moroccan gilled mushrooms, and European marasmioid and collybioid species, to a Japanese treatment of several genera in the *Agaricales,* a fungal inventory of the Black Forest's swamps, mires, and bogs, an introduction to Alaskan cryptogams, and an overview of fungi in all their aspects. A list of newly published books to be included in upcoming Book reviews and notices is given at the end.

Ascomycetes

Schimmelpilze und deren Bestimmung. 3. neu bearbeite Aufl. By L.E. Petrini & O. Petrini. 2010. J. Cramer in der Gebrüder Borntraeger Verlagsbuchhandlung, Johannesstraße 3A, 70176 Stuttgart, Germany. <mail@schweizerbart.de>. Pp. x + 170, figs 33. ISBN 978-3-443-50035-1. Price € 39.80.

This short textbook first appeared in the series Bibliotheca Mycologica in 2002 (see Mycotaxon 86: 480–481, 2003) and was reissued in that series in 2008 with only very minor changes (see Mycotaxon 110: 511–512, 2009). The first obvious difference in this third edition is that it is not released as a part of the Bibliotheca Mycologica series — it has attractive coloured front and back covers with photographs rather than the standard bright green of a Bibliotheca Mycologica, something that will immediately make it more appealing to students. The book has also swelled by 26 pages, has five more figures, and I was personally gratified to see that the authors had acted

[1] Books for consideration for coverage in this column should be mailed to the Book Review Editor at the address above. All unsigned entries are by the Book Review Editor.

on particular points raised in my review of the second edition. This was not just a matter of correcting author attributions, and inserting cited references missing from the "Literatur" section but entailed the adoption of more recent molecular classifications and references, including the demise of the category "deuteromycet" — although "Coelomycetes" and "Hyphomycetes" persist for pragmatic reasons as headings in the keys. The authors have in large measure vindicated my comment "that they could have produced a book that was more authoritative and reflected our current knowledge of mould fungi". I was especially pleased to see that much of the increased length was due to new entries for additional genera, along with the re-arrangement and expansion of some of the photograph plates so as to include details of additional fungi. Unfortunately, the reproduction quality of some photographs taken from the previous edition is far from optimal (e.g., Abb. VIII.4). In addition, the short section on chemotaxonomic and molecular approaches to classification has been extended slightly; perhaps the section could be even longer in a fourth edition to explain in some detail the different molecular methods that can be employed in identification and the pitfalls of relying solely on sequence-comparisons. This textbook will now be even of more value to German-speaking students than the earlier editions. Indeed, those who bought the second edition should promptly discard it and buy the third!

My final comment is that I would like also to see this available in an English translation, especially as there is currently no really equivalent work in print. In particular, the plates showing different types of conidiogenesis in detail merit a much wider audience than they will receive hidden in a German text-book. I will be interested to see if this suggestion is taken up, and, if it is, I will be really pleased with the additional evidence that comments made in book reviews can have tangible results; the genre would then have been unequivocally vindicated.

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GUIDEBOOK

Common interior Alaska cryptogams. Fungi, lichenicolous fungi, lichenized fungi, slime molds, mosses, and liverworts. By G.A. Laursen & R.D. Seppelt. 2009. University of Alaska Press, PO Box 756240, Fairbanks, AK 99775, U.S.A. <fypress@uaf.edu> Pp. 256, plates 338, figs 113. ISBN 9781602230583. Price $26.95.

The vast and highly varied landscapes of interior Alaska provide a home for numerous fungi and mosses and liverworts, to which a first introduction is given in this field guide.

An introduction to the area, well known because of Denali National Park, to the various groups of organisms treated in this book, and to mushroom hunting in these wild areas precedes the main part of the book in which mushrooms distributed over various groups such as gilled mushrooms, gasteromycetes and assorted ascomycetes, lichens and lichenicolous fungi, slime molds, and mosses and liverworts are described. A glossary, list of references, and an appendix in which mycological reagents are treated finish off the book.

Each species is represented with a small photo and, in the case of the mosses, also with line drawings. The fungal photos are not always sharp and in some cases overexposed, which makes identification hard. Keys to the species are not provided, and only a small selection of species made it into the book (e.g., 80 gilled fungi). This is the first guidebook I have seen in which lichenicolous fungi have been given a place, which is really a very nice asset. Some of the names are a little out of date (e.g. *Microcollybia* for what is now *Collybia* and *Collybia* for *Gymnopus*; *Rozites caperatus* for *Cortinarius caperatus*). There is no indication whether the descriptions and the photos are based on the same specimens or whether the specimens that got their photos in the book were conserved in a herbarium.

The copy I read has several misprinted pages, and I hope that this is not a widespread problem.

All in all, it is a nice first introduction to mushrooms, fungi, and mosses of the fascinating northwest.

Agaricales and other gilled mushrooms

Compléments à la Flore des champignons supérieurs du Maroc de G. Malençon et R. Bertault. By J.-C. Maire, P.-A. Moreau, G. Robich (editors). 2009. Confédération européenne de mycologie méditerranéenne, Nice. Pp. 775, plates 58, figs 50. No ISBN number. Price ca. € 116.00.

The out-of-print work by Malençon & Bertault (1970, 1975) on Moroccan mushrooms is a classic example of well-executed, thorough flora work based on meticulous observations, fieldwork over a long period of time, and a sound insight in fungal taxonomy.

With a huge increase in interest in the mycoflora of the southern European Mediterranean countries, an update was deemed necessary. The CEMM (Confédération européenne de mycologie méditerranéenne) initiated the project of which this book is the result. It is not just a review of the original work with updated names — no, original material, collections, and water colours (many unpublished) that were kept at MPU were for the first time sent out to the contributors.

A total of 32 mycologists (amateur and professionals) from eight countries contributed, and the level of depth and manner of treatment was more or less left to the discretion of each contributor. There are pieces in French, Italian, Spanish, and English. The coordinator, Pierre-Arthur Moreau, regretted that it was not possible to include *Russula* and *Psathyrella* in the present work. During the research ten new taxa were discovered or names proposed by Malençon validated. Also a number of new combinations was necessary. For each species, the name originally used by Malençon & Bertault, the currently accepted or adopted name, lists of material examined, and comments are given. Original drawings and watercolours (both in colour and in black-and-white) from the notes made by Malençon, in some cases by the authors, illustrate the species.

For some groups a detailed account of all collections is given (e.g., for *Lactarius* sect. *Deliciosi* in the revision by Jorinde Nuytinck) while treatment is much less detailed for others, but overall the extensive discussions and notes are interesting and insightful. The genus *Hygrocybe* is included in two versions due to a small mistake by the coordinating editors.

