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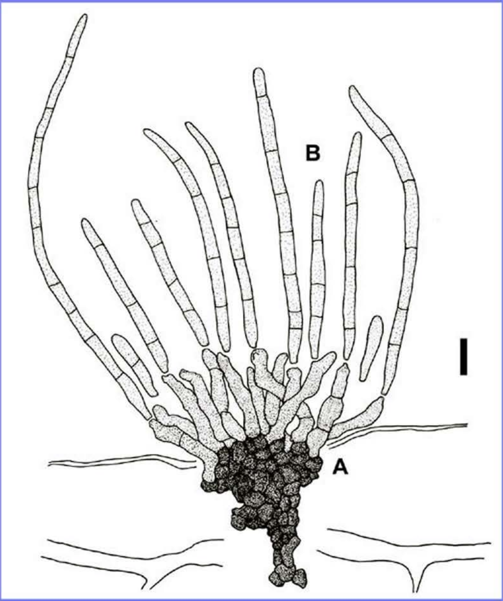

Silva & Pereira, p. 265
Fig 3. *Pseudocercospora rigidae.*
Sporodochial conidiomata arising from dark-brown subepidermal stromata.
(Scale bar = 10 µm).

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Conidial fungi from the semi-arid Caatinga biome of Brazil.[1–4]

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Arthrorhaphis vacillans, new to the Iberian Peninsula

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Abstract — *Arthrorhaphis vacillans* is recorded for the first time from the Iberian Peninsula. Remarks on its ecology and on its differences with closely related species in the Iberian Peninsula are made.

Key words — *Baeomyces rufus*, key, lichenicolous lichens, Spain

Introduction

Arthrorhaphis vacillans Th. Fr., a species of lichenicolous lichen growing on *Baeomyces rufus* (Huds.) Rebent., is reported for the first time from Sierra Cebollera Natural Park in the northern part of the Iberic System, La Rioja in northern Spain. It is a rare species with scattered North Hemisphere distribution up to now unknown from the Iberian Peninsula lichen flora. The Sierra Cebollera Natural Park is protected from 1995 due to its natural and biogeographical importance, since it represents a transition zone between the Eurosiberian and Mediterranean Regions (Mendiola 1983). Climatic conditions are more or less continental: upper areas of the Reserve correspond to the cold temperate belt, whereas the lowlands correspond to the sub-mediterranean belt (Mendiola 1983). Geologically, siliceous rocks from the upper Jurassic are predominant.

Ecology and distribution

Arthrorhaphis vacillans was found at 1420 m on medium acid soils along both sides of a track crossing a mixed beech-pine forest (*Pino-Cytision purgantis* Rivas-Martínez 1965, *Fagenion sylvaticae* Luquet 1926). The fact that it was found growing on *Baeomyces rufus* thalli rather than independently is considered unusual (Obermayer 1994). At our collection site, *Baeomyces* covered a large area and the number of thalli infected was high.

A. vacillans is considered a rather rare species that has an arctic-alpine disjunct distribution. The studies of vascular plants by Mendiola (1983) indicate that up to 10.1 % of the local flora belongs to this arctic-alpine contingent. *A. vacillans* has been previously recorded from Mongolia (Biazrov 2006); Russian Siberia, where it seems to be relatively common (Zhurbenko 1986), China and Nepal (Obermayer 1996), Greenland (Hansen & Obermayer 1999, Thomson 1997), and Europe. The European distribution is scattered and represented by few records, with the species reported from Iceland (Orange 1990), Norway and Sweden (Santesson et al. 2004, Ihlen 1998), United Kingdom (Coppins 2002), and Austria, Germany and Faeroe Islands (Obermayer 1994). Discovery of *A. vacillans* in Spain extends its distribution southward.

Remarks

Until now, only three *Arthrorhaphis* species were known from the Iberian Peninsula (Llimona & Hladun 2001): *A. citrinella* (Ach.) Poelt, *A. alpina* (Schaer.) R. Sant., and *A. grisea* Th. Fr. The first two taxa only rarely begin their development on *Baeomyces* (Obermayer 1996). *A. citrinella* usually has a sorediate thallus and is characterized by its medulla lacking Ca-crystals and large (50–110 × 2.5–3.5 µm) 6–9-septate ascospores. *A. alpina* is so closely related to *A. vacillans* that sterile thalli can be often impossible to differentiate. *A. alpina* has longer (30–50 µm) 5–10(–14)-septate ascospores (Obermayer 1996). *A. grisea*, usually parasitic on *Baeomyces* thalli that it partially discolours, is only rarely found growing independently (Pérez-Ortega 2004). The presence of large (30–50 × 2–2.5 µm) 12–15-septate ascospores readily separates *A. grisea* from young, under-developed *A. vacillans* thalli when apothecia are present. *A. grisea* is relatively uncommon to the Iberian Peninsula, where it has previously been recorded only from La Rioja (Etayo 1991) and Asturias (Pérez-Ortega 2004).

A. alpina var. *jungens* Obermayer & Poelt, described from Tibet (Obermayer 1995), is a morphological intermediate between *A. alpina* var. *alpina* and *A. vacillans*. *A. alpina* var. *jungens* shows a rougher apothecial disc with somewhat thicker margin, longer asci (80–110 µm) and slightly longer spores —(14–)17–25(–28) µm that are often more than 3-septate (3–5(–7) septa; Obermayer 1995). *A. vacillans* produces slightly (16–20(–22) µm) smaller spores with up to 3 septa. However, more research is needed to determine the genetic distance between these two taxa.

Specimen examined—**SPAIN.** La Rioja. Sierra Cebollera, Villoslada de Cameros, 30TWM2756, 1420 m, on *Baeomyces rufus* at track-side, *Pérez-Ortega*, 30 June .2005 (HERB. PÉREZ-ORTEGA). *TLC*—Rhizocarpic acid.

Key to the known *Arthrorhaphis* species in the Iberian Peninsula:

1. Thallus yellow to yellowish green, parasitic on *Baeomyces* or not 2
1. Thallus grey or immersed, almost always parasitic on *Baeomyces* .... *A. grisea*
2. Thallus without Ca-crystals in the medulla, spores ≥ 50 µm .... *A. citrinella*
2. Thallus with Ca-crystals in the medulla, spores usually ≤ 50 µm 3
3. Ascospores (2-)3-septate, 15–22 µm long .... *A. vacillans*
3. Ascospores 3–14-septate, 25–55 µm long .... *A. alpina*

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Preliminary list of cercosporoid fungi from Poland

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Abstract – In this paper, results of a comprehensive, annotated checklist of cercosporoid hyphomycete species in Poland are summarized. 67 species are hitherto known from Poland. The complete annotated list comprising 32 *Cercospora*, 31 *Passalora*, two *Stenella* and two *Pseudocercospora* species is available on the following Mycotaxon website: http://www.mycotaxon.com/ resources/weblists.html

Key words – mitosporic fungi, hyphomycetes

Introduction

Cercospora and allied genera are anamorphs of the ascomycetous genus *Mycosphaerella* Johanson (e.g., Braun & Melnik 1997, Kim & Shin 1998, Crous & Braun 2003). Since *Cercospora* was established by Fresenius (1863), the number of species assigned to this genus increased rapidly, followed by a significant expansion of its generic concept, including numerous *Passalora*-like fungi (Braun & Melnik 1997).

The first worldwide monograph of *Cercospora* Fresen. s. lat. was published by Chupp (1954). Later, Deighton (e.g., 1967, 1976), Braun (1995), Braun & Melnik (1997) and other authors narrowed the generic concept of *Cercospora* s. lat. and divided it into smaller units. Recently Crous & Braun (2003) recognized four true cercosporoid genera, viz. *Cercospora*, *Pseudocercospora* Speg., *Passalora* Fr. and *Stenella* Syd., and several other morphologically similar genera, based on molecular sequence analyses and a reassessment of morphological characters.

First reports of cercosporoid fungi collected in Poland date back to the late 19th-century, when Hennings (1892), Schroeter (1892, 1897) and Hellwig (1897) listed various fungal species found in the vicinity of the town of Świecie, in Lower Silesia, in the Sudeten Mts., and in the vicinity of the town of Września near Poznań, respectively. First studies in the 20th century, for example by Garbowski (e.g. 1929, 1935), Garbowski & Juraszkówna (1933) and Leszczenko (1937), predominantly contained data on parasites of crop and ornamental plants. First records of cercosporoid fungi found in natural plant communities were published from the Tatra National Park (Starmachowa 1963), followed by collections from the Ojców and Pieniny National Parks (e.g. Kućmierz 1973, 1976, 1977), the Poleski and Białowieża National Parks (e.g Mułenko 1988-1989, 1994a, b, 1996), and recently from the Słowiński National Park (Adamska 2001). Studies by Danilkiewicz (1987, 1987-1990) conducted in the left-bank valley of the central Bug river provided valuable information on parasitic fungi in riparian communities.

Materials and methods

The list of cercosporoid fungi was complied using reports available in the literature. The species listed were usually recorded on living plant organs. *Cercospora* sp. collected on honeydew of *Abies* sp. represents an exception and is somewhat rather doubtful.

The fungal nomenclature and taxonomy follows Crous & Braun (2003). Species names used in the original publications, which deviate from those in the latter publication, are cited as synonyms. The host plant nomenclature follows Mirek et al. (2002).

Results

A list containing 32 species of the genus *Cercospora*, 31 species of *Passalora* and two species of *Pseudocercospora* as well as *Stenella* is given below. *Cercospora* species were collected on 46 host plants belonging to 33 genera and 17 families of both classes of the *Magnoliophyta* (*Magnoliopsida*, *Liliopsida*). The highest amounts of cercosporoid parasites were recorded on representatives of the *Fabaceae* (nine species), *Brassicaceae* (six), and *Violaceae* (four). *Passalora* species were collected on 92 host plants belonging to 58 genera and 19 families, including the *Poaceae* (with 25 species), *Apiaceae* (with 14 species), *Rosaceae* (with seven species), *Onagraceae* (with six species), *Chenopodiaceae* and *Rubiaceae* (with four species each), which represent the host plant families with most cercosporoid species. Only two species of *Stenella* and *Pseudocercospora*, respectively, are known from Poland, viz., *S. lythri* on *Lythrum salicaria* L., *S. subsanguinea* on *Maianthemum bifolium* (L.) F.W. Schmidt, *P. geicola* on *Geum montanum* L. and *P. opuli* on *Viburnum opulus* L.

Substrates, literature references and synonyms are included in the complete checklist (PDF file) available on the Mycotaxon webside: http://www.mycotaxon.com/resources/weblists.html.

The checklist includes the following *Cercospora* species recorded from Poland: *C. apii* Fresen., *C. armoraciae* Sacc., *C. barbareae* (Sacc.) Chupp, *C. beticola* Sacc., *C. cardamines* Losa (*cardaminae*), *C. carotae* (Pass.) Kazn. & Siemaszko, *C. curvata* (Rabenh. & A. Braun) Wollenw., *C. depazeoides* (Desm.) Sacc., *C. euphrasiae* Ondřej, *C. kabatiana* Allesch. ex Lindau, *C. lycii* Ellis & Halst., *C. maianthemi* Fuckel, *C. medicaginis* Ellis & Everh., *C. meliloti* Oudem., *C. mercurialis* Pass., *C. nasturtii* Pass., *C. olivascens* Sacc., *C. ononidis* (Auersw.)

Höhn., *C. pantoleuca* Sacc., *C. paridis* Erikss., *C. physalidis* Ellis, *C. pietrenii* Dominik, *C. plantaginis* Sacc., *C. radiata* Fuckel, *C. senecionis* Ellis & Everh., *C. setariae* G.F. Atk., *C. tragopogonis* Ellis & Everh., *C. violae* Sacc., *C. violae-sylvaticae* Oudem., *C. zebrina* Pass., *C. zonata* G. Winter.

The genus *Passalora* is represently by *P. actaeae* (Ellis & Holw.) U. Braun & Crous, *P. ariae* (Fuckel) U. Braun & Crous, *P. avicularis* (G. Winter) Crous et al., *P. bacilligera* (Mont. & Fr.) Mont. & Fr., *P. bellynckii* (Westend.) U. Braun, *P. bupleuri* (Pass.) U. Braun, *P. campi-silii* (Speg.) U. Braun, *P. carlinae* (Sacc.) U. Braun & Crous, *P. circumscissa* (Sacc.) U. Braun, *P. comari* (Peck) U. Braun, *P. concors* (Casp.) U. Braun & Crous, *P. depressa* (Berk. & Broome) Sacc., *P. dissiliens* (Duby) U. Braun & Crous, *P. dubia* (Riess) U. Braun, *P. ferruginea* (Fuckel) U. Braun & Crous, *P. fulva* (Cooke) U. Braun & Crous, *P. galii* (Ellis & Holw.) Arx, *P. graminis* (Fuckel) Höhn., *P. malkoffii* (Bubák) U. Braun, *P. heterospora* (Höhn.) Höhn., *P. microsora* (Sacc.) U. Braun, *P. microsperma* Fuckel, *P. minutissima* (Desm.) U. Braun & Crous, *P. montana* (Speg.) U. Braun & Crous, *P. murina* (Ellis & Kellerm.) U. Braun & Crous, *P. punctum* (Lacroix) S. Petzoldt (*puncta*), *P. rhamni* (Fuckel) U. Braun, *P. ribis-rubri* (Săvul. & Sandu) U. Braun, *P. rosicola* (Pass.) U. Braun, *P. scandicearum* (Magnus) U. Braun & Crous and *P. vexans* (C. Massal.) U. Braun & Crous.

Pseudocercospora opuli (Höhn.) U. Braun & Crous, *P. geicola* U. Braun, *Stenella lythri* (Westend.) J.L. Mulder and *S. subsanguinea* (Ellis & Everh.) U. Braun complete the list of cercosporoid species recorded from Poland.

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Notes on some Japanese smut fungi. IV. *Mundkurella japonica*, sp. nov.

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Abstract—A new smut fungus, *Mundkurella japonica* on *Kalopanax pictus*, is described and illustrated from Japan. *Mundkurella kalopanacis*, another species on *Kalopanax pictus*, known only from the type locality in Korea, was also revised and compared with the new species. The Japanese specimens of *M. japonica*, collected from Ibaraki Pref. (Honshu) and three localities in Hokkaido, possess greenish brown and mainly (52–75 %) 3–4-celled fertile spores while those of *M. kalopanacis* possess light yellowish brown and mainly (75 %) 1–2-celled fertile spores.

Key words—*Araliaceae*, taxonomy, *Urocystales*, *Ustilaginomycetes*

Introduction

In the autumn of 1993, a smut fungus on *Kalopanax pictus* (*Araliaceae*) was observed in the Forestry and Forest Products Research Institute, Ibaraki Pref., Japan. Later it was found on the same host in three localities in Hokkaido. The causal agent of the disease is a *Mundkurella* species.

Mundkurella is a small and unusual smut genus with four known species on *Araliaceae*: *M. heptapleuri* Thirum. on *Heptapleurum venulosum* Seem. (India), *M. mossii* Savile on *Aralia nudicaulis* L. (Canada and USA), *M. kalopanacis* on *Kalopanax pictus* (Korea), and *M. schefflerae* Vánky et al. on *Schefflera digitata* J.R. Forst. & G. Forst. (New Zealand) (cfr. Thirumalachar 1944; Savile 1975; Vánky 1990, 2002; Vánky et al. 1999). The members of this genus possess sori localized in fruits, inflorescences, stems, petioles, and leaves forming swellings filled with spores. *Mundkurella* spp. possess two characteristics that

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are uncommon for smut fungi, namely the presence of (i) two kinds of mature and ornamented spores, and (ii) 1–4 celled spores. All *Mundkurella* species are parasites on woody plants (*Aralia, Heptapleurum, Kalopanax,* and *Schefflera*), which is rare for smut fungi.

In the present article, the morphological characteristics of the Japanese specimens were compared with those of the only known species of *Mundkurella* on *Kalopanax*, viz. *M. kalopanacis*.

Materials and methods

Morphological observations of dry herbarium specimens, held in the mycological collections of the Institute of Agriculture and Forestry, University of Tsukuba, Tsukuba (TSH), and Faculty of Agriculture, Hokkaido University, Sapporo (SAPA), were made under light microscope (LM) and scanning electron microscope (SEM). For observations in LM, the spores were mounted in lactophenol solution on glass slides by gently heating to the boiling point and then cooling. The measurements of spores are given in the form: min-max (mean ± 1 standard deviation). In the description, a symbol '$n/_x=$' is used to indicate the total numbers of measured specimens and fertile spores. For studies in SEM, the spores were attached to specimen holders by double-sided adhesive tape and coated with platinum-palladium with a Hitachi E-1030 ion sputter. The surface structure of spores was observed and photographed with a Hitachi S-4200 scanning electron microscope.

Comparative morphology and taxonomy of *Mundkurella* specimens on *Kalopanax*

Mundkurella kalopanacis Vánky, Mycol. Res. 94: 271, 1990. Figs 3–4, 7; Table 1

Sori subepidermal, confined to the tips of stem and usually situated closely below the cluster of compound umbels; producing considerable, irregular swellings up to 1 cm long and 0.5 cm wide which are filled with spores. **Spore mass** powdery, dark brown or brown-vinaceous, heterosporous; liberated after rupturing of the epidermis. **Spores** of two kinds: (i) one-celled, sterile and usually collapsed, suborbicular, broadly elliptical, ovate or slightly irregular in outline, 14.5–23 × 12–19.5 µm, pale yellowish brown, densely and finely verruculose to verrucose, and (ii) 1- to 4-celled (1–2- celled spores 75 %, 3–4-celled spores 25 %; $n/_1=266$), fertile spores with rich cell contents, subglobose, broadly ellipsoidal, ovoid or slightly irregular, sometimes irregularly rounded rectangular, 10–19 × 9–13 (13.0±1.7 × 11.1±0.9) µm ($n/_1=50$), light yellowish brown; wall two-layered, internal layer 0.4–0.7 µm thick, outer layer 0.5–0.6 µm thick densely and finely verruculose; warts up to 0.2 µm high, confluent or isolated. Both kinds of spores often have a short appendage. Intermediate forms of spores may occur.

> **SPECIMEN EXAMINED** — On *Kalopanax pictus*. KOREA: Mt. Kongo, Sanseian, Harigiri, 13 Aug 1928, K. Kondo (Holotype in SAPA – *s.n.*; host as *K. ricinifolius* (Siebold & Zucc.) Miq.).

Known distribution: only from the type collection.

The Japanese specimens possess greenish brown and mainly 3- to 4-celled fertile spores while these of *M. kalopanacis* possess light yellowish brown and mainly 1- to 2-celled fertile spores (Table 1). Because of these differences we treat the Japanese collections of *Mundkurella* as a separate species which is described and illustrated here as:

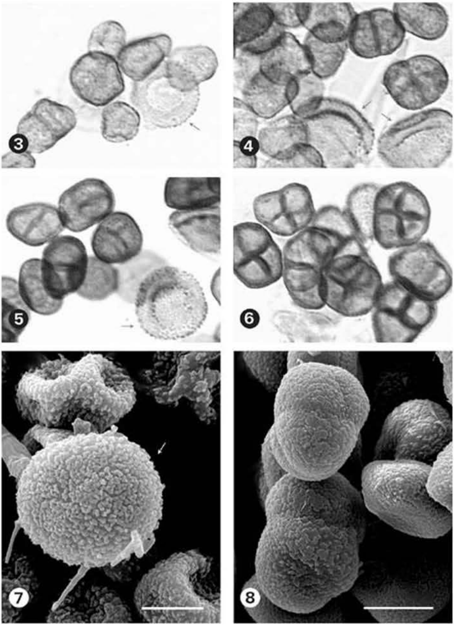
Mundkurella japonica Denchev & Kakish., sp. nov. Figs 1-2, 5-6, 8-12; Table 1

Mycobank # MB 511034

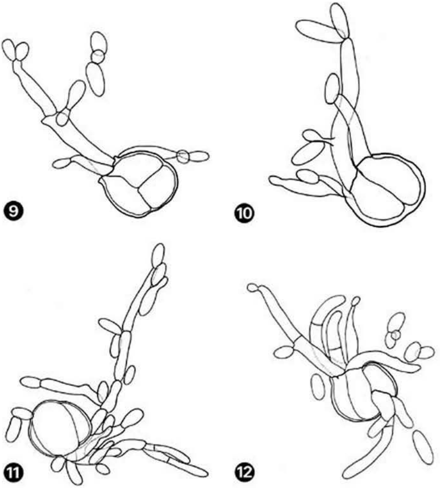
> *Holotypus in matrice Kalopanax pictus (Thunb.) Nakai (Araliaceae), Japonia, Honshu, Ibaraki Pref., Kukizaki-machi, "Forestry and Forest Products Research Institute", 2.X.1993, leg. M. Kakishima (TSH S1129); isotypus in H.U.V. 16 732. Paratypi in matrice Kalopanax pictus: TSH S1123, TSH S1126, TSH S1127, TSH S1128.*
>
> ***Sori*** *in fructibus vel pedicellis; in fructibus endospermium atque embryo omnino destruentes; in pedicellis tumores considerabiles efformantes.* ***Massa sporarum*** *pulverea, atroviridi-olivacea, atrobrunnea vel brunneo-vinosa.* ***Sporae*** *duplicis generis: unicellulares, steriles, plerumque collapsae, late ellipticae, ovate, suborbiculares vel irregulares, 11–24 × 10–19 µm, pallide viridi-olivaceae, dense et minute verruculosae, aliquando verrucosae; sporae 1–4-cellulares, fertiles, subglobosae, ovoideae, late ellipsoideae, ellipsoideae vel irregulares, aliquando globosae vel irregulariter rotundato-rectangulares, 10,5–24 × 8–17 (15,8±2,2 × 12,2±1,3) µm (n/*$_5$*=220), viridi-olivaceae vel atroviridi-olivaceae; pariete bistrato, stratum internum fuscatum, 0,5–0,8 µm, stratum externum pallide coloratum, 0,5–0,9 µm, dense et minute verruculosae, verrucae usque ad 0,2 µm altas. Germinatio per septatum basidium, quod basidiosporas lateralia atque terminalia efformat.*
>
> *Etymology:* the name refers to Japan.

Sori in the fruits destroying the endosperm and embryo, or in the cluster of compound umbel, situated subepidermally in the bases of the umbels, rarely also in some umbel pedicels (near the base of the umbel), producing considerable, irregular swellings of variable size and shape. **Spore mass** powdery, dark greenish brown, dark brown or brown-vinaceous, heterosporous. **Spores** of two kinds: (i) one-celled, sterile and usually collapsed, broadly elliptical, ovate, suborbicular or slightly irregular in outline, variable in size, 11–24 × 10–19 µm, pale greenish brown, densely and finely verruculose, sometimes verrucose (warts up to 0.6 µm high), and (ii) 1- to 4-celled (1- to 2-celled spores 40 %, 3- to 4-celled spores 60 %; n/$_4$=1945), fertile spores with rich cell contents, subglobose, ovoid, broadly ellipsoidal, ellipsoidal or slightly irregular, sometimes globose (especially some 1-celled spores) or irregularly rounded rectangular (some 4-celled spores), 10.5–24 × 8–17 (15.8±2.2 × 12.2±1.3) µm (n/$_5$=220), medium to

Figs 1-2. *Mundkurella japonica*. Habit.



Figs 3-6. Sterile (arrow) and fertile spores in LM. **3-4.** *Mundkurella kalopanacis* (holotypus). **5.** *M. japonica* (TSH S1126). **6.** *M. japonica* (TSH S1128). **Figs 7-8.** Sterile (arrow) and fertile spores in SEM. **7.** *M. kalopanacis* (Holotypus) (fragments of mycelia belong to a contaminant). **8.** *M. japonica* (TSH S1126). Scale bars: 7 = 6 µm, 8 = 7.5 µm.



Figs 9-12. Spore germination of *Mundkurella japonica* on water agar (0.3-1.5 %) at 20-25 °C.

dark greenish brown; wall two-layered, inner layer darker, 0.5–0.8 µm thick, outer layer lighter, 0.5–0.9 µm thick, very densely and finely verruculose; warts up to 0.2 µm high, mainly confluent. Both kinds of spores often have a short appendage (up to 3 µm), occasionally a long one (up to 8 µm), more or less the same colour as the spore. Intermediate forms of spores may occur. Spore germination results in 1–4-celled basidia, often several basidia from the same spore, producing laterally and apically sessile, ellipsoidal basidiospores.

SPECIMENS EXAMINED — On *Kalopanax pictus*. **JAPAN: Hokkaido, Kamikawa-shicho,** NAKAGAWA-MACHI, KOTOHIRA, 14 Sep 1994, leg. S. Tsukada (TSH S1123); **Hokkaido, Abashiri-shicho,** NISHIOKOPPE-MURA, MT. UENSHIRI, Sep 1995, leg. Akimoto (TSH S1126) and 26 Nov 1997, leg. S. Tsukada (S1127); **Hokkaido, Ishikari-shicho,** CHITOSE-

SHI, SHIKOTSU-LAKE, 7 Oct 1998, leg. S. Tsukada (TSH S1128); **Honshu, Ibaraki Pref.** (Holotypus).

Distribution: Japan (Hokkaido, Honshu).

Comments—The fertile spores of *Mundkurella japonica* are mainly 3- to 4-celled (52–75 %, mean 60 %) while these of *M. kalopanacis* are mainly 1- to 2-celled (75 %) (Table 1). *Mundkurella japonica* seems to be morphologically more closely related to *M. schefflerae* on *Schefflera* but despite the resemblance, there are differences in the frequency of the number of the cells of the fertile spores and in the sizes of the sterile spores, namely in *M. schefflerae* the fertile spores are mainly 1- to 3-celled and the sterile spores measure 14–26 (–32) × 12–24 µm (cfr Vánky et al. 1999: 332).

Key to *Mundkurella* species

1 Fertile spores thick-walled (1.5–2 µm, excluding the warts; warts 0.4–0.7 µm high), mainly 1- to 2-celled, dark brown. On *Heptapleurum* .... ***M. heptapleuri***

1* Fertile spores thin-walled, not dark brown. On other plant genera 2

2 Fertile spores light to medium yellowish brown 3

2* Fertile spores medium to dark greenish brown 4

3 Sterile spores 17–27 (–31) µm long. Fertile spores yellowish brown, mainly 2- to 4-celled. On *Aralia* .... ***M. mossii***

3* Sterile spores 14.5–23 µm long. Fertile spores light yellowish brown, mainly 1- to 2-celled. On *Kalopanax* .... ***M. kalopanacis***

4 Sterile spores 11–24 µm long. Fertile spores mainly 3- to 4-celled. On *Kalopanax* .... ***M. japonica***

4* Sterile spores 14–26 (–32) µm long. Fertile spores mainly 1- to 3-celled. On *Schefflera* .... ***M. schefflerae***

Acknowledgements

We gratefully acknowledge Dr Kálmán Vánky (Herbarium *Ustilaginales* Vánky, Tübingen, Germany) and Dr Roger G. Shivas (Queensland Department of Primary Industries and Fisheries, Indooroopilly, Australia) for critically reading the manuscript and serving as pre-submission reviewers; Director and Curator of SAPA (Herbarium of Hokkaido University) for loan of the cited specimen.

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Table 1. Morphological features of *Mundkurella kalopanacis* and *M. japonica*

SPECIES/ SPECIMEN	DIMENSION OF FERTILE SPORES (µm)				n	RATIO OF 1- to 2- / 3- to 4-celled spores (%)	n	COLOUR of 1-4-celled, fertile spores
	LENGTH		WIDTH					
	min-max	M±S.D.	min-max	M±S.D.				
M. KALOPANACIS								
SAPA (Type)	10.0-19.0	13.0±1.7	9.0-13.0	11.1±0.9	50	75/25	266	light yellowish brown
M. JAPONICA								
TSH S1123	11.5-22.5	15.9±2.2	10.0-14.0	12.3±1.1	30	41/59	267	medium to dark greenish brown
TSH S1126	10.5-18.5	13.4±1.8	8.0-14.0	10.5±1.3	40	48/52	737	medium to dark greenish brown
TSH S1127	11.0-21.5	15.9±2.5	8.5-15.5	11.6±1.3	40	not measured	–	medium to dark greenish brown
TSH S1128	11.5-24.0	16.7±2.8	9.5-15.5	12.5±1.4	50	25/75	276	medium to dark greenish brown
TSH S1129 (Type)	12.5-21.0	16.7±1.9	10.0-17.0	13.3±1.5	60	38/62	665	medium to dark greenish brown

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Conidial fungi from the semi-arid Caatinga biome of Brazil. *Cubasina microspora* sp. nov., a note on *C. albofusca*, and some new records for South America

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Abstract — *Cubasina microspora*, found on a decaying petiole in the "Serra da Jibóia", Caatinga biome, Bahía State, Brazil, is described and illustrated. It is distinguished by subglobose conidia with constricted septa and verruculose, macronematous conidiophores. New observations are provided based on re-examination of type material of *Cubasina albofusca*, and 14 species of conidial fungi are reported as first records for South America.

Key words — hyphomycetes, litter fungi, semi-arid fungi, systematics

Introduction

The semi-arid region of Brazil is located almost exclusively in the northeast of the country. This large expanse of drylands, which stretches between 3–17° S and 35–45° W, covers almost 8% of the territory of Brazil, occupying an area of approximately 900,000 km^2 (Giulietti et al. 2006). The climate of northeast Brazil is one of the most complex systems in the world and creates an enormous diversity and instability in rainfall patterns. The annual precipitation within the region varies from 250 to 800 mm, usually restricted to a few months during the year (Velloso et al. 2002). The seasonal availability of water strongly influences the distribution of plants, fungi and other organisms.

The predominant vegetation type in this region is composed of several forms known as "Caatinga". The Caatinga biome is characterized by forest with semideciduous or deciduous canopy in the dry season. The structure of this biome can vary considerably from forests composed of spiny trees (6 to 10 m tall) with an understory of small shrubs, to sub-shrubs and annual herbs predominantly belonging to *Leguminosae*, cacti, bromeliads, and *Euphorbiaceae* (Giulietti et al. 2006).

However, some hygrophilous forests, resembling islands, are distributed within the Caatinga biome. The vegetation of these islands is similar to the Atlantic rain forest (Velloso et al. 2002). The "Serra da Jibóia" is one of nine such areas occurring in this biome which have characteristics of the Atlantic rain forest vegetation.

During several expeditions from 2005 to 2006 through the "Serra da Jibóia", approximately 150 conidial fungi were collected from dead plant material. Some of these are new species or new records for Brazil, South America, and the Neotropics. One of these fungi showed remarkable differences from previously described hyphomycetes and is therefore described as a new species.

Materials and methods

Samples of litter plant material were placed in separate paper bags and taken to the laboratory, then incubated in Petri dishes, at 25° C in moist chambers composed of plastic containers (50 L capacity) with 200 ml of sterile water plus 2 ml of glycerol. The plant material was examined at regular intervals for the presence of microfungi. Mounts were prepared in polyvinyl alcohol-glycerol (8 g in 100 ml of water, plus 5 ml of glycerol) and measurements made at a magnification of × 1000.

Taxonomy

Cubasina microspora M.F.O. Marques, Gusmão & R.F. Castañeda **anam. sp. nov.**

MycoBank MB 510873 Figs 1–5

Conidiophora *macronemata, mononemata, simplicia vel ramosa, erecta, flexuosa, geniculata, verruculosa, 10–16 septata, hyalina, 175–197.5 × 5 µm.* ***Cellulae conidiogenae***

monoblasticae, integratae, terminales et intercalares, sympodiales, leviae, hyalinae, 6–13 × 4.5–6 µm. ***Conidia*** *solitaria, subglobosa, dictyoseptata, inconspicue constricta ad septa, acropleurogena, levia, brunnea, 13–19 × 10–15 µm, base obconice truncata, 6–7.5 × 4.5–6 µm.* ***Teleomorphosis*** *ignota.*

Etymology: Greek, *mikrós*, minuscule referring to size; *sporós*, seed referring to the conidium.

Conidiophores macronematous, mononematous, simple or branched, erect, or flexuous, sometimes geniculate, apex verruculose, 10- to 16-septate, hyaline 175–197.5 × 5 µm. **Conidiogenous cells** monoblastic, integrated, terminal and intercalary, sympodial, smooth, hyaline, 6–13 × 4.5–6 µm. **Conidia** solitary, subglobose, dictyoseptate, inconspicuously constricted at septa, acropleurogenous, smooth, 13–19 × 10–15 µm, base conical-truncate, 6–7.5 × 4.5–6 µm.

Teleomorph unknown.

COMMENTS: The monotypical genus *Cubasina* R.F. Castañeda was described with *C. albofusca* as the type species (Castañeda Ruíz 1986). The above description of *C. microspora*, based on a specimen collected in nature, shows some differences in conidium and conidiophore morphology from the description of *C. albofusca*. Conidia have an irregular apical cellular protuberance, longer conical-truncate bases, conspicuous constrictions at septa, and smooth, macronematous conidiophores. The conidia of *C. microspora* lack an apical cellular irregular protuberance and have smaller conical-truncate bases and inconspicuous constricted septa. The conidiophores of *C. microspora* studied during the present work are verruculose, whereas those of *C. albofusca* are smooth.

TYPUS: BRAZIL. BAHIA: Santa Terezinha, "Serra da Jibóia", on dead petiole of an unidentified dicotyledonous plant, 03.VII.2006, coll. M.F.O. Marques. **Holotype:** HUEFS107192 (permanent slides).

Cubasina albofusca R.F. Castañeda, Deuteromycotina de Cuba, Hyphomycetes IV (La Habana): 6. 1986. Figs 6–7

Conidiophores macronematous, mononematous, simple or branched, erect, flexuous, geniculate, smooth, hyaline 40–150 × 2–3.5 µm. **Conidiogenous cells** monoblastic, integrated, terminal and intercalary, smooth, sympodial, hyaline, 7–15 × 4–7 µm. **Conidia** solitary, globose to subglobose, dictyoseptate, constricted at the septa, with an apical cellular irregular protuberance, acropleurogenous, smooth, pale brown to brown, 17–25 × 10–18 µm, base conical-truncate, 9–10.5 × 4.5–6 µm.

Specimen examined: CUBA. ISLA DE JUVENTUD: La Melvis, on dead branch in stream, 25.IX.1985, R.F. Castañeda Ruíz, C85/154, INIFAT (Typus).

COMMENTS: *C. albofusca* was described originally from the dead branches of *Cissampelos pareira* L. (*Menispermaceae*) in Cuba. It was later found in

Hungary on *Fagus sylvatica* (*Fagaceae*) and wood (Revágy 1998) and in Lithuania (Markovskaja & Treigienė 2004).

New records for South America from the Brazilian semi-arid Caatinga biome

Beltraniella amoena R.F. Castañeda, Cano & Guarro, Mycotaxon 58: 244. 1996.

Setae 30–255 × 6–9 µm; conidiophores 31.5–45 × 4.5–6.0 µm; conidiogenous cells 24–27 × 3–4.5 µm; conidia 25.5–30 × 6–7.5 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of *Clusia melchiorii* Gleason, 14.IV.2006, F.R. Barbosa (HUEFS114724); 12.VI.2006, (HUEFS114723; URM78768).

Ceratosporella compacta R.F. Castañeda, Guarro & Cano, Mycotaxon 60: 276. 1996.

Conidiophores 30–64 × 6–11 µm; conidia 58–79 × 5–6 µm; appendages 22–42 × 2–3 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on decaying petioles of an unidentified dicotyledonous plant, 15.X.2005, M.F.O. Marques (HUEFS107190); 12.VII.2006, (HUEFS107191); 31.X.2005, (URM78783).

Flosculomyces floridaensis B. Sutton, Mycologia 70(4): 789. 1978.

Conidiophores 29–64 × 2.5–3 µm; conidiogenous cells 6–7.5 × 3–3.5 µm; apex 4–5 µm wide; conidia with 3 cells, 8.5–9.6 µm diam; conidia with 4 cells, 9–11 µm diam.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of *Clusia nemorosa* G. Meyer, 26.XII.2005 F.R. Barbosa (URM78770); 15.II.2006, (HUEFS114741); 3.III.2006, (HUEFS114740); 14.IV.2006, (HUEFS11472); 4.VII.2006 (HUEFS114739).

Guedea novae-zelandiae S. Hughes, New Zealand J. Bot. 18(1): 65. 1980.

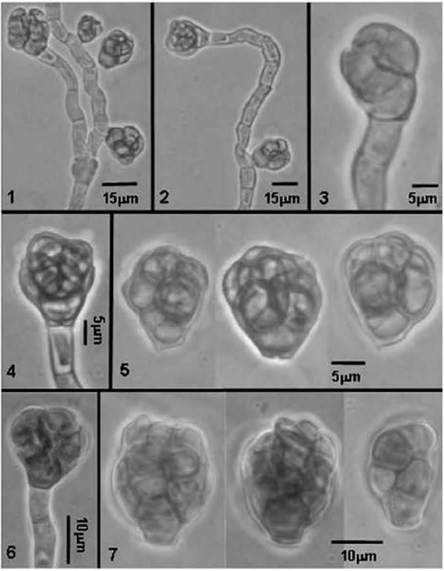
Conidiophores 240–300 × 3–3.5 µm; conidiogenous cells, 6–15 × 3–4 µm; conidia 9–13 × 6–7 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of *Clusia nemorosa*, 21.VI.2006, F.R. Barbosa (HUEFS114743; URM78765).

Idriella setiformis R.F. Castañeda & G.R.W. Arnold,
Revista Jard. Bot. Nac., Univ. Habana 6(1): 50. 1985.

Setae 85–117.5 × 4–5 µm; conidiophores 20–54 × 3–3.5 µm; conidiogenous cells 11–25 × 2.5–3 µm; conidia 24–27 × 2–2.5 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of *Clusia nemorosa*, 16.II.2006, F.R. Barbosa (HUEFS114748; URM78719); 21.VI.2006, (HUEFS114750); 04.VII.2006, (HUEFS114749).



Figs. 1–5. *Cubasina microspora*, from holotype (HUEFS107192). **Figs. 1–2.** Conidiophores, conidiogenous cell development and conidia. **Fig. 3–5.** Conidiogenous cell and conidia. **Figs 6–7.** *C. albofusca*, from holotype (INIFAT C85/154) Conidiogenous cell and conidia.

Idriella ramosa Matsush., Bull. Natnl. Sci. Mus., Tokyo 14(3): 466. 1971.

Conidiophores macronematous 40–90 × 4–5 µm; conidia 27–34 × 1–2 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of an unidentified dicotyledonous plant, 12.XII.2005, M.F.O. Marques (HUEFS114783).

Kylindria pluriseptata R.F. Castañeda, Fungi Cubenses II (La Habana) 7: 1987.

Conidiophores 300–450 × 11–12 µm; conidiogenous cells 27–31.5 × 6–7 µm; conidia, 30–31.5 × 4.5–7 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**,"Serra da Jibóia", on dead leaves of *Clusia melchiorii*, 27.X.2005, F.R. Barbosa (HUEFS114751); 27.X.05, (HUEFS114753); 28.XII.2005, (HUEFS114754; URM 78738); 11.IV.2006, (HUEFS114752).

Phragmocephala elegans R.F. Castañeda,
Deuteromycotina de Cuba, Hyphomycetes III (La Habana): 26. 1985.

Conidiophores 13.5–19.5 × 3 µm; conidia 13.5–22.5 × 10.5–13.5 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of an unidentified dicotyledonous plant, 28.XII.2005, M.F.O. Marques (HUEFS107195); on decaying petioles of unidentified dicotyledonous plant, 04.VII.2006, M.F.O. Marques (HUEFS107196).

Phragmocephala stemphylioides (Corda) S. Hughes, Canad. J. Bot. 36: 796. 1958.

Conidiophores 45–100 × 5–7.5 µm; conidia of two types, primary conidia 22.5 × 10 µm diam., secondary conidia 12.5–15 × 10 µm diam.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of an unidentified dicotyledonous plant, 15.X.2005, M.F.O. Marques (HUEFS107197).

Pseudoacrodictys deightonii (M.B. Ellis) W.A. Baker & Morgan-Jones, Mycotaxon 85: 380. 2003.

Conidiophores 200–250 × 15–25 µm; conidia 45–62.5 × 25–53 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia" on dead leaves of an unidentified dicotyledonous plant, 11.II.2006, M.F.O. Marques (HUEFS107198).

Selenodriella fertilis (Piroz. & Hodges) R.F. Castañeda & W.B. Kendr.,
Univ. Waterloo Biol. Ser. 33: 34. 1990.

Conidiophores 165–195 × 5.3–6 µm; conidiogenous cells 12–15 × 3–3.5 µm; conidia 10–16 × 1.2 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of *Clusia melchiorii*, 25.IV.2006, F.R. Barbosa (HUEFS114761).

Sporidesmiella vignalensis W.B. Kendr. & R.F. Castañeda,
Univ. Waterloo Biol. Ser. 33: 43. 1990.

Setae 56–80 × 2–3 µm; conidiogenous cells 7–15 × 2–3 µm; conidia 17–18 × 2–2.2 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of an unidentified dicotyledonous plant, 09.II.2006, M.F. O. Marques (HUEFS107198).

Stachybotrys bisbyi (Sriniv.) G.L. Barron, Mycologia 56: 315. 1964.

Conidiophores 108–315 × 5–9 µm; conidiogenous cells 12–15 × 2.5–3 µm; conidia 10–15 × 3–5 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on decaying petiole of an unidentified dicotyledonous plant, 03.XI.2005, M.F.O. Marques (HUEFS105743).

Stachybotrys kampalensis Hansf., Proc. Linn. Soc. London 155: 45. 1943.
Conidiophores 127.5–155 × 7.5–10 µm; conidia 10–12 × 5–7 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on decaying leaves of an unidentified dicotyledonous plant, 09.XII.2005, M.F.O. Marques (HUEFS107200).

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We are deeply indebted to Prof. Lori M. Carris (Washington State University) and Prof. Uwe Braun (Martin-Luther-University) for kindly reviewing the manuscript and for many suggestions that greatly improved it. We thank Ciencia y Tecnología para el Desarrollo (CYTED RED-XII.J) and the Cuban Ministry of Agriculture for facilities. Part of the support for this work came from the UK Darwin Initiative to RFCR. The author RFCR thanks Drs. Marc Stadler, David W. Minter, Pedro Crous, Uwe Braun, Ludmila Marvanová, Cony Decock, Paul M. Kirk, Walter Gams, Jerry A. Cooper, Rosa M. Arias, and Josep Cano for their generous and valuable assistance with literature not available in our library. Author LFP Gusmão thank the CNPq (proc. 471619/2004) and FR Barbosa, MFO Marques for CAPES and "Programa de Pós-graduação em Biologia de Fungos – UFPE".

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MYCOTAXON

Volume 102, pp. 25–32 *October–December 2007*

Conidial fungi from the semi-arid Caatinga biome of Brazil. *Subramaniomyces pulcher* sp. nov. and notes on *Sporidesmium circinophorum*

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Abstract — During an investigation of microfungi on dead plant material in a semi-arid region of northeast Brazil, two interesting fungi were collected that are herein described and illustrated. *Subramaniomyces pulcher*, distinguished by catenulate, broad fusiform to limoniform, brown to dark brown basal and intercalary conidia and acerose, hyaline apical conidia, is proposed as a new species. The *Selenosporella*-like synanamorph of *Sporidesmium circinophorum*, which arises from the apical or subapical cell of the conidial rostrum, is also reported.

Key words — anamorphic fungi, hyphomycetes, leaf litter, systematics

Introduction

The Brazilian semi-arid zone, known as the Caatinga biome, was described in detail by Velloso et al. (2002) and Giulietti et al. (2006). This zone, located almost exclusively in the northeast of the country, is an expanse of dry lands that stretches between 3–17° S and 35–45° W, covers almost 8 % of the territory of Brazil, occupying an area approximately 900 000 km^2. The climate of northeast

Brazil is one of the most complex systems in the world, with an annual rainfall up to 2000 mm along the coast and only 300–500 mm in the semi-arid zone.

During a mycological survey of conidial fungi from the semi-arid region in Bahia and Pernambuco States, a conspicuous fungus clearly related to the genus *Subramaniomyces* was collected. This genus was proposed by Varghese & Rao (1980) to accommodate their new species, *S. indicus*, and *Hemibeltrania navicularis*. Kirk (1982), who considered that *Ramularia fusisaprophytica* (Matsushima 1971) provided an earlier name, proposed *S. fusisaprophytica* with *S. navicularis* and *S. indicus* as synonyms. Castañeda (1985) described *S. ventricosus* but later (Castañeda & Kendrick 1990) reassigned his species as *Lauriomyces ventricosus* (R.F. Castañeda) R.F. Castañeda & W.B. Kendr., leaving *Subramaniomyces* with two accepted species, *S. fusisaprophyticus* and *S. simplex* U. Braun & C.F. Hill (Braun & Hill 2002). Below *S. pulcher* is proposed as a new third species for *Subramaniomyces*.

Sporidesmium circinophorum Matsush. is also described and illustrated.

Materials and methods

Samples of plant litter collected in separate paper bags were taken to the laboratory where each was incubated at 25° C in Petri dishes within 50 L plastic moist chambers containing 200 ml sterile water and 2 ml glycerol. The plant material was screened at regular intervals for microfungi. Mounts were prepared in polyvinyl alcohol-glycerol (8 g per 100 ml H_20, plus 5 ml glycerol). Measurements made under oil at a magnification of ×1000.

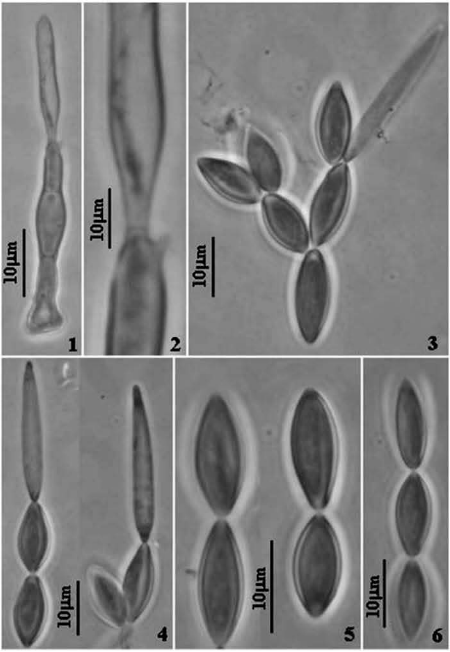
Taxonomy

Subramaniomyces pulcher A.C.R. Cruz, Gusmão & R.F. Castañeda **anam. sp. nov.**
MycoBank #: MB 510881 Figs 1–6

Coloniae *in substrato naturali effusae, caespitosae, griseo-brunneae.* ***Mycelium*** *plerumque in substrato immersum.* ***Hyphae*** *septatae, ramosae, 1.5–2.0 µm diam., pallide brunneae vel brunneae, laeviae.* ***Conidiophora*** *macronematosa, mononematosa, 1- ad 8-septata, simplicia, erecta, recta vel flexuosa, ad basim lobulata, 4–7 µm crassa, infra brunnea, dilute brunnea vel subhyalina ad apicem, laevia, 24–90 × 2.5–5 µm.* ***Cellulae conidiogenae*** *polyblasticae, cum proliferationibus sympodialibus, interdum monoblasticae, determinatae, denticulatae, cylindricae vel subulatae, pallide brunneae vel subhyalinae, 8–28 × 2.5–4.0 µm.* ***Ramoconidia*** *holoblastica, navicularia, unicellularia, hyalina, laevia, sicca, 15–21 × 3–5 µm.* ***Conidia*** *blastocatenulata, unicellularia, laevia, sicca, dimorpha, diverse pigmentifera; conidia (conidiis apicalibus exclusa) late fusiformia ad limoniformia, 11–15 × 4.5–6.0 µm, brunnea vel atrobrunnea; conidia apicalia late acerosa, incolorata, 20–28 × 3.0–5.5 µm.* ***Teleomorphosis*** *ignota.*

Etymology: Latin, *pulcher*, meaning beautiful.

Colonies on the natural substratum effuse, caespitose, gray-brown. **Mycelium** superficial and immersed. **Hyphae** septate, branched, 1.5–2.0 µm, pale brown



Figs. 1-6. *Subramaniomyces pulcher*, from holotype (HUEFS120863). **Fig. 1.** Conidiophore. **Fig. 2.** Conidiogenous cell and denticle. **Figs. 3-6.** Intercalary and terminal conidia.

Scale is indicated by bars.

to brown, smooth. **Conidiophores** macronematous, mononematous or densely grouped, simple, 1- to 8-septate, erect, straight or flexuous, basal cell 4–7 µm wide, radially lobed, brown below, pale brown to subhyaline towards the apex, smooth, 24–90 × 2.5–5 µm. **Conidiogenous cells** polyblastic, sympodially proliferating, sometimes monoblastic, denticulate, determinate, integrated, cylindrical to subulate, smooth, subhyaline to pale brown, 8–28 × 2.5–4.0 µm. **Ramoconidia** holoblastic, mostly navicular, aseptate, smooth, dry, colorless, 15–21 × 3–5 µm. **Conidia** blastocatenulate, aseptate, smooth-walled, dry, dimorphic, variously pigmented, all conidia (except the apical conidia) are broadly fusiform to limoniform, brown to dark brown, 11–15 × 4.5–6.0 µm; apical conidia are broadly acerose, colorless 20–28 × 3.0–5.4 µm. **Teleomorph** unknown.

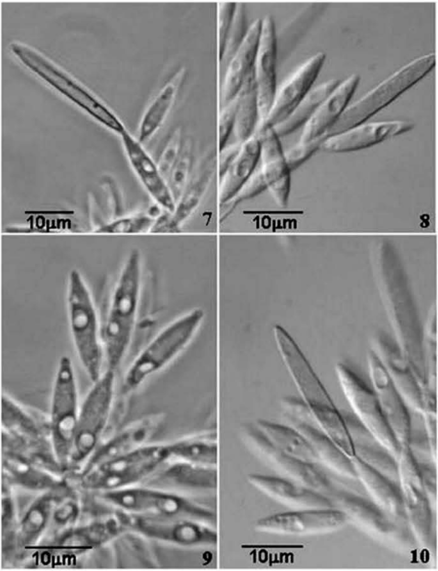
TYPUS: BRAZIL. PERNAMBUCO, Buíque, on an unidentified rotten leaf, 25.VIII.2006, coll. A.C.R. da Cruz. **HOLOTYPE: HUEFS120863.**

Comments: The genus *Subramaniomyces* was introduced by Varghese & Rao (1980) for species with fusiform unicellular conidia in long branched chains. Kirk (1982) amended the original description based on *S. fusisaprophyticus*, noting as a conspicuous character that the terminal conidia are morphologically distinct from the basal and intercalary. With respect to conidial morphology in *Subramaniomyces*, *S. pulcher* resembles only *S. fusisaprophyticus*. That species, however, differs in having basal and intercalary conidia that are fusiform, 15–20 × 2.5–3.5 µm, and subhyaline and terminal conidia that are acerose to narrowly navicular, 25–35 × 2.5–3.0 µm, and brown to dark brown (Kirk 1983, Bhat & Sutton 1985, Cooper 2005).

Subramaniomyces fusisaprophyticus (Matsush.) P.M. Kirk,
Trans. Br. Mycol. Soc. 78(1): 71. 1982. Figs. 7–10
≡ *Ramularia fusisaprophytica* Matsush., Microfungi of the Solomon Islands and Papua-New Guinea (Osaka): 48. 1971.
= *Hemibeltrania navicularis* B. Sutton, Kavaka 4: 43. 1977 (1976).
≡ *Subramaniomyces navicularis* (B. Sutton) Varghese & V.G. Rao, Kavaka 7: 85. 1980.
= *Subramaniomyces indicus* Varghese & V.G. Rao, Kavaka 7: 83. 1980 (1979).

Colonies on the natural substratum caespitose to velvety, hyphophyllous, gray. Conidiophores macronematous, mononematous, erect, simple or branched, septate, smooth, radially lobed at the base, brown, up to 45 µm tall, 5–7 µm wide at the base. Conidiogenous cells polyblastic, terminal, sympodially proliferating, denticulate. Conidia fusiform, blastocatenate, truncate at each end, 13–20 × 3–5 µm, smooth, dimorphic, differently pigmented, all basal and intercalary conidia subhyaline, terminal conidia navicular, brown.

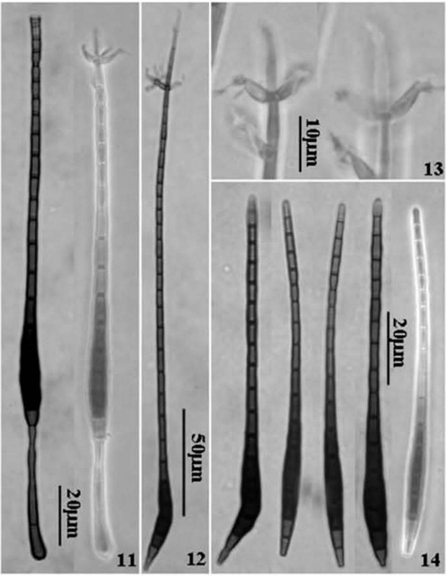
Specimen examined: **CUBA. MANTANZAS:** Mantanzas, Sierra de Bibanasi, on dead leaf of *Diospyros crassivervis* (*Ebenaceae*), 9.IV.1991, coll. R.F. Castaneda, INIFATC91/122.



Figs. 7-10. *Subramaniomyces fusisaprophyticus*, from INIFAT C91/122. Intercalary and terminal conidia. Scale is indicated by bars.

Sporidesmium circinophorum Matsush.,
Icon. microfung. Matsush. lect. (Kobe): 136 (1975) Figs. 11–14

Colonies on the natural substrate, effuse, conspicuously hairy, amphigenous, black. Mycelium mostly immersed. Hyphae septate, branched, smooth, brown. **Conidiophores** mononematous, macronematous, simple, 0- to 5-septate, erect, straight or curved, brown to dark brown, 20–63 × 6–9 µm, sometimes



Figs. 11-14. *Sporidesmium circinophorum*, from (HUEFS120862). Figs. 11-13. Details of conidiophores, conidiogenous cells and *Selenosporella*-like synanamorph developing at the apical cell of the conidia. Fig. 14. Conidia. Scale is indicated by bars.

reduced to conidiogenous cells. **Conidiogenous cells** monoblastic, integrated, terminal, determinate, subulate, pale brown to brown, 9–19 × 3–7 µm. **Conidia** holoblastic, solitary, narrowly obclavate, 15- to 30-septate, rarely 6-septate, acrogenous, mostly longi-rostrate (rostrum cylindrical, brown, multi-septate, 69–234 × 3.0–4.5 µm); obconically truncate at the base, smooth-walled, with basal and suprabasal cells pale brown, remaining 3 to 5 cells dark brown and black at the septa, 60–273 × 9–12 µm (rostrum included). **Synanamorph** *Selenosporella*-like, sometimes arising from the apical or subapical cells of the conidial rostrum, with polyblastic, inconspicuously denticulate, cylindrical to subulate, slightly inflated at the apex, sympodial, indeterminate or determinate, pale brown to subhyaline, more less verticillate conidiogenous cells, 6.5–12.5 × 2–3 µm. **Conidia** fusiform, solitary, aseptate, smooth-walled, hyaline, 3.5–5.5 × 0.5 µm.

Specimen examined: **BRAZIL. Bahia: Senhor do Bonfim**, on unidentified leaf, 05.X.2006, coll. A.C.R. da Cruz., HUEFS120862.

Comments: *Sporidesmium circinophorum* was described from pure culture on potato sucrose agar (Matsushima 1975). Although the conidia are morphological similar to the specimen described above, there are some new characters observed in this fungus from nature: 1) the basal cell and sometimes supra-basal cell are brown, not dark brown to black as are the other 3-4 succeeding cells; 2) a *Selenosporella*-like synanamorph sometimes arises from the apical cell.

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We are deeply indebted to Prof. Lori M. Carris (Washington State University), Dr. Paul M. Kirk (CABI), and Prof. U. Braun (Martin-Luther-Universität) for kindly reviewing the manuscript and for many suggestions that greatly improved it. We thank Ciencia y Tecnología para el Desarrollo (CYTED RED-XII.J) and the Cuban Ministry of Agriculture for facilities. Part of the support for this work came from the Program of Research of Biodiversity in the Brazilian Semi-arid (PPBIO Semi-arid/Ministry of Technology and Science). The author ACR Cruz thanks the CNPq, FAPESB (Proc. APR071/2007) and "Programa de Pós-graduação em Botânica – PPGBot/UEFS". The author RFCR thanks Drs. David W. Minter, Pedro Crous, Uwe Braun, Ludmila Marvanová, Cony Decock, Jerry A. Cooper, Rosa M. Arias, Josep Guarro, Walter Gams, Antonio Hernández-Gutiérrez, Carlos Inacio and Josep Cano for their generous and valuable assistance with literature not available in our library.

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Matsushima T. 1975. Icones Microfungorum a Matsushima Lectorum. Published by the author, Kobe.

Varghese KI, Rao VG. 1980 (1979). Forest microfungi I. *Subramaniomyces*, a new genus of Hyphomycetes. Kavaka 7: 83–85.

Velloso AL, Sampaio EVSB, Pareyn FCC (Eds). 2002. Ecorregiões propostas para o Bioma Caatinga. Associação de plantas do Nordeste, Instituto de Conservação Ambiental, The Nature Conservancy do Brasil. Recife.

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Conidial fungi from the semi-arid Caatinga biome of Brazil. *Diplococcium verruculosum* sp. nov. and *Lobatopedis longistriatum* sp. nov.

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Abstract — During investigation of microfungi on dead plant material in a semi-arid region of northeast Brazil, two interesting fungi were collected and are herein described and illustrated. *Diplococcium verruculosum* is distinguished by catenulate, oblong to cylindrical, 1- to 4-septate, verruculose, pale brown conidia and *Lobatopedis longistriatum* is characterized by vermiform, uncinate, striate, 16- to 31-septate, brown to dark brown conidia; both are proposed as new species.

Key words — anamorphic fungi, hyphomycetes, leaf litter, systematics

Introduction

The Brazilian semi-arid zone, called the Caatinga biome, is located almost exclusively in the northeast of the country. This is an expanse of dry lands which stretches between 3–17°S and 35–45°W, covers almost 8% of the territory of

Brazil, and occupies an area approximately 900,000 km^2. The climate of northeast Brazil is one of the most complex systems in the world, with an annual rainfall up to 2000 mm along the coast and only 300–500 mm in the semi-arid zone (Giulietti et al. 2006). During a mycological survey of conidial fungi from the semi-arid region in Bahia and Pernambuco states two conspicuous fungi were collected that are clearly related to the genera *Diplococcium* and *Lobatopedis*; these collections are described herein as new taxa.

Materials and methods

Samples of plant litter collected in separate paper bags were taken to the laboratory where each was incubated at 25° C in Petri dishes within 50 L plastic moist chambers containing 200 ml sterile water and 2 ml glycerol. The plant material was screened at regular intervals for microfungi. Mounts were prepared in polyvinyl alcohol-glycerol (8 g per 100 ml H_20, plus 5 ml glycerol), and measurements were made at a magnification of × 1000. The fungi were isolated from single conidia captured under a stereo microscope, immediately transferred to Petri dishes on oat meal agar, and incubated at 25° C under alternating cycles of 12 h of daylight and darkness.

Taxonomy

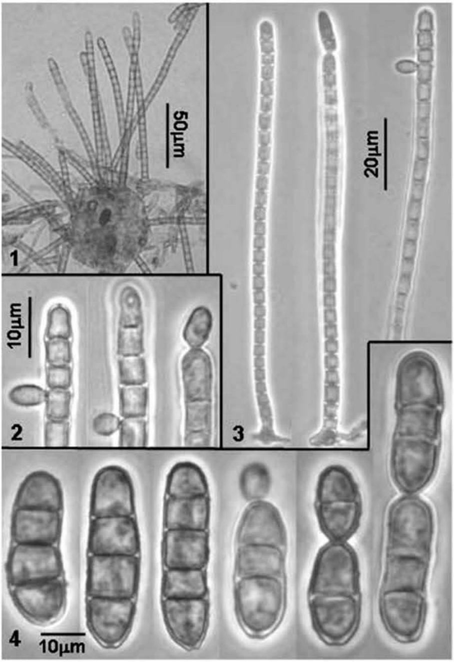
Diplococcium verruculosum A.C.R. Cruz, Gusmão & R.F. Castañeda, **anam. sp. nov.**

MycoBank MB510999 Figs. 1–4

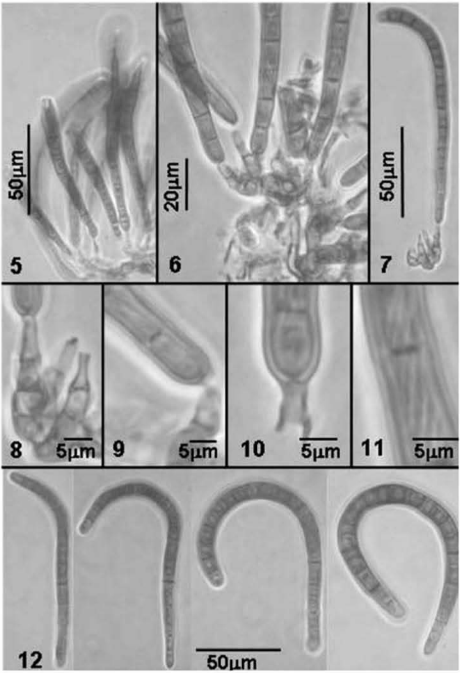
Coloniae *in substrato naturali effusae, velutinae, amphigenae, brunneae.* ***Mycelium*** *partim superficiale et partim in substrato immersum.* ***Hyphae*** *septatae, ramosae, laeves, brunneae.* ***Conidiophora*** *macronematosa, mononematosa, erecta, recta, cylindrica, usque ad 25-septata, simplicia, brunnea vel pallide brunnea, circa apicem verruculosa, cetero laevia, 93–215 × 4–5 µm.* ***Cellulae conidiogenae*** *mono- et polytreticae, terminales et intercalares, cylindricae, pallide brunneae, plerumque verruculosae interdum laeves, in conidiophoris incorporatae.* ***Conidia*** *breviter blastocatenulata, oblonga usque ad cylindrica, 1- ad 4-septata, dilute brunnea, verruculosa, sicca, 9–25 × 4.5–6.0 µm.* ***Teleomorphosis*** *ignota.*

Etymology: Latin, *verruculosus*, referring to the small wart-like projections covering the outer wall of the conidia.

Colonies on the natural substratum effuse, velvety, amphigenous, brown. **Mycelium** superficial and immersed. **Hyphae** septate, branched, smooth, brown. **Conidiophores** macronematous, mononematous, densely grouped, simple, up to 25-septate, erect, straight or flexuous, cylindrical, rounded at the apex, brown to pale brown, below smooth, but 2-4-cells apical and subapical verruculose, 93–215 × 4–5 µm. **Conidiogenous cells** mono- and polytretic, determinate, integrated, cylindrical, terminal and intercalary, pale brown, mostly verruculose, sometimes smooth. **Conidia** short blastocatenulate, oblong to cylindrical, 1- to 4-septate, pale brown, verruculose, dry, 9–25 × 4.5–6.0 µm. **Teleomorph** unknown.



Figs. 1-4. *Diplococcium verruculosum* (From HUEFS120872). 1-3. Aspects of conidiophores, coniogenous cells and conidia. 4. Conidia. Scale indicated by bars.



Figs. 5-12. *Lobatopedis longistriatum* (From HUEFS120870). 5-7. Aspects of conidiogenous cells and conidia. 8-10. Details of conidia production and rexolytic secession. 11. Detail of longitudinally striate conidia. 12. Conidia. Scale indicated by bars.

TYPUS: BRAZIL. BAHIA: Senhor do Bonfim, on unidentified rotten leaf, 11.X.2006, coll. A.C.R. da Cruz. HOLOTYPE: HUEFS120872.

Comments: The genus *Diplococcium* Grove is distinguished by polytretic conidiogenous cells that produce conidia in short acropetal, branched or unbranched chains. Most of the described species were included in a treatment and key by Goh & Hyde (1998). Two other species described are *D. atrovelutinum* U. Braun et al. (Braun et al. 1996) and *D. hughesii* C.J.K. Wang & B. Sutton (Wang & Sutton 1998). Only *D. asperum* Piroz. (Pirozynski 1972) is similar in ornamentation to *D. verruculosum*, but the former has 1-septate, ellipsoid to obclavate conidia. *Diplococcium stoveri* (M.B. Ellis) R.C. Sinclair et al. (Sinclair et al. 1985) and *D. varieseptatum* Goh & K.D. Hyde (Goh & Hyde 1998) superficially resemble *D. verruculosum*, but *D. stoveri* has conidia that are cylindrical to obclavate, 1- to 7-septate, slightly constricted at the septa, brown, smooth, 14–33 × 6–9 µm; *D. varieseptatum* has conidia that are cylindrical to ellipsoid, (1–)2–3(–5)-septate, brown, dark at the septa, smooth, (11–) 19–42(–60) × (5–)7–11(–15) µm. Both species can be easily separated from *D. verruculosum*.

Lobatopedis longistriatum A.C. Cruz, Gusmão, S.M. Leão & R.F. Castañeda, **anam. sp. nov.**

MYCOBANK MB510998 **Figs. 5–12**

Ad omnibus speciebus Lobatopedis differt quod habet conidia solitaria, acrogena, vermiformia, uncinata, 16- ad 31-septata, longitudinaliter striata, brunnea usque ad atrobrunnea, laevia, 95–188 × 6.5–8.0 µm.

Etymology: Latin, *longistriatus-*, referring to the longitudinal parallel striae covering the outer wall of the conidia.

Colonies on the natural substratum effuse, amphigenous, dark brown to black. **Mycelium** superficial and immersed. **Hyphae** septate, branched, brown, 2–3 µm diam., smooth. **Conidiophores** macronematous, mononematous, densely complex, grouped or solitary, simple or irregularly branched, arising from superficial and immersed hyphae, erect to recumbent, straight or flexuous to slightly curved, brown below, very pale brown to subhyaline towards the apex, smooth, 19–33 × 3.5–4 µm. **Conidiogenous cells** monoblastic, determinate, integrated, terminal, lageniform to cylindrical or subulate, smooth, subhyaline to hyaline, 3–6 × 3–5 µm. **Conidia** holoblastic, solitary, acrogenous, vermiform, uncinate, 16- to 31-septate, striate with striae longitudinally parallel, brown to dark brown, dry, 95–188 × 6.5–8.0 µm; with a marginal frill 0.6–6.0 µm long produced by rhexolytic conidial secession. **Teleomorph** unknown.

TYPUS: BRAZIL. PERNAMBUCO, Buíque, on unidentified rotten leaf, 16.VIII.2006, coll. A.C.R. da Cruz. HOLOTYPE: HUEFS120870.

Culture from the holotype: **Colonies** on oat meal agar extract, attaining 20–25 cm after 13 days at 25°C, floccose, dark olivaceous. **Reverse** black to blackish green. **Hyphae** thick walled, septate, brown, 2–3 µm diam, smooth. **Conidia** solitary, acrogenous, vermiform, uncinate to semi-circular, longitudinally striate, dark brown, 166–238× 6–8 µm, with marginal frill 2–7 µm long.

Culture deposited: CCMB 295.

Comments: The genus *Lobatopedis* was introduced by Kirk (1979) for a single species, *L. foliicola*. Subsequently two other species were described, *L. elegans* P.M. Kirk (Kirk 1982) and L. *variabilis* B. Sutton (Sutton 1993). The morphology of conidiophores and conidiogenous cells of *L. longistriatum* is very close to *L. variabilis*, but the latter species has conidia solitary or catenate, ellipsoid to fusiform, 2- to 9-septate, verruculose, brown, 11–25 × 6–8 µm and can be differentiated easily from *L. longistriatum*.

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MYCOTAXON

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Conidial fungi from the semi-arid Caatinga biome of Brazil. New species *Deightoniella rugosa* & *Diplocladiella cornitumida* with new records for the neotropics

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Abstract — Two interesting fungi collected during investigations of microfungi on dead plant material in a semi-arid region of northeast Brazil are herein described and illustrated. *Deightoniella rugosa* is distinguished by oval to ovate, 4-septate conidia with rugose to tuberculate, dark brown basal and suprabasal cells and subhyaline to hyaline basal cells. *Diplocladiella cornitumida* is distinguished by asymmetrical conidia; one arm is somewhat conical, whereas the other arm is irregularly conical, tumid and brown. Illustrations of conidia of recently published *Deightoniella* and *Diplocladiella* species are provided. A key to *Deightoniella* species published since the most recent treatment of the genus by M.B. Ellis in 1976 is presented, and 16 species of conidial fungi are reported as first records for the neotropics.

Key words —systematics, tropical fungi, hyphomycetes

Introduction

The "Serra da Jibóia" is one of nine hygrophilous mountains that occur in the semi-arid region of northeast Brazil known as the Caatinga biome (Velloso et al. 2002). The vegetation on this mountain is similar to that of the Atlantic rain forest and resembles a hygrophilous island. Expeditions to this area during 2005 and 2006 were conducted to collect leaf litter and dead leaves of a specific plant, *Clusia melchiorii* Gleason, one of the predominant plants in the area. Two interesting fungal specimens collected from this substrate are proposed as new species.

Materials and methods

Samples of plant litter collected in separate paper bags were taken to the laboratory where each was incubated at 25° C in Petri dishes within 50 L plastic moist chambers containing 200 ml sterile water and 2 ml glycerol. The plant material was screened at regular intervals for microfungi. Mounts were prepared in polyvinyl alcohol-glycerol (8 g per 100 ml H_2O, plus 5 ml glycerol), and measurements were made at a magnification of × 1000.

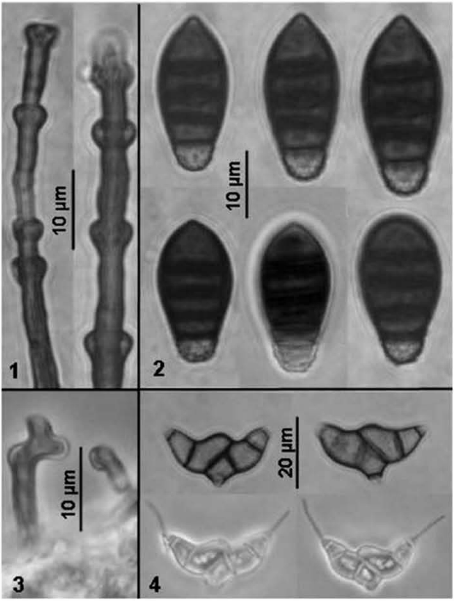
Taxonomy

Deightoniella rugosa F.R. Barbosa, Gusmão & R.F. Castañeda, **anam. sp. nov.**
MycoBank MB 510874. Figs 1, 2, 12

***Coloniae** in substrato naturali, pilosae, effusae, atrobrunneae. **Conidiophora** macronematosa, mononematosa, 32–135 × 4–5 µm, simplicia, septata, erecta, levia, brunnea, cum aspecto nodosa in proliferarionibus percurrentibus infundibuliformis. **Cellulae conidiogenae** monoblasticae, terminales, indeterminatae, in conidiophoris incorporatae, cum 1- ad 5-enteroblasticis proliferationibus percurrentibus ipsis loci conidiogeni ut videantur annulis infudibuliformis incrassatis, atrobunneis vel brunneis, 4–5 µm latis. **Secessio conidiorum** schizolytica. **Conidia** solitaria, holoblastica, 20–23 ×11.5–13.0 µm, ovalia vel obovata, plerumque miniumbonata ad apicem, rotundata ad basim, rugosa, interdum ad usque tuberculata in cellulis basalibus et suprabasalibus et cetero laevibus; 4-euseptata, sicca, atrobunnea et nigra ad septo, sed saepissime subhyalina ad cellula basalis. **Teleomorphosis** ignota.*

Etymology: Latin, *rugosus*, referring to the wart-like projections covering the outer wall of the conidia.

Colonies on the natural substratum effuse, hairy, dark brown. Mycelium mostly immersed, composed of septate, branched, smooth, brown hyphae.



Figs. 1, 2. *Deightoniella rugosa*. 1. Conidiophores. 2. Conidia.
Figs. 3, 4. *Diplocladiella cornitumida*. 3. Conidiophores. 4. Conidia. Scale indicated by bars.

Conidiophores macronematous, mononematous, simple, 3- to 7-septate, nodose at each proliferation, erect, straight or flexuous, smooth, brown to dark brown, 32–135 × 4–5 µm. **Conidiogenous cells** monoblastic, integrated, terminal, indeterminate, with 1- to 5-enteroblastic, percurrent proliferations, broadly infundibiliform, dark brown to brown, 4–5 µm wide. **Conidial secession** schizolytic. **Conidia** solitary, holoblastic, oval or obovate, mostly umbonate at the apex, rounded and slightly melanized at the base, 4-euseptate, rugose to tuberculate at the basal and suprabasal cells and smooth at the other cells, brown to dark brown, but hyaline or subhyaline at the base, dry, 20–23 ×11.5–13.0 µm. **Teleomorph** unknown.

> **TYPUS: BRAZIL. Bahia:** Santa Terezinha, "Serra da Jibóia", on dead leaf of *Clusia melchiorii*, 05.V.2006, coll. F.R. Barbosa. **HOLOTYPE:** HUEFS120865 (permanent slides).

Comments: The genus *Deightoniella* was introduced by Hughes (1952) for two species, *D. africana* S. Hughes and *D. arundinacea* (Corda) S. Hughes. Ellis (1957, 1971, 1976) subsequently added several species and a taxonomic account for the genus. The main diagnostic features of *Deightoniella* are the infundibuliform, sometimes incurved, "annellation" produced by the outer wall after each enteroblastic percurrent proliferation of the conidiogenous cells and the dark or slightly melanized scar at the basal cells of the conidia. *D. rugosa* can be compared with *D. arecae* W.Q. Chen (Chen 1998) in conidial shape and number of septa, but *D. arecae* has obpyriform to obclavate, 4-septate, verrucose, 52–65 × 17–20 µm, pale olivaceous brown to olivaceous brown conidia; *D. rugosa* is therefore clearly distinct from this species. Other species described after *D. ichnanthi* M.B Ellis (Ellis 1976) are: *D. argemonensis* Pollack & F.D. Matthews (Pollack & Matthews 1976), *D. roumeguerei* (Cavara) Constant. (Constantinescu 1983), *D. rosariensis* Mercado (Mercado Sierra 1984), *D. alni* Ondřej and *D. caricina* (Bres.) Ondřej (Ondřej 1984). The generic concept applied to *Deightoniella* has been expanded, and the genus is now somewhat heterogeneous because it includes species with distoseptate and euseptate conidia (Figs 5–12). These species could be separated into a new genus following criteria similar to those adopted by Kirk (1982) and Subramanian (1992) in the genera *Sporidesmiella* and *Sporidesmium* respectively.