Interesting is the find of a putative species of the genus *Cleistocybe*, a genus that was recently described (Ammirati et al. 2007) for veiled *Clitocybe*-like species. In general the names are up to date, although in some cases the authors adhere to some older generic concepts (e.g. *Stropholoma* instead of *Leratiomyces*; *Sericeomyces* instead of *Leucoagaricus*).

This is an extremely valuable work, contributing greatly to our knowledge of north African and Mediterranean taxa in general, and also a great example of a group effort to which many contributed.

Ammirati JF, Parker AD, Matheny PB. 2007. *Cleistocybe*, a new genus of *Agaricales*. Mycoscience 48: 282–289.

Malençon G, Bertault R. 1970. Flore des champignons supérieurs du Maroc. I. Travaux de l'Institut scientifique chérifien et de la Faculté des Sciences de Rabat, Série botanique et biologie végétale 32: 604 pp., 133 figs, 33 pl.

Malençon G, Bertault R. 1975. Flore des champignons supérieurs du Maroc. II. Travaux de l'Institut scientifique chérifien et de la Faculté des Sciences de Rabat, Série botanique et biologie végétale 33: 540 pp., 105 figs, 22 pl.

Taxonomic studies on *Agaricales* of Hokkaido, Northern Japan, with special reference to *Melanoleuca, Oudemansiella, Xerula, Volvariella* and *Pluteus*. By S. Takehashi, T. Hoshino & T. Kasuya. 2010. Non profit organization The forum of Fungi in northern Japan, Kanayama 1-3 10-3, Teine-ku, Sapporo, Hokkaido, 006-0041, Japan. <BXG05024@nifty.com>. Available from SANO Books, Sakae-machi 6-19, Aioi-city, Hyogo 678-0008, Japan, <e_sano@d2.dion.ne.jp>. Pp. 145 + xiii, numerous plates, numerous figs. ISBN 978-4-9905010-0-6. Price ¥ 5.600.

Keys and descriptions with photos and line drawings for four genera of *Agaricales* from Hokkaido form the mainstay of this book assembled by the

"Forum of Fungi" in northern Japan, a group of mushroom enthusiasts who have been researching and documenting the fungi of this northernmost of the four main islands of Japan. Since the 1938 publication by Imai, there has not been a comprehensive update of this seminal work, until this initiative, which treats *Melanoleuca*, *Oudemansiella*, *Xerula*, *Volvariella*, and *Pluteus*. The taxonomic part, which is in Japanese and English, is interspersed with Japanese only sections, with descriptions of some of the collecting sites, fungal names used by the Ainu, fruiting phenology, Hokkaido in fungal epithets, fungi under snow cover, and a separate page on the morphology and ecology of *Melanoleuca verrucipes*.

A total of four *Melanoleuca*, three *Oudemansiella*, 13 *Xerula*, four *Volvariella*, and 28 *Pluteus* taxa are treated in detail. It is impressive that this volume tackles two difficult genera, *Pluteus* and *Melanoleuca*. Species that could not be identified are presented as "X" sp., and comments and comparisons with the literature etc. are given for each taxon. The descriptions are complete and the illustrations are adequate (including SEM photos of the spores for *Melanoleuca*) and clearly labeled as to which collections they reference.

It is a bit of a disappointment to discover that the name 'idahoensis' does not refer to a place in Japan, but to the western American state of Idaho!

This work will serve as a modern treatment for these genera for Japan, and as an example for other areas of the world.

Imai S. 1938. Studies on the *Agaricaceae* of Hokkaido. I. Journal of the faculty of Agriculture Hokkaido Imperial University 43: 1–378.

A monograph of marasmioid and collybioid fungi in Europe. By V. Antonín & M.E. Noordeloos, 2010. IHW-Verlag & Verlagsbuchhandlung, Postfach 1119, 85378 Eching, Germany <dr.schmid@ihwverlag.de>. Pp 480, figs 131, Plates 130. ISBN 978-3-930167-72-2. €139.00.

This is the updated version of the two earlier volumes on the marasmioid and gymnopoid fungi of Europe (Antonín & Noordeloos 1993, 1997); more colour photos, especially for the marasmioid species, recently described species, and new notes have been added. With almost 500 pages and 130 colour plates, the 'monograph' is a very impressive book indeed. To free space, the lists of examined specimens and excluded species are provided separately on a CD that comes with the book. An introduction to the group, overviews of past classifications, and phylogenetic placements inferred from phylogenetic DNA analyses are given in the introduction, together with an explanation of names selected (see below). Keys to the genera, groups, and species make it relatively easy to find a name for your specimens. Extensive descriptions of macroscopical and microscopical characters for each taxon, notes on ecology, occurrence, and

habitat, and comments on similar taxa and other interesting and necessary information are included.

By publishing now, the authors had to make many decisions on the classification, as the phylogeny of this group of species is in no way completely settled. For instance, just this spring, Hughes et al (2010) proposed the new genus *Connopus* for *Gymnopus acervatus*. The group of species treated in this book, once smugly accommodated in the white spored catch-all family *Tricholomataceae*, has been shown to fall into four families (*Tricholomataceae* in a strict sense, *Marasmiaceae*, *Omphalotaceae*, and *Physalacriaceae*). Various authors (e.g. Mata et al 2004, 2006; Wilson & Desjardin 2005) have studied different taxa in this group using different sets of molecular markers as a base for their phylogenetic hypotheses, resulting in a jig saw puzzle for which we still only have a small number of pieces, some of them fitting together, others representing different parts of the picture. It also does not help that the majority of the species of *Marasmius* and *Marasmiellus* is tropical. Antonín & Noordeloos, who did not perform molecular-phylogenetic analyses on the European taxa themselves, relied on work by others. They decided to treat *Setulipes* (*Marasmius androsaceus* et al) within *Gymnopus* {based primarily on work by Mata et al. (2006)} — still quite controversial, as up to now only a very few *Setulipes* species have been analyzed. *Micromphale* species are also included in *Gymnopus*, whereas in 1997 Antonín and Noordeloos placed them in *Marasmiellus*. *Marasmius*, *Gymnopus*, and *Marasmiellus* are recognized as being not monophyletic, with *Marasmius* even spread over two families. But as the dust has not yet settled on the phylogenies of these taxa, this is indeed a good compromise. *Gloiocephala*, the small gelatinized and almost lamella free species growing on grasses and the like, is again a separate genus, not at all close to the core group of *Marasmius*. *Mycetinis* accommodates the garlic smelling species formerly placed in *Marasmius*; but now *M. epidryas* is also in *Mycetinis*. It must be frustrating for users to know that more name changes will be imminent.

At the species level, the group of species around *Gymnopus dryophilus* definitely needs more work: Mata et al (2006) showed that *G. ocior* is restricted to North America, yet the name is still maintained here for a European species.

With a work of this size there are of course many details to attend to, and there the book does fall short. Species numbers in keys are occasionally off, the two parts of a lemma of a key may cite the same habitat, the list of substrate specialists taken from the 1993 book omits most of *Gymnopus*, a figure legend may still have the old genus name, and so on.

Nevertheless, these are minor comments on a very useful, well illustrated, very informative book.

Antonín V, Noordeloos ME. 1993. A monograph of *Marasmius, Collybia* and related general in Europe. Part 1: *Marasmius, Setulipes*, and *Marasmiellus*. Libri Botanici 8.

Antonín V, Noordeloos ME. 1997. A monograph of *Marasmius, Collybia* and related general in Europe. Part 1: *Collybia, Gymnopus, Rhodocollybia, Crinipellis, Chaetocalathus*, and additions to *Marasmiellus*. Libri Botanici 17.

Hughes KW, Mather DA, Petersen RH. 2010. A new genus to accommodate *Gymnopus acervatus (Agaricales)*. Mycologia doi:10.3852/09-318

Mata JL, Hughes KW, Petersen RH. 2004. The phylogenetic position of *Marasmiellus juniperinus*. Mycoscience 45: 214–221.

Mata JL, Hughes KW, Petersen RH. 2006. An investigation of /omphalotaceae (*Fungi:* Euagarics) with emphasis of the genus *Gymnopus*. Sydowia 58: 191–289.

Wilson AW, Desjardin DE. 2005. Phylogenetic relationships in the gymnopoid and marasmioid fungi (*Basidiomycetes*, euagarics clade). Mycologia 97: 667–679.

FUNGAL INVENTORIES

Die Funga der Moore des Hochschwarzwaldes. Ergebnisse einer Langzeitstudie. By D. Laber. 2010. Beiheft zur Zeitschrift für Mykologie Band 11. Deutsche Gesellschaft für Mykologie, Postfach 700447, 81304 München, Germany. <schatzmeister@dgfm-ev.de>. Pp 208, figs 43, plates 84. Price € 25.

Over the course of 34 years, 578 forays into different types of moors, swamps, bogs, brooksides, and other watery habitats in the higher ranges of the Black Forest were undertaken by the author and her husband. The results of all this work are reflected in this excellent publication. A thorough introduction, with detailed information on the visited areas, their vegetation, and their fungi is followed by a checklist of all 671 fungal species identified and detailed descriptions of selected interesting species. The author focused on the more conspicuous basidiomycetes and ascomycetes, leaving to one side crust fungi and the ascomycetes that form small fruitbodies. The area and its fungi stand out because of the granite and gneiss bedrock, which complicates comparison with the mycoflora of other similar European habitats situated on limestone (Favre 1948 for the Jura, Moreau 2002 for the French northern Alps, Einhellinger 1976 & 1977 for Bavarian swamps and bogs). One finding in the present work is that species regarded as northern and occurring in Scandinavia are also at home in this montane area further south. I am very impressed by the fact that the names are very up-to-date; it is clear that a huge effort has been put into using the proper nomenclature, an extraordinarily difficult task that demands a large library.

The checklist part gives for each taxon the exact habitats, the number of finds per location, the fruiting period, the highest altitude found, and a picture reference. Full descriptions are complemented by line drawings and discussions of the finds.

This work is important in a number of ways. It gives the mycoflora of one area at one point in time, which is great in respect to possible changes that will take place; currently the area still gets a high amount of precipitation, but this might change in the future. Such a comprehensive and illustrated overview of the fungi in one habitat type in one region can help identify species in other similar habitats. An extremely good example of what dedicated research over a long period can achieve, the 'Funga' also demonstrates that one need not be a professional mycologist to contribute. Similar research, but not as long-running, was done by a team of mycologists on Vancouver Island (Canada) (e.g. Roberts et al. 2004), but the longevity and thoroughness of the German study make it stand out. In short, the Laber work is highly recommended, not only for those interested in central European mycoflora but also for everybody interested in doing fungal surveys themselves.

Einhellinger A. 1976. Die Pilzen in primären und sekundären Pflanzengesellschaften oberbayerischer Moore, Tel 1. Ber. Bayer. Bot. Ges. 47: 75–149.

Einhellinger A. 1977. Die Pilzen in primären und sekundären Pflanzengesellschaften oberbayerischer Moore, Tel 2. Ber. Bayer. Bot. Ges. 48: 61–146.

Favre J. 1948. Les associations fongiques des haut marais jurassiens. Beiträge zur Kryptogamenflora der Schweiz 10: 1–228.

Moreau P-A 2002. Analyse écologique et patromoniale des champignons supérieurs dans les tourbières des Alpes du Nord. Thesis Université de Savoie. 336 pp.

Roberts C, Ceska O, Kroeger P, Kendrick B, 2004. Macrofungi from six habitats over five years in Clayoquot Sound, Vancouver Island. Canadian Journal of Botany 82: 1518–1538.

Fungi in General

The kingdom *Fungi*. The biology of mushrooms, molds and lichens. By S.L. Stephenson. 2010. Timber Press, 133 SW 2nd Avenue #450, Portland, OR 97204, U.S.A. <info@timberpress.com>. Pp. 328, plates 124. ISBN 978-0-88192-891-4. Price $34.95, £ 20.00.

Not a text book, not a collection of fungal stories, but an introduction to the world of fungi for lay persons and amateur mycologists – that is what this book boils down to.

After an introduction to the subject, various groups of fungi, not necessarily taxonomic units, are treated. Aquatic fungi first, followed by terrestrial fungi divided into subgroups (ascomycetes and zygomycetes, truffles and their kin, gilled fungi and other basidiomycetes, lichens and slime molds). Chapters on the roles of fungi in the environment, interactions between fungi and humans and other animals, and fossil fungi, plus a glossary and a list of references make this book complete. Two sets of colour photos, a total of 124 plates, illustrate it quite nicely. There are neither diagrams of life cycles and such nor phylogenetic trees to clarify the concepts given in the text.