Key to *Deightoniella* species described after Ellis (1971, 1976)

1a. Conidia somewhat or coarsely verrucose, rugose or tuberculate 2
1b. Conidia smooth 4

2a. (1a) Conidia 0- to 3- septate, very dark brown, constricted
at the distal septum, 16–60 × 12 –16 µm .... *D. argemonensis*
2b. Conidia 4-septate 3

3a. (2b) Conidia obpyryform to obclavate, pale olivaceous brown to
olivaceous brown, 52–65 × 17–20 µm .... *D. arecae*
3b. Conidia oval or obovate, mostly umbonate at the apex, hyaline to
subhyaline at the basal cell, other cells brown to dark brown,
20–23 ×11.5–13.0 µm .... *D. rugosa*

4a. (1b) Conidia 1-septate 5
4b. Conidia more than 1-septate 6
5a. (4a) Conidia obclavate to fusiform, with olivaceous basal cell and
hyaline or subhyaline apical cell, 30–45 ×12–15 µm .... *D. caricina*
5b. Conidia ovate to broadly ellipsoidal, hyaline to pale brown,
30–45 × 12–15 µm .... *D. roumeguerei*
6a. (4b) Conidia obclavate, obpyriform to oblong, 2- to 6-distoseptate,
pale brown, 25–49 × 7.8–13.7 µm .... *D. rosariensis*
6b. Conidia obclavate to cylindrical, 1- to 6-septate,
fuscous, 25–49 × 7.8–13.7 µm .... *D. alni*

Diplocladiella cornitumida F.R. Barbosa, Gusmão & R.F. Castañeda, **anam. sp. nov.**

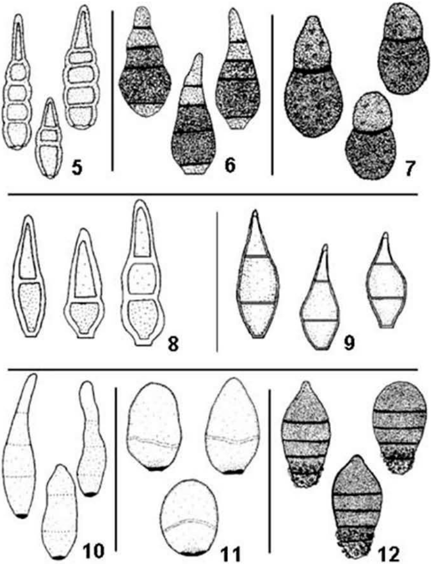
MYCOBANK MB 510875 FIGS 3, 4, 16.

> ***Coloniae*** *in substrato naturali effusae, granulosae, brunneae.* ***Mycelium*** *plerumque in substrato inmersum.* ***Conidiophora*** *macronematosa, mononematosa, geniculata, septata, brunnea.* ***Cellulae conidiogenae*** *polyblasticae, terminales, indeterminatae cum proliferationibus sympodialis et cicatricibus declivibus.* ***Conidia*** *solitaria, acropleurogena, in forma litterae Graecae upsilon, laevia, brunnea, interdum utrimque appendiculata; appendice 9–11 × 1 µm, omnia conidia 24–30 µm crassa (appendicibus exclusa), cellula basale breviter cylindrica, subhyalina vel dilute brunnea, 1.8–3.6 × 2.4–3.6 µm et cellula suprabasali trapezoidea, 6–8 × 7–9 µm, cum 2-ramis divergentibus, 3-cellularis, asymmetricis; una rami plus minusve conicis, 13–16 × 8–9 µm, alter rami irregulatim conicis manifeste tumidis ad cellulis basalibus, 13 –17 × 11–14 µm,* ***Teleomorphosis*** *ignota.*
>
> *Etymology:* Latin, *cornu*, horn; *tumidus*, tumid - referring to a swollen base or protuberance of one conidial arm.

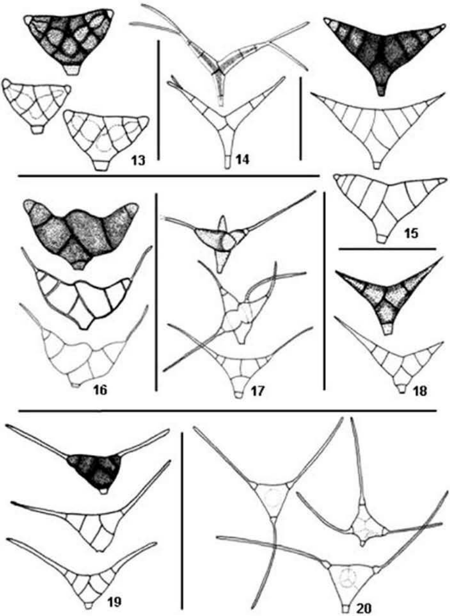
Colonies on the natural substratum effuse, granulose, brown. **Mycelium** mostly immersed. **Hyphae** septate, branched, brown, smooth. **Conidiophores** macronematous, mononematous, simple, septate, geniculate, smooth, brown. **Conidiogenous cells** polyblastic, terminal, indeterminate, sympodially proliferating with flattened, obscure scars. **Conidia** solitary, acropleurogenous, broadly Y-shaped, smooth-walled, brown, sometimes with a filiform, unbranched, subhyaline cellular appendage at each end; appendages 9–11 × 1 µm, body of conidia 24–30 µm wide (appendages excluded), basal cell short cylindrical, subhyaline to pale brown, 1.8–3.6 × 2.4 –3.6 µm; supra-basal cell trapezoid, 6–8 × 7–9 µm with 2 divergent arms, 3-celled, bilaterally asymmetrical; one arm somewhat conical, 13–16 × 8–9 µm, other arm irregularly conical, tumid, 13–17 × 11–14 µm. **Teleomorph** unknown.

> TYPUS: BRAZIL. BAHIA: Santa Terezinha, "Serra da Jibóia", on dead leaf of *Clusia melchiorii*, 25.IV.2006, coll. F.R. Barbosa. HOLOTYPE: HUEFS120864 (permanent slides).

NOTE: Seven accepted species have been described in *Diplocladiella*: *D. scalaroides* G. Arnaud ex M.B. Ellis (Ellis 1976), *D. tricladioides* Nawawi



Figs. 5-12. Conidia of *Deightoniella* species.
5. *Deightoniella alni*. 6. *D. arecae*. 7. *D. argemonensis*.
8. *D. caricina*. 9. *D. ichnanthi*.
10. *D. rosariensis*. 11. *D.roumeguere*. 12. *D. rugosa*.



Figs. 13-20. Conidia of *Diplocladiella* species.
13. *Diplocladiella alta*. 14. *D. appendiculata*. 15. *D. aquatica*.
16. *D. cornitumida*. 17. *D. heterospora*. 18. *D. scalarioides*.
19. *D. taurina*. 20. *D. tricladioides*.

(Nawawi 1985), *D. appendiculata* Nawawi (Nawawi 1987), *D. heterospora* R.F. Castañeda (Castañeda Ruíz 1988), *D. taurina* Cazau et al. (Cazau et al. 1993), *D. aquatica* O.H.K. Lee et al. (Lee et al. 1998), *D. alta* R. Kirschner & Chee J. Chen (Kirschner & Chen 2004). All species were compared by Cazau et al. (1993) and Kirschner & Chen (2004) compared the lengths of the conidiophores. *Diplocladiella cornitumida* differs from all other described species in the genus by having asymmetrical conidia with one arm conical and one arm tumid or swollen (Figs 13-20).

New records for the neotropics from Brazil's semi-arid Caatinga biome

Acrogenospora gigantospora S. Hughes, N. Zeal. J. Bot. 16(3): 314. 1978.

Conidiophore 261–684 × 7.5–12 µm; conidia 25.5–30 × 24–25.5 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on decaying bark of unidentified dicotyledonous plant, 24.II.2006, coll. M.F.O. Marques (HUEFS107277); 08.XI.2005, coll. M.F.O. Marques (URM78798).

Anungitea globosa B. Sutton & Hodges, Nova Hedwigia 29(3-4): 594. 1978.

Setae not observed; conidiophore 52.5–94.5 × 3–4 µm; conidiogenous cells 11–14 × 1.8–2 µm; conidia 9.5–12 × 1–2 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on decaying leaves of *Clusia melchiorii*, 20.VI.2006, coll. F.R. Barbosa (HUEFS114722).

Dactylaria belliana B.C. Paulus, et al., Fungal Diversity 14: 146. 2003.

Conidiophores 27–43 × 2.5–3 µm; conidiogenous cells 9–10.5 × 3–3.5 µm; conidia 19–24.5 × 1–1.2 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on dead leaves of *Clusia nemorosa* G. Mey., 18.X.2005, coll. F.R. Barbosa (HUEFS114728).

Dactylaria ficusicola B.C. Paulus et al., Fungal Diversity 14: 149. 2003.

Conidiophore 90–156 × 3–6 µm; conidiogenous cells 6–9 × 4–4.5 µm; conidia 12–15 × 0.9–1.5 µm.

Specimen examined: **BRAZIL. Bahia: Santa Terezinha**, "Serra da Jibóia", on decaying leaves of *Clusia melchiorii*, 26.X.2005, coll. F.R. Barbosa (HUEFS114737); 01.XI.2005, coll. F.R. Barbosa (HUEFS114736); 27XII.2005, coll. F.R. Barbosa (HUEFS114732; URM78761); 14.II.2006, coll. F.R. Barbosa (HUEFS114735); 24.II.2006, coll. F.R. Barbosa (HUEFS114734); 26.IV.2006, coll. F.R. Barbosa (HUEFS114733); 13.VI.2006, coll. F.R. Barbosa (HUEFS114731); 22.VI.2006, coll. F.R. Barbosa (HUEFS114730).

Dendryphiopsis atra (Corda) S. Hughes, Can. J. Bot. 31: 655. 1953.

Conidiophores 172.5–242.5 × 5–10 µm; conidiogenous cells 12.5–27.5 × 5–10 µm; conidia 37.5–45 × 12.5–20 µm.

Examined material: **BRAZIL. Bahia: Santa Terezinha**, Serra da Jibóia, on decaying twigs of unidentified dicotyledonous plant, 21.XII.2005, coll. M.F.O. Marques (HUEFS107283).

Dictyochaeta pluriguttulata Kuthub. & Nawawi, Mycol. Res. 95(10): 1212. 1991.

Setae 200–300 × 5–10 µm; conidiophores 25–35 × 5 µm; conidia, with or without rudimentary appendices at each end, 20–25 × 1.2–2 µm.

Specimen examined: BRAZIL. BAHIA: Santa Terezinha, "Serra da Jibóia", on decaying branches of unidentified dicotyledonous plant, 02.III.2006, coll. M.F.O. Marques (HUEFS107284).

Dictyosporium bulbosum Tzean & J.L. Chen, Mycol. Res. 92(4): 500. 1989.

Conidiophores and conidiogenous cells not observed; conidia with 5-6 arms, 31.5–36 × 21–24 µm; appendages 7.5–9 × 4–6 µm.

Specimen examined: BRAZIL. BAHIA: Santa Terezinha, "Serra da Jibóia", on decaying leaves of *Clusia melchiorii*, 13.VI.2006, coll. F.R. Barbosa (HUEFS114738).

Dictyosporium digitatum J.L. Chen et al., Mycol. Res. 95(9): 1145. 1991.

Conidiophores and conidiogenous cells not observed; conidia 63–75 × 15–19.5 µm; appendage 5–8 µm;

Specimen examined: BRAZIL. BAHIA: Santa Terezinha, "Serra da Jibóia", on bark of unidentified dicotyledonous plant, 24.II.2006, coll. M.F.O. Marques (HUEFS107285; URM78813).

Kionochaeta nanophora Kuthub. & Nawawi, Trans. Br. Soc. 90(3): 440. 1988.

Conidiophores 225–370 × 10–12,5 µm; conidia 4–5 × 1 µm.

Specimen examined: BRAZIL. BAHIA: Santa Terezinha, "Serra da Jibóia", on bark of unidentified dicotyledonous plant, 19.XII.2005, coll. M.F.O. Marques (HUEFS-107288).

Kionochaeta pughii Kuthub. & Nawawi, Trans. Br. Mycol. Soc. 90(3): 437. 1988.

Conidiophores 160–195 x 7.5–10 µm; conidia 8–9 x 1 µm.

Specimen examined: BRAZIL. BAHIA: Santa Terezinha, "Serra da Jibóia", on bark of unidentified dicotyledonous plant, 21.XII.2005, coll. M.F.O. Marques (HUEFS107289).

Kionochaeta spissa P.M. Kirk & B. Sutton, Trans. Br. Mycol. Soc. 85(4): 715. 1986.

Conidiophores 216–270 × 6–7.5 µm; conidiogenous cells 5.5–8.5 × 2.5–4 µm; conidia 5–6.5 × 0.7–1.2 µm.

Specimen examined: BRAZIL. BAHIA: Santa Terezinha, "Serra da Jibóia", on decaying leaves of unidentified dicotyledonous plant, 10.II.2006, coll. M.F.O. Marques (HUEFS107194); 24.IV.2006, coll. M. F. O. Marques (URM78818).

Pleurophragmium varieseptatum Matsush.,
Icones Microfungorum a Matsushima lectorum (Kobe): 117. 1975.

Conidiophores 40.5–97.5 × 4.5–5.5 µm; conidia 9.5–18 × 2,5–4 µm.

Specimen examined: BRAZIL. BAHIA: Santa Terezinha, "Serra da Jibóia", on decaying leaves of *Clusia nemorosa* G. Meyer, 16/2/2006, coll. F.R. Barbosa (HUEFS114760).

Phragmocephala stemphylioides (Corda) S. Hughes, Can. J. Bot. 36: 796. 1958.

Conidiophores 45–100 × 5–7.5 µm; conidia of two types, first conidia ellipsoid 22.5 × 10 µm and second conidia globose to ellipsoid 12.5–15 × 10 µm.

Examined material: BRAZIL. Bahia: Santa Terezinha, "Serra da Jibóia" on decaying leaves, 28.II.2005, coll. M. F. O. Marques (HUEFS107197).

Sporidesmiella parva (M.B. Ellis) P.M. Kirk, Trans. Br. Mycol. Soc. 79(3): 486. 1982.

Conidiophores 119–325 × 4–5 µm; conidia 20–30 × 3–5 µm.

Specimen examined: BRAZIL. Bahia: Santa Terezinha, "Serra da Jiboia", on dead twigs of unidentified dicotyledonous plant, 12.XII.2005, coll. M.F.O. Marques (HUEFS107293); 29.XII.2005, coll. M.F.O. Marques (HUEFS107294);

Yinmingella mitriformis Goh et al., Can. J. Bot. 76(10): 1693. 1999.

Stroma 99–150 × 58.5–85.5 µm; conidiogenous cells 9–18 × 3–7.5 µm; conidia 15–19.5 × 7.5–12 µm.

Examined material: BRAZIL. Bahia: Santa Terezinha, "Serra da Jibóia" on decaying twigs, 02.III.2006, coll. M. F. O. Marques (HUEFS107298).

Zanclospora novae-zelandiae S. Hughes & W.B. Kendr., N. Zeal. J. Bot. 3: 152. 1965.

Conidiophores 200–250 × 5–7.5 µm; conidiogenous cells 7–10 × 2–3 µm; conidia 17–26 × 1.2–2 µm.

Examined material: BRAZIL. Bahia: Santa Terezinha, "Serra da Jibóia", on dead bark, 19.IV.2006, coll. M. F. O. Marques (HUEFS107299); 09.V.2006, coll. M. F. O. Marques (URM78844).

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MYCOTAXON

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A novel *Paecilomyces* species isolated from soil in China

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Abstract — *Paecilomyces tenuis* sp. nov. was isolated from soil of Hubei Province, China. The new species is described and illustrated, and its relationships to the related species are briefly discussed. This fungus is characterized by the very slender phialides and fusiform to ellipsoidal conidia. Morphological characteristics and molecular analyses of ITS-5.8S region sequences strongly support the establishment of *P. tenuis* in the genus *Paecilomyces*.

Key words — classification, mitosporic fungus, molecular identification, taxonomy

Introduction

Many studies have revealed most members of *Paecilomyces* are important entomogenous fungi. During 2004–2006, about 1000 soil samples from China were collected, isolated and examined. Some novel soil *Paecilomyces* species possessing monophialides were discovered (Han et al. 2007, Liang et al. 2006, Li et al. 2006). In this study, *Paecilomyces tenuis* from a soil sample of eastern China is described. Comparisons were made between the new species and its similar taxa based on morphological characteristics. Analysis of the sequences of rDNA ITS1-5.8S-ITS2 region were carried out and phylogeny tree was constructed for this proposal.

Materials and methods

Sample collection and strain isolation

Strain GZUIFR-C43-1 was isolated from Jingzhou, Hubei Province. Two grams of soil were added to a flask containing 20 ml sterilized water and glass beads. The soil

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*Corresponding author

suspension was shaken for about 10 min, and then diluted to concentrations of 10^{-1}–10^{-3}. One ml suspension (10^{-3}) was mixed with Martin medium in a sterilized 9 cm diam Petri dish and incubated at 26°C for 14 days.

Strain identification

The strain studied was transplanted onto Czapek agar, potato dextrose agar (PDA), and Sabouraud agar. After incubation at 26°C for 14 days, the strain was identified based on colony character, conidiogenous structures and temperature response according to Brown & Smith (1957) and Samson (1974).

Reagent and DNA extraction

Taq polymerase and dNTP were from Shanghai Sangon; Agarose Gel DNA Purification kit ver 2.0 was from TRKARA Company.

Table 1 List of strains used in this study

NAME	GENBANK NO.	NAME	GENBANK NO.
Byssochlamys fulva	AY753341	*P. lilacinus*	AF368804
Paecilomyces aerugineus	AY753346	*P. marquandii*	AB099511
P. amoeneroseus	AY624168	*P. niphetodes*	AY624191
P. cateniannulatus	AY624172	*P. penicillatus*	AY624194
P. cateniobliquus	AY624173	*P. variotii*	AY753337
P. coleopterorum	AY624177	*P. viridis*	AY624197
P. farinosus	AY624178	*T. leycettanus*	AY753342
P. fumosoroseus	AJ608982	*T. ohiensis*	AB176634
P. ghanensis	AY624185	*T. trachyspermus*	AY533699
P. javanicus	AY624186	*P. tenuis* (this work)	EU004812

Two strains from soils of Hubei Province used for the molecular identification were incubated on Czapek agar and potato dextrose agar. Subsequently, the fresh sporulating cultures were used for DNA extraction according to Tigano-Milani et al. (1995), and DNA was stored at –20°C.

PCR amplification and determination of ITS sequencing

Polymerase chain reaction (PCR) amplification was performed according to the manufacturer's instructions. 50 μL reaction system: 10 × reaction buffer 5 μL, dNTP 1 μL, primer ITS4 1 μL, ITS5 1 μL, Pfu buffer 0.5 μL, 2 μL of template DNA and ddH_2O 39.5 μL. To amplify ITS1-5.8S-ITS2 rDNA sequence, the ITS5 (5'-GGTGAGAGATTTCT GTGC-3') and ITS4 (5'-TCCTCCGCTTATTGATATGC-3') primers were used following these amplification parameters: after 5 mins at 94°C, 35 cycles of 94°C for 40 s, 49°C for 40 s, 72°C for 1 min, and finally 10 mins at 72°C (White et al. 1990). PCR products were purified using an Agarose Gel DNA Purification kit ver 2.0 according to its procedure (TRKARA Company). The 1 μL purification product was determined in ρ = 1% Agarose by electrophoresis and sequenced using the above primers by Beijing Sunbiotech Co. Ltd. The rDNA ITS1-5.8S-ITS2 region of the strain was submitted to GenBank.

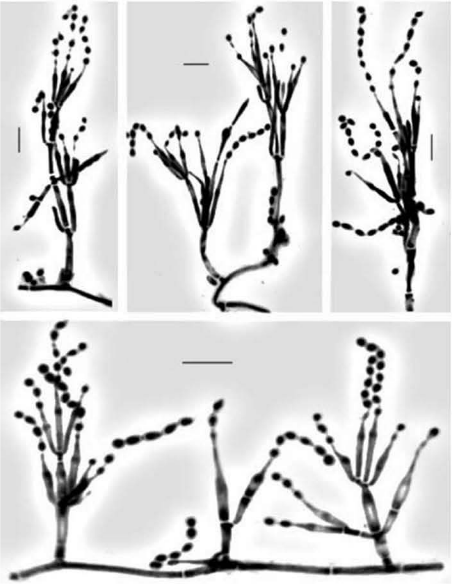

Fig. 1 Conidiogenous structures of *P. tenuis*. Bars = 10μm

Sequence alignment and phylogenetic analysis

Table 1 lists strains used in the molecular study. Some ITS1-5.8S-ITS2 region nucleotides sequences of representative species of *Paecilomyces* and other genera were obtained from GenBank database. The sequence of the new species was aligned with related fungi using the Clustal X1.83 computer program for multiple sequence alignment and manually corrected. The phylogenetic tree was constructed by neighbor-joining method (NJ) of MEGA version 3.1 (Kumar et al. 2004). Confidence values for individual branches were determined by bootstrap analysis (1000 replications).

Table 2 Comparison of the characters between *P. tenuis* and the related species

NAME	PHIALIDES		CONIDIA	
	Base shape	Length :Width ratio	Shape	Size (µm)
P. stipitatus	Cyl or Ell	9.7:1	Sub	1.7–5.9 × 1.3–3.3
P. aerugineus	Cyl	4.8:1	Ell or Fus	6–8.5 × 2.5–3.5
P. farinosus	Cyl or Ell	7.5:1	Ell or Fus	2–3 × 1.0–1.8
P. lilacinus	Cyl or Ell	4.5:1	Fus	2.5–3.0 × 2.0–2.2
P. marquandii	Cyl	7.5:1	Fus	3.0–3.5 × 2.0–2.2
P. puntonii	Cyl	6.4:1	Ell or Cyl	3.0–5.0 × 1.5–2.0
P. variotii	Cyl	10:1	Ell or Cyl	3.6–5.0 × 1.5–4.0
P. tenuis	Cyl or clavate	10:1	Fus or Ell	S 3.0–3.6 × 1.2–2.2 L 5.4–9 × 1.8–2.4

Cyl = Cylindrical; Ell = Ellipsoidal; Sub = Subglobose; Fus = Fusiform S = smaller conidia; L = larger conidia

Results and discussion

Taxonomy

Paecilomyces tenuis **Y.F. Han & Z.Q. Liang, sp. nov.**

MYCOBANK MB 510919, GENBANK EU004812 Fig. 1

> *In agaro Czapekii, coloniae 30 mm diam,14 diebus ad 26°C, ablae; reversum luteolum. Hyphae septatae, hyalinae, 1.0–1.2 µm crassae. Conidiophora erecta, septata, hyalina, e hyphis submerses oriunter, ad 12– 18 µm longa, 3.0 µm crassa, compluries verticillata quoties binas ad quaternas phalides ferunt. Phialides 9.0–15 × 0.9 – 1.8 µm, gracilis, e basi inflata cylindricusa vel claviformisa in collum longum angustatae. Conidia continua, hyalina, levia, fusiformia vel ellipsoidea, 3.0–3.6 × 1.2–2.2 µm vel 5.4 – 9 × 1.8 – 2.4 µm.*
>
> ***Holotypus*** *GZUIFR-C43-1 isolatus,e soli, Jingzhou city, provinca Hubei, China. IV, 2005, Y.F.HAN et Z.Q.LIANG, in Guizhou Univ, conservatur.*

Colony on Czapek agar, attaining a diameter of 30 mm within 14 days at 26°C, flat, white, compact in the middle, loose at the margine. Reverse yellowish, white at the margin. Vegetative hyphae hyaline, smooth-walled, 1.0–1.2 µm wide. Conidiophores septate, 12–18 × 3.0 µm, forming verticillate branches with phialides in whorls of 2 to 4. Phialides divergent, very slender, consisting of a cylindrical or clavate basal portion and a thin distinct neck, 9–15 × 0.9– 1.8 µm. Conidia hyaline, smooth–walled, fusiform to long-ellipsoidal, with two types in size, the smaller 3.0–3.6 × 1.2–2.2 µm, the bigger 5.4–9 × 1.8–2.4 µm. Thermotolerant.

> MATERIAL EXAMINED: The holotype, GZUIFR–C43–1, was isolated by Y.F. Han and Z.Q. Liang from soil of Jinzhou, Hubei Province, China, April, 2005, deposited in the Institute of Fungus Resources.

Distribution: Hubei Province, China.

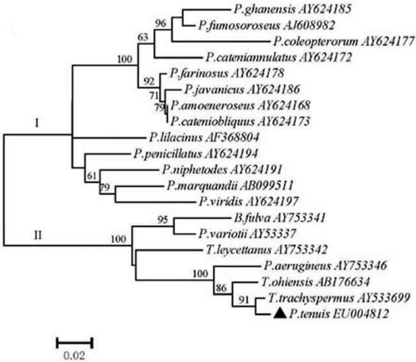

Fig.2 Phylogenetic tree based on analysis of rDNA ITS1-5.8S-ITS2 sequences of *Paecilomyces tenuis* and some related species.

In *Paecilomyces*, species that resemble *P. tenuis* in having phialides with cylindrical bases and ellipsoidal or fusiform conidia include *P. aerugineus* Samson, *P. farinosus* (Holmsk.) A.H.S. Br. & G. Sm., *P. lilacinus* (Thom) Samson, *P. marquandii* (Massee) S. Hughes, *P. puntonii* (Vuill.) Nann., *P. stipitatus* Z.Q. Liang & Y.F. Han, and *P. variotii* Bainier. Among them, *P. stipitatus* and *P. variotii* share similar length/width ratios (Table 2). *P. stipitatus* differs in having subglobose conidia and a unique septate stalk under the phialides base, while *P. variotii* possesses differently sized conidia. Morphologically, *P. tenuis* is new in the genus *Paecilomyces*.

Distinctions of *P. tenuis* from its related species based on sequence analysis

MEGA3.1 was used to analyze *Paecilomyces* species and related rDNA ITS1–5.8S–ITS2 sequences (Table 1) and to construct a phylogenetic tree (Fig. 1) by the NJ method. Results show 20 strains divided into two clades. Clade I includes members in the *Hypocreales*, which are all mesophilic. Clade II (100% bootstrap support) contains members of the *Eurotiales* including the new species *P. tenuis*, which are thermophilic or thermotolerant species. In the phylogenetic tree, *Paecilomyces tenuis* is close to *Talaromyces trachyspermus* (Shear) Stolk & Samson, *T. ohiensis* Pitt, and *P. aerugineus*. The anamorph stages of *T. trachyspermus* and *T. ohiensis* (*Penicillium lehmanii* Pitt and *Penicillium panasenkoi* Pitt respectively) exhibit phialides with the compact whorls and short necks typical of the genus *Penicillium* (Stolk & Samson 1980). *Paecilomyces aerugineus* produces green colonies with simple conidiophores bearing groups of 2 to 3 phialides (Samson 1974). *Paecilomyces tenuis* is differentiated by its divergent and long-necked, very slender phialides. Both morphological characteristics and molecular analyses support *P. tenuis* as an independent new species.

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Survey of *Lepraria* and *Leprocaulon* in Greenland

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Abstract — For a survey of the lichen genera *Lepraria* and *Leprocaulon* in Greenland about 700 specimens from various localities of Greenland in C were examined. Thirteen species and two varieties of *Lepraria* and three species of *Leprocaulon* are reported. *Lepraria alpina* var. *zeorinica* var. nov. and *L. caesioalba* var. *groenlandica* var. nov. are described. The first detailed description of the recently introduced *L. gelida* is provided. New to Greenland are: *L. atlantica, L. borealis, L. caesiella, L. caesioalba, L. elobata, L. gelida, L. jackii, L. nivalis* and *Leprocaulon gracilescens*. For all taxa information on thallus morphology, secondary chemistry, substrata and distribution together with distribution maps is given and a key is provided.

Key words — taxonomy, sterile lichens, *Stereocaulaceae*, High Arctic, Low Arctic

Introduction

The genera — The genus *Lepraria* Ach. (*Stereocaulaceae, Ascomycota*) comprises morphologically simple lichen-forming fungi that never develop fruiting bodies. It is distributed worldwide. Most species have a leprose thallus with the surface entirely composed of soredia (Tønsberg 1992) while a few taxa are squamulose or isidiate (Tønsberg 2004, Wirth et al. 2004, Crespo et al. 2006). The taxonomy is largely based on the chemistry of secondary metabolites as these lichens produce a wide variety of lichen substances, and other characters are scarce. Since Laundon (1989, 1992) revised the species concept in the genera *Lepraria* and *Leproloma* Nyl. ex Cromb., another genus that was synonymized with *Lepraria* (Kukwa 2002, and literature cited therein), leprarioid lichens have been rather intensely studied by several taxonomists in many countries, with ca. 30 species recently described (Aptroot 2002; Aptroot et al. 1997; Baruffo et al. 2006; Bayerová et al. 2005; Elix 2005, 2006; Elix et al. 2005; Knudsen & Elix

2007; Knudsen et al. 2007; Kukwa 2002, 2006a, b; Lendemer 2005; Leuckert et al. 1995; Lindblom 1995; Lohtander 1994, 1995; Orange 2001; Orange & Wolseley 2005; Orange et al. 2001b; Øvstedal & Lewis Smith 2001; Saag & Saag 1999; Sipman 2003, 2004; Slavíková-Bayerová & Orange 2006; Tønsberg 1992, 2002, 2004, 2007; Tønsberg & Zhurbenko 2006; Wirth et al. 2004). However, for many regions, including Greenland, modern data are still limited.

The representatives of *Leprocaulon* Nyl. also lack sexual structures. The genus mostly occurs in the Southern Hemisphere and in arctic-alpine to temperate areas in the Northern Hemisphere (Lamb & Ward 1974, Ryan 2002). The thalli are usually dwarf fruticose, with more or less developed pseudopodetia and phyllocladia-like structures that are more or less covered with granules. In some species the pseudopodetial structures are very poorly developed and a crustose powdery, granular or subsquamulose thallus is formed (Lamb & Ward 1974, Brodo et al. 2001, Ryan 2002). As in *Lepraria,* the lichen substances are important in the taxonomy of *Leprocaulon.* This genus has been of somewhat lesser interest to taxonomists recently (Lamb & Ward 1974, Alstrup 1979, Leuckert & Kümmerling 1989, Schindler 1990, Golubkova et al. 1996, Marcano et al. 1997, Brodo et al. 2001, Ryan 2002) and its position within the *Lecanoromycetes* is still not settled.

Species of *Lepraria* and *Leprocaulon* grow intermixed in Greenland, sometimes being hard to separate in the field. They are not inconspicuous and often occur abundantly in their habitats, forming extensive crusts on the ground or on rock faces. In many ways, leprarioid lichens are analogous to the soil-crust organisms that have only recently received particular attention among biologists (Belnap & Lange 2001). Some of them are members of the Greenland soil-crust communities described by Hansen (2001b).

History of exploration of leprarioid lichens in Greenland — Pioneers among the collectors of Greenland lichens who visited Greenland in the first half of the 19th century (such as the German mineralogist K.L. Giesecke and Danish botanists J. Vahl and M. Wormskiold) almost totally neglected the 'byssoid' and leprarioid lichens (Branth & Grønlund 1888). The same applies to the Swedish botanist, Th.M. Fries, who visited Greenland in 1871.

The Norwegian lichenologist, P.F. Scholander, was the first who systematically collected leprarioid lichens in Greenland. *Crocynia neglecta* (Nyl.) Hue [now accepted as *Lepraria neglecta*], the first species from this group to be reported from Greenland, was collected by him in Southeast Greenland in 1932 (Lynge 1932, Dahl et al. 1937). Lynge (1937) mentioned *C. neglecta* again and a few years later (Lynge 1940) reported numerous localities for this species in Central and Northeast Greenland (visited in 1929 and 1930) and described *C. arctica* [now accepted as *Lepraria vouauxii*] as new to science. The original material for this species was collected by C. Kruuse in Southeast Greenland in 1902.

In 1937 the Norwegian botanist, E. Dahl, visited Southwest Greenland and collected specimens of *Crocynia neglecta* (Dahl 1950). He noted that the species was chemically not uniform.

Since the middle of the 20th century, numerous specimens were gathered during botanical fieldwork in various parts of Greenland with the purpose to make representative collections for the visited areas. In particular, the Danish botanist P. Gelting collected leprarioid lichens extensively during his leadership of the University of Copenhagen's Arctic Station from 1946 to 1954. Most of these collections remained unstudied and form an important source for the present investigation. Gelting's material originates mainly from Disko, but also from neighboring areas on the mainland and even other parts of Greenland. Another important collector of leprarioid lichens was the Danish lichenologist, V. Alstrup, who worked mostly in Southwest, Central West and Northwest but also in North and Northeast Greenland (Alstrup et al. 2000). F. Daniëls (1975, 1982) mentioned those lichens from Southeast Greenland.

Southwest and Central West Greenland have been easily accessible for a long period and without doubt are the best known regions, but with modern transport, no part of Greenland can any longer be considered inaccessible. Thus E.S. Hansen, who so far has made the most comprehensive collections of leprarioid lichens in Greenland, has visited almost all parts of Greenland since 1969 and published his finds from the following regions of the island in numerous publications together with co-authors: South and Southwest Greenland (Hansen 1978a, 1993b, 2000a, b, 2006; Hansen & Lund 2003), Central West Greenland (Hansen 1991, 1997, 1998, 1999, 2005), Northwest Greenland (Hansen 1980, 1983, 1989, 2002a), Southeast Greenland (Hansen 1978b, c, 2002b), Central East Greenland (Hansen 1982, 1995a, 1996), Northeast and North Greenland (Alstrup et al. 2000; Hansen 1995b, 2001a), and Greenland in general (Hansen 1995c, 2001b). The collections mentioned in these papers have been revised during the present investigation.

Further Greenland records of *Leprocaulon* are presented in the more general survey of arctic lichens by Thomson (1984).

Altogether, six species of *Lepraria* and *Leprocaulon* have been reported from Greenland up to now:

Lepraria alpina [sub nomine *L. cacuminum*];
Lepraria eburnea (sub nomine *L. frigida*);
Lepraria lobificans;
Lepraria neglecta;
Lepraria vouauxii (sub nomine *L. arctica*);
Leprocaulon subalbicans.

Thus far, the following leprarioid lichens have been distributed as part of Lichenes Groenlandici Exsiccati supplied by the Botanical Museum, University of Copenhagen: *Lepraria eburnea* (nos 816, 931, 971 – sub nomine *L. frigida*), *L. neglecta* (nos 83, 320), *L. vouauxii* (nos 348, 598, 757 – sub nomine *Leproloma vouauxii*) and *Leprocaulon subalbicans* (nos 219, 411, 544, 927, 938).

Climate and vegetation zones in Greenland — Most of Greenland is located in the Arctic climate zone (Putnins 1970, Fristrup 1981). The arctic climate is defined as having a mean temperature below 10°C for July, the warmest month. The low July temperature is associated with a short growing season, and the two factors together prevent the development of forests in the arctic climate zone. Except for North Greenland, summer temperatures are mostly between 6°–8°C, being more uniform along the west coast than on the east coast where they drop considerably toward the north. The winter temperature is not a factor delimiting arctic climate zones, and mean temperatures for the winter months vary far more than summer temperatures, contributing the most to the drop in annual mean at northern latitudes. Precipitation decreases towards the north and tends to be lower at the west coast, with a maximum in late summer, and higher on the east coast, with a maximum in the winter (Heide-Jørgensen & Johnsen (1997).

Two subzones are distinguished, a High and a Low Arctic zone (Heide-Jørgensen & Johnsen 1997). However, some authors use different classifications (Böcher et al. 1959, 1968; Daniëls 1982, Jensen 1999). The two main types can be further subdivided into oceanic and continental subtypes. Due to the complicated orography of Greenland, the types and subtypes form a mosaic at local level. Thus, the boundary between High and Low Arctic on the distribution maps in this article is a generalization, based more on the distribution of plant communities than on climatic observations (Heide-Jørgensen & Johnsen 1997). For the same reason, the subtypes are here not further indicated.

The vegetation is mostly confined to more or less coastal areas because about 82% of Greenland is covered by an ice sheet.

In the High Arctic, the lack of *Salix glauca* shrubs and the dominance of *Cassiope tetragona* and *Dryas* heaths are distinctive. In addition, many vascular plants have their northern or southern distribution limit at the border between High and Low Arctic. Climatologically, the high arctic climate has a large yearly temperature amplitude with very low winter minima; the daily temperature amplitude in summer is small and the precipitation is low. The low arctic climate has a smaller yearly temperature amplitude, a larger daily temperature amplitude, less sunshine and more precipitation.

In the southernmost part of Greenland, the Subarctic zone covers a relatively small inland area at the inner part of the great fjord system (Sermilik, Tunugdliarfik and Tasermiut). The Subarctic climate allows copses of *Betula* and *Salix* to develop.

Leprarioid lichens are more or less common in all zones apart from the most continental ones. The lichen flora of the oceanic zone in the northern High Arctic is very poorly known, with only few reports from this area (Lynge 1923). It is probably far richer in species, as suggested by the preliminary observations of E. S. Hansen, who collected numerous lichens at the northern coast of Greenland in 2007 (E. S. Hansen unpublished, this material is not included in the present study). The continental zone of the northern High Arctic is fairly well known lichenologically, as more than 400 taxa of lichens previously have been reported from this area (Alstrup et al. 2000; Hansen 1995b, 2001a). It is of particular interest because of the occurrence of rare lichens with a disjunct distribution (Hansen 1993a). The oceanic vegetation zone of the southern High Arctic is very rich in lichens with either oceanic or continental distribution (Lynge & Scholander 1932, Lynge 1940, Hansen 1995a). The Low Arctic zones have often been studied by lichenologists and are very rich in macro- and microlichens. The Subarctic/Boreal zone has a comparatively rich epiphytic lichen flora in addition to other substrata (Dahl 1950, Hansen 1971, Alstrup 1982) due to the presence of tree growth there.

Material and methods

This study is based on collections from the Botanical Museum, University of Copenhagen (C). Altogether about 700 specimens from various localities of Greenland were examined. Some additional material from other herbaria (H, LD, TU, TUR, UPS) was analysed for comparison. Morphology and anatomy were studied using a stereomicroscope Olympus SZ40 equipped with additional objectives and a camera mounting kit. Thin layer chromatography (TLC) was carried out according to Orange et al. (2001a). Mostly solvent A, sometimes also C, was used. For the evaluation of the plates, photographs were taken in UV 254 and 366 nm before sulphuric acid treatment and in visible light and UV 366 nm afterwards, using a digital camera Olympus C4040. The availability of digital images of the UV fluorescence adds to the sensitivity of the method and makes processing the chemical information easier. Some fatty acids which cannot be distinguished by TLC are reported as pairs, for instance "roccellic/angardianic acid." Stictic acid is usually accompanied by constictic and cryptostictic acids while both pannaric acid 6-methylester and porphyrilic acid often occur together with related dibenzofurans (Elix & Tønsberg 2004). These complexes are referred to as "stictic acid complex," "pannaric acid 6-methylester and accessories" and "porphyrilic acid and accessories."

The localities of the taxa are mapped using the software DMAP (Morton 2003). Localities based on literature records only are not included in this paper.

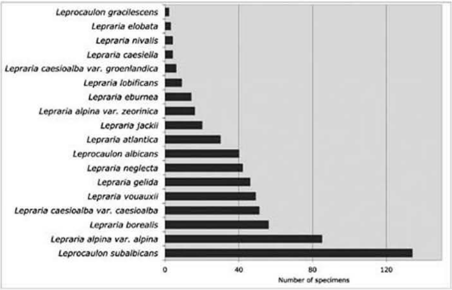

Figure 1. Numbers of specimens of *Lepraria* and *Leprocaulon* taxa in Greenland.

Results

Thirteen species (plus two new varieties) of *Lepraria* and three species of *Leprocaulon* were recorded during this revision, ten of them new to Greenland. *Leprocaulon subalbicans*, *Lepraria alpina* var. *alpina* and *L. borealis* are the most abundant taxa (Fig. 1).

The numerous chemotypes found in these taxa are summarized in Table 1. The concept of chemotypes used here is quite narrow: addition or absence of any secondary compound is regarded as marker of a separate chemotype in order to get an overview of the whole chemical variation of the studied taxa.

The distribution of *Lepraria* and *Leprocaulon* species in Greenland is summarized on the coincidence map (Fig. 2). The areas richest in species are mainly situated in the Low Arctic zone, including most of the west coast from Nuussuaq and Qeqertarsuaq (Disko) down to southernmost Greenland and the east coast around Tasiilaq. In the High Arctic, only in the Qaanaaq (Thule) area in the northwest were ten or more taxa found. A considerable part of the north coast is without records.

Key to *Lepraria* and *Leprocaulon* in Greenland*

1. Pseudopodetia and/or phyllocladia present 2
1. Pseudopodetia and/or phyllocladia absent 4

2. Pseudopodetia with distinct central axis of conglutinated hyphae,
well developed 3
2. Pseudopodetia without central axis, of free, but dense hyphae only,
often poorly developed .... *Leprocaulon subalbicans*
3. Squamatic and baeomycesic acids present,
atranorin absent .... *Leprocaulon albicans*
3. Squamatic and baeomycesic acids absent,
atranorin present .... *Leprocaulon gracilescens*

4. Soredia coarsely granular (*Lepraria neglecta* type) 5
4. Soredia powdery or cottony (not *Lepraria neglecta* type) 10

5. Alectorialic acid present (KC+ red or orange, K+ yellow) ....*Lepraria neglecta*
5. Alectorialic acid absent (KC– or if + red or orange then K reaction otherwise) ... 6

6. Porphyrilic acid present 7
6. Porphyrilic acid absent 8

7. Zeorin present .... *Lepraria alpina* var. *zeorinica*
7. Zeorin absent .... *Lepraria alpina* var. *alpina*

8. Stictic or fumarprotocetraric (exceptionally protocetraric) acid present 9
8. Stictic, fumarprotocetraric and protocetraric acids absent .... *Lepraria borealis*

9. Zeorin present .... *Lepraria caesioalba* var. *groenlandica*
9. Zeorin absent .... *Lepraria caesioalba* var. *caesioalba*

10. Alectorialic acid present (KC+ red or orange, K+ yellow) 11
10. Alectorialic acid absent (KC– or if + red or orange then K reaction otherwise) . 12

11. Porphyrilic acid present .... *Lepraria gelida*
11. Porphyrilic acid absent, occasionally other substances
(e.g. protocetraric acid, roccellic acid) present .... *Lepraria eburnea*

12. Pannaric acid 6-methylester present .... *Lepraria vouauxii*
12. Pannaric acid 6-methylester absent 13

13. Porphyrilic acid present (usually together with
atranorin and a fatty acid) .... *Lepraria atlantica*
13. Porphyrilic acid absent 14

14. Stictic acid present 15
14. Stictic acid absent 17

15. Zeorin present 16
15. Zeorin absent .... *Lepraria nivalis*

16. Thallus cottony, medulla well developed .... *Lepraria lobificans*
16. Thallus powdery, medulla not evident .... *Lepraria elobata*

17. Zeorin present, fatty acids absent .... *Lepraria caesiella*
17. Zeorin absent, fatty acids present .... *Lepraria jackii*

* Identification of lichen substances should be carried out using TLC if not indicated otherwise in the key.

Table 1. Chemotypes of the studied taxa.*

Taxon	CHEMOTYPE	# of SPECIMENS	P-DEPSIDS β-ORCINOL SERIES	M-DEPSIDS β-ORCINOL SERIES	DEPSIDONES β-ORCINOL SERIES	BENZYLESTHERS β-ORCINOL SERIES	DIBENSOFURANES	TRITERPENES	HIGHER ALIPHATIC ACIDS
L. alpina var. *alpina*	(1)	60	ATR				PORPH + ACCS		ROC/ANG
	(2)	6	ATR				PORPH + ACCS		RANG
	(3)	7	ATR				PORPH + ACCS		
	(4)	2					PORPH + ACCS		ROC/ANG
	(5)	10					PORPH + ACCS		
L. alpina var. *zeorinica*	(1)	10	ATR				PORPH + ACCS	ZEO	ROC/ANG
	(2)	1	ATR				PORPH + ACCS	ZEO	RANG
	(3)	4	ATR				PORPH + ACCS	ZEO	
L. atlantica	(1)	6	ATR				PORPH + ACCS		ROC/ANG
	(2)	6	ATR				PORPH + ACCS		RANG
	(3)	1	ATR				PORPH + ACCS		ROC/ ANG, RANG
	(4)	17					PORPH + ACCS		
L. borealis	(1)	23	ATR						ROC/ANG
	(2)	18	ATR						RANG
	(3)	3	ATR						ROC/ ANG, RANG
	(4)	8	ATR						
	(5)	4							ROC/ANG
L. caesiella	(1)	2	ATR					ZEO	ROC/ANG
	(2)	2	ATR					ZEO	
L. caesioalba var. *caesioalba*	(1)	11	ATR		FUMAR				ROC/ANG
	(2)	17	ATR		STICT COMPL				ROC/ANG
	(3)	8	ATR		STICT COMPL				RANG
	(4)	1	ATR		STICT COMPL				ROC/ ANG, RANG
	(5)	14	ATR		STICT COMPL				
L. caesioalba var. *groenlandica*	(1)	4	ATR		STICT COMPL			ZEO	ROC/ANG
	(2)	1	ATR		STICT COMPL			ZEO	RANG
	(3)	1	ATR		STICT COMPL			ZEO	
L. eburnea	(1)	1			PROT	ALEC			
	(2)	2				ALEC			ROC/ANG
	(3)	11				ALEC			

Table 1 concluded.

TAXON	CHEMOTYPE	# of SPECIMENS	P-DEPSIDS β-ORCINOL SERIES	M-DEPSIDS β-ORCINOL SERIES	DEPSIDONES β-ORCINOL SERIES	BENZYLESTHERS β-ORCINOL SERIES	DIBENSOFURANES	TRITERPENES	HIGHER ALIPHATIC ACIDS
L. elobata		3	**ATR**		**STICT COMPL**			**ZEO**	
L. gelida		46				**ALEC**	**PORPH**		
L. jackii	(1)	9	**ATR**						**ROC**
	(2)	7	**ATR**						**JACK/ RANG**
	(3)	2	**ATR**						**JACK/ RANG, ROC**
	(4)	2	**ATR**						**UNID**
L. lobificans	(1)	8	**ATR**		**STICT COMPL**			**ZEO**	
L. neglecta	(1)	23				**ALEC**			ROC/ANG
	(2)	13				**ALEC**			
	(3)	4	ATR			**ALEC**			ROC/ANG
	(4)	2	ATR			**ALEC**			
L. nivalis	(1)	2	**ATR**		**STICT COMPL**				RANG
	(2)	2	**ATR**		**STICT COMPL**				
L. vouauxii	(1)	44					**PN6ME + ACCS**		
	(2)	4					**PN6ME + ACCS**		ROC/ANG
	(3)	1	ATR				**PN6ME + ACCS**		
Leprocaulon albicans		40		**SQ, BAEOM**					ROC/ANG
Leprocaulon gracilescens	(1)	1	**ATR**						**ROC/ANG**
	(2)	1	**ATR**						**RANG**
Leprocaulon subalbicans	(1)	118		**SQ, BAEOM**					ROC/ANG
	(2)	3		**SQ, BAEOM**					
	(3)	2	ATR	**THAMN**					ROC/ANG
	(4)	11		**THAMN**					ROC/ANG

*Diagnostic substances are in bold. ALEC – alectorialic acid; ATR – atranorin; BAEOM – baeomycesic acid; FUMAR – fumarprotocetraric acid; JACK/RANG – jackinic or rangiformic acid; PN6ME+ACCS – pannaric acid 6-methylester and accessory dibenzofurans; PORPH+ACCS – porphyrilic acid and accessory dibenzofurans, PROT – protocetraric acid; RANG – rangiformic acid; ROC – roccellic acid; ROC/ANG – roccellic or angardianic acid; SQ – squamatic acid; STICT COMPL – stictic acid complex; THAMN – thamnolic acid; UNID – unidentified fatty acid; ZEO – zeorin.

The Species

Lepraria alpina (de Lesd.) Tretiach & Baruffo, Nova Hedwigia 83: 395 (2006), **var. *alpina***

Crocynia alpina de Lesd., Bull. Soc. Bot. France 61: 85 (1914).

Leproloma cacuminum sensu J.R. Laundon, The Lichenologist 24: 345 (1992); *Leproloma angardianum* (Øvstedal) J.R. Laundon, The Lichenologist 21(1): 19 (1989); *Lepraria angardiana* Øvstedal, Nova Hedwigia 37: 687 (1983); *Lepraria caerulescens* (Hue) Botnen & Øvstedal, Polar Research 6: 130 (1988); *Lepraria cacuminum* sensu Loht., Ann. Bot. Fennici 32: 52 (1995); non *Diploicia cacuminum* A. Massal., Symm. Lich. Nov.: 52 (1855).

Thallus — As typical in the *L. neglecta* group, coarsely granular, hard, rarely softer and of looser consistence. See detailed description under *L. alpina* var. *zeorinica*.

Lichen substances — Five chemotypes occur in Greenland: (1) with atranorin, porphyrilic and roccellic/angardianic acids (n = 60); (2) with atranorin, porphyrilic and rangiformic acid (n = 6); (3) with atranorin and porphyrilic acid without fatty acids (n = 7); (4) with porphyrilic and roccellic/angardianic acids without atranorin (n = 2); (5) with porphyrilic acid only (n = 10).

Discussion — This species was known under the name *Lepraria cacuminum* (A. Massal.) Loht. until very recently, when Baruffo et al. (2006) found the lost type material of *Diploicia cacuminum*, the basionym for *Lepraria cacuminum* (Laundon 1992), and proved that it belonged to quite another lichen, *Buellia insignis* (Hepp) Th. Fr. The new combination *Lepraria alpina* (based on *Crocynia alpina*) was proposed and a neotype selected.

L. alpina is morphologically very similar to *L. caesioalba*, although often a little softer and with looser overall appearance. Both these taxa belong to the *L. neglecta* group, thallus of which is characterized by coarsely granular and hard soredia. A further species, *L. atlantica*, was separated from *L. alpina* by Orange (2001) on the basis of a powdery or almost cottony thallus constitution. Its distinctiveness has also been shown by DNA studies (Ekman & Tønsberg 2002, Slavíková-Bayerová & Fehrer 2007). Several thalli studied by us were intermediate between these two species; more granular specimens were assigned to *L. alpina*, more powdery ones to *L. atlantica*. Previously only a few intermediate specimens were known and the two species were considered to be morphologically strictly distinct (Orange 2001, Baruffo et al. 2006). We can report almost a continuum in morphology of the two taxa in Greenland.

Chemically, presence of porphyrilic acid and accessories is diagnostic for *L. alpina* var. *alpina* in Greenland (Table 1).

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens, rarely on rocks.

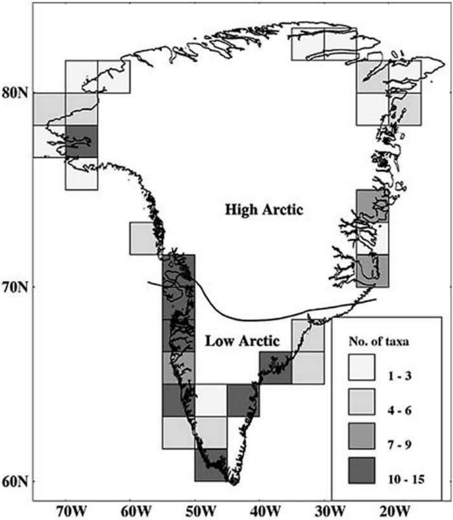

Figure 2. The distribution of *Lepraria* and *Leprocaulon* species in Greenland. Coincidence map.

Distribution — *L. alpina* var. *alpina* is abundant across the Low Arctic in Greenland but scarce in the High Arctic and totally absent from the north coast (Fig. 3A). Only a few localities have been reported earlier (Leuckert & Kümmerling 1991).

Number of specimens examined — 85

Selected specimens examined. Greenland. Arsuk, (61°11'N, 48°28'W), 8. Jul 1993 E. S. Hansen ESH-93.0358 (C). Uutaap Kuua, (67°01'N, 53°12'W), 5. Aug 1998 E. S. Hansen ESH-98.393 (C). Nugssuaq Peninsula, (70°01'N, 51°57'W), 29. Oct 1949 P. Gelting (C). Disko, Godhavn, Arktisk Station, Augpilagtunguaq (Flagklippen), (69°15'N, 53°33'W), 1. Mar 1952 P. Gelting 17268 (C).

Lepraria alpina* var. *zeorinica L. Saag, **var. nov.**
MycoBank — MB 510912

Thallus leprosus, granulosus, similis Lepraiae alpinae *var.* alpinae. *Atranorinum, zeorinum et acidum porphyrilicum continens.*

TYPUS: Greenland, Qingertivaq, alt. 550 m (66°06'N, 37°13'W), mosses and soil (humus), 30 July 1970, E. S. Hansen ESH-70.0032 [C – holotypus, TU – isotypus; porphyrilic acid (major), atranorin (minor), zeorin (minor)].

Thallus — Crustose, leprose, with granular appearance, thick and hard, rarely thin and/or somewhat softer; often dark grey, sometimes light grey to almost white, predominantly with bluish ("cold") tinge; firmly attached to the substrate, usually growing in irregular patches up to several cm in diam., sometimes young thalli forming rosettes up to 1 cm in diam.; thallus margin diffuse, rarely delimited and sublobed; medulla occasionally present, not evident; **soredia** variably sized, mostly coarse, (70–)100–150(–190) µm in diam., often pruinose, sometimes with short projecting hyphae; **consoredia** present in variable amount, from few to abundant, typically 200–300 µm in diam., convex or ellipsoidal; small patches with leprose surface with no distinguishable individual soredia rarely present.

Lichen substances — Four chemotypes are recorded in Greenland: (1) with atranorin, zeorin (in variable amounts, sometimes in traces), porphyrilic and roccellic/angardianic acids (n = 10); (2) with atranorin, zeorin, porphyrilic and rangiformic acids (n = 1); (3) with atranorin, zeorin and porphyrilic acid without fatty acids (n = 4).

Discussion — Zeorin has not been reported from *L. alpina* before, and its content in the collections from Greenland seems to be constant enough to justify a taxonomic rank. We describe this taxon on the level of variety because it is not morphologically distinguishable from *L. alpina* var. *alpina*. Presence of both porphyrilic acid with accessories and zeorin is diagnostic for *L. alpina* var. *zeorinica* (Table 1). A single specimen with *L. alpina* morphology but containing atranorin and zeorin only was also found in the material but is excluded from the new variety.

Etymology — The epithet "*zeorinica*" refers to the content of zeorin.

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens.

Distribution — Until now *L. alpina* var. *zeorinica* is known only from Greenland where its distributional pattern is similar to that of the typical variety. It is less frequent in the High Arctic, where it has only one locality on the central eastern coast (Fig. 3A).

Number of specimens examined — 16

Selected specimens examined. Greenland. Zackenberg, area E of river, up to Aucellabjerg (74°28'N, 20°12'W), 22. Jul 1994 E. S. Hansen ESH-94.022 (C). Ikateq, Ikateq, alt. 200 m (65°57'N, 36°40'W), 13. Aug 1971 E. S. Hansen ESH-71.0249 (C). Narsaq, S-slope of Narsaq Fjeld, (60°57'N, 46°03'W), 27. Jul 1978 V. Alstrup 243927ah (C). Ødesund, (66°10'N, 35°31'W), 1901–1902 C. Kruuse (C). Mikis Fjord, (68°10'N, 31°32'W), 21. Jul 1971 E. S. Hansen ESH-71.0917 (C). Qingertivaq, alt. 550 m (66°06'N, 37°13'W), 30. Jul 1970 E. S. Hansen ESH-70.0032 (C). Narsaq, Kangerdluarssuk, S of Lakseelvdalen, alt. 332 m (60°53'N, 45°46'W), 16. Jul 1978 V. Alstrup 243892 (C).

Lepraria atlantica Orange, The Lichenologist 33: 462 (2001)

Thallus — Material from Greenland is leprose, diffuse, soft, powdery, sometimes almost cottony; light grey to whitish, often greenish; **soredia** medium sized, sometimes coarse and of the same size as those of *L. alpina*, usually with short projecting hyphae; medulla often distinct.

Lichen substances — *L. atlantica* was described as chemically identical to *L. alpina* (Orange 2001). In Greenland four chemotypes are recorded: (1) with atranorin, porphyrilic and roccellic/angardianic acids (n = 6); (2) with atranorin, porphyrilic and rangiformic acids (n = 6); (3) with atranorin, porphyrilic acid and both fatty acids, roccellic/angardianic and rangiformic acids (n = 1); (4) with porphyrilic acid only, often in small amounts (n = 17).

Discussion — *L. atlantica* morphologically resembles most closely *L. jackii*. In Greenland the latter has a more cottony thallus, of a looser consistence. Chemically, these two species are different as *L. atlantica* produces porphyrilic acid unlike *L. jackii*.

Some specimens are morphologically intermediate between *L. atlantica* and *L. alpina*, notably most of them belong to chemotype (4) with only porphyrilic acid in the thallus. The absence of atranorin and fatty acids in chemotype (4) may depend on the overall low concentration of secondary substances in these specimens or it may still be a distinct chemotype. See also the discussion under *L. alpina*.

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens, rarely on rocks.

Distribution — Reported here as new to Greenland. *L. atlantica* has a relatively rather wide distribution in Greenland being more frequent in the Low Arctic and the Qeqertarsuaq (Disko) area (Fig. 3B).

Number of specimens examined — 30

Selected specimens examined. Greenland. Disko, Godhavn, Flagstangklippen, (69°15'N, 53°33'W), 4. Jun 1950 P. Gelting (C). Scoresbysund, (70°29'N, 21°58'W), 23. Jul 1987 E. S. Hansen ESH-87.0756 (C). Aasiaat, (68°42'N, 52°52'W), 1. Jul 1992 E. S. Hansen ESH-92.0059 (C). Tre Løvers Ø, (64°11'N, 41°08'W), 26. Aug 1970 E. S. Hansen ESH-70.0424 (C).

Lepraria borealis Loht. & Tønsberg, in Lohtander, Ann. Bot. Fennici 31: 224 (1994)

Thallus — Coarsely granular, hard, sometimes somewhat softer and of looser consistence, but never with small soredia or near-cottony composition; thallus margin diffuse or often delimited and with obscure sublobes or rim. Usually closely resembles *L. caesioalba*, as both taxa belong to the *L. neglecta* group.

Lichen substances — Two main chemotypes are recorded in Greenland: (1) with atranorin and roccellic/angardianic acids (n = 23); (2) with atranorin and rangiformic acid (n = 18); and additionally, (3) with both fatty acids, besides atranorin (n=3); (4) with atranorin only, lacking any fatty acids (n = 8); (5) with roccellic/angardianic acid only, lacking atranorin (n = 4).

Discussion — Specimens of *L. borealis* lacking rangiformic acid were also reported by Kukwa (2006b). Specimens with atranorin only or fatty acids only were tentatively placed in this taxon by us; they can alternatively be considered deficient representatives of *L. alpina* as there are no distinctive morphological differences between these two species (Prigodina-Lukošienė et al. 2003, Kukwa 2006b; see also Lohtander 1995).

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens, sometimes on rocks.

Distribution — Reported here as new to Greenland. Like other members of the *L. neglecta* group, *L. borealis* is rather widely distributed in Greenland, most frequently found in the Low Arctic (Fig. 3C).

Number of specimens examined — 56

Selected specimens examined. Greenland. Ikasaulaq, (65°59'N, 37°26'W), 11. Jul 1970 E. S. Hansen ESH-70.2870 (C). Scoresbysund, (70°29'N, 21°58'W), 21. Jul 1987 E. S. Hansen ESH-87.0604 (C). Qingertivaq, alt. 200 m (66°06'N, 37°13'W), 3. Aug 1970 E. S. Hansen ESH-70.2018 (C). Ikasaulaq, (65°59'N, 37°26'W), 12. Jul 1970 E. S. Hansen ESH-70.3619 (C).

Lepraria caesiella R.C. Harris, in Lendemer, Opuscula Philolichenum 2: 51 (2005)

Thallus — Pale bluish grey (fades to white in the herbarium), poorly delimited, consisting of loosely to densely packed soredia/consoredia without medulla and prothallus, initially of scattered soredia/consoredia, then forming small patches which fuse to form extensive, irregular, ± continuous thalli, rather thin, 0.1–0.2 mm thick; **soredia** 20–30 µm in diam., filled with small crystals, with short, irregular, projecting hyphae, 25–30 µm long; **consoredia** to 100 µm in diam. (after Lendemer 2005).

Greenland specimens that were assigned to this species had slightly larger soredia (up to 65 µm in diam.) and slightly shorter projecting hyphae; otherwise they correspond to this description.

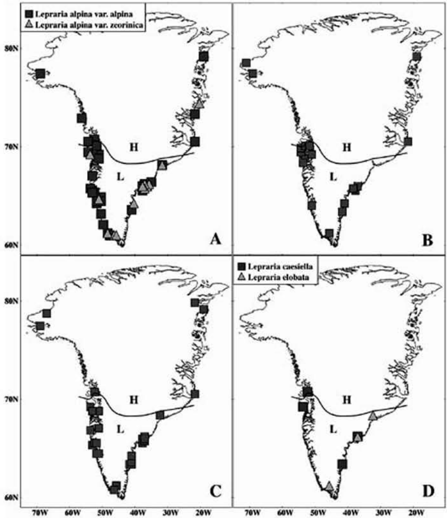

Figure 3. Distribution of *Lepraria* species and varieties in Greenland. (A) *L. alpina* var. *alpina* (squares), *L. alpina* var. *zeorinica* (triangles); (B) *L. atlantica*; (C) *L. borealis*; (D) *L. caesiella* (squares), *L. elobata* (triangles). H – High Arctic; L – Low Arctic.

Lichen substances — All four specimens contain atranorin and zeorin, two of them have roccellic acid as an accessory. Roccellic acid was not reported in original description by Lendemer (2005).

Discussion — *L. caesiella* was recently described from North America, but was known earlier as "*Lepraria* sp. 3" (Harris 1977). Its most distinctive feature is the chemical content comprising atranorin and zeorin and lacking divaricatic acid; otherwise it is stated to be rather similar to *L. incana* (L.) Ach. The Greenland specimens resemble a relatively densely packed morph of *L. incana*, still being a bit paler. *L. incana* can be morphologically quite variable, sometimes forming relatively loose cottony cushions and sometimes consisting of sparse or denser separate soredia only.

Substrate and ecology — On soil and bryophytes.

Distribution — *L. caesiella* is reported here as new to Greenland. It is confined to the Low Arctic (one locality is situated on the border with the High Arctic) (Fig. 3D). Elsewhere it is common in the eastern USA and Canada.

Number of specimens examined — 4

Specimens examined. Greenland. Disko, Godhavn, Snespurveloggia, (69°15'N, 53°32'W), 8. Apr 1953 P. Gelting 19777 (C). Uummannaq, (70°41'N, 52°08'W), 15. Jul 1987 E. S. Hansen ESH-89.0041 (C). Eqalungmiut, (63°28'N, 41°55'W), 15. Aug 1970 E. S. Hansen ESH-70.1265 (C). Qingertivaq, alt. 150 m (66°06'N, 37°13'W), 29. Jul 1970 E. S. Hansen ESH-70.0187 (C).

Lepraria caesioalba (de Lesd.) J.R. Laundon, The Lichenologist 24: 324 (1992), **var. *caesioalba***

Crocynia caesioalba de Lesd., Bull. Soc. Bot. France 61: 84 (1914); *Leproloma caesioalba* (de Lesd.) M. Choisy, Bull. mens. Soc. linn. Lyon II 19: 12 (1950).
Crocynia henrici de Lesd., Bull. Soc. Bot. France 61: 84 (1914).

Thallus — As usual in the *Lepraria neglecta* group. See detailed description under the morphologically identical *L. caesioalba* var. *groenlandica*.

Lichen substances — Five chemotypes are recorded in Greenland: (1) with atranorin, fumarprotocetraric and roccellic/angardianic acids (n = 11); (2) with atranorin, the stictic acid complex and roccellic/angardianic acid (n = 17); (3) with atranorin, the stictic acid complex and rangiformic acid (n = 8); (4) with atranorin, the stictic acid complex, roccellic/angardianic and rangiformic acid (n=1); (5) with atranorin and the stictic acid complex only (n = 14).

Discussion — *L. caesioalba* comprises several chemotypes, e.g. Leuckert et al. (1995) distinguished three and Tønsberg (2004) five. In this paper, the classification of Leuckert et al. (1995), with additions, is followed, and specimens containing only atranorin and fatty acid(s) are placed in *L. borealis* as described by Lohtander (1994) and Prigodina-Lukošienė et al. (2003). The presence of atranorin and fumarprotocetraric acid or stictic acid complex is considered diagnostic (Table 1).

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens, rarely on rocks.

Distribution — *L. caesioalba* var. *caesioalba* is reported here as new to Greenland. It is widely distributed both in the Low and High Arctic (with more localities in the Low Arctic) but absent from the north coast (Fig. 4A).

Number of specimens examined — 51

Selected specimens examined. Greenland. Angmagssalik, (65°36'N, 37°38'W), 3. Jul 1985 E. S. Hansen ESH-85.0255 (C). Angmagssalik, Qingertivaq, (66°06'N, 37°13'W), B. Jensen & J. Jensen 69-3085 (C). Tasilaq, (66°04'N, 37°02'W), 21. Jul 1970 E. S. Hansen ESH-70.1365 (C). Qingertivaq, alt. 700 m (66°06'N, 37°13'W), 31. Jul 1970 E. S. Hansen ESH-70.0021 (C).

Lepraria caesioalba* var. *groenlandica L. Saag, **var. nov.**

MycoBank — MB 510911

Thallus leprosus, granulosus, similis Lepraria caesioalbae *var.* caesioalbae. *Atranorinum, zeorinum et acidum sticticum continens.*

TYPUS: Greenland. Qaanaaq, Thule, alt. (77°29'N, 69°12'W), soil (humus) and mosses, 28 June 1986 E. S. Hansen ESH-86.0321 (C – holotypus, TU – isotypus; atranorin, zeorin, rangiformic acid, stictic acid, constictic acid (trace)).

Thallus — Crustose, leprose, with granular appearance, thick and hard, rarely thin and/or somewhat softer; usually dark grey, sometimes light grey to almost white, mostly with bluish ("cold") tinge; securely attached to the substrate, sometimes growing in irregular patches up to several cm in diam., often young thalli forming smaller rosettes with concentric zones often visible; thallus margin diffuse or often delimited and with obscure sublobes or rim; medulla sometimes present, not evident; **soredia** variably sized, mostly coarse, 100–150(–200) µm in diam., often pruinose, rarely with short projecting hyphae; **consoredia** frequent, typically 200–300 µm in diam, convex or ellipsoidal.

Lichen substances — *L. caesioalba* var. *groenlandica* differs from the stictic acid chemotypes of *L. caesioalba* var. *caesioalba* by producing zeorin. Three chemotypes are recorded in Greenland: (1) with atranorin, zeorin, the stictic acid complex and roccellic/angardianic acid (n = 4); (2) with atranorin, zeorin, the stictic acid complex and rangiformic acid (n = 1); (3) with atranorin, zeorin and the stictic acid complex only (n = 1).

Discussion — *Lepraria caesioalba* var. *groenlandica* is described here on the level of variety because it does not differ morphologically from *L. caesioalba* var. *caesioalba*. Chemically this new variety is similar to *L. elobata* which is morphologically different in the following aspects: *L. elobata* has thin powdery thallus composed of mostly fine soredia (consoredia are rare) and diffuse thallus margin, unlike the varieties of *L. caesioalba*. *L. caesioalba* may be a collective species (Ekman & Tønsberg 2002, Tønsberg 2004) but without comprehensive molecular study the separation on species level seems not justified.

Etymology — The epithet *"groenlandica"* is derived from the latin name of Greenland.

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens.

Distribution — *L. caesioalba* var. *groenlandica* is known only from Greenland. It is scattered across the Low Arctic, with one locality in the northwest of the High Arctic region (Fig. 4A).

Number of specimens examined — 6

Selected specimens examined. Greenland. Julianehåb district, Akia (60°41'N, 46°05'W), 28. Jul 1969 J. Andersen & E. S. Hansen ESH-69.0711 (C). Qaanaaq, Thule (77°29'N, 69°12'W), 28. Jun 1986 E. S. Hansen ESH-86.0321 (C). Isertoq, (66°39'N, 38°24'W), 21. Aug 1971 E. S. Hansen ESH-71.1138 (C). Ikasaulaq (65°59'N, 37°26'W), 10. Jun 1970 E. S. Hansen ESH-70.2957 (C). Maluto, bay nearby (64°17'N, 51°44'W), 5. Aug 1990 E. S. Hansen ESH-90.1239 (C).

Lepraria eburnea J.R. Laundon, The Lichenologist 24: 331 (1992)

Lepraria frigida J.R. Laundon, The Lichenologist 24: 332 (1992)

Thallus — Leprose, powdery, often cottony, soft, usually thick; white to light grey, often cream or slightly greenish, sometimes with rose tinge (herbarium specimens, caused by alectorialic acid); thallus margin diffuse, rarely delimited; medulla distinct, white; soredia loosely packed, variably sized, mostly coarse, usually with short projecting hyphae.

Lichen substances — Three main chemotypes were described in *L. eburnea* by Orange (1997): (I) with alectorialic and protocetraric acids; (II) with alectorialic, psoromic and 2'-O-demethylpsoromic acids; (III) with alectorialic acid only. In Greenland also three chemotypes can be separated: (1) with alectorialic and protocetraric acids, (chemotype I sensu Orange 1997) (n = 1); (2) with alectorialic and roccellic/angardianic acids (n = 2); (3) with alectorialic acid only (chemotype III sensu Orange 1997) (n = 11).

Discussion — *L. frigida,* earlier reported from Greenland by Hansen (2002b), was synonymized with *L. eburnea* by Orange (1997). The detection of protocetraric acid in some specimens of *L. frigida,* including its holotype, demonstrated a chemical continuity between *L. frigida* and *L. eburnea* – the protocetraric acid concentration ranging from trace to major. Orange (1997) also pointed out the close morphological resemblance between these species which had already been discussed by Laundon (1992).

L. eburnea often has a thick, soft and cottony appearance. In Greenland, however, thalli are usually a bit more densely packed, a few being almost granular, but still clearly different from the chemically similar *L. neglecta.* Alectorialic acid is considered a diagnostic substance in both these taxa (Table 1).

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens, rarely on rocks.

Distribution — Although not numerous, *L. eburnea* is rather widely distributed, being more frequent in the Low Arctic and absent from the southern- and northernmost parts of the territory (Fig. 4B).

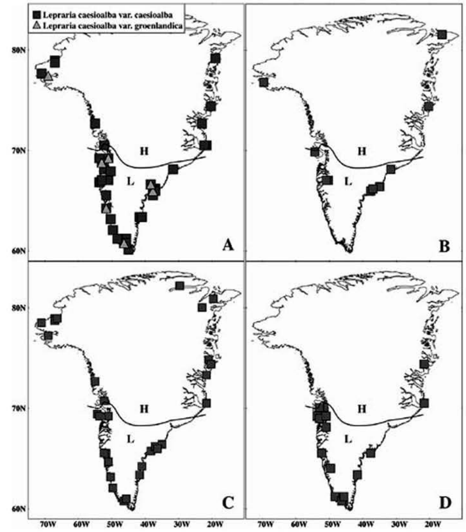

Figure 4. Distribution of *Lepraria* species and varieties in Greenland. (A) *L. caesioalba* var. *caesioalba* (squares), *L. caesioalba* var. *groenlandica* (triangles); (B) *L. eburnea*; (C) *L. gelida*; (D) *L. jackii*. H – High Arctic; L – Low Arctic.

Number of specimens examined — 14

Selected specimens examined. Greenland. Qingertivaq, (66°06'N, 37°13'W), 31. Jul 1970 E. S. Hansen ESH-70.0131 (C). Disko, head of Nordfjord, alt. 30 m (69°56'N, 54°17'W), 11. Aug 1975 V. Alstrup 75087 (C). Zackenberg: area E of river, up to Aucellabjerg, (74°28'N, 20°12'W), 25. Jul 1994 E. S. Hansen ESH-94.172 (C). Kangerlussuaq, (67°02'N, 50°40'W), 28. Jul 1998 E. S. Hansen ESH-98.218 (C).

Lepraria elobata Tønsberg, Sommerfeltia 14: 197 (1992)

Thallus — Leprose, powdery, not cottony, thin; whitish grey, usually greenish; thallus margin always diffuse; medulla not evident; **soredia** mostly fine, loosely to relatively densely packed, predominantly without projecting hyphae; **consoredia** rare.

Lichen substances — Greenland specimens contained atranorin, the stictic acid complex and zeorin (n = 3).

Discussion — *L. elobata* is chemically identical with *L. lobificans*, however, it is quite well defined morphologically. The thallus of *L. elobata* is thin and does not have a well developed medulla and projecting hyphae from soredia, unlike *L. lobificans*. Distinction of *L. elobata* as a separate species is confirmed by its unique DNA sequences (Ekman & Tønsberg 2002). *L. elobata* is also chemically similar to *L. caesioalba* var. *groenlandica* but is different morphologically, see the discussion under that taxon. In Greenland the material of *L. elobata* is morphologically similar to *L. caesiella*. The latter species differs chemically in not producing the stictic acid complex.

Substrate and ecology — On soil and bryophytes.

Distribution — *L. elobata* is reported as new to Greenland. It has been found in three localities on the southern and western coast of the Low Arctic (Fig. 3D).

Number of specimens examined — 3

Specimens examined. Greenland. Qingertivaq, alt. 600 m (66°06'N, 37°13'W), 31. Jul 1970 E. S. Hansen ESH-70.1948 (C). Narssarssuaq, (61°10'N, 45°25'W), 10. Jul 1980 E. S. Hansen ESH-80.0044 (C). Brandal, (68°17'N, 32°15'W), 24. Aug 1932 P. F. Scholander (C).

Lepraria gelida Tønsberg & Zhurb., Graphis Scripta, 18: 64 (2006)

Thallus — Crustose, leprose, powdery-cottony to slightly granular; white, cream or light creamy grey, sometimes with rose tinge (herbarium specimens), only very rarely with bluish ("cold") tinge; not very firmly attached to the substrate; usually growing in irregular patches 1–3(-4) cm, rarely up to 10 cm in diam., sometimes young thalli form rosettes up to 1 cm in diameter; usually thick and relatively soft, soredia in cushions, rarely thin and soredia sparsely and evenly distributed; variably sized leprose surfaces without or with only sparse individual soredia present, sometimes relatively large, giving the thallus a cottony-woolly appearance; thallus margin diffuse or delimited and rarely obscurely sublobed; medulla distinct, white, rarely thin and not evident; **soredia** variably sized, relatively loosely composed, mostly 65–100 µm, occasionally few up to 200 µm in diam., with short to medium projecting hyphae (Fig. 5).

Lichen substances — Only one chemotype occurs, with alectorialic and porphyrilic acids (n = 46).

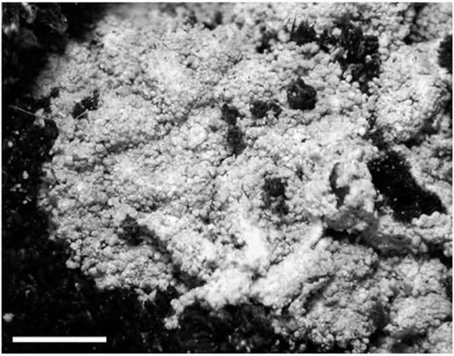

Figure 5. *Lepraria gelida*. Uummannaq, Hansen ESH-89.0095 (C). Scale 2 mm.

Discussion — Two morphotypes were recognizable in most of the material - a common one which is creamy, softer, more cottony, with evident medulla and smaller soredia with distinct projecting hyphae (Fig. 5); and a rare type which is greyish white, mostly with bluish („cold") tinge, with more granular appearance, thin and not evident medulla, slightly larger soredia and very short and scarcely projecting hyphae on the soredia. The latter, granular type is still quite distinct from the *L. neglecta* group.

L. gelida was recently described as new by Tønsberg & Zhurbenko (2006) briefly and the description provided here above is more detailed.

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens, rarely on bark of low shrubs.

Distribution — *L. gelida* is reported as new to Greenland. It is rather evenly distributed along the coast both in the Low and High Arctic zones (Fig. 4C). Its world distribution was earlier known to comprise Svalbard and the Russian arctic islands near the Taimyr peninsula (Tønsberg & Zhurbenko 2006).

Number of specimens examined — 46

Selected specimens examined. Greenland. Fligely ved Kuhn Ø, (74°49'N, 20°45'W), 30. Jul 1988 E. S. Hansen (C). Uummannaq, (70°41'N, 52°08'W), 16. Jul 1989 E. S.

Hansen ESH-89.0095 (C). Fligely ved Kuhn Ø, (74°49'N, 20°45'W), 30. Jul 1988 E. S. Hansen ESH-88.0972 (C). Qingertivaq, alt. 600 m (66°06'N, 37°13'W), 8. Aug 1970 E. S. Hansen ESH-70.2289 (C). Disko, Blåfjeld, Nuk kitleq, alt. 25 m (69°22'N, 54°15'W), 13. Aug 1951 P. Gelting 14375b (C). Disko, Godhavn, Quvnerssuaq, alt. 110 m (69°15'N, 53°33'W), 6. Aug 1953 P. Gelting 20686 (C). Disko, Godhavn, Arktisk Station, Snespurveloggia, (69°15'N, 53°33'W), 29. Mar 1952 P. Gelting 17344a (C). Upernavik, Prøven, Akuliaruseq, (72°35'N, 55°10'W), 22. Aug 1951 P. Gelting (C). Inglefield Land, Hiawatha Camp, (78°50'N, 67°18'W), 29. Jul 1999 E. S. Hansen ESH-99.0410 (C). Inglefield Land, Hiawatha Camp, (78°50'N, 67°18'W) 29. Jul 1999 E. S. Hansen ESH-99.0453 (C). Narsaq, at outlet from Taseq, alt. 460 m (60°57'N, 45°48'W), 1. Aug 1980 V. Alstrup 80700 (C).

Lepraria jackii Tønsberg, Sommerfeltia 14: 200 (1992)

Thallus — Leprose, diffuse, powdery, often cottony, soft, often thick; light green to light grey; irregularly shaped; thallus margin diffuse; medulla often evident, white; soredia loosely packed, mostly small, sometimes up to 60 µm in diam., with short to medium projecting hyphae usually present.

Lichen substances — *L. jackii* contains atranorin and one or two fatty acids - jackinic/rangiformic and roccellic/angardianic acid. All Greenland specimens contained atranorin, fatty acids were encountered as follows: (1) roccellic/angardianic acid only (n=9); (2) jackinic/rangiformic acid only (n=7); (3) jackinic/rangiformic and roccellic/angardianic acid (n=2); (4) unidentified fatty acid (n=2).

Discussion — *L. jackii* is chemically similar to *L. borealis*, but differs clearly from it morphologically; the latter belongs to the *L. neglecta* group and is characterized by coarsely granular and hard soredia. A few specimens from Greenland have abnormally large and densely packed soredia.

Recently *Lepraria toensbergiana* Š.Slavíková & Kukwa was separated from the morphologically identical *L. jackii* on the basis of its chemistry (atranorin together with the newly described fatty acid toensbergianic acid) and its montane distribution (Bayerová et al. 2005, Bayerová & Haas 2005). However, Baruffo et al. (2006) found toensbergianic acid as an accessory only in the specimens containing other fatty acids that were considered typical to *L. jackii*. They also observed a wide ecological and distributional overlap between these species. Furthermore, the ITS sequences of the species differ only in four nucleotides (Bayerová et al. 2005). As no other evidence for the distinctiveness of the species was available, *L. toensbergiana* was reduced to a synonym of *L. jackii* (Baruffo et al. 2006). From Greenland no specimens containing toensbergianic acid are known.

Three further species related to *L. jackii* were described by Slavíková-Bayerová & Orange (2006), *Lepraria celata* Š.Slavíková, *L. humida* Š.Slavíková & Orange, and *L. sylvicola* Orange, chemical separation of which is based on the contents of atranorin and different fatty acids. In this paper we still treat *L. jackii* s. lato.

Substrate and ecology — On mosses and soil, sometimes overgrowing other lichens.

Distribution — Reported here as new to Greenland. *L. jackii* is mainly found in the Low Arctic, with only 2 localities on the east coast in the High Arctic zone (Fig. 4D).

Number of specimens examined — 20

Selected specimens examined. Greenland. Ilulissat, (69°13'N, 51°06'W), 27. Jul 1992 E. S. Hansen ESH-92.0956 (C). Disko, Kutdlisat, alt. 20 m (70°02'N, 52°57'W), 1. Aug 1950 P. Gelting (C). SWn, Disko, Godhavn, Qeqertarsuaq, (69°15'N, 53°32'W), 2. Aug 1996 E. S. Hansen 291 (C). Kronprinsens Ejland, Imerigsoq, (69°01'N, 53°19'W), 8. Oct 1958 P. Gelting 19432 (C).

Lepraria lobificans Nyl., Flora 56: 196 (1873)

Thallus — Leprose, cottony, soft, usually thick, green to light grey; thallus margin diffuse, rarely delimited or with sublobes (not in Greenland material); medulla prominent, white; **soredia** loosely packed, variably sized, with medium to long projecting hyphae.

Lichen substances — Atranorin, zeorin and the stictic acid complex.

Discussion — Large and prominent thalli are often common for this widely distributed species elsewhere in the world. In Greenland *L. lobificans* forms only small woolly patches, often in cracks and crevices between other lichens and mosses.

Roccellic/angardianic acid was additionally detected in one specimen from Greenland which was morphologically very similar to *L. lobificans*. The fatty acids are normally not encountered in that species. The specimen with roccellic/angardianic acid is chemically identical with another recently described species *L. santosii* Argüello & A.Crespo (Crespo et al. 2006) which is morphologically distinct by the raised rim at the thallus margin and lobate, often subsquamulose growth form.

Substrate and ecology — On soil and bryophytes.

Distribution — *L. lobificans* has a western distribution in Greenland, being confined to the Low Arctic zone (Fig. 6A).

Number of specimens examined — 9

Selected specimens examined. Greenland. Disko, Godhavn, alt. 25 m (69°15'N, 53°33'W), 18 May 1952 P. Gelting 17832b (C). Ilulissat, (69°13'N, 51°06'W), 27. Jul 1992 E. S. Hansen ESH-92.0950 (C). Disko, Godhavn, Arktisk Station, Snespurveloggia, (69°15'N, 53°33'W), 29. Mar 1952 P. Gelting 17340 (C). Disko, Godhavn, (69°15'N, 53°33'W), 19. Sep 1953 P. Gelting (C).

Lepraria neglecta (Nyl.) Erichsen, in Lettau, Feddes Repert. 61: 127 (1958)
Lecidea neglecta Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 4: 233 (1859)

Thallus — As typical in the *L. neglecta* group, coarsely granular, hard, rarely of somewhat looser constitution; usually dark grey, sometimes light grey to almost white, mostly with bluish ("cold") tinge, often also with rose tinge (herbarium specimens, caused by alectorialic acid). Very similar to *L. caesioalba*.

Lichen substances — Four chemotypes are present in Greenland: (1) with alectorialic acid and angardianic/roccellic acid (n = 23); (2) with alectorialic acid only (n = 13); (3) with alectorialic acid, atranorin and angardianic/roccellic acid (n = 4); (4) with alectorialic acid and atranorin without fatty acids (n = 2).

Discussion — The morphologically similar species to *L. neglecta* include *L. alpina*, *L. borealis* and *L. caesioalba*; they are collectively referred to as the *L. neglecta* group. Chemically, they all are different, e.g. porphyrilic acid and accessory dibenzofurans are diagnostic for *L. alpina*, atranorin and rangiformic acid for *L. borealis*, atranorin and fumarprotocetraric acid or stictic acid complex for *L. caesioalba*, and alectorialic acid for *L. neglecta*.

Substrate and ecology — Mostly on mosses, also on soil, sometimes overgrowing other lichens, rarely on rocks.

Distribution — *L. neglecta* has a wide distribution in Greenland being more frequent in the Lower Arctic and absent from the north coast, similar to other members of this group (Fig. 6B).

Number of specimens examined — 42

Selected specimens examined. Greenland. Angmagssalik, Sermelikvejen, alt. 90 m (65°36'N, 37°37'W), 18. Jul 1995 H. Büttmann & Ch. Lünterbach (C). Sdr. Strømfjord, NE of the airport, alt. 100 m (67°03'N, 50°40'W), 26. Jul 1991 V. Alstrup 91091 (C). Uummannaq, (70°41'N, 52°08'W), 17. Jul 1989 E. S. Hansen ESH-89.0548 (C). Tasilaq, alt. 50 (66°04'N, 37°02'W), 18. Jul 1970 E. S. Hansen ESH-70.3265 (C).

Lepraria nivalis J.R. Laundon, The Lichenologist 24: 327 (1992)
Crocynia murorum de Lesd., Bull. Soc. Bot. France 95:199 (1948).

Thallus — Material from Greenland is leprose, cottony, soft, usually thick; white to light grey, usually with bluish ("cold") tinge; thallus margin delimited, with obscure sublobes or diffuse; medulla present, white; soredia loosely packed, variably sized, sometimes coarse, usually with projecting hyphae usually present.

Lichen substances — Like in *L. caesioalba*, several chemotypes have been distinguished in *L. nivalis* (Laundon 1992, Leuckert et al. 1995, 2004). All Greenland specimens contained atranorin and the stictic acid complex, in two of them additionally rangiformic acid was detected.

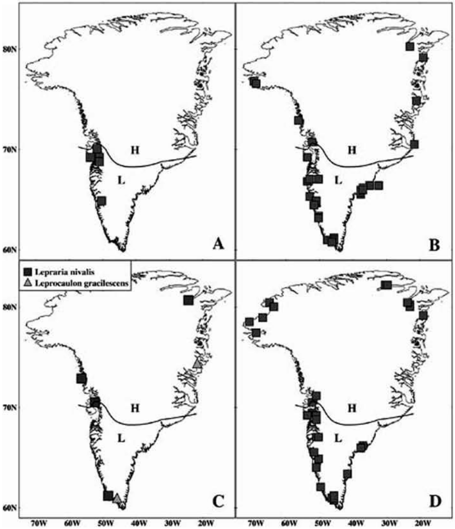

Figure 6. Distribution of *Lepraria* and *Leprocaulon* species in Greenland. (A) *Lepraria lobificans*; (B) *L. neglecta*; (C) *Lepraria nivalis* (squares), *Leprocaulon gracilescens* (triangles); (D) *Lepraria vouauxii*. H – High Arctic; L – Low Arctic.

Discussion — *L. nivalis* is very heterogeneous both chemically and morphologically, possibly including different taxa (Baruffo et al. 2006, Crespo et al. 2006). Related taxa include *L. crassissima* (Hue) Lettau and *L. isidiata* (Llimona) Llimona & A.Crespo (Crespo et al. 2006). *L. crassissima* has a distinctive chemistry containing divaricatic and nordivaricatic acids; *L. isidiata* has a unique morphology – isidia and a very thick, lobed thallus.

L. nivalis is distributed in Europe, North America and Asia, the stictic acid chemotypes being most common in Mediterranean Europe and Macaronesia (Baruffo et al. 2006, Leuckert et al. 1995, 2004). The Greenland localities are the northernmost so far. Two specimens assigned to *L. nivalis* contained rangiformic acid, the fatty acid which has not been reported from this species before. It is possible that the Greenland specimens represent another undescribed taxon but more collections and investigation are needed to establish that. Hereby we report these specimens as tentatively assigned to *L. nivalis*.

Substrate and ecology — On soil and mosses.

Distribution — Reported here as new to Greenland from four scattered localities (Fig. 6C).

Number of specimens examined — 4

Specimens examined. Greenland. Arsuk, (61°11'N, 48°28'W), 8. Jul 1993 E. S. Hansen ESH-93.0396 (C). Mylius Erichsen Land, Campanuladal, mountain NW Campanula Sø, alt. 570 m (80°40'N, 24°20'W), 10. Jul 1995 V. Alstrup & F. J. A. Daniels 4182 (C). Upernavik, (72°48'N, 56°09'W), 31. Jul 1989 E. S. Hansen ESH-89.0835 (C).

Lepraria vouauxii (Hue) R.C. Harris, in Egan, The Bryologist 90: 163 (1987)

Crocynia vouauxii Hue, Bull. Soc. Bot. France 71: 392 (1924); *Leproloma vouauxii* (Hue) J.R. Laundon, The Lichenologist 21: 13 (1989).

Crocynia arctica Lynge, Skr. om Svalbard og Ishavet 81: 19 (1940); *Lepraria arctica* (Lynge) Wetmore, Publs Mich. St. Univ. Mus., biol. ser., 3: 440 (1968).

Thallus — Leprose, usually cottony, soft, thick; white, cream to greyish cream; thallus margin delimited, sublobed or diffuse; medulla absent to prominent, white, usually present; soredia rather loosely packed, mostly coarse, often with short projecting hyphae.

Lichen substances — The diagnostic substance of this species is pannaric acid 6-methylester, often accompanied by a selection of related dibenzofurans and very rarely atranorin (Elix & Tønsberg 2004). This is also the main pattern in the Greenland chemotypes: (1) with pannaric acid 6-methylester only (n = 44); (2) with pannaric acid 6-methylester and roccellic/angardianic acid (n = 4); (3) with pannaric acid 6-methylester and atranorin (n = 1). Roccellic/angardianic acid as an accessory compound has been reported earlier (Laundon 1989, Leuckert et al. 1995).

Discussion — *L. vouauxii* can be quite variable in its thallus characters but is usually recognizable by its consistence and colour in Greenland. The recently described *L. gelida* (Tønsberg & Zhurbenko 2006) may resemble this species morphologically and has a similar distribution pattern in Greenland. Still, the pannaric acid 6-methylester content of *L. vouauxii* makes it distinct from other species.

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens, rarely on rocks.

Distribution — *L. vouauxii* is common in Greenland, being distributed discontinuously in the south, northeast and northwest of the island (Fig. 6D).

Number of specimens examined — 49

Selected specimens examined. Greenland. Godthåbsfjord, Ilulialik, Igdlorssuit, (64°47'N, 50°35'W), 9. Aug 1976 V. Alstrup 76753o (C). Søndre Strømfjord, Kellervik, (67°02'N, 50°54'W), 28. Jul 1991 V. Alstrup 913010 (C). Godthåbsfjord, Ilulialik, Igdlorssuit, alt. 40 m (64°47'N, 50°35'W), 17. Jul 1976 V. Alstrup 76084 (C). Qingertivaq, (66°06'N, 37°13'W), 18. Aug 1970 E. S. Hansen ESH-70.2420 (C).

Leprocaulon albicans (Th. Fr.) Nyl., in Hue, Nouv. Archiv. Mus. 3, ser. 2: 248 (1890)

Stereocaulon albicans Th. Fr., De Stereocaulis et Pilophoris Commentatio, p. 36 (1857).

Thallus — Material from Greenland is white to pale grey, usually with a blue („cold") tinge, sometimes forming a thick crust on the substrate reminding thalli of the *Lepraria neglecta* group, except for the presence of pseudopodetia and phyllocladia; **pseudopodetia** slender, darker near the base, usually less than 1 cm tall, with distinct central axis; **phyllocladial granules** coarse, hard, convex, 150–300 µm in diam. For a detailed description see Lamb & Ward (1974) and Ryan (2002).

Lichen substances — Lamb & Ward (1974) distinguished three chemical strains: (I) atranorin, psoromic, conpsoromic and rangiformic acids together with unidentified fatty acids; (II) atranorin, protocetraric and rangiformic acids with unidentified fatty acids, plus up to 3 other unidentified substances; (III) atranorin, squamatic and baeomycesic acids and unidentified fatty acids. All examined specimens from Greenland contained squamatic, baeomycesic and roccellic/angardianic acids as in strain (III) but without atranorin.

Discussion — Strain III of *L. albicans* is chemically identical to the strain IV of *L. subalbicans* according to Lamb & Ward (1974) (see under that species). The morphological differences between these two species are often not distinct either, although the height of the pseudopodetia (a few mm in *L. albicans* and up to 1 cm in *L. subalbicans*) is considered diagnostic. Anatomically, the pseudopodetia of *L. albicans* have a distinct central axis whereas a central axis is not distinguishable in *L. subalbicans* (Lamb & Ward 1974). In practice the separation is often problematic due to poorly developed thalli.

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens.

Distribution — *L. albicans* is a southwestern to western species in Greenland, being rare in the High Arctic zone (Fig. 7A).

Number of specimens examined — 40

Selected specimens examined. Greenland. Sdr. Isortoq, Nuuk, alt. 40 m (65°30'N, 52°09'W), 2. Aug 1977 V. Alstrup 771592 (C). Sukkertoppen, Igdlut Kaigigdlit, alt. 40 m (65°31'N, 52°01'W), 3. Aug 1977 V. Alstrup 77931e (C). Qaanaaq district, Moriussaq, alt. 400 m (76°45'N, 69°50'W), 2. Aug 1992 V. Alstrup 922327 (C). Disko, Mudderbugten, Alakariaq, (69°44'N, 51°57'W), 20. Aug 1975 V. Alstrup 038 (C).

Leprocaulon gracilescens (Nyl.) I.M. Lamb & A. Ward,

J. Hattori Bot. Lab. 38: 523 (1974)

Stereocaulon gracilescens Nyl., Ann. Sci. Nat. Bot. ser. 4, 11: 210 (1859).

Thallus — Morphologically identical with *L. albicans*, for the description see under that species.

Lichen substances — Contains atranorin and fatty acids. In Greenland, two chemotypes are recorded: (1) with atranorin and roccellic/angardianic acid (n = 1); (2) with atranorin and rangiformic acid (n = 1).

Discussion — This species may alternatively be considered a chemotype of *L. albicans* (Lamb & Ward 1974, Brodo et al. 2001) but proper nomenclatural change has not been proposed.

Substrate and ecology — On soil and bryophytes.

Distribution — Reported here as new to Greenland from two localities on the southern and western coasts (Fig. 6C).

Number of specimens examined — 2

Specimens examined. Greenland. Clavering Ø, Theodolit-plateauet, (74°22'N, 21°23'W), 29. Jul 1994 E. S. Hansen ESH-94.271 (C). Narsaq, Kangerdluarssuk, hill in Lakseelvdalen, alt. 230 m (60°54'N, 45°47'W), 4. Jul 1978 V. Alstrup 243846o (C).

Leprocaulon subalbicans (I.M. Lamb) I.M. Lamb & A. Ward,

J. Hattori Bot. Lab. 38: 534 (1974)

Stereocaulon subalbicans I.M. Lamb, in Imshaug, The Bryologist 60: 220 (1957).

Thallus — White to pale grey, usually with blue („cold") tinge; minutely fruticose, at least in some places, but granules often confluent and **pseudopodetia** sometimes almost indistinguishable; whole thallus usually only a few mm tall including pseudopodetia; often forming a thick crust on substrate, reminding thalli of the *Lepraria neglecta* group except for the presence of small phyllocladia and the diameter of granules; central axis in the pseudopodetia not differentiated; **phyllocladial granules** coarse, hard, 150–300 µm in diam. For a detailed description see Lamb & Ward (1974).

Lichen substances — Lamb & Ward (1974) distinguished 4 chemical strains with additional deficient sub-types („phases") in *L. subalbicans:* (I) with atranorin, psoromic, conpsoromic and divaricatic acids plus one unknown substance; (II) with atranorin, protocetraric acid, unidentified fatty acids and two unknown

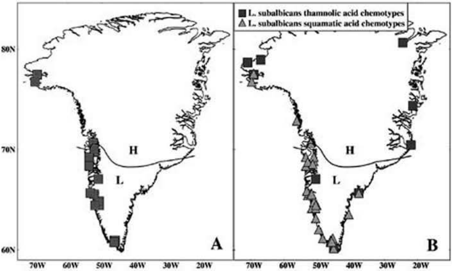

Figure 7. Distribution of *Leprocaulon* species and chemotypes in Greenland. (A) *L. albicans*; (B) *L. subalbicans* thamnolic acid chemotypes (squares), *L. subalbicans* squamatic acid chemotypes (triangles). H – High Arctic; L – Low Arctic.

substances; (III) with atranorin, thamnolic acid and unidentified fatty acids; (IV) with atranorin, squamatic and baeomycesic acids and unidentified fatty acids. In the present study, four chemotypes were found: (1) with squamatic, baeomycesic and roccellic/angardianic acids (n = 118); (2) with squamatic and baeomycesic acids only (n = 3); (3) with atranorin, thamnolic and roccellic/angardianic acids (n = 2); (4) with thamnolic and roccellic/angardianic acids (n = 11). The chemotypes (1) and (2) belong to the strain IV and the chemotypes (3) and (4) to the strain III sensu Lamb & Ward (1974). Atranorin which is a constant component of full chemical spectra of all strains according to Lamb & Ward (1974), is reported missing in some deficient phases by these authors, for instance strain III, deficient phases I and II and strain IV, deficient phase II. Atranorin is usually lacking in the Greenland material.

Discussion — See discussion under *L. albicans.*

Substrate and ecology — On soil and bryophytes, sometimes overgrowing other lichens, rarely on rocks.

Distribution — Thamnolic acid chemotypes are known to be common in USA and Canada, whereas chemotypes with squamatic and baeomycesic acids are relatively rare on the world scale (Lamb & Ward 1974, Brodo et al. 2001, McCune 2004). The different chemotypes have distinct distribution patterns also in Greenland: thamnolic acid chemotypes are widespread, although scattered, having more localities in High Arctic, while the much more common chemotypes (1) and (2) occur in the south and west, mostly in the Low Arctic (Fig. 7B).

Number of specimens examined — 134

Selected specimens examined. Greenland. Narsaq, S-slope of Kangerdluarssuk, alt. 40 m (60°51'N, 45°53'W), 17. Jul 1978 V. Alstrup 243901j (C). Qaanaaq district, Moriussaq, mountain E of village, alt. 300 m (76°46'N, 69°48'W), 2. Aug 1992 V. Alstrup 92232 (C). Nanortalik, (60°09'N, 45°15'W), 29. Jun 1993 E. S. Hansen ESH-93.0196 (C). Mylius Erichsen Land, Campanuladal, N Campanulasø, alt. 120 m (80°40'N, 24°20'W), 11. Jul 1995 V. Alstrup & F. J. A. Daniels

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Two new anamorphic fungi from Brazil: *Cacumisporium tropicale* and *Acrodictys irregularis*

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Abstract — *Acrodictys irregularis* and *Cacumisporium tropicale,* found on a decaying twig of an unidentified plant and on stem of unidentified *Poaceae* respectively, in "Morro do Corcovado", Rio de Janeiro, Brazil are described and illustrated. *A. irregularis* is characterized by irregular, lenticular, globose, obovoid, dictyoseptate conidia with 1-3 cellular protuberances, while *C. tropicale* is distinguished by its verrucose to tuberculate, brown conidiophores and fusiform, 3-septate, brown, smooth-walled conidia. A key to accepted *Cacumisporium* species is provided.

Key words — conidial fungi, systematics, tropical rainforest

Introduction

During an expedition in 2002 through Brazil's "Morro do Corcovado" rainforest, two conspicuous anamorphic fungi from the genera *Acrodictys* and *Cacumisporium* were collected. The specimens showed remarkable differences from previously described species and are therefore described as two new species.

Materials and methods

Samples of plant litter collected in separate paper bags were taken to the laboratory where each was incubated at 25° C in Petri dishes within 50 L plastic moist chambers containing 200 ml sterile water and 2 ml glycerol. The plant material was screened at regular intervals for microfungi. Mounts were prepared in polyvinyl alcohol-glycerol (8 g per 100 ml H_20, plus 5 ml glycerol), and measurements were made at a magnification of × 1000. The fungi were isolated from single conidia captured under a stereo microscope and immediately transferred to Petri dishes of corn meal agar, mixed 1:1 with carrot extract, and incubated at 25° C under alternating cycles of 12 h of light and dark.

Taxonomy

Acrodictys irregularis R.F. Castañeda, Gusmão & Guarro, **anam. sp. nov.**

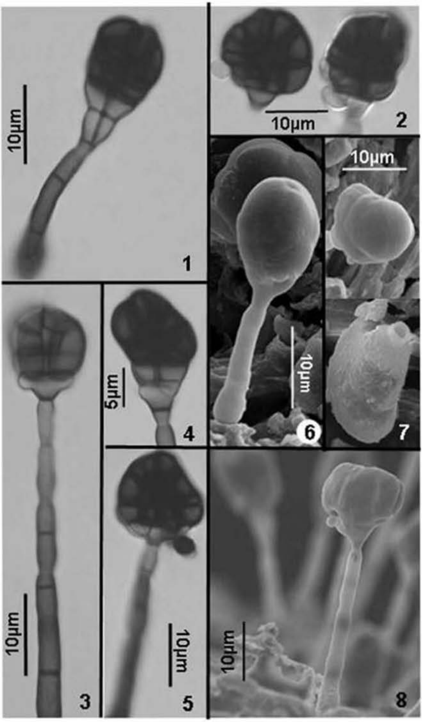
MycoBank MB 490015 Figs. 1-8

Coloniae *in substrato naturali effusae, nigrae. Mycelium partim superficiale et partim in substrato immersum, ex hyphis septatis, laevibus, atrobrunneis vel brunneis 1-3 µm diam., compositum.* ***Conidiophora*** *macronematosa, mononematosa, erecta, recta vel flexuosa, cylindrica, 2- to 6-septata, laevia, 30–80 × 5–7 µm, nigra vel atrobrunnea ad basim et brunnea usque ad apicem.* ***Cellulae conidiogenae*** *hologenosae (holoblasticae), uniloculosae, laeves, brunneae, 4–10 × 3–4 µm, in conidiophoris incorporatae, cum 1-3(-5) proliferationibus percurrentis doliiformibus praeditae.* ***Secedentia conidiorum*** *schizolytica.* ***Conidia*** *solitaria, dictyoseptata, polymorpha, irregularia, obovalia, obovata, globosa, lenticularia vel compressa, 16–23 × 13–18 µm, atrobrunnea vel brunnea, sed cellulis basalibus dilute brunneis, conicis truncatis, 2–5 × 2.5–5.5 µm; 1-3-protuberanciis cellularibus, globosis, mammiformibus usque ad irregularibus, 2–6 × 4 µm (globosis 3–4 µm diam.), dilute brunneis vel brunneis praedita, ex cellulis basalibus et suprabasalibus, lateraliter orientibus.* ***Teleomorphosis:*** *ignota.*

TYPUS: Brazil, Rio de Janeiro, Morro do Corcovado, on decaying twig. Coll. A.M. Stchigel and J. Guarro, 12.X.2002, (INIFAT C02/64). Holotype: HUEFS120867, Culture: IMI 390521.

Etymology: Latin, *irregularis*, referring to the irregular conidial shape.

Figs. 1-8. *Acrodictys irregularis*, from holotype (HUEFS120867). **Figs. 1, 3, 5.** Conidiophores, conidiogenous cell and conidium. **Figs. 2, 4.** Conidia showing protuberant cells. **Figs. 6-8.** Conidiophores, conidiogenous cells and conidia (SEM). Scale is indicated by bars.


10µm
1
10µm
2
10µm
10µm
6
7
10µm
3
5µm
4
10µm
5
10µm
8

Colonies on the natural substratum effuse, black. Mycelium superficial and hyphae brown. **Conidiophores** differentiated, mononematous, erect, straight or flexuous, cylindrical, 2- to 6-septate, smooth-walled, 30–80 × 5–7 µm, black to dark brown at the base and brown towards the apex. **Conidiogenous cells** hologenous, unilocal, smooth-walled, brown, 4–10 × 3–4 µm, integrated, with 1-3(-5) doliiform percurrent proliferations. **Conidial secession** schizolytic. **Conidia** solitary, dictyoseptate, irregular, polymorphic, obovate, globose, lenticular to complanate, 16–23 × 13–18 µm, dark brown to brown, truncate, 2–5 × 2.5–5.5 µm, pale brown at the conical basal cell; with 1-3 protuberant, globose, mammiform to irregular cells which arise from the basal or supra basal cells of the conidia, 2–6 × 4 µm, (globose 3–4 µm diam.).

Teleomorph: unknown

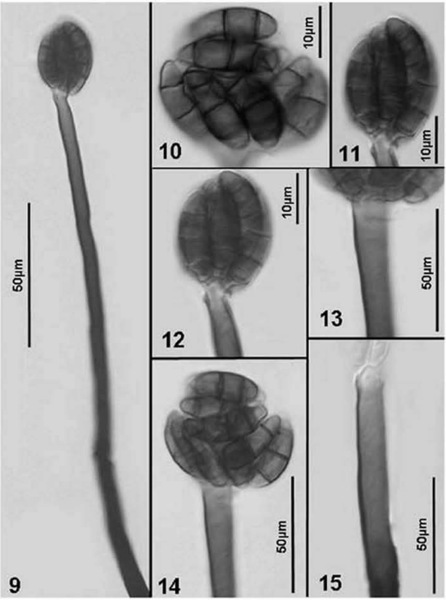
Culture from the holotype: **Colonies** on corn meal mixed 1:1 with carrot extract, attaining 17–29 cm after 10 days at 25° C, cottony, grayish brown. Reverse gray. Hyphae thick-walled, septate, brown, 1.5–2.5 µm diam., verrucose to tuberculate. **Conidiophores** macronematous, smooth, pale brown to brown, 3- to 4-septate, up to 60 µm tall, 5 µm wide. **Conidia** dictyoseptate, lenticular to complanate, obovoid, globose to irregular, brown to dark brown, with 1-2-protuberant cells pale brown, smooth-walled, 18–24× 18–29 µm.

Comments: The genus *Acrodictys* was erected by Ellis (1961) for the type species, *A. bambusicola* M.B. Ellis. This genus is distinguished by dictyoseptate, pigmented conidia formed at the apex of differentiated, mononematous, erect, brown conidiophores. The conidiogenous cells are hologenous (holoblastic), unilocal, integrated, determinate or indeterminate with several lageniform or doliiform percurrent proliferations and schizolytic conidial secession. Conidium ontogeny and conidiogenesis in *Acrodictys* were documented and discussed by Baker et al. (2002). According to the generic concept proposed by these authors, other accepted *Acrodictys* species are *A. atroapicula* C.J.K. Wang & B. Sutton (Wang & Sutton 1982) and *A. elaeidicola* M.B. Ellis (Ellis 1961). None of these species resembles *A. irregularis* in conidial morphology. *Acrodictys micheliae* Kodsueb & McKenzie (Kodsued et al. 2006) lacks doliiform or lageniform proliferations, and has enteroblastic, percurrent proliferations and cylindrical to ovoid conidia based on illustrations. This species is most closely related to the genus *Junewangia* W.A. Baker & Morgan-Jones (Baker et al. 2002).

Cacumisporium capitulatum (Corda) S. Hughes, Can. J. Bot. 36: 743. 1958

FIGS. 9-15

Colonies on natural substratum, effuse, hairy, brown to dark brown. Conidiphores macronematous, mononematous, simple, 4- to 8-septate, brown, pale towards the apex, 130–350 × 7–12 µm, smooth, with several annellations



Figs. 9-15. *Cacumisporium capitulatum*, from INIFAT C06/29. **Figs. 9-14.** Conidiogenous cells and conidia. **Fig. 15.** Details of conidiogenous cell proliferation. Scale is indicated by bars.

produced by enteroblastic, percurrent proliferation of the conidiogenous cells. Conidia accumulating in brown, somewhat mucilaginous masses, botuliform, 3-septate, pale brown in the end cells and brown to dark brown in the median cells, smooth, 17–20 × 5–7 µm.

Specimen examined: Cuba, Pinar del Río, Soroa. ex twig of unidentified plant, Coll. R.F. Castañeda, 16.II.2006, INIFAT C06/29.

Cacumisporium tropicale R.F. Castañeda, Gusmão & Stchigel, **anam. sp. nov.**

MycoBank MB490707 Figs. 16-23

Coloniae in substrato naturali effusae, pilosae, brunneae. Mycelium plerumque superficiale et partim in substrato immersum, ex hyphis septatis, ramosis, 1.5–3.0 µm, brunneis, verrucosis vel verruculosis interdum laevibus compositum. ***Conidiophora*** *macronematosa, mononematosa, usque ad 390 µm alta, 8–12 µm crassa ad basim, laevia vel verruculosa ad basim et plerumque verrucosa usque ad tuberculata ad apicem, laevia vel verruculosa ad basim, 6- ad 11-septata, ad basim brunnea, ad apicem pallidiora.* ***Cellulae conidiogenae*** *hologenosae (holoblasticae), terminales, brunneae ad dilute brunneae vel subhyalinae, verruculosae vel tuberculatae, indeterminatae, cum proliferationibus percurrentibus enteroblasticis et elongationibus holoblasticis sympodialibus.* ***Conidia*** *holoblastica, late fusiformia interdum navicularia usque ad ellipsoidea, 3-septata, leviter curvata, 12–17 × 6–8 µm, brunnea, laevia, sicca.* ***Teleomorphosis:*** *ignota.*

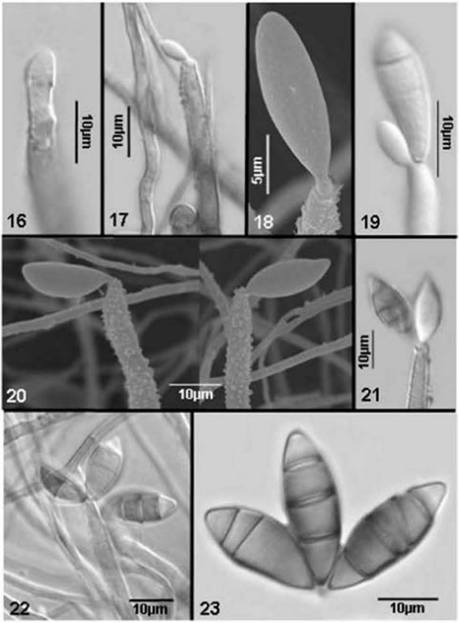
TYPUS: Brazil, Rio de Janeiro, "Morro do Corcovado", on decaying stem of unidentified *Poaceae*, Coll. A.M. Stchigel and J. Guarro, 12.X.2002, INIFAT C02/63. Holotype: HUEFS120868.

Etymology: Latin, *tropicalis*, referring to the tropical region where the specimen was collected.

Colonies on the natural substratum effuse, hairy, brown. **Mycelium** mostly superficial and partially immersed. **Hyphae** septate, branched, 1.5–3.5 µm, brown, verrucose to verruculose, sometimes smooth. **Conidiophores** macronematous, mononematous, 6- to 11-septate, erect, straight or flexuous, simple, up to 390 µm tall, 8–12 µm wide at the base, brown at the base, almost colourless or pale brown towards the apex, always verrucose to tuberculate towards the apex, smooth or verruculose at the base. **Conidiogenous cells** hologenous (holoblastic), terminal, brown, pale brown to subhyaline, verruculose to tuberculate, indeterminate with combined enteroblastic percurrent proliferations and holoblastic sympodial elongation. **Conidia** holoblastic, broad fusiform, sometimes navicular or somewhat ellipsoid, 3-septate, slightly curved, 12–17 × 6–8 µm, brown, smooth-walled, dry. Teleomorph: unknown.

Additional specimen examined: Brazil, Rio de Janeiro, "Morro do Corcovado", on decaying twig of unidentified plant, Coll. A.M. Stchigel and J. Guarro, 12.X.2002, INIFAT C02/111. Cultures deposited: CBS 111737, CBS112308, IMI 390520.

Culture from the holotype: **Colonies** on corn meal agar mixed 1:1 with carrot extract, attaining 22–27 cm after 10 days at 25° C, floccose, brown. Reverse dark brown. Hyphae thick-walled, septate, brown, 2–4.5 µm diam, verrucose to tuberculate. **Conidiophores** macronematous, verrucose to tuberculate towards the apex, verruculose at the base, brown, 3- to 9-septate, up to 132 µm tall, 5–8 µm wide. **Conidia** fusiform to navicular, (2-) 3 (-4)-septate, dark brown, smooth-walled, 15–21 × 7–9 µm.



Figs. 16-23. *Cacumisporium tropicale*, from holotype (HUEFS120868). **Figs. 16-19.** Details of conidiogenous cell proliferation and conidium ontogeny. **Fig. 20.** Conidiophore ornamentation (SEM). Conidia showing protuberant cells. **Figs 21, 22.** Successive production of conidia. **Fig. 23.** Conidia. Scale is indicated by bars.

Comments: The genus *Cacumisporium* Preuss comprises five accepted species: *C. capitulatum* (Goos 1969, Ellis & Ellis 1997), *C. sigmoideum* (Mercado & Castañeda 1987), *C. spooneri* (Kirk 1992), *C. rugosum* (Tsui et al. 2001), and *C. pleuroconidiophorum* (Castañeda et al. 2007). Two other described species, *C. tenebrosum* Preuss (Kirk 1992) and *C. curvularioides* R.F. Castañeda & W.B. Kendr. (Castañeda & Kendrick 1991), have been declared as synonyms of *C. capitulatum* and *C. pleuroconidiophorum*, respectively (Kirk 1992, Castañeda et al. 2007). *C. capitulatum* is the species most resembling *C. tropicale* but the former has botuliform, slightly curved, brown conidia and smooth-walled conidiophores, clearly differentiating it from the latter species.

Key to *Cacumisporium* species

1 Conidia smooth-walled 2
Conidia rugose, 28–35 × 14–20 µm, 3-septate, obovoidal to ellipsoidal, two central cells dark brown, end cells pale brown .... *C. rugosum*

2 (1) Conidia with some cells strongly pigmented 3
Conidia without strongly pigmented cells or all cells with almost the same pigmentation 4

3(2) Conidia 3-septate, slightly sigmoid to obturbinate curved, middle cells brown to pale brown, end cells hyaline, 18–28 × 8–9 µm .... *C. pleuroconidiophorum*
Conidia 3-septate, sigmoid to navicular, curved, 26–41 × 7–10 µm, middle cells yellow-brown to reddish brown, end cells hyaline .... *C. sigmoideum*

4 (2) Conidiophores smooth-walled 5
Conidiophores verrucose to tuberculate, conidia broad fusiform to navicular, 3-septate, 12–17 × 6–8 µm, brown .... *C. tropicale*

5(4) Conidia botuliform, 3-septate, 17–20 × 5–7 µm 14–22 × 4–6 µm, brown with paler extremes .... *C. capitulatum*
Conidia 7-septate, 26–32 × 3–5 µm, narrowly ellipsoid to somewhat fusiform, dark brown .... *C. spooneri*

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We are deeply indebted to Prof. Lori M. Carris (Washington State University) and Dr. D.W. Minter (CABI) for kindly reviewing the manuscript and for many suggestions that greatly improved it. We thank Ciencia y Tecnología para el Desarrollo (CYTED RED-XII.J) and the Cuban Ministry of Agriculture for facilities. The author RFCR thanks Drs David W. Minter, Pedro Crous, Uwe Braun, Ludmila Marvanová, Cony Decock, Jerry A. Cooper, Rosa M. Arias, Josep Guarro, Walter Gams, Antonio Hernández-Gutiérrez, Carlos Inacio and Josep Cano for their generous and valuable assistance with literature not available in our library. The author LFP Gusmão thanks the CNPq (proc. 471619/2004) for financial support.

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Re-evaluation of *Radulomyces rickii* and notes on *Radulomyces* and *Phlebiella* (*Basidiomycota*)

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Abstract—Three new collections of a corticioid fungus occurring on *Taxus* and *Juniperus* in NW Iran were compared with the type of *Radulomyces rickii*, and they appeared to be conspecific. SEM pictures of basidiospores were obtained from the type, Iranian material, and *R. confluens* and their spore measurements were compared. Both *R. confluens* and *R. rickii* have smooth and non-smooth basidiospores. An emended description of *R. rickii* is given and possible links between *Radulomyces* and *Phlebiella* with regard to their spore and basidium morphology and recent DNA studies is discussed.

Key words—Arasbaran forests, spore dimorphism, taxonomy

Introduction

In a recent mycological survey in NW Iran by the senior author (MGH), three resupinate corticioid fungi were collected from conifers. Their outer appearance, roundish spores and the presence of hyphidia first reminded us of *Globulicium* Hjortstam. However, the rather thick-walled spores and the shape of apiculus are familiar to *Radulomyces* M.P. Christ. According to literature (Christiansen 1960, Jülich & Stalpers 1980, Boidin et al. 1988) *R. rickii* has subglobose spores, 7-9 × 6-8 µm, similar to those in Iranian collections (see Table 1). Some other characters, like smooth hymenium in *R. rickii* also seemed to fit with our material. However, controversy has existed whether *R. rickii* is a species of its own or an extreme variation of *R. confluens* (Fr.) M.P. Christ. with different spores and hymenial morphology (see Eriksson et al. 1981, Hjortstam & Ryvarden 1986). When Christiansen (1960) introduced the genus *Radulomyces*, he defined *R. rickii* to have separable basidiocarps with loosening margin, characters that were not seen in Iranian material. On the other hand,

Table 1. Basidiospore sizes in *Globulicium hiemale*, *Radulomyces confluens* and *R. rickii*.*

SPECIES	L VARIATION (µm)	W VARIATION (µm)	L (µm)	W (µm)	Q	Q*
Globulicium hiemale (90/3)	**(10.0-)11.0-14.0(-15.5)**	**(9.0-)10.5-13.5(-15.5)**	**12.46**	**11.82**	**1.00-1.12(-1.17)**	**1.05**
Kotiranta 21410	(11.7-)12-14	11-13(-13.5)	12.64	11.97	1.00-1.09(-1.11)	1.06
Kotiranta 18841	(10.0-)10.7-14.0(-15.5)	(9.0-)10.5-13.0(-15.0)	12.51	11.95	1.00-1.12(-1.17)	1.05
Kotiranta 18807	(10.7-)11.0-13.5(14.0)	10.0-12.5(-14.0)	12.21	11.54	1.00-1.11(-1.15)	1.06
Radulomyces confluens (90/3)	**6.0-8.6(-9.9)**	**4.5-6.5(-7.0)**	**7.32**	**5.57**	**1.09-1.51(-1.76)**	**1.32**
Hallenberg 2010	(6.0-) 6.9-8.5(-9.9)	(4.5-) 5.0-6.5(-7.0)	7.78	5.76	1.14-1.65(-1.76)	1.36
Kotiranta 11760	6.0-8.0(-8.5)	4.8-6.1(-6.4)	7.15	5.53	1.09-1.45	1.30
Speirs SA 142	(6.0)6.4-8.0(-8.6)	4.7-6.0(-6.5)	7.02	5.43	1.16-1.40(-1.49)	1.30
Radulomyces rickii (150/5)	**(6.2-) 7.3-9.5 (-9.6)**	**(5.9-) 6.2-8.6 (-8.9)**	**7.88**	**7.18**	**0.9-1.24 (-1.29)**	**1.08**
TYPUS	(6.5-)7-8(-8.8)	(6.3-)6.6-8(-8.4)	7.5	7.2	1-1.1	1
F15109	(6.2-)6.7-8.1	(6.1-)6.4-7.2	7.1	6.7	0.9-1.1	1
Ghobad-Nejhad 472	(7.0-)7.4-9(-9.5)	6.0-8.1 (-8.9)	8.31	7.21	1.07-1.29	1.15
Ghobad-Nejhad 392	(7.3-)7.9-9.2(-9.6)	(6.2-)6.9-8.9	8.33	7.50	1.04-1.17 (-1.29)	1.11
Ghobad-Nejhad 397	(6.8-) 7.8-9.2 (-9.5)	(5.9-)6.5- 8.2 (-8.6)	8.15	7.30	(1.04-)1.07-1.17(-1.27)	1.12

* The figure in brackets following each species name represents n (see Materials and methods); for single specimens n=30/1.

Table 2. Basidium sizes in *Globulicium hiemale*, *Radulomyces confluens*, and *R. rickii*.*

Species	L variation (µm)	W variation (µm)	L (µm)	W (µm)	Q*
Globulicium hiemale (30/3)	(30-)36-56	8-15	45.90	12.12	3.81
Radulomyces confluens (30/3)	22-38	5-9	31.40	6.98	4.55
Radulomyces rickii (30/3)	(17-) 23-41	5.5-11	30.70	8.58	3.72

*The figure in brackets following each species name represents n (see Materials and methods).

Boidin et al. (1988) reported finely spinulose spores in *R. rickii* when seen in SEM, accepting it as a good species, and Larsson et al. (2004) showed that *R. rickii* is distinct from *R. confluens* in a phylogenetic nrDNA tree. However, none of these observations included the study of type material. We examined the type of *R. rickii* (selected by Hjortstam & Ryvarden 1986) and additional material. The specimens from Iran are in accordance with the type, except that they are on decorticated coniferous wood rather than on corticated angiosperm like the type.

This study confirms that *R. rickii* can be separated microscopically from *R. confluens*, since there is a slight but significant difference in spore size and form (Fig 9, Table 1) and also a small difference in basidium size (Table 2). Both species bear ornamented spores, whereas the occurrence of both smooth and ornamented basidiospores in a single specimen has been neglected. The possible link between *Radulomyces* and certain species of *Phlebiella* P. Karst., previously shown by DNA studies (Larsson et al. 2004, Binder et al. 2005), is also discussed.

Materials and methods

Specimens were studied in 5% potassium hydroxide (KOH), Melzer´s reagent (IKI) and Cotton Blue (CB). Measurements and drawings were made in CB and KOH. Drawings were made by using a drawing tube.

Thirty spores per specimen were measured (n=number of spores measured from the given number of specimens, for instance 60/2 means that 60 spores were measured from two specimens). The following abbreviations are used: L=mean length, W=mean width, Q=range of variation in L:W ratio, Q*=quotient of the mean spore length and mean spore width. The values L and W in Tables 1 and 2 represent at least 90% of the measurements. No measurements derive from spore prints.

SEM pictures were taken from herbarium material. Specimens were fixed in 3% Glutaraldehyde and OsO_4, and dehydrated with ascending series of Ethanol, followed by Critical point drying (Bal-Tec CPD 030) using CO_2. Dried specimens were coated with Platinum (Agar sputter device), and spores were photographed with Scanning electron microscope (Zeiss DSM 962).

Redescription of *Radulomyces rickii*

Radulomyces rickii (Bres.) M.P. Christ. (1960),
Dansk Bot. Ark. 19(2): 128 FIGS 5, 8.
=*Cerocorticium rickii* (Bres.) Boidin, Gilles & Hugueney (1988), Crypt. Mycol. 9(1): 45.
=*Corticium rickii* Bres. (1898), in Rick, Österr. Bot. Z. 48: 136.

Holotype: Austria, Feldkirch, ad truncos Sambuci nigrae, Oct 1897 J. Rick (F15108 in S) (studied).

Basidiocarp resupinate, orbicular, in patches, hard and ceraceous when dry, relatively thin, closely adnate, smooth, light cream-coloured with a tint of grey when young, later slightly brownish, at first turning reddish in IKI, but soon fading, turning yellow-brown in KOH; margin mostly distinct, pruinose, very fine fibrils rare (hand lens!).

Hyphal system monomitic, hyphae hyaline, clamped; subiculum thin, about 15–30 µm thick, hyphae thin-walled, 3–3.5 µm wide, gelatinized, difficult to see; subhymenial hyphae thin-walled, often inflated, slightly CB+, 2–3 µm wide, densely intricate and very difficult to discern.

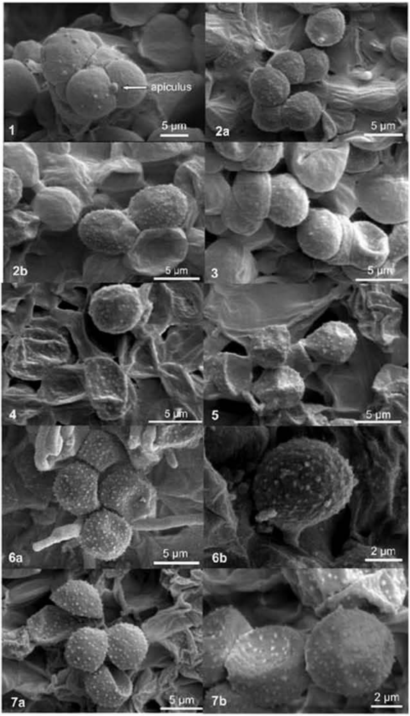
Cystidia absent.

Hyphidia (paraphysoid hyphae) sparse to fairly abundant, clamped, exceeding the hymenial surface, 20–60 × 2–2.3 µm, usually thin-walled, sometimes slightly thick-walled, often with protuberances and branches; apex obtuse, bluish in CB (contents); no crystals seen.

Basidia basally clamped, with numerous oil drops in plasma, at least at the beginning pleural, later clavate to cylindrical, sometimes slightly constricted, often stalked, (17–) 23–41 × 5.5–11 µm, L=30.7 µm, W=8.6 µm, (n=30/3), with four, at first rather prominent, later almost needle-like, only up to 5 µm long sterigmata, which fade quickly after the sporulation.

Basidiospores globose or subglobose, with oil drops, smooth or minutely warted, warts seen especially in KOH, (6.5–)7–8(–8.8) × (6.3–)6.6–8(–8.4) µm, L=7.5 µm, W=7.2 µm, Q=1-1.1, Q^*=1 (TYPE, F15108, S), (6.2–)6.7–8.1 × (6.1–) 6.4–7.2 µm, L=7.1 µm, W=6.7 µm, Q=0.9–1.1, Q^*=1 (F15109, S), thin- to slightly thick-walled, CB+, IKI-, KOH-, with a sharp apiculus and sometimes with a pointed lateral germ pore (biapiculate!).

Figs 1-7. SEM pictures of basidiospores. Fig. 1. *Globulicium hiemale* (Kotiranta 21410). Figs 2a-b. *Radulomyces confluens* (Hallenberg 2010). Fig. 3. *R. confluens* (Kotiranta 11760). Fig. 4. *R. confluens* (Speirs SA 142). Fig. 5. *Radulomyces rickii* (type). Figs 6a-b. *R. rickii* (Ghobad-Nejhad 472). Figs 7a-b. *R. rickii* (F15109).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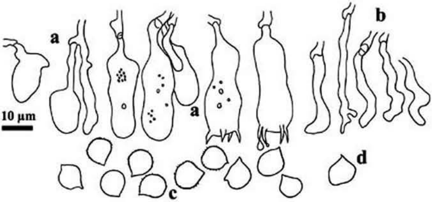

Fig. 8. *Radulomyces rickii* (type, F15108, S).
a) Basidia at different stages of development, b) hyphidia,
c) basidiospores, d) characteristically collapsed basidiospore.

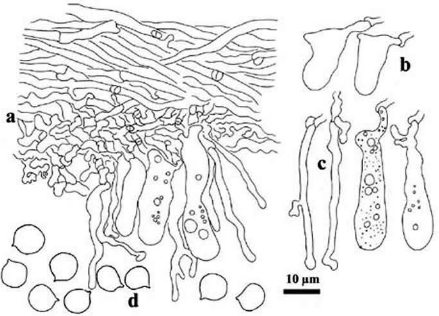

Fig. 9. *Radulomyces rickii*, Ghobad-Nejhad 472.
a) Section through basidiocarp, b) basidia, c) hyphidia, d) basidiospores.

Ecology and distribution—*R. rickii* grows on corticated or decorticated wood of both gymnosperms and angiosperms and is widely distributed but everywhere relatively rare. Bourdot & Galzin (1928) mention it from France from *Buxus, Clematis, Prunus* and *Calluna* and Boidin et al. (1988) add *Arbutus unedo, Atriplex halimus, Hortensia, Magnolia, Philadelphus, Physocarpus opulifolius* and *Sambucus nigra*. Christiansen (1960) reports it on *Pinus* in Denmark, Gorjón et al (2006) on *Arbutus unedo* in Italy, Schultheis & Tholl (2003) from Luxembourg, Cunningham (1963) on *Podocarpus totara* (gymnosperm), and *Coprosma grandifolia, Coriaria sarmentosa, Hakea saligna, Nothofagus fusca* (angiosperms) from New Zealand; and from Australia on *Acacia* and *Eucalyptus*, and Malençon (1952) on *Juniperus thurifera* in Morocco. In the United Kingdom it is known from different hardwoods as well as *Taxus* (Legon et al. 2005), and according to Hjortstam & Ryvarden (2007) *R. rickii* is known from Argentina, Brazil and Colombia as well.

All three Iranian specimens were collected in rather dry mixed deciduous forests in Arasbaran area, East Azerbaijan province in NW Iran, in forests dominated by *Acer* spp., *Carpinus betulus, Cornus mas, Lonicera* spp., and *Quercus* spp., at 1200–1350 m above sea level. The specimens were found on decorticated, dead but still hard, standing stumps of *Juniperus communis* and on an attached root of *Taxus baccata*. Herbarium material of *R. confluens* should be restudied before the comprehensive distribution area and the habitat preferences of *R. rickii* are clear.

Additional notes

The microstructure of *R. rickii* (Fig 9) shows densely intricate hyphae that are very difficult to discern, resembling the same structure seen in *Phlebiella*. Even in outer appearance, *R. rickii* (particularly when growing on decorticated coniferous wood like the Iranian specimens) greatly resembles *Aphanobasidium pseudotsugae* (Burt) Boidin & Gilles (=*Phlebiella pseudotsugae* (Burt) K.H. Larss. & Hjortstam).

Moreover, Boidin & Gilles (1989) mention very similar traits for *Aphanobasidium* aff. *canariense* (Manjón & G. Moreno) Boidin & H. Michel (=*A.* aff. *sphaerosporum* Boidin & Gilles) from Reunion — so similar that we first thought our specimens represented *Phlebiella*. Because microscopical similarities undoubtedly occur, we also studied some species of *Phlebiella* s.l.

The genus *Phlebiella* is characterized by pleural basidia and all the species are without cystidia. Otherwise it is morphologically very variable, including species with basidiospores ranging from allantoid to globose, warted to smooth, and amyloid to inamyloid. Therefore it is not surprising that *Phlebiella* has been divided into several genera or subgenera. The concept of Oberwinkler´s (1965) genus *Xenasmatella* (separated into subg. *Xenasmatella* and subg. *Amyloxenasma* Oberw.) is approximately the same as *Phlebiella*, used by Hjortstam et al. (1988). Jülich (1979) separated the genus *Aphanobasidium* for amyloid or inamyloid, smooth-spored species. *Aphanobasidium* was accepted by Boidin & Gilles (1989) but divided in subg. *Aphanobasidium* for non-amyloid species and subg. *Amyloxenasma* for amyloid ones. Hjortstam & Larsson (1987) kept *Phlebiella* in a wide sense, dividing it into three subgenera, viz. subg. *Aphanobasidium*, subg. *Amyloxenasma*, and subg. *Phlebiella* with the same delimitation of taxa as suggested by Boidin & Gilles (1989). Subg. *Amyloxenasma* was later raised to generic level (Hjortstam & Ryvarden 2005). All the above cited classifications reserve *Phlebiella* s. str. for species with soft, fibrillose basidiocarps and ornamented spores.

As had Larsson et al. (2004), Binder et al. (2005) observed that *Radulomyces* and *Phlebiella* are nested together but questioned this grouping since "other than their corticioid habit, there are no obvious characters that suggest a close relationship among *Radulomyces*, *Phlebiella* ...". Larsson later (2007) hypothesized a connection between *Aphanobasidium* and *Radulomyces* based on their affinity to pterulaceous fungi cultivated by ants. Moreover, as illustrated by Oberwinkler (1965: plate 12), young basidia of *R. confluens* can be pleural and there are also a few hyphidia. Except for the small and needle-like sterigmata, in neither *R. confluens* nor *R. rickii* (Figs 8–9) do fully grown basidia resemble those of *Phlebiella*. Oberwinkler (1965) introduced the term "podobasidia" for pleural basidia that take a clavate form when mature.

Spore dimorphism — Figs 1-7 illustrate the occurrence of both smooth and non-smooth spores in a single specimen in *Globulicium hiemale* (Laurila) Hjortstam (Fig 1), *Radulomyces confluens* (Figs 2-4), and *R. rickii* (Figs 5-7). Such spore dimorphism might have arisen from different stages of spore development. We also examined *Radulomyces molaris* (Chaillet ex Fr.) M.P. Christ. and selected specimens of smooth-spored *Phlebiella* s.l. species (see specimens examined). We could see smooth and non-smooth spores in all of them using ×2000 magnification in phase contrast microscope, or ×1000 light microscope with careful observation.

Not much can be said about the indication of the granulate spores in *Globulicium hiemale* (Fig 1). *Corticium hiemale* Laurila has been transferred to several genera including *Aleurodiscus* J. Schröt., *Cerocorticium* Henn. and *Radulomyces*. However, recent phylogenetic studies (Larsson et al. 2006, Larsson 2007) reveal that *G. hiemale* nests neither in *Radulomyces* nor *Aleurodiscus*, but falls rather in a subclade of the *Rickenella* clade within *Hymenochaetales*.

In the type material of *R. rickii* relatively many spores are biapiculate (see Fig 8). We do not know whether this is normal (not seen in the Iranian material) or only some kind of anomaly. Boidin et al. (2004) described *Aphanobasidium*

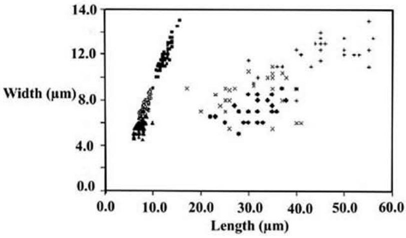

Fig. 10. Spore and basidium sizes of *Globulicium hiemale*, *Radulomyces confluens* and *Radulomyces rickii*. Each symbol represents a single spore (left) or basidium (right). Spore symbols: *G. hiemale* (▪), *R. confluens* (▲), *R. rickii* (Δ). Basidium symbols: *G. hiemale* (+), *R. rickii* (×), *R. confluens* (●).

biapiculatum Boidin & Gilles when they encountered such spores in specimens from Réunion

The morphological links between *Radulomyces* and *Aphanobasidium* (*Phlebiella*) can be found in spore ornamentation, pleural basidia, at least when young, small sterigmata and intricate hyphal structure.

Specimens examined—*Amyloxenasma grisellum*. **Finland.** Uusimaa: Helsinki, decorticated fallen log of *Populus tremula* or *Salix caprea*, 03.V.1992 Saarenoksa 00792 (H).

Aphanobasidium pseudotsugae. **Finland.** Uusimaa: Tammisaari, Gullö, Edesbacka, poor *Pinus sylvestris* dominated bog, on small corticated *Pinus*, 27.IX.2001 Kotiranta 18886 & Saarenoksa (H.K.), and Kotiranta 18880 & Saarenoksa (H); Uusimaa: Inkoo, on conifer timber, 25.V.1989 Kotiranta 7321 (H). **Russia.** Sverdlovsk region, on corticated *Picea*, N61°29′: E59°38′, alt. 490m, 12.VIII.2005 Kotiranta 20914 (H).

Globulicium hiemale. **Finland.** Etelä-Häme: Padasjoki, Vesijako Strict Nat. Res., *Picea* twig at 1.8m high, 13.IX.2001 Kotiranta 18807 (H); Varsinais-Suomi: Tammisaari, Tenhola, Lökudden Nat. Res., decorticated *Thuja* branch, 11.X.2006 Kotiranta 21410 & Saarenoksa (H); Uusimaa: Tammisaari, Gullö, Edesbacka, dead *Picea abies* branches at 1.8 m height, 27.IX.2001 Kotiranta 18841 & Saarenoksa (H).

Radulomyces confluens. **Iran.** Golestan: Golestan National Park, fallen log of *Quercus*, 26.IV.–8.V.1978 Hallenberg 2010 (GB). **Russia.** Sverdlovsk obl., Ekaterinburg, Biol. Sta., dead *Prunus* in thicket, 16.IX.1994, Kotiranta 11760 (H). **Canada.** Ontario, Ottawa, Falowfield, *Acer saccharum*, 5.X.1954 Speirs SA 142 (H).

Radulomyces molaris. **England.** Richmond, fallen branch of *Quercus robur*, 13.IX.1992 Niemelä 5599 (H). **Iran.** East Azerbaijan: Jolfa, Missan village, fallen branch of *Acer monspessulanum*, N38°86′: E46°44′, alt. 820m, 29.IX.2006 Ghobad-Nejhad 302 and Vaighan village Ghobad-Nejhad 404 (H, MGH ref. herb). **Yugoslavia.** Zagreb, Žumberačko, on *Quercus cerris*, 7.VII.1974 M. & S. Tortić 37-74 (H).

Radulomyces rickii (see type) and **Austria.** Feldkirch, ad corticem Sambuci nigrae, Nov. 1897 J. Rick (F15109 in S), and ad ramos Pruni spinosae, (F15110 in S). **Iran.** East Azerbaijan: W Kaleibar, 15 km from Asheqloo, Vaighan village, dead attached root of *Juniperus communis*, N38°52′40″: E 46°49′30″ alt. 1350m, 2.X.2006 Ghobad-Nejhad 392 and 397 & Sohrabi (H, MGH ref. herb.); Kaleibar, 4 km from the road of Khoda-afarin to Jolfa, Kalale village, N38°56′12″: E46°45′52″, alt. 1200 m, dead standing stump of *Taxus baccata*, 6.X.2006 Ghobad-Nejhad 472 & Sohrabi (H, MGH ref. herb).

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Postia japonica (*Basidiomycota*), a new polypore from Japan

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Abstract — A new polypore, *Postia japonica*, collected from Japan, is described and illustrated. The new species grows mostly on *Castanopsis cuspidata*, and has imbricate basidiocarps. Microscopically it has monomitic contextual hyphae but dimitic tramal hyphae. Its skeletal hyphae are weakly dextrinoid, and its inner hyphal walls become swollen in KOH. Its basidiospores are ellipsoid tapering toward apiculus. Cultural characters of the species are given according to the present study, and this fungus probably causes a brown rot.

Key words — *Polyporaceae*, taxonomy, wood-rotting fungi

Introduction

Postia Fr. is a cosmopolitan genus causing a brown rot on both angiosperms and gymnosperms, and around 40 species have been found so far (Gilbertson & Ryvarden 1987, Ryvarden & Gilbertson 1994, Núñez & Ryvarden 2001, Bernicchia 2005, Niemelä 2005, Wei & Dai 2006, Rajchenberg 2006). The genus is characterized by mostly light coloured basidiocarps with clamped generative hyphae; its hyphal structure is mostly monomitic, but some species have skeletals in trama; its basidiospores are hyaline, thin-walled, negative in both Melzer's reagent and Cotton Blue. *Postia* is similar to *Tyromyces* P. Karst., which, however, causes a white rot.

A huge basidiocarp growing on living *Castanopsis cuspidata* ('oat chestnut') trees was found in central Japan during November of 2006. Microscopic and cultural studies showed it to represent an unnamed species of *Postia*. Several specimens of the same fungus had been previously collected on the oat chestnut from other parts of Japan; we describe them here as a new species. Specimens are deposited at the herbarium of Forestry and Forest Products Research Institute, Japan (TFM), and the herbarium of the Institute of Applied Ecology, the Chinese Academy of Sciences (IFP). In the text the following abbreviations are used: IKI = Melzer's reagent, KOH = 5% potassium hydroxide, CB = Cotton Blue, CB– = acyanophilous, IKI– = both inamyloid and indextrinoid. L = mean spore length (arithmetical average of all spores), W = mean spore width (arithmetical average of all spores), Q = extreme values of the length/width ratios among the studied specimens, and n = the number of spores measured from given number of specimens. Sections were studied at magnifications up to ×1000 using a Nikon Eclipse E600 microscope and phase contrast illumination. Drawings were made with the aid of a drawing tube. Special color terms follow Rayner (1970) and Petersen (1996).

Cultural characters of the new species were studied on PDA plates at 25 °C and described according to Nobles (1965). Extracellular oxidase reactions were tested with 1-naphthol ethanol solution and tyrosine ethanol suspention according to Käärik (1965).

Descriptions

Postia japonica **Y.C. Dai & T. Hatt., sp. nov.** **Fig. 1**

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Carpophorum annuum, pileatum, imbricatum; facies pororum cremea; pori rotundi, 2–3 per mm. Systema hypharum monomiticum contexti, dimitic tramae, hyphae generatoriae fibulatae, hyphae contexti 3–9 μm in diam. Sporae ellipsoideae, IKI–, CB–, 4.5–5.5 × 3–3.5 μm.

Type — Japan. Ibaraki Pref., Kasama, Sashiro Forest Park, on base of living tree of *Castanopsis cuspidata*, 25.XI.2006 *Dai 8046 & Hattori* (holotype in IFP, isotypes in TFM, H).

Etymology. — *Japonicus* (Latin), referring to Japan, the country of origin.

Fruitbody. — Basidiocarps annual, imbricate, always forming cluster, fleshy-corky when fresh, becoming hard corky upon drying. Pileus semicircular to flabelliform, projecting up to 5 cm, 8 cm wide and 1.3 cm thick, thinning out toward margin. Pileal surface pale grayish cream to pale ochraceous, colour almost unchanged when dry, indistinctly concentrically zonate, velutinate when juvenile, becoming rough with age, radially wrinkled upon drying; margin acute, wavy, becoming blackish upon drying. Pore surface white to cream, often with droplets of amber liquid, becoming grayish cream when bruised or dry; pores mostly round, sometimes irregular, 2–3 per mm; dissepiments thin, entire to lacerate. Context white to cream, hard corky upon drying, up to 0.5 cm thick at base. Tubes concolorous with pore surface, corky, up to 0.8 cm long.

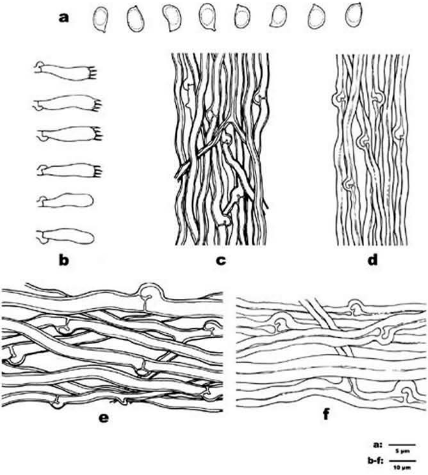

Fig. 1. Microscopic structures of *Postia japonica* (drawn from the holotype). —a: Basidiospores. —b: Basidia and basidioles. —c: Hyphae from trama in CB. —d: Hyphae from trama in KOH. —e: Hyphae from context in CB. —f: Hyphae from context in KOH.

Hyphal structure. — Hyphal system dimitic; generative hyphae bearing clamp connections; skeletal hyphae present in the trama only, thick-walled, weakly dextrinoid, CB–; inner wall of all hyphae becoming swollen in KOH.

Context. — Generative hyphae hyaline, thick-walled with a wide lumen, occasionally branched, more or less regularly arranged, some collapsed, 3–9 µm in diam.

Tubes. —Generative hyphae hyaline, thin- to thick-walled with a wide lumen, occasionally branched, subparallel along the tubes, 3–5 µm in diam; skeletal hyphae thick-walled with a wide lumen, softening in KOH, occasionally branched, subparallel along the tubes, some collapsed, 2–5 µm in diam. Gloeoplerous hyphae occasionally present, almost same thickness as skeletals. Cystidia and cystidioles absent. Basidia clavate, with four sterigmata and a basal clamp connection, 22–25 × 5–6 µm; basidioles in shape similar to basidia, but slightly smaller.

Spores. —Basidiospores ellipsoid tapering toward apiculus, hyaline, thin-walled, smooth, usually bearing a big guttule, IKI–, CB–, (4.1–)4.5–5.5(–6) × (2.8–)3–3.5(–4) µm, L = 5.06 µm, W = 3.14 µm, Q = 1.58–1.65 (n = 150/5).

Additional specimens (paratypes) examined. — Japan. Kyoto Pref., Kiyomizu, living tree of *Castanopsis cuspidata*, 29.XI.1998 Hattori (TFM F-19255, IFP); 21.XI.1999 Hattori (TFM F-19345, IFP); 29.X.2000 Hattori (TFM F-19674, IFP). Nara Pref., Mt. Kasugayama, living tree of *Castanopsis cuspidata*, 25.XI.2002 Maruyama (TFM F-20443, IFP).

Cultural characters. — Growth moderate in speed, plates covered in 2–3 weeks. Advancing zone even, appressed, some mycelia submerged in the agar, white. Mat white, aerial mycelium woolly. Reverse unchanged. Odour none. Hymenophore development not seen within 6 weeks. Generative hyphae from aerial mycelium and submerged mycelium thin- to slightly thick-walled, moderately branched, hyaline, 2.5–8 µm in diam., bearing clamp connections, occasionally swelled at the tip. Chlamydospores scattered, 14–20 × 7–12 µm.

Extracellular peroxidase activities: 1-naphthol, –; tyrosine, –. So the species most probably causes a brown rot.

Species code. — 1. 3. (7.) 26. 34. 36. 38. 42–43. 54. (Nobles 1965).

Cultures examined. — WD-2338, isolated from tissue of the basidiocarp of the holotype; WD-2103, isolated from tissue of the basidiocarp of TFM F-19345 (stored in MAFF-Genebank and culture bank of FFPRI).

The new species is characterized by imbricate basidiocarps, tough context, monomitic contextual hyphae, dimitic tramal hyphae, dextrinoid skeletals, and ellipsoid basidiospores tapering toward apiculus. In addition, the inner walls of hyphae become swollen in KOH, and it grows mostly on living tree of *Castanopsis cuspidata*. *Postia japonica* resembles *Tyromyces* and *Climacocystis* Kotl. & Pouzar, too, but the latter two genera cause a white rot. Cultural study shows the new species most probably causes a brown rot, so it is a typical species in *Postia*. *Ryvardenia* Rajchenb. also causes a brown rot but differs from *Postia* in producing thick-walled basidiospores.

Postia japonica resembles *Tyromyces galactinus* (Berk.) J. Lowe in producing imbricate basidiocarps. The latter occurs in Japan and China and has a similar ecology as *Postia japonica*. However, *Tyromyces galactinus* has both smaller pores (5–7 per mm) and basidiospores (3.2–3.8 × 2.7–3 µm); its hyphal structure is consistently monomitic, and its hyphae are negative in Melzer's reagent and KOH.

Climacocystis borealis (Fr.) Kotl. & Pouzar has imbricate basidiocarps, and its hyphal structure and basidiospores also resemble those in *Postia japonica*. But *C. borealis* has larger pores (1–2 per mm), plenty of thick-walled and amyloid cystidia, and it mostly grows on coniferous trees in boreal forests.

Ryvardenia cretacea (Lloyd) Rajchenb. shares a similar consistency and hyphal structure with *Postia japonica*, but *R. cretacea* produces a solitary basidiocarp with larger (6–7.5 × 4.5–6 µm; Rajchenberg 1994) thick-walled basidiospores. In addition, it was found on *Nothofagus cunninghamii* from Tasmania, Australia.

Ryvardenia campyla (Berk.) Rajchenb. is similar to *Postia japonica* by sharing imbricate basidiocarps and ellipsoid basidiospores, but the former has a ferruginous upper surface and sclerified basidioles, and its basidiospores thick-walled and bigger (5–7 × 4–5 µm; Rajchenberg 1994).

Postia punctata Rajchenb. & P.K. Buchanan, described from South America and Australia (Rajchenberg & Buchanan 1996), and shares imbricate basidiocarps and ellipsoid basidiospores with *P. japonica*. However, *P. punctata* has resinous spots on its pileal surface and resinous seams in the context; in addition, it has a consistently monomitic hyphal structure, and its basidiospores (5–6.5 × 3–3.5 µm; Rajchenberg & Buchanan 1996) are longer than in *P. japonica*.

Other specimens examined. — *Climacocystis borealis*. China. Jilin Prov., Antu County, Changbaishan Nature Reserve, stump of *Pinus*, 19.IX.2002 *Dai 3813 (IFP)*. Sweden. Uppland Prov., Vänge, Fiby urskog, stump of *Picea*, 25.XI.1994 *Dai 1920 & Niemelä* (IFP). *Tyromyces galactinus*. China. Jiangsu Prov., Nanjing, Zijinshan Park, stump of *Pinus*, 3.VI.2005 *Dai 6575 & 6580* (IFP).