From the list of chapters it should be clear that also some non-fungi such as the water molds and slime molds are treated, as they look and behave like fungi and have traditionally been studied by mycologists. The author indicates that many of the old categories and classifications do not hold up in the age in which phylogenetic methods to compare DNA sequences have revolutionized fungal classifications, but he still uses old terms such as gasteromycetes and aphyllophorales. That is a missed chance, in my opinion, for such a book is an excellent place to introduce amateur mycologists to new insights.

The kingdom *Fungi* contains enough interesting tidbits and fascinating mycological oddities to entice the reader, and it might pave the road to other more comprehensive books.

Book Announcements

Les myxomycètes. By M. Poulain, M. Meyer & J. Bozonnet, 2010. FMBDS, 8, Avenue de la Plaine, 74000 Annecy, France, <philippecattin74@orange.fr>. 2 vols, Plates 546. € 80 (before Oct 2010) € 120.

FoodMold: an interactive CD guide to foodborne fungi. By J.I. Pitt, E. Rico-Munoz & E.S. Johnson, 2009. BCN Research Laboratories, 2491 Stock Creek Blvd, Rockford, TN 37853, U.S.A. foodmold@bcnlabs.com. $ 340.

Fascinating microfungi (hyphomycetes) of Western Ghats, India. By D.J. Bhat, 2010. Broadway Book Centre. Pp xii, 222, figs 127. $80.00 (includes shipping).

Systematics of *Calonectria*: a genus of root, shoot and foliar pathogens. By L. Lorenzo, P.W. Crous, B.D. Wingfield & M.J. Wingfield, 2010. Studies in Mycology 66. CBS Fungal Biodiversity Centre, Uppsalalaan 8, 3584 CT, Utrecht, the Netherlands, http://shop.fungalbiodiversitycentre.com Pp 71 € 40.

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Fungal nomenclature

1. The IMC9 Edinburgh Nomenclature Sessions

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Three successive groundbreaking two-hour long nomenclatural sessions were held August 3–5, 2010, during this summer's International Mycological Congress (IMC9) in Edinburgh, Scotland. Convener/Rapporteur David Hawksworth (Spain/UK), who supervised preparation of the IMC9 nomenclatural booklet + questionnaire, was assisted by Chair Ron Petersen (USA), Vice-Chair Scott Redhead (Canada), Nomenclature Committee for Fungi (NCF) Secretary Lorelei Norvell (USA), and Advisor & International Botanical Congress Rapporteur-général John McNeill (UK). IMC delegates attending each day's session voted on nomenclatural proposals to recommend actions to next year's International Botanical Congress (IBC) Nomenclature Section in Melbourne. Attendance was relatively high, particularly in view of the conflict caused by scheduling the three nomenclature and three (of four) poster sessions for the same 2–4 pm time periods. As each poster session presented authors and posters for only one day, this was an unfortunate conflict that influenced attendance numbers at the nomenclatural sessions. However, the questionnaires, distributed to all IMC9 delegates for return to the registration desk by the end of the Congress, permitted each delegate a chance to express an opinion, even if unable to attend any or all of the Nomenclature Sessions.

Originally the entire proceedings, which proved to be lively, informative, and often amusing, were to be recorded. Due to an unfortunate communications failure, no recordings survive. The overly brief summary below has therefore been extracted from secretarial notes, the nomenclature booklet, and the returned questionnaires.

Background

When initially formed in 1971, the International Mycological Association (IMA) established a Nomenclature Secretariat to address issues of concern to mycologists. This led to a series of proposals on starting points and other matters that were adopted by the International Botanical Congress in Sydney in 1981, after which it was disbanded, having completed its tasks. Since that time, discussions of nomenclatural issues at IMCs have been confined to occasional debates on particular topical issues. However, at IMC8 in Cairns in 2006, some delegates spoke strongly in favour over a separate Code for fungi. Subsequently, proposals that could fundamentally change aspects of fungal nomenclature have been published; these are to be voted on at the forthcoming International Botanical Congress (IBC) in Melbourne in July, 2011. As IBCs occur only every six years, and decisions made there generally come into force 1-2 years later, any issues not decided in 2011 would have to wait until 2018 or 2019 to be implemented. The Nomenclature Sessions at IMC9 were convened to (1) enable a broad spectrum of mycologists to express their views on a wide range of topics and also to vote on proposals already made and (2) establish that IMCs can incorporate effective Nomenclatural Sessions.

Session 1: Governance of fungal nomenclature

Approximately 100 delegates attended the first session convened by Hawksworth at 2 pm on August 3. After Chair Petersen set forth the 'rules of engagement' for audience participation during all sessions, two introductory background presentations were given. Vincent Demoulin (Belgium, Chairman of the Committee for Fungi) spoke in defense of retaining governance of fungi within the Botanical Code and Hawksworth reported on the progress being made toward one unified code for all organisms. (See Appendix 1, below.)

The floor was then opened to discussion of the formal proposals for the governance of fungal nomenclature, the composition of the Nomenclature Committee for Fungi, and a (very) brief discussion of the proposed exclusion of *Microsporidia* from the ICBN. At the close of the two-hour session, those remaining in the auditorium were polled as to their preferences, summarized as follows:

Props. 016–020 (see Mycotaxon 108: 1–4) all passed. Votes were actually counted for the first two proposals: both Prop. 016 (to amend the current

Botanical Code to establish more clearly that it covers fungi, including changing the name to the "International Code of Botanical and Mycological Nomenclature") & PROP. 017 (to replace "plants" by "plant(s) or fungus/fungi" throughout) passed with 87 yes and 4 no votes. Thereafter, due to time pressures, only the 'no' votes (out of 91 total) were counted, with 3 voting against Prop. 018 (to provide for the election of the Permanent Nomenclature Committee for Fungi by an International Mycological Congress), 3 voting against Prop. 019 (to relegate decision-making on proposals relating solely to organisms treated as fungi to an IMC), and 1 against PROP. 020 (to insert a new Div. III.5 requiring the presence of the Secretary for the Committee for Fungi or Committee alternate on the Editorial Committee).

Unanimous support was given to retaining the current members of the COMMITTEE FOR FUNGI until the 2014 IMC10 in Bangkok, provided that the 2011 International Botanical Congress in Melbourne accepts the fungal governance proposals above.

PROPS. 048–051 (to exclude the governance of the phylum *Microsporidia* from the Code; see MYCOTAXON 108: 505–507) passed with only one dissenting vote, but as the vote was held as delegates were leaving the session, it may not accurately reflect the wishes of the majority. Demoulin has since submitted PROP. 190 to limit Art. 45.4 (p. 514, this volume).