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Fusarium kyushuense, a newly recorded species from China

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Abstract — *Fusarium kyushuense* was isolated from rice seeds collected in Fuquan City, Guizhou Province, China. The recovered isolates produce carmine pigments on PDA, microconidia on polyphialides in the aerial mycelia in a continuous range of shape and size. Chlamydospores were not observed. ITS ribosomal DNA and partial β-tubulin gene sequences are consistent with the morphological identification. This is the first record of this species from China.

Key words —*Oryza sativa*, phylogeny, taxonomy, trichothecenes

Introduction

The possible contamination of grain and feed by mycotoxins produced by *Fusarium* species necessitates the correct identification of these fungi. During 2005–2006 we investigated and identified *Fusarium* species on cereals in China. Included among these isolates was one strain that produced few-septate aerial conidia resembling *F. sporotrichioides* and *F. chlamydosporum* in morphology. This strain was identified as *F. kyushuense* based on the shape of the microconidia produced by polyphialides in the aerial mycelia and the absence of chlamydospores. This record is the first of *F. kyushuense* in China as well as the first report of the species outside Japan.

Materials and methods

Morphological identification

Rice seeds collected in Guizhou province, China were surface sterilized in 3–5 % NaOCl for 3–5 min, then placed on PSA (potato sucrose agar) plates and incubated at 25 °C for 4 days as described by Nelson et al. (1983). *Fusarium* colonies were subcultured on SNA (synthetischer nährstoffarmer agar, Leslie & Summerell 2006) and a single-spore isolate was grown on PSA in the dark at 25 °C for the description of growth rate and colony characters. Cultures on SNA were incubated under a 12 hr light period of black light/fluorescent light at 25/20 °C (day/night) to stimulate the production of sporodochia (Booth 1971, Nelson et al. 1983), and for the production of chlamydospores on SA (soil agar) at 25 °C (Klotz et al. 1988, Leslie & Summerell 2006).

Molecular identification

DNA extraction, PCR amplification and nucleotide sequencing: Mycelium was grown in GYM (glucose yeast medium) and DNA was extracted by using the modified method of Cenis (1992) and Lu et al. (2004) and stored and prepared as described by Lu et al. (2004). PCR amplification and sequencing of the ITS region were performed by using primers ITS1 and ITS4 (White et al. 1990). The β-tubulin gene was amplified and sequenced by using primers T1 and T22 (O' Donnell & Cigelnik 1997). The PCR for both primer sets was performed as described by Geiser et al. (2001, 2005). The sequence reactions employed an Applied Biosystems Prism BigDye terminator v3.1 kit, were analyzed on an Applied ABI PRISM 3730 DNA Sequencer (Sangon, Shanghai, China), and edited with DNAStar. The 505 bp ITS and 1254 bp β-tubulin sequences have been deposited in GenBank under the accession numbers EF487532 and EF487533.

DNA sequences and phylogenetic analysis: Similar ITS sequences of related *Fusarium* species were downloaded from GenBank following a BLAST search. The accession numbers of the similar β-tubulin sequences and several ITS sequences were chosen according to Yli-Mattila et al. (2004), and these sequences were obtained from GenBank as well. The sequences were automatically aligned with related data from GenBank by using Clustal X (1.81). Sequence alignments were adjusted and analyzed with MEGA3.1. Phylogenetic analyses of the sequences were performed using Neighbor-Joining with 1000 bootstrap replications (64238 random seed). *F. avenaceum* (ITS sequence accession numbers AF009186 and AY618233, β-tubulin sequences accession numbers AF405447 and AF405454) were used as the outgroup.

Results

Fusarium kyushuense O'Donnell & T. Aoki, Mycoscience 39: 2, 1998.

(Figs. 1-2)

Morphological characteristics — On PSA colonies growing very fast, reaching 70 (65–73) mm diam after 4 days in the dark at 25 °C. Aerial mycelium

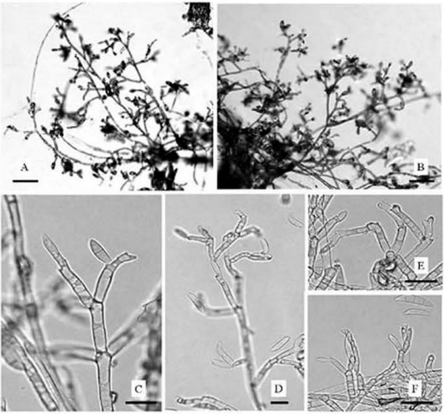

Fig. 1. Morphological characters of *Fusarium kyushuense*
A–B: Conidiophores photographed in situ, bar = 30 µm.
C–F: Conidiophores and conidiogenous cells with conidia, bar = 10 µm.

floccose, initially white-to-rose, then becoming carmine or red. Pigmentation in reverse was reddish-brown or blood-color. Microconidia in the aerial mycelia produced by polyphialides giving the colony a powdery appearance. Sporodochia on SNA orange. Monophialides and polyphialides produced on irregularly or verticillately branched conidiophores on developing aerial mycelia; polyphialides abundant. Conidiophores were densely branched. Conidiogenous cells predominantly polyphialides with 2–7 loci (even more), producing only single conidia from each locus (i.e. polyblastic). Conidiogenous cells on sporodochia monophialides. Macroconidia on sporodochia falcate, apical cells curved and acute, with distinct or indistinct basal foot cells. Sporodochial macroconidia 3–5-septate, 3-septate: 25–40 × 3.3–5 µm; 4-septate: 35–45 × 3.5–4.8 µm; 5-septate: 35–47 × 3.8–5 µm. Aerial conidia abundant, straight or slightly curved, variable in shapes and sizes, clavate, often in a continuous

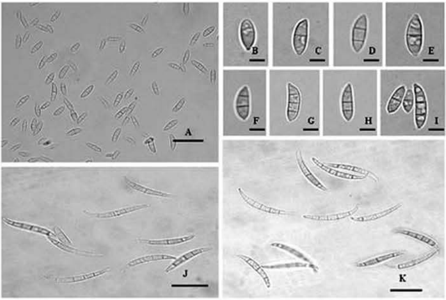

Fig. 2. Conidia of *Fusarium kyushuense*
A: Aerial conidia, bar = 20 µm. B–I: Aerial conidia, bar = 5 µm.
J–K: Sporodochial macroconidia, bar = 20 µm.

range of size and shape with acute apical cells and apedicellate basal cells, but never globose or pyriform, 0–3-septate, 0-septate: 7.5–12 × 2.5–4.5 µm (av. 9 × 3.5 µm); 1-septate: 8–17.5 × 3–4.8 µm (av. 14 × 4.1 µm); 2-septate: 12.5–20 × 3.5–5 µm (av. 15.7 × 4.2 µm); 3-septate: 15–22.5 × 3.5–5 µm (av. 18.2 × 4.1 µm). Chlamydospores absent.

Specimen examined: *isolated from Oryza sativa L. seed, Fuquan City, Guizhou, China, IBE000002. The living culture is deposited in CBS (CBS 121807) and Institute of Bio-Resources and Environment, Dalian Nationalities University, Dalian City, China.*

Phylogenetic analysis: The ITS (ca 440 bp) and partial β-tubulin sequences (ca 210 bp) were used for phylogenetic analyses. Neighbor-Joining analysis of the ITS sequences (seed = 64238) was performed with MEGA3.1. The Neighbor-Joining tree places strain IBE000002 and five previously described Japanese strains (NRRL 3509, NRRL 6490, NRRL 6491, NRRL 25348, and BBA 70812) of *F. kyushuense* in a single monophyletic clade with 100% bootstrap value support. A Neighbor-Joining analysis of the ca 210 bp β-tubulin sequence also resolved a monophyletic clade with 98% bootstrap support. The alignment shows that there is only one base different between the β-tubulin sequences of Chinese strain IBE000002 and two Japanese strains, BBA70812 and BBA70813 (GenBank accession numbers AF404181 and AF404182).

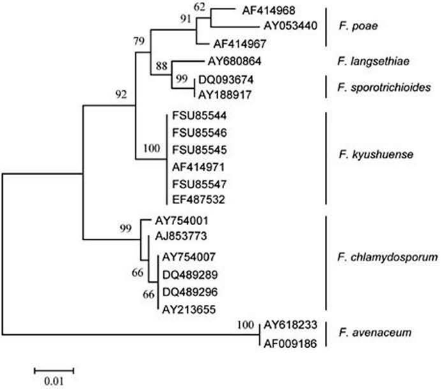

Fig. 3. **Majority rule strict consensus Neighbor-Joining bootstrapped tree for ITS sequences.** Bootstrap values > 50% indicated above the nodes (1000 replicates, seed = 64238). FSU85544, FSU85545, FSU85546, FSU85547 and AF414971 represent Japanese strains of *F. kyushuense*. EF487532 was isolated from China. *F. avenaceum* sequences AY618233 and AF009186 form the outgroup.

Discussion

This is the first report of *F. kyushuense* in China. Aoki & O'Donnell (1998) originally described *F. kyushuense* with Japanese strains previously misidentified as *F. nivale*, *F. tricinctum* and *F. sporotrichioides*. This species is unique in that it produces polyphialides and dry heads of conidia in the aerial mycelia.

Initially, *F. kyushuense* can easily be confused with *F. sporotrichioides* (Gerlach & Nirenberg 1982) for the colony morphology and the production of polyphialides with fusoid microconidia, but *F. kyushuense* is distinguished from *F. sporotrichioides* by the absence of napiform microconidia and

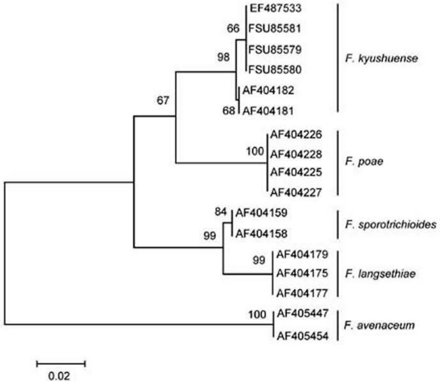

Fig. 4. Majority rule strict consensus Neighbor-Joining bootstrapped tree for partial β-tubulin sequences. The Chinese strain IBE000002 of *F. kyushuense* (# EF487533) clusters with Japanese strains (GenBank accession # FSU85579, # FSU85580, # FSU85581, # AF404181, and # AF404182, 1000 replicates, seed = 64238). *F. avenaceum* sequences AF405447 and AF405454 form the outgroup.

chlamydospores. *F. kyushuense* is differentiated from *F. chlamydosporum* (Wollenweber & Reinking 1935) by the absence of chlamydospores and the production of conidia of continuous sizes and shapes with 0-3 septate. *F. kyushuense* is similar to *F. arthrosporioides* (Wollenweber & Reinking 1935) in the production of conidia of continuous shapes and sizes and the absence of chlamydospores. But according to Nelson et al. (1983), there are no obvious polyphialides produced by *F. arthrosporioides*. And the slender macroconidia produced by *F. arthrosporioides* are distinctive from those of *F. kyushuense*.

The DNA sequence analysis clearly separates *F. kyushuense* from *F. sporotrichioides* and *F. chlamydosporum*. Although *F. kyushuense* and *F. poae* are closely related phylogenetically (Yli-Mattila et al. 2004, Knutsen et al. 2004), morphological characters alone suffice to distinguish these species.

F. kyushuense was reported to be able to produce trichothecenes and to be closely associated with cereal grains (Aoki & O'Donnell 1998). Since its description in 1998, *F. kyushuense* has not been widely reported and it was thought that its distribution might be restricted to Japan. Our identification of this fungus from outside of Japan suggests that *F. kyushuense* may exist elsewhere and that it may occur on a broad range of cereals at least throughout East Asia.

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Foliose genera of *Physciaceae* (lichenized *Ascomycota*) of South Korea

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Abstract — This is the first comprehensive report of foliose genera of *Physciaceae* from Korea. Of the approximately 250 specimens of these lichens deposited in KoLRI, Korea, examined morphologically, 26 species in 5 genera were identified. Three species are new to Korea: *Phaeophyscia hispidula*, *Pyxine consocians*, and *Pyxine copelandii*. A key to all species in South Korea is followed by brief diagnoses or descriptions of all species now recorded for the country.

Keywords — chemistry, flora, morphology, new record, taxonomy

Introduction

Foliose genera of *Physciaceae* are represented by *Physcia* (s. lat.) and *Pyxine*. Although the concept of *Pyxine* has remained somewhat stable since the original description by Fries (1825), that of *Physcia* s. lat. has been variously treated by different lichenologists. Because Poelt's (1965) classification of the *Physciaceae* has been regarded as the most stable in recent years, we follow his taxonomic system in accepting the genera *Physcia*, *Pyxine* (Fries 1825), *Hyperphyscia* (Müller 1894), *Dirinaria* (Clementi 1909), *Physconia* (Poelt 1965), and *Phaeophyscia* (Moberg 1977) within the family. Esslinger (1986) suggested transferring *Phaeophyscia* species with pale white lower surfaces to a new genus (*Physciella*). As most lichenologists still do not accept the new genus, we do not recognize *Physciella* in this paper.

Previously only a limited number of foliose genera of *Physciaceae* have been reported for South Korea (Park 1990, Moon 1999, Kashiwadini et al. 2002, Hur et al. 2005), most in flora works. The current report on foliose lichens in

Physciaceae is a result of the taxonomic study of approximately 250 specimens collected in South Korea from 2003 to 2006. All specimens are now deposited in Korean Lichen Research Institute (KoLRI).

Key to foliose species (*Physiaceae)*

1. Upper cortex K+ yellow, atranorin present 2
1. Upper cortex K-, atranorin absent 10

2. Apothecia sub-lecanorine type, algae absent in exciple when mature 3
2. Apothecia lecanorine type, algae present in exciple 7

3. Soredia and isidia absent .... ***Pyxine limbulata***
3. Soredia or isidia present 4

4. Soredia present 5
4. Isidia present 6

5. Soredia laminal, hemispherical .... ***Pyxine copelandii***
5. Soredia marginal, capitate .... ***Pyxine sorediata***

6. Isidia coralloid; medulla white to pale yellow .... ***Pyxine consocians***
6. Isidia granular to fingerlike; medulla yellow .... ***Pyxine endochrysina***

7. Rhizines absent .... ***Dirinaria applanata***
7. Rhizines present 8

8. Soredia absent .... ***Physcia stellaris***
8. Soredia present 9

9. Soralia most laminal, some marginal .... ***Physcia caesia***
9. Soralia marginal .... ***Physcia orientalis***

10. Ascospores *Physconia* type, with uniform cell wall 11
10. Ascospores *Physcia* or *Pachysporaria* type, with non-uniform cell wall 2

11. Soralia marginal and lateral, linear .... ***Physconia detersa***
11. Isidia marginal and laminal, granular .... ***Physconia grumosa***

12. Lower surface very pale brown to almost white 13
12. Lower surface dark brown to black 14

13. Soredia, isidia, and lobules absent .... ***Phaeophyscia denigrata***
13. Soralia laminal, crater-shaped .... ***Phaeophyscia melanchra***

14. Rhizines squarrosely branched .... ***Phaeophyscia squarrosa***
14. Rhizines simple 15

15. Medulla white 16
15. Medulla orange red 24

16. Soredia, isidia, and lobules absent 17
16. Soredia, isidia or lobules present 18

17. Cortical hairs marginal .... ***Phaeophyscia hirtella***
17. Cortical hairs absent .... ***Phaeophyscia hirtuosa***

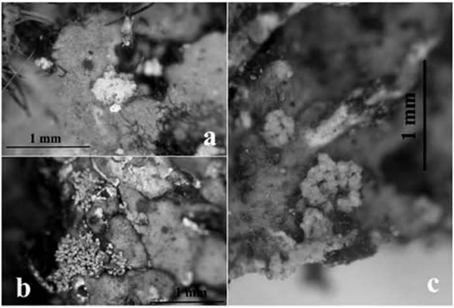

Plate I. New records to South Korea. **a.** *Phaeophyscia hispidula* (Hur 030164), showing the near terminal capitate soralia. **b.** *Pyxine consocians* (Hur 040935), showing the coralloid isidia. **c.** *Pyxine copelandii* (Hur 050563), showing the laminal hemispherical soralia and granular soredia.
a, b, c: scale bar = 1 mm.

18. Soredia or isidia present 19
18. Lobules present 23

19. Soredia present 20
19. Isidia laminal and marginal, granular, black .... ***Phaeophyscia sciastra***

20. Soralia subterminal, spherical to capitate .... ***Phaeophyscia hispidula***
20. Soralia marginal or submarginal 21

21. Soralia submarginal .... ***Phaeophyscia limbata***
21. Soralia marginal 22

22. Soredia granular, never spreading to upper surface.......... ***Phaeophyscia adiastola***
22. Soredia granular, spreading to upper surface, mixed with lobules .... ***Phaeophyscia exornatula***

23. Lobules erect; zeorin present .... ***Phaeophyscia imbricata***
23. Lobules procumbent; zeorin absen .... ***Phaeophyscia trichophora***

24. Ascospores only *Pachysporaria* type .... ***Phaeophyscia endococcinodes***
24. Ascospores *Physcia* and *Pachysporaria* type 25

25. White hairs present on exciple .... ***Phaeophyscia erythrocardia***
25. Black rhizines present at the base of exciple ....***Phaeophyscia pyrrhophora***

Dirinaria applanata (Fée) D.D. Awasthi, in Awasthi & Agarwal,
J. Indian Bot. Soc. 49: 135, 1970

Remarks: *D. applanata* is characterized by the spherical to capitate soralia that grow on the lobe ridges. It resembles *D. picta* (Sw.) Schaer. ex Clem., which differs in having small, dot-shaped laminal soralia.

Selected specimens examined: Mt. Jangheung Cheongwan: N34°32'39.8", E126°56'51.5", on *Pinus*, Hur 050536, 7 Oct. 2005. Jejudo: N33°27'15.4", E126°33'41.1", alt. 370 m, on bark, Hur 040851, 040854, 29 Aug. 2004. Bokildo: N34°8'8.9", E126°30'23.5", alt. 5 m, on rock, Hur 041637, 30 Dec. 2004. Byeon Sanbando, Naesosa: N35°36'50.3", E126°35'22.6", alt. 20 (6) m, on bark, Hur 040164-1, 13 Mar. 2004. Mt. Chiri: on wood, Hur 030028, 22 May 2003. Mt. Dooryun: on bark, Hur 030107, 4 Apr. 2003. Mt. Jogae: N34°59'27.9", E127°20'1.8", alt. 235 m, on bark, Hur 040013, 31 Jan. 2004.

Phaeophyscia adiastola (Essl.) Essl., Mycotaxon, 7 (2): 293, 1978

Remarks: *P. adiastola* is characterized by marginal, granular soredia that never extend to the upper surface. It is similar to *P. orbicularis* (Neck.) Moberg, differentiated by finer, orbicular soralia.

Selected specimens examined: Jejudo: N33°27'15.4" E126°33'41.1", alt. 370 m, on bark, Hur 040860, 29 Aug. 2004. Mt. Gyeryongs: N36°21'47.4" E127°13'30.8", alt. 440 m, on *Quercus*, Hur 041617, 23 Oct. 2004. Mt. Gaya: N35°48'36.9" E128°8'20.9", alt. 746 m, on rock, Hur 060105, 5 May 2006. Mt. Sorak: N38°10'23.2" E128°18'17.6", alt. 355 m, on rock, Hur 050230, 16 Jun. 2005. Mt. Baewoon: N35°36'16.9" E127°38'26.9", alt. 893 m, on rock, Hur 060582, 17 Aug. 2006.

Phaeophyscia denigrata (Hue) Moberg, Acta Bot. Fennica 150: 124, 1994

Remarks: *P. denigrata* is characterized by grayish white to pale brown lower surface, and absence of soredia, isidia, and lobules. Hur et al. (2005) recorded the species in Korea first as *Physciella denigrata* (Hue) Essl. following Esslinger (1986), who transferred *Phaeophyscia* species with pale white lower surfaces to *Physciella,* a genus still not accepted by most lichenologists. In this paper, we follow Poelt (1965) and maintain it in *Phaeophyscia.*

Specimen examined: Mt. Naejang: N35°48'11.2" E129°18'47.3", on bark, Hur 030457, 29 June 2003.

Phaeophyscia endococcinodes (Poelt) Essl., Mycotaxon, 7 (2): 301, 1978

Remarks: *P. endococcinodes* has a red medulla, *Pachysporaria*-type ascospores, and no zeorin. It is similar to *P. endococcina* (Körb.) Moberg, but differs in that the latter has *Physcia*-type ascospores and zeorin.

Selected specimens examined: Mt. Chiri: N35°19'7.7" E127°39'47.2", alt. 1515 m, on bark, Hur 040322, 23 Apr. 2004. Mt. Gaya: N35°48'45.7" E128°6'57.8", alt. 1040 m, on bark, Hur 040203, 15 Apr. 2004. Mt. Baegwoon: N35°4'9.6" E127°39'24.4", alt. 985 m, on bark, Hur 041290, 25 Sept. 2004. Jejudo: N33°22'42.8" E126°35'57.9", alt. 965 m, on bark, Hur 040768, 28 Aug. 2004.

Phaeophyscia erythrocardia (Tuck.) Essl., Mycotaxon, 7 (2): 302, 1978

Remarks: *P. erythrocardia* is characterized by a yellow medulla, a slightly maculate upper surface, presence of both *Pachysporaria*- and *Physcia*-type ascospores, and absence of zeorin. It resembles *P. endococcinodes*, which, however, is corticolous and possesses only *Physcia*-type ascospores.

Selected specimens examined: Mt. Chiri: N35°17'37.4" E127°32'58.4", alt. 1410 m, on *Quercus*, Hur 060235, 17 Jun. 2006. Jejudo: N33°23'18.1" E126°29'45.1", alt. 975 m, on bark, Hur 040698, 27 Aug. 2004. Buseok temple: on rock, Hur 030833, 4 Oct. 2003. Mt. Deogyo: N35°45'53.5" E127°40'52.9", alt. 1499 m, on bark, Hur 060573, 11 Aug. 2006.

Phaeophyscia exornatula (Zahlbr.) Kashiw.,
Bull. Natn. Sci. Mus., Tokyo, Ser. B, 10 (3): 126, 1984

Remarks: *P. exornatula* is characterized by white maculae near the lobe tips and granular to capitate marginal soralia that sometimes extend to the upper surface. It is similar to *P. limbata*, which differs in the type of soredia. The taxonomic relationship between *P. exornatula* and *P. limbata* is ambiguous.

Selected specimens examined: Mt. Deogyo: N35°49'32.6" E127°44'30.0", alt. 1300 m, on *Quercus*, Hur 060534, 10 Aug. 2006. Mt. Chiri: N35°17'37.4" E127°32'58.4", alt. 1410 m, on *Quercus*, Hur 060234-b, 17 Jun. 2006. Mt. Baekwoon: N35°6'23.3" E127°36'15.4", alt. 664 m, on bark, Hur 060383, 27 Jun. 2006. Mt. Hugseok: 34°41'21.1" E126°40'47.5", alt. 230 m, on bark, Hur 050496, 23 Sept. 2005. Mt. Bugue: 35°48'7.3" E127°23'56.4", alt. 683 m, on bark, Hur 050426, 11 Sept. 2005. Mt. Palgong: 35°36'18.7" E127°28'14.2", alt. 873 m, on rock, Hur 050408, 10 Sept. 2005. Mt. Taebaek: alt. 1215 m, on bark, Hur 041040, 12 Sept. 2004.

Phaeophyscia hirtella Essl., Mycotaxon, 7: 304, 1978

Remarks: *P. hirtella* is characterized by marginal cortical hairs on the lobes and apothecia. It is similar to *P. hirtuosa*, which has hairs only on the apothecia.

Selected specimens examined: Mt. Songni: N36°32'44.1" E127°51'29.5", alt. 450 m, on bark, Hur 060029, 21 Apr. 2006. Mt. Deogyu: N35°53'3" E127°46'46.3", alt. 633 m, on bark, Hur 050034, 2 Apr. 2005. Unju-sa: N34°55'13.2" E126°52'51.7", alt. 70 m, on bark, Hur 050378, 4 Sept. 2005. Jejudo: N33°27'15.4" E126°33'41.1", alt. 370 m, on bark, Hur 040859, 29 Aug. 2004.

Phaeophyscia hirtuosa (Kremp.) Essl., Mycotaxon, 7: 303, 1978

Remarks: *P. hirtuosa* has pale cortical hairs on the exciple and lacks them on the lobes. It resembles *P. hirtella*, which does have hairs on the lobes.

Specimens examined: Mt. Dooryun: on bark, Hur 030099, 4 Apr. 2003. Mt. Worak: N36°51'36.6" E128°5'27.4", alt. 245 m, on rock, Hur 041160, 041164, 18 Sept. 2004.

Phaeophyscia hispidula (Ach.) Essl., Mycotaxon, 7: 305, 1978 Plate Ia

Description: Thallus foliose, loosely adnate to substrate; lobes discrete, irregularly branched, tips blunt, black rhizines extending out of both sides of lobes, like black border on the lobes; upper surface dark gray, slightly accented, dark; isidia and lobules absent; soralia subterminal, spherical to capitate, discrete; lower surface black with pale brown tips, with dense rhizines; rhizines simple, black. Apothecia laminal, lecanorine type, sessile, exciple with pale cortical hairs at sides and near top, with black rhizines below; disc brown to black, gloomy, to 6 mm in diam. Ascospores 8 per asci, brown, 2-celled, *Physcia*-type, 20-25×7.5 µm.

Chemistry: Thallus K-, C-, KC-, P-; medulla K-, C-, KC-, P-; no substances detected.

Remarks: *P. hispidula,* new to Korea, has black rhizines extending out of both sides of lobes (like black borders) and soralia that are subterminal, spherical to capitate, and discrete. It is similar to *P. limbata*, but the latter has marginal to submarginal soredia, granular, and fascicular.

Specimen examined: Mt. Jogye: on rock, Hur 030164, 24 Apr. 2003.

Phaeophyscia imbricata (Vain.) Essl., Mycotaxon, 7: 308, 1978

Remarks: *P. imbricata* has erect lobules and zeorin. It is similar to *P. trichophora*, which differs by having procumbent lobules and lacking zeorin.

Selected specimens examined: Jejudo: N33°33'26.0" E126°43'56.9", on rock, Hur 040890, 29 Aug. 2004. Mt. Odae: N37°46'6.9" E128°35'38.7", on bark, Hur 040492, 8 May 2004. Mt. Sorak: N38°10'23.2" E128°18'17.6", on rock, Hur 050232, 16 Jun. 2005. Mt. Bugue: N35°48'20.3" E127°23'14.7", on rock, Hur 050444, 11 Sept. 2005. Mt. Naejang: N35°29'42.2" E126°53'44.5", on rock, Hur 030605, 8 Aug. 2003.

Phaeophyscia limbata (Poelt) Kashiw.,
Bull. Natn. Sci. Mus., Tokyo, ser. B, 10 (3): 129, 1984

Remarks: *P. limbata* is characterized by having marginal to submarginal fascicular soralia. It is similar to *P. hispidula*, but the latter's soredia are capitate.

Selected specimens examined: Mt. Palgong: N35°36'1.8" E127°27'57.4", on bark, Hur 050395, 10 Sept. 2005. Mt. Sobaek: N36°57'26.7" E128°86'36.2", alt. 594 m, Hur 030708, 1 Oct. 2003. Mt. Jogae: N34°59'27.9" E127°20'1.8", on rock, Hur 040014, 31 Oct. 2004. Mt. Taebaeg, alt. 1005 m, on bark, Hur 030389, 25 Jun. 2003.

Phaeophyscia melanchra (Hue) Hale, Lichenologist, 15: 158, 1983

Remarks: *P. melanchra* is characterized by having crater-shaped soralia on the upper surface, a very pale brown lower surface, and no substances in thallus. It is similar to *P. chloantha* (Ach.) Moberg, which is distinguished by labriform soralia at the lobe tips. Hur et al. (2005) previously recorded the species in Korea as *Physciella melanchra* (Hue) Essl. We follow Poelt (1965) in placing it in *Phaeophyscia*.

Specimens examined: Jejudo: N33°28'25.5" E126°29'47.7", alt. 145 m, on rock, Hur 040625, 26 Aug. 2004. Wondang temple, Jeju: on rock, Hur 030381, 20 Jun. 2003. Mt. Duryun: on rock, Hur 030312, 7 Jun. 2003. Mt. Jogye: on rock, Oh 030167, 24 Apr. 2003. Mt. Daedun, N37°06'27.6" E128°56'48.8", on rock, Hur 030312, 7 Jun. 2003. Mt. Sunwoon: alt. 50-60 m, on rock, Hur 030226, 030231, 11 May 2003.

Phaeophyscia pyrrhophora (Poelt) D.D. Awasthi & M. Joshi, India J. Mycol. Res. 16: 278, 1978

Remarks: *P. pyrrhophora* has a red medulla, no soredia, isidia, or lobules, and no zeorin in the thallus. It resembles *P. endococcina*, but the latter has narrower lobes, contains zeorin, and grows mostly on rock.

Selected specimens examined: Mt. Chiri: N35°18'16.5" E127°34'14.0", alt. 1450 m, on *Quercus*, Hur 060299, 17 Jun. 2006. Mt. Deogyo: N35°46'53.9" E127°41'48.1", alt. 1345 m, on dead bark, Hur 060561, 11 Aug. 2006. Mt. Gaya: N35°48'53" E128°7'31.7", alt. 1170 m, on *Quercus*, Hur 060131, 5 May 2006. Mt. Taebaek: N37°6'0.4" E128°57'4.3", alt. 1225 m, on bark, Hur 030867, 2 Nov. 2003; alt. 1340 m, on rock, Hur 041083, 12 Sept. 2004.

Phaeophyscia sciastra (Ach.) Moberg, Symb. Bot. Upsal. 22 (1): 47, 1977

Remarks: *P. sciastra* is characterized by having laminal and marginal, black, granular isidia. It resembles *P. nigricans* (Flörke) Moberg but differs in the lower surface color. It also resembles *P. kairamo* (Vain.) Moberg, but the latter has isidia sometimes surrounded by cortical hairs and tending to form lobules.

Specimens examined: Mt. Chiri, N35°17'25.7" E127°31'59.7", alt. 1420 m, on *Quercus*, Hur 060174, 17 Jun. 2006; Hur 030047, 22 May 2003. Mt. Juhul: N36°46'30.1" E128°6'12.6", alt. 1040 m, on bark, Hur 040133, 29 Feb. 2004.

Phaeophyscia squarrosa Kashiw., Bull. Natn. Sci. Mus., Tokyo, Ser. B, 10 (1): 47, 1984

Remarks: *P. squarrosa* has squarrosely branched rhizines and a slightly maculate upper surface.

Selected specimens examined: Mt. Chiri: N35°19'26" E127°36'46.5", alt. 1555 (1425) m, on *Quercus*, Hur 060864, 28 Sept. 2006. Mt. Juhul: N36°46'30.1" E128°6'12.6", alt. 1040 m, on bark, Hur 040132, 29 Feb. 2004.

Phaeophyscia trichophora (Hue) Essl., Mycotaxon, 7: 311, 1978

Remarks: *P. trichophora* is characterized by having abundant and flat lobules. It is similar to *P. imbricata*, but the latter has erect lobules and lacks zeorin.

Specimens examined: Mt. Naejang: N35°29'44.7" E126°53'41.3", on rock, Hur 050006, 8 Jan. 2005. Baegdam temple: N38°11'16.4" E128°21'42.7", on rock, Hur 041524, 11 Oct. 2004.

Physcia caesia (Hoffm.) Fürnr., Nat. Topogr. Regensburg, 2: 250, 1839

Remarks: *P. caesia* is characterized by presence of laminal and marginal, and capitate soralia. It is similar to *P. aipolia* (Ehrh. ex Humb.) Fürnr., but the latter usually has apothecia and lacks soredia. The two species were thought to be 'species pair' (Poelt 1970 1972 Moberg 1977), but the molecular analyses (Lohtangder et al. 2000 Myllys et al. 2001) suggest that they are conspecific. This conclusion has so far not been widely accepted, so in this paper, we maintain the distinction.

> **Specimen examined:** Jejudo, N33°27'42.3" E126°55'22.5", on rock, Hur 040912, 29 Aug. 2004.

Physcia orientalis Kashiw., Mem. Ntl. Sci. Mus., Tokyo, 18: 101, 1985

Remarks: *P. orientalis* is characterized by absence of white maculae on the upper surface and by presence of marginal and capitate soralia. It is similar to *P. albicans* (Pers.) J.W. Thomson, but the latter has labriform soralia.

> **Specimens examined:** Mt. Duryun: on wood, Hur 030095, 4 Apr. 2003. Mt. Sonum: N35°29'55.7" E126°35'17.3", alt. 10 m, on bark, Hur 040044, 20 Feb. 2004. Byeonsanbando, Naesosa: N35°36'50.3" E126°35'22.6", on bark, Hur 040164, 13 Mar. 2004. Bokildo: N34°8'8.9" E126°30'23.5", alt. 5 m, on rock, Hur 041649, 30 Dec. 2004.

Physcia stellaris (L.) Nyl., Act. Soc. Linn. Bordeaux, 21: 307, 1856

Remarks: *P. stellaris* lacks cilia and soredia and has a prosoplectenchymatous lower cortex. It is similar to *P. aipolia*, which differs by an obviously maculate upper surface and the presence of zeorin.

> **Specimens examined:** Sorogdo: on rock, Hur 030081, 23 Mar. 2003. Bokildo: N34°8'8.9", E126°30'23.5", alt. 5 m, on rock, Hur 041642, 30 Dec. 2004; N34°9'14.7", E126°37'33.2", alt. 5 m, on rock, Hur 041671, 31 Dec. 2004. Geogeum-do: N34°25'20.8", E127°8'43.1", alt. 10 m, on rock, Hur 050213, 7 May 2005.

Physconia detersa (Nyl.) Poelt, Nova Hedwigia, 9: 30, 1965

Remarks: *P. detersa* is characterized by bluish-black, K-, and linear soralia located on lateral margins. It is similar to *P. leucoleiptes* (Tuck.) Essl., which differs by labriform soralia, and K+ yellow reaction of medulla. Park's (1990) earlier report of a *P. detersa* from Korea with labriform soralia was probably based on a misidentification. As we have not yet found *P. leucoleiptes*, however, Park's report should be reexamined.

> **Specimens examined:** Mt. Chiri: N35°18'23.3", E127°35'18", alt. 1339 (1220) m, on *Quercus*, Hur 20060798, 28 Sept. 2006; N35°18'28.9", E127°35'30.6", alt. 1408 (1295) m, on *Quercus*, Hur 20060822, 28 Sept. 2006. Mt. Deogyo: N35°46'15.9", E127°41'06.7", alt. 1302 m, on *Quercus*, Hur 20060563, 11 Aug. 2006. Mt. Sorak, N38°06'37.5", E128°24'38.3", alt. 1315 m, on bark, Hur 041427, 10 Oct. 2004. Mt. Sobaek, alt. 1420 m, on bark, Hur 030779, 2 Oct. 2003.

Physconia grumosa Kashiw. & Poelt, in Kashiw., Ginkgoana, 3: 56, 1975

Remarks: *P. grumosa* is characterized by marginal and laminal, granular isidia.

> **Specimen examined:** Mt. Odae, N37°46'4.5", E128°35'58.1", alt. 1400 (1390) m, on *Quercus*, Hur 040497, 8 May 2004.

Pyxine consocians Vain., Philipp. J. Sci., C 8: 109, 191. **Plate Ib**

Description: Thallus foliose, adnate tightly to the substrate; lobes crowded, irregularly branched, tips blunt, linear pseudocyphella marginal; upper surface grayish yellow, slightly accented, dark, densely pruinose near tips, some irregular laminal pseudocyphella; isidia laminal, coralloid; lower surface black with pale tips, coarse, with rhizines, rhizines black with pale tips, simple to branched into cluster. Medulla white to pale yellow. Apothecia sub-lecanorine type, to 3 mm in diam., disc black, slightly shiny; ascospores brown, 2-celled, *Pachysporaria* and *Physcia* types, 17.5-22.5 × 6-7.5μm. Pycnidia laminal, black, conidia bacilliform, 2.5 × 0.25-0.5μm.

Chemistry: Thallus K+ yellow, C-, P-; medulla K+ dirty red, C-, P+ pale dirty red; atranorin, zeorin, and norstictic acid (minor) contained.

Remarks: *P. consocians,* new to Korea, is characterized by marginal and laminal pseudocyphellae, coralloid isidia, and norstictic acid.

> **Specimens examined:** Mt. Chiri: alt. 734 m, on bark, Hur 040935, 4 Sept. 2004. Mt. Deogyu: N35°51'30.2" E127°46'2.4", alt. 1040 m, on bark, Hur 050070, 2 Apr. 2005.

Pyxine copelandii Vain, Philipp. Journ. Sci., C 8: 110, 1913 **Plate Ic**

Description: Thallus foliose; lobes discrete, dichotomously to irregularly branched, tips blunt, pseudocyphella marginal; upper surface grayish yellow, slightly accented, dark, densely pruinose near tips, some pseudocyphella laminal; soralia laminal, spherical, soredia bluish gray, granular; lobules marginal, round, constricted at base, densely pruinose, pseudocyphella marginal, linear; lower surface black, coarse, with sparse black rhizines, the tips branched into clusters. Medulla white to pale yellow. Apothecia and pycnidia not seen.

Chemistry: Thallus K+ yellow, C-, P-; medulla K+ red, C-, P+ orange; atranorin and norstictic acid (minor) contained.

Remarks: *P. copelandii,* which is new to Korea, has marginal and laminal pseudocyphella, spherical soralia, and norstictic acid. It is similar to *P. retirugella* Nyl. but lacks the latter's coralloid soralia.

> **Specimens examined:** Mt. Baega: N34°32'33.1" E126°55'46.7", alt. 334 m, on rock, Hur 050563, 8 Oct. 2005. Mt. Sobaek: N36°57'24.7" E128°26'27.8", alt. 546 m, on rock, Hur 030705, 1 Oct. 2003. Mt. Talma: N34°22'34.8" E126°35'8.8", alt. 425 m, on rock, Hur 050365, 26 Jul. 2005.

Pyxine endochrysina Nyl., Lich. Jap.: 34, 1890

Remarks: *P. endochrysina* is characterized by having marginal linear pseudocyphellae, dark, granular to fingerlike isidia, and a yellow medulla. It resembles *P. limbulata*, but the latter has no isidia.

Selected specimens examined: Jejudo: N33°30'26.2" E126°54'30.6", on rock, Hur 040899, 29 Aug. 2004. Mt. Hugseok: N34°41'21.4" E126°40'51.4", alt. 203 m, on rock, Hur 050471, 23 Sept. 2005. Mt. Naejang: alt. 659 m, on rock, Hur 030434, 29 Jun. 2003. Sorogdo: alt. 15 m, on rock, Hur 030069, 23 Mar. 2003. Mt. Bokildo: N34°9'14.7" E126°37'33.2", alt. 5 m, on rock, Hur 041675, 31 Dec. 2004.

Pyxine limbulata Müll. Arg., Flora 71: 112, 1891

Remarks: *P. limbulata* is characterized by having yellow medulla, marginal linear pseudocyphellae, and dense pruina on the upper surface. It is similar to *P. endochrysina* but lacks the latter's isidia.

Specimen examined: Mt. Chiri, N35°20'24" E127°42'15.1", alt. 1366 m, on *Acer*, Hur 2006060741, 16 Sept. 2006.

Pyxine sorediata (Ach.) Mont., Hist. Cuba., 9: 188, 1842

Remarks: *P. sorediata* is characterized by marginal linear pseudocyphellae, submarginal or subterminal capitate and coarse soralia, and a yellow medulla. It is similar to *P. endochrysina* but lacks the latter's granular to fingerlike isidia.

Specimen examined: Mt. Taebaeg: N37°6'11.4" E128°55'55.8", alt. 1254 m, on bark, Hur 030659-1, 20 Aug. 2003.

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Cercosporoid fungi from Thailand 3. Two new species of *Passalora* and six new records of *Cercospora* species

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Abstract — This report is a part of a comprehensive study on cercosporoid fungi in Thailand, which started in October 2005. In this paper, twelve species of *Cercospora* and *Passalora* collected in Thailand are treated. *Passalora barleriigena* and *P. sidae-mysorensis* are described here as new species. Six species of *Cercospora* are reported as new records for Thailand. *Broussonetia papyrifera* and *Cucurbita moschata* are reported associated with *Cercospora* for the first time. Four species of *Cercospora* represent *Cercospora apii* sensu lato.

Key words — biodiversity, hyphomycetes, foliar diseases, phytopathogenic fungi, taxonomy

Introduction

Studies on cercosporoid fungi in Thailand based on the current taxonomy of this fungal group summarized by Crous & Braun (2003) are urgently needed since all previous studies (Giatgong 1980, Petcharat & Kanjanamaneesathian 1989, Sontirat et al. 1980) were based on Chupp's wide generic concept (Chupp 1954). Additions to the cercosporoid fungi in Thailand, based on modern taxonomic concepts, were published by Braun et al. (2006) and Hunter et al. (2006).

The present work is a further contribution to survey the biodiversity of cercosporoid fungi in Thailand, with the aim to provide a comprehensive database of this group of fungi. To date, 79 species of cercosporoid fungi have been recorded from Thailand (Meeboon et al. 2007a,b). In this paper, two new species of *Passalora* are described and six new records of *Cercospora* species are reported.

Materials and methods

Specimens with disease symptoms of cercosporoid fungi on leaves were collected during the course of field trips by using a 10× magnifying lens. Detailed observations of morphological characters were carried out by means of an Olympus CX31 light microscope using oil immersion (1000×).

Specimens for microscopic observation were prepared by hand sectioning. Water and lactophenol were used as mounting media. Thirty conidia, hila, conidiophores, conidiogenous loci, and 10 stromata were measured for each specimen. Line drawings were prepared at a magnification of 1000×. Voucher specimens are deposited in the CMU Herbarium, Biology Department, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand.

Results and discussion

New species of cercosporoid fungi from Thailand

Passalora barleriigena Meeboon & Hidayat, **sp. nov.** Figure 1

MycoBank MB 510839

Etymology: the epithet refers to the genus name of the host.

Maculae amphigenae, subcirculares vel irregulares, pallidae vel pallide brunneae, margine primo indistincto, deinde fusco, 1-14 mm diam. Caespituli amphigeni. Stromata parva, 7.5-20 µm diam., ex cellulis, globosis vel subglobosis, brunneis, 3-7, composita. Conidiophora brevia, 4-7, dense fasciculata, per stoma emergentia, 1-3-septata, non-ramosa, 1-2-geniculata, tenuitunicata, levia, 22-66 × 3.5-5 µm, basi atro-brunnea, apicem versus pallidiora. Cellulae conidiogenae integratae, terminales. Loci conidiogeni conspicui, incrassati, fuscati, 1-2 µm diam. Conidia solitaria, obclavata, rarissime oblonge cylindrici, recta (interdum curvata), basi leviter obconice truncata, apice rotundato, 25-50 × 3.5-5 µm, 1-3(-4)-septata, subhyalina vel pallide brunnea, hila incrassata et fuscata, 1-2 µm diam.

Holotype: On leaves of *Barleria lupulina* Lindl. (*Acanthaceae*), THAILAND, Chiang Mai Province, Doi Suthep-Pui National Park, 30 December 2005, Jamjan Meeboon (CMU 28212). Paratype: the same locality, 10 December 2006, Jamjan Meeboon and Ikumitsu Araki (CMU 28213).

Leaf spots amphigenous, subcircular to irregular, pale to pale brown, margin at first indefinite in young spots, later conspicuous, dark, 1-14 mm in diameter. ***Caespituli*** amphigenous. ***Stromata*** small, 7.5-20 µm in diameter, composed of 3-7 globose to subglobose, brown cells. ***Conidiophores*** short, 4-7, densely fasciculate, emerging through the stomata, 1-3-septate, unbranched, 1-2-geniculate, thin-walled, smooth, 22-66 × 3.5-5 µm, dark brown at the base, paler toward the apex. ***Conidiogenous cells*** integrated, terminal. ***Conidiogenous loci*** conspicuous, thickened and darkened, 1-2 µm in diameter. ***Conidia*** solitary, mostly obclavate, occasionally oblong-cylindrical, straight (occasionally curved), slightly obconically truncated at the base, mostly tapering toward a

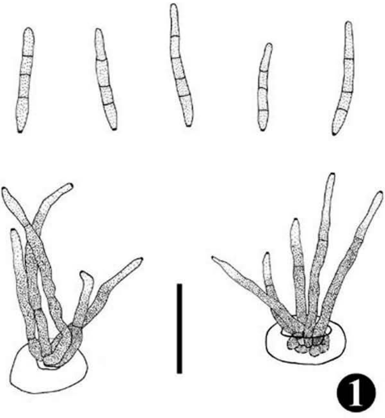

Figure 1. Conidia, conidiophores, and stroma of *Passalora barleriigena*.
(Scale bar = 25 µm).

blunt, rounded apex, 25-50 × 3.5-5 µm, 1-3(-4)-septate, subhyaline to pale brown, hila thickened and darkened, 1-2 µm diam.

Notes: Only one other species of *Passalora*, *P. acanthicola* (Hansf.) U. Braun & Crous has been recorded from *Acanthaceae* (on *Acanthus* spp.) (Crous & Braun 2003). *Passalora barleriigena* is distinct from *P. acanthicola* in having unbranched and shorter conidiophores (22-66 × 3.5-5 µm vs 150-250 × 4-6 µm in *P. acanthicola*). The solitary conidia of *P. barleriigena* are also distinct from those of *P. acanthicola*, which are reported as sometimes being in branched chains (Chupp 1954, Deighton 1987). The conidia of *P. acanthicola* are cylindrical, rounded at both ends and measure 20-95 × 4-6 um.

Passalora sidae-mysorensis Meeboon & Hidayat, sp. nov. Figure 2

MYCOBANK MB 510840

Etymology: the epithet refers to the name of the host.

Maculae amphigenae, subcirculares, centro pallide brunneo, deinde atro-brunneo, margine indistincto, 3-13 mm diam. Caespituli amphigeni. Stromata nulla vel parva, ad 9.5 μm diam., ex cellulis globosis vel subglobosis, 2-4, composita. Conidiophora 5-12, laxe vel dense fasciculata, 2-4-septata, ramosa, 2-3-geniculata, 83-112 × 5-6.5 μm, basi brunnea, apicem versus pallidiora, tenuitunicata vel leviter crassitunicata, levia. Cellulae conidiogenae integratae, terminales, sympodiales. Loci conidiogeni cospicui, leviter incassati et fuscati, 1-2.5 μm diam. Conidia catenata, interdum ramicatenata, cylindrica vel breve clavata, basi obconice truncata, apicem versus saepe latiora, 14-40 × 6-9 μm, 0-3-septata, subhyalina vel pallidus-brunneus, levia, tenuitunicata, hila incrassata et fuscata, 1-2.5 μm diam.

Holotype: On leaves of *Sida mysorensis* Wight & Arn. (*Malvaceae*), THAILAND, Chiang Mai Province, Chiang Mai University, 15 November 2005, Jamjan Meeboon (CMU 28207). Paratype: the same locality, 2 October 2006, Jamjan Meeboon (CMU 28206).

Leaf spots amphigenous, subcircular, center pale brown, darker towards the periphery with inconspicuous margin, 3-13 mm in diameter. ***Caespituli*** amphigenous. ***Stromata*** lacking to small, if present up to 9.5 μm in diameter, composed of 2-4 globose to subglobose, brown cells. ***Conidiophores*** 5-12, loosely to densely fasciculate, arising from stromata, 2-4-septate, branched, strongly geniculate 2-3 times near the tip, thin-walled to slightly thickened, smooth, 83-112 × 5-6.5 μm, brown at the base and paler towards the apex. ***Conidiogenous cells*** integrated, terminal, sympodially proliferating. ***Conidiogenous loci*** conspicuous, slightly thickened and darkened, 1-2.5 μm in diameter. ***Conidia*** catenate, sometimes in branched chains, cylindrical to short clavate, at base obconically truncate and narrow at the base, broader towards the apex, 14-40 × 6-9 μm, 0-3-septate, subhyaline to pale brown, thin-walled, smooth, hila thickened and darkened, 1-2.5 μm diam.

Notes: Seven species of *Passalora* are hitherto known associated with *Malvaceae*, viz, *P. althaeigena* (J.M. Yen & S.K. Sun) U. Braun & Crous, *P. bastardiae* (Petr. & Cif.) U. Braun & Crous, *P. hughesii* (Munt.-Cvetk.) U. Braun & Crous, *P. malvacearum* (B. Rai & Kamal) U. Braun & Crous, *P. pavoniicola* U. Braun & Freire, *P. sidarum* (Petr. & Cif.) U. Braun & Crous and *P. sidae-cordifoliae* Crous et al. These species, except for *P. althaeigena* and *P. sidae-cordifoliae*, are former *Mycovellosiella* species, i.e., they are distinguished from *P. sidae-mysorensis* by having superficial mycelium with solitary conidiophores (Braun & Freire 2004, Chupp 1954, Muntañola 1960, Petrak & Ciferri 1932, Rai & Kamal 1985). *Passalora althaeigena* is also characterized by having amphigenous leaf spots and colonies, as well as fasciculate conidiophores (Hsieh & Goh 1990, Crous & Braun 2003), but it is distinct from *P. sidae-mysorensis* by its much longer, pluriseptate conidia, formed singly. Two species of *Passalora* have been described from *Sida* spp., viz, *P. sidae-cordifoliae* and *P. sidarum*. The

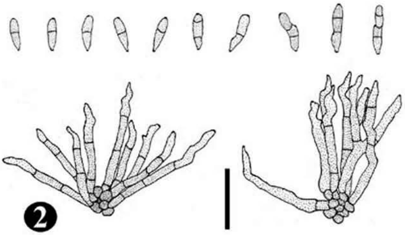

Figure 2. Conidia, conidiophores, and stroma of *Passalora sidae-mysorensis*.
(Scale bar = 50 µm).

latter species, previously assigned to *Mycovellosiella*, has superficial mycelium with solitary conidiophores, and *P. sidae-cordifoliae* is distinguished from *P. sidae-mysorensis* by solitary, much longer, pluriseptate conidia (Crous et al. 1999).

New records of cercosporoid fungi from Thailand

Cercospora basellae-albae R.K. Srivast., S. Narayan & A.K. Srivast., Indian Phytopathol. 47: 229. 1994.

Material examined: On leaves of *Basella alba* L. (*Basellaceae*), THAILAND, Chiang Mai Province, Chiang Mai University, 27 November 2005, Jamjan Meeboon (CMU 28214).

Cercospora beticola Sacc., Nuovo Giorn. Bot. Ital. 8: 189. 1876.
(= *Cercospora apii* sensu lat.)

Material examined: On leaves of *Beta vulgaris* L. (*Chenopodiaceae*), THAILAND, Chiang Mai Province, Mae Jo University, 19 August 2005, Jamjan Meeboon (CMU 28208).

Cercospora broussonetiicola Y.L. Guo & L. Xu, Mycosystema 21: 181. 2002.

Material examined: On leaves of *Broussonetia papyrifera* Vent. (*Moraceae*), THAILAND, Chiang Mai Province, Mae Jo University, 19 August 2005, Jamjan Meeboon (CMU 28209).

Notes: *Cercospora broussonetiicola* has only been reported on *Broussonetia kaempferi* Siebold (Crous & Braun 2003). This is the first report of this fungus on *B. papyrifera*.

Cercospora cucurbitacea Ellis & B.T. Galloway, U.S.D.A. Dept. Bull. 1366: 40. 1926.

Material examined: On leaves of *Cucurbita moschata* Duchesne ex Poir. (*Cucurbitaceae*), THAILAND, Chiang Mai Province, Chiang Mai University, Faculty of Agriculture, 19 January 2005, Jamjan Meeboon (CMU 28216).

Notes: *Coccinia* sp., *Cucumis sativus* and *Cucurbita* sp. are known to be hosts of *Cercospora cucurbitacea* (Crous & Braun 2003). *Cucurbita moschata* is a new host species.

Cercospora elaeagni Heald & F.A. Wolf, Mycologia 3: 16. 1911.

Material examined: On leaves of *Elaeagnus conferta* Roxb. (*Elaeagnaceae*), THAILAND, Chiang Rai Province, A. Wiang Pa Pao, 11 November 2005, Jamjan Meeboon (CMU 28210).

Cercospora leucaenae A.N. Shukla & Sarmah, Indian Forester 110: 1066. 1984.

Material examined: On leaves of *Leucaena leucocephala* (Lam.) de Wit (*Leguminosae, Mimosoideae*), THAILAND, Chiang Rai Province, A. Wiang Pa Pao, 11 November 2005, Jamjan Meeboon (CMU 28217).

Additional records of cercosporoid fungi in Thailand

Cercospora brassicicola Henn., Bot. Jahrb. Syst. 37: 166. 1905.

Material examined: On leaves of *Brassica oleracea* L. (*Brassicaceae*), THAILAND, Chiang Rai Province, A. Wiang Pa Pao, 19 October 2005, Jamjan Meeboon (CMU 28218).

Cercospora citrullina Cooke, Grevillea 21: 31. 1883.

(= *Cercospora apii* sensu lat.)

Material examined: On leaves of *Sechium edule* (Jacq.) Sw. (*Cucurbitaceae*), THAILAND, Chiang Rai Province, A. Wiang Pa Pao, 19 December 2005, Jamjan Meeboon (CMU 28215).

Cercospora gerberae Chupp & Viégas, Bol. Soc. Brasil. Agron. 8: 27. 1945.

(= *Cercospora apii* sensu lat.)

Material examined: On leaves of *Gerbera jamesonii* Adlam cultivar (*Asteraceae*), THAILAND, Chiang Rai Province, A. Wiang Pa Pao, 9 March 2005, Jamjan Meeboon (CMU 28219).

Cercospora ipomoeae G. Winter, Hedwigia 26: 34. 1887.

(= *Cercospora apii* sensu lat.)

Material examined: On leaves of *Ipomoea aquatica* Forssk. and *Ipomoea nil* (L.) Roth (*Convolvulaceae*), THAILAND, Chiang Rai Province, A. Wiang Pa Pao, 9 March 2005, Jamjan Meeboon (CMU 28220 and CMU 28221).

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A new combination and new records of *Pouzarella* (*Agaricales, Entolomataceae*) from Brazil

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Abstract– The new combination *Pouzarella dysthales* var. *acystidiosa* comb. et stat. nov. is proposed. We also provide the first record of *P. ferreri* sp. prov. for Brazil. Both species were collected on a taxonomic survey carried out in areas of secondary forest of the Atlantic Rain Forest biome in South Brazil. Both species are classified in *Pouzarella* section *Dysthales* subsection *Dysthales*.

Key words– *Basidiomycota*, Santa Catarina, taxonomy

Introduction

The genus *Pouzarella* Mazzer is considered as a subgenus within the genus *Entoloma* (Fr.) P. Kumm. by some authors (Manimohan et al. 2006) or considered by other researchers as an autonomous genus (Mazzer 1976, Baroni & Ortiz 2002). The species placed in *Pouzarella* are a distinctive group of taxa within the large family *Entolomataceae*. These species are characterized by the usually small mycenoid habit of the basidiomata, a pileus surface strongly fibrillose to woolly and a pubescent stipe with an obviously strigose base. Microscopically, the genus is characterized by the elongate and multi-angled basidiospores, encrusted pigments on the hyphae of the pileipellis, pileus context and stipe trama, and the scattered basidia with intracellular pigment (Mazzer 1976, Noordeloos 1979, 1981).

Although *Pouzarella* is considered cosmopolitan in distribution, there are few papers concerning the occurrence of this genus in the Southern Hemisphere. In Brazil, four species have been recorded. *Pouzarella squamifolia* (Murrill) Mazzer (Singer & Digilio 1952, Putzke & Cavalcanti 1997) was cited only for Rio Grande do Sul, *P. dysthales* (Peck) Mazzer was cited for Rio Grande do Sul (Putzke & Cavalcanti 1997) and Paraná (Meijer 2001), *P. strigosissima* (Rea) Mazzer was cited for Rio Grande do Sul (Putzke & Cavalcanti 1997) and for Amazonas (Souza & Aguiar 2004), and *Pouzaromyces* aff. *sepiaceobasalis* E. Horak was cited only for Paraná (Meijer 2006).

In this study, one additional species (*Pouzarella ferreri*) and one additional variety (*P. dysthales* var. *acystidiosa*) are recorded for the first time in Brazil. Both species are classified in *Pouzarella* section *Dysthales* subsection *Dysthales* (Mazzer 1976) because of their tomentose pileus surface and thin-walled non-setiform caulocystidia.

Material and methods

These new reports for Brazil were collected during a taxonomic survey in the Parque Natural Municipal São Francisco de Assis, Blumenau, Santa Catarina, Brazil (S26°55'15.9", W49°04'16.8"). Vegetation in this area is characterized by late secondary forest pertaining to the Atlantic Rain Forest biome. Plots of 20 x 20 m were established and visited monthly for collection from January 2004 to December 2005. Microscopic analyses (measurements and color citation) were made from dried basidiomata tissues mounted in 5% KOH. All illustrations of microscopic features were made with the aid of a drawing tube. The Qm represents the mean length/width quotient of the total spores measured. All the specimens are deposited in herbarium SP (Instituto de Botânica, São Paulo, SP, Brazil).

Species descriptions

Pouzarella dysthales var. ***acystidiosa*** (Noordel.) Karstedt & Capelari,
comb. et stat. nov. FIG. 1
MycoBank: MB510904
Basionym: *Entoloma dysthales* f. *acystidiosum* Noordel. Persoonia 10: 219. 1979.

Pileus convex to campanulate, grayish brown, darker in the center, radially translucent-striate and sulcate, pubescent or tomentose, concolorous with the pileus, margin pubescent, context thin, 6–7 mm diam. **Lamellae** adnate, gray or slightly brown, more or less concolorous with the pileus margin, distant, edges even, with 1–3 lamellulae. **Stipe** cylindric with a subbulbous base, translucent, apex concolorous with the pileus margin, becoming brown towards the base, pubescent, hairs concolorous with those in the pileus, decreasing in density towards the apex, hollow, base with pale grayish brown strigose hairs, 18–22 × 1 mm. Odor and taste not recorded. **Spore print** not observed.

Basidiospores strongly angled in profile and face views with 6–8 facets, inamyloid, with an evident hilar appendix, 15–19 × 7.5–9 µm (Qm = 1.89). **Basidia** clavate, hyaline, thin-walled, bi and tetrasporic, 35–50 × 12.5–16.25 µm. **Pleurocystidia** and **cheilocystidia** absent. **Lamella trama** subparallel,

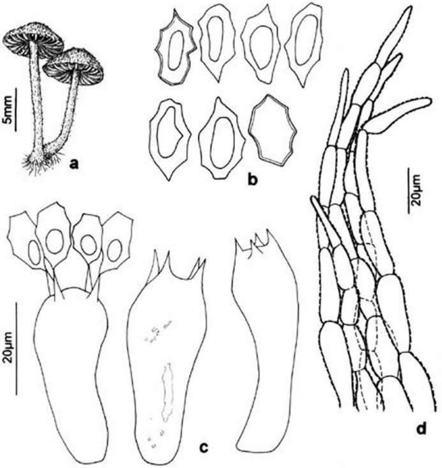

Figure 1. *Pouzarella dysthales* var. *acystidiosa*: a. basidioma, b. basidiospores, c. basidia, d. hairs of the pileipellis.

brownish, mostly with thin-walled and encrusted hyphae, septate, 3.75–11.25 µm diam. Context brownish, difficult to observe the hyphae individually, mostly collapsed. **Pileipellis** trichodermium with chains or erect cells up to 250 µm long, with the end cell having a rounded apex, individual cells of the chains 40–81.25 x 12.5–21.25 µm, thick-walled (1.25 µm), encrusted, subcutis of interwoven hyphae. **Stipe trama** with hyaline hyphae, thin-walled, septate, with chestnut encrustation, hyphae thinner at medulla, 3.75–7.5 µm diam., hyphae with diameter broader near the margin (more external), 7.5–13.75 µm diam. **Stipitipellis** covered by hairs equal to those of the pileipellis, without setiform caulocystidia. **Clamp connections** absent in all tissues.

Habitat: scattered to gregarious in Tropical Atlantic Rainforest, lignicolous.

Specimens examined: BRAZIL. SANTA CATARINA STATE: Blumenau, Parque Natural Municipal São Francisco de Assis (26°55'15.9"S 49°04'16.8"W), 30.IX.2005, *F. Karstedt 569* (SP).

Distribution: Portugal (Noordeloos 1979), Brazil.

Comments: *Pouzarella dysthales* is a small *Pouzarella* species with grayish brown color that has three different varieties (*P. dysthales* (Peck) Mazzer var. *dysthales*, *P. dysthales* var. *acystidiosa* and *P. dysthales* forma *keralense* Manim. & Noordel.). The Brazilian material examined from Parque Natural Municipal São Francisco de Assis is identified as *P. dysthales* var. *acystidiosa* because of the absence of cheilocystidia, which we consider a difference that warrants raising this taxon to the rank of variety. The Brazilian collection is lignicolous, whereas *P. dysthales* var. *acystidiosa* collected by Dennis in Portugal (Noordeloos 1979) is terrestrial.

Others species similar to *Pouzarella dysthales* var. *acystidiosa* are *Pouzarella caribaea* T.J. Baroni & B. Ortiz and *Pouzaromyces minutus* E. Horak. *Pouzarella caribaea* differs in characters such as the presence of smaller basidiospores 12.5–16.5 × 8.3–11.3 µm (Qm = 1.48), larger basidia 50–60 × 14–20 µm, and the presence of cheilocystidia (Baroni & Ortiz 2002) while *Pouzaromyces minutus* differs in the pileus color that varies from brownish to beige and in possessing a stipe densely covered with brownish or white fibrils (Horak 1973).

Pouzarella ferreri T.J. Baroni, S.A.Cantrell & Perd.-Sánch., ined. FIG. 2

Pileus hemispheric when young, becoming campanulate to convex, red, with orange margin, tissues turning black from handling or when old, radially translucent-striate and sulcate, covered with red hairs, margin pubescent, context thin, 6–15 mm diam. **Lamellae** sinuate, grayish, distant, with 1–3 lamellulae. **Stipe** cylindric, translucent, grayish-white in the apex yellowish in direction the base, turning black when old, covered with reddish orange hairs, decreasing in density towards the apex, hollow, base with evident white strigose hairs, 20–40 × 1–2 (–4) mm. **Spore print** pinkish with grayish tints.

Basidiospores in profile strongly angled with 7–8 facets, inamyloid, hyaline, assymetric, hilar appendix present, 16–19 × 7.5–10 µm (Qm = 1.78). **Basidia** clavate, hyaline, tetrasporic, 32.5–44 × 14–17.5 µm, abortive basidia filled with dark brown pigments present. **Pleurocystidia** absent. **Cheilocystidia** clavate to globose, hyaline, sometimes brownish, thin-walled, 26–37.5 × 17.5–25 µm. **Lamella trama** subparallel, hyaline, thin-walled, septate hyphae, walls brown encrusted, hyphae broader at mediostratum, 12.5–24 µm diam., and narrower in laterostratum, 3.5–6.5 µm diam. **Pileipellis** a hymeniderm, differentiated from the context, with inflated hyphae, brownish, with rounded apex, 29–31

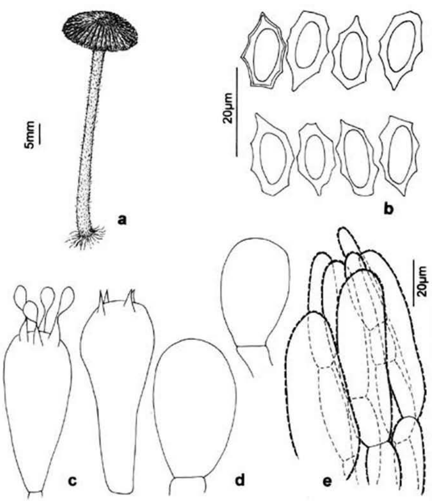

Figure 2. *Pouzarella ferreri*: a. basidioma, b. basidiospores, c. basidia, d. cheilocystidia, e. hairs of the pileipellis.

µm diam., interwoven with groups of brownish hyphae, mostly with encrusted walls, septate, 13–20 µm diam. **Stipitipellis** covered by hairs equal to those of the pileipellis, with non-setiform caulocystidia. **Clamp connections** absent in all tissues.

Habitat: scattered to gregarious, in Tropical Atlantic Rainforest, saprotrophic.

Specimens examined: BRAZIL. SANTA CATARINA STATE: Blumenau, Parque Natural Municipal São Francisco de Assis (26°55'15.9"S 49°04'16.8"W), 15.VI.2004, *Karstedt 408* (SP); 29.VII.2004, *Karstedt 416* (SP); 05.IX.2004, *Karstedt 435* (SP); 30.X.2004, *Karstedt 461* (SP); 18.XI.2004, *Karstedt 468* (SP); 13.XII.2004, *Karstedt 486* (SP);

19.V.2005, *Karstedt 534* (SP); 01.VII.2005, *Karstedt 548* (SP); 29.VII.2005, *Karstedt 549e* (SP); 29.VII.2005, *Karstedt 549f* (SP); 30.IX.2005, *Karstedt 580* (SP); 1.XI.2005, *Karstedt 589* (SP).

Distribution: Brazil, Dominican Republic and Costa Rica as *Pouzarella squamifolia* (Halling & Mueller 2005).

Comments: *Pouzarella ferreri* was collected from June to October during 2004 and 2005, with higher numbers of basidiomata produced in July 2004 and August 2005, suggesting that cold temperature triggers basidioma formation.

Pouzarella ferreri is characterized by its red pileus with orange margin covered by red hairs, stipe covered with reddish orange hairs, blackening tissues, white basal mycelium, and presence of cheilocystidia. *Pouzarella ferreri* is similar to other South America species of the genus in the conspicuous presence of cheilocystidia. It is directly comparable to *Pouzaromyces sepiaceobasalis* E. Horak from Argentina (Horak 1983) and *Rhodophyllus squamifolius* (Murrill) Singer cited from Brazil by Singer & Digilio (1952). The former differs from *Pouzarella ferreri* by possessing a golden brown pileus, smaller basidiospores (14.6–16.2 × 7.8–9.2 µm) and larger cheilocystidia (15–70 × 15–15 µm) and the latter differs by its black to gray pileus (sensu Singer & Digilio 1952) and larger cheilocystidia (56 × 20 µm). Two other species with a reddish pileus are *Pouzaromyces aureocrinitus* E. Horak and *Pouzaromyces erinaceus* E. Horak, also from Argentina, but these differ by their absence of cheilocystidia (Horak 1983).

Pouzarella squamifolia sensu Halling & Mueller (2005), cited from Costa Rica, was the closest species to the collected material, differing only in size of pileus (12–20 mm) and basidiospores (14–16 × 7.5–9 µm). The analyzed material and *Pouzarella squamifolia* sensu Halling & Mueller differ from *Pouzarella squamifolia* sensu Murrill (Murrill 1915, Singer 1942) by the latter's melleous surface, ferrugineous-fulvous hairs that do not blacken when handled, and broadly fusiform or clavate cheilocystidia (T.J. Baroni, personal communication).

T.J. Baroni (personal communication) examined the identity of *P. squamifolia* sensu Halling & Mueller and verified that it is *Pouzarella ferreri*.

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MYCOTAXON

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Six sorediate crustose lichens new to Poland

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Abstract — *Lecanora farinaria*, *L. norvegica*, *L. pannonica*, *Pycnora leucococca*, *Rinodina degeliana* and *Scoliciosporum gallurae* are reported for the first time for Poland. All belong to the difficult group of sorediate crustose lichens. Taxonomic descriptions and comments are provided.

Key words — lichenized fungi, taxonomy, lichen metabolites, geographical distribution

Introduction

Sorediate crustose lichens are one of the most difficult groups to identify. They cause many problems, as they are usually sterile and the thallus characters overlap in many, even distantly related, taxa. Secondary chemistry is, however, very useful as many species are characterized by specific sets of lichen substances. Some taxa have the same chemistry, but in most cases, there are differences in morphology. This group of lichens was much ignored in the past and only recently more attention was paid to its taxonomy (e.g. Laundon 1989, 1992; Tønsberg 1992, Fryday & Coppins 1997). However, such taxa are still much under-recorded in many regions and Poland makes no exception.

Despite an earlier key to commonly sterile sorediate crustose lichen species in Poland (Nowak & Tobolewski 1975), this group has been much neglected until recently. Specimens were generally determined using only thallus characters and spot tests with simple chemicals, with no thin-layer chromatography (TLC) employed. After the recent revision of the lichen genus *Lepraria* Ach. (see Kukwa 2006), this situation changed and many taxa were reported for the first time for the country (Śliwa & Tønsberg 1995, Śliwa 1996, Kowalewska & Kukwa 2003, Czarnota & Kukwa 2004, Kukwa 2006). Also the distribution of many taxa is now better understood (e.g., Kukwa 2005a, b; Kubiak 2005, Jabłońska & Kukwa 2007). Nonetheless, the current state of knowledge of sterile sorediate crustose lichens is still far from satisfactory. Many species are still greatly under-recorded so that it still is impossible to estimate their true distribution and frequency. This part of the Polish lichen biota remains one of the most insufficiently studied one in the country.

By presenting six taxa new to Poland in this paper, we both contribute to the knowledge of sorediate crustose lichen taxa and expand the knowledge of lichen diversity in the country.

Material and methods

Material studied, including types, and used in this paper was deposited in the following herbaria: B, BG, BM, E, GZU, KRAM, OLTC and UGDA. Chemical analyses were performed by thin-layer chromatography (TLC in solvent A, B and C) according to the methods of Orange et al. (2001).

The taxa

Lecanora farinaria Borrer

in Hooker & Sowerby, Supplement to the English Botany 2, tab. 2727. 1834.

Thallus crustose, endo- to episubstratal, minutely areolate to tuberculate, slightly shiny, grey-green; **prothallus** not distinct; **soralia** bursting from the apices of areoles or tuberculae, ±flat to convex, rounded to irregular, sometimes partly confluent; **soredia** fine, in colour similar to the thallus, but usually slightly lighter; **apothecia** absent in Polish material.

Chemistry: According to Tønsberg (1992) the species produces atranorin, chloroatranorin, roccellic acid and rarely unidentified fatty acids in traces. In Polish specimens we detected atranorin and roccellic acid (chloratranorin not tested).

Ecology—In all collection sites the species was found in deciduous forest on even bark of *Carpinus betulus* and *Quercus rubra*. Among accompanying species *Buellia griseovirens* (Turner & Borrer ex Sm.) Almb., *Fuscidea arboricola* Coppins & Tønsberg, *Hypogymnia physodes* (L.) Nyl., *Lecanora thysanophora* R.C. Harris, *Mycobilimbia epixanthoides* (Nyl.) Vitik. et al., *Parmelia sulcata* Taylor, *Pertusaria amara* (Ach.) Nyl., *Ropalospora viridis* (Tønsberg) Tønsberg and *Trapeliopsis flexuosa* (Fr.) Coppins & P. James were noted.

Geographical distribution—The species has been reported rather from scattered localities, but the distributional range is rather wide. In Europe the species is known from Austria (Tønsberg et al. 2001), Great Britain (Coppins 2002), Italy

(Sardinia) (Zedda 2002), Ireland (Fox 2004), Norway (Tønsberg 1992), Portugal (Boom 2005), Spain (Llimona & Hladun 2001), Sweden (Tønsberg 1998) and Ukraine (Kondratyuk & Coppins 1999). It is also recorded from Asia (Hong Kong) (Aptroot & Seaward 1999) and North America (Esslinger 2006).

Comments—The species has a very distinct chemistry and morphology. However it can be confused with the morphologically similar *Buellia griseovirens* and *Lecanora expallens* Ach. They can be most easily separated by its chemistry, as the former produces norstictic acid and atranorin, the latter usnic acid, xanthones and zeorin, whereas *L. farinaria* contains atranorin and roccellic acid (Tønsberg 1992).

Specimens examined—**POLAND. Ilawa Lakeland.** Between Nowa Wieś and Ryjewo villages, forest section No. 200 (53°51'20"N, 18°58'41"E), on *Carpinus betulus* — 01.I.2004 Kukwa *2880* (UGDA-L-*11580*). E of Szadowo settlement, Liwa river valley (53°46'21"N, 19°03'47"E), on *Carpinus betulus*—12.IV.2004 Kukwa *3080* (UGDA-L-*10781*). E of Ryjewo village, forest section No 216 (53°50'18"N, 18°57'51"E), on *Carpinus betulus*—30.08.1996 Kukwa (UGDA-L-*12560*). **Olsztyn Lakeland.** Olsztyn town, Las Miejski forest (53°48.122'N, 20°27.520'E), on *Quercus rubra*—02.V.2005 Kubiak (OLTC-L).

Reference material examined—**GREAT BRITAIN. England: Sussex.** Hurstpierpoint, Danny sand-fields, on wood—s.dat. Borrer (holotype-BM).

Lecanora norvegica Tønsberg
Sommerfeltia 14: 165. 1992.

Thallus crustose, episubstratal, continuous in most parts, with flat areoles, pale grey; **prothallus** white, distinct; soralia mostly diffuse, flat to convex in younger parts of thallus, but later becoming fused; **soredia** fine, concolorous with the thallus, or lighter to almost white; **apothecia** absent.

Chemistry: The species produces atranorin and protocetraric acid (Tønsberg 1992) and those substances were detected in Polish specimens too.

Ecology—The species was found on bark of pines in peat bog pine forest and in mixed forest. It was accompanied by typical pine dwellers like *Hypocenomyce scalaris* (Ach.) M. Choisy, *Hypogymnia physodes*, *Lecanora conizaeoides* Nyl. ex Cromb., *Lepraria* spp., *Pseudevernia furfuracea* (L.) Zopf and, in one case it was growing together with *Cliostomum leprosum* (Räsänen) Holien & Tønsberg.

Geographical distribution—The species has been rather recently described (Tønsberg 1992) and is not commonly recorded so far. It is known from Estonia (Jüriado et al. 2000), Norway (Tønsberg 1992), Sweden (Santesson 1993) and Switzerland (Dietrich & Scheidegger 1996).

Comments—*L. norvegica* is very distinct on account of the presence of protocetraric acid. That substance is a rare secondary metabolite among crustose, sorediate taxa and is not known in any superficially similar species.