Session 2: Mandatory pre-publication deposit in a nomenclatural repository, electronic publication, type cultures, and illustrations

After opening introductions, Paul Kirk (UK) provided an overview of the current strides made in data-basing taxonomic names of all organisms worldwide. (See Appendix 1, below.)

A fluctuating audience (estimated at 97 total for the 2-hour session) discussed at length and eventually recommended PROPS. 117–119 (see MYCOTAXON 111: 514–519). PROP. 117 (to require deposition of names and required nomenclatural information in a recognized repository (such as MycoBank) for valid publication) received 58 yes, 5 no, and 1 abstaining votes. PROPS. 118 (to recommend deposit of minimal information elements, accession identifiers, and bibliographical details for valid publication) and 119 (to require citation of a repository identifier for valid publication) received almost universal support, with 1 and 2 abstentions respectively. Kirk also announced that it would be possible to deposit names with the Index of Fungi, although the mechanism (still in progress) was not detailed.

An informal poll showed no clear consensus for or against valid electronic publication of names. PROP. 138 (which seeks to add Rec. 88B.3, including the phrase 'permanently preserved in a metabolically inactive state' or its equivalent

Chairman Ron dominates the auditorium while Paul Kirk explains nomenclatural databases on August 4.

when designating a culture as a type) likewise showed no clear consensus with the majority abstaining.

The session concluded with a second informal poll (showing 4 for, 25 against, and the majority abstaining) regarding the addition of illustrations as a requirement for valid publication.

Session 3: Moving to one name for one fungus & ending the requirement of Latin diagnoses for valid publication

Approximately 145 delegates attended the final (and most controversial) "Article 59" session on August 5. Background on attempts to modify dual nomenclature was provided by Redhead (Secretary for the Special Committee on Names of Fungi with a Pleomorphic Life History), followed by a presentation by Walter Gams (Netherlands), who spoke on the limitations of "teleotypifying" fungal names according to Art. 59.7. (See also Appendix 1, below.)

Emotions ran high in this session, and discussion was lively, entertaining, lengthy — and inconclusive. No formal proposals were before the Session, so no vote was scheduled on Art. 59. It was assumed that Congress participants would mark their opinions on their questionnaires.

Due to the lengthy Art. 59 debate, the scheduled discussion and vote on whether to end the requirement of a Latin diagnosis for the valid publication of scientific names (also to be considered in 2011 at Melbourne) became a side issue. Entrants crowding the doors for the next scheduled mycological session dictated Chair Petersen's decree for adjournment, which drowned out the plaintive cry from the back of the hall, "Why can't we vote to abolish Latin?" and a call to hold a vote on Art. 59.

Final resolution approved by the General Assembly — and a note of caution

At the close of the first Nomenclature Session, 103 questionnaires had already been returned. By the evening of the final session, Hawksworth and Norvell had tabulated 167 results and identified three clear preferences for presentation to the delegates during the IMC9 closing ceremonies on August 6. The General Assembly voted by acclamation to approve the resolution below:

> This General Assembly of the IMA endorses the decisions of the Nomenclature Session convened during IMC9 with respect to
>
> —the transference of the governance of the nomenclature of fungi from the International Botanical to International Mycological Congresses,
>
> —the mandatory pre-publication deposit of nomenclatural information in a recognized depository for the valid publication of new fungal names,
>
> —the acceptability of English as an alternative to Latin in the valid publication of fungal names,
>
> and requests the permanent Nomenclature Committee for Fungi, the special Committee on the names of Pleomorphic Fungi, the International Commission on the Taxonomy of Fungi, and the next International Botanical Congress to take note of the results of the questionnaire completed by delegates of IMC9.

In summary, we must emphasize that these are recommendations and not approved changes. Currently fungal names are still governed by the International Code of Botanical Nomenclature, and — until changed — a Latin description or diagnosis is still required, as are other established requirements for valid publication as set forth in the current International Code of Botanical

Petersen, Hawkworth, and IBC Rapporteur-général McNeill await the Art. 59 'discussions' on August 5.

Vice-Chair (& photographer) Redhead post-session

Nomenclature (McNeill & al. 2006). Nonetheless the interest shown in nomenclature at IMC9 was gratifying, and we are optimistic that many of the innovations supported by most mycologists will be made.

Appendix 1: IMC9 Nomenclature Session presentation abstracts

Fewer nomenclatural codes, not more, is what we need (Demoulin): At the first IMC (Exeter, 1971) the idea of a nomenclature code especially for fungi was discussed and a nomenclature committee was created under the auspices of the IMA. This committee reported at the 2nd IMC in Tampa, Fla. 1977. At that congress, the idea of a mycological code was abandoned in favour of more involvement by mycologists in the elaboration of the Botanical Code, which has ruled the nomenclature of fungi since its origin. A consequence was the important change in the starting point system adopted at the 13th International Botanical Congress (Sydney, 1981).

Progress towards a BioCode (Hawksworth): In October 2009, the General Assembly of the International Union of Biological Sciences (IUBS) decided to re-activate the initiative to produce a unified Code of nomenclature for all organisms, by updating the Draft BioCode (1997). This is being taken forward by the International Committee for Bionomenclature of the IUBS/IUMS (International Union of Microbiological Societies). The need for, and route towards, a revised and agreed BioCode is reviewed as a background to the Session's deliberations.

A web of data for fungal biology research— the registration question (Kirk): Why do we give names to fungi? It's a simple question with a simple answer - to allow us to effectively communicate about the fungi, for the name is the link to all that is known about the organism. But in this answer the word 'us' is already of secondary importance. The web is the primary means of communication today and increasingly that means computer to computer communication. In addition, the current version of the web - a web of information - is rapidly being replaced by a web of data (the Semantic Web, especially Linked Data using RDF triples of entity-attribute-value) which will allow more rapid (real time) advances in synthesis, analysis, hypothesis, etc. The founder of the web Tim Berners-Lee, amongst others, is pushing for this to happen and we can be part of this effort. This short presentation will describe how name registration can operate, how associated data can be made available, what the barriers are, and how it all fits into existing and developing major global initiatives. It will indicate how fungal taxonomist and nomenclaturalists can be part of this with respect to the names we give to fungi.