L. norvegica can be confused with *Cliostomum leprosum* and *Loxospora elatina* (Ach.) A. Massal., both with white-grey thalli. However, they contain caperatic acid and thamnolic acid, respectively, as the major diagnostic substances. Also *Ochrolechia microstictoides* Räsänen may resemble *L. norvegica*, especially when it grows on pines, but that species produces variolaric and lichesterinic acids (Tønsberg 1992).

> Specimens examined—**POLAND. Dolina Gwdy.** Cisy w Czarnem nature reserve (53°44'15"N, 16°58'45"E), on *Pinus sylvestris*—13.XI.2004 Kukwa *3673* (UGDA-L-*12604*). **Kaszuby Lakeland.** Kurze Grzędy nature reserve, forest section No. 134i (54°23'26"N, 17°57'51"E), on wood—27.V.2005 Kukwa (UGDA-L-*12804*).
>
> Reference material examined—**NORWAY.** T. Tønsberg, Lich. Isid. Sored. Crust. Exs. 11 (BG L). **Oppland.** Vågå, Lalm, alt. 400 m, on *Pinus sylvestris*—22.VI.1990 Tønsberg *13131b* (BG L-*23788*).

Lecanora pannonica Szatala

Ann. Hist. Nat.-Mus. Natl. Hung., ser. nov. 5: 135. 1954.

Thallus crustose, in shades of grey, sometimes with a slightly blue tinge, episubstratal, thick and bullate areolate to verrucose; **areoles** crowded, never dispersed; **prothallus** not observed; **soralia** rounded to slightly irregular, discrete, formed at the tops of areoles, slightly convex or flat to excavate, in some cases with a thalline rime around; **external** soredia greyish to dark blue grey, internal greenish grey; **apothecia** and pycnidia not observed in Polish material.

Chemistry: According to Brodo et al. (1994) and Ryan et al. (2004) the species produces atranorin (major), chloroatranorin (minor), roccellic acid (trace), gangaleoidin (major to trace) and norgangaleoidin (trace). In Polish specimens atranorin (major), roccellic acid (rather major), gangaleoidin (major) and possibly a trace of norgangaleoidin were found (chloratranorin not tested).

Ecology—At the collection sites *L. pannonica* was found on old brick made buildings and grew on shaded to well-insolated walls. It was accompanied by typical taxa growing on man made substrata, mainly by *L. dispersa* agg. and *Caloplaca* spp.

Geographical distribution—The species is known from Austria (Brodo et al. 1994), Belgium (Diederich & Sérusiaux 2000), France, Germany, Great Britain (Brodo et al. 1994), Holland (Aptroot et al. 1999), Italy, Macedonia (Brodo et al. 1994), Slovakia (Pišút 1999), Spain (Llimona & Hladun 2001), Great Britain (Coppins 2002) and North America (Ryan et al. 2004).

Comments—*L. pannonica* is easily recognizable by the convex, somehow bullate areoles, delimited soralia with dark blue external soredia and the presence of atranorin and gangaleoidin in the thallus (Brodo et al. 1994, Ryan et al. 2004). It is commonly sterile and it can be confused with *Porpidia tuberculosa* (Sm.) Hertel & Knoph. Both taxa have similarly coloured soredia, but the latter has more or less even thallus, areoles, if present, are never such convex and it produces confluentic acid as a main secondary metabolite (Galloway & Coppins 1992, Fryday 2005). Also *Tephromela grumosa* (Pers.) Hafellner & Cl. Roux and *T. pertusarioides* (Degel.) Hafellner & Cl. Roux have similar darkly pigmented outer soredia. However soredia in *T. grumosa* tend to cover more or less almost the whole thallus, especially in older parts. It differs also chemically and produces atranorin and lichesterinic acid (Purvis 1992, Brodo et al. 1994). *T. pertusarioides* is morphologically more similar to *L. pannonica* due to delimited soralia, but differs in the presence of α-collatolic acid in the thallus (Brodo et al. 1994).

Some morphs of *L. caesiosora* Poelt with dark soredia can be mistaken for *L. pannonica* as well, but that species predominately differs in the chemistry as it contains fatty acids instead of gangaleoidin (Brodo et al. 1994). So far, *L. caesiosora* has not been reported from Poland.

Specimens examined—**POLAND. Iława Lakeland.** Postolin village, old Gothic church (53°52'15"N, 19°03'26"E), on brick—30.IX.1997 Kukwa (UGDA-L-*12746*, KRAM-L). Przezmark village, Teutonic castle (53°51'42"N, 19°29'32"E), on brick—04.VII.2003 Boczkaj, Kukwa (UGDA-L-*12747*). **Nizina Staropruska.** Frombork town, Teutonic castle (54°22'17"N, 19°40'19"E), on bricks—11.III.2007 Szymczyk (UGDA-L-*14067*).

Reference material examined—**AUSTRIA.** A. Vězda, Lich. Sel. Exs. 1808 (isoneotypi-B, BM). J. Poelt & M. Steiner, Lich. Alp. 257 (B, BM). **GERMANY.** H. T. Lumbsch & G. B. Feige, Lecanoroid Lich. 8 (B, BM).

Pycnora leucococca (R. Sant.) R. Sant.

Santesson et al., Lichen-Forming and Lichenicolous Fungi of Fennoscandia: 275, 2004.
– *Hypocenomyce leucococca* R. Sant., in Moberg, Thunbergia 2: 3. 1986.

Thallus episubstratal, grey, but with distinct pinkish tinge in the herbarium, consisting of subsquamiform areoles; **areoles** persistently discrete in Polish material, ± circular to irregular, becoming larger and sorediate by age; **prothallus** not evident; **soralia** marginal, labriform; **soredia** concolorous with the thallus; **apothecia** not known..

Chemistry: The species is very uniform in chemistry and only alectorialic acid with satellites were reported (Tønsberg 1992), as in Polish specimen we detected. Due to the presence of that chemosyndrome, the thallus becomes pinkish in herbarium.

Ecology—The only specimen was collected on bark of *Fagus sylvatica* in a beech forest. There was no information on accompanied species in the collecting site.

Geographical distribution—The species has been reported so far from Austria (Hafellner & Türk 2001), Czech Republic (Palice 1999), Finland (Santesson et al. 2004), Norway (Tønsberg 1992), Rumania (Palice 1999), Russia (Kubiak et al. 2003), Slovakia (Pišút et al. 1996), Sweden (Santesson et al. 2004), Switzerland (Dietrich & Scheidegger 1996) and Great Britain (Coppins 2002) as well as from Greenland (Alstrup 2004) and North America (Esslinger 2006).

Comments—*P. leucococca* is well characterized by the presence of alectorialic acid, small subquamulose (rarely non-squamulose), well-separated from each other thallus areoles and marginal soralia (Tønsberg 1992). It can be confused with *P. sorophora* (Vain.) Hafellner, another sorediate and alectorialic acid containing member of the genus. That species differs in the crustose, often yellowish brown areoles (Tønsberg 1992).

> Specimen examined—**POLAND. Beskid Żywiecki.** Góra Rycerzowa Mała Mt., alt. c. 1175 m (49°24'N, 19°04'E), on *Fagus sylvatica*—07.VIII.1964 Nowak (KRAM-L-14420).

Rinodina degeliana Coppins

Lichenologist 15: 147. 1983.

Thallus episubstratal, not delimited, irregularly spreading, areolate, matt, areoles crustose or usually subsquamulose, irregularly rounded to triangular, tending to become raised at the edge, greenish grey to grey; **prothallus** not evident; **soralia** discrete, marginal, at first linear, but becoming labriform, concolorous with the thallus or white grey, soredia granular; **apothecia** absent in Polish specimens.

Chemistry: The species produces atranorin, chloratranorin, zeorin and sometimes traces of unidentified terpenoids (Tønsberg 1992). In Polish specimens we detected atranorin and zeorin (chloratranorin not tested).

Ecology—The species was collected on smooth to moderately rough bark of deciduous trees. In all localities *R. degeliana* was found in moderately humid, mixed or deciduous forests.

Geographical distribution—The species is rather rarely reported and is known from Austria (Tønsberg et al. 2001), Estonia (Aptroot et al. 2005), Finland (Santesson et al. 2004), Lithuania (Motiejūnaitė et al. 2005), Norway (Tønsberg 1992), Sweden (Coppins 1983), Great Britain (Coppins 2002) and North America (Esslinger 2006).

Comments—The combination of crustose to subsquamiform thallus areoles, marginal, mostly labriform soralia and its content of atranorin and zeorin make *R. degeliana* very distinct from other crustose sorediate lichens. Only *R. griseosoralifera* Coppins has identical chemistry, but it differs in non-subsquamiform, but rounded, flat to ± convex thallus areoles and blue-grey external soredia (Tønsberg 1992).

Specimens examined — **POLAND. Bory Tucholskie.** C. 2.5 km W of Stara Rzeka village (53°39'22"N, 18°16'40"E), on *Tilia cordata*—14.VI.2004 Kukwa *3317* (UGDA-L-*11794*). **Olsztyn Lakeland.** Kudypy dendrological park, (53°46'N, 20°22'E), on *Carpinus betulus*—24.V.2006 Kubiak (OLTC-L). Dęby Napiwodzkie nature reserve (53°30'15"N, 20°38'43"E), on *Corylus avellana*—17.VIII.2005 Kubiak (OLTC-L)

Reference material examined—**SWEDEN. Lule Lappmark. Kvikkjokk par.** 3 km SSW of Kvikkjokk, SE slope of Nammatj, 66°56'N, 17°42'E, on *Salix* sp.—28.07.1977 Coppins *6238*, Tibell (holotype-E). **NORWAY. Nordland:** Vefsn, the W bank of lake Fustvatn, S of Storvik, alt. 40-50 m, on *Betula* sp.—02.IX.1982 Tønsberg *7618a* (BG L-*23046*).

Scoliciosporum gallurae Vězda & Poelt

in Nimis & Poelt, Studia Geobot. 7 (suppl. 1): 221. 1987.

Thallus crustose, episubstratal, indeterminate, greenish to greenish grey, forming small individuals on the twigs, consisting exlusively of rounded soredia and consoredia with well developed soredial wall; **prothallus** and typical **soralia** not evident; **apothecia** present in all collections, rather flat when young, but becoming extremely convex with the age, pale to dark brown, hymenium and hypothecium colourless, epithecium brown, asci 8-spored, spores 0-3 septate, fusiform, usually slightly curved, 17–24 × 3–4(–4.5) µm.

Chemistry: Gyrophoric acid and lecanoric acid were detected (see also Tønsberg 1992). Sometimes the concentration of those substances might be low, as the thalli did not react red with C even in squash preparations.

Ecology—The species was collected on young trees and twigs in open places. All collecting sites are in very close vicinity of the seashore, where *S. gallurae* is probably common. It was associated with *Lecanora carpinea* (L.) Vain., *L. pulicaris* (Pers.) Ach., *L. symmicta* (Ach.) Ach., *Lecanora* sp., *Micarea nitschkeana* (J. Lahm ex Rabenh.) Harm., *Physcia tenella* (Scop.) DC. and *Xanthoria parietina* (L.) Th. Fr.

Geographical distribution—So far the species is known only from Europe and is reported from Austria (Hafellner & Türk 2001), Belgium (Diederich & Sérusiaux 2000), Germany (Sparrius 2000), Italy (Nimis & Poelt 1987), Luxembourg (Diederich & Sérusiaux 2000), Norway (Tønsberg 1992), Portugal (Boom & Giralt 1996), Slovakia (Guttová & Palice 2004) and Spain (Longán & Gómez-Bolea 1999).

Comments—*S. gallurae* is a rather small and inconspicuous lichen species. In the field it can be easily mistaken for *S. chlorococcum* (Graewe ex Stenh.) Vězda. *S. chlorococcum* is, however, easily separated by the absence of soredia, and longer, wider and more richly septate ascospores. Sometimes *S. gallurae* is thought to be only an immature form of *S. chlorococcum* with smaller and not well developed spores (Tønsberg 1992), but so far, no certain intermediate forms are known.

S. gallurae can be confused with *S. sarothamni* (Vain.) Vězda as both taxa posses soredia and produce gyrophoric acid. They predominantly differs in the spore characters, which are fusifom, straight to slightly curved and up to 3-septate in *S. gallurae*, and acicular, mostly S-shaped and up to 7-septate in *S. sarothamni*. When sterile, those taxa seem to be almost indistinguishable, at least in material from Poland.

S. gallurae is superficially similar to taxa of the *Micarea prasina* complex, *M. micrococca* (Körb.) Gams ex Coppins, *M. prasina* Fr. and *M. viridileprosa* Coppins & Van den Boom. All those taxa have oblong-ellipsoid to ovoid, mostly 0–1 septate spores, and additionally *M. micrococca* and *M. prasina*, lack gyrophoric acid. *M. viridileprosa* contains that substance, but has the micareoid type of the photobiont with smaller, 4.5–7 µm in diam. cells (Coppins & van den Boom 2001, Tønsberg 1992).

Specimens examined — **POLAND. Hel Peninsula.** Helskie Wydmy nature reserve, (54°39'24"N, 18°46'27"E), on *Populus tremula*—15.X.2006 Kukwa *5369b* (UGDA-L). **Wiślana Split.** N of Mikoszewo village, Mewia Łacha nature reserve, (54°20'52"N, 18°57'58"E), on *Salix* sp.—28.III.2004 Kukwa *2955* (UGDA-L). **Słowińskie Coast.** Bielawa nature reserve (54°47'39"-54°48'11"N, 18°13'44"-18°16'06"E), on *Betula* sp., *Populus tremula* and *Salix* sp.—2006 Kukwa *4846, 4896 5196, 5209* (UGDA-L, KRAM-L)

Reference material examined—**ITALY. Sardinia: Prov. Cagliari.** Arcu Neriddu, M. Sette Fratelli—Wittmann & Pilsl (holotypus-GZU).

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MYCOTAXON

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Two new species of *Rhytismataceae* on twigs of conifers from Yunnan Province, China

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Abstract — Two new species of *Rhytismataceae* are described from Yunnan Province, China. *Coccomyces lijiangensis* on twigs of *Pinus armandii* is somewhat similar to *C. papillatus* but differs by the dimension and shapes of asci and ascospores. *Therrya abieticola* on twigs of *Abies* sp. is morphologically similar to *Coccomyces guizhouensis* but differs by smaller ascomata and filiform paraphyses with knobs.

Key words — *Ascomycota*, *Rhytismatales*, taxonomy

Introduction

Species of *Coccomyces* De Not. are characterized by having more or less circular ascomata opening by several radiate or irregular splits, cylindrical to clavate asci, and filiform to fusiform ascospores, which are often surrounded by gelatinous sheaths (Sherwood 1980, Cannon & Minter 1986, Johnston 1986). Species of *Coccomyces* are similar to species of *Therrya* Sacc., but the latter have apically knobbed paraphyses embedded in gelatinous sheaths forming an epithecium and multi-septate ascospores (Reid & Cain 1961, Sherwood 1980). The affinities among *Coccomyces*, *Therrya*, and related genera are discussed in detail by Sherwood (1980) and Johnston (1986).

With more than 100 species, *Coccomyces* is the second largest genus of the *Rhytismatales* and is known worldwide (Sherwood 1980, Johnston 1986, 2000; Spooner 1990). In China, 24 species are reported (Korf & Zhuang 1985, Lin 1998, Hou et al. 2006). *Therrya* is a smaller genus with only six species (Reid & Cain 1961, Funk 1980, Yuan & Mohammed 1997). There is no information about this genus in China. In the present paper we describe a new species in the genus *Therrya* and a new one in the genus *Coccomyces*.

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Materials and methods

Sections of different thickness of ascomata were made by hand using a razor blade. Microscopic preparations were made in water, Melzer's reagent, 5% KOH, or 0.1% (w/v) cotton blue in lactic acid. For observation of ascomatal outlines in vertical section, sections were mounted in lactic acid or cotton blue with pretreatment in water. Gelatinous sheaths surrounding ascospores and paraphyses were observed in water or cotton blue. Ascospore contents were drawn based on observations in water mounts. Measurements were made from 20 ascospores and asci for each specimen using material mounted in 5% KOH or Melzer's reagent.

Taxonomy

Coccomyces lijiangensis C. L. Hou & M. Piepenbr., **sp. nov.**

MycoBank 511133 FIGURES 1-5

Ascomata 700–1200 μm, orbicularia; paraphyses filiformes; asci 55–95 × 4–6 μm, clavati; ascosporae 45–70 × 0.8–1 μm, filiformes.

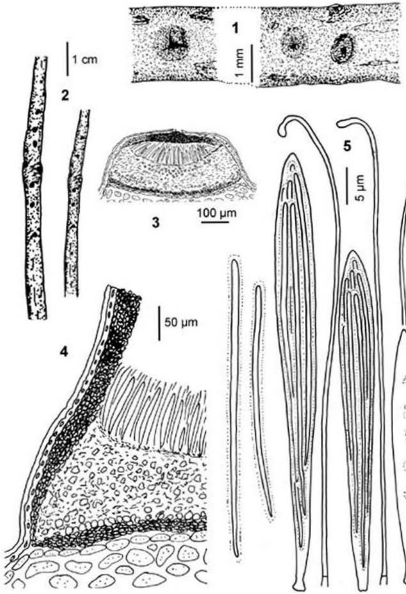
Etymology: Lijiang, referring to the place where the specimen was collected.

HOLOTYPE: On twigs of *Pinus armandii* Franch. (*Pinaceae*), CHINA. YUNNAN: Lijiang, alt. ca. 3000 m, 30 VII 2001, C. L. Hou, M. Piepenbring, R. Kirschner, and Z. L. Yang 151 (AAUFP 90042).

Ascomata on dead or living twigs attached to stems, usually in the lower suppressed part of the tree, more frequently on 1–2 year old twigs. In surface view ascomata 700–1200 μm, circular or subcircular, grey or black grey, coarse on the surface, with a depressed centre and a small central papilla when young, opening by 3–5 irregular lobes, without a preformed dehiscence line. In median vertical section, ascomata intracortical, 300–400 μm thick, covering stroma up to 40–65 μm thick near the centre of the ascoma, slightly becoming thinner towards the edges, not extending to the basal stroma, composed of an outer layer of host tissue and an inner layer of brown to dark brown thick-walled textura angularis. Periphysoids and excipulum absent. Basal stroma well-developed, composed of an outer layer of black to dark brown angular cells, 18–25 μm thick, an inner layer of pale brown to hyaline hyphae and numerous crystals variable in shape and size. Subhymenium 20–30 μm thick, composed of textura intricata. Paraphyses 90–125 μm long, filiform, unbranched, septate, ca. 1 μm wide, at the apex up to 2–3 μm diam. and often hooked. Asci ripening sequentially, 55–95 × 4–6 μm, cylindrical, short-stalked, acute at the apex, J-, 8-spored. Ascospores fasciculate, 45–70 × 0.8–1 μm, filiform, tapering towards the base, hyaline, aseptate, with 1–2 μm thick gelatinous sheaths.

Conidiomata and zone lines not seen.

Known distribution: Only from the type locality.



Figs. 1-5. *Coccomyces papillatus* on twigs of *Pinus armandii*. 1. Twigs bearing ascomata. 2. Ascomata observed under a dissecting microscope. 3. Ascoma in vertical section. 4. Structure of an ascoma in vertical section. 5. Paraphyses, a young ascus, two mature asci with ascospores, and discharged ascospores.

Habitat: *C. lijiangensis* was collected from living, suppressed twigs and dead twigs.

Notes: Six species of *Coccomyces* are known on twigs of *Pinus* spp., i.e. *C. cembrae* Rehm, *C. guizhouensis* Y. R. Lin & B. F. Hu, *C. irretitus* Sherwood, *C. papillatus* Sherwood, *C. parvulus* Sherwood, and *C. strobi* J. Reid & Cain (Sherwood 1980, Lin et al. 1994). The ascomata of *C. lijiangensis* are very similar to those of *C. guizhouensis*, *C. papillatus*, and *C. strobi*. All three species have ascomata on five-needle pines with a depressed centre and a small central papilla when young. The shape of ascoma and ascomatal structure in vertical section are more similar to *C. papillatus*. However, the asci of our collection are shorter and much narrower, the ascospores are much longer and narrower, and the shapes of asci, ascospores, and paraphyses at tops are quite different. Furthermore, the host tissues are combined much tighter with fungal tissues in covering stroma for our collection than those in *C. papillatus*. Therefore, it is described here as new.

Therrya abieticola C. L. Hou & M. Piepenbr., **sp. nov.**

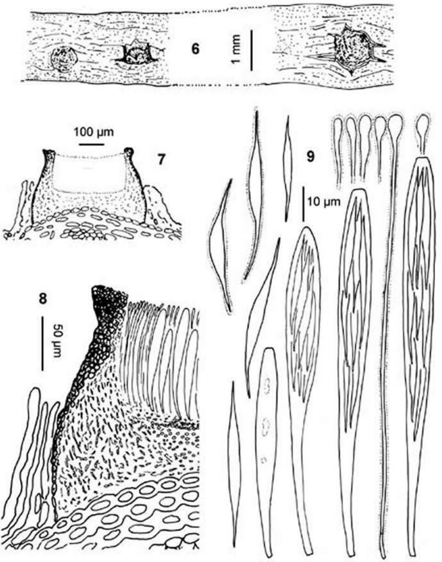
MycoBank 511067 **FIGURES 6-9**

Ascomata 450–650 µm, nigra, orbicularia; paraphyses filiformes; asci 90–140 × 7–10 µm, clavati; ascosporae 30–50 × 2.5–4.5 µm, filiformes.

Etymology: referring to the host.

HOLOTYPE: On twigs of *Abies* sp. *(Pinaceae)*, CHINA. YUNNAN: Laojunshan, alt. ca. 2400 m, 25 VII 2001, C. L. Hou, M. Piepenbring, R. Kirschner, and Z. L. Yang 103 (AAUFP 90036).

Ascomata on twigs, 450–650 µm diam. From surface view, more or less circular, slightly raising above the surface of the substrate at maturity, opening by irregular splits to expose a slightly dark hymenium, lips absent, entire surface dark brown to black, often crimpled before ascoma open. In median vertical section, ascoma 250–350 µm high, covering stroma 45–70 µm thick near the centre, and thicker towards the edge, consisting of an outer layer of host cortical tissue near the basal stroma, a layer of dark brown textura angularis, which does not extend to the basal layer, and an inner layer of short hyphae which are connected to the basal stroma, basal stroma well-developed, up to 200 µm thick, composed of short, hyaline hyphae and small cells. Subhymenium 8–12 µm thick, consisting of small, hyaline cells. Paraphyses 100–155 × 1–1.5 µm, filiform, not branched, swollen up to 3–6(–8) µm at the apex and forming knobs, usually surrounded by gelatinous sheaths but not forming epithecium. Asci ripening sequentially, 90–140 × 7–10 µm, clavate, truncate at the apex, with a conspicuous stalk, broadest near the middle, tapering gradually to the stalk, without circumapical thickening, J-, 8-spored. Ascospores 30–50 × 2.5–4.5 µm, fusiform, acerose acute at both ends, hyaline, aseptate, with a thin or indistinguishable gelatinous sheath.



Figs. 6-9. *Therrya abieticola* on twigs of *Abies* sp. 6.Twig bearing ascomata observed under a dissecting microscope. 7. Ascoma in vertical section. 8. Structure of an ascoma in vertical section. 9. Paraphyses, an immature ascus, mature asci with ascospores, and discharged ascospores.

Conidiomata and zone lines not observed.

Known distribution: Only from the type locality.

Habitat: On dead or senescent twigs of *Abies* sp.

Notes: There are six species of *Therrya* are known worldwide and five of them occur on twigs of conifers (Reid & Cain 1961, Funk 1980). The other species, *T. eucalypti* Z. Q. Yuan, occurring on eucalypts, might be closely related to *Colpoma* Wallr. instead of *Therrya* based on its morphology and host (Yuan & Mohammed 1997). Shapes of asci, ascospores, and paraphyses of the new species are very similar to those of type species of *T. pini* (Alb. & Schwein.) Höhn. (Reid & Cain 1961), although the tops of paraphyses do not form a conspicuous epithecium. *T. abieticola* differs from the known species of *Therrya* in having aseptate ascospores. Shapes of ascospores of *T. abieticola* are similar to those of *Coccomyces guizhouensis* (Lin et al. 1994). The latter differs in the larger ascomata and filiform paraphyses without knobs at apex, as well as occurrence on *Pinus armandii* instead of on *Abies* sp.

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MYCOTAXON

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Two new *Gymnopus* species from the Island of Andros (Kiklades, C. Aegean, Greece)

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Abstract — Two new species of *Gymnopus* from the island of Andros (Kiklades, C. Aegean, Greece) are described and discussed. *Gymnopus dysosmus* is a uniformly coloured dark brown species with unpleasant garlic smell, similar to that of *G. impudicus* but differing by the dark basidiocarps, long and slender, almost cylindrical spores and a greenish brown reaction of the pileipellis hyphae with alkali. *Gymnopus amygdalisporus* shows also a similar but clearer green reaction with alkali, especially of the trama hyphae and it is therefore placed in the sect. *Levipedes* subsect. *Alcalivirentes* where it takes a unique position with its dark date-brown to olivaceous pileus, yellowish-brown distant lamellae and broadly ellipsoid to amygdaliform spores.

Key words — *Omphalotaceae*

Introduction

Reports on the macrofungi from the islands of the Aegean archipelagos are scarce in literature (Petrak 1943a,b; Plank 1980). In the frame of the inventory of the Greek macrofungi, the islands of Andros, Naxos and Amorgos (Kiklades, Central Aegean, Greece) have been thoroughly investigated. Andros has been visited periodically by P. Lizoň (1993-1997); furthermore from 1995 until recently, it is being inventoried almost yearly, mainly from September to March, by E. Polemis. Some preliminary results of this work, including several records new for Greece, were presented in national check-lists (Zervakis et al. 1998, 1999) and during scientific conferences (Polemis et al. 2002). Among other interesting species, two collections belonging to *Gymnopus* from Andros

— the first from an abandoned field with *Pteridium aquilinum* and the second in littoral alluvial grassland — are found to be new species. They are illustrated and described below.

Material and methods

The material was collected and photographed in the field by the first author during his visits to Andros in 2004. Extensive notes were made from the fresh material. Microscopical analyses were performed using a Leica DM 1000 microscope using standard techniques. Drawings were made with help of a drawing tube.

Taxonomy

Although the genus *Gymnopus* in Europe is fairly well known due to the work of Antonín & Noordeloos (1997), a number of new taxa have recently been described, mainly from the Mediterranean (Bañares et al. 2007, Contu 2000, Ortega et al. 2003, Villareal et al. 2002). At present 41 species are known from Europe, including the following two new taxa from Andros. Both new species fit well within the core of the genus *Gymnopus* as circumscribed in a phylogenetic context by Mata et al. (2007)

Gymnopus dysosmus **Polemis & Noordel., sp. nov.** **Fig. 1.**

MycoBank # 511107

Pileus 10-30 mm, hemisphericus vel convexus, depressus, hygrophanus, haud translucido-striatus, obscure brunneus, pallescens, glaber; lamellae subdistantes, adnatae, ventricosae, crassae, obscure griseobrunneae; stipes 30-50 × 3-4 mm, pileo concolor, pruinosus, glabrescens; odor saporque foetens. Sporae (7.5)8.0-11(12) × (3.0)3.3-4.5 µm, oblongae, lacrymoideae vel cylindraceae, Q = 2.0-2.9, inamyloideae; basidia tetrasporigera, fibulata; acies lamellarum heterogenea; cheilocystidia 20-30 × 4-8 µm, clavata vel fusiformia, inconspicua; pileipellis cutis hyphis cylindraceis 3-13 µm latis constitutus pigmentis incrustatis; caulocystidia 16-38 × 4-8 µm, cylindracea vel flexuosa, interdum coralloidea, incrustata; fibulae presentes. Habitat inter Pteridium locis ruderalis. Holotypus: "Greece, Kiklades (C. Aegean), Isl. Andros, Valley of Vori stream, 2km from the shore, 1 Dec. 2004, E. Polemis 04-A805 (L)

Etymology—*dys* = bad, *osme* = smell, referring to the fetid smell.

Description—Basidiomata medium sized, fasciculate, uniformly colored dark (grey-) brown, with a strong fetid-garlic smell. Pileus 10- 30 mm, hemispherical to convex, with distinct central depression, with slightly inflexed and soon deflexed to straight and undulating margin, hygrophanous, when moist dark date-brown, not or faintly striate at margin, somewhat sulcate, smooth, matt when dry, pallescent on drying to pinkish or ochraceous grey-brown, fawn, at centre remaining darker for a long time. Lamellae subdistant to moderately crowded, L=26-34, l=1-3, narrowly adnate and often forked near to attachment

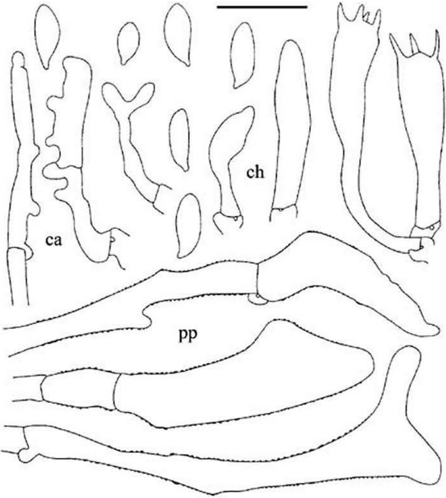

Fig.1. *Gymnopus dysosmus*. Spores, cheilocystidia (ch), basidia, caulocystidia (ca), and pileipellis (pp) [from holotype]. Bar = 20 µm.

to stipe, ventricose and rather thick, dark greyish-brown, almost concolorous with pileus, slightly paler towards edge, pallescent on drying. Stipe 30-50 × 3-4 mm, cylindrical to somewhat compressed, uniformly dark brown, concolorous with pileus, initially almost entirely white pruinose then almost smooth and glabrous to slightly fibrillose, with abundant white rhizoids at base. Context thin in pileus, dark brown to pinkish brown, thin and concolorous with surface in stipe. Smell and taste strong, unpleasant fetid or like garlic.

Basidiospores (n=30) (7.5)8.0-11(12) × (3.0)3.3-4.5µm, Q = 2-2.9 Qav = 2.4, oblong, lacrymoid to cylindrical, hyaline, smooth, thin-walled, inamyloid.

Basidia 26-36(42) × 6-8.5(9) µm, 4-spored, clavate, clamped. Lamella edge heterogeneous. Cheilocystidia 20-30 × 4-8 µm, clavate-fusiform, to cylindrical, not branched, inconspicuous. Pleurocystidia absent. Hymenophoral trama subregular made up of cylindrical, thick-walled, moderately branched 2,5-10 µm wide hyphae, greenish-brown in KOH, with coarsely incrusting pigment. Subhymenial hyphae thin-walled, hyaline, often irregularly gnarled-coralloid. Pileipellis a cutis of cylindrical, radially arranged, 3-13 µm wide hyphae, with slightly thickened, brownish walls, with fine to coarse incrustations in distinct bands, with short lateral projections; terminal elements fusoid, often irregular to lobate, up to 20 µm broad. Stipitipellis a cutis made up of cylindrical, slightly thick-walled smooth or incrusted yellow-brown, 2-6 µm wide, hyphae. Caulocystidia 16-38 × 4-8 µm, smooth to finely incrusted, cylindrical to flexuous, often lobate or branched to somewhat coralloid, hyaline. Clamp connections abundant in all tissues. Pileus surface of exsiccates turning black with KOH, greenish-brown under microscope in KOH. No part of basidiomata amyloid, dextrinoid, or metachromatic in cresyl blue.

Habitat: Gregarious in an abandoned field on wet mossy soil with residues of *Pteridium aquilinum* and twigs of unidentified shrubs.

> **Collection examined.** Greece, Kiklades (C. Aegean), Isl. Andros, Valley of Vori stream, 2km from the shore, 1 Dec. 2004, E. Polemis 04-A805 (holotype L, isotype LGAM-AUA).

Gymnopus dysosmus keys out in section *Vestipedes* Antonín, Halling & Noordel. on account of the pileipellis structure of repent, not inflated, hardly diverticulate hyphae, and in subsect. *Impudicae* Antonín & Noordel. because of the strong fetid smell (Antonín & Noordeloos 1997, 2008). It differs from all the known European species by the long, narrow spores. The otherwise similar *G. impudicus* (Fr.) Antonín, Halling & Noordel. usually has less dark basidiocarps, well differentiated cheilocystidia and spores measuring (5.5)6.5–9.0(9.5) × (2.9)3.2–4.5 µm, with Q value between 1.7 and 2.2. *Gymnopus herinkii* Antonín & Noordel. has much paler colours, spores 6.5–9.0(9.5) × 3.5–4.5 µm, Q = (1.6)1.7–2.1, and a completely fertile lamella edge without cystidia. None of the North American species described by Halling (1983) fits with the present species.

Gymnopus amygdalisporus Polemis & Noordel., **spec. nov.** Fig.2.

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> *Pileus 10-40(-50) mm, hemisphericus vel convexus demum expandus, obtuse umbonatus, haud hygrophanus, haud translucido-striatus, obscure rufobrunneus vel sepiaceus, margine versus olivaceo tincto, initio pruinosus demum glabrescens, innate fibrillosus; lamellae distantes, adnatae, anastomosae vel furcatae, brunneae; stipes 30-50 × 3-10(-20), cylindricus vel compressus, argillaceo-brunneus, fibrillosus vel leviter rimosus; odor saporque adstringens. Sporae (7.0)8.0-9.5(11.4) × (4.2)4.7-6.0(6.5) µm, amygdaliformiae,*

inamyloideae; basidia tetrasporigera; acies lamellarum heterogenea; cheilocystidia 17-50 × 3.0-9.5 µm, cylindracea, flexuosa vel irregulariter clavata, interdum coralloidea; pileipelis cutis hyphis cylindraceis, 2-20 µm latis, elementis terminalibus cylindraceis, clavatis vel fusiformibus, ad 70 × 12 µm, pigmentis incrustatis; fibulae presentes. Habitat inter Juncus in pratis stercoratis Holotypus: "Greece, Isl. Andros, Kiklades (C. Aegean), Vori beach, 1 Dec. 2004, E. Polemis 04-A796 (L)"

Etymology: *amygdalus* – almond, referring to the almond shaped spores.

Basidiomata fasciculate, medium sized, tricholomatoid, thick-fleshed. Pileus 10-40(50) mm, hemispherical, convex to plano-convex with low, blunt umbo, slightly involute or straight and finally irregularly undulate margin, not hygrophanous, not translucent striate, dark chestnut brown, purplish date-brown to sepia, somewhat paler with olivaceous tinge at margin, initially finely pruinose, glabrescent, then smooth and glabrous or faintly and indistinctly innately fibrillose. Lamellae rather distant L=20-30, l=1-3, adnate, ventricose, moderately thick, often anastomosing, forked and veined, brownish, umber gradually pallescent towards the edge to buff-ochraceous. Stipe 30-50 × 3-10(15-20) mm, irregularly cylindrical to compressed, slightly tapering downwards or rooting, buff to clay-buff, entirely fibrillose to somewhat rimose. Context relatively thick, ochraceous, cream in stipe to grayish-brown in pileus, reddish-brown under the pileus and stipe cuticle. Smell and taste unpleasant rancid.

Basidiospores (n=30) (7.0)8.0-9.5(11.4) × (4.2)4.7-6.0(6.5) µm, Q = 1.4-2.0, Qav. = 1.6, amygdaliform, ellipsoid, often with large refracting drop, yellowish in KOH, smooth, thin-walled, inamyloid. Basidia 30-40 × 7-10 µm, mostly 4-spored but few 2-spored also seen, clavate, clamped, often with necropigment, which appears yellow-brown in KOH and reddish-brown in ammonia. Lamella edge heterogeneous. Cheilocystidia 17-50 × 3-9.5 µm, cylindrical, flexuose to irregularly clavate, rarely branched to somewhat gnarled or coralloid. Hymenophoral trama regular, made up of hyaline cylindrical elements, 40-110 × 2-10 µm. Pileipelis a cutis made up of 2-20µm wide, cylindrical hyphae, with cylindrical, clavate to fusiform terminal elements up to 70 × 12 µm, pigment membranal reddish-brown in KOH and coarsely incrusting forming a zigzag pattern, hyaline smooth, gnarled hyphae also present. Tramal hyphae distinctly blue-green with KOH. Stipitipellis a cutis made up of cylindrical up to 7 µm wide, hyphae, thin- to slightly thick-walled, smooth or finely incrusted reddish-brown in KOH.. Clamp connections abundant in hymenium but rare or absent in all other tissues. No part of basidiomata amyloid, dextrinoid, or metachromatic in cresyl blue.

Habitat: Gregarious, on soil and on litter in littoral grassy pastures with *Juncus acutus*, on manured soil.

Collection examined. Greece, Isl. Andros, Kiklades (C. Aegean), Vori beach, 1 Dec. 2004, E. Polemis 04-A796 (Holotypus, L, isotype LGAM-AUA).

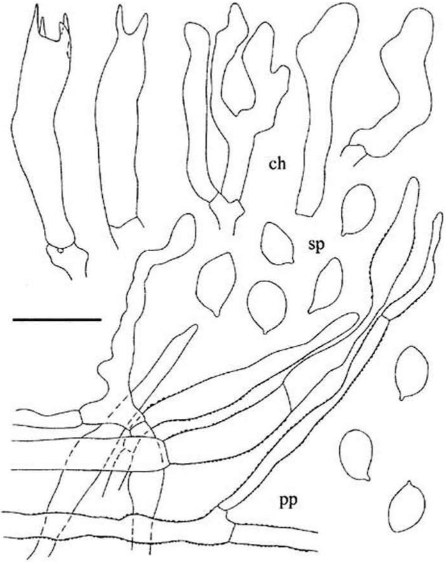

Fig. 2. *Gymnopus amygdalisporus*. Spores, basidia, cheilocystidia (ch) and pileipellis (pp) [from holotype]. Bar = 20 µm.

Gymnopus amygdalisporus shows a distinct green discoloration of the tramal hyphae in KOH, which places it in sect. *Levipedes* subsect. *Alcalivirentes* Antonín & Noordel. (Antonín & Noordeloos 1997). A number of new species has recently been described from the Mediterranean. *Gymnopus potassiovirescens* Contu is similar but differs by having a less fibrillose stipe, narrower spores, and lacks coralloid hyphae in the pileipellis (Contu 2000). *Gymnopus bisporus* (J. Carbó & Pérez-De-Greg.) Vila & Llimona from Catalonia is a much smaller species with practically glabrous stipe, 2-spored basidia, and without cheilocystidia (Vila & Llimona 2006). *G. inusitatus* (Vila & Llimona) Vila & Llimona, also described from Spain, has a glabrous stipe, much more slender spores and lacks cheilocystidia (Vila & Llimona 2006).

Acknowledgments

We are grateful to Dr. Vladimír Antonín, Moravian Museum, Brno, Czech Republic, for valuable advice on the new species. The Moraitis Legacy and the Municipality of Korthi (Andros) are greatly acknowledged for granding E. Polemis' Ph. D. studies during 2003 - 2006. Access to the facilities of the N.H.N (The Netherlands) for E. Polemis was achieved thanks to the financial support from the European Commission's Research Infrastructure Action via the SYNTHESYS project. Mrs Dr Else C. Vellinga, University of Berkeley, California, U.S.A. and Prof. Dr. Thomas W. Kuyper, University of Wageningen, The Netherlands kindly reviewed this paper before submission. We are very grateful for their constructive comments. Dr. Jan Frits Veldkamp, National Herbarium of the Netherlands, Leiden, is acknowledged for advice regarding the Latin diagnoses. Anita Walsmit-Sachs is thanked for preparing the line drawings.

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Phragmosporangium uniseriatum in Brazil

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Abstract—Specimens of *Phragmosporangium uniseriatum* were isolated from soil samples of the Brazilian Atlantic Rainforest. Description, comments, and illustrations are presented.

Key-words—Brazilian ecosystem, *Oomycota*, *Saprolegniaceae*

Introduction

The genus *Phragmosporangium* was proposed by R.L. Seymour (Johnson et al. 2005) with only one species, *Phragmosporangium uniseriatum*. This genus in the *Saprolegniaceae* (*Oomycota*) is characterized by filamentous zoosporangia, branched or unbranched, sometimes sinuous or lightly coiled, with an apical cell often curved, usually formed by the conversion of entire hypha. The zoospores are discharged in a dictyucoid way, disposed in a single row. *Phragmosporangium uniseriatum* was isolated from Liberian and Nigerian soil samples, in 1970, by R.L. Seymour, and it has not been found anywhere else, even after 10.000 soil samples had been verified from many tropical areas in the world (Johnson et al. 2005).

Material and methods

Soil samples were collected from Brazilian Atlantic Rainforest areas in the State of São Paulo (Cubatão municipality – "Pilões River Valley" – 23°53'S 46°30'W and Santo André municipality - "Reserva Biológica de Paranapiacaba" - 23°46'S 46°18'W) and, in the State of Minas Gerais (Ingaí municipality - "Reserva do Boqueirão" - 21°20'S 45°01'W). In the laboratory these samples were baited by the multiple baiting technique (Milanez 1989), and the isolates purified in the CMA (corn meal agar – 17g) with penicillin (0.1g), streptomycin sulphate (0.05g) and vancomycin (0.01g) to 1L of distilled water and/or MP_5 (maltose peptone agar). The specimens were preserved in Wheaton's bottles (100mL) in a freezer with *Sorghum* seeds, by the Castellani method (Milanez 1989, Figueiredo & Pimentel 1975) and incorporated in the Fungi Culture Collection of the "Instituto de Botânica de São Paulo" (SPC).

Results and discussion

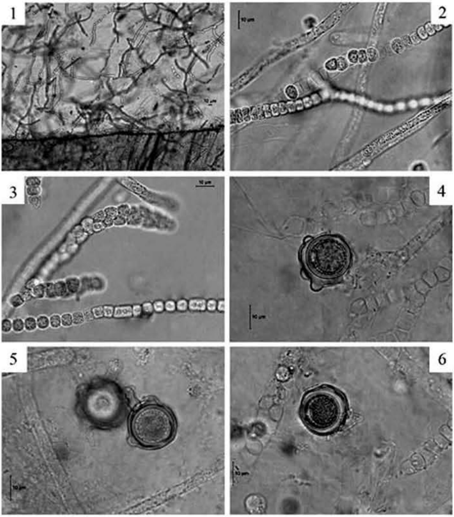
Phragmosporangium uniseriatum R.L. Seym., Mycotaxon 92: 8. 2005. Figs 1-6

Mycelium delicate; two weeks colony on *Sorghum* sp. seeds 1.5–2.0 cm diam. Gemmae lacking. Zoosporangia filamentous, long, branched or unbranched, sinuous, with 1-2 spore rows (usually 1); discharge of spores dictyucoid, rarely by wall deliquescence. Spores spherical (6-8 µm diam) or elongate (6–15 x 6–10 µm). Oogonia brownish, lateral, spherical, (17–)20–28.5(–30) µm diam., occasionally catenulate; oogonial wall with inner surface smooth and outer surface smooth, irregular, or papillate; oogonial stalks unbranched, short, straight, or slightly curved. Oospheres maturing. Antheridial branches androgynous and monoclinous, apically or laterally appressed, 1-2 per oogonium (usually 1); fertilization tubes present. Oospores brownish, (13–) 17.5–25 µm diam, subcentric, some centric, single, sometimes showing a pellucid spot, filling or not the oogonium.

REPRESENTATIVE SPECIMENS EXAMINED: **BRASIL. São Paulo: Santo André,** Reserva Biológica de Paranapiacaba, 23°46'52"S46°18'77"W, 23°46'53"S and 46°18'75"W, 26-VIII-2004, 18-XI-2004, *A.L. Gomes* SPC 1996.

The isolates were observed growing on snake skin and *Sorghum* sp. seeds, forming poor colonies in the last substrate. The Brazilian isolates differed from the original description (Johnson et al. 2005) in that the spores were arranged in one or two rows inside the sporangia, the oospores were centric, beside the subcentric, and the outer oogonial wall ranged from smooth to papillate, not only irregular. The oogonia, as the oospores, have a brownish color not mentioned in the original description; the presence of an elongate, strongly curved apical cell in the sporangia was not observed either. The sexual structures were smaller than the ones described by Johnson et al. (2005), who cited measurements of (23–)25–29(–33) µm diam for the oogonia and (19–)24–28(–32) µm diam for the oospores. The size variations may be due to the environmental conditions, although they have not been mentioned in the original description.

The genus *Phragmosporangium* appears similar to *Dictyuchus* and *Brevilegnia*. However, the conversion of an entire hypha into a sporangium with an internal



Figures 1-6. *Phragmosporangium uniseriatum*. — 1. Mycelium on snake skin. 2. Dictyucoid discharge of the zoospores. 3. Sporangia filamentous with 1-2 spores row. 4. Papillate oogonium with subcentric oospore and monoclinous antheridium 5. Oogonium with a centric oospore. 6. Oogonium with a subcentric oospore evidencing a fertilization tube of the antheridium.

linear arrangement is unique to *Phragmosporangium*. The Brazilian isolates are not only the first known occurrence for South America; they represent the first record after the original description. *P. uniseriatum* appears common in the soil from Atlantic Rainforest, with the specimens generally isolated when snake skin is used as bait.

Acknowledgments

The first author would like to thank Dr. D. E. Padgett, who confirmed the identification. FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) and CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) provided the financial support. We also are grateful to Dr. Mónica M. Steciow and Dr. Angélica M. Arrambari for reviewing the manuscript.

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Records of *Hypomyces*, including two new species, from Chanchamayo, Peru

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Abstract — During a short collecting trip to four closely situated localities in Chanchamayo Province, Peru, ten species of *Hypomyces* (including *Cladobotryum*) were recorded. The new species *Hypomyces robledoi*, found on *Ganoderma australe*, represents a unique morphotype among fungicolous *Hypocreaceae*. *Cladobotryum novovarium* is described as a tropical counterpart of *H. aurantius*. Most of the remaining species, found mainly as anamorphs, have not been recorded previously from South America.

Key words — fungicolous fungi, systematics, tropical ascomycetes

Introduction

The knowledge of fungicolous *Hypocreaceae* from tropical regions was summarized recently in an overview of the taxa found in a national park in Thailand (Põldmaa & Samuels 2004). Tropical America was considered to be better explored with respect to these fungi compared to other respective areas of the world. Published data are based on collections from the Caribbean region (Cuba, Puerto Rico) and selected countries of South America (Brazil, Colombia, French Guiana, Guyana, Venezuela). To our knowledge there are no published records of *Hypocreaceae* from Peru.

In February-March 2007 a four-day expedition was undertaken to the Chanchamayo District (Chanchamayo Prov., Junin Dpto.) in central Peru, ca 200 km northeast of Lima. The collecting sites were at 600-1000 m altitude with two of them along roadsides in human-disturbed areas near the city of La Merced (La Cruz, Kimiri). Miguel Grau and Kimo were situated in the Amazonian rain forests at the eastern slopes of the Andes. Although the visit was too short to provide an overview of the *Hypocreaceae* in the area, it yielded several collections representing unnamed taxa, two of which are described in this paper. Seven species not reported earlier from South America include the common and cosmopolitan *H. sympodiophorus*. The rest, found as anamorphs, had been collected previously only in a few localities. These involve *H. mycophilus, H. sibirinae, H. viridigriseus* and *Cladobotryum odorum* (anamorphic *Hypomyces*), all recorded also in North America. *Cladobotryum cubitense* was known only from Cuba. Despite the several collections available for *H. australis* and *H. subiculosus* from South America, distinguishing between these species and their allies is difficult.

A collection with an unusual set of morphological characters, collected on *Ganoderma australe*, is described as a new species of *Hypomyces* (Fr.) Tul. & C. Tul. Recently, six species of fungicolous *Hypocreaceae* were reported on fruitbodies of *Ganodermataceae* from Thailand (Põldmaa & Samuels 2004). This high diversity is attributed to the fact that fruitbodies of many members of this host group are perennial and in moist tropical conditions offer ideal conditions for development of a diverse mycota. The other new species described herein, was found on the cosmopolitan *Schizophyllum commune*. This *Cladobotryum* anamorph is very similar to that of *H. aurantius*, differing mainly in the formation of imbricate conidial chains. The remaining collections from Peru also were found on fruitbodies of various aphyllophoralean basidiomycetes.

A few anamorphic collections from Peru, representing undescribed species of the *H. rosellus*- and *H. subiculosus*-complexes, will be dealt with in future studies along with additional material from other tropical areas. The same applies to specimens of *Hypocrea, Sphaerostilbella* and *Sporophagomyces.* Following is a preliminary report of the genus *Hypomyces* from Chanchamayo province in Peru.

Materials and methods

Ascospores or conidia were isolated onto 2 % malt extract agar (MEA, Oxoid Ltd.) and grown at 25 °C in alternating 12/12h fluorescent light and darkness. KOH– indicates that perithecia and/or subiculum do not change their colour when treated with 3% aqueous potassium hydroxide solution. The measurements given for ascospores and conidia represent the mean values (the innermost number) and limits of the 90% range of estimated normal distribution in case of >25 measured units (number given in brackets). For other structures the absolute ranges of 10–20 measurements are presented. Specimens are deposited at the Tartu Fungal Herbarium (TAA) and cultures at the Tartu Fungal Culture Collection (TFC) and Centraalbureau voor Schimmelcultures (CBS, Utrecht).

DNA was extracted from pure cultures but in the case of *H. robledoi* also from the stromatal layer containing perithecia with mature ascospores on the natural substratum. Extraction followed the protocol supplied by the manufacturer of the High pure PCR template preparation kit used (Roche Applied Science). PCR was performed with puReTaq Ready-To-Go™ PCR Beads (Amersham Biosciences) and products purified with Exo-SAP (Amersham Biosciences) according to the manufacturer's instructions. Primers used for PCR and/or sequencing: ITS1, ITS4, ITS5 (White et al. 1990), LROR, LR5 and LR7 (http://www.biology.duke.edu/fungi/ mycolab/primers.htm). Sequence fragments were inspected and assembled using Sequencher 4.7 (Gene Codes Corp.). Continuous stretches of the ITS1-5.8S-ITS2, followed by 1300 bp from the 5' end of the LSU rDNA (obtained from the teleomorph on the host in case of *H. robledoi*) of the new species and LSU sequences only from other strains were submitted to the European Molecular Biology Laboratory (EMBL) database. Phylogenetic analyses followed the procedures described by Põldmaa & Samuels (2004).

Taxonomy

Cladobotryum cubitense R.F. Castañeda & G.R.W. Arnold,
Feddes Repertorium 98: 414. 1987. **Figs. 1–3.**

Specimen examined (anamorph only): Peru, Junin Dept., Chanchamayo Distr., Kimiri, on agaric (*Lentinus* ?); 1 March 2007, leg. K. Põldmaa, TAA 171215, culture TFC 2007-13, CBS 121646; GenBank 779857.

This species has been known only from Cuba, where the type specimen was found to grow on decaying agarics (Arnold & Castañeda Ruiz 1987). The collection from Peru and the conidial isolation obtained on MEA correspond well to the original description. Characteristic are fast growth and profuse cream-coloured aerial mycelium, reaching the lid of the Petri dish, as well as abundant conidiation. The colony reverse, at first yellow, becomes crimson, as is characteristic of *Hypomyces* species producing the pigment aurofusarin. The conidiogenous cells are attenuated towards the tip with the base being much wider (3–4 µm) than reported for the type. Conidia are cylindrical, rarely ellipsoidal, often of irregular shape being bent at the base, in the lower half or in the middle, some sigmoid. Almost all conidia are 3-septate, measuring 18.3–23.5–27.8 × 5.4–6.5–7.6 µm on MEA (n = 60) and 26–33 × 6.0–7.5 µm on the natural substratum. They are thus somewhat longer and considerably wider than was reported in the original description but match with the measurements obtained from examination of the ex-type strain (Põldmaa & Samuels 2004). Conidiogenesis is retrogressive as reflected by shortening of the conidiogenous cells and the hila at the base of conidia that also become gradually wider and more laterally placed. Conidia are joined in clusters of 3–5 at their bases at the single conidiogenous locus; sometimes they appear to have an additional scar of attachment in the chain that is left at the base in opposite position to the hilum. Remarkable is the occasional formation of intercalary conidia on the stipe of the conidiophore (Fig. 2). Despite an accompanying figure of chlamydospores, these are said to be absent in the diagnosis of *C. cubitense*.

In old cultures of the Peruvian collection abundant chlamydospores are found among submerged and aerial mycelium. These are composed of (sub)globose, hyaline to pale yellowish, smooth and thick-walled cells 11–30 µm diam that arise from an intercalary cell, forming lateral chains or clusters.

The poorly conidiating ex-type strain examined has lost its characteristic colouration leading Põldmaa & Samuels (2004) to suggest conspecificity of *C. cubitense* with the morphologically similar anamorph of *H. khaoyaiensis* K. Põldmaa & Samuels. The fresh isolation from Peru, however, provides ample morphological and cultural characteristics to enable distinction of these two species. The morphologically very similar *C. semicirculare* G.R.W. Arnold et al. differs by narrower conidia and forming violet or brown pigment in culture and LSU rDNA characters (Kirschner et al 2007).

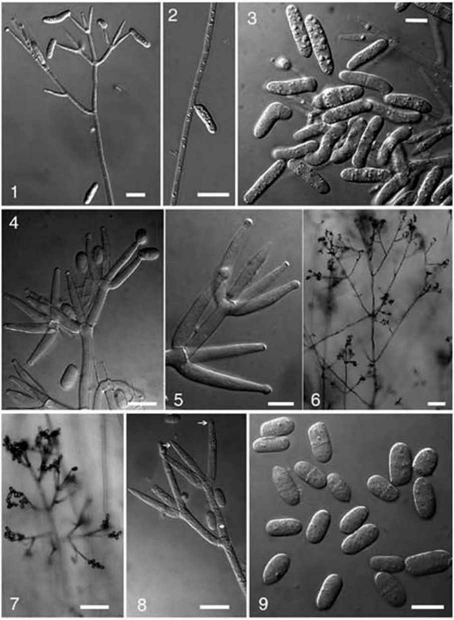
Cladobotryum novovarium K. Põldmaa, **sp. nov.**

MycoBank MB 511077, GenBank 779856 **Figs. 4–9.**

Cladobotryuo vario Nees anamorphosi Hypomycetis aurantii *(Pers.) Tul. & C. Tul. similes, sed conidiis ad basim imbricate catenatis. Species tropica, in Peruvia lecta.*

White to yellowish delicate to dense cottony mat covering host's hymenophore and upper surface of basidiomata. Conidiophores profusely branched, 6.0–7.5 µm wide, forming conidiogenous cells on short supporting branches 20–30 × 6–8 µm. Conidiogenous cells held in verticils of 3–5; subulate, aseptate or rarely with 1 septum, 16–35 µm long, 4.5–6.5 µm wide near base, attenuating to 1.5–2.8 µm at tip, tip with periclinal thickening and sometimes with a collarette; conidia held obliquely at the single locus. Conidia broadly cylindrical, 11.1–13.9–16.7 × 5.8–7.3–8.7 µm, l/w 1.5–1.9–2.4 (n = 30); 1(–2)-septate. Chlamydospores not observed.

Colonies on MEA spreading fast, reaching 90 mm diam in 5 d; aerial mycelium scarce to moderate, 1(–2) mm high, white, margin even; reverse ivory to pale yellow; odour sweetish bitter; conidiation abundant. Conidiophores ascending, profusely branched, branching irregular or verticillate, main branches in opposite position, 5–6 µm wide, becoming to 13 µm wide and thick-walled (to 1.3 µm) in age. Conidiogenous cells formed directly on conidiophores or on short lateral branches in verticils of 2–3(–5), subulate, 30–50 µm long, attenuating from 3–6.5 µm at the base to 1.2–2.8 µm at the tip, becoming gradually shorter (20–25) and wider (5.5–9.0 µm), sometimes also 1-septate or ampulliform when old, with the tip becoming wider and the prominent periclinal thickening to 1 µm during retrogressive conidiogenesis; producing numerous conidia obliquely. Conidia broadly ellipsoidal or cylindrical, straight; 8.7–11.6–14.5 × 4.5–5.9–7.2 µm, l/w 1.6–2.0–2.4 (n = 80); (0–)1-septate; basal hilum central but becoming gradually wider, shorter and more laterally placed on successive conidia; held in long imbricate chains. Chlamydospores formed



Figs. 1-9. *Cladobotryum* species. — 1–3. *C. cubitense* on MEA. 1. Topmost part of a conidiophore. 2. Intercalary conidium formed directly on conidiophore stipe. 3. Conidia. 4–9. *C. novovarium*. 4–5. Conidiogenous cells forming conidia, on the host. 6. Conidiophore branching. 7. Imbricate chains of conidia. 8. Top of a conidiophore, arrows pointing to periclinal thickenings at conidiogenous loci. 9. Conidia. 6–9. On MEA.

Scale bars. 1, 2, 4, 8 = 20 µm. 3, 5, 9 = 10 µm. 6, 7 = 50 µm.

from intercalary cells on submerged and aerial hyphae; cells subglobose, 3–17 µm diam, hyaline to pale yellowish; wall to 1.5 µm thick, smooth; arising from an intercalary cell, forming lateral chains or irregular aggregations of 2–8 cells.

Holotype: Peru, Junin Dept., Chanchamayo Prov., Chanchamayo Distr., near La Merced, La Cruz, on *Schizophyllum commune* Fr., 28 Feb 2007, leg. L. Ryvarden & K. Põldmaa, TAA 171208, culture TFC 2007-10, CBS 121647.

Characteristics of this new anamorph and cultures grown on MEA correspond well to those observed in *H. aurantius*. The latter is the only species of *Hypomyces* and *Cladobotryum* in which conidia are held in end-to-end chains. In the culture from the Peruvian specimen, however, the successive conidia are formed obliquely and held at their bases in imbricate chains, a distinctive feature of the anamorph of *H. subiculosus*. The latter differs by narrower, sparingly branched conidiophores and heterogeneous conidia, the shape of which depends on the order of formation in the chain. Both species are very common but *H. subiculosus* occurs mostly in subtropical and tropical regions. Whereas *H. aurantius* is common in temperate regions (Rogerson & Samuels 1993); Arnold (1986) reported several collections of both stages from Cuba. Similar conidiophores and conidia characterise also *C. penicillatum* W. Gams described from Europe (Gams 1980). The species differs in slower growth and production of a red pigment in culture.

Very similar collections from Japan were described and illustrated by Matsushima (1975) as *Cladobotryum* sp. Conidia are said to be formed in irregular chains, often obliquely. However, the long end-to-end conidial chains of *H. aurantius* appear this way because they do not remain straight when conidia slide along the side of each other. Moreover, in the accompanying drawings by Matsushima, all the conidia have centrally placed hila at their base or they stand straight when still attached to the conidiogenous locus. Disc-like connections between conidia are reported to distinguish it from *C. varium* but these are considered insufficient for species delimitation by de Hoog (1978). Such discs of refractive material, probably originating from the outer wall of the conidiogenous cell occur also in the anamorph of *H. aurantius* as depicted by Rogerson & Samuels (1993) and in *C. novovarium* (Fig. 5) at the apices of conidia still in the process of maturation at the conidiogenous locus.

In *C. novovarium*, production of conidia in an oblique position is reflected in the morphology of conidia in which the hila at the base become gradually more flattened and laterally placed. Sometimes there appears to be an additional scar of attachment that arises by close contact to the adjacent conidium in the chain and is placed in opposite side of the base of a single conidium. In *H. aurantius* the hila are always central on the successively formed conidia and in case they become anastomosed in the chain, each conidium is joined with its base to the area at or near the top of the next conidium. Additional differences involve the placement of conidiogenous cells which is more reminiscent of a penicillus in *H. aurantius*. In the material of *C. novovarium* on the host, branching is profusely verticillate with conidiogenous cells and supporting branches being shorter than those formed in culture. The conidial chains, even though including over 20 conidia, seem not to extend as long as those of *H. aurantius*. Characteristic of *C. novovarium* is also the strong smell, reminding that observed in cultures of *C. odorum* but never in *H. aurantius*.

Phylogenetic analyses of the LSU rDNA sequences used by Põldmaa et al. (1999) and Põldmaa & Samuels (2004) along with the LSU sequence of *C. novovarium* and additional sequences of *H. aurantius* available in Genbank resulted in most parsimonious trees (data not shown) in which the Peruvian specimen formed a sister group to the clade comprising sequences of *H. aurantius* and *C. gracile* K. Põldmaa. Based on the presented data, the specimen from Peru is described as a new species that is considered to be the counterpart of *H. aurantius* in the tropics. In order to understand whether the geographical distribution of *H. aurantius* and *C. novovarium* are indeed not overlapping, strains of *H. aurantius* from the tropics need to be studied.

Cladobotryum odorum G.R.W. Arnold, Feddes Repert. 99: 29. 1988.

SPECIMENS EXAMINED (anamorph only): Peru, Junin Dept., Chanchamayo Distr., Kimo, on decayed fruitbodies of *Polyporus ciliatus* Fr. or *P. dictyopus* Mont.; 2 Mar 2007, leg. K. Põldmaa, TAA 171230, culture TFC 2007-15; Miguel Grau, ca 1000 m altitude, on *Cyclomyces tabacinus* (Mont.) Pat.; 3 Mar 2007, leg. K. Põldmaa, TAA 171250, culture TFC 2007-20, CBS 121665, GenBank 779862.

Hypomyces australis (Mont.) Tul. & C. Tul., Ann. Sci. Nat., Bot., IV, 13: 12. 1860.

Subiculum effused over host's hymenophore, thin, arachnoid, buff, KOH–hyphae hyaline, 4.5–6.5 µm wide. Perithecia gregarious, semi-immersed in the subiculum; obpyriform, 290–350 µm high, 200–240 µm diam; buff to pale yellowish brown, KOH–; wall 10–15 µm thick, pseudoparenchymatous; papilla obtuse, 80–100 high, tapering from 80–120 µm wide at the base to 30–50 µm at the top, with surface cells measuring 10–13 × 8–11 µm. Asci cylindrical, 150–200 × 6.5–7.5 µm, tip thickened to 2.5 µm; ascospores uniseriate with overlapping ends. Ascospores fusiform, 26.7–30.0–33.4 × 4.9–5.9–6.8 µm, l/w 3.9–5.0–6.0 (n = 25), hyaline, medianly 1-septate; verrucose, with warts to 0.5 µm high; apiculate, apiculi 5–7.5 µm long, 2–3.5 wide at the base, with acute tips.

Conidiophores arising from delicate mycelium on host; unbranched, 3.3–3.7 µm wide, frequently septate; conidiogenous cells formed in pairs directly on the conidiophore or on short supporting branches, ending with one terminal locus. Conidia ellipsoidal to broadly cylindrical, 32–37 × 13–14 µm, (1–)3-septate, hilum central and narrow but mostly laterally placed and wide; held in imbricate chains. Chlamydospores not observed.

Colonies on MEA spreading slowly to moderately fast, reaching 20–25 mm diam in 7 d; cottony, aerial mycelium sparse, to 3 mm high; margin fasciculate; whitish, reverse not coloured. Conidiation scarce to moderate. Odour lacking. Conidiophores arising from submerged hyphae but mostly from aerial hyphae, not differentiated from these; unbranched or branching irregularly, bearing one or seldom 2 or 3 verticils of conidiogenous cells near the top. Conidiogenous cells held in verticils of 2–4, 25–50 µm long, 2–3 µm wide, attenuating to 1.0–2.5 µm at the tip, becoming gradually shorter and wider at their tip during retrogressive conidiogenesis; with one terminal locus, producing to 8 conidia. Conidia broadly ellipsoidal, clavate, obpyriform or occasionally subglobose, straight, 21.3–27.3–33.2 × 9.4–11.5–13.7 µm, l/w 1.8–2.4–3.0 (n = 25), 1–3-septate, hyaline; hilum narrow and central or wide (to 3.5 µm diam) and laterally placed; held in imbricate chains. Chlamydospores observed on submerged hyphae, intercalary, subglobose, 12–14 µm diam, hyaline, smooth-walled.

SPECIMENS EXAMINED: Peru, Junin Dept., Chanchamayo Distr., Miguel Grau, ca 1000 m altitude, on *Stipitochaete damicornis* (Link) Ryv.; 3 Mar 2007, leg. K. Põldmaa, TAA 171426, culture TFC 2007-18, CBS 121663; GenBank 779860.

Distinctive of the Peruvian collection are the comparatively large ascospores with long acute apiculi formed in pale KOH– perithecia and subiculum. Among aphyllophoricolous *Hypomyces* only *H. australis*, *H. novae-zealandiae* Dingley and *H. tegillum* Berk. & M.A. Curtis have KOH– perithecia forming over 30 µm long ascospores. Ascospores in the type specimens of *H. novae-zealandiae* and *H. tegillum* exceed 40 µm, while in *H. australis* 35 µm is the upper limit. In all three species the subiculum is very thin, parchment-like with perithecial colour ranging from pale yellowish to orange or even reddish brown in *H. tegillum*. In the type material of *H. australis* and the collections of *H.* cf. *australis* from Thailand perithecia appear almost black (Põldmaa & Samuels 2004). Heterogeneous specimens have been attributed both to *H. australis* and *H. tegillum* by Rogerson & Samuels (1993), some of which definitely represent other species (Põldmaa & Samuels 2004). Especially diverse are the anamorphs in collections cited as *H. australis*, none of which matches that in the type specimen (Põldmaa & Samuels 2004).

In the Petri dish with colonies originating from germinated ascospores as well as in the subcultures from the first transfer from the Peruvian specimen, the growth of the colonies was slow and only few conidia were produced, and then only after two or three weeks. In subsequent transfers onto MEA, conidiation became more abundant, remaining still moderate. The developing anamorph is most similar to that of *H. khaoyaiensis*, differing in culture characteristics. Namely, growth rate of the culture from the Peruvian specimen is slightly slower and aerial mycelium more scanty and lower. The margin of colonies is characteristically fasciculate due to single hyphae growing faster out of the colony, followed by extensive branching as well as due to conidia from the margin falling beyond the growing edge and establishing new growth. Conidiogenesis is obviously retrogressive in both cases. The culture from Peru has fewer branched conidiophores and lacks 'secondary conidiation' described for *H. khaoyaiensis*. The conidia are straighter and wider than in the collections of *H. khaoyaiensis* or *H.* cf. *australis* from Thailand, but resemble those found in specimens of *H. tegillum* (Põldmaa & Samuels 1999). For this species there are no data of the anamorph in the type or any cultures available for comparison.

For the time being, the Peruvian collection is identified as *H. australis*, bearing in mind that there are diverse collections of tropical *Hypomyces* that share ascospore size and morphology but differ in colour of perithecia and anamorph characters. These could be identified as *H. australis*, *H. novae-zealandiae* or *H. tegillum*. These 3 species are difficult to demarcate due to the lack of ex-type cultures and heterogeneity of the available collections.

Hypomyces mycophilus Rogerson & Samuels, Mycologia 85: 250. 1993.

Specimens examined (anamorph only): Peru, Junin Dept., Chanchamayo Distr., near La Merced, La Cruz, on *Phlebia* sp., 28 Feb 2007, leg. K. Põldmaa, TAA 171211, culture TFC 2007-11, CBS 121648; Kimiri, on *Lentinus*?; 1 Mar 2007, leg. K. Põldmaa, TAA 171215, culture TFC 2007-12; Miguel Grau, ca 1000 m altitude, on a small decaying agaric on a palm; 3 Mar 2007, leg. K. Põldmaa, TAA 171440 culture TFC 2007-21.

Hypomyces robledoi K. Põldmaa, **sp. nov.**
MycoBank MB 511076, GenBank 779859 **Figs. 10–16.**

Subiculum effusum, pallidum; hyphae hyalinae, 2–4.5 µm latae. Perithecia dense aggregata, immersa, ampulliformia, 310–390 × 180–250 µm; eburnea, KOH ope colore immutata; papilla 75–100 µm alta. Asci cylindrici, 120–150 × 4–6 µm, octospori. Ascosporae fusiformes, 15.4–17.4–19.4 × 3.1–3.6–413 µm, aeque bicellulares, hyalinae, verrucosae, apiculatae; apiculi 1.0–1.5(–2.0) µm longi. Coloniae in agaro maltoso byssaceae, albae; conidiophora irregulariter ramosa. Rami conidiogeni vel cellulae conidiogenae 45–275 µm longae, ad basim 1–2 µm latae, ex uno loco ad 6 conidia producentia, conidia lateraliter adhaerentia. Conidia variabilissima, cylindracea, ellipsoidea, fusiformia, obpyriformia, citriformia, ovoidea vel globosa 5.0–13.7–22.4 × 2.6–4.2–5.9 µm; 0–1(–3)-septata; hyalina. Chlamydosporae absentes.

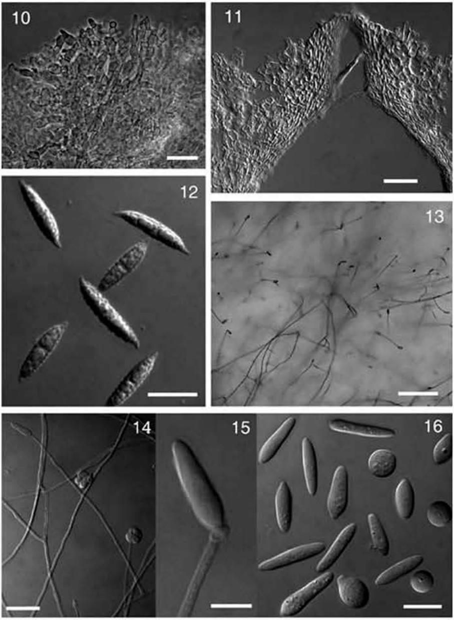
Etymology: named after the Argentinean mycologist Gerardo Robledo who collected the type specimen.

Colony effused, thin, 9 × 6 cm stromatic layer on host's pore surface, whitish to ivory, fertile in most parts; mycelium in few scattered areas without perithecia and between upper parts of perithecia composed of KOH–, tightly arranged, thin-walled hyphae, 2–4.5 µm wide in the inner part; hyphae of the 60–70 µm thick upper region of the stromatic layer frequently septate, occasionally branched, terminating in free ends, composed of swollen cells, 8–13 × 6–9 µm. Perithecia densely aggregated, contiguous with each other at the lateral walls or with very thin mycelium in between; immersed in subiculum, with only tips of papillae visible and protruding at maturity; ampulliform, 310–390 high, 180–250 µm diam; ivory, KOH–; perithecial wall 20–25 µm thick, composed of longitudinally elongated flattened cells 10–20 µm long, ca 3 µm wide, thin-walled; papilla low, 75–100 µm high, with obtuse tip, composed of narrow elongated cells, those reaching the surface clavate to subglobose, 6.0–9.5 × 2.5–6.5, wall to 1 µm thick, continuous with subiculum when still immersed, lacking outgrowths when protruding at maturity; pseudoparenchyma between basal parts and below perithecia (at most 75 µm thick) of isodiametric to slightly elongated thin-walled cells 5–10 × 3–7 µm. Asci cylindrical, 120–150 × 4–6 µm, apex simple or thickened to 1.3 µm; ascospores uniseriate with ends overlapping. Ascospores fusiform, 15.4–17.4–19.4 × 3.1–3.6–4.1 (n = 65) µm, l/w 3.7–4.7–5.8; 1-septate, septum median; wall verrucose, with warts up to 0.5 µm high; ends apiculate, apiculi 1.0–1.5(–2.0) µm, often bent and shorter at one end, with obtuse tips.

Colonies on MEA spreading moderately fast, reaching 30 mm diam in 7 d; aerial mycelium moderate to profuse, cottony, 1(–2) mm high, white, with even margin; reverse uncoloured; no odour; conidiation abundant. Conidium-bearing cells or branches integrated singly in sparingly and irregularly branched aerial hyphae, sometimes arising from submerged hyphae; 40–275 µm long, 1–2 µm wide at the base, tapering gradually but only slightly towards the tip; 2–6-septate; each branch terminating in a single conidiogenous cell bearing one conidiogenous locus at the top; each locus producing 1–6 conidia, held together side by side in straight, oblique or transverse position at the locus, occasionally attached by the base at the middle of the next conidium. Conidia very variable in size and shape, cylindrical, ellipsoidal, fusiform, obpyriform, citriform, ovoid to globose; straight or sometimes slightly curved; 5.0–13.7–22.4 × 2.6–4.2–5.9 µm, l/w 0.7–3.5–6.4 (n = 140); 0–1(–3)-septate but mostly aseptate; base flattened or with a low central hilum. Chlamydospores not observed.

Holotype: Peru, Junin Dept., Chanchamayo Prov., Chanchamayo Distr., Kimo, on *Ganoderma australe* (Fr.) Pat.; 2 Mar 2007, leg. G. Robledo, TAA 171240, culture TFC 2007-17, CBS 121664.

Hypomyces robledoi, found on *Ganoderma australe*, is a unique member of the fungicolous *Hypocreaceae*. It has warted and apiculate two-celled non-disarticulating ascospores that are found only in the genus *Hypomyces*. The other features of the teleomorph as well as the anamorph are not shared among the members of *Hypomyces*, *Arachnocrea*, *Sphaerostilbella* or *Sporophagomyces*,



Figs. 10-16. *Hypomyces robledoi.* —10. Free ends of hyphae composed of swollen cells at the surface of the stroma-like byssus between perithecia. 11. Median longitudinal section through perithecial papilla. 12. Ascospores. 13. Conidiophores with conidia arising on MEA. 14, 15. Conidia at conidiogenous loci. 16. Conidia.

Scale bars. 10, 11, 14 = 20 µm. 12, 16 = 10 µm. 13 = 50 µm. 15 = 5 µm.

growing on non-agaricoid basidiomata. In the aphyllophoricolous species of these genera, the scattered to gregarious perithecia usually become half-free in a subiculum composed of loosely interwoven hyphae. The very densely aggregated perithecia of *H. robledoi*, however, are almost completely embedded in a stroma-like thin byssus, the texture of which remains partly hyphal. Regarding these features it resembles species of *Hypomyces* that abort agaricoid basidiomata, e.g. *H. lactifluorum* (Schwein.) Tul. & C. Tul., *H. lateritius* (Fr.) Tul. & C. Tul., *H. luteovirens* (Fr.) Tul. & C. Tul. growing on *Russulaceae* as well as *H. hyalinus* (Schwein.) Tul. & C. Tul. on species of *Amanita* (Rogerson & Samuels 1994). As in those species, there is no obvious anamorph on the host of *H. robledoi*. On the other hand, a pseudoparenchymatous layer, mostly reduced to a minute stroma below the perithecia and the outer layer of perithecia, is found in several species of *Sphaerostilbella* (Põldmaa & Samuels 2004).

Characteristic of *H. robledoi* is the anatomy of perithecial layer. A distinctive outer region of the stroma-like byssus is composed of entirely moniliform hyphae with free ends at the surface. While in some *Hypomyces* species mummifying the fruitbodies of *Russulaceae* subicular hyphae tend to become swollen or to have free ends at the surface, these features are found in combination only occasionally (e.g., in *H. luteovirens*). In aphyllophoricolous species of *Hypomyces* free ends of subicular hyphae with incrusted walls have been found only in *H. auriculariicola* K. Põldmaa & Samuels. Short hyphae with free ends grow out from the perithecial wall, usually at the base of the papilla in *H. villosus* Samuels & Rogerson and in several species of *Sphaerostilbella*. *Hypomyces robledoi* lacks outgrowths from the perithecial wall, and the outer cells of the papilla are not prominently swollen as in aphyllophoricolous species of *Hypomyces*.

The ascospores in the specimen from Peru are typical of *Hypomyces* because they are fusiform, medianly septate, apiculate and covered with warts. The dimensions of the ascospores and apiculi fall in the lower range among those of the aphyllophoricolous and agaricicolous *Hypomyces*, most suggestive of *H. succineus* Rogerson & Samuels. *Sphaerostilbella* is characterised by ellipsoidal or naviculate nonapiculate ascospores. The only exception is *S. broomeana* (Tul. & C. Tul.) K. Põldmaa (originally described in *Hypomyces*) that has the largest ascospores in the genus (10–15 × 2.5–3 µm) bearing small, <1 µm apiculi at the ends. It is close to *H. robledoi* in ascospore morphology and dimensions but the latter do not overlap. Although *H. robledoi* occurs on the same group of hosts as the recently described *S. ganodermatis* K. Põldmaa & Samuels, the latter species is clearly distinct because of its minute aseptate ascospores, perithecial morphology and the *Gliocladium* anamorph.

The ascospores that were inoculated onto MEA did not germinate within one week. However, after a few weeks some colonies had appeared in both of the inoculated Petri dishes. Each of these was reinoculated and found to constitute the same anamorph. DNA was extracted from two subcultures. Their rDNA ITS and LSU sequences were found to be identical, also when compared to the respective sequences obtained from the teleomorph material on the host. It is possible that the cultures did not originate from ascospores but from fragments of the perithecia or surrounding hyphae in the drop of water in which the material was smashed and spread onto the agar medium. However, because all the subcultures that grew were indistinguishable in morphology and at the molecular level, the described anamorph is considered to be the asexual stage of *H. robledoi*.

The anamorph of *H. robledoi* is unique among the aphyllophoricolous species of *Hypocreaceae* because of the simple conidiophores producing mostly aseptate but extremely variable conidia that are irregularly agglutinated at the single locus at the tip of the conidiogenous cell in the absence of uniting liquid. Neither periclinal thickenings nor collarettes were observed at the conidiogenous loci suggesting holoblastic conidial development. Conidia appear to be formed in basipetal chains even though they do not remain attached to each other in a linear fashion. Rather, they adhere laterally as they slide past and come to lie adjacent to neighbouring conidia. Anamorphs of aphyllophoricolous *Hypomyces* produce septate blastic/phialidic conidia held singly or in dry chains at one or several loci of the conidiogenous cell or branch (*Cladobotryum* sensu Rogerson & Samuels 1993). In contrast, conidia of most members of the *Hypocreales*, including those occurring on aphyllophores, are held in a drop of liquid at the tip of a phialidic conidiogenous cell. Regarding the mostly aseptate conidia that stick together laterally at the single conidiogenous locus, the anamorph of *H. robledoi* resembles that of *H. cervinigenus* Rogerson & Simms growing on ascomata of *Helvella* species, the acremonium-like anamorphs of *H. lateritius* and *H. lithuanicus* Heinr.-Norm. on *Lactarius* spp., and the anamorph of *H. succineus* growing on *Pholiota* sp. Similarities can likewise be found with the acremonium-like anamorph of *Sporophagomyces chrysostomus* (Berk. & Broome) K. Põldmaa & Samuels, which also grows on fruitbodies of *Ganoderma* species. In this species, however, the cylindrical 1–3-septate conidia are held in drops of clear liquid.

Remarkable is also the great variation of shape and size in conidia of *H. robledoi*, comparable in the *Hypocreaceae* only to that in the verticillium-like synanamorphs of boleticolous species of *Hypomyces*. However, part of that variability might be attributed to the effect of culture media. Some *Cladobotryum* anamorphs have been observed to produce more variable and longer conidia in culture than in nature (Bastos et al. 1981, Põldmaa et al. 1997). Next to the *Hypomyces* colony on the host there are several kinds of conidial fungi, any one of which resembles closely that observed in culture.

The generic placement of this obviously new species poses difficulties. On morphological grounds, *H. robledoi* possesses features that characterize the genus *Hypomyces*. Although each of the characters is found in individual groups in the genus, their combination in a single species is unique for *H. robledoi*. Therefore the species could represent an early diverged lineage in the large complex of fungicolous *Hypocreaceae*. Phylogenetic analyses of the LSU rDNA sequence of *H. robledoi* along with those used in the previous studies of the author reveal equivocal relationships of the species within the *Hypocreaceae* (data not shown). Different ways of analyses and number of sequences included result in phylogenetic trees with alternative placements of *H. robledoi*. It either shows affinities to agaricicolous species of *Hypomyces (H. luteovirens)* and to members of *Sphaerostilbella* or appears basal in the *Hypocreaceae*. However, any of these relationships receives considerable support. At present, it is considered most reasonable to describe the new species in *Hypomyces*. A phylogeny-based rearrangement of this obviously paraphyletic genus along with its closest relatives is likely to alter the generic placement of this unique morphotype in the future.

Hypomyces sibirinae Rogerson & Samuels, Mem. New York Bot. Gard. 59: 31. 1990.

Specimens examined (anamorph only): Peru, Junin Dept., Chanchamayo Distr., Miguel Grau, on a decaying resupinate basidiomycete; 3 Mar 2007, leg. K. Põldmaa, TAA 171261, culture TFC 2007-22.

Hypomyces subiculosus (Berk. & M. A. Curtis) Höhn., Ann. Mycol. 8: 468. 1910.

Specimens examined (anamorph only): Peru, Junin Dept., Chanchamayo Distr., Miguel Grau, on a small agaric on a log; 3 Mar 2007, leg. K. Põldmaa, TAA 171249, culture TFC 2007-19, CBS 121654; 779861.

Hypomyces sympodiophorus Rogerson & Samuels, Mycologia 85: 268. 1993.

Specimens examined: Peru, Junin Dept., Chanchamayo Distr., Kimiri, on *Stereum ostrea* (Blume & T. Nees) Fr.; 1 Mar 2007, leg. G. Robledo, culture TFC 2007-14.

Hypomyces viridigriseus K. Põldmaa & Samuels, Sydowia 49: 88. 1997.

Specimens examined (anamorph only): Peru, Junin Dept., Chanchamayo Distr., Kimo; on *Phellinus gilvus* (Schwein.) Pat.; 2 Mar 2007, leg. K. Põldmaa, TAA 171234, culture TFC 2007-16, CBS 121651; GenBank 779858.

The anamorph and characteristics of the culture, derived from conidia of the Peruvian specimen correspond to the previous description of *H. viridigriseus* (Põldmaa et al. 1997). The conidia, however, are even more variable on MEA, with some 4- or 5-septate conidia as long as 80 µm. The smallest, 1-septate conidia tend to be broadly obovate. Remarkable are also the comparatively wide, thick-walled and greenish-brown main branches of the conidiophores.

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Determination of fungal air spora in Afyonkarahisar, Turkey

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Abstract — The microfungal air spora of Afyonkarahisar district were determined by using Air Ideal samplers. 2400 fungal colonies were isolated from 216 samples taken monthly from six different areas of Afyonkarahisar in 2005. 32 different microfungal taxa were identified. Frequencies of the main genera were *Penicillium* (35.8%), *Cladosporium* (24.5%), *Alternaria* (13.1%), *Aspergillus* (8.9%), *Ulocladium* (6.6%), *Drechslera* (0.6%), *Rhizopus* (0.5%), *Polyscytalum* (0.1%), and sterile colonies (12.0%). The full list is posted on http://www.biyoloji.aku.edu.tr/KONUK/07117.pdf

Key words — airborne fungi, bio-aerosols, inner Aegean region

Introduction

Airborne fungi are among the most common organisms in nature. They are considered to be correlated with air pollution and proposed as a cause of adverse health effects in humans, animals and plants, e.g. acting as aeroallergens and causing infections. More than 80 fungal genera have been associated with respiratory tract disorders (Shelton et al. 2002, Beaumont et al. 1985, Flückiger et al. 2000, Su et al. 2001). Several studies report that exposure to large concentrations of airborne microbes is often associated with asthma and rhinitis (Beaumont 1988) and hypersensitivity pneumonitis (Siersted & Gravesen 1993).

Examination of typical fungal distributions at one particular location can be helpful in identifying associations between domestic fungal sensitivity and clinical prevention of seasonal allergic diseases (Li 1995, Verhoeff & Burge 1997).

Identification of outdoor air spora is important, but only limited information on indoor fungi is available in Afyonkarahisar (Orman et al. 2005, 2006). Similarly, there is no published information on outdoor fungal air spora in different parts of Afyonkarahisar. The purpose of the present work was to determine the types and relative frequencies of outdoor fungal air spora in Afyonkarahisar.

Material and methods

The altitude of the province is around 1000m with moderately high mountains (to 1300 m) and lower areas (from 688m) among them (Anonymous 2001). Its landscape is covered by moderately high mountains with lowlands among them. Its vegetation is mainly steppe with a low incidence of woodlands (15%). The province is situated in a lake district.

The concentration of airborne fungal spores from 6 areas in the centre of Afyonkarahisar (ANS Campus, Esentepe, Gümüşkent, Mecidiye, Sahipata, Yukarıpazar) have been measured. Samples were collected using an Air Ideal™ aerobiocollector with an air intake of 100 L/min and impact speed of <20 m/sec set to capture particles from 3 to 10 microns. Spores were directly collected onto agar Petri dishes.

Cultures were identified to species level using the following mycological taxonomic keys: Pitt (1979), Hasenekoğlu (1991), and Raper et al. (1949) for *Penicillium* and related species; Raper & Fennell (1965) for *Aspergillus* species; and Barnett & Hunter (1998), Hasenekoğlu (1991), and Ellis (1971) for other fungal species.

In this paper, author citations are abbreviated following Brummitt & Powell (1992).

Afyonkarahisar has a typical continental climate regime and it is situated on transition zones of Euro-Siberian and Iran-Turanian vegetation regions. Statistical analyses were carried out by using both SPSS 11.0 and 13.0. In these analyses Pearson and Spearman correlations and one-way ANOVA were performed.

Results and discussion

A total of 2400 fungal colonies were isolated from 216 Petri dishes. 32 fungal species were identified and 287 non-sporulating (sterile) cultures also obtained. The highest maximum yearly average of species tallied was observed in Sahipata at 799 CFU/m^3. Esentepe (775 CFU/m^3) and Gümüşkent (575 CFU/m^3) had the next highest averages. ANS Campus had the lowest colony numbers (279 CFU/m^3). At all sampling sites, the dominant genus was *Penicillium,* which comprised 35.9% of the samples identified. Next came *Cladosporium* (24.5 %)

followed by *Alternaria* (13.1 %), sterile colonies (12.0%), *Aspergillus* (8.9%), *Ulocladium* (6.6%), *Drechslera* (0.6%), *Rhizopus* (0.5%), and *Polyscytalum* (0.1%). *Cladosporium cladosporioides* was the species found most frequently followed by *Alternaria alternata* and *Cladosporium herbarum*. When their presentation and climatic data, obtained from Afyonkarahisar Meteorological station, were compared statistically, no significant variations in fungal concentrations were found ($p>0.05$). Similar results have been reported by Efe (1995), Asan et al (2003), and Fang et al (2005).

Cladosporium spores probably occur more abundantly worldwide than any other spore type and are the dominant air spora in many areas, especially in hot climates as corroborated by Takahashi (1997), Şen & Asan (2001), and El-Morsy (2006). *Cladosporium herbarum*, is often the major contributor to inhalant allergy and allergic asthma in humans (Cosentino et al. 1995).

Alternaria alternata allergens have long been considered to cause significant respiratory allergies and serious cases of respiratory arrest (O'Hollaren et al. 1991, Vijay et al. 1990).

In brief, Afyonkarahisar has clinically important fungi, such as *Cladosporium* and *Penicillium*, that dominate the air spora. The fact that the number of taxa was lower in this study compared to previously reported results may be explained by the geographic position and vegetation of the study area, a bowl-like city surrounded by mountains.

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Psilocybe subbrunneocystidiata (*Strophariaceae, Agaricales*): a new species from southern Brazil

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Abstract — A new southern Brazilian species, *Psilocybe subbrunneocystidiata*, is described from Rio Grande do Sul State. This species is placed in sect. *Brunneocystidiatae* according to its colored cystidia and subrhomboid basidiospores. All members of *Psilocybe* sect. *Brunneocystidiatae* are tropical and hallucinogenic.

Key words — *Basidiomycota*, bluing species, subtropical fungi

Introduction

Efforts to document the diversity of the family *Strophariaceae* Singer & A.H. Sm. in Rio Grande do Sul State, in south Brazil are currently under way. These efforts have revealed a more diverse group than previously reported. Some new records and taxa recently published by Cortez & Coelho (2003, 2004), Cortez & Silveira (2007a, b), Guzmán & Cortez (2004, 2005) and Silva et al. (2006) support this statement. During collections for a fungal survey of the *Strophariaceae* from the Itapuã State Park (Silva et al. 2006), we found a new species of *Psilocybe* (Fr.) P. Kumm., which is described in the present work.

Materials and methods

For detailed information on the study area, see Silva et al. (2006). Microscopic observations of the studied material were made obtaining thin sections of the pileus and stipe of dried specimens, mounted on 10% NH_4OH, 5% KOH simple or with 1% Congo red solution. At least 25 measurements of each microstructure were taken, and drawn with the aid of a light tube. In basidiospore description, Q is the quotient between the length and width and n is the number of measured basidiospores (apiculus excluded). General color names used in description are personal interpretations of the authors, once that they were noted immediately after the gathering.

Taxonomy

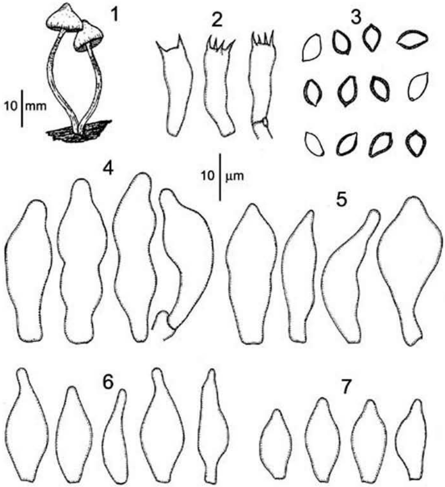
Psilocybe subbrunneocystidiata P.S. Silva & Guzmán, **sp. nov.** FIGS. 1-7

MYCOBANK: MB 47340

> *Pileus circa 10 mm latus, convexus et subumbonatus, laevis, rufobrunneus vel nigricans. Lamellae subadnatus, fuscus, marginis candicans. Stipes circa 25 × 1 mm, albidus vel brunneolus vel rufobrunneus. Velum pauperum progressus. Sporae (4.5-)5-6(-7.5)× 3-4 × 3-4 µm, subrhomboidae vel subellipsoidae, crassitunicata, subbrunneolus. Pleurocystidia ex duobus typus: A: (14-)25-35 × (4-)9-12(-13)µm, subfusiformis vel ventricosa rostrata, griseoulus, subbrunneolus vel hyalinae, B: 18-25(-27) × (5-)6-10 (-11)µm, analoga typus A. Cheilocystidia (15-)17-20(-25) × (4-)5-7(-8)µm, griseolus, ventricosus rostratus vel subfusiformis. Pileipellis subgelatinosus. Hyphae fibulatae. Habitus lignicola, in silva subtropicalis. Holotypus hic designatus: Silva 086/04 in ICN 139168 conservatus; XAL isotypus conservatus.*

Pileus 10 mm in diam., convex to subumbonate, reddish-brown to blackish-brown after drying, surface dry, smooth, margin striate and somewhat crenate. ***Lamellae*** subadnate, close, dark brown, with the margin slightly whitish. ***Stipe*** 25 x 1 mm, sinuous, whitish, brownish or reddish-brown then finally blackish with distinct bluing tones, especially toward the base, surface smooth to squamulose, with whitish small squamules present at the base. ***Veil*** poorly developed in mature state and not forming an annulus on stipe. ***Spore print*** not obtained.

Basidiospores (4.5-)5-6(-7.5) × 3-4 × 3-4 µm, Q = 1.5-2, n = 25, subrhomboid in face-view, subellipsoid to oblong in side-view, thick-walled, wall up to 1 µm thick, with conspicuous germ-pore and apiculus, brownish-yellow; a few basidiospores are abnormal, (7.5-)8.5-10 × 4-5 × 3.5-5 µm, subrhomboid in both face and side-view. ***Basidia*** 13-24 × 4.5-7 µm, 4-spored, ventricose-clavate, with a median constriction, hyaline. ***Pleurocystidia*** of two types A: (14-)25-35 × (4-)9-12(-13) µm, rare, pale gray, yellowish to hyaline, with the base yellowish brown, subfusoid-rostrate or ventricose-rostrate, with a narrow base, some with a middle constriction; B: 18-25(-27) × (5-)6-10 (-11) µm, common, subfusoid with a narrow base or ventricose-rostrate or sublageniform with a narrow or wide base, with the same color as above. ***Cheilocystidia*** (15-)17-20(-25) × (4-)5-7(-8) µm, ventricose-rostrate, subfusiform-rostrate or sublageniform, with a narrow or wide base, with the same color as pleurocystidia. ***Hymenophoral trama*** regular, with hyphae 4-15 µm wide, thin-walled, hyaline, encrusted with yellowish-brown pigment. ***Subhymenium*** with globose elements up to 13 µm wide, hyaline or pale orange or brownish. ***Pileipellis*** an ixocutis of subgelatinized



Figs. 1-7. *Psilocybe subbrunneocystidiata*.
1. Basidiomata. 2. Basidia. 3. Basidiospores. 4. Pleurocystidia type A.
5. Pleurocystidia type B. 6. Cheilocystidia. 7. Caulocystidia.

hyphae, 3-5 (-10) µm wide, hyaline to pale yellow, thin-walled. ***Stipitipellis*** with hyaline to pale yellow, encrusted walls hyphae, 4-6.5 µm wide. ***Caulocystidia*** (15-)17-35 × 5-10 µm, subfusoid, clavate or ventricose, hyaline, with slightly thickened walls, grouped in clusters on the apex. ***Clamp connections*** present on most septa.

Habitat: Gregarious to caespitose, on a decayed trunk in a subtropical forest ("restinga" vegetation).

Studied material: BRAZIL. Rio Grande do Sul State: Viamão, Itapuã State Park, 22 May 2004, P.S. Silva 086/04 (ICN 139168, holotype; XAL, isotype).

Remarks: Because of the color of both pleuro- and cheilocystidia, *P. subbrunneocystidiata* belongs to *Psilocybe* sect. *Brunneocystidiatae* Guzmán, where all the known members are caerulescent and have a noteworthy tropical distribution (Guzmán 1983, 1995; Horak & Desjardin 2006). Moreover all these species are considered as hallucinogenic following the concept of Guzman (1983). The Brazilian material presents a combination of features that do not agree with any known species of this section. *Psilocybe brunneocystidiata* Guzmán & E. Horak, from Papua New Guinea (Guzmán & Horak 1978, Horak 2006), differs in the papillate and squamulose pileus, annulate stipe, pleurocystidia of one type only. *Psilocybe neocaledonica* Guzmán & E. Horak, from New Caledonia (Guzmán & Horak 1978, Horak 2006), and *P. aureicystidiata* E. Horak & Desjardin, from Indonesia (Horak & Desjardin 2006), are also phenetically similar species but they differ mainly in the chrysocystidium-like pleurocystidia with a central yellow refractive body.

Psilocybe subbrunneocystidiata increases our knowledge of the genus in Brazil and broadens our understanding of the distribution of *Psilocybe* sect. *Brunneocystidiatae*, which is a remarkably southern hemisphere austral group. *Psilocybe subbrunneocystidiata* supports the relationship between the Australasian and South American *Psilocybe* mycobiotas discussed by Guzmán (1983), Guzmán & Horak (1978) and Horak & Desjardin (2006).

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Observations in *Pluteus* section *Pluteus* in Spain: two new records for Europe

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Abstract — *Pluteus atropungens* and *Pluteus brunneidiscus* are recorded for the first time in Europe. Both are described and briefly discussed. Based on the revision of the type collections, *Pluteus washingtonensis* is considered a synonym of *P. brunneidiscus*.

Key words — *Pluteaceae*, biodiversity

Introduction

The genus *Pluteus* Fr. (*Agaricales*, *Basidiomycota*) has received little attention in studies of fungal biodiversity in the Iberian Peninsula (Spain, Portugal) and Balearic Islands (Spain). The records of *Pluteus* are often included in general checklists. Prior to our study the only monographic paper on this genus was an article by Muñoz-Sánchez (1991) dealing with species of section *Pluteus*, mainly based on collections from the Basque Country (northern Spain). Regional studies on *Pluteus* within the Iberian Peninsula have been published in recent years, as a part of the "Flora Mycologica Iberica" project (Justo & Castro 2004; Justo et al. 2005a, b, 2006).

After revising the collections deposited in the Iberian herbaria and newly collected material, an annotated checklist of the genus in our area has been published (Justo & Castro 2007). According to our revision 33 taxa of *Pluteus* occur in the Iberian Peninsula and Balearic Islands.

Here we present the most interesting results concerning section *Pluteus*, characterized by the presence of metuloid pleurocystidia and pileipellis arranged as a cutis (Vellinga & Schreurs 1985).

Pluteus atropungens and *Pluteus brunneidiscus* are recorded for the first time in Europe. Type collections of both species have been studied, and closely related taxa are discussed. A key to all members of section *Pluteus* in the Iberian Peninsula and Balearic Islands is provided.

Material and methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (1988, 1990). Color annotations in the macroscopical descriptions are from Munsell soil color charts (2000). Terminology for describing the pleurocystidia follows Singer (1986) and Bonnard (1988): cervinus-type cystidia are generally fusiform, provided with 2-4 (6) apical hooks; magnus-type cystidia lack apical hooks and usually have a rather acute apex; intermediate cystidia is the term used for the pleurocystidia situated near the lamella edge. The notation [90, 5, 3] indicates that measurements were made in 90 spores in 5 samples in 3 collections. All structures were measured in Congo Red or an equal mixture of Congo Red and KOH (5%). The following abbreviations are used: avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient.

Taxonomic descriptions

1. ***Pluteus atropungens*** A.H. Sm. & Bartelli, Michigan Botanist 4: 61. 1965. Fig. 1

Type study—Basidiospores [30, 1, 1] 5.5-9.0 × 4.8-7.0 µm, avl × avw = 7.3 × 5.9 µm, Q = 1.0-1.53, avQ = 1.24, mostly (broadly) ellipsoid but (sub)globose spores also present. **Basidia** 20-32 × 6-9 µm, mostly 4-spored but 2- and 1-spored basidia also present, broadly clavate. **Pleurocystidia** 58-80 × 15-28 µm, metuloid, (narrowly) fusiform, narrowly lageniform or (narrowly) clavate, mostly with rounded apex and without hooks, rarely with 1-3 short hooks at apex, with up to 3 µm thick wall. **Intermediate cystidia** without apical hooks, with obtuse apex, some very thin-walled except at apex, and there up to 2 µm thick. **Cheilocystidia** 40-110 (140) × 15-30 µm, (narrowly) clavate, spheropedunculate, lageniform, cylindrical or flexuous, with brown pigment. **Pileipellis** a cutis; hyphae 5-25 µm wide, cylindrical, with brown pigment; terminal elements 75-190 µm long, cylindrical to fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-20 (25) µm wide, cylindrical, colorless or with brown pigment. **Clamp connections** present in all tissues.

Description of all collections

Pileus (40) 50-80 (100) mm hemispherical when young, later applanate or plano-convex, with or without low obtuse umbo at centre, slightly depressed at centre in older specimens; surface innately fibrillose, specially at centre, dry, brown to blackish brown [approx. 7.5YR 2.5/1 to 2.5/3]; margin translucently striate, in older specimens becoming rimose and showing white context underneath. **Lamellae** L = 58-92, l= (0)1-3, moderately crowded, free, ventricose, up to 9 mm broad, white when young, later pink to vinaceous, with blackish brown edge, flocculose under lens. **Stipe** 50-100 × 10-20 mm, cylindrical, subequal or

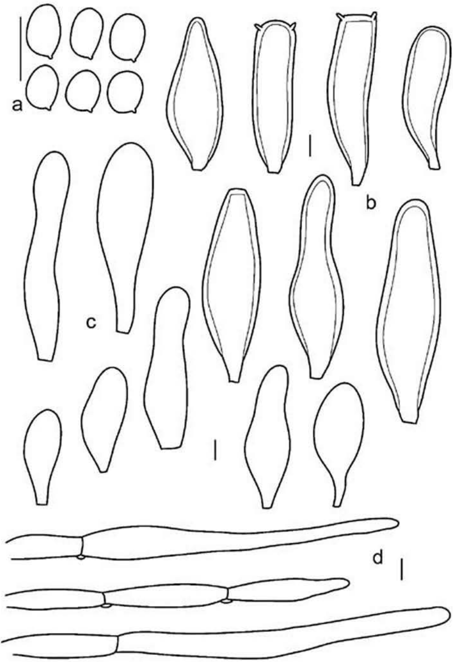

Fig. 1: *Pluteus atropungens*—a: spores (from holytpe and MA-54269); b: pleurocystidia (from holotype and MA-54269); c: cheilocystidia (from holotype); d: pileipellis (from holoype).
Scale bars = 10 µm.

with broad bulbous base, white but covered with longitudinal blackish brown fibrils, solid. **Context** in pileus white or blackish near pileipellis; in stipe white to pale cream near base. **Smell** of crushed context strongly pungent. **Taste** very unpleasant. **Spore print** not recorded.

Basidiospores [90, 5, 3] 5.5-8.5 (9.0) × 4.5-6.5 (7.0) µm, avl × avw = 7.2-7.7 × 5.2-5.9 µm, Q = (1.0)1.1-1.6 avQ = 1.24-1.5, subglobose to ellipsoid, rarely globose. **Basidia** 20-38 × 6-11 µm, mostly 4-spored but 2- and 1-spored basidia also present, broadly clavate. **Pleurocystidia** 60-110 × 15-35 µm, metuloid, (narrowly) fusiform, narrowly lageniform or (narrowly) clavate, mostly with rounded apex and without hooks, rarely with 1-3 short hooks at apex, with up to 4 µm thick wall. **Intermediate cystidia** without apical hooks, with obtuse apex, some very thin-walled except at apex (up to 2 µm thick), colorless or with brown pigment. **Cheilocystidia** (20) 25-110 (140) × 10-30 µm, (narrowly) clavate, sphaeropedunculate, lageniform, cylindrical or flexuous, with brown pigment. **Pileipellis** a cutis; hyphae 5-25 µm wide, cylindrical, with brown pigment; terminal elements 40-190 (210) µm long, cylindrical to fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-20 (25) µm wide, cylindrical, colorless or with brown pigment. **Clamp connections** present in all tissues.

Habitat and distribution—Gregarious or solitary, on wood of broad-leaved trees (*Populus*) or on sawdust. Known from the U.S.A and Spain, possibly also from Chile. October-November.

Collections examined—**Spain: Ávila:** Peguerinos, on wood of unidentified broad-leaved tree, 24.X.1976, F.D. Calonge, MA-Fungi 4633; **Valladolid:** Laguna de Duero, on *Populus* stump, 19.XI.1994, A. Garcia Blanco et al., MA-Fungi 54269; **U.S.A: Michigan:** Marquette Co., Marquette, 20.X.1959, I. Bartelli, coll. A.H. Smith 62033 (MICH, Holotype).

Comments—The above description is based on the Spanish collections and the holotype. Data on smell and taste were not recorded for the Spanish collections so they are taken from the original description (Smith & Bartelli 1965).

Our collections have fewer (sub)globose spores than the type but otherwise fit well with the original description macro and microscopically. The type collection was recorded on sawdust while the Spanish collections grew on wood of broad-leaved trees.

Pluteus atropungens is characterized by the following combination of characters: pleurocystidia mostly without apical hooks, cheilocystidia pigmented, caulocystidia absent, clamp connections present and habitat on sawdust or wood of broad-leaved trees. Up to now it is only known from the U.S.A and Spain. Other species of sect. *Pluteus* with pigmented cheilocystidia are discussed below.

Pluteus atromarginatus (Singer) Kühner grows on coniferous wood and has hooked pleurocystidia. It is widely distributed in Europe and North America (Singer 1956, Vellinga 1990, Banerjee & Sundberg 1995).

Pluteus martinicensis Singer& Fiard comes very close to *P. atropungens* as it also has unhooked pleurocystidia, however it has distinct tufts of caulocystidia and indistinct smell. This species is only known from Martinique and India (Pegler 1983, Pradeep et al. 2002). The type collection [MARTINIQUE: Bois inferieur de la Vallée de la Rivère du Lorrain, 100 m, 4.V.1975, Fiard, 489 Coll A (F, Holotype)] was examined and the following observations were made:

Basidiospores [30, 1, 1] 6.5-7.5 (8.0) × (5.5) 6.0-7.0 µm, avl × avw = 7.1 × 6.3 µm, Q = 1.0-1.2, avQ = 1.12, globose to broadly ellipsoid. **Basidia** 20-35 × 6-10 µm, 4-spored, broadly clavate. **Pleurocystidia** 78-100 × 18-25 µm, metuloid, (narrowly) fusiform, clavate or narrowly lageniform, mostly with rounded apex and without hooks, rarely with 1-3 short hooks at apex, with up to 4 µm thick wall. **Intermediate cystidia** mostly without apical hooks, with obtuse apex, colorless or rarely with brown pigment. **Cheilocystidia** 50-88 × 10-20 µm, (narrowly) clavate, lageniform, narrowly utriform or fusiform, with brown pigment. **Pileipellis** a cutis; hyphae 5-20 µm wide, cylindrical, with brown pigment; terminal elements 87-112 µm long, cylindrical to fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-20 µm wide, cylindrical, colorless or with brown pigment. **Caulocystidia** 50-70 × 14-18 µm, in prominent tufts, clavate to lageniform, some with subcapitate apex, colorless or with brown pigment. **Clamp connections** present in all tissues.

Pluteus spegazzinianus Singer, *Pluteus aporpus* Singer and *Pluteus eucryphiae* Singer are three closely related taxa with colored cheilocystidia that grow on wood of angiosperms. All three species differ from *P. atropungens* because of the cervinus-type pleurocystidia. These species are known from several countries in South America (Singer 1958, 1961, 1986).

The herbarium of New York Botanical Garden harbors a collection from Chile (NY 77425) labeled as "*Pluteus coprophilus* Singer ined". The collection was recorded on ox dung, and initially submitted to NY as a possibly new species. However, before the name was published Singer changed his mind and considered it identical with *Pluteus atropungens*. After revising the collection we agree with Singer's opinion, however we have not included this collection in the above description because it lacks notes on the macroscopical characters. It should be noted that the habitat on dung is rather unusual for a *Pluteus* species; if more collections on the same habitat are recorded its relation with *Pluteus atropungens* should be reevaluated. The original notes and our own observations on the collection are available at http://sweetgum.nybg.org/vh/specimen.php?irn=751.

2. *Pluteus brunneidiscus* Murrill, N. Amer. Fl. 10: 131. 1917 Fig. 2
Pluteus washingtonensis Murrill, N. Amer. Fl. 10: 135. 1917

Type study of *Pluteus brunneidiscus*—Basidiospores [30, 1, 1] 6.5-8.6 × 4.5-6.5 µm, avl × avw = 7.6 × 5.5 µm, Q = 1.29-1.47, avQ = 1.38, (broadly) ellipsoid. **Basidia** 18-30 × 6-10 µm, 4-spored broadly clavate. **Pleurocystidia** 64-95 × 18-24 µm, abundant but many collapsed, metuloid, (narrowly) fusiform, with 2-4 hooks at apex, with up to 1.5 µm thick wall. **Intermediate cystidia** mostly collapsed, similar to pleurocystidia, some without hooks. **Cheilocystidia** 35-47 × 15-20 µm, abundant but mostly collapsed, clavate or sphaeropedunculate, colorless. **Pileipellis** a cutis of cylindrical hyphae, with brown pigment or colorless; terminal elements difficult to observe, cylindrical to fusiform. **Stipitipellis** a cutis; hyphae 5-20 µm wide, cylindrical, colorless or with brown pigment. **Clamp connections** present at least in pileipellis and at base of cheilocystidia.

Photographs of microscopical characters are available at http://sweetgum.nybg.org/vh/specimen.php?irn=519097

Type study of *Pluteus washingtonensis*—Basidiospores [30, 1, 1] 6.5-9.6 × 5.3-7.1 µm, avl × avw = 8.1 × 6.2 µm, Q = 1.18-1.42, avQ = 1.30, (broadly) ellipsoid. **Basidia** 20-33 × 6-10 µm, 4-spored, broadly clavate. **Pleurocystidia** 50-68 × 12-20 µm, abundant but many collapsed, metuloid, (narrowly) fusiform, with 2-4 hooks at apex, with up to 2 µm thick wall. **Intermediate cystidia** mostly collapsed, similar to pleurocystidia, some without hooks. **Cheilocystidia** 32-50 × 15-20 µm, abundant but mostly collapsed, clavate or spheropedunculate, colorless. **Pileipellis** a cutis of cylindrical hyphae, with or without brown pigment; terminal elements difficult to observe, cylindrical to fusiform. **Stipitipellis** a cutis; hyphae 5-20 µm wide, cylindrical, colorless or with brown pigment. **Clamp connections** present at least in pileipellis and at base of cheilocystidia.

Photographs of microscopical characters are available at http://sweetgum.nybg.org/vh/specimen.php?irn=807168

Description of all collections

Pileus (15) 30-55 (80) mm hemispherical when young, later applanate or plano-convex, without umbo, slightly depressed at centre in older specimens; surface innately fibrillose, especially at centre, becoming rimose towards margin, dry or slightly viscid when moist, brown (7.5YR 4/3-4/6, 5/3-5/8), darker at centre (7.5YR 2.5/2-2.5/3, 3/3-3/4); margin translucently striate. **Lamellae** L = 55-78, l= (0)1-3, (moderately) crowded, free, ventricose, up to 5 mm broad, white when young, later pink, with whitish even edge, flocculose under lens. **Stipe** 30-50 (90) × 5-15 mm, cylindrical, subequal or with broad bulbous base, white

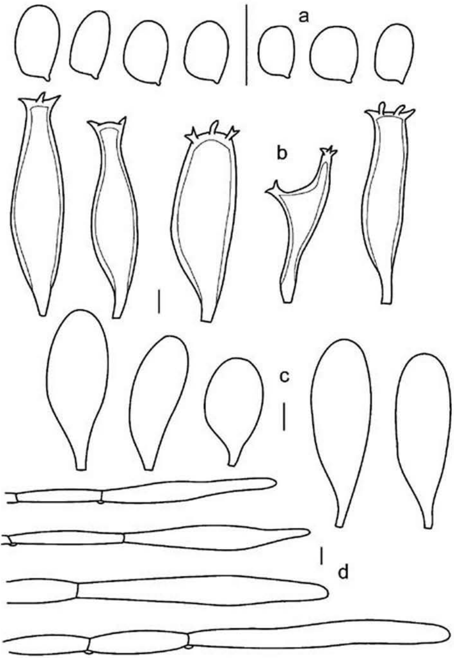

Fig. 2: *Pluteus brunneidiscus*—a: spores (from FS Earle 524 and WA Murrill 348); b: pleurocystidia (from ARAN-5006001 and N1263); c: cheilocystidia (from ARAN-5006001); d: pileipellis (from ARAN-5006001). Scale bars = 10 µm.

but covered with longitudinal brown fibrils, solid. **Context** in pileus white or pinkish near lamellae; in stipe white. **Smell** indistinct to subraphanoid. **Taste** as smell. **Spore print** not recorded.

Basidiospores [240, 9, 7] (5.5) 6.0-9.5 × (4.0) 4.5-6.5 (7.0) µm, avl × avw = 7.3-8.1 x 4.7-6.2 µm, Q = (1.10) 1.15-1.6 (1.7), avQ = 1.30-1.45, (broadly) ellipsoid, a few subglobose or oblong. **Basidia** 17-35 × 6-12 µm, 4-spored, broadly clavate. **Pleurocystidia** 65-95 × 15-25 µm, metuloid, (narrowly) fusiform to cylindrical, some with long peduncle, with 2-5 acute or obtuse, sometimes bifid, hooks at apex, with up to 3 µm thick wall. **Intermediate cystidia** similar to pleurocystidia, some very thick walled (up to 6 µm), others thin walled, some with bifid hooks at apex. **Cheilocystidia** 30-70 (80) × 15-30 µm, (narrowly) clavate or spheropedunculate, colorless. **Pileipellis** a cutis; hyphae 5-25 (30) µm wide, cylindrical, with brown pigment; terminal elements 50-180 µm long, cylindrical to fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-25 µm wide, cylindrical, colorless or with brown pigment. **Clamp connections** present in all tissues.

Habitat and distribution—Solitary, on wood of broad-leaved trees (*Fagus*, *Quercus*). Known from the U.S.A and Spain. June-November.

> **Collections examined**—**Spain: Huelva:** Aracena, La Galbana, in mixed forest of *Quercus ilex* subsp. *ballota* & *Quercus suber*, on wood, 8.XI.2003, L. Romero de la Osa, JA-CUSSTA 3069; **Navarra:** Donamaria, on *Fagus sylvatica* wood, 11.VII.1999, J.M. Lekuona, ARAN 5006001; **U.S.A: Connecticut:** Redding, 20.VII. 1902, F.S.Earle 524 (NY, Holotype of *P. brunneidiscus*); **Michigan:** Emmet Co., west branch of the Maple River, 2.IX.1957, A.H. Smith 57824 (MICH); Emmet Co., Tahquamenon Falls State Park, 13.VII.1953, R. Singer, N1263 (F); ibidem, 20.VI.1953, N81 (F); **Washington:** Seattle, 20.X. 1911-1.XI.1911, WA Murrill 348 (NY, Holotype of *P. washingtonensis*); ibidem, WA Murrill 705 (NY).

Comments—*Pluteus brunneidiscus* and *Pluteus washingtonensis* are both characterized by the small to medium-sized basidiocarps, with brown pileus usually darker at centre, cervinus-type cystidia and clamp connections. Singer (1956) and Banerjee & Sundberg (1995) already pointed at the similarity between the two species, and Singer (1986) cited *P. washingtonensis* as "probably conspecific with *P. brunneidiscus*". The only difference observed between the type collections of both taxa was the slightly bigger spores of *P. washingtonensis* (see above).

Banerjee & Sundberg (1995) described the terminal elements on pileipellis of *P. brunneidiscus* as "narrow with rounded ends" and the same elements in *P. washingtonensis* as "versiform". This was the only character used to separate them in the key elaborated by those authors. In the type collections the terminal elements were difficult to observe, but in modern collections (see description above) the shape of these elements was found to be variable within the same basidiocarp and with the same range of variation observed in most members of sect. *Pluteus*. As no morphological characters were found to separate the two, *P. brunneidiscus* and *P. washingtonensis* are considered here synonymous.

The two Spanish collections fit well with the observations on the type material, and with the macroscopical characters of modern descriptions (Singer 1956, Banerjee et Sundberg 1995).

Several species, very similar or perhaps identical with *P. brunneidiscus*, were placed together by Singer (1986) in stirps *Subcervinus*; they are briefly discussed here:

Pluteus subcervinus (Berk. & Broome) Sacc., described from Sri Lanka has been suggested to be synonymous with *P. brunneidiscus* and *P. washingtonensis* (Singer 1956). The type collection [SRI LANKA: Central Province, Kandy District, year 1869, GHK Thawaites 9717 (K, Holotype)] has been studied, but unfortunately it is in very bad condition. The following observations were made:

Basidiospores [30, 1, 1] 5.4-8.5 × 4.4-5.5 µm, avl × avw = 6.9 × 5 µm, Q = 1.16-1.63, avQ = 1.39, (broadly) ellipsoid. **Basidia** not observed. **Pleurocystidia** 55-70 × 15-20 µm, abundant but many collapsed, metuloid, (narrowly) fusiform, with 1-3 hooks at apex; with up to 2 µm thick wall. **Intermediate cystidia** not observed. **Cheilocystidia** not observed. **Pileipellis** not observed. **Stipitipellis** not observed. **Clamp connections** not observed.

A modern description of this taxon can be found in Pradeep et al. (2002) and little differences were observed with our concept of *P. brunneidiscus*. Size of basidiocarps ("pileus 5.5-8 cm") and shape of the cheilocystidia ("often with a short neck or capitulum") are the most deviating characters. This could not be checked because the collection [K(M)90736] has been mislaid (Dr. Aguirre-Hudson (Kew Gardens), pers. comm.)

The synonymy of *P. subcervinus* and *P. brunneidiscus* remains unresolved. More collections from South Asia should be revised and compared with the above description of *P. brunneidiscus* before a final decision is made. It should be noted that the epithet *subcervinus* is the oldest available of all the taxa included in stirps *Subcervinus*.

Pluteus fibulatus Singer differs from *P. brunneidiscus* mainly by the strongly fibrillose surfaces of pileus and stipe. It is only known from Argentina and Brazil (Singer 1958, 1961).

Pluteus nigropallescens Singer has a black pileus, the stipe lacks longitudinal fibrils, and it has a terrestrial habitat. It is known from Venezuela (Singer 1961).

Pluteus mesosporus Singer has broader spores, "6.8-9 µm" according to Singer (1961); it is known from Venezuela. More research, and new collections, in this group of South American species are needed to test their relation with *P. brunneidiscus*.

The last species included by Singer (1986) in stirps *Subcervinus* is *Pluteus shii* Hongo. No information about this species could be retrieved in Japanese literature (Dr. Kobayashi, pers. comm.) and the name is not included in the Index Fungorum databases.

The European *Pluteus brunneoradiatus* Bonnard comes also very close to *P. brunneidiscus* but differs in the length of cheilocystidia (up to 105 (120) µm) and the scarcity of clamp connections: only 10% of the septa have a clamp (Bonnard 1987, 1993; Citérin & Eyssartier 1998).This species is known from Switzerland and Spain (Justo et al. 2007).

Future studies in this group, preferably combining molecular, morphological and biogeographical data, should address the significance of clamp-connections and other morphological characters for specific delimitation.

Key to the species of *Pluteus* sect. *Pluteus* present in the Iberian Peninsula and Balearic Islands

1. Clamp connections present 2
1. Clamp connections absent 10

2. Lamella edge brown. Cheilocystidia with brown pigment 3
2. Lamella edge concolorous or whitish. Cheilocystidia colorless 4

3. On coniferous wood. Pleurocystidia mostly with 2-4(5) hooks at apex .... ***P. atromarginatus***
3. On angiosperm wood. Pleurocystidia mostly without hooks at apex .... ***P. atropungens***

4. On coniferous wood 5
4. On angiosperm wood (rarely terrestrial) 6

5. Pileus greyish brown .... ***P. pouzarianus*** Singer var. ***pouzarianus***
5. Pileus white .... ***P. pouzarianus*** var. ***albus*** Bonnard

6. Cheilocystidia up to 100-120 µm long 7
6. Cheilocystidia up to 70 µm long 8

7. Pileus brown [7.5YR 2.5/2-4/6], strongly radially fibrillose.
   Clamp connections present only at 10 % of septa .... ***P. brunneoradiatus*** Bonnard
7. Pileus cream or ochraceous [10YR 7/3-7/4, 8/3-8/4], squamose at centre.
   Clamp connections common in all tissues .... ***P. sandalioticus*** Contu & Arras

8. Basidiocarp white .... ***P. pellitus*** (Pers.: Fr) P. Kumm
8. Basidiocarp pigmented 9

9. Pileus and/or stipe with blue-green tinges [Gley1 5/1-5/2; Gley2 8/1].
   Spores, avl × avw = 8.5-9.5 × 6.4-6.7 µm .... ***P. salicinus*** (Pers.: Fr.) P. Kumm
9. Pileus and stipe without blue-green tinges.
   Spores, avl × avw = 7.3-8.1 × 4.7-6.2 µm .... ***P. brunneidiscus*** Murrill

10. Pileus brown [7.5YR 3/3-3/4, 4/6, 5/8, 10YR 2/2-7/3].
Smell raphanoid .... ***P. cervinus*** (Schaeff.) P. Kumm

10. Pileus entirely white or only ochraceous at centre [10YR 8/2-8/6].
Smell sweet-nauseating or indistinct 11

11. Smell sweet-nauseating. Cheilocystidia scarce or absent, lamella edge totally or partially gelatinized. Spores, avl × avw = 6.1-7.0 × 4.3-4.8 µm
.... ***P. petasatus*** (Fr.) Gillet

11. Smell indistinct. Cheilocystidia abundant, lamella edge not gelatinized.
Spores, avl × avw = 7.3-8.0 × 5.1-5.8 µm. ... ***P. nothopellitus*** Justo & M.L. Castro

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Pluteus nothopellitus **sp.nov. and a review of white species in *Pluteus* section *Pluteus***

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Abstract — A new white species of *Pluteus* sect. *Pluteus* is described. *Pluteus nothopellitus* is characterized by the absence of clamp connections, relatively big spores and habitat on angiosperm wood. The status of *Pluteus pellitus* is analyzed, with comments on taxa with white basidiocarps within the section.

Key words — *Pluteaceae*, biodiversity

Introduction

Section *Pluteus* of the genus *Pluteus* Fr. is characterized by the presence of metuloid pleurocystidia and pileipellis arranged as a cutis (Vellinga & Schreurs 1985). The identity of taxa with white basidiocarps within the section, especially *Pluteus pellitus*, has been the subject of many controversies over the past decades. Some authors (Kühner & Romagnesi 1953, Singer 1956, Moser 1983, Bonnard 1995) regard *P. pellitus* as a species with clamp-connections and small spores, while others consider this species as lacking clamps and having bigger spores (Vellinga 1987, 1990; Banerjee & Sundberg 1995).

Collections from Europe and North America have been revised and two species are recognized: *Pluteus pellitus* is considered the correct name for the species with clamps, following the neotypification by Bonnard (1995), while a new name is proposed for the species without clamps, viz. *Pluteus nothopellitus*. A key to all known representatives of section *Pluteus* with white basidiocarps is provided.

Materials and methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (1988, 1990). Terminology for describing the pleurocystidia follows Singer (1986) and Bonnard (1988): *cervinus*-type cystidia are generally fusiform, provided with 2-4 (6) apical hooks; *magnus*-type cystidia lack apical hooks and usually have a rather acute apex; intermediate cystidia is the term used for the pleurocystidia situated near lamella edge, which are described separately from the rest. Color annotations in the macroscopical descriptions are from Munsell soil color charts (2000). The notation [270, 9, 9] indicates that measurements were made in 270 spores in 9 samples in 9 collections. All structures were measured in Congo Red or an equal mixture of Congo Red and KOH (5%). The following abbreviations are used: avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient.

Taxonomic descriptions

1. *Pluteus nothopellitus* Justo & M.L. Castro sp. nov. Fig. 1, 2

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Misapplied—*Pluteus pellitus* sensu Vellinga, Fl. Agaricina Neerlandica 2: 37. 1990, sensu Banerjee & Sundberg, Mycotaxon 52: 220. 1995

Pluteus pellitus *similis sed differt sporis majoribus et hyphis sine fibulis.*

Holotypus: "SPAIN: A Coruña: Cambre, Cecebre, on fallen branch of *Quercus robur*, 30 September 2004, coll. A. Justo 58 (MA)"

Etymology: *nothopellitus*, from the greek "νοθος" and the epithet *pellitus*, means false pellitus because of its similarity and previous confusion with *P. pellitus*.

Pileus 35-70 mm hemispherical when young, later applanate or plano-convex, with or without low umbo and slightly depressed at centre in older specimens; surface smooth or innately fibrillose at centre, dry or slightly viscid when moist, white, sometimes with some light brown spots around centre (10YR 5/3-5/4); margin translucently striate, especially in older specimens. **Lamellae** L = 40-65, l = 1-3, moderately crowded, free, ventricose, up to 8 mm broad, white when young, later pale pink (2.5YR 8/3-8/4), with white even edge, flocculose under lens. **Stipe** 40-65 × 3.5-10 (15) mm, cylindrical, with broad bulbous base, white, smooth to innately fibrillose, solid. **Context** in pileus white or pinkish (2.5YR 7/4, 7/6) near lamellae; in stipe white to greyish. **Smell** indistinct. **Taste** indistinct (recorded as subraphanoid in one collection). **Spore print** pink to brownish pink (2.5YR 5/6, 6/6, 7/6).

Basidiospores [270, 9, 9] (6.0) 6.5-9.0 (9.5) × 4.5-6.5 (7.0) µm, avl × avw = 7.3-8.0 × 5.1-5.8 µm, Q = (1.15)1.2-1.7, avQ = 1.36-1.54 (broadly) ellipsoid, a very few oblong. **Basidia** (18) 20-35 × 6-9 (10) µm, 4-spored, broadly clavate. **Pleurocystidia** 55-90 (100) × 15-25 µm, metuloid, (narrowly) fusiform to cylindrical, sometimes with long peduncle, with 2-4 acute or obtuse hooks at apex, with up to 4 µm thick wall. **Intermediate cystidia** similar to pleurocystidia, but sometimes with thin (up to 0.5-1 µm) wall and/or without conspicuous hooks at apex. **Cheilocystidia** 20-70 (75) × 10-25 (30) µm, (narrowly) clavate, spheropedunculate, colorless. **Pileipellis** a cutis; hyphae 5-28 µm wide, cylindrical, mostly colorless, but sometimes (at centre of pileus) with some pale brown pigment; terminal elements (40) 65-180 (215) µm long, cylindrical or fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-15 (25) µm wide, cylindrical, colorless. **Clamp-connections** absent.

Habitat and distribution—Solitary on wood of broad-leaved trees (*Alnus, Corylus, Fagus, Quercus*). Known with certainty from Spain, The Netherlands, Germany and U.S.A (Michigan), but probably more widespread. August-October.

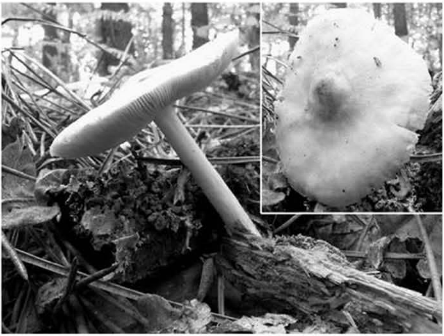

Fig. 1: *Pluteus nothopellitus*—basidiocarp and pileus detail (both from holotype). Photo by Juan Carlos Alonso.

Collections examined—**Spain: A Coruña:** Cambre, Cecebre, on fallen branch of *Quercus robur*, 30.IX.2004, A. Justo 58 (MA, Holotype); idem, LOU-Fungi 18726 (Isotype); **Germany:** Teutoburgerwald, on stump (probably *Fagus*), in mixed deciduous woods on calcareous loamy soil, 25.IX.1965, C. Bas 4560A (L); **The Netherlands: Drenthe:** Gellbroek, on very rotten fallen branch of *Alnus*, in *Alnus* forest on moist, rich humose soil, 26.IX.1984, EJM Arnolds 5201 (L); Nieuw-Balinge, St. Bos, on trunk of broad-leaved tree, 3.IX.1974, (L); **Flevoland:** Noordoostpolder, on dead branch of *Quercus*, 12.IX.1986, F. Tjallingii s.n. (L); **Gelderland:** Middagten, on dead stem of *Corylus*, 29.X.1972, F. Tjallingii s.n (L); Winterswijk, on unidentified wood (probably *Fagus*), 26.X.1975, J. Schreurs 30 (L); **Utrecht:** Baarn, Groeneveld, on *Fagus*, 10.VIII.1971, G.A. De Vries s.n. (L); **U.S.A: Michigan:** Tahquamenon Falls State Park, on unidentified wood of broad-leaved tree, 3.IX.1953, A. H. Smith 42452 (MICH).

Comments—*Pluteus nothopellitus* is separated from other members of section *Pluteus* by the following combination of characters: white basidiocarps; smell and taste indistinct; habitat on wood of broad-leaved trees; average spore size 7.3-8.0 × 5.1-5.8 µm and absence of clamp-connections.

The name *Pluteus pellitus* has been used for this species (Vellinga 1990, Banerjee & Sundberg 1995); however, *P. pellitus* is a different species with clamp connections and smaller spores, on average 5.8-6.5 × 4.3-4.6 µm (Bonnard 1995; see also discussion under *P. pellitus*).

Other clampless members of section *Pluteus* with white basidiocarps are briefly discussed here:

Pluteus albineus Bonnard has narrower spores (4-5(6) µm) and dimorphic cheilocystidia: long cystidia (reaching 100 µm) on the centre of gill edge and short on both sides (Bonnard 2001). This species is only known from Switzerland.

Pluteus atricapillus var. *albus* Vellinga differs in the raphanoid smell and taste. This variety was described by Vellinga (Vellinga & Schreurs 1985) but later subsumed in the synonymy of *Pluteus cervinus* (Schaeff.) P. Kumm. by the same author (Vellinga 1990). It is known from the type locality (Leiden, The Netherlands).

Pluteus cinerascens P. Banerjee & Sundb. has a raphanoid smell and taste and the injured or bruised places along margin of pileus become grey. The presence of *magnus*-type pleurocystidia near lamella edge was emphasized by Banerjee & Sundberg (1995). However in the original description the same authors described these structures as "pleurocystidia near lamella edge mostly of *cervinus*-type interspersed with a few *magnus*-type" (Banerjee & Sundberg 1993).

Pluteus lipidocystis Bonnard grows on coniferous wood, has narrower spores (4-5.1 µm), longer cheilocystidia (up to 102 µm) and is mainly characterized by the presence of cells with lipid contents in the hymenium (Bonnard 1986). Up to now it is only known from the type collection (Les Bougeries, Switzerland)

Pluteus petasatus (Fr.) Gillet usually has a distinct sweet or sweet-nauseating smell, smaller spores (avl × avw = 6.1-7.0 × 4.3-4.8 µm in the Spanish collections), and lacks a well-developed strip of cheilocystidia. This species is widely distributed in Europe and North America (Vellinga 1990, Banerjee & Sundberg 1995; pers. obs.)

Pluteus viscidulus Singer comes very close to *P. nothopellitus*, but it has smaller spores (5-6.5 × 3.5-4 µm). The isotype of *P. viscidulus* [ARGENTINA: Tucumán: near Tapia, 1.I.1949, R. Singer T797 (MICH, Isotype)] was examined and the following observations were made:

Basidiospores [30,1,1] 5-6.5 × 3.5-4 µm, Q = 1,45-1,65; avQ = 1,53, (broadly) ellipsoid. **Basidia** 13-24 × 6-8 µm, 4-spored. **Pleurocystidia** 75-100 × 16-22 µm, fusiform, sometimes pedunculate, with 2-4 conspicuous hooks at apex.

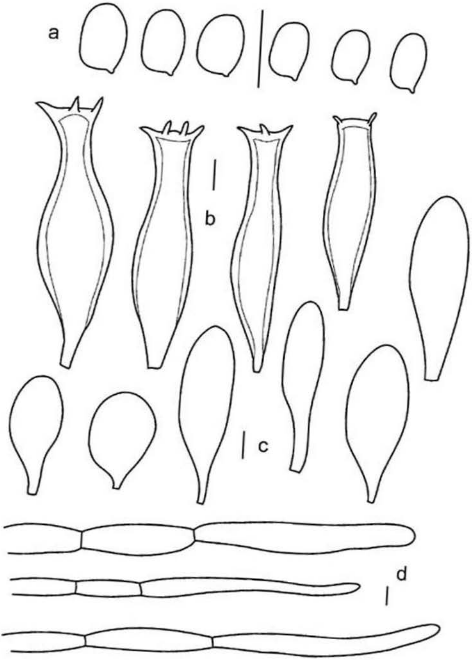

Fig. 2: *Pluteus nothopellitus*—a: spores; b: pleurocystidia; c: cheilocystidia; d: pileipellis (all from holotype). Scale bars = 10 µm.

Cheilocystidia clavate or spheropedunculate 30-55 × 15-20 µm. **Pileipellis** a cutis; hyphae 5-19 µm wide, cylindrical, mostly colorless, rarely with some pale brown pigment; terminal elements 60-130 µm long, cylindrical, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-14 µm wide, cylindrical, colorless. **Clamp connections** absent.

Singer (1958) also cites a collection from Gainesville (Florida, U.S.A.) that he hesitantly places together with the South American collections. According to Singer (1958) the Florida collection has bigger spores. As this collection has not been studied by us, no conclusions can be drawn about its identity but it probably belongs to *P. nothopellitus*.

Pluteus viscidulus is known with certainty from South America (Argentina, Brazil).

2. *Pluteus pellitus* (Pers.: Fr.) P. Kumm., Führer Pilzk.: 98. 1871 **Fig. 3**

Agaricus pellitus Pers., Syn. Meth. Fung.: 366. 1801; *Agaricus pellitus* Pers. : Fr., Syst Mycol. 1: 198. 1821.

Excluded—*Pluteus pellitus* sensu Vellinga, Fl. Agaricina Neerlandica 2: 37. 1990, sensu Banerjee & Sundberg, Mycotaxon 52: 220. 1995 (= *Pluteus nothopellitus*).

Neotypus—France: Môle, 31.VII.1960, R. Kühner SA-60-2 (G-K coll. 19803)

Type study

Basidiospores [30/1] 5.5-7.5 (8.0) × 3.8-5.3 (5.5) µm; avl × avw = 6.5 × 4.6 µm, Q = 1.18-1.67 (1.75); avQ= 1.42; (broadly) ellipsoid, rarely oblong. **Pleurocystidia** abundant, metuloid, 67-95 × 18-24 µm, thick walled, with 2-4 hooks at apex, (narrowly) fusiform. **Cheilocystidia** abundant but mostly collapsed, (narrowly) clavate or spheropedunculate, 25-45 × 14-23 µm. **Pileipellis** a cutis, with some ascending hyphae, colorless; terminal elements 60-150 × 10-14 µm, cylindrical or fusiform, tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 7-18 µm wide, colorless. **Clamp connections** present in all tissues.

Composite description

Pileus 40-75 mm hemispherical when young, later applanate or plano-convex, with or without low umbo at centre; surface smooth, innately fibrillose or squamulose at centre, dry or slightly viscid when moist, white; margin translucently striate in older specimens. **Lamellae** L = 43-72, l = (0)1-3, moderately crowded, free, ventricose, up to 7 mm broad, white when young, later pale pink (2.5YR 8/3-8/4), with white even edge, flocculose under lens. **Stipe** 40-60 × 5-15 mm, cylindrical, with broad bulbous base, white, smooth to innately fibrillose, solid. **Context** in pileus white or pinkish near lamellae; in stipe white. **Smell and taste** indistinct. **Spore print** not recorded.

Basidiospores [90, 3, 3] 5.0-7.5 (8.0) × 3.5-5.0 (5.5) µm, avl × avw = 5.8-6.5 × 4.3-4.6 µm, Q = 1.2-1.6 (1.7), avQ = 1.34-1.46 (broadly) ellipsoid, rarely oblong. **Basidia** 15-32 × 6-9 (10) µm, 4-spored, broadly clavate. **Pleurocystidia** 50-95

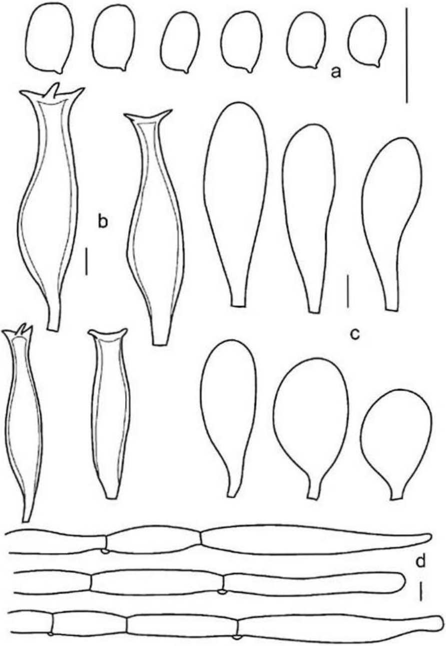

Fig. 3: *Pluteus pellitus*
a: spores (from neotypus); b: pleurocystidia (from neotypus and LOU-Fungi 15215);
c: cheilocystidia (from LOU-Fungi 15215); d: pileipellis (from LOU-Fungi 15215).
Scale bars = 10 µm.

× 12-25 µm, metuloid, (narrowly) fusiform to cylindrical, sometimes with long peduncle, with 2-4 acute or obtuse hooks at apex, with up to 3 µm thick wall. **Intermediate cystidia** similar to pleurocystidia, but sometimes with thin (up to 0.5-1 µm) wall and/or without conspicuous hooks at apex. **Cheilocystidia** 25-65 × 13-27 µm, (narrowly) clavate, spheropedunculate, colorless. **Pileipellis** a cutis; hyphae 7-25 µm wide, cylindrical, colorless, terminal elements 60-165 µm long, cylindrical or fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 6-20 µm wide, cylindrical, colorless. **Clamp connections** present in all tissues.

Habitat and distribution—On wood of angiosperms, probably also terrestrial (see below). Known with certainty from France and Spain, but probably more widespread, at least in Europe.

Collections examined—SPAIN: **Pontevedra:** Pontevedra, A Xunqueira, on stump of *Eucalyptus cinerea*, 7.V.1998, M. Lago & D. Solís, LOU-Fungi 15215; ibidem, on remnants of *Eucalyptus globulus*, 2.VI.1997, M. Lago, LOU-Fungi 15216; FRANCE: Môle, 31.VII. 1960, R. Kühner SA-60-2 (G-K, Neotype).

Comments—The identity of *Pluteus pellitus* has been disputed over the past decades and two different taxonomic concepts exist in mycological literature: Kühner & Romagnesi (1953), Singer (1986), Moser (1983) and Bonnard (1995) consider this species as having clamp-connections and relatively small spores, e.g. 5.5-7.5 × 4-5 µm according to Kühner & Romagnesi (1953). However Vellinga (1990) and Banerjee & Sundberg (1995) regard *P. pellitus* as a species without clamps and with bigger spores, e.g. 7.0-8.5 × 4.5-5.5 µm according to Vellinga (1990).

Bonnard (1995) neotypifies *P. pellitus* with a collection made by Kühner that fits the original description by Persoon (1801). According to Bonnard (1995) the presence of conspicuous fibrils on pileus is an important character of this species as it was emphasized on Persoon's description and is also mentioned in the collection chosen as neotype. The Spanish collections have innate fibrils on the pileus, especially around center, but this character is shared by many other members of the section, including *P. nothopellitus*, so it can be hardly used as a differentiating character for *P. pellitus*.

The habitat of *P. pellitus* is given as "on the ground" (Persoon 1801), "in *Fagus* forest near trunks" (Fries 1821), and "on the ground in a forest of *Juniperus*" (neotypus). The Spanish collections were gathered on *Eucalyptus*. Duchemin (2000) cites this species from Normandy (France) growing on a broad-leaved tree. Only with more collections the habitat of this species can be established with certainty.

To avoid enlargement of taxonomic confusion, the neotypification made by Bonnard is accepted here, and *Pluteus pellitus* is considered the correct name for a species of section *Pluteus* with the following combination of characters:

white basidiocarps; smell and taste indistinct; habitat on wood of angiosperms (probably also terrestrial); average spore size 5.8-6.5 × 4.3-4.6 µm and presence of clamp-connections.

Other members of section *Pluteus* with white basidiocarps and clamp-connections are briefly discussed here:

Pluteus pouzarianus var. *albus* Bonnard grows on coniferous wood and lacks the fibrillose pileus surface of *P. pellitus*.

Pluteus brunneoradiatus var. *albus* and *Pluteus primus* var. *purus* are mentioned as provisional names by Bonnard (1993) and defined mainly as white variants of these normally pigmented species, but they had not been formally (and validly!) published yet. *P. brunneoradiatus* var. *albus* grows on wood of broad-leaved trees and, as the type variety, is characterized by the scarcity of clamp-connections. *P. primus* var. *purus* differs from *P. pellitus* in the habitat on coniferous trees, bigger (> 7 × 5 µm) spores, and the cheilocystidia reaching 200 µm long (Bonnard 1993). Although they had not been validly published, both taxa are included in the key below for completeness and practical reasons.

Key to the members of sect. *Pluteus* with white basidiocarps

1. Clamp connections present 2
1. Clamp connections absent 5

2. Growing on coniferous wood 3
2. Growing on angiosperm wood or terrestrial 4

3. Cheilocystidia up to 200 µm long .... ***P. primus*** **var.** ***purus***
3. Cheilocystidia up to 60 µm long .... ***P. pouzarianus*** **var.** ***albus***

4. Clamp connections common in all tissues .... ***P. pellitus***
4. Clamp connections scarce(< 10% of septa) .... ***P. brunneoradiatus*** **var.** ***albus***

5. Cells with lipid content present in the hymenium .... ***P. lipidocystis***
5. Cells with lipid content absent 6

6. Smell raphanoid 7
6. Smell sweet-nauseating or indistinct 8

7. Injured or bruised places along margin of pileus becoming grey .... ***P. cinerascens***
7. Pileus not becoming grey .... ***P. atricapillus*** **var.** ***albus***

8. Smell sweet-nauseating. Cheilocystidia absent or very scarce .... ***P. petasatus***
8. Smell indistinct. Cheilocystidia abundant 9

9. Cheilocystidia dimorphic: up to 100 µm on the centre of lamella edge and shorter on both sides .... ***P. albineus***
9. Cheilocystidia not dimorphic and up to 70 µm long 10

10. Spores (6.0)6.5-9.0(9.5) × 4.5-6.5(7.0) µm. Europe and North America .... ***P. nothopellitus***
10. Spores 5.0-6.5 × 3.5-4.0 µm. South America .... ***P. viscidulus***

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MYCOTAXON

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An annotated checklist of *Pluteus* in the Iberian Peninsula and Balearic Islands

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Abstract—The checklist collates all 33 taxa of *Pluteus* reported from the Iberian Peninsula (Spain, Portugal) and Balearic Islands (Spain). The complete checklist is posted at http://www.mycotaxon.com/resources/weblists.html, with data on the collections, distribution, ecology and phenology of each taxon.

Key words—*Pluteaceae*, biodiversity

Introduction

Pluteus Fr. is the type genus of the family *Pluteaceae* Kotl. & Pouzar (*Agaricales*, *Basidiomycota*). Its main characteristics are the pluteoid basidiomes (i.e. free lamellae; context of pileus and stipe discontinuous), pink spore print and inverse lamella trama. It comprises about 300 species (Kirk & al. 2001) and is distributed in all continents except Antarctica (Singer 1986).

Monographic studies in the genus had been carried out in Europe (Kühner & Romagnesi 1956, Orton 1986, Vellinga 1990) North America (Smith & Stuntz 1958, Homola 1972, Banerjee & Sundberg 1995) and South America (Singer 1958, 1961). A worldwide monographic approach was published by Singer (1956).

In the Iberian Peninsula (Spain, Portugal) and Balearic Islands (Spain) *Pluteus* records are often cited in general checklists. Prior to our study, the only monographic paper on this genus was an article by Muñoz-Sánchez (1991), which focused on species in section *Pluteus*, mainly based on collections from the Basque Country (northern Spain). Regional studies on *Pluteus* within the Iberian Peninsula had been published in recent years, as a part of the Flora Mycologica Iberica project (Justo & Castro 2004, Justo & al. 2005a, b, 2006).

Fig. 1. Provinces of the Iberian Peninsula and Balearic Islands.

Material & methods

We have studied the collections gathered by members of the Mycology Lab at Vigo University between 1991and 2006. Collections of *Pluteus* deposited in the Iberian herbaria, both official and personal, have been revised.

The information obtained from the bibliographic references of *Pluteus* in the Iberian literature has been incorporated into the distribution maps for each species.

Catalogue

In the online checklist (http://www.mycotaxon.com/resources/weblists.html), the following information is given for each taxon: a list of all collections examined; a map of its distribution in our area and some brief comments on its ecology and phenology.

We present a catalogue of the 33 taxa of *Pluteus* recorded in the Iberian Peninsula and Balearic Islands, arranged according to the subdivision of the genus by Vellinga & Schreurs (1985), arranged within each (sub-)section alphabetically.

Section *Pluteus*—*Pluteus atromarginatus* (Singer) Kühner; *Pluteus atropungens* A.H. Sm. & Bartelli; *Pluteus brunneidiscus* Murrill; *Pluteus brunneoradiatus* Bonnard; *Pluteus cervinus* (Schaeff.) P. Kumm.; *Pluteus nothopellitus* Justo & M.L. Castro; *Pluteus pellitus* (Pers.: Fr.) P. Kumm.; *Pluteus petasatus* (Fr.) Gillet; *Pluteus pouzarianus* Singer var. *pouzarianus; Pluteus pouzarianus* var. *albus* Bonnard; *Pluteus salicinus* (Pers.: Fr.) P. Kumm.; *Pluteus sandalioticus* Contu & Arras

Section *Villosi* Schreurs & Vellinga—*Pluteus ephebeus* (Fr.: Fr.) Gillet; *Pluteus hispidulus* (Fr.: Fr.) Quél. var. *hispidulus; Pluteus hispidulus* var. *cephalocystis* Schreurs

Section *Celluloderma* Fayod

Subsection *Hispidodermini* (Fayod) Vellinga & Schreurs—*Pluteus exiguus* (Pat.) Sacc.; *Pluteus leoninus* (Schaeff.: Fr.) P. Kumm.; *Pluteus plautus* (Weinm.) Gillet; *Pluteus umbrosus* (Pers.: Fr.) P. Kumm.

Subsection *Eucellulodermini* Singer ex Singer—*Pluteus aurantiorugosus* (Trog) Sacc.; *Pluteus chrysophaeus* (Schaeff.) Quél.; *Pluteus cinereofuscus* J.E. Lange; *Pluteus cyanopus* Quél.; *Pluteus diettrichii* Bres.; *Pluteus insidiosus* Vellinga & Schreurs; *Pluteus luctuosus* Boud.; *Pluteus nanus* (Pers.: Fr.) P. Kumm.; *Pluteus pallescens* P.D. Orton; *Pluteus phlebophorus* (Ditmar: Fr.) P. Kumm.; *Pluteus poliocnemis* Kühner; *Pluteus romellii* (Britzelm.) Sacc.

Subsection *Mixtini* Singer ex Singer—*Pluteus podospileus* Sacc. & Cub.; *Pluteus thomsonii* (Berk. & Broome) Dennis

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Hemistropharia, a new genus in *Agaricales*

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Abstract—*Hemistropharia* is described as a new monotypic genus for *Agaricus albocrenulatus* Peck, earlier often placed in *Pholiota* or *Stropharia*. *Hemistropharia* is macroscopically somewhat similar to *Stropharia* and *Pholiota* but differs in having large, amygdaloid spores and in lacking chrysocystidia. Phylogenetic analyses based on ITS2 and LSU nuclear rDNA sequence data suggest a placement of *Hemistropharia albocrenulata* in the vicinity of the hymenogastraceae and tubarieae clades.

Keywords—*Strophariaceae*, *Hemipholiota*, phylogeny, taxonomy

Introduction

In 1873, Peck described the species *Agaricus albocrenulatus*, a rather large and conspicuous agaric growing on wood. The species was described as *Pholiota fusca* Quél. in Europe (Quélet 1877), and that name was used for some time before its identity with *P. albocrenulata* was established. The species has later been transferred to various genera, but as the morphological characters are rather unique, the generic placement has often been disputed.

Saccardo (1887:760) placed it in *Pholiota* considering the macromorphological characters and habitat. Singer transferred it to *Hebeloma* (1939) but later (1951) changed his mind and placed it in *Pholiota* subg. *Hemipholiota* Singer. Other authors, for example Kreisel (1964) and Ryman & Holmåsen (1984), have placed it in *Stropharia*.

Several of the morphological characters of *P. albocrenulata* deviate considerably from the concept of *Pholiota* and related genera. For example, the differences in spore-shape and structure have been extensively described (Malençon 1964, Malençon & Bertault 1970). In two recent *Pholiota* monographs, therefore, the species was either temporarily placed in subgenus *Hemipholiota* (Jacobsson 1990) or excluded from the genus (Holec 2001), but with both authors mentioning that the species might better be placed within a separate monotypic genus.

As the morphological characters of *P. albocrenulata* do not correspond with those of *Pholiota* or any other known genus, it has for some time been obvious that the species needs a new genus. Moncalvo et al. (2002) showed through phylogenetic analyses of LSU sequence data that *P. albocrenulata* clearly falls outside the strophariaceae clade and takes a rather isolated position on a single branch within the *Agaricales*.

As a consequence, we propose the new genus *Hemistropharia* for *P. albocrenulata*. The name is chosen because the species possesses many macro-morphological similarities with *Stropharia*. We have used ITS2 and LSU sequence data to further explore the position of *P. albocrenulata* within *Agaricales* (Matheny et al. 2006) in an effort to be able to suggest a phylogenetic position of the new genus.

Materials and methods

Sequences of the ITS2 region and approximately 900 base pairs of LSU nuclear rDNA were obtained from fresh material or from herbarium specimens following protocols described in Larsson & Larsson (2003). Sequenced collections have been deposited at Göteborg University Herbarium (GB) and sequences submitted to GenBank (accession numbers EU029941-EU029949). Additional sequences included in the analyses were either generated by us and used in earlier studies or obtained from GenBank. The selection was based on the results of other phylogenetic studies of *Agaricales* (Moncalvo et al. 2002, Matheny et al. 2006) and results from a blast search of the ITS2 region of *P. albocrenulata* in GenBank. Three species of *Tulostoma* and *Lycoperdon* were selected for rooting of trees.