How do mycologists wish to treat names based on anamorphs? (Redhead): Fungal nomenclature dates back to Linnaeus (1753) when the use of microscopes was limited and the existence of sexual life cycles amongst them was unknown. Nearly 200 years later (1935) mycologists realized they had been naming different

parts of fungal life-cycles as new species or genera, and formalized nomenclature rules giving priority to names for pleomorphic fungi based upon perfect states. Exceptions and refinements were instituted in 1950 and continue today. Many fungi only produce anamorphs, many generic names are based upon anamorphs, and many fungi are better known under anamorph names. However, complications in merging and then prioritizing names have created a nightmare situation that has divided the mycological community and now acts as a roadblock. Proposals to block the deliberate generation of alternative names and smooth the transition to normal nomenclature were partially approved for Article 59 in the International Code of Botanical Nomenclature (2006) while remaining issues were referred to a Special Committee by the IBC. After >4 years this Committee was unable to reach consensus upon changes. Some mycologists have decided to ignore existing rules or to take nomenclatural risks. Genetic sequence phylogenetic analyses have revealed many new relationships leading to binomial recombinations and even a PHYLOCODE. Having reached an impasse it can be asked if mycologists wish to eliminate dual nomenclature? If the answer is yes, it may be asked how to resolve conflicts, and then to create a process or body capable of dealing with such conflicts.

TELEOTYPIFICATION OF FUNGAL NAMES AND ITS LIMITATIONS (Gams): This presentation was submitted without a formal abstract and too late to be included in the printed program. Gams discussed the effects of 'teleotypification,' which permits — after a teleomorph discovered for a fungus previously known only as an anamorph (and for which there is no existing legitimate name for the holomorph) — designation of an epitype exhibiting the teleomorph stage for the hitherto anamorphic name, even when there is no hint of the teleomorph in the protologue of that name. Several examples were forwarded to show that teleotypification is not the same as ordinary epitypification. For further information, see Props. (172–174), p. 513, this volume.

Rapporteur David, José Dianese, and Secretary Lorelei tabulate questionnaire responses in the EICC registration hall on August 3.

Appendix 2: IMC9 Nomenclature questionnaire results

From August 1–10, IMC9 delegates returned questionnaires in which they were to circle a Y (yes) or N (no) to 24 questions on 4 topics. We discovered during our first tabulation that one number (#19) appeared twice, bringing the actual number of questions to 25, and have renumbered the text below accordingly. Of the 174 questionnaires received, 7 were declared 'spoiled' as the respondents had placed an X over an option so that we could not determine whether agreement or rejection was intended. Both raw numbers and majority percentages are shown. We note that protocols followed at the 2005 International Botanical Congress in Vienna with respect to the preliminary mail-in ballots decreed that propoals receiving 60% or higher support merited further discussion by the attending Nomenclature Section, while 75% support virtually ensured passage for all but the most controversial proposals. In the results reported below, opinions showing 60% (or greater) support are highlighted in bold.

A. Codes of nomenclature

(Fungal names are now governed by the International Code of Botanical Nomenclature)

1 One code for the future nomenclature of all organism names would be ideal
y-72 n-71 ... 50% (TIE)

2 Fungi should continue to be covered under the Botanical Code (ICBN)
y-54 n-76 ..... 58% NO

3 Fungi should continue to be covered under the ICBN provided it is renamed the "Botanical and Mycological Code" y-97 n-40 ..... **71% YES**

4 Fungi should be covered by a separate mycological Code (ICMN)
y-51 n-91 ..... 61% NO

5 Under either ICBN or ICMN, decisions on fungal nomenclature should be voted at an International Mycological Congress (and not an International Botanical Congress), guided by a secure advanced web publication and mail/email votes y-133 n-21 .... **86% YES**

B. Language requirements for valid publication of names

6 Latin diagnoses/descriptions should continue to be required
y-49 n-91 ..... 65% NO

7 English diagnoses/descriptions rather than Latin should be required
y-69 n-69 ... 50% (TIE)

8 Either Latin or English diagnoses/descriptions should be required
y-88 n-56 ..... **61% YES**

9 Diagnoses/descriptions in any language should be permitted
y-4 n-135 ..... 97% NO

C. Nomenclatural information databasing

10 Deposition of key nomenclatural information in one or more approved depositories (e.g. MycoBank) should be made mandatory for the valid publication of new fungal names y-134 n-21 .... **86% YES**

11 Historic names not included in *Index Fungorum* (after a set date) should no longer be treated as validly published y-55 n-68 ..... 55% NO

12 Deposited names should be automatically protected against any unlisted names after a date to be agreed y-90 n-39 ..... **70% YES**

13 An accurate and free list should be prepared of names in use or available for use y-126 n-19 .... **87% YES**

14 Names with key information deposited (e.g. in MycoBank) should be automatically available provided other Code requirements are met — y-105 n-22 ... **83% YES**

15 Electronic on-line only publication should be accepted without restriction — y-24 n-126 .... **84% NO**

16 Electronic on-line only publication should be accepted only when key nomenclatural information has been deposited (e.g. in MycoBank) — y-113 n-36 .... **76% YES**

17 For journals publishing online and printed copies, the dates of names should be those when the works are available in final form on-line — y-101 n-40 .... **72% YES**

18 For journals publishing online and printed copies, the dates of names should be those when the works are distributed in printed form — y-63 n-73 ..... **54% NO**

19 Special Group Committees should be empowered to create lists of acceptable and rejected names in particular groups (e.g. *Fusarium, Trichocomaceae*, yeasts) — y-102 n-31 .... **77% YES**

D. NAMES FOR PLEOMORPHIC FUNGI (ANAMORPHS, TELEOMORPHS)

20 The established system allowing dual nomenclature for anamorphs and teleomorphs should continue via Art. 59 — y-67 n-71 ..... **51% NO**

21 Article 59 should revert back to its status prior to changes in the 2006 Vienna Code, i.e. keeping separate anamorph and teleomorph names — y-43 n-82 ..... **66% NO**

22 A system of progressively establishing one name for each fungus should be enacted via modification of existing Articles (e.g. Art. 59) — y-101 n-38 .... **73% YES**

23 The historical practice of allowing valid names for different morphs of a species should be prohibited in the future via modification of existing Articles — y-74 n-45 ..... **62% YES**

24 The ability to select a "teleotype" (a type of epitypification) with a sexual state for a fungus previously only known in the asexual state should be continued — y-88 n-31 ..... **74% YES**

25 Article 59 (that permits the dual system) should be deleted provided other changes ensure this would not retroactively invalidate existing names — y-66 n-47 ..... **58% YES**

Acknowledgments

We thank John McNeill (Royal Botanic Garden Edinburgh) for his perennially wise counsel and cheerful guidance. We further thank special presenters Vincent Demoulin, Paul Kirk, and Walter Gams; José Dianese (Brazil) for assisting in tabulating questionnaire results on August 3; and all those who participated in the nomenclatural discussions and/or completed questionnaires at IMC9 Edinburgh.