Sequences were aligned using the data editor in PAUP* (Swofford 2003). Gaps for insertion-deletion events were introduced to aid in the alignment. Heuristic searches for most parsimonious trees were performed using PAUP*. All transformations were considered unordered and equally weighted. Variable regions with ambiguous alignment were excluded, and gaps were treated as missing data. Heuristic searches with 1000 random-addition sequence replicates, TBR branch swapping, were performed. Relative robustness of clades was assessed by the bootstrap method using 1000 heuristic search replicates with 100 random taxon additional sequence replicates and TBR swapping.

Results

The alignment of the 35 sequences was 1453 characters long. After exclusion of ambiguous areas, 1168 characters remained for the analysis, of which 919 were constant, 71 were variable but parsimony uninformative, and 178 were parsimony informative. The maximum parsimony analysis yielded ten most

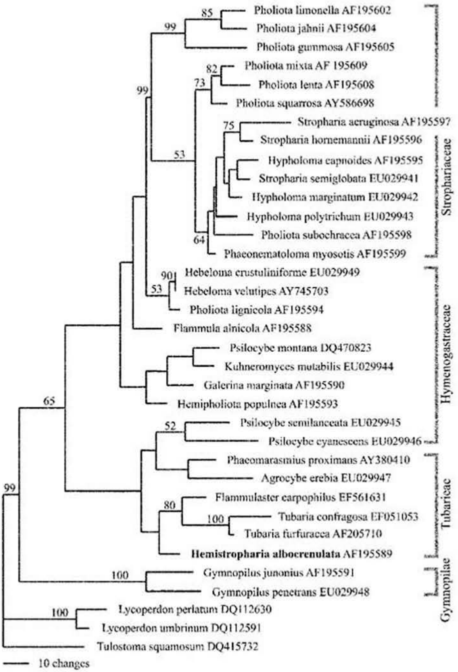

Figure 1. One of ten most parsimonious trees generated from the phylogenetic analysis showing the placement of *Hemistropharia albocrenulata*. Bootstrap values greater than 50% are indicated on branches. Name of clades follow Matheny et al. 2006.

parsimonious trees (length=641, CI= 0.4899, RI= 0.6175). Figure 1 shows one of the most parsimonious trees. The tree is presented as a phylogram and bootstrap values are indicated on branches.

The phylogenetic analyses recovered *Strophariaceae* as a monophyletic clade with 99% bootstrap support. The results confirm earlier studies indicating that *Hemistropharia albocrenulata* does not belong in *Strophariaceae*. Also *Hemipholiota populnea* falls outside the strophariaceae clade and seems to belong in the hymenogastraceae clade. *Hemistropharia albocrenulata* did not cluster with *Hemipholiota populnea* in any of our analyses, which supports the decision not to place the species in *Hemipholiota*. *Hemistropharia albocrenulata* clusters with the tubarieae clade, on a branch without bootstrap support (fig 1). The resolution among the hymenogastraceae and tubarieae clades is partly unresolved and few branches received support. However, the analyses support and confirm *Hemistropharia* as a unique and independent genus. Because of the low resolution and lack of bootstrap support within the tree a more precise position of the new genus could not be suggested.

Genus description

Hemistropharia Jacobsson & E. Larss. ***gen. nov.***

MycoBank MB 511171

Stropharia similis sed lamellis initio violaceo-cinereus et guttula alba secernentes, sporae magnis, amygdaliformibus, chrysocystidiis absens.

Pileo carnoso, glutinosus, squamoso, non hygrophano. Lamellis adnatis - subdecurrens. Stipes squarrosus, annulatus. Cheilocystidiis dense, clavatus.

Typus generis—Agaricus albocrenulatus.

Hemistropharia albocrenulata (Peck) Jacobsson & E. Larss., **comb. nov.**

MycoBank MB 511172

Basionym: *Agaricus albocrenulatus* Peck, Bull. Buffalo Soc. Nat. Sci. 1:49, 1873.

Hemistropharia albocrenulata is characterized by a 3-10 cm broad, dark brown pileus, which is glutinous in moist weather and covered with small, whitish and fibrillose scales. The lamellae are moderately crowded, pale grey with a more or less violaceous flush when young, later becoming dark greyish brown but with a persistently white edge. When young and fresh the edge exudes small white drops. The stipe measurements are 30-120 x 5-15 mm. It is at first solid, then hollow and has a rather distinct annulus. At apex it is pale and pruinose, below the annulus it is gradually darkening and squarrose from ± upraised scales. There is no distinct odour but the taste of the flesh is bitter. The spore deposit is dark rusty brown.

Microscopically, it is characterized by large, amygdaloid spores (11-14(-15) x 5.5-7(-7.5) µm) with a small but distinct germ-pore and densely packed cheilocystidia, which are narrowly clavate (40-70 x 5-15 µm). Chrysocystidia or other pleurocystidia are absent.

Discussion

Hemistropharia is characterized morphologically by having a dark brown, glutinous and scaly pileus, a squarrose stipe with annulus and a rusty brown spore deposit. The characters may appear similar to those of *Pholiota* and *Stropharia* but the violaceous grey gills with a white edge exuding small white drops when young are quite different from all species of these genera. Also the micro-morphological characters are unique in *Hemistropharia*. The large and distinctly amygdaloid (subfusoid) spores differ considerably from those found in any member of *Pholiota*, *Hemipholiota* or *Stropharia*. In these genera the spores, without exceptions, are ellipsoid-ovoid to slightly reniform. The chrysocystidia typically found in most members of *Strophariaceae* are absent in *Hemistropharia*. They are, however, also absent in *Hemipholiota*. The phylogenetic analyses based on ITS2 and LSU sequence data support the description of the monotypic genus *Hemistropharia*.

Acknowledgements

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MYCOTAXON

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Is *Cortinarius austrovenetus* a synonym of *C. walkerae*?

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Abstract — *Cortinarius austrovenetus* is compared with *C. walkerae* (*'walkeri'*). Data are offered to support a proposal of synonymy. The taxon is re-described in detail having been collected several times in Tasmania, and its taxonomic position is discussed.

Key words — *Dermocybe, Cortinarius walkeri*

Introduction

Cortinarius austrovenetus is a bright green or yellow-olivaceous *Cortinarius* commonly collected in Tasmania in wet sclerophyll forests and probably ectomycorrhizal with *Eucalyptus* spp. The eye-catching colour cannot fail to attract attention and the species, being often found, apparently has quite a wide distribution.

Its resemblance to *Cortinarius atrovirens* Kalchbr. of the northern hemisphere, with which it also shares some of the main pigments, suggests a relationship.

Cortinarius walkerae was described with green-bluish colours and placed by the authors in subgenus *Dermocybe*. The green colour is fairly uncommon in *Cortinarius*. Therefore, as descriptions of *Cortinarius austrovenetus* and that of *Cortinarius walkerae* have several points in common, the two species were compared to ascertain whether they might be synonyms.

Materials and methods

Twelve collections identified as *Cortinarius austrovenetus* were made in South Tasmania between 1994 and 2002. Further, fragments of the *C. austrovenetus* lectotype (AD 4125) were obtained from the Adelaide herbarium and of *C. walkerae* from the Kew herbarium. For the exsiccata, fragments of gills, stipe and pileipellis were softened in an L4 solution. The microscopic investigation was carried out with a Zenith 2000 optical microscope. Spores and tissues were observed and measured using an eye-piece micrometer (×10) and an oil-immersion objective (×100). The spore measurements from the holotype of *C. walkerae,* of the Tasmanian collections as well as from the exsiccata of AD 4125, lectotype of *C. austrovenetus,* were processed in Microsoft Excel. The results (Table 1) show the statistical measurements of all three fungi considered, indicating the minimum, maximum, mean, and standard deviation of 25 assessments.

Compared to KOH or other chemical reviving solutions, the L4 buffer solution [H_2O (80 ml.), KOH (0.8 g.), NaCl (0.8 g.), Invadin JFC [conc.] (0.5 g.), phenol (0.5 g.), pure glycerine (20 g. = 16 ml)] has the advantage of being neutral. It is very useful when reviving tissues of *Dermocybe* or other fungi where the observation of pigments is of primary importance.

The SEM examination was performed on one *C. austrovenetus* representative and the *C. walkerae* holotype, with the materials first revived prior to being coated in gold and screened.

Specimens are lodged at the Botanic Gardens and State Herbarium of Adelaide (AD), the Kew Gardens Herbarium (KEW), the Hobart State Herbarium (HO), and the Gasparini personal herbarium (PHN).

TLC is the acronym of thin layer chromatography.

Examinations

Cortinarius walkerae Cooke & Massee, in Cooke, Grevillea 22: 36 (1893), as '*walkeri*'.

COOKE & MASSEE's description:

> Pileus about 1 in. across, convex, then expanded, but the margin persistently incurved and more or less wavy, somewhat umbonate, smooth, even, dry, minutely silky, pale green, becoming bluish green with age, flesh thin, except at the disk white with a tinge of green; stem 1 in. long, two lines thick, slightly thickened at the base, silky fibrillose, reddish, stuffed; gills annexed, rounded behind, about 1½ line broad, thin, rather crowded, reddish, then powdered with the bright ferruginous spores, margin entire; spores elliptical, with an oblique apiculus, smooth, ferruginous 10 × 5 µ.
>
> On the ground. Blue Mountains, Australia. (Miss A.F. Walker; comm. Sir Ferd. Mueller.)

MY EXAMINATION of a portion of the holotype obtained from Kew Herbarium:

The spores are ellipsoidal and poorly ornamented (7.8–)8.2–9.4(–10.5) × 5.6(–6) Q = 1.6–1.7. The basidia 4-spored, 30–35 × 6–7 µm, but the gill-margin is full of short, cylindrical sterile cells. Among the trama hyphae there are many winy coloured droplets of pigment.

These observations confirm the observations by Moser (1962), who also examined the *C. walkerae* holotype, that "the cuticular hyphae are violet, 5–7 µm, and they have stained the herbarium sheet wine-red".

Note: Although *C. 'walkeri'* was the name originally published that has been used since it was proposed, it is nevertheless an error that requires correction (McNeill et al. 2006: ICBN Art. 60.11 N.4). The epithet honours the holotype collector, Miss Walker, and must therefore be corrected to the feminine form, *walkerae*. The correction does not affect the valid publication by Cooke & Massee (ICBN Art. 32.7)

Cortinarius austrovenetus Cleland, Trans. & Proc. Roy. Soc. S. Australia 52: 220 (1928).

Synonym: *Dermocybe austroveneta* (Cleland) M.M. Moser & E. Horak, Beih. Nova Hedwigia 52: 505 (1975).

CLELAND's description:

> Pileus up to 3 in. (7.5 cm), convex, then nearly plane, more or less gibbous, with subinnate villous down, dark green (near Olive Citrine, XVI, near Yellow Ochre, XV), darker in the centre (Light Brownish Olive, XXX). Gills adnate to slightly sinuate, moderately close, Olive Ochre (XXX), near Yellow Ochre (XV). Stem up to 3 in. (7.5 cm), rather stout (up to 0.5 in., 1.2 cm, below) to slender, slightly attenuated upward, fibrillose, hollow, pallid tinge with the colour of the gills. Flesh thick over the disk, very attenuated towards the edge. Veil fugacious. Spores oblique, dull brown, 9.5 to 13 × 5.5 to 6.5, sometimes 8 × 5 µm South Australia, Mount Lofty, National Park, Kuitpo. June to August.

TASMANIAN COLLECTIONS *Fig. 1*

Pileus (39–)40–60(–70) mm, convex-campanulate, then irregularly convex and gibbous, usually slightly umbonate, but sometimes retaining a pronounced umbo. Cuticle smooth or fibrillose, shiny, tacky or viscid when wet but not glutinous, colour variable, usually green, emerald green, citrine or olivaceous at the margin, the disk frequently dark (from blackish green to dark olivaceous), often with radial blackish fibrils, often with purplish hues on drying. Lamellae close, L = 50–60, fairly thin and low, edge smooth, annexed to emarginate, lemon-yellow or greenish yellow or pale ochraceous yellow, very soon reddish to orange (sometimes orange when still immature). Stipe 40–50(–100) × 6–15(–22) mm, comparatively stout, mostly cylindrical, sometimes slightly clavate, whitish or cream-colour, often with yellow, orange or brown stains, but reddish, brick-colour, or orange near the base when dry. Context whitish with pale yellowish hues in the sub-cuticular region.

Microscopy (fig.2): Spores ovoid to shortly elliptical or narrowly elliptical or subamygdaliform (6.7–)7.9–9.2(–12) × (3.8–)4.9–5.6(–7.5) µm, L/B = (1.3–)1.5–1.8(–2.4), warts punctuate or small and comparatively prominent.

FIG. 1. *Cortinarius walkerae* (coll N. A20428A2).

Different types of spores were observed, sometimes even within the same collection. In SEM mycrograph (coll. 15.5.1997) they appear broadly ovoid, with a large central drop and with mostly shallow and indistinct warts and a sub-labyrinthiform profile, while there are some with a much more prominent ornamentation. Hymenium: lamellar trama regular, embedding purplish, cyclamen-coloured pigment droplets; basidia from smallish and cylindrical to medium and clavate, 30–40 × 7–9 µm, 2- or 4-spored, containing cyanophilous granules. Some collections show a considerable number of versiform small sterile cells on the margin, in some others only clavate basidioles are visible. Epicutis formed by a thin layer of subparallel or slightly entangled hyphae, slightly gelatinised, cylindrical hyphae, 7.5–10 µm wide, encrusted by a red-brownish pigment with some repent tufts.. Hypoderm indistinct, the lowest strata being formed by oval cells 30 × 18 µm. Clamp-connections throughout. Veil hyphae mixed with those of cuticle, filamentous 3.5–4.5 µm wide, pale, encrusted by a yellowish (to red-brownish) pigment. Masses of a purple pigment are often found amongst the hyphae of the pileipellis and/or of the gills trama.

In exsiccata the basidiomes mostly medium-sized, dark in colour, with purple stains on gills and stipe: large purple stains are moreover often present in the wrapping paper.

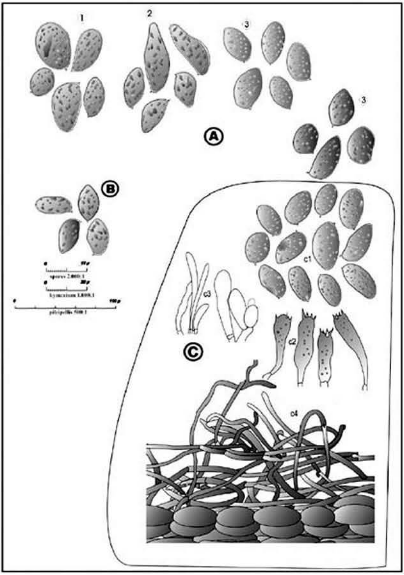

Fig. 2. Microscopy. (A) *C. austrovenetus* holotype – AD 4125. Basidiospores from 4 collections. (B) *C. walkerae* holotype. Basidiospores. (C) Synthesis from Australian collections – c1: spores, c2: basidia, c3: cystidia, c4: pileal structure.

Habitat: Sclerophyll eucalypt forests.

Chemical reactions KOH blood red on cutis and base of stipe, gills carmine, flesh brown with red halo, guayac ++ (blue). Melzer, TL4, Fe_2SO_4, FMP, $AgNO_3$ nil.

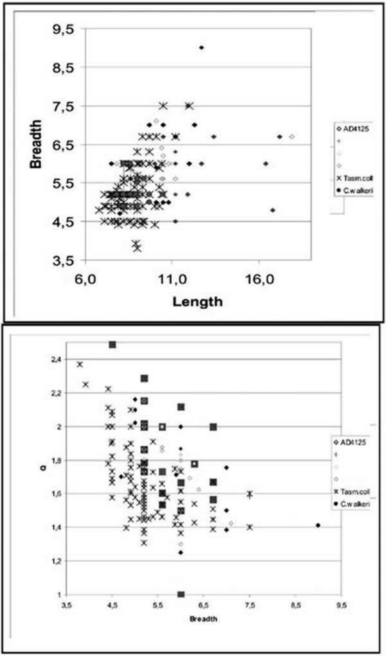

FIG. 3 Scatter diagram. Comparison of the spore measurements taken from Australian collections (dash), *C. walkerae* holotype (circle on line), and AD 4125 diamonds).

Specimens examined: Mt. Wellington, nr. Neika, A.V. Ratkowsky, 1 May 1994, PHN 940501A0, Pipeline, A.V. Ratkowsky, 17 May 1994, PHN 940517A1, Neika, A.V. Ratkowsky, 22 May 1994, PHN 940522A2, Pipeline Track, A.V. Ratkowsky, 23 Jun 1995 PHN 950623A0, Cartwright Creek, A.V. Ratkowsky, 31 May 1995, PHN 950531A0, A.V. Ratkowsky, 23 Jun 1995, PHN 950623A0, Pillinger, D. Ratkowsky, 25 Apl 1997 PHN 970425A1, Myrtle Forest, D. Ratkowsky, 3 May 1997, PHN 970503A0, Snug Tiers, D. Ratkowsky, 4 May 1997 PHN 970504A0, Pillinger, D. Ratkowsky 15 May 1997, PHN 970515A4. The Lacey's estate way to Cradle Mountain: B. Gasparini 28 Apl 2002 PHN A20428A0, Mt. Field National Park, Tall Trees Track (Taps) G. Gates, D. Ratkowsky & B. Gasparini 28 May 2002, HO522410.

Results

In the scatter diagram (fig. 3) the spore measurements of the twelve collections from Tasmania considered in the present work, and those of the specimens stored at Kew under the name *C. walkerae,* form a very close cluster. The only slightly deviating item is coll. 970513A4 in the length/breadth diagram, but even this collection is close in the breadth/Q diagram. In both diagrams the ratios taken from the holotype *C. walkerae* fall close to the Tasmanian collections.

Concerning the AD lectotype, it can be noted that the L/B diagram shows quite a close position to this cluster for one collection, whereas the other three fall outside the cluster; the B/Q appearing quite close for all except the one marked with a square (2nd from top) which has a very large deviation (2.7).

Table 1. Comparison of spore measurement averages in *Cortinarius austrovenetus* and *C. walkerae* collections.

Averages	Tasmanian '*D. austroveneta*' (12 collections, 1994–2002)	AD 4125 (4 collections)	*Cortinarius walkerae* (holotype)
Length (µm)	(6.7–)7.9–92(–12)	(7.5–)8.7–12.2(–17.9)	(7.8–)8.2–9.4(–10.5)
Breadth (µm)	(3.8)4.9–5.6(–7.5)	(4.5–)5.2–6.5(–9)	(4.9–)5–5.6(–6)
Length/ Breadth	(1.3–)1.5–1.8(–2.4)	(1.25–)1.48–2.1(–3.5)	(1.4–)1.52–1.8(–2)

Discussion

The original Cooke & Massee description of *C. walkerae* differs only marginally from the Cleland description of *C. austrovenetus*. In *C. walkerae*, the lamellae and stipe are described as "reddish" whereas in Cleland's taxon the gills are described as yellow as is the stipe, which may, however, have orange flushes.

It is not unusual, especially for inexperienced mushroom collectors, to observe the most striking features and colours, whilst overlooking other descriptive traits. The most striking feature (the brilliantly green cap) was noted immediately by Mrs. Walker, the original collector, with the description left to be completed at a later date, after the basidiomes had aged. In fact, it would not be surprising to discover that the specimens were delivered to Sir Ferdinand von Mueller some days later. The present author knows how quickly *Cortinarius* fruit bodies — and particularly *C. austrovenetus* specimens — change their colour. The two primary original pigments austrovenetin and protohypericin, which are highly photosensitive, soon degrade to skyrin and hypericin, thus turning the lamellae orange to reddish. This process is clearly outlined by Gill et al. (1988, 1989).

Fig. 5 shows the plates obtained from the TLC performed on some of the Tasmanian collections where endocrocin does not appear to be present.

It is not unlikely that the orange hues, which are often present in the stipe, were described as reddish, while the gills might have been described as 'reddish' due to their having been described from mature fruit-bodies, when the pigment has undergone a photo-oxiding process.

Because field descriptions can be easily influenced by subjective considerations, comparison of the dried type specimens may prove more reliable.

The SEM projection (fig. 4) taken from coll. 970513A4 and that from the Kew holotype are substantially equal in shape, size and decoration. The presence of numerous short sterile cells on lamellae is also common to both collections. Some disagreement exists between the spores examined by the author and Cleland's microscopic description of *C. austrovenetus* "spores oblique, dark brown, 9.5 to 13 × 5.5 to 6.5 µm", which is considerably outside the close cluster of the collections from Tasmania and of the *C. walkerae* holotype. But Cleland's stated "sometimes 8 × 5 µm" does fall well within our cluster.

Cleland's habit of mixing collections is well known. It would not be impossible for different collections to be included in AD 4125. Grgurinovic (1997), having examined Cleland's herbarium, did not find enough elements to divide the species, in spite of having observed that the spores had partly a different profile and decoration. This is confirmed by the present examination.

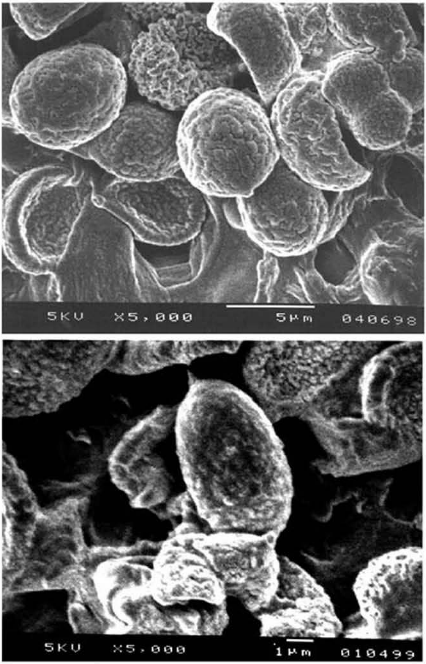

Fig. 4. Basidiospore micrographs.
top: coll. 970513A4,
bottom: *C. walkerae* holotype.

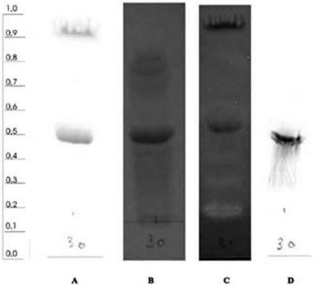

Fig. 5. Thin-Layer Chromatography. A: day light. Half way spot: hypericin, top: mixture hyperuicin + skyrin. B: day light, different solvent. Half way spot: skyrin , light spot top: hypericin C: UV light skyrin. Bright spot: hypericin, dark top spot: skyrin. D: day light (another different solvent). In B&W only one bright spot is visible: brown-orange skyrin, purple, hypericin, mixed.

Systematic position

Moser & Horak (1975) placed *Cortinarius austrovenetus* in subgenus *Icterinula* of genus *Dermocybe*. Subgenus *Icterinula* can thus be characterized by species with "yellow orange, fawn, olivaceous colours in gills and stipe and often in caps; containing yellow anthraquinonic pigments. Cap dry or viscid." Moser & Horak, who further divided the subgenus into sections, included the present species in section *Pauperae*, which they described:

> "Pileus more or less viscid or glutinous. Lamellae yellow or with yellow component, always with endocrocin* plus pigments derived from it and from oxidation (neutral anthraquinones) and/or dimerisation of atrochrysone. No flavomannin compounds present."

Analysis of ITS sequences by Chambers et al. (1999) suggest that *C. austrovenetus* occupies a segregate position within *Dermocybe*, and subsequent molecular analyses by Garnica (pers. comm.) confirm the existence of a sister clade in *Dermocybe* that also includes *Cortinarius icterinus* (E. Horak) E. Horak.

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* However, according to Gill (pers.com., in litt.), no endocrocin has ever been found in *C. austrovenetus*.

Conclusion

The preceding analysis should demonstrate that *C. walkerae* and *C. austrovenetus* are conspecific and that *C. austrovenetus* is a later synonym of *C. walkerae*.

Acknowledgements

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A new species of *Hansfordia*, an endophyte from *Anoectochilus roxburghii*

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Abstract — A new species, *Hansfordia pallens*, is described, illustrated and compared with similar *Hansfordia* species. It was isolated from living leaves of *Anoectochilus roxburghii* in Guangxi Province, China. This endophyte is typical of *Hansfordia* in morphology but clearly differs from other species in this genus based on the characters of conidiophores and conidia.

Key words — conidiogenous cell, taxonomy

Introduction

The genus *Hansfordia* was established by Hughes (1951) with the type species *H. ovalispora* S. Hughes. This genus was considered to be a synonym of *Dicyma* Boulanger by von Arx (1982), but at the present time the two taxa are considered to be different genera that can be distinguished by the presence (in *Hansfordia*) or absence (in *Dicyma*) of separating cells. Index Fungorum lists twenty species names under the genus *Hansfordia* on its CABI website (www.indexfungorum.org/Names/Names.asp), but it appears likely that some are probably misplaced there and should be transferred to other genera (Kirk 1986). We have found many interesting species of hyphomycetes have been found during our studies of endophytes in China. Among the isolates obtained is an undescribed species of the genus *Hansfordia*, isolated from living leaves of *Anoectochilus roxburghii*, which is described here as a new taxon.

Materials and methods

Asymptomatic branches of *Anoectochilus roxburghii* were collected from Guangxi, China, and endophytic fungi isolated within 24 h. Fifteen samples were taken from each tree — five each from roots (1 × 1 cm), stems (1 × 1 cm)

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*Corresponding author

and leaves (1 × 0.5 cm). All samples were surface sterilized with 70% ethanol for 15 s, rinsed in sterile distilled water for 15 s, submerged in 2% sodium hypochlorite for 2-3 min, washed twice in sterile distilled water for 2-3 min and dried on sterile filter paper. The samples were transferred to plates containing potato dextrose agar (PDA) amended with streptomycin (100 mg/l) and incubated at 25 ± 2C° for approximately 4 weeks in the dark. The plates were checked on alternate days, and fungal tips emerging from plant tissues were then subcultured on PDA. The endophytic fungi were identified according to their macroscopic and microscopic characteristics. Conidiomata and conidia were obtained from sub-cultured plates after 4 weeks of growth in the dark at 25C°.

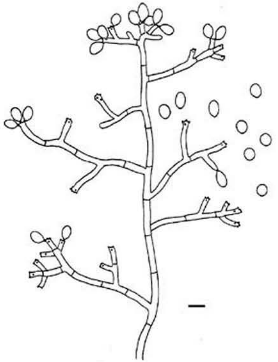


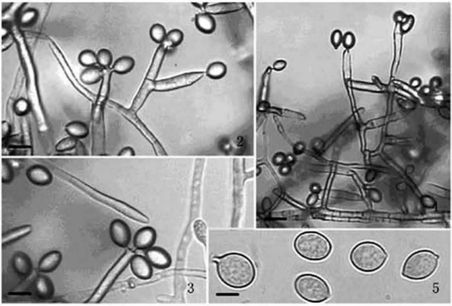
Fig. 1. Conidiophores and conidia of *Hansfordia pallens* (CGMCC 1516). Bar = 10 µm

Taxonomy

Hansfordia pallens K.X. Hu & S.X. Guo, **sp. nov.** Figs. 1-5

MycoBank MB 511087

Coloniae in PDA post 7 dies ad 25 C° usque ad 60 mm diam. Mycelium partim immersum et partim superficiale, ex hyphis septatis, ramosis, laevibus, pallid croceis, 2-3.5 µm latis compositum. Conidiophora macronematosa, mononematosa, erecta vel repentia, multo



Figs. 2-5. *Hansfordia pallens* (CGMCC 1516). Conidiophores and conidia on PDA.
Bars: 2-3 = 10 µm; 4 = 20 µm; 5 = 5 µm

ramosa, recta vel flexuosa, hyalina vel pallide crocea, laevia, ad apicem non setiformia, longitudine indeterminata 2.5-4.5 µm lata. Cellulae conidiogenae polyblasticae, integratae, hyalinae, terminales, 12.5-32.5 × 3-4.5 µm. Conidiorum secessio rhexolytica, fracta ab cellula intercalari. Conidia acrogena, postea acropleurogena, solitaria, sicca, ellipsoidea vel globosa, laevia, aseptata, subhyalina, 8-13.5 × 5.5-7.5 µm, basi hilo circa 1µm lato leniter prominenti.

Colonies on PDA superficial and immersed, pale yellow, up to 60 mm diam in 7 days at 25 C°. Mycelium septate, smooth, branched, pale yellow, 2-3.5 µm wide. Conidiophores macronematous, mononematous, erect or repent, much branched, straight or flexuous, hyaline or pale yellow, smooth, apices not setiform, of indeterminate length, 2.5-4.5 µm wide. Conidiogenous cells polyblastic, integrated, hyaline, terminal, 12.5-32.5 × 3-4.5 µm. Conidial secession rhexolytic by fracture of the wall of a small separating cell. Conidia acrogenous, later acropleurogenous, solitary, subhyaline, dry, ellipsoidal or globose, smooth, nonseptate, 8-13.5 × 5.5-7.5 µm, with a slightly protruding basal hilum about 1 µm wide.

Holotype: CHINA. Guangxi. RongShui County. 18 Aug. 2005, in living foliage of *Anoectochilus roxburghii*, X.M. Chen No. HHL5, CGMCC 1516.

Species in the genus *Hansfordia* are distinguished mainly by the morphology of conidiophores and conidia. Of the present species, *H. pulvinata* (Berk. & M.A. Curtis) S. Hughes is the most common with a cosmopolitan distribution

(Hughes 1958, Kirk 1986). Conidia of *H. pulvinata* are smaller (4-7 µm) than those of *H. pallens*. In addition, conidiophores of *H. pulvinata* are sometimes setiform, a feature not present in those of *H. pallens*. *H. cinnamomi* Deighton resembles *H. pallens* but the conidia of this species are bigger (14-20 × 10-12 µm) (Deighton 1960). *H. pallens* differs from other species as follows: in *H. ovalispora* conidia are smaller (8-11 × 4-6 µm) and conidiophores are setiform; conidia of *H. caricis* P.M. Kirk are smooth or minutely echinulate and 6-8 × 3.5-4.5 µm (Kirk 1986); *H. biophila* (Cif.) M.B. Ellis has narrower (6-12 × 2.5-3.5 µm) and minutely verrucose conidia (Ellis 1976); *H. nebularis* (Cooke & Ellis) M.B. Ellis and *H. indica* P. Rag Rao have significantly smaller conidia, 3-5 × 3-4 µm and 2.5-4.5 × 2-3 µm, respectively (Ellis 1976, Rao & Rao 1980); in *H. catalonica* Mercado et al. conidia are broadly obovoid, turbinate or sometimes ellipsoidal, 4.5-12 × 3.5-5 µm (Gené et al. 2000).

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MYCOTAXON

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Lichen biota of Zonguldak, Turkey

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Abstract — A contribution to the lichen biota of Turkey is presented. A total of 222 lichen taxa (including two subspecies, five varieties, and one lichenicolous fungus) were determined from 80 different localities in Zonguldak. *Arthonia pinastri*, *Aspicilia inornata*, *Cladonia humilis* var. *bourgeanica*, *Opegrapha culmigena*, *Psorula rufonigra* and *Strigula ziziphi* are new to Turkey; 205 lichen species and one lichenicolous fungus (*Lichenoconium erodens*) are new for Zonguldak. Distribution and substrata are summarized. The complete checklist is posted at http://www.mycotaxon.com/resources/weblist.html.

Keywords — *Ascomycetes*, biodiversity, flora, mycota

Introduction

In recent years there has been substantial increase in the number of lichenogical contributions referring to the lichen biota of Turkey (John & Breuss 2004, Nimis & John 1998, Yazıcı & Aslan 2003, Yazıcı et al. 2005). However several regions of Zonguldak province remain unexplored. Thirty-one taxa are known from Zonguldak, which is located in the western Black Sea region (Breuss & John 2004, Szatala 1960, Yazıcı & Aslan 2006). The present paper gives further informations to our knowledge of the lichen flora of Turkey.

Material and methods

The study area is situated between 41°00'35"–41°35'35" N and 31°17'55"–32°19'50" E. Zonguldak region has a typical oceanic climate with a precipitation

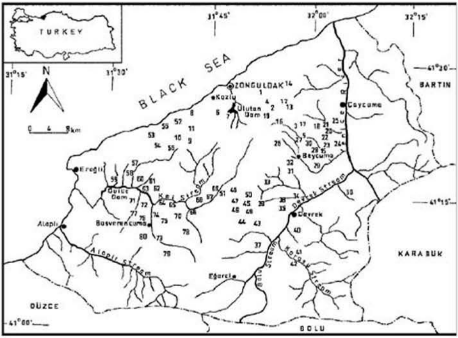

Figure 1. Map of the collecting sites and numbers

regime of type 2 (Akman 1990). The present report is based on samples collected on eighty different stations in Zonguldak between 07 July 2005 and 10 January 2006.After drying at room temperature, the lichen samples were identified using a stereo and light microscope. Secondary metabolites were identified by usual spot tests and TLC methods (Mayrhofer 1988, Poelt 1974, Poelt & Vězda 1981, Purvis et al. 1992, Rambold 1989, Roux & Sérusiaux 2004, Wirth 1995). Vouchers are stored in the herbarium of the Biology Department, Faculty of Sciences and Arts, Giresun University.

Results

A total of 222 lichen taxa belonging to 73 genera in *Ascomycotina*, including two subspecies, five varieties, and one lichenicolous fungus are determined from 80 different localities in Zonguldak province, Turkey. *Arthonia pinastri, Aspicilia inornata, Cladonia humilis* var. *bourgeanica, Opegrapha culmigena, Psorula rufonigra* and *Strigula ziziphi* are new to Turkey; 205 lichen species and one lichenicolous fungus (*Lichenoconium erodens*) are new for Zonguldak.

Discussion

Crustose species were noted in 65 localities and appear very common, especially in the north near the coastal areas of the Black Sea. Generally in these areas, crustose lichens prefer to grow mostly on deciduous trees and occasionally on rocks. Among the crustose lichens collected, 12 were found only in Ilıksu district. *Lecanora, Caloplaca* and *Pertusaria* are the most common crustose lichen genera. Of these, *Lecanora* is the most common, recorded for 24 localities. This genus grows both on rocks and deciduous substrates in the most part of study area. *Caloplaca* species were generally found on the rocks next to the streams in north of the study area.

The most common foliose genera are *Peltigera, Melanelia* sensu lato, *Parmelia, Physcia, Phaeophyscia* and *Xanthoria*. As expected not many *Peltigera* species were recorded in the forests, especially in north parts due to high rainfall, washing of the soil and deficiency of light. In some inner parts of the study area, however, (e.g., near Sipahiler, Esenlik, Elmacı, Üçköy, Köroğlu), *Peltigera* characteristically grows on mosses and soil in well-lit *Quercus* dominated forests even in spite of the heavy burning of coal.

Fruticose lichen taxa were identified in a total of 33 localities and of these, nine are near to the Black Sea and inner areas. Most (21 taxa) fruticose species represent *Cladonia* spp, with the remaining belonging to *Ramalina* and *Usnea*. Members of *Cladonia,* which typically grow on mosses or in soil at the base of trees, were found in well-lit undergrowth and at forest edges. *Ramalina* species were found only on *Quercus* in open forests, especially in Sıpahıler village, Hacıalı turning, and Kızılcapınar village. *Usnea* species were found on *Pyrus, Malus* and *Prunus* along roadsides towards the south of the study area in Düzpelit village and Armutlu district.

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MYCOTAXON

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A new species of *Pseudocercospora* on *Palicourea rigida* (*Rubiaceae*) from Minas Gerais, Brazil

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Abstract — The leaf-spotting hyphomycete *Pseudocercospora rigidae* sp. nov., collected on *Palicourea rigida* from the Brazilian cerrado, is described, illustrated, discussed and compared with allied species reported on *Rubiaceae*.

Key words — biodiversity, cercosporoid hyphomycetes, phytopathology, taxonomy, tropical fungi

Palicourea rigida Kunth (local Brazilian name: bate-caixa) is a woody perennial plant in the *Rubiaceae*, characteristic of the Brazilian cerrado. During a botanical survey in the cerrado of Carrancas city in Minas Gerais State, Brazil, samples of *P. rigida* with necrotic lesions caused by a cercosporoid hyphomycete were collected. The leaf-spotting fungus on *P. rigida* proved to be a new species of the genus *Pseudocercospora* Speg., which is described, illustrated and discussed in this paper. This work is part of an ongoing program of surveying and describing the mycodiversity in the state of Minas Gerais.

Material and methods

Selected small samples of the fungus were removed from fresh leaf spots and mounted in lactophenol. Observations, measurements and illustrations were carried out by means of an OLYMPUS BX 50 light microscope (Hamburg, Germany) fitted with a drawing tube.

Taxonomic description

Pseudocercospora rigidae Meiriele Silva & O.L. Pereira, **sp. nov.** FIGS 1-3
MYCOBANK 510922

Differt a Pseudocercospora palicoureina *conidiophoris 11-25 µm longis, conidiis 22-102 µm longis et 0-9 septatis.*

Etymology: inhabiting *Palicourea rigida*.

Holotype: BRAZIL, Minas Gerais, Carrancas, on leaves of *Palicourea rigida*, 10 Feb. 2007, O. L. Pereira (VIC 30472).

Leaf spots amphigenous, vein-delimited or irregular (Figs. 1-2), necrotic, grayish with distinct brownish margin, 0.3–12.5 mm diam. or confluent and larger, covering large areas of the leaf surfaces. Stromata well developed, subepidermal, erumpent, dark brown, 22.0–57.0 µm diam. Caespituli amphigenous, commonly hypophyllous, brown. Conidiophores rupturing epidermis, arising from subepidermal stromata, in dense fascicles, erect to decumbent, straight, cylindrical to geniculate-sinuous, unbranched, 11.0–25.0 × 3.0–4.5 µm, thin-walled, medium brown, 0-3-septate, smooth. Conidiogenous cells terminal, integrated, 2.5–4.0 µm wide, medium brown, smooth. Conidiogenous loci inconspicuous, not darkened, unthickened. Conidia solitary, obclavate-cylindrical, straight to slightly curved, 22.0–102.5 × 3.0-4.0 µm, apex obtuse, base obconically truncate, 0–9-septate, pale brown, smooth, thin-walled, hila unthickened, not darkened.

Comments — Only two cercosporoid fungi were known to occur on a member of the genus *Palicourea*, viz. *Pseudocercospora palicoureina* (Petr. & Cif.) U. Braun (Braun 2001a), reported on *Palicourea domingensis* (Jacq.) DC. and *P. galeottiana* M. Martens from the Dominican Republic and Mexico (Chupp 1954, Crous & Braun 2003) and *Pseudocercospora palicoureae* O.L. Pereira & R.W. Barreto, reported on the toxic weed *Palicourea marcgravii* A. St. Hil. in Brazil (Pereira & Barreto 2006).

Pseudocercospora rigidae is the second cercosporoid fungus reported on a member of *Palicourea* in South America. It clearly differs from the other South American species, *P. palicoureae*, in having well-developed stromata. The latter species produces only faintly chlorotic symptoms on infected leaves, stromata are lacking and shorter conidiophores emerge through stomata (Pereira & Barreto 2006). *P. rigidae* is morphologically closer to *P. palicoureina* than to *P. palicoureae*, due to its well-developed stromata. However, *P. rigidae* is distinguished from *P. palicoureina* by its shorter, exclusively unbranched conidiophores and longer conidia with 0–9 septa.

Numerous *Pseudocercospora* spp. have been described from hosts of other, not closely related rubiaceous genera, including some species that are morphologically close to the new species. *P. genipicola* U. Braun & F.O. Freire (Braun & Freire 2002), described from Brazil, is distinguished by its larger stromata, up to 100 µm diam, shorter conidia, 10–40(–55) µm long, and mainly epiphyllous caespituli. The Asian *P. ixorae* (Solheim) Deighton is very similar, but differs in having zonate leaf spots and shorter conidiophores and conidia (Chupp,, 1954, Hsieh & Goh,, 1990). The North American *P. houstoniae* (Ellis

Figure 1. *Pseudocercospora rigidae* (VIC 30472). Diseased *Palicourea rigida* plant in the field (Brazilian cerrado).

& Everh.) U. Braun & Crous (Chupp 1954) has indistinct lesions and longer conidiophores and shorter conidia. Finally, the South African *P. psychotriicola* (Chupp & Doidge) Crous & U. Braun (Chupp 1954, Crous & Braun 1994) is

Figure 2. *Pseudocercospora rigidae* (VIC 30472). Detail of infected leaf, showing vein-delimited or irregular necrotic spots.

characterized by having much longer and wider conidiophores, up to 75 × 6 µm. *P. gardeniae* (Boedijn) Deighton, known from Asia on *Gardenia* spp. (Braun 2001b) and Brazil on *Tocoyena* sp. (Braun & Freire 2004), as well as the

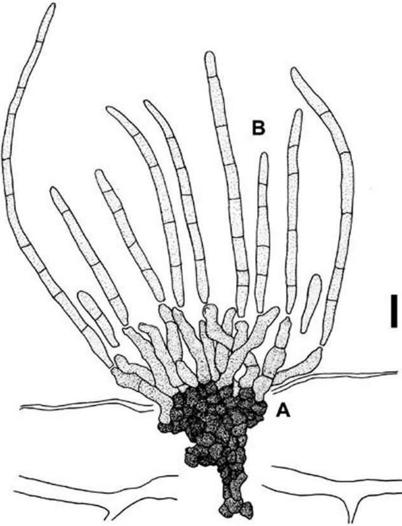

Figure 3. *Pseudocercospora rigidae* (VIC 30472). Sporodochial conidiomata arising from dark-brown subepidermal stromata (A), bearing obclavate-cylindrical solitary conidia with obtuse apex and truncate base, showing unthickened hila (B). Scale bar: 10 µm.

Indian *P. morindae* (Syd.) Sarbajna (Chupp 1954) are morphologically barely distinguishable from *P. rigidae*. However, as far as is known, *Pseudocercospora* species are believed to have narrow host ranges, i.e., they appear restricted to hosts representing a single genus or closely allied genera. The hosts of the species above are not closely allied: *Palicourea* is assigned to the tribe *Psychotrieae (Psychotriinae)*, *Morinda* to the *Morindeae (Psychotriinae)*, and both *Gardenia* and *Tocoyena* in the subtribe *Gardeniinae (Gardenieae)* with the latter belonging to a different subfamily).

Furthermore, *P. morindae* has somewhat narrower conidiophores and conidia and is geographically isolated from the fungus on *Palicourea rigida* in Brazil. *P. gardeniae* differs by longer conidiophores and shorter conidia (Braun 2001b). Hence, the introduction of a new species for the latter fungus seems to be justified.

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MYCOTAXON

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Lepiotaceous fungi in California, U.S.A. – 5. *Lepiota oculata* and its look-alikes

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Abstract—The small brown-scaled and brown-centred representatives of the *Leucoagaricus/ Leucocoprinus* clade (*Agaricaceae*) in California are discussed. Besides *Lepiota oculata*, described from Oregon, three other species were detected and are described here as new. The primary diagnostic characters to separate the species are the pileus covering and the cheilocystidia: a cutis of repent, non-differentiated hyphae and subcapitate cheilocystidia in *La. infuscatus*; a trichodermal covering with differentiated terminal elements and cylindrical narrow cheilocystidia in *L. oculata*; the same type of pileus covering but cheilocystidia distinctly narrowed into a pedicel in *La. paraplesius*, and a trichodermal pileus covering with tufts of narrowly lageniform elements in *La. ophthalmus*. All species are widespread and can occur in the same areas. A key to the species is included.

Key words—biodiversity, nrITS-sequences, taxonomy, western North America

Introduction

California's mycoflora is rich in lepiotaceous fungi, especially species belonging to the *Leucoagaricus/Leucocoprinus* clade (Vellinga 2004a, b). Many species still await description (Sundberg 1967; Vellinga 2004a).

The brown-eyed scaly species *L. oculata* was the object of the present study; the type collection was studied and comparisons with modern collections were made, resulting in the description of three new species, based on morphological characters concerning spores, cheilocystidia and pileus covering, and nrITS-sequences.

Methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (2001). Colour annotations in the macroscopical descriptions are from Munsell soil color charts (1975). The notation [40,3,3] indicates that measurements were made on 40 spores in three samples in three collections. The following abbreviations are used: L for lamellae, l for lamellulae, 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* and *La.* for *Leucoagaricus*. All collections are in UC unless otherwise stated. Herbarium abbreviations are according to Holmgren & Holmgren (1998). Standard molecular methods were applied (e.g. Vellinga et al. 2003); the primer pair ITS1F and ITS4 were used both for PCR and sequencing (Gardes & Bruns 1993), and the program PAUP* version 4.0 (Swofford 2002) performed the phylogenetic analyses. All nrITS sequences have been deposited in GenBank; accession numbers are listed with the collections. Latin descriptions of the new species have been deposited in MycoBank.

Taxonomic descriptions

1. Lepiota oculata J.E. Lange & Zeller in Zeller,
Mycologia 30: 473. 1938. FIGURES 1, 2, 3A&B, 7

Description of type collection (Zeller 8014 (NY)) (fig. 1)

Zeller (1938): "Pileus 1.2-1.8 cm in diam. convex, expanding almost plane, with a small, slightly prominent umbo, almost membranous, especially toward the margin; surface silky-fibrillose with delicate pilose-fibrillose squamules, which are dense and reddish-brown forming an almost continuous cuticle at the umbo, and polar and even more minute toward the edge, where white tissue between the squamules is exposed; margin membranous slightly fringed and rimose; gills free, rather narrow, white; stem almost glabrous, slightly floccose above, white, 3.5 cm × 1.5-2 mm.; annulus white, superior (about 2/3 up), somewhat funnel-shaped, distinct, persistent; spores ovoid, 6-7.5 × 3.2-3.6 µ, white, smooth, cells on edge of gills hair-like or subcapitate (apex about 5 µ in diam.)."

Basidiospores [20,1,1] in side view 7.1-8.8 × 3.9-4.6 µm, avl × avw = 7.8 × 4.3 µm, Q = 1.65-2.0, avQ = 1.82, oblong with adaxial side less curved than abaxial side, in most cases amygdaloid, some with faint apical papilla, in frontal view oblong to oboval with apical papilla, dextrinoid, metachromatic in Cresyl blue, congophilous. **Basidia** 18-20 × 7.5-9 µm, narrowly clavate to clavate, 4-sterigmate. Lamella edge sterile; **cheilocystidia** 22-60 × 4-7 µm, cylindrical with rounded apex, slightly narrowly clavate to fusiform, thin-walled, colourless. **Pleurocystidia** absent. **Pileus covering** trichodermal with terminal elements 40-110 × 5-12 µm, narrowed into pedicel, often a bit curved, and slightly tapered towards apex, rarely subcapitate, some irregularly branched, with brown incrusting walls. **Clamp connections** absent.

Microscopical description of modern material (fig. 2)

Basidiospores [91,6,6] in side view 6.7-8.8 × 3.6-4.6 µm, on average 6.5-7.8 × 3.9-4.4 µm, Q = 1.62-2.05, average Q = 1.67-1.86, amygdaliform, some oblong, some with apical papilla, in frontal view oblong-ovoid, thick-walled, uni-

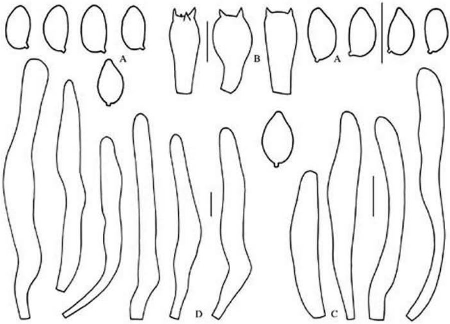

Fig. 1: *Lepiota oculata* – A. Spores; B. basidia; C. cheilocystidia; D. elements of pileus covering (all from holotype). Scale bars 10 µm.

guttulate, congophilous, dextrinoid and metachromatic in Cresyl Blue. **Basidia** 16-27 × 7.0-9.0 µm, with 4 sterigmata. Lamella edge sterile; **cheilocystidia** 34-64 × 4.0-8.0 µm, cylindrical, often wavy, slightly capitate or with apex as wide as rest of cystidia, not narrower at base than in centre. **Pleurocystidia** absent. **Pileus covering** trichodermal with terminal erect elements, 35-115 × 5-13 µm, cylindrical with rounded apex, slightly attenuated into short pedicel, with brown walls, especially in lower half; connecting hyphae short-celled with incrusting brown pigment. **Clamp connections** absent.

Habitat and distribution – Solitary to gregarious, terrestrial in mixed coniferous, or mixed coniferous-deciduous forests, mainly in coastal areas (but this might be caused by a collection bias), known from Oregon to central California. Not found under *Cupressus macrocarpa*. Fruiting from the end of September in Oregon to the end of November in California.

COLLECTIONS EXAMINED – U.S.A., Oregon, Tillamook Co., near Hemlock, 27.IX.1931, J.E. Lange & S.M. Zeller 8014 (holotype, NY).

U.S.A., California, Humboldt Co., Big Lagoon Park, 24 Oct. 2003, E.C. Vellinga 3100 (Genbank EU141947); ibidem 11 Nov. 2004, E. C. Vellinga 3275 (Genbank EU141950);

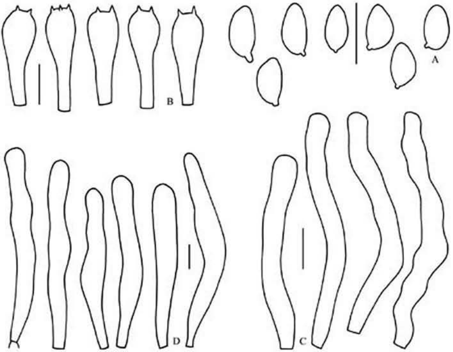

Fig. 2: *Lepiota oculata* – A. Spores; B. basidia; C. cheilocystidia; D. elements of pileus covering (all from collection E.C. Vellinga 3100). Scale bars 10 µm.

Patrick's Point S.P., 23 Oct. 2003, E.C. Vellinga 3085 and 3092; Marin Co., Point Reyes, Greenpicker's trail, 6 Oct. 2001, E.C. Vellinga 2640; Tomales Bay S.P., 28 Nov. 2001, E.C. Vellinga 2748 (Genbank EU141949); Mendocino Co., Jackson State Forest, 19 Nov. 2005, E.C. Vellinga 3403 (Genbank EU141948).

COMMENTS – *Lepiota oculata* is a rather common species in the western states of the U.S.A., and is recognized by its brown pileus centre, the cylindrical cheilocystidia, and the erect, cylindrical, brown-walled elements of the pileus covering.

The spore sizes of the type collection, as measured by the present author, are in the higher range of the species. Zeller (1938), and Smith (1966) gave considerably smaller spore sizes for the same collection.

The macroscopical description as given by Zeller (1938) is quite comprehensive; a slightly wider range of pileus sizes (up to 35 mm) has been found, and the colour code for the brown of the pileus centre was found to be 7.5 YR 5/6 (see fig. 3A & B for habitat sketches).

2. *Leucoagaricus paraplesius* Vellinga, sp. nov.

Figures 3 D&E, 4, 7

MycoBank MB 511148

Lepiotae oculatae *similis, sed in cheilocystidiis versus basim attenuatis et in spatii interni transcripti sequentia ("ITS") differt.*

Holotypus: 'U.S.A., California, Humboldt Co., Big Lagoon Park, 11 Nov. 2004, E.C. Vellinga 3276 (UC)'.

Etymology: The epithet *paraplesius* is a transliteration and latinization of the Greek παραπλησιος, meaning 'very similar', because of the close resemblance to *L. oculata*.

Pileus 14-39 mm, conical with blunt apex, expanding to plano-convex or applanate with prominent to very low umbo or with flattened centre, at centre dull olivaceous brown to reddish brown (10 YR 4/4, 7.5 YR 4/2, 10 YR 5/3-4 to 5 YR 4/3), tomentose, around centre surface broken up into very small fibrillose-tufty squamules to dots or uplifted plush-like fibrils, either radially arranged or more concentrically aligned, not very obvious, on white radially fibrillose background; margin slightly exceeding lamellae. **Lamellae**, L = 35-40, l = 1, moderately crowded, free and remote from stipe, slightly ventricose 2-3 mm wide, white with pinkish-creamish tinge; edge white, fine-flocculose. **Stipe** up to 115 mm long, 2-5 mm wide, cylindrical, or compressed, up to 4-7 mm wide at base, white all over, with white tomentum at lower half and loosely fibrillose all over, hollow. **Annulus** made up of an ascending white cuff and a white flaring part with a brown rim. **Context** white and dull pileus, white and shiny in stipe. **Smell** indistinct; **taste** not recorded. **Spore print** not recorded.

Basidiospores [40,3,3] in side view 6.1-7.8 × 3.6-4.7 µm, avl × avw = 6.5-7.4 × 3.9-4.4 µm, Q = 1.51-1.83, avQ = 1.67-1.71, amygdaliform, oblong, ellipsoid, some with apical papilla, in frontal view oblong to ellipsoid, rather thick-walled, uni-guttulate, congophilous, dextrinoid and metachromatic in Cresyl Blue. **Basidia** 15-27 × 7.0-8.5 µm, with 4 sterigmata. Lamella edge sterile; **cheilocystidia** 30-63 × 5.0-9.0 µm, cylindrical to narrowly clavate with rounded apex, narrowed at base into pedicel, colourless. **Pleurocystidia** absent. **Pileus covering** made up of more or less repent hyphae with clearly differentiated uplifted terminal elements, 55-115 × 6-10 µm, cylindrical, with rounded apex, with brown walls, especially in lower half, in one collection (ecv3089) 36-77 × 7-15 µm and distinctly narrowly clavate, arising from short-celled hyphae with brown incrusting pigment. **Clamp connections** absent.

Habitat and distribution – In small groups, terrestrial, in forests with *Picea sitchensis*, October and November, not often collected and distribution not well known.

Collections examined – U.S.A., Oregon, Lane Co., Siuslaw National Forest, east of Siltcoos Lake, 3 Nov. 1999, F.A. Camacho (coll. E.C. Vellinga 2374). U.S.A., California, Humboldt Co., Big Lagoon Park, 11 Nov. 2004, E.C. Vellinga 3276 (Holotype, UC; Genbank EU141946); Patrick's Point S.P., 23 Oct. 2003, E.C. Vellinga 3089.

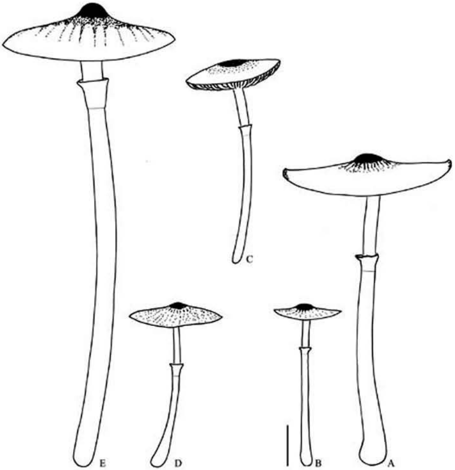

Fig. 3: Habitus sketches: A & B. *Lepiota oculata* (A from ecv3085; B from ecv2640)
C. *Leucoagaricus ophthalmus* (from ecv3132)
D & E. *La. paraplesius* (D from ecv2374; E from ecv3276).
Scale bar is 10 mm.

COMMENTS – *Leucoagaricus paraplesius* is rare and only known from a few collections from Oregon and California so far. It is very close to *L. oculata* and differs in the shape of the cheilocystidia: narrow and cylindrical in *L. oculata*, cylindrical but narrowed into pedicel in *La. paraplesius*. The differences in ITS sequences are considerable (fig. 7), and warrant recognition as a separate species.

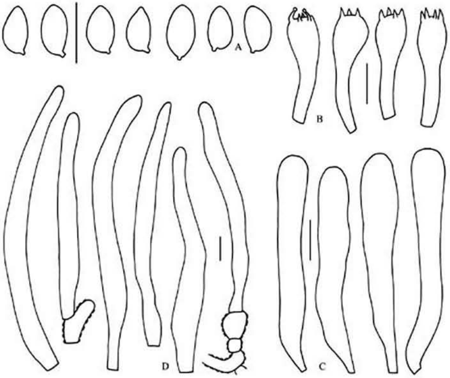

Fig. 4: *Leucoagaricus paraplesius* – A. Spores; B. basidia; C. cheilocystidia; D. elements of pileus covering (all from holotype). Scale bars 10 µm.

3. *Leucoagaricus ophthalmus* Vellinga, sp. nov.

FIGURES 3C, 5, 7

MYCOBANK MB 511149

> Lepiotae oculatae *affinis; operimenti pilei structura cellulis lageniformibus, et in spatii interni transcripti sequentia ("ITS") differt.*
>
> ***Holotypus:*** 'U.S.A., California, Mendocino Co., Jackson State Forest, near mushroom corner, 18 Nov. 2000, E.C. Vellinga 2536 (UC)'.
>
> ***Etymology:*** The epithet *ophthalmus* is a transliteration and latinization of the Greek οφθαλμος, 'eye', because of the resemblance of the pileus covering to an eye, and the resemblance to *L. oculata*.

Pileus when young, 13-15 mm wide and 7-9 mm high, paraboloid or conico-convex when young, when mature 19-31 mm, expanded to applanate or even plano-concave with low to pronounced umbo, when very young totally brown, later fading out in outer half of radius, in adult specimens with striking brown, red-brown disc, (5 YR 4-3/3, 5 YR 4/4, 7.5 YR 3-4/4, 7.5 YR 6/4), with age fading at disc, velvety-plush-like, around umbo with small fibrillose scales or

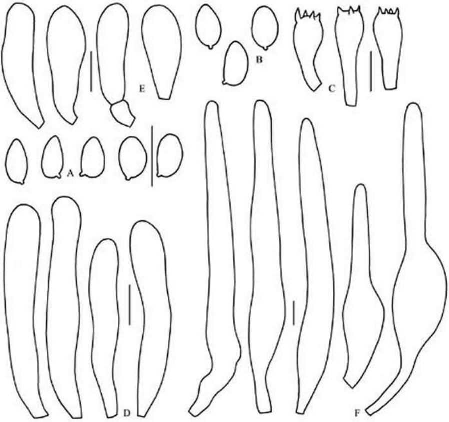

Fig. 5: *Leucoagaricus ophthalmus* – A & B Spores; C basidia; D & E cheilocystidia; F. elements of pileus covering (A, C, D and F from holotype; B and E from coll. E.C. Vellinga 2700).
Scale bars 10 µm.

small brown plush-like squamules on white, radially fibrillose background, and much paler than at centre, in some specimens strikingly white; margin in young specimens fimbriate, exceeding lamellae. **Lamellae** L = ± 40-45, l = 0 or 1, moderately crowded, free, but close to stipe, ventricose, or not ventricose, 1.5-3 mm wide, white, slightly yellowish or pale cream in older specimens, rarely with pink sheen, with white fimbriate, cystidiose edge. **Stipe** 38-60 × 1.5-3 mm, gradually widening to 3- 5 mm wide base, hollow, white and shiny, pruinose or innately fibrillose all over, with white basal mycelium. **Annulus** ascending, flaring, 1-1.5 mm from stipe, white and dull, with fimbriate brown edge. **Context** white, dull and very thin in pileus, shiny white in stipe. **Smell** indistinct, slightly fungoid or like rubber (as in *L. cristata* (Bolton : Fr.) P. Kumm.). **Taste** rather strong, fungoid. **Spore print** white.

Basidiospores [135,9,9] in side view 5.9-8.9 × 3.4-4.4 µm, average 6.5-7.8 × 3.8-4.1 µm, Q = 1.48-2.25, average Q = 1.67-1.84, amygdaliform with rather acute apex, more rarely oblong, often with faint apical papilla, in frontal view fusiform-ellipsoid with rather acute apex, uniguttulate, thick-walled, congophilous, dextrinoid, metachromatic in Cresyl Blue. **Basidia** 15-26 × 6.5-9.0 µm, with 4 sterigmata. Lamella edge sterile; **cheilocystidia** 30-72 × 5-9.5 µm, cylindrical with rounded apex, slightly thick-walled, in one collection (ecv2700) considerably shorter: 19-32 × 6.5-10.5 µm (fig. 4E), sometimes apically branched, slightly thick-walled, colourless. **Pleurocystidia** absent. **Pileus covering** with tufts of erect elements; terminal elements 44-179 × 8-22.5 µm, narrowly lageniform, rarely cylindrical, with brown walls in lower part; connecting hyphae repent, with brown incrustations. **Clamp connections** absent.

Habitat and distribution – Solitary to growing in groups, terrestrial among moss and litter, in various kinds of forests, with or without *Picea sitchensis* or *Sequoia sempervirens*, not known from *Cupressus macrocarpa* stands, widespread and recorded from northern Oregon to central coastal California, October and November.

COLLECTIONS EXAMINED – U.S.A., Oregon, Lincoln Co., Lincoln City, Devils Lake Park, 21 Oct 1999, E.C. Vellinga 2366 (Genbank AY 176384).

U.S.A., California, Humboldt Co., Big Lagoon Park, 24 Oct. 2003, E.C. Vellinga 3099; ibidem, 11 Nov. 2004, E.C. Vellinga 3274 (Genbank EU141951); near Orrick along Davidson Rd., 10 Nov. 2004, E.C. Vellinga 3262; Mendocino Co., Jackson State Forest, near mushroom corner, 18 Nov. 2000, E.C. Vellinga 2536 (holotype, UC; Genbank EU141953); ibidem, 17 Nov. 2001, E.C. Vellinga 2695 (Genbank EU141955), 2701 (Genbank EU141952), and 2716 (Genbank EU141954); ibidem, 22 Nov. 2003, E.C. Vellinga 3132; ibidem, 18 Nov. 2006, E.C. Vellinga 3499; Van Damme S.P., 18 Nov. 2001, E.C. Vellinga 2686 (Genbank EU141956).

COMMENTS – *Leucoagaricus ophthalmus* differs from *L. oculata* in the structure of the pileus covering; with terminal elements clearly lageniform in *La. ophthalmus* and cylindrical in *L. oculata*.

4. *Leucoagaricus infuscatus* Vellinga, sp. nov. FIGURES 6, 7

MYCOBANK MB 511150

Lepiotae oculatae *affinis; operimenti pilei structura cutiformi, cheilocystidiis subcapitatis, et in spatii interni transcripti sequentia ("ITS") differt.*

Holotypus: 'U.S.A., Yuba Co., Camptonville, Pendola Rd, 24 Nov. 2006, E.C. Vellinga 3506 (UC)'.

Etymology: The epithet *infuscatus* means 'brownish', because of the brown colour of the pileus.

Pileus 18-24 mm, applanate or shallowly plano-convex, with or without shallow central depression, brown (7.5 YR 3/4) at centre and there tufted, around centre

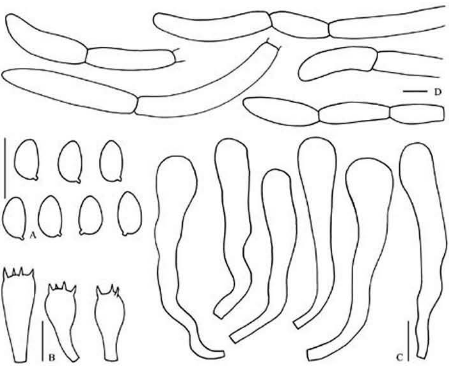

Fig. 6: *Leucoagaricus infuscatus* – A. Spores; B. basidia; C. cheilocystidia; D. elements of pileus covering (all from holotype). Scale bars 10 µm.

with brown spiderweb-like (lens) fibrils radiating towards margin on white background, in older specimens totally whitish around central brown spot; marginal zone sulcate. **Lamellae,** L = 35, l = 0 or 1, distinctly free, not crowded, not distant, ventricose, slightly pinkish cream coloured, with concolourous even edge. **Stipe** 60-65 × 2.5-3 mm, gradually widening towards 4 mm wide base, whitish on watery pinkish cream-colored background, hollow. **Annulus** situated rather high on the stipe, with whitish cuff and small brown rim. **Context** whitish dull in pileus, whitish shiny in stipe. **Smell** not recorded; **taste** not recorded. **Spore print** not recorded.

Basidiospores [60,4,4] in side-view 5.6-7.6 × 3.4-4.4 µm, avl × avw = 6.1-6.6 × 3.7-3.9 µm, Q = 1.5-1.95, avQ = 1.63-1.68, ellipsoid to oblong, with rounded apex, not or slightly amygdaliform, in frontal view ellipoisd to oblong, rather thick-walled, uniguttulate, congophilous, dextrinoid and metachromatic in Cresyl blue. **Basidia** 17-27 × 7.0-8.5 µm, with 4 sterigmata. Lamella edge sterile; **cheilocystidia** 26-57 × 4.0-12 µm, narrowly clavate or cylindrical and subcapitate, wavy, slightly thick-walled, colourless. **Pleurocystidia** absent.

Pileus covering a cutis, made up of repent hyphae with 2-3 coloured inflated terminal cells in a row; terminal elements 22-77.5 × 7.5-13 µm, with irregular intracellular golden-brown to brown pigment, in some cells also incrusting; these coloured cells are less frequent towards pileus margin than in centre. **Clamp connections** absent.

Habitat and distribution – Poorly known; solitary or in small groups, terrestrial, in different coniferous woods, under *Sequoia sempervirens*, *Pinus muricata* and *Pseudotsuga menziesii*, and under *Pinus lambertiana*, recorded from the foothills of the central Sierra Nevada, and the coastal areas of central California, probably less common than *L. oculata* and *La. ophthalmus*; November.

Collections examined – U.S.A., California, Marin Co., Mt Tamalpais, Bon Tempe Lake, shadowside, 29 Nov. 2004, E.C. Vellinga 3326 (Genbank EU141945); Mendocino Co., Jackson State Forest, Mushroom corner, 20 Nov. 2004, E.C. Vellinga 3298 (Genbank EU141943); Mendocino Co., Van Damme S.P., Fern Canyon, 21 Nov. 2004, E.C. Vellinga 3310; Yuba Co., Camptonville, Pendola Rd, 24 Nov. 2006, E.C. Vellinga 3506 (Holotype, UC; Genbank EU141944).

Comments – The macroscopical description is only based on the notes accompanying the type collection. The microscopical description takes all collections into account.

This might be '*L. brunneodisca*' as provisionally described by Sundberg (1967).

The pileus covering of *La. infuscatus* resembles that of the blackish *L. atrodisca* Zeller in its cutis-like structure, and is quite different from the other three species described here.

Discussion

The position and affiliations of these species within the *Leucoagaricus/Leucocoprinus* clade are not clear yet. Morphologically they come close to species like *La. melanotrichus* (Malençon & Bertault) Trimbach and *La. tener* (P.D. Orton) Bon; the former is placed in section *Leucoagaricus* subsect. *Melanotrichi* Bon, and the latter in section *Rubrotincti* subsect. *Trichodermi* Bon & Migl. (Bon 1993).

A formal combination of *Lepiota oculata* in *Leucoagaricus* or *Leucocoprinus* is not made here, as the systematics of this clade is in flux, and genus name changes might be necessary in the near future.

The habitat and distribution of the species are poorly known. All four seem to be widespread in California and at least three of the four have been found on the same day in the same locality, a Sitka spruce forest in northern California.

Several other small brown species occur in Europe, viz. *La. tener*, *La. brunneocingulatus* (P.D. Orton) Bon, and the recently described *La. brunneosquamulosus* P. Mohr & Dähncke.

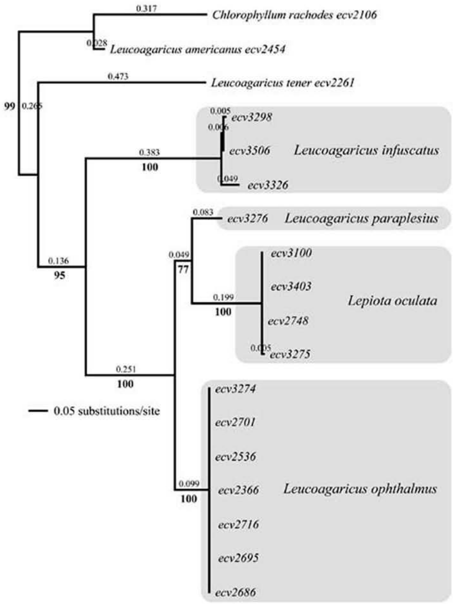

Fig. 7: Phylogenetic relationships among small brown *Leucoagaricus* species inferred from Maximum Likelihood analyses of a dataset of nrITS sequences; 236 characters were informative; the HKY85 variant was used as model. Bootstrap values (in bold) are based on 100 replicates. *Chlorophyllum rachodes* (Vittad.) Vellinga and *Leucoagaricus americanus* (Peck) Vellinga were used as outgroup. All sequences have been deposited in GenBank.

Leucoagaricus tener has fragile fruitbodies with brown drops on pileus and stipe, non-amygdaloid spores, and a pileus covering made up of repent hyphae (Orton 1960, Vellinga 2001). Brown-capped species with drops on the stipe have not been reported from western North America yet, but a species close in nrITS sequences to *La. tener* occurs in New Jersey (U.S.A.), but awaits formal description as a new species.

Leucoagaricus brunneocingulatus is sturdier than *La. tener*, the stipe is brown below the annulus and the pileus covering elements are fusiform.

The brown-scaled *La. brunneosquamulosus* has bigger spores with a distinct germ pore, but resembles the Californian species in the cylindrical cheilocystidia and the cylindrical to narrowly lageniform terminal elements of the pileus covering (Mohr & Ludwig 2004).

Key to the brown-centred squamulose species of the *Leucoagaricus/ Leucocoprinus* clade in western North America

1. Pileus covering a cutis made up of chains of up to three cylindrical to inflated elements with intracellular brown pigment; spores predominantly with rounded apex (fig. 6) .... ***La. infuscatus***
1. Pileus covering with erect terminal elements; spores amygdaliform or with slight apical papilla
    2. Pileus covering with tufts of erect narrowly lageniform, brown-walled elements (fig. 5F) .... ***La. ophthalmus***
    2. Pileus covering with erect cylindrical, brown-walled elements (figs 1D, 2D)
        3. Cheilocystidia cylindrical equally wide over total length (fig. 1C, 2C) .... ***L. oculata***
        3. Cheilocystidia cylindrical and narrowed into pedicel (fig. 4C) .... ***La. paraplesius***

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The care of the curator of fungi in the New York Botanical Garden is highly appreciated. Prof. Zhu-Liang Yang and Dr. Alfredo Vizzini were so kind as to comment on a draft of the manuscript. Funding by NSF grant DEB 0618293 is gratefully acknowledged.

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Lactarius in Northern Thailand: 3. *Lactarius* subgenus *Lactariopsis*

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Abstract—In this third paper in a series on *Lactarius* in Northern Thailand, *Lactarius* subgenus *Lactariopsis* is treated. In the area, this subgenus is represented by two species. *Lactarius leoninus* (previously described from Papua New Guinea) and *Lactarius pilosus*, which is proposed as a new species here. *L. pilosus*, close to the temperate species *Lactarius vellereus*, is characterized by a large, white to pale yellow, velvety pileus, pileipellis and stipitipellis structures with long, thick-walled terminal elements, and small spores.

Keywords—*Russulaceae*, morphology, taxonomy

Introduction

The genus *Lactariopsis* Henn. was created by Hennings (1902) for a species sharing most characters with the genus *Lactarius* but with an involute margin connected to the stipe by a membranaceous velum that later forms an annulus on the stipe. This species was *Lactariopsis zenkeri* Henn. from Cameroon. Heim (1937) first accepted the genus and described another African species, *L. pandani* R. Heim, with a thick velum, but later (Heim 1938) treated *Lactariopsis* as a subgenus in the genus *Lactarius*. Singer (1942) considered this group as *L.* sect. *Lactariopsidei* Singer and described the first representatives from South America.

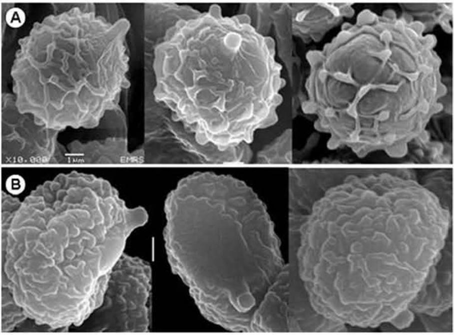

Fig. 1: SEM photographs of *Lactarius* subgenus *Lactariopsis* basidiospores. (A) *L. leoninus* Huyen T. Le 259; (B) *L. pilosus* Huyen T. Le 205 (holotype). Scale bar = 1 µm (A, B).

Verbeken (1998), who considered the presence of a secondary veil an artificial character, emended the subgenus with additional supportive characters. The velum can be absent or present, but all representatives are characterized by rather low ornamented spores with irregularly shaped, sometimes connected warts, by mostly abundant, emergent and often very large pseudocystidia, and by a pileipellis that ranges from lamprotrichopalisade to lampropalisade or mixed trichopalisade or lamprotrichoderm. Thick-walled and hair-shaped elements are abundant, scattered or (rarely) absent. Originally, Verbeken (1998) recognized two sections besides the annulate *L.* section *Lactariopsidei*. Molecular data confirm the subgenus, but the division into sections or an annulate versus exannulate group is not supported (Verbeken et al., unpubl. data).

Materials and methods

The study is based on Le and Desjardin collections made during the period 2003–2006, augmented with Verbeken and Walleyn collections from June 2004. Examined specimens are deposited in the following herbaria: Herbarium

Universitatis Gandavensis (GENT), Herbarium of Chiang Mai University (CMU), and San Francisco State University (SFSU).

Macromorphological features are all based on fresh material. The colours were described in daylight conditions using terms and notations in a colour guide by Kornerup & Wanscher (1978). Latex colour was recorded as it was exuded from the mushroom, from a drop placed on a glass slide held over white paper, and from a drop placed directly on white paper. We also recorded changes of the latex on the context or lamellae, and latex colour changes through time. The reaction of tissue of the pileus and latex to the chemicals $FeSO_4$ and KOH (2.5%–10%) was noted. Pictures of the fruit bodies will be published on the Russulales News website (http://www.mtsn.tn.it/russulales-news/).

Micromorphological characters were documented from the analyses of dried material. Spores were observed in Melzer's reagent for measurements and drawings; all other structures in 2–5% KOH or Congo-red. For each collection at least 20 spores were measured. Spores were measured in side view in Melzer's reagent, excluding the ornamentation and measurements are given as MINa–*AVa*–*AVb*–MAXb in which *AVa* = lowest mean value for the measured collections, *AVb* = greatest mean value. Q stands for "quotient length/width" and is given as MINQ–*Qa*–*Qb*–MAXQ in which *Qa* and *Qb*, stand for the lowest and the highest, respectively mean quotient for the measured specimens. All pertinent micromorphological features were illustrated with the aid of a drawing tube attached to an Olympus CX-41 research compound microscope. For the details of description and terminology of micromorphological features see Verbeken (1998).