2. Proposals to conserve or reject fungal names

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Abstract — Formal proposals to conserve or protect fungal names are published in TAXON and considered by the IAPT permanent Nomenclature Committee for Fungi, which recommends conservation or rejection to the General Committee. The recently published Prop. 1945 (to conserve the name *Thelephora comedens* with a conserved type) is summarized and other proposals still under discussion by the Committee are listed. The complete text of all formal nomenclatural proposals is available on the internet at <www.ingentaconnect.com/content/iapt/tax>. Those wishing to comment on a proposal still under consideration by the Nomenclature Committee for Fungi are invited to contact Secretary Norvell.

Recently published

(1945) PROPOSAL TO CONSERVE the name *Thelephora comedens* (*Vuilleminia comedens*) with a conserved type (*Basidiomycota*). [Masoomeh Ghobad-Nejhad & Nils Hallenberg. 2010. TAXON 59(4): 1277–1278.]

SUMMARY: The name *Thelephora comedens* Nees : Fries is currently applied to a "basidiomycetous corticioid fungus presently known as *Vuilleminia comedens* (Nees : Fr.) Maire, which serves as type for the genus *Vuilleminia* Maire." The epithet *comedens* is typified by a color drawing of a specimen in UPS that appears not to have been examined by anyone (including Fries) since publication of *T. comedens* in 1816–1817; the authors are unaware of any other Fries or Nees specimens representing *T. comedens* and regard the UPS specimen as the only extant material. The specimen does not conform to the current concept of *V. comedens* but represents a *Hyphoderma*. To preserve the stability of the species concept with the name, the authors propose as conserved type a specimen collected by Petrak from *Quercus*, which they regard to represent *T. comedens* as currently recognized.

Other conservation proposals

(Committee for Fungi vote in progress)

PROP. 1769, to conserve the name *Cortinarius speciosissimus* against *C. rubellus, C. orellanoides,* and *C. rainierensis* (*Basidiomycota*).

PROP. 1810, to conserve the name *Hemipholiota* against *Nemecomyces* (*Agaricales, Basidiomycota*).

PROP. 1828, to conserve *Aspicilia aquatica* against *Lichen mazarinus* (*Ascomycota*: *Pertusariales*: *Megasporaceae*).

PROP. 1829, to reject the name *Verrucaria thelostoma.*

PROP. 1830, to reject the name *Pyrenula umbonata* (lichenized *Ascomycota*).

PROP. 1831, to conserve the name *Mixia* against *Phytoceratiomyxa* (*Basidiomycota*).

PROP. 1852, to conserve the name *Olivea tectonae* (T.S. Ramakr. & K. Ramakr.) R.L. Mulder against *Olivea tectonae* (Racib.) Thirum. (*Basidiomycota*).

PROP. 1861, to conserve the name *Aspicilia farinosa* (*Ascomycota*: *Pertusariales*: *Megasporaceae*) with a conserved type.

PROP. 1862, to conserve the name *Psoroma versicolor* (*Degeliella versicolor*) against *Psoroma subdescendens* (lichenized *Ascomycota, Pannariaceae*).

PROP. 1863, to conserve the name *Craterellus cinereus* (Pers. : Fr.) Donk with a conserved type against *Craterellus cinereus* Pers. (*Basidiomycota*).

PROP. 1888, to conserve the name *Glomus* (*Fungi, Glomeromycota, Glomerales*) as being of neuter gender.

PROP. 1896, to conserve the name *Lichen lichenoides* (*Leptogium lichenoides*) against *Lichen tremelloides* and *L. tremella* (lichenized *Ascomycota*).

PROP. 1897, Proposal to reject the name *Lecidea epiploica* (lichenized *Ascomycota*).

PROP. 1898, to conserve *Stirtonia* A.L. Sm, (lichenized *Ascomycota, Arthoniales*) against *Stirtonia* R. Gr. bis (*Bryophyta, Dicranales*).

PROP. 1899, to conserve the name *Hebeloma cylindrosporum* against *Hebeloma angustispermum* (*Basidiomycota*).

PROP. 1918, to conserve the name *Dermatocarpon* (*Placopyrenium*) *bucekii* against *Placidium steineri* (lichenized *Ascomycota, Verrucariaceae*).

PROP. 1919, to conserve *Lactarius* (*Basidiomycota*) with a conserved type.

PROP. 1926, to conserve *Cladia* against *Heterodea* (*Ascomycota*).

PROP. 1927, to conserve the name *Agaricus rachodes* (*Basidiomycota*) with that spelling.

3. Proposals to amend the Code

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Abstract — Current proposals to amend the International Code of Botanical Nomenclature will soon be placed on a ballot to be distributed to all members of the International Association of Plant Taxonomists, scheduled for return prior to the 2011 International Botanical Congress in Melbourne, Australia. Summaries of recently published proposals of particular interest to mycologists are given for Props. 172–174 (to amend teleotypification procedures set forth in Art. 59.7), Prps. 183–184 (to require deposition of information concerning typification of fungal taxa), and Props. 185–190 (to amend Arts. 15, 36, and 45). Previous proposals also affecting fungal nomenclature are also listed. The complete text of all proposals is available for free download at <www.ingentaconnect.com/content/iapt/tax>.

Recently published proposals

(Committee for Fungi vote in progress)

(172–174) Three proposals to amend Article 59 of the CODE concerning teleotypification of fungal names. Proposed by Walter Gams, Walter M. Jaklitsch, Roland Kirschner & Martina Réblová. TAXON 59(4): 1297.

SUMMARY: Three proposals to clarify the effect of teleotypification are provided. Prop. 172 proposes to eliminate Art. 59.7, thereby returning Art. 59 to the pre-Vienna situation. The alternate, Prop. 173, would modify the current Art. 59.7 so as to avoid including taxa with teleomorph-typified names within otherwise entirely anamorphic genera. If Prop. 173 is enacted, Prop. 174 would add Recommendation 59A.4, which specifies that newly discovered anamorphs should only be classified under teleomorph-

typified generic names when no suitable anamorph-typified generic names are available. Prop. 174 further species that a subsequent discovery of a teleomorph will require epitypification by a specimen exhibiting the teleomorph.

(183–184) Proposals to require deposition of information concerning typification of names of fungal taxa, with an associated Recommendation. Walter Gams. 2010. TAXON 59(5): 1626–1627.

SUMMARY: — Anticipating probable acceptance of Props. 117–119 to require deposition of nomenclatural information for valid publication of newly introduced fungal taxonomic names effective January 1, 2013, under PROP. (183) Gams would add a clause to Art. 7.10 that would make deposition in a recognized repository compulsory for effective typification from 2013 onwards.

PROP. (184) would insert new Recommendation 37bisA.2 (with appropriate cross-references) to encourage anyone publishing choices for names of fungal organisms to record the choice of name, orthography, or gender in a recognized repository, citing this and its record number in the place of effective publication.

(185–190) Proposals to amend Articles 15, 36, and 45. Vincent Demoulin. 2010. TAXON 59(5): 1627–1628.

SUMMARY: These five proposals were prompted by discussion in the Nomenclature Committee for Fungi and in the IMC9 Nomenclature sessions. PROP. 185 would insert into Art. 15.1 the sentence, "The spelling used by a sanctioning author is treated as conserved, except if it is to be corrected or standardized under Art. 60" and would instruct the Editorial Committee to insert an example to clarify what is meant by sanctioning. PROPS. 186–189 would modify Art. 36 to permit the use of a Latin OR English diagnosis, as is now permitted for fossil nomenclature under the current CODE. Prop. 190 seeks to limit Art. 45.4 to the first sentence, to be reworded as, "If a taxon is treated as belonging to the algae or fungi, any of its names need satisfy only the requirements of the non-botanical code that the author was using for status equivalent to valid publication under the present CODE (but see Art. 54 regarding homonymy." A new Art. 45.5 is proposed to clarify that authors who regard organisms as representing fungi must also follow the CODE, which governs fungi, and not some other non-botanical code. This modification would thus make Art. 45 applicable to groups similar to the *Microsporidia* but which are not covered by Props. 48–51 (see below).

Other proposals to amend the CODE affecting fungi

(Committee for Fungi vote in progress; see also IMC9 Nomenclature Session summary, this volume, pp. 503–509)

PROPS. (016–020), to amend the CODE to make clear that it covers the nomenclature of fungi, and to modify its governance with respect to names of organisms treated as fungi.

PROPS. (048–051), to exclude the phylum *Microsporidia* from the CODE.

PROPS. 117–119, to make deposition of nomenclatural information for all newly introduced names of fungal taxa a prerequisite for valid publication.

NOMENCLATURAL NOVELTIES AND TYPIFICATIONS PROPOSED IN MYCOTAXON 113

Aschersonia fusispora Jun Z. Qiu, C.Y. Sun & Xiong Guan, p. 82

Athelopsis parvispora Avneet P. Singh, Dhingra & J. Kaur, p. 327

Bionectria vesiculosa J. Luo & W.Y. Zhuang, p. 245

Ceratocystiopsis minuta (Siemaszko) H.P. Upadhyay & W.B. Kendr. 1975 (lectotypified), p. 13; (epitypified), p. 14

Chaetospermum setosum Rajeshkumar, S.K. Singh & P.N. Singh, p. 398

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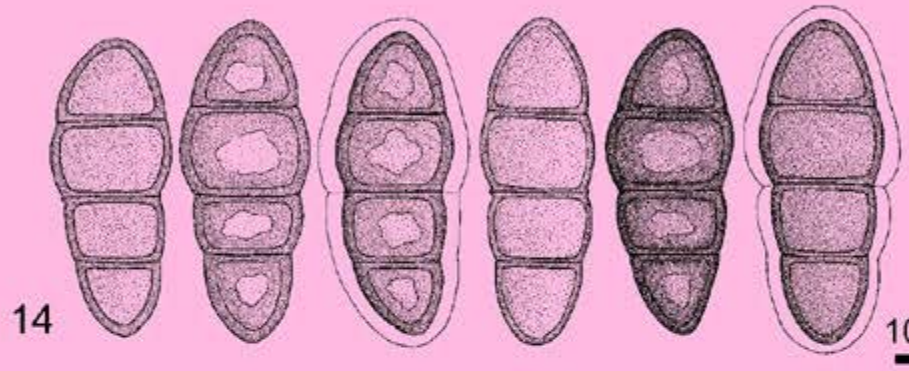

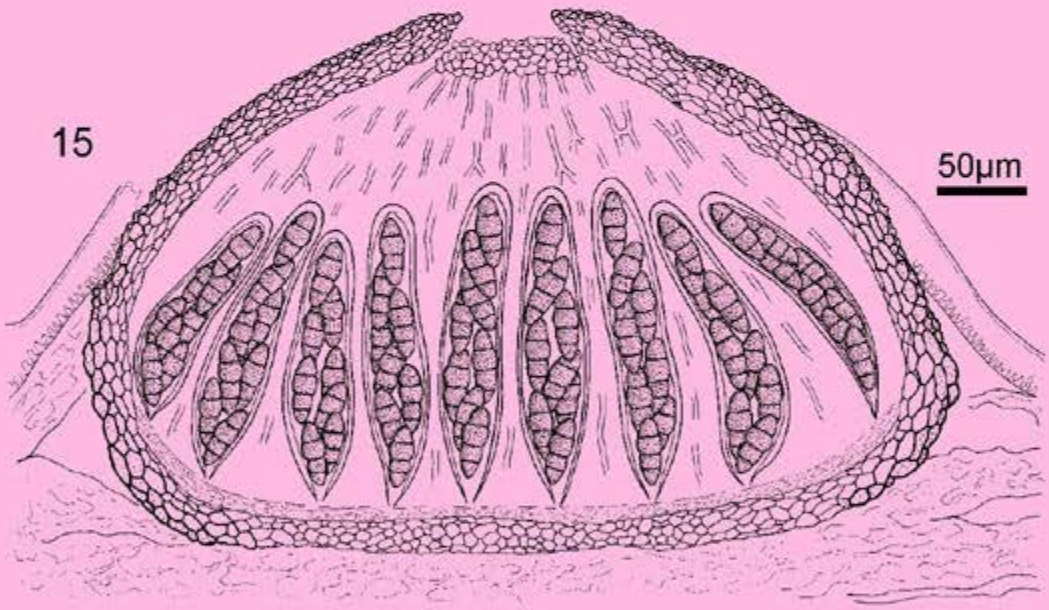

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