Results

Lactarius **subgen.** ***Lactariopsis*** (Henn.) R. Heim, Prodr. Fl. Mycol. Madagascar 1: 36. 1938.

=*Lactariopsis* Henn., Bot. Jahrb. Syst. 30: 51. 1902.

Type species—*Lactarius zenkeri* (Henn.) Singer

1. ***Lactarius leoninus*** Verbeken & E. Horak, Aust. Syst. Bot. 12: 775 (1999)

Figs. 1A, 2A,B

Pileus 18–70 mm diam., plano-convex to widely infundibuliform, smooth when young, rugose when old, golden yellow (5B7-8) to orange (5AB7) on disc, light orange (5A5) to yellow orange (4A5-6) on margin; margin strongly striate to sulcate, wavy; extreme margin membranaceous thin and somewhat overhanging. *Lamellae* decurrent, subdistant, 1–7 mm broad, with 3 series of lamellulae, yellowish white (3A2-3) to pastel yellow (3A4), reddish yellow (4A6-7) when bruised. *Stipe* 20–50 × 7.5–15 mm, cylindrical, central, dry, smooth to long fibrillose, pale yellow white (4A2-3) to pale orange (5A3).

Context 3–8 mm thick, yellowish white (2A1-2), solid in stipe, light yellow (3A2) with KOH 10%, light orange (5A5-6) with $FeSO_4$; odour none to mild; taste mild. *Latex* white, unchanging, light yellow (2A3) with KOH 10%. *Spore print* white cream.

Spores 6.2–*7.6–8.1*–9.5 × 5.6–*6.5–7.1*–7.8 µm, subglobose to broadly ellipsoid, (Q = 1.05–*1.14–1.17*–1.3; n = 60); ornamentation amyloid, composed of warts up to 0.5(1) µm high, subconical to irregular and sometimes elongated, mostly connected by fine lines; plage mostly centrally amyloid. *Basidia* 40–65 × 8–11 µm, 4-spored, with sterigmata 3–6 × 1.7–2 µm, subclavate, hyaline, thin-walled. *Pleuromacrocystidia* absent. *Pleuropseudocystidia* abundant, 9–18 µm diam., emergent, subfusiform (near apex) to cylindrical or tortuous, with moniliform apex, with needle-like contents, thin-walled. *Lamella edge* sterile, composed of pseudocystidia and marginal cells; marginal cells 15–30 × 3–7 µm, hyaline, cylindrical, sometimes subclavate. *Hymenophoral trama* with hyphae, sphaerocytes and abundant lactifers. *Pileipellis* a trichopalisade, 70–90 µm thick; terminal elements 15–35 × 3–7 µm, cylindrical to subcylindrical, thin-walled; subpellis composed of filamentous hyphae and sphaerocytes, thin-walled. *Stipitipellis* a cutis, 60–75 µm thick. *Clamp connections* absent.

Habitat and distribution: solitary to gregarious on the soil, among leaves, in forest dominated by *Castanopsis armata*, *Castanopsis* sp. Described from Papua New Guinea, on the soil, in submontane broad-leaved rain forest dominated by *Anisoptera polyandra* (Dipterocarpaceae; Verbeken & Horak 1999). Recorded here for the first time from Thailand.

> *Material examined:* THAILAND, Chiang Mai Province, Mae Taeng Distr., Mae Sae village, Highway 1095 at 55 km marker, N. 19°14.328' E. 098°38.294', 990 m a.s.l., dominated by *Castanopsis* sp., *Pinus* sp., and *Lithocarpus* sp. trees, 03 June 2005, Huyen T. Le 259 (CMU, SFSU, GENT) – ibid., dominated by *Castanopsis* sp., *Pinus* sp., and *Lithocarpus* sp. trees, 09 June 2006, leg. Roy Halling, Huyen T. Le 421 (CMU, SFSU, GENT) – Chiang Mai Prov., Mae Taeng Distr., Highway 1095 at 22 km marker, N19°07.57' E98°45.65', 750 m a.s.l., xeric broad-leaf forest (*Dipterocarpus* spp. + *Tectona grandis*) with *Pinus kesiya*, under *Pinus*, 04 June 2006, leg. Roy Halling, Huyen T. Le 389 (CMU, SFSU, GENT).

DISCUSSION: The species was described from lowland rainforest in Papua New Guinea and until now has been known only from the type locality (Verbeken & Horak 1999). The species is easily recognized by the golden yellow colours and the strongly striate-sulcate cap that is very thin-fleshed. The thin and membranaceous overhanging margin is typical for the representatives formerly classified in *L.* sect. *Chamaeleontini* Verbeken and suggestive of the velum present in other species of the subgenus.

These Thai populations differ in two important field characters from the type specimen: the taste is mild instead of very acrid and the milk is not observed to change to pale yellow, although the fact that it changes yellow with KOH

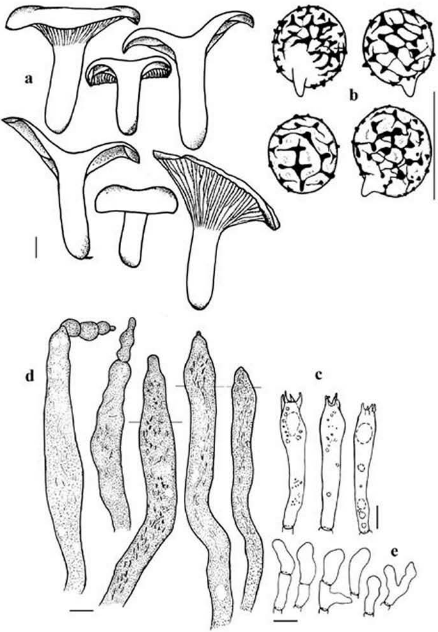

Fig. 2A: *Lactarius leoninus*.
a. basidiomes, b. basidiospores, c. basidia,
d. pleuropseudocystidia, e. marginal cells.
Scale bars = 10 mm (basidiomes) and 10 µm.

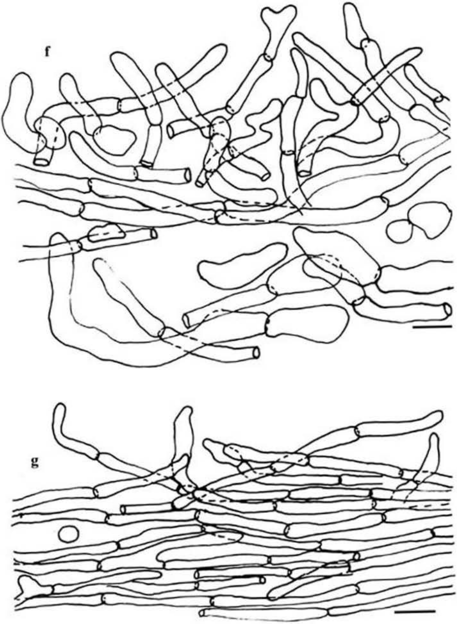

Fig. 2B: *Lactarius leoninus*.
f. pileipellis, g. stipitipellis.
Scale bars = 10 µm.

is often an indication of a natural change. All microscopic features match very well and despite the macroscopic differences we consider the specimens conspecific. More collections are needed to find out whether the difference in acridity belongs to the infraspecific variability or whether different varieties exist.

2. *Lactarius pilosus* Verbeken, H.T. Le & Lumyong **sp. nov.** **Figs. 1B, 3A,B**

MycoBank # 510956

Pileus 70-200 mm diam., infundibuliformis, siccus, velutinus, albidus, cum brunneo-aurantiacis maculis. Lamellae decurrentes, subdistantes ad confertae, interdum furcatae, pallide luteae, brunnescentes cum tacto. Stipes 14-60 mm longus, 11-30 mm largus, cylindratus, siccus, velutinus, albus ad albidus, cum brunneis maculis. Contextus firmus, albidus, immutabilis, vulgo gustu acris. Latex albus, pallide luteus in sicco. Basidiosporae globosae ad ellipsoideae, 5.5–7.0–7.3–9.0 × 4.9–5.8–6.8–7.7 µm (Q = 1.02–1.07–1.21–1.43; n = 140), incomplete ad subcomplete reticulatae, cristis usque ad 0.8 µm altis ornatae, macula suprahilaris vulgo centrale amyloidea. Basidia 45-60 × 6-10 µm, subclavata ad cylindrata, tetraspora. Pleuromacrocystidia abundantia, 50-128 × 5-10 µm, emergentia, cylindrata vel subclavata, interdum mucronata vel moniliformia. Cheilomacrocystidia abundantia, 40-75 × 3-7 µm. Pileipellis lamprotrichoderma, cellulae terminales 30-320 × 2-7 µm, pariete incrassato.

Type—THAILAND, Chiang Mai Prov., Doi Suthep-Pui National Park, Sangasahasri Lane to Huai Kok Ma village, on soil or between leaf litter, N. 18°48.62' E. 098°54.60', 1145 m a.s.l., old-growth forest with *Castanopsis armata*, *Castanopsis* sp., *Schima* sp., *Lithocarpus polystachyus*, and other trees, 30 June 2004, Huyen T. Le 205 (CMU (holotype), SFSU, GENT).

Etymology—*pilosus* (Lat.): hairy with distinct long ascending hairs.

Pileus 70–200 mm diam., deeply infundibuliform with inflexed and wavy margin, dry, velvety to silky, irregularly rugose especially around disc and near margin, white, light orange (5A4) to light yellow (4A4) on disc, pale yellow (3A3) to light yellow (3A2-4) on margin, with brownish orange (5C5) spots. *Lamellae* decurrent, subdistant to close (4–5 lamellae/cm) with 2–3 series of lamellulae, sometimes furcate, 3–10 mm broad, pale yellow (2-3A2-4) to greyish pale yellow (3AB4), light orangish brown to brownish yellow (5C7) or brown (6D7) when bruised. *Stipe* 14–60 × 11–30 mm, cylindrical to tapering downwards, eccentric to central, dry, velvety, smooth to rugose, white to yellowish white (3A2-3), greyish light yellow (4AB4) to brownish orange (5C5-6) or brownish yellow (5C4) when bruised, with yellowish brown (5D8) spots. *Context* 4–13 mm thick at mid-radius in pileus, white to yellowish white (1A1-2) changing to pale yellow (1A3) when dry, solid in stipe, yellow (3A5-6) with KOH 10%, light orange (5A4) to orange (5A6) with $FeSO_4$; odour flower-like or fragrant sweet; taste mild in Huyen T. Le 205, but very acrid in other collections. *Latex* abundant, white, changing to yellowish white (1A2) or pale yellow (2A3) when dry, yellow (3A6) to deep yellow (4A8) with KOH 10%. *Spore print* yellowish white (3A2) (observed in Huyen T. Le 227).

Basidiospores 5.5–*7.0–7.3*–9.0 × 4.9–*5.8–6.8*–7.7 µm, (Q = 1.02–*1.07–1.21*–1.43; n = 140), globose to ellipsoid; ornamentation amyloid, forming an incomplete to almost complete reticulum; ridges often with a slightly split aspect, < 0.8 µm high; plage mostly centrally amyloid. *Basidia* 45–60 × 6–10 µm, subclavate to cylindrical, 4-spored, hyaline sometimes with guttate contents; sterigmata 3–8 × 1.5–2 µm. *Pleuromacrocystidia* abundant, 50–128 × 5–10 µm, emergent, cylindrical to subclavate, tapering upwards, subfusoid-acute, sometimes mucronate or moniliform, hyaline, guttate, with granular and needle-like contents, thin-walled to slightly thick-walled. *Pleuropseudocystidia* 5–10 µm diam., cylindrical to slightly tortuous, narrower towards the apex, thin-walled. *Lamella edge* mostly sterile, sometimes basidia present but mainly composed of cheilomacrocystidia and marginal cells; cheilomacrocystidia abundant, 40–75 × 3–7 µm, emergent, narrowly clavate to cylindrical, narrower at apex, thin- to thick-walled, hyaline, sometimes guttate and granular; marginal cells 15–35 × 4–6 µm, cylindrical, sometimes subfusiform, hyaline, thin-walled. *Hymenophoral trama* with hyphae, sphaerocytes, and abundant lactifers. *Pileipellis* a lamprotrichoderm to lamprotrichopalisade, 80–350 µm thick; terminal cells erect, 30–320 × 2–7 µm, cylindrical, 1–2 septate, thin to thick-walled; subpellis 40–120 µm thick, composed of filamentous hyphae and sphaerocytes. *Stipitipellis* a lamprotrichoderm; suprapellis 25–60 µm thick, with terminal cells 35–360 × 2.5–7 µm, thick-walled, 1–2 septate; subpellis composed of thin-walled filamentous hyphae. Clamp connections absent.

Habitat and distribution: Growing solitary on soil and leaves in mid- to high-elevation broadleaf or mixed primary and secondary forests with *Castanopsis*, *Lithocarpus*, and *Pinus kesiya*; so far only known from Thailand.

Material examined: THAILAND, Chiang Mai Prov., Doi Suthep-Pui National Park, Sangasahasri Lane to Huai Kok Ma village, on soil or between leaf litter, after raining, N. 18°48.62' E. 098°54.60', 1145 m a.s.l., old-growth forest with *Castanopsis armata*, *Castanopsis* sp., *Schima* sp., *Lithocarpus polystachyus*, and other trees, 30 June 2004, Huyen T. Le 205 (CMU, SFSU, GENT) – Chiang Mai Prov., Mae Taeng Distr., Mae Sae village, highway 1095, 55 km marker, N 19°14.328' E 98°38.294', 990 m a.s.l., 28 July 2004, Huyen T. Le 204 (CMU, SFSU, GENT) – ibid., 05 October 2004, leg. Edward Grand, Huyen T. Le 227 (CMU, SFSU, GENT) – Chiang Mai Prov., Mae Taeng Distr., Tung Joaw village, forest trail, N 19°08.07' E98°38.90', 1300 m a.s.l., secondary forest with *Pinus kesiya*, *Castanopsis* etc., 30 August 2003, Huyen T. Le 56 (CMU, SFSU, GENT) – ibid., 16 October 2005, leg. Edward Grand, Huyen T. Le 380 (CMU, SFSU, GENT) – Chiang Mai Prov., Mae Taeng Distr., Tung Joaw village, forest trail, N19°08.07' E98°38.90', 1423 m a.s.l., secondary forest with *Pinus kesiya*, *Castanopsis* etc., 30 August 2003, Huyen T. Le 69 (CMU, SFSU, GENT)– ibid., 16 July 2005, Huyen T. Le 349 (CMU, SFSU, GENT).

Discussion The taste is usually described as acrid in the field, except for Huyen T. Le 205 (noted as mild). It is possible that acridity is variable, but in the European *L. vellereus* (Fr.: Fr.) Fr., the context tastes mild while the latex is burning acrid, suggesting that a mild context is influenced by a possibly acrid latex. (An acrid

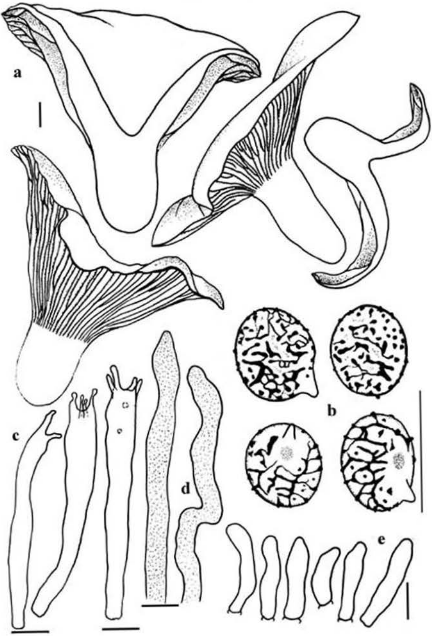

Fig. 3A: *Lactarius pilosus*.
a. basidiomes, b. basidiospores, c. basidia,
d. pleuropseudocystidia, e. marginal cells.
Scale bars = 10 mm (basidiomes) and 10 µm.

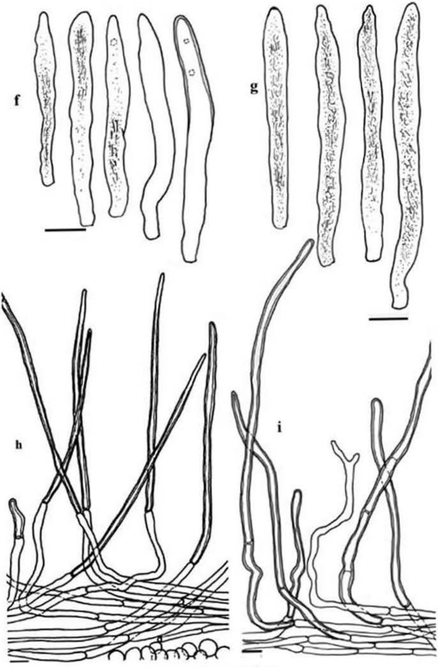

Fig. 3B: *Lactarius pilosus*.
f. cheilomacrocystidia, g. pleuromacrocystidia, h. pileipellis, i. stipitipellis.
Scale bars = 10 µm.

taste is often (erroneously) inferred for the context when context and latex are not tasted separately).

The spores of *L. pilosus* are distinctly smaller than in the European *L. vellereus* (7.7–*9.1–10.6*–12 × 6.3–*7.1–8.2*–9.6 μm, Heilmann-Clausen et al. 1998). Molecular data confirm that *L. pilosus* represents a separate species (Le et al., unpubl) and support this Thai species as distinct from similar American species. The most similar species in North America is *L. subvellereus* Peck, which also differs by the larger spore size (7.5–9.5 × 6.5–8.5 μm; Hesler & Smith 1979). Macroscopically *L. subvellereus* differs by the more distant gills, the latex is unchanging with KOH, the taste of the context is sharply acrid and the taste of the latex is mild or bitter (Hesler & Smith 1979).

Acknowledgments

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Leucocoprinus flavus, an exotic lepiotoid taxon new to Europe

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Abstract—*Leucocoprinus flavus*, originally described from tropical Africa, is reported from Europe for the first time, based on northern Italian collections (Turin, Piedmont). The basidiomata have been collected in an urban park under *Cedrus atlantica*. A description of the European specimens as well as illustrations and drawings of the main micro-morphological features are provided. The features distinguishing *L. flavus* from similar species are summarized and a key to the yellow European species in sect. *Denudati* is presented.

Key words—*Agaricaceae*, biodiversity, *Basidiomycota*, *Leucoagaricus*

Introduction

The genus *Leucocoprinus* Pat. (*Basidiomycota*, *Agaricomycetes*, *Agaricales*, *Agaricaceae*; Vizzini 2004, Hibbett 2006) belongs to the *Leucoagaricus*/*Leucocoprinus* clade (Vellinga 2004a) which encompasses lepiotoid fungi with spore-wall dextrinoid, congophilous and cyanophilous, with metachromatic inner wall in Cresyl blue and perispore swelling in acetic acid after ammonia, clamp connections absent, lamella trama trabecular, partial veil (annulus) present, spores smooth or minutely roughened, with or without germ-pore, spore print generally white (rarely pinkish-cream to brown), and pileus covering extremely variable. Within this clade, *Leucocoprinus* as circumscribed by Singer (1986), Bon (1993) and Vellinga (2001, 2003, 2004a) is morphologically well characterized by the following combination of characters: a basidiome that is generally small-sized, fragile and thin-fleshed with a *Parasola*- to *Bolbitius*-like habitus, a sulcate-striate pileal margin, and heteromorphic basidia starting short and squat that are always separated from each other and surrounded by pseudoparaphyses (sensu Singer & Gamundí 1963, called also brachybasidioles, pavement cells) and usually inflated in the mature hymenium.

Recent molecular work (Johnson & Vilgalys 1998, Johnson 1999, Vellinga 2004a) has indicated some support for a monophyletic *Leucocoprinus* placed within *Leucoagaricus* Locq. ex Singer (*Sericeomyces* Heinem. included); *Leucocoprinus* and *Leucoagaricus* together form a sound monophyletic group. On the contrary, *Leucoagaricus* alone is not well supported, comes out paraphyletic, and seems to function as a taxonomic garbage bin for lepiotoid taxa that do not fit well into other, better-defined, genera. *Leucoagaricus* species thus apparently represent a heterogeneous and artificial set of disparate taxa not all phylogenetically closely related.

Leucocoprinus includes species with a solitary to gregarious growth habit, sometimes in clusters. All are terrestrial saprobes, colonizing compost and rich soils or rarely fruiting on rotten wood, wood chips, or sawdust. The majority have a tropical to subtropical distribution (Pegler 1977, Singer 1986, Guzmán & Guzmán-Davalos 1992), and they are absent from arctic and subalpine habitats (Peintner & Horak 1999, Vellinga 2004b); in cool-temperate areas some species have been introduced in greenhouses (e.g. Hennings 1889, Møller 1953, Smith 1981, Babos 1985, Migliozzi et al. 1989, Pidlich-Aigner & Hausknecht 2001) or similar environments such as nurseries, hotbeds, median strips, compost heaps and flowerpots. The spores appear to be resistant to steam sterilization of the soil. More records of tropical species growing outdoors in temperate regions, may result due to the ongoing warming up of the globe (Lenton 2006, Gange et al. 2007).

In the Neotropics, species of the *Leucocoprinus/Leucoagaricus* clade are cultivated by attine ants (the so called "fungus-growing" or "leaf-cutting" ants in the *Hymenoptera, Formicidae, Attini*) in an advanced obligatory mutualism (Mueller 2002, Mueller et al. 2001, 2005) in which basidiome formation is suppressed. The belief has long been that these cultivars are clonally propagated, but cryptic sex was recently demonstrated (Mikheyev et al. 2006).

During a mycological survey in the "Parco del Valentino" in Turin (Piedmont, western Italy), an area rich in allochthonous shrub and tree species, a remarkable species of *Leucocoprinus* was collected under *Cedrus atlantica* (Endl.) G. Manetti ex Carrière. It is well-characterized by a bright lemon-yellow pileus with rusty hues at centre and long ellipsoid spores without germ-pore. Thorough studies of the material have led to the identification of the taxon as *L. flavus*. Below we present an extensive description and photograph of the Italian collections of this rarely illustrated species, new to the European mycobiota.

Materials and methods

Macroscopic characters were examined from fresh material. Colour references follow Séguy (1936), indicated as Se in front of a colour code. Microscopical studies are based on dried material using a Leica DM 4500 B compound microscope with magnifications up to 1000 x. The microscopic analyses were carried out on free hand sections and observed on mounts in the following reagents: Congo Red in 10% ammonia, 3% KOH, ammonia and acetic acid, Cresyl Blue in water, and Melzer's reagent. Microscopic structures were drawn with a camera lucida mounted on the compound microscope. Measurements of the basidiospores do not include the apiculus. The following abbreviations have been used: [X, Y, Z] indicates that measurements were made on X spores, in Y samples from Z collections; Q = the quotient of length and width of the spores in side view; Qm = average quotient; L = number of entire lamellae; l = number of lamellulae between each pair of entire lamellae. All examined material has been deposited and preserved in the Mycologia section of the Herbarium of the Plant Biology Department, University of Turin, Italy (TO). Herbarium abbreviations refer to Holmgren & Holmgren (1998).

Taxonomy

Leucocoprinus flavus (Beeli) Heinem.,
Bull. Jard. Bot. nat. Belg. 47(1/2): 84, 1977. (Figs. 1-4)
Lepiota flava Beeli, Bull. Soc. roy. bot. Belg. 64: 215, 1932.

SELECTED DESCRIPTIONS AND FIGURES: Heinemann, in Flore illustrée des champignons d'Afrique Centrale 5: 98-99, fig. 55, 1977; Smith & Weber, in Contr. Univ. Mich. Herb. 15: 304-305, pl. 1, fig. 1, 1982.

SELECTED ICONOGRAPHY: Heinemann, in Flore illustrée des champignons d'Afrique Centrale 5: pl. 15, fig. 5, 1977.

MACROMORPHOLOGICAL FEATURES (Fig. 1). PILEUS at first conico-campanulate, then convex to plano-convex and applanate, 8-25 mm in diam., with low obtuse umbo; surface dry, finely granulose-pruinose at centre, not squamulose, bright yellow (Se 241-242) to lemon-yellow (Se 271-273) when young, gradually rusty-brown (Se 246-248) at centre when old; margin even, slightly plicate-striate (up to 1/3 of radius) when dried. LAMELLAE crowded, L = 40-55, l= 0-1(2), free and remote from stipe, subcollariate, segmentiform to slightly ventricose, up to 2.5 mm wide, whitish to pale-yellow, with concolorous, minutely fimbriate to eroded-flocculose edge. ANNULUS (partial veil) ascending, midway on stipe, membranous, persistent, becoming movable, whitish, with a yellowish rim. STIPE cylindrical, 30-60 × 2-3 mm, slightly broadening downwards, hollow, smooth, pale lemon-yellow, white in basal part. CONTEXT both in pileus and stipe very thin, fragile, soft, whitish, with rusty hues below the centre of the

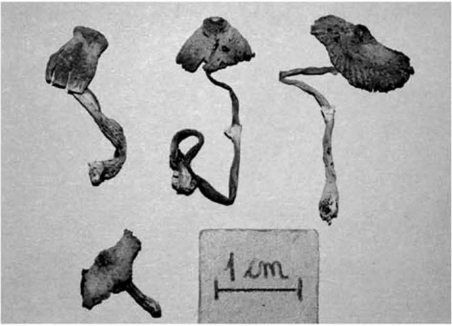

Fig. 1: *Leucocoprinus flavus*: dried basidiomes (from TO HE28).

pileus. SMELL strong, fruity. TASTE mild, with a bitter aftertaste. SPORE PRINT whitish.

MICROMORPHOLOGICAL FEATURES (Figs. 2-4). SPORES [90,6,3] (6.6) 7.2-9.0 (10.5) × (3.3) 3.7-5.0 (5.6) µm, on average 8.0 × 4.3 µm, Q = 1.6-2.0, Qm = 1.87, narrowly ellipsoid-subamygdaliform in side-view, oblong-ellipsoid in frontal view, smooth, hyaline, mostly biguttulate, without germ-pore, thin-walled, dextrinoid, congophilous, slightly cyanophilous, and metachromatic (with pink-red inner wall in Cresyl blue and perispore swelling in ammonia and acetic acid) (Fig. 2a). BASIDIA 4-spored, 13-21 × 8-11 µm (Figs. 2b-c, 3b), surrounded by 4-6 pseudoparaphyses, (12) 13-15 × 8-10 µm (Figs. 2c, 3c). CHEILOCYSTIDIA not abundant, 24-42 (45) × 8-13 (15) µm, extremely variable in shape, mostly clavate to subcylindrical or sublageniform, rarely utriform, rounded in apical part, sometimes slightly capitate, occasionally twisted at base, thin-walled, colourless, sometimes apically encrusted with fine crystals and subtended by an oleiferous hypha (Fig 3a). PLEUROCYSTIDIA absent. PILEIPELLIS without globose elements (sphaerocytes), consisting of appressed, radially arranged, elongate, easily-collapsing, 5-10 (12) µm wide elements, cylindrical, sausage-shaped, inflated to irregular or puzzle-shaped, sometimes branched, not disarticulating, with repent to erect, cylindrical to clavate or fusoid cystidia-like terminal cells, and yellowish, thick, prevalently intracellular pigment (Fig.

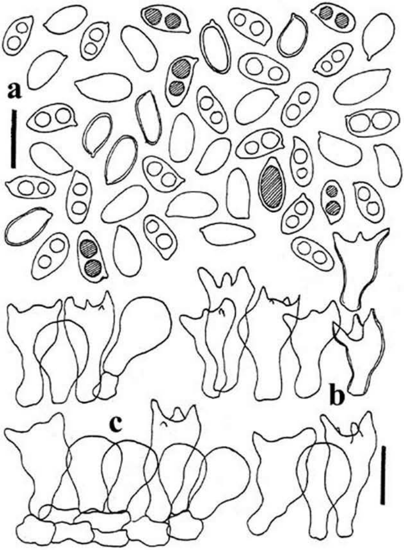

Fig. 2: *Leucocoprinus flavus*. Microscopic characters.
a. Spores. b. Basidia, c. Pseudoparaphyses and basidia (all from TO HE28).
Scale bars = 10 µm.

4a). Abundant extracellular yellow-rusty to brownish concretions, 80-120 × 35-70 µm, which, by squeezing, break down into long raphids (needle-shaped crystals). OLEIFEROUS HYPHAE abundant, present both in lamella- and in pileitrama below pileipellis, 3-8 µm wide, with strongly refractive, more or less yellowish and very homogeneous content (thromboplera, thromboplerous

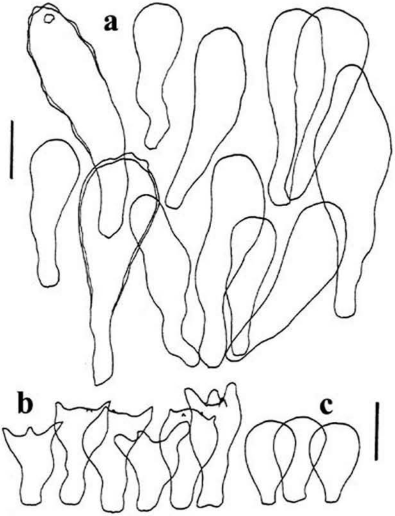

Fig. 3: *Leucocoprinus flavus*. Microscopic characters.
a. Cheilocystidia. b. Basidia, c. Pseudoparaphyses (all from TO HE28).
Scale bars = 10 µm.

hyphae sensu Clémençon 1993, 2004), irregular in outline, meandering, with occasional septa (Fig. 4b); sometimes they subtend cystidia-like elements with yellowish parietal pigment. PILEITRAMA composed of colourless cylindrical elements, 12-16 µm wide (Fig. 4c). STIPITIPELLIS a cutis of not-coloured ovoid-

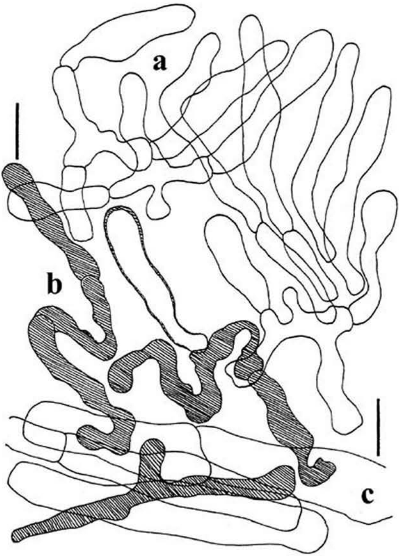

Fig. 4: *Leucocoprinus flavus*. Microscopic characters.
a. Pileipellis. b. Oleiferous hyphae. c. Pileitrama (all from TO HE28).
Scale bars = 10 µm.

cylindrical elements, 8-18 µm wide. ANNULUS made up of cylindrical elements, 3-7 µm wide, with slightly gelatinized walls. CLAMP CONNECTIONS absent.

ECOLOGY basidiomes solitary to gregarious, not in clusters, saprotrophic and terrestrial, in an urban park, under *Cedrus atlantica*.

Material examined: 20/06/1990, Giardino Roccioso, Parco del Valentino (Turin, Italy), leg. et det. A. Vizzini, TO HE28; 20/06/1991, Giardino Roccioso, Parco del Valentino, leg. et det. A. Vizzini, TO HE41 and 15/06/1993, Giardino Roccioso, Parco del Valentino, leg. et det. A. Vizzini, TO HE73.

Discussion

The genus *Leucocoprinus* accommodates ca. 70 species (Vellinga 2007), and additional, as-yet undescribed taxa are continuously being discovered (Gimenes 2007). The traditional splitting of the genus in four sections based on spore and stipe covering characters (Heinemann 1977b) is still provisional, and extensive taxon sampling and molecular supporting data are needed. However, following the traditional taxonomic outline, *L. flavus* fits well in sect. *Denudati* Herink (Herink 1959), which contains species with thin-walled non-citriform spores lacking a germ-pore (Heinemann 1977b; Singer 1986; Candusso & Lanzoni 1990; Bon 1993; Migliozzi 1995, 1996, 1997). Within this section *L. flavus* is clearly delimited by a unique combination of characters: pileus with vivid, deep yellow tinges (persistent, not vanishing in dried specimens), with marginal zone striate only when old, pileipellis without sphaerocytes, oblong spores with Q = 1.6-2.0 and basidiomes growing wild in woodlands also in temperate regions.

This is a rarely illustrated species; the Italian specimens represent the first report of *L. flavus* from Europe. The species was originally described by Beeli (1932, 1936) as *Lepiota flava* from tropical (equatorial) Africa, Congo (now Democratic Republic of Congo), based on two collections by M. Goossens-Fontana (dated 1928 and 1929) at Binga in woodland soil. Later Heinemann (1977b) recombined the species in *Leucocoprinus* (1977a), providing an extended description and a colour illustration based on additional specimens by M. Goossens-Fontana collected in a coffee plantation in 1951. *L. flavus* is also known from Kyoto, Japan (Hongo 1959, Imazeki & Hongo 1965), under trees and from Indiana, North America (Smith & Weber 1982), under mixed hardwoods.

Our specimens agree fairly well with the descriptions and illustrations cited above — especially in Heinemann (1977b) and Smith & Weber (1982) — except for organoleptic features and spores dimension range (Table 1). We believe that these discrepancies are not significant enough to suggest the presence of more species than had hitherto been noticed (a so-called species complex), and, in our opinion, they may mirror both the intraspecific variability and subjectivity of the characters considered. The variance in cited spore widths may result from the different methods of measuring spores used by the authors.

The yellow-brown interhyphal concretions observed in the pileipellis by Heinemann (1977b) and us are probably generated by autolysis of the hyphae and consequent condensation of their pigments.

TABLE 1: Morphological characters of collections attributed to *L. flavus* by different mycologists.

CHARACTERS	BEELI (1932, 1936)	HONGO (1959), IMAZEKI & HONGO (1965)	HEINEMANN (1977b)	SMITH & WEBER (1982)	OUR COLLECTIONS
SMELL	not reported	none	not reported	not reported	penetrating, fruity
TASTE	very bitter	not checked	very bitter	mild	mild /sl. bitter after long chewing
SPORES (µm)	4-5 × 2 (1932) 5-6 × 3-3.5 (1936)	6-7(8.5) × 3-3.7	5.8-7.8 × (3.2)3.4-4.0	(6)7.5-9 × 3.8-5.3	(6.6)7.2-9(10.5) × (3.3)3.7-5 (5.6)
OLEIFEROUS HYPHAE	present (1936)	not reported	not reported	not reported	abundant

TABLE 2: Discriminating features between *L. flavus* and *L. aureofloccosus*

CHARACTERS	*L. FLAVUS*	*L. AUREOFLOCCOSUS* (Hennings 1889, Bon 1993, Mohr 1994)
PILEUS SURFACE	finely fibrillose-granulose, dry	smooth, with golden flocks, subviscid
PILEUS MARGIN	not becoming striate until basidiome at least partially dried	well striate from the beginning
ANNULUS	ascendant, membranous, persistent	fibrillous, early disappearing
HABITAT	apparently wild, in woodland areas	in greenhouses
PILEIPELLIS	xerocutis-xerotrichoderm of articulated elements	ixohymeniderm, of clavate to subcapitate elements
SPORES	3.0-5.0 µm wide, Q = 1.6-2.0	2.5-3.5 µm wide, Q= ≥ 2.0
OLEIFEROUS HYPHAE	present and abundant	not described, reported

Leucocoprinus aureofloccosus (Henn.) M.M. Moser is regarded as the closest taxon among the yellow to sulphur-yellow species in section *Denudati*. Hennings (1889, 1898) first reported it from under palm and banana trees in a greenhouse of the Berlin Botanical Garden, Germany. The distinguishing characters are summarized in Table 2 above.

L. aureofloccosus sensu Rick (1937) from South America could correspond to *L. citrinellus* (fide Raithelhüber 1987).

L. straminellus (Bagl.) Narducci & Caroti (= *L. denudatus* (Rabenh.) Singer) is widespread all over Europe (probably of tropical origin) in greenhouses, botanical gardens, plant pots, hotbeds but rarely recorded from the wild. *L. straminellus* is characterized by a pale lemon-yellow to cream pileus (whitish in var. *albus* (Joss.) Migl. & Rava), abundant sphaerocytes in the pileipellis, and broadly ellipsoid to subglobose spores (5.0-8.5 × 4.0-7.0 µm, Q = 1.1-1.6; Herink 1959, Josserand 1974, Heinemann 1977b, Wasser 1979, 1980; Smith 1981, Lanzoni 1986, Migliozzi et al. 1989, Candusso & Lanzoni 1990, Rödel 1990, Knudsen 1992, Mohr 1992, Bon 1993, Wasser 1993, Kelderman 1994, Migliozzi & Rava 1999, Rocabruna & Tabarés 2001, Pidlich-Aigner & Hausknecht 2001, Vellinga 2001).

L. medioflavus (Boud.) Bon, a rare species found in Europe in pots and greenhouses, has a whitish pileus with yellowish tinges localized only at disc centre (completely white in var. *niveus* Migl. & Rava), ellipsoid to subglobose spores (5.5-6.5 (7) × 3.5-4.2 µm; Bon 1976, Heinemann 1977, Babos 1985, Lanzoni 1986, Migliozzi et al. 1989, Migliozzi & Rava 1999) and, as highlighted by Bon (1976) and Migliozzi et al. (1989), by rare sphaerocytes in the pileipellis.

L. lanzonii Bon et al. described from a greenhouse in Rome, Italy (Bon et al. 1989), differs in having basidiomes that exude small yellow-amber droplets when fresh, lack an annulus, and have a whitish-yellow pileus with orange-brown hues at centre, a stipe dotted with brown granules and usually with rhizomorphs at base, spores 5.0-6.5 × 3.5-4.5 µm, a pileipellis with sphaerocytes, and clearly differentiated pileo- and caulocystidia with brown intracellular pigment (Migliozzi et al. 1989, Candusso & Lanzoni 1990, Bon 1993).

Among the remaining extra-European species characterized by yellowish tinges and spores without a germ-pore, *L. flavescens* (Morgan) H.V. Sm., reported from North America in greenhouses, has a pale-yellow greenish pileus with a contrasting brown disc, broadly ellipsoid to subglobose spores less than 7 µm long, and a pileipellis made up of swollen and thin-walled clavate-pyriform to globose elements, 10-50 µm wide (Smith 1981, Smith & Weber 1982).

Leucocoprinus sp., an apparently undescribed new species reportedly related to *L. flavus* (Gimenes 2007) from Parque Estadual das Fontes do Ipiranga, São Paulo, Brazil, with broadly ellipsoid spores (6.5-7.5 × 4.0-6.5 µm, Q = 1.33) and abundant sphaerocytes, is, in our opinion, much closer, if not identical, to *L. straminellus*.

L. citrinellus (Speg.) Raithelh., judging from the original diagnosis (Spegazzini 1898) and a subsequent description by Raithelhuber (1987), is hardly distinguishable from *L. straminellus*, as previously already indicated by Møller (1953).

Furthermore, the striate pileus margin and the presence of pseudoparaphyses distinguish *L. flavus* from the delicate and fragile yellow- coloured species placed in *Leucoagaricus* (e.g. *L. sulphurellus* (Pegler) B.P. Akers, *L. viridiflavoides*

B.P. Akers & Angels, *L. medioflavoides* Bon, *L. deceptivus* (Grilli) Consiglio & Contu; Pegler 1983, Grilli 1989, Akers et al. 2000, Bon 1993, Consiglio & Contu 2004) with which it could be confused.

In conclusion, we propose the following simplified identification key:

Key to the yellow-coloured *Leucocoprinus* species of sect. *Denudati* found in Europe

1. Pileus subviscid, covered with golden granules, pileipellis a hymeniderm,
spores cylindrical, Q ≥ 2 .... *L. aureofloccosus*

1. Pileus dry, pileipellis not a hymeniderm, Q ≤ 2

2. Fresh basidiomes exuding yellow-amber droplets, annulus absent,
stipe dotted with yellow-brown granules,
brown-pigmented pileo- and caulocystidia present .... *L. lanzonii*

2. Fresh basidiomes not exuding droplets, annulus present,
stipe not dotted, pileo- and caulocystidia absent

3. Pileus striate only at maturity, spores oblong Q = 1.6-2.0 .... *L. flavus*

3. Pileus striate from the very beginning, spores ellipsoid, Q < 1.6

4. Pileus completely yellowish,
with abundant sphaerocytes .... *L. straminellus*

4. Pileus yellowish at centre only, whitish towards margin,
with very few sphaerocytes .... *L. medioflavus*

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MYCOTAXON

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Six lichenized and non–lichenized fungi new to Turkey

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Abstract—Five species of lichenized and one non–lichenized fungi– *Arthonia punctella, Lecania olivacella, Lecidea sarcogynoides, Miriquidica leucophaea, Polyblastia dermatodes* and *Rinodina castanomelodes*– are new to Turkey. *A. punctella, L. olivacella, L. sarcogynoides,* and *P. dermatodes* are also new to Asia. For each, a short description is presented.

Keywords—*Ascomycotina*, Bursa, lichens, Mardin, Osmaniye

Studies of lichens in Turkey are not as extensive as in other countries. Therefore the lichen biota of Turkey is still poorly known despite the several studies that have been carried out in the last six years. (Aslan et al. 2002a,b, John & Breuss 2004, Yazıcı 2006, Yazıcı & Aslan 2005, 2006a,b, Yazıcı & Aptroot 2007, Yazıcı et al. 2004, 2005).

In previous studies some species are noted from Osmaniye and MustafaKemalpaşa, Bursa (Nimis & John 1998, Yazıcı & Aslan 2006a). However many regions in these provinces remain unexplored. The present paper gives further information to our knowledge of the lichen flora of Turkey.

The present report is based on collections from three different provinces Osmaniye, Mardin, Bursa between 24 August 2003 and 11 February 2007.

After drying at room temperature, the lichen samples were identified using a stereo and light-microscope. Secondary metabolites were identified by usual spot tests (Mayrhofer 1988, Poelt 1974, Poelt & Vězda 1981, Purvis et al. 1992, Rambold 1989, Wirth 1995). Vouchers are stored in the herbarium of the Biology Department, Faculty of Sciences and Arts, Giresun University.

Results

Arthonia punctella Nyl.

Thallus absent, lichenicolous, parasitic on thalli of *Diplotomma* sp. next to *Aspicilia contorta* subsp. *hoffmanniana*. Apothecia 0.1–0.4 mm diam., inhabiting thallus, crowded in 5.5 mm diam circular shaped, black, rounded when young, slightly oblong-irregular ellipsoid, smooth at first, later slightly convex, apothecial sections K–; epithecium dark reddish-brown, K+ dull or ± dark olive-green; hymenium c. 35–50 µm tall, colourless, I + blue; hypothecium 35–65µm tall, dark reddish-brown, K + dull or olive-green. Paraphysoids 1.3–3(-3.5) µm wide; apices to 4(-5) µm wide, thickened and with pigment. Ascospores 12(-13)–17(-18) × 5–5.5(-6) µm, 1-septate, ovoid to oblong-ellipsoid, colourless at first but soon brown and warted.

Arthonia punctella is a parasitic, suboceanic and cool-temperate species, usually growing usually on *Diplotomma alboatrum* on rocky seashore cliffs with sandstone rock.

Known throughout Europe (Austria, Belgium, England, France, Germany, Ireland, Luxembourg, Scotland, Sweden) and from Costa Rica. New to Asia.

> Mardin: Midyad; Acırlı village, cemetery, 37°50' N, 41°10' E, parasitic on *Diplotomma* sp. (young, not developed and close to *Aspicilia contorta* subsp. *hoffmanniana*) on calcareous rock, 400 m, 11 February 2007, Yazici 2011.

Ecology of the survey area — The cemetery and surroundings are more or less flat. Some fields are rough and the mountains are not very high. There are also streams and rivers. The well-lit site, which is occasionally exposed to strong winds in winter, is barren and poor in respect to the forest. It has poor tree communities with *Populus, Pyrus* and *Pinus* are occasionally present in some fields. The area is characterized by Mediterranean and terrestrial climate with hot, dry summers and wet, cold winters. Rainfall averages 668 mm per year, with the highest precipitation occurring in March (115.8 mm). Temperature averages range from a low of -2.6 °C in February to a high of 42.5 °C in July.

Lecania olivacella (Nyl.) Zahlbr.

Thallus of 1.2 cm diam., irregular, mostly composed by scattered small scales or areoles (0.4–0.8 mm diam.); partially growing on *Verrucaria* sp., dirty white-grey to yellow-brown. Apothecia to 0.3(-0.4)–0.7 mm diam., sessile, mostly single to crowded in 1–3 groups; disc circular, ellipsoid or broadly ellipsoid, orange-red to dark brown, when moist becoming paler to cinnamon-brown, a dark-pigmented edge often persists, flat to convex; thalline exciple lecanorine, margin more or less irregular, sometimes partially crenulate, some part not developed, narrow, whitish, or whitish-grey, with an algal-rich medulla and cortical zone of isodiametric cells; true exciple narrow, upper part with dark-pigmented walls; hymenium 55–65 µm tall. Epihymenium brown to orange; paraphyses mostly unbranched, the apices slightly swollen and pigmented. Ascus *Bacidia*-type, 8-spores, Ascospores (10-)11.5–14 × 4.5–6 µm, 1-septate, colourless, thin-walled. Tahllus K–, C–, KC–, P–.

This species grows on calcareous and basic siliceous rocks and *L. olivacella* is a widespread but rare species with a wide altitudinal range.

Known throughout Europe (Austria, England, France, Germany, Greece, Italy, Ireland, Norway, Spain, Sweden) and from North Africa. New to Asia

Mardin: Midyad: Acırlı village, cemetery, 37°50' N, 41° 10' E, on calcareous rock, 400 m, 11 February 2007, Yazici 2010.

Ecology of the survey area — See *Arthonia punctella.*

Remarks—*Lecania olivacella* is similar to *L. hutchinsiae* and *L. sylvestris* but with somewhat thicker, scaly-areolate thallus. The apothecia with a persistent thalline exciple, with an algal-rich medulla, and disc sligthly concave- flat to ± convex help differentiate *L. olivacella* from the other two taxa.

Lecidea sarcogynoides Körb.

Thallus mostly absent, but in some parts of rimose or verrucose to areolate, dispersed greyish-white areoles; areoles irregular to roundish, pale to irregularly convex, with rough to smooth or nitid surface, 0.2–0.6(-0.7) mm. Apothecia (0.4-)0.5–1.2 mm diam., rounded to irregularly shaped, dispersed or often in groups (spreading out about 100–150 cm^2); disc plane to slightly convex, black, dark-brown, matt to subnitid, occasionaly pruinose; margin at first distinct, later mostly vanishing, matt to subnitid black, sometimes pruinose, sessile, strongly constricted at the base; true exciple persistent, lateral hymenium (35-)50–80 µm thick, inner zone red to pale brown pigmented, hymenia with lumina, often flexuose, purple-black at outer edge, pale reddish within, K + purplish; epithecium green-black or dark-olivegreen, (6-)7–15(-16) µm tall; hymenium (30-)35–45(-60) µm tall, reddish or pale reddish to violet, I + bluish-brown, K + reddish-purple in parts; hypothecium dark brown-black, (50-)80–180(-300) µm. Paraphyses, more or less branched, occasionally anastomosing; apices olivaceous, capitate. Asci 30–40(-45) × (8-)9–11(-12)µm, *Lecidea*-type. Ascospores 9–13(-14) × (2.5-)3–3.5(-4) µm, oblong to ellipsoid-oblong. Thallus K–, C–, KC–, P–.

Lecidea sarcogynoides grows on non-calcareous, exposed mineral-rich rock stones and steeply inclined faces in lichen-poor communities.

Known throughout Europe (Channel Is., England, Italy, Norway, Portugal, Sweden), North Africa, South Africa, New Zealand, South America, and Australasia. New to Asia.

> Osmaniye: Center; Zorkun high plateau, Yoncalıdüzü district, on granit rock (stone), the edge of forest, 1700 m, 37° 01' 04"N, 36° 17' 10"E, 20 August 2006, Yazici 2002 .

Ecology of the survey area — The climate is typically mediterranean with high levels of humidity. The summers are hot and dry while the winters are snowy, rainy, and windy. The dense, deeply shaded forest contains *Pinus*, *Carpinus* and *Picea orientalis*. Some streams flow near the stand.

Remarks—*Lecidea sarcogynoides* is similar to the *L. auriculata* group, but its purple-black exciple, and slightly reddish-violet hymenium and *Sarcogyne*-like apothecia differ from the red-black exciple, greenish hymenium, and less abruptly truncated ascospores found in *L. auriculata*. Additionally *Lecidea*-type asci help separate *L. sarcogynoides* from *Adelolecia pilati*, characterized by *Bacidia*-type asci. *Lecidea capensis* and *L. tragorum* differ from *L. sarcogynoides* mainly in an areolated and nitid brownish thallus.

Miriquidica leucophaea (Flörke ex Rabenh.) Hertel & Rambold

Thallus areolate, up to 45–55 mm diam., 1.8(-2) mm thick; areoles 0.1–1 mm diam., rather shiny, roundish or angular-roundish, mostly contiguous, flat to convex, cortex c. 10–15 μm thick or verrucose and contorted, rarely some minutely lobate, pale grey, grey-white, mostly glossy; hypothallus black between the areoles. Apothecia 0.3–1(-1.1) mm diam., roundish or mostly angular-roundish, crowded to dispersed, sessile, adpressed or constrict at the base; disc mostly plane or convex and pruinose, dark brown-black or subnitid, paler when wet; true exciple thin, persistent, well developed, black, nitid, later excluded, concolorous with the disc, brownish, the inner part sometimes containing algae; epithecium olive-brown, or occasionaly brown. Hypothecium pale, with erect hyphae, hymenium (45-)55–65(–70) μm tall, colourless, I ± blue, epihymenium dark olive-brown, paraphyses mostly branched and anostomosing. Asci c. (30-)35 × 12(-13) μm, Ascospores 8(-9)–14(-15) × 4–6.5(-7) μm. Medulla I–, thallus and medulla K–, C–, KC–P–; exciple C ± slightly pink.

This lichen occurs in the holoarctic region, on the base-rich bark of isolated trees such as *Populus*, *Juglans*, *Fraxinus*, *Sambucus* and siliceous rocks in the alpine zone as well as at lower altitudes.

Known from The British Isles, Germany, Norway, Sweden, North America, and Australia. New to Turkey.

Bursa: MustafaKemalpaşa; surroundings of Suuçtu Waterfall, on siliceous rock, 650 m, 39° 53' N, 28° 19' E, 24 August 2003, Yazici 2005 .

Ecology of the survey area — The vegetation of this area is characterized by *Quercus* and *Pinus* trees. The climate is typically continental and cool Mediterranean: rainfall averages 668 mm per year and humidity is high (73 %). Temperatures range from a low of -16 °C in winter to a high of 40 °C in summer. It is very windy in winter. The well-lit stand, which lies ~ 15 m from Suuçtu Waterfall, has very steep slopes.

Remarks— *Miriquidica leucophaea* resembles *v griseoatra.* The grey or grey-white, often glossy, and rarely a few minutely lobate areoles help separate the two species. *M. leucophaea* is a polymorphic species found on metal-rich rocks or (rarely) wooden fencing; more hygrophytic than *M. griseoatra,* it is most frequently found in sheltered areas such as on faces with a late snow-lie. *M. leucophaea* differs from *M. deusta,* which has nitid brown areoles, subimmersed apothecia and a well-developed hypothallus in as well as grey to creamy thallus, sessile apothecia and poorly-developed hypothallus.

Polyblastia dermatodes A.Massal.

Thallus immersed (endolithic), c. 0.5 cm diam., scurfy-cracked, thin, c. 0.2(-0.3) mm thick, white or pale grey-white, diffuse or evanescent, occasionally with a thin, slightly black prothallus between areoles. Perithecia 0.2–0.5(-0.6) mm diam., immersed, c. 0.2 mm tall from thallus surface, slightly white-pruinose, crowded but not confluent, lacking involucrellum and forming pits; apex plane, black; ostiole often ± depressed, but finally gaping; true exciple dark-brown to black above but paler below, 0.1mm thick. Periphyses 30–50 µm long. Asci 8-spored, 130 × 40 µm; ascospores (25-)30–50(-52) × (12-)13–25 µm, submuriform with 3–4 transverse and 1–2 longitudinal septa, ellipsoid or longly ellipsoid or broadly-clavate, colourless. Tallus and medulla K–, C–, KC–, P–

This species grows on shaded, old mortar of walls, inclined calcareous rocks, sunny hard limestone, dolomite and chalk nodules.

Known throughout Europe (Belgium, the British Isles, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway, Romania, Slovenia) and Australia. New to Asia.

Mardin: Midyad; Acırlı village, cemetery, on calcareous rock, 400 m, 37°50' N, 41° 10' E, 11 February 2007, Yazici 2006.

Ecology of the survey area — See *Arthonia punctella.*

Remarks—*Polyblastia dermatodes* is similar to *P. verrucosa* but lacks an involucrellum and has immersed thallus and perithecia. Consistently submuriform spores help differentiate *P. dermatodes* from *Thelidium incavatum,* which has ellipsoid spores.

Rinodina castanomelodes H. Mayrhofer & Poelt

Thallus definitely epilitic, thick, grey-white, grey-brown to dark-bown, ± diffuse or areolate; areoles small, flat, some with apothecia. Apothecia to 0.5 mm diam., sessil, superficial, lecanorine; disc concave to flat, dark-brown to black; true exciple persistent and with thalloid puffy margin concolorous with the thallus; epihymenium dark-brown, 20–40 µm tall; paraphyses swollen, 6–8 µm wide; hymenium inspersed with oil droplets, 85–115 µm tall; hypothecium 75(-80)–105(-110) µm. Asci 8-spores, clavate, *Lecanora*-type; ascospores 15–21 × (9-)10–13(-14) µm, with conspicuously pigmented dark cross-band along the septa, *bischoffii*-type. Thallus K–, C–, KC–, P–.

Rinodina castanomelodes is an arctic-alpine to boreal-montane, perhaps circumpolar lichen, lime-loving species, found on soft limestone, marl calcareous schists and man-made substrates in upland areas.

Known throughout Europe (Czech Republic, Macedonia, Poland, Slovakia, Spain, Switzerland), Central Asia, and North America. New to Turkey.

Osmaniye: Center; Zorkun high plateau, Çağşırlı district, roadside, on granit rock (stone), 1750 m, 37° 01' 02" N, 36° 17' 02" E, 20 August 2006, Yazici 2008.

Ecology of the survey area — See *Lecidea sarcogynoides*.

Remarks — *Rinodina castanomelodes* is similar to *R. calcigena*, which has ellipsoid spores that are consistently narrower and more oblique than those of *R. castanomelodes*. Additionally, the species is related to the widespread *R. bischoffii* from which it differs especially by the well-developed thallus and additional morphological differences.

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Phaeocollybia in western North America 5: *P. ochraceocana* sp. nov. and the *P. kauffmanii* complex

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Abstract — A new phaeocollybia is described from Oregon and California temperate coniferous rainforests that shares with *P. luteosquamulosa* a trilaminate suprapellis, a feature unusual in the genus. *Phaeocollybia ochraceocana* differs in its orange to tawny coloration, more abundant pileus squamules, more extensive suprapellis, a mediopellis lacking in roughened gel-encrusted hyphae, cheilocystidia that rarely produce apical extensions and lack gel incrustations, and much smaller basidiospores. Both species belong to the *P. kauffmanii* complex, a morphologically defined group characterized by robust stature, vertical-monopodial pseudorhizae, stuffed stipes with cartilaginous rinds surrounding firm pith, brown verruculose limoniform basidiospores, and thin-walled, clavate cheilocystidia. A revised key to the complex incorporates the new and four morphologically similar species.

Key words — *Agaricales, Basidiomycota, Cortinariaceae*, ectomycorrhiza, Northwest Forest Plan

Introduction

Phaeocollybia is a genus of brown-spored agarics usually easily recognized in the field by their deeply rooting cartilaginous stipes and normally viscid conic-campanulate pilei. Home to close to one-third of the world's known species, western North America has proven an exceptionally fertile area for research into the taxonomy and biology of the genus (Smith 1957, Smith & Trappe 1972, Horak 1977, Bandala 1994, Norvell 1998ab). The first phaeocollybias described from the region, all from the Pacific Northwest United States, were one 'naucoria' from Oregon [Murrill 1917: now *P. radicata*] and two 'naucorias' from Washington state [Smith 1937; now *P. attenuata* and *P. kauffmanii*], all described before Heim (1931) erected the genus *Phaeocollybia*.

Table 1. _Phaeocollybia_ species in western North America (excluding Mexico)

NAME	SUBGENUS	SECTION	DISTRIBUTION
*_P. ammiratii_ Norvell 2000	_Fibulophaeocollybia_	_Subattenuatae_	BC, WA, OR, CA
P. attenuata (A.H.Sm.) Singer 1951	_Phaeocollybia_	_Phaeocollybia_	BC, WA, OR, CA
*_P. benzokauffmanii_ Norvell 2000	_Phaeocollybia_	_Phaeocollybia_	WA, OR, CA
P. californica A.H.Sm 1957	_Phaeocollybia_	_Versicolores_	OR, CA
P. dissiliens A.H.Sm. & Trappe 1972	_Fibulophaeocollybia_	_Radicatae_	OR, CA
P. fallax A.H.Sm 1957	_Phaeocollybia_	_Phaeocollybia_	BC, ID, WA, OR, CA
*_P. gregaria_ A.H.Sm. & Trappe 1972	_Phaeocollybia_	_Phaeocollybia_	OR
*_P. kauffmanii_ (A.H.Sm.) Singer 1940	_Phaeocollybia_	_Phaeocollybia_	BC, ID, WA, OR, CA
*_P. lilacifolia_ A.H.Sm 1957	_Phaeocollybia_	_Phaeocollybia_	WA, OR
*_P. luteosquamulosa_ Norvell 2000	_Phaeocollybia_	_Phaeocollybia_	WA, OR, CA
*_P. ochraceocana_ sp. nov.	_Phaeocollybia_	_Phaeocollybia_	OR, CA
P. olivacea A.H.Sm 1957	_Phaeocollybia_	_Phaeocollybia_	(WA), OR, CA
*_P. oregonensis_ A.H.Sm. & Trappe 1972	_Phaeocollybia_	_Microsporae_	BC, WA, OR
P. phaeogaleroides Norvell 2002	_Fibulophaeocollybia_	_Subattenuatae_	BC, OR
P. piceae A.H.Sm. & Trappe 1972	_Phaeocollybia_	_Phaeocollybia_	BC, WA, OR, CA
P. pleurocystidiata Norvell & Redhead 2000	_Phaeocollybia_	_Versicolores_	WA, OR, CA
P. pseudofestiva A.H.Sm 1957	_Phaeocollybia_	_Versicolores_	BC, WA, OR, CA
P. radicata (Murrill) Singer 1951	_Fibulophaeocollybia_	_Radicatae_	BC, WA, OR, CA
*_P. redheadii_ Norvell 2000	_Phaeocollybia_	_Phaeocollybia_	BC, WA, OR, CA
P. rifflipes Norvell 2002	_Phaeocollybia_	_Phaeocollybia_	WA, OR, CA
P. rufotubulina Norvell 2004	_Phaeocollybia_	_Versicolores_	OR, CA
P. scatesiae A.H.Sm. & Trappe 1972	_Phaeocollybia_	_Versicolores_	WA, OR, CA
P. sipei A.H.Sm 1957	_Phaeocollybia_	_Microsporae_	BC, WA, OR, CA
*_P. spadicea_ A.H.Sm 1957	_Phaeocollybia_	_Versicolores_	WA, OR, CA
*_P. tibiikauffmanii_ Norvell 2004	_Phaeocollybia_	_Versicolores_	OR

*included in _P. kauffmanii_ complex, sensu lato, keyed in this publication.

Smith (1957ab) and Smith & Trappe (1972) described thirteen more species from California, Oregon, and Washington (see Table 1). Two decades later, Redhead & Norvell (1993) described a seventeenth species, *P. carmanahensis*, from British Columbia (Canada). Recent morphological, macrochemical, and molecular analyses suggest a high degree of endemism for *Phaeocollybia*, supporting 15 of the above named species as valid (Norvell 1998ab, 2000, 2002, 2004; Norvell & Redhead 2000). Norvell (1998a, 2000) excluded *P. deceptiva* A.H. Sm. & Trappe as a species of *Cortinarius* subg. *Telamonia*, and Norvell (1998a) and Norvell & Redhead (2000) found *P. carmanahensis* conspecific with *P. oregonensis*. During the past seven years, Norvell (2000, 2002, 2004) and Norvell & Redhead (2000) described nine additional phaeocollybias from British Columbia in western Canada and California, Oregon, and Washington in the Pacific Northwest United States (Table 1).

Phaeocollybia has come to be regarded as an old-growth indicator for the region (Ammirati & al. 1993, 1994; Norvell 1992, 1995, 1998ab; Norvell & al. 1994; Norvell & Exeter 2004). The infrequency of their collection prompted the U.S. government to include thirteen species in its report on Northern Spotted Owl habitats (FEMAT 1993). The FEMAT report led to the Northwest Forest Plan and its survey and management of 234 listed potentially endangered and threatened fungi (NWFP: USDA-USDI 1994; Castellano et al. 1999, 2003). Of the 13 phaeocollybias currently listed by the Oregon Natural Heritage Information Center (ONHIC 2007) as rare, threatened, or endangered, four are listed as extremely rare or vulnerable to extirpation in the state.

In 1998, the USDI-BLM Salem District Office funded Norvell and Exeter to research epigeous-fruiting ectomycorrhizal basidiomycete species richness across three different Douglas-fir (*Pseudotsuga menziesii*) age-classes in a montane BLM reserve forest near Pedee (Polk County), Oregon. Five years later, the oldest (~150-year old) and most species-rich stand had produced 158 targeted basidiomycetes (Norvell & Exeter 2004). The surprisingly large number of phaeocollybias (eleven in all) collected from the stand's two 50 × 4 m transects was particularly noteworthy. Six of the phaeocollybias were targeted 'survey & manage' species (i.e., *P. attenuata*, *P. fallax*, *P. gregaria*, *P. kauffmanii*, *P. piceae*, *P. spadicea*). Also collected were profuse clusters (including the holotype) of *P. tibiikauffmanii* and numerous *P. ammiratii*, *P. benzokauffmanii*, and *P. rifflipes* basidiomes. The eleventh phaeocollybia matched a similar collection from California's Jedediah Smith State Park and is described below.

Materials and methods

Specimen collection and examination procedures follow those outlined in Norvell (1998ab, 2000). Developmental terms (e.g. tibiiform diverticula, sarcodimitic tissues, pellicular veil, vertical-monopodial pseudorhizae) are explained in Norvell (1998ab).

Non-standardized color names in lower case are followed by parenthesized Ridgway (1912, in title case) and bracketed Munsell (1976, alpha-numeric) color references. Anatomical measurements were taken from fresh specimens or tissues rehydrated in 6% aqueous KOH using the SpotInsight visualization software associated with the Leitz DMRB microscope. Basidiospore dimensions were determined from spores obtained from the stipe apex; the median dimension is followed by the overall range (in parentheses). Micrographs were processed to remove lens specks and other digital artifacts in print preparation; annotations only were added, and original micrographs retained on file. "Aerial stipe" refers to the portion of the stipe above the ground; "origin" refers to the pseudorhizal origin in the substrate at the very base of the basidiome.

Herbaria are abbreviated according to Holmgren et al. (1990), with "PNW" denoting the Pacific Northwest Mycology Service herbarium. Starred (*) collections denote those determined by Norvell during her NWFP identification duties. Separate collection dates are not listed for the six date-based numbered Chronosequence Study collections (e.g., a200101801-22 = 18 October 2000, old-growth transect #1, collection 22). Collector abbreviations include RLE (Exeter) and LLN (Norvell).

Taxonomy

Phaeocollybia luteosquamulosa and 'lut x'

The Oregonian old growth transect and Californian Jedediah Smith State Park specimens noted above share many features with *Phaeocollybia luteosquamulosa:* robust stature, fibrillose pileus, trilaminate pileipellis, thin-walled clavate cheilocystidia, and spore shape and ornamentation. However, Norvell (2000) excluded the two collections from her new species, referring them instead to 'lut x' based on differences in pileus color and basidiospore size. Since then, eleven additional Oregon collections — eight from the same Polk County site and one each from Coos, Douglas and Lane counties — support recognition of 'lut x' as a separate species, described below.

Phaeocollybia ochraceocana Norvell & Exeter **sp. nov.** **Plates 1–4**

MycoBank 511266

Pileus 14–55 mm latus, carnosus, convexus e campanulatus, humidulus, squamulosus, ochraceo- vel aurantio-fulvus; caro pallida; lamellae ochraceae, fulvo-brunnescentes e sporis; stipes usque ad 15 mm crassus versus apicem, <65 mm supra terram et <160 mm longa cum pseudorhiza attenuata, aequalis vel ventricosus, subsquamulosus, farctus, versus apicem bubalinus vel cinnamomeus, versus subapicem vinaceus vel salmoneus. Sporae 7.2–8.7 × 4.4–5.5 µm, citriformes, verruculosae cum rostro glabro usque ad 0.5 µm et cum apiculo excentrico glabro; ixocutis cum suprapelle ochraceo cum pigmento encrustato, mediopelle gelatinosa hyalina et subpelle aurantio cum pigmento diffuso et intraparietali;

Plate 1. *Phaeocollybia ochraceocana* (RLE2007-033; WTU HOLOTYPE, PNW ISOTYPE) basidiomes are diagnosed by subviscid appressed fibrillose tawny pilei, orange-cream gills producing rough brown lemon-shaped basidiospores, robust ochraceous and orange cartilaginous stipes stuffed with solid pith, and narrow to vertical-monopodial pseudorhizas. Scale in millimeters.

cheilocystidia abundans, tenui-tunicatae, cum cylindraceae ad 2.5 µm late vel claviformia vel mucronao vel subcapitata ad 8.9 µm lata versus apicem, hyalina. Fibulae desunt in texturis omnibus. Ad terram in silvis coniferarum.

Etymology: from the Latin *ochraceo-* + *-cana* for the canescent sheen that develops as the drying ochraceous top pileus layer lifts slightly up from the lower tissues.

Holotype: USA, OREGON, Polk Co. BLM Reserve Forest, Pedee chronosequence old growth transect, under *Tsuga heterophylla* and *Pseudotsuga menziesii* on 11 October 2007 by R.L. Exeter (WTU: RLE2007-033; isotypes PNW-MS, OSC).

Composite description of all cited collections

Basidiomes solitary to gregarious, medium to large, robust. Pileus ≤120 mm diam, convex to campanulate with obtuse umbos and inrolled/incurved edges, lightly squamulose to merely appressed scaly on disc and margin, lubricous to subviscid, orange to tawny. Young lamellae creamy buff to tan. Stipe robust, apex ≤28 mm diam, combined length with pseudorhiza ≤200 mm, pale salmon colored cartilaginous cortex surrounding firm pale buff medulla. Pseudorhiza vertical-monopodial, tapering downward to blunt or slightly curled upwards origin. Presumed mycorrhizal.

Basidiospores ~7.4 × 4.7 µm, limoniform, verruculose except over smooth eccentric apiculi and short (≤0.5 µm) apical beaks, medium amber in KOH, paler in H_2O. Basidia 4-spored. Cheilocystidia abundant, thin-walled, filamentous and (narrow, broad) clavate elements intermixed, apices variously obtuse, subglobose, or slightly mucronate. Pileipellis trilaminate with compact suprapellis of narrow yellow-encrusted hyphae, equally compact colorless, gelatinized mediopellis, and sordid orange-amber subpellis. Tramal tissues ± sarcodimitic in pseudorhiza and stipe. clamp connections absent.

Fluorescence lamellae intense pale yellow white and stipitipith deep purple in UV. Syringaldazine reaction negative except for slight magenta tinge on gills of one very young specimen. Dried pileus either uniformly dull orange-brown with light yellow brown edge or metallic ochraceous orange. Ecology: solitary to gregarious in autumn in coniferous (*Tsuga, Pseudotsuga, Sequoia*) old-growth temperate rainforests in Oregon and northern California.

Plate 2. All *Phaeocollybia ochraceocana* specimens at right were collected during 1999–2007 at the type locality (USDI-BLM Reserve Forest Chronosequence Fungal Community Transect O1, Pedee, Polk County, Oregon, USA). —A. Canescence caused by separation of drying suprapellis from moist medio-/subpelli and waterlogged pileus trama alerted collectors to potential new species (a1991202o1-02, pnw). —B. Specimens with ochraceous tawny sticky caps, three-layered cap cuticle, small spores, and lightly fibrillose caps & stipes collected the next year also supported a new fungus associated with old-growth western hemlock and Douglas-fir (a2001018o1-22 pnw). —C. Holotype (RLE2007-033, wtu holotype) collection in situ. —D & E. Remnants of pellicular (universal) sheath on stipe (RLE2007-009, pnw): D— Darker fibrils easily visible on pale ochraceous stipe apex. E— Upraised ochraceous-tawny stipe fibrils appear darker than the bright golden-yellow fibrils found in the closely related *P. luteosquamulosa*. —F. Appressed fibrils on tawny to ochraceous pilei (left, center) and solid stipe pith, inrolled young cap margin, and 'free' gill attachment (right) help diagnose *P. ochraceocana* (RLE2007-033, wtu holotype). Scale in mm.


A
B
C
D
E
F

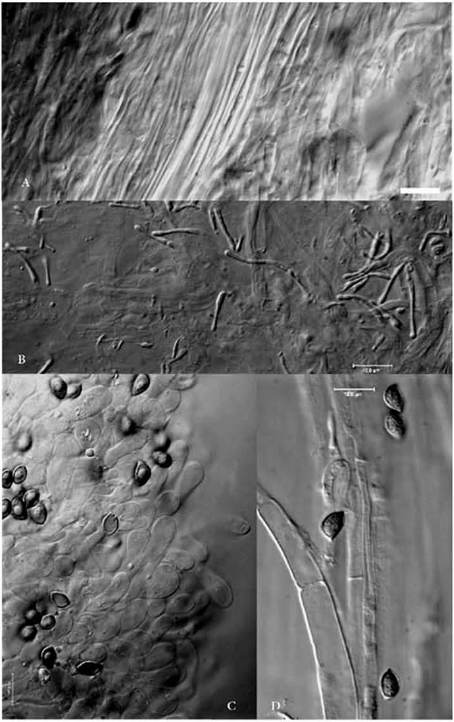
Technical description of holotype

Pileus 14–55 mm diam, conic-convex expanding to broadly campanulate with low obtuse umbo, straight to downcurved inner margin, downturned and occasionally sinuate outer margin, and inrolled to incurved edge; surface moist to lubricous, silky or squamulose, scales present, short, appressed to upraised; nonstriate, hygrophanous; color either uniform or zonate with umbo, inner margin, and moist scales near orange tawny (Deep Chrome, Cinnamon [7.5YR5–6/6–8]), outer margin and edge slightly paler (Buckthorn Brown [10YR 6/6]), damaged areas brown, scales when uplifted orange yellow (Apricot Yellow [2.5Y 8/8, 10YR 9/4]); hygrophanous, dried pileus dark brown (Mummy Brown [10YR5/6]) with tawny (Antimony Yellow) edge. Context firm, confluent through stipe and pileus; color tan (Cartridge Buff [3.75Y 9/2]). Odor not distinctive or mildly farinaceous when crushed. Taste slightly bitter. Lamellae pale tan (Light Buff, Pale Orange Yellow) when young, drying to ochre-colored (Antimony Yellow [10YR 7/10]). Primordial sheath remnants visible without hand lens as scattered to numerous squamules or fibrils on pileus, stipe, and pseudorhiza; color bright orange-yellow to red-orange. Stipe central to slightly eccentric, rigid, ≤65 mm above the ground, combined length with pseudorhiza ≤150 mm; apex 5–15 mm diam, +/- equal and gradually tapering downwards to origin; surface dry, appressed to shaggy fibrillose and often with short yellow-orange fibrillose patches; color of apex buff (near Light Buff [10YR 8/4]) when young, below more orange ochraceous (near Warm Buff, Antimony Yellow [10YR 6/6]), developing orange-brown colors at ground level and below (see pseudorhiza), bruising orange to brown; stuffed with firm, pale pinkish ([10YR9/2) pith; cartilaginous rind 1–2 mm thick/ (near Warm Buff 10YR7/4]). Pseudorhiza vertical-monopodial, ≤2/3 overall length, continuous with stipe and gradually tapering to a blunt or upward curled origin; color drab brown to salmon colored (Drab, Salmon [10YR 4-5/2-3, 7.5YR 8/8]).

Spore Print pale cinnamon brown.

Plate 3. *Phaeocollybia ochraceocana* microfeatures. —**A.** Trilaminate pileipellis comprises a bright yellow orange suprapellis (right) overlying a colorless gelatinized compact mediopellis (center) and an orange to orange-brown subpellis (left; a2001101o2-31, pnw). The suprapellis is in fact the residual universal pellicular sheath gradually broken up by surface abrasion to form highly pigmented patches over the colorless layer; dark splotches in the suprapellis are pools of yellow-orange pigment dissolved by KOH mountant, a reaction easily observed under a dissecting microscope. —**B.** The generic diagnostic tibiiform diverticula here emanate from hyphae of a relatively intact suprapellis on an immature pileus (RLE2007-09, pnw). —**C.** Gill section containing variably clavate thin-walled cheilocystidia, basidia, and basidiospores (a1991202o1-02, pnw). —**D.** Limoniform, beaked, verrucose brown basidiospores on stipitipellis (RLE2007-57, pnw).

Scale bars = 10 µm.


A
B
C
D

Basidiospores [x_{30}] = 7.8 × 4.9 µm [7.2–8.6 × 4.4–5.5 µm], slightly compressed in end view, amygdaliform in face view, limoniform in profile, verruculose with exosporium irregularly projecting beyond outline except on short (0.5 µm) apical callus and eccentric apiculus; color in KOH medium amber, in H_20 paler amber. Basidia 4-spored, clavate [18–36 × 5–8 µm]. Cheilocystidia abundant, arising from the lamellar trama, lengths variable and indeterminate, narrow hyphidia (2–2.5 µm diam) intermixed with variously clavate elements, apices at times subcapitate subglobose atop slender pedicels, at other times tapering; all elements thin-walled, colorless, lightly gelatinized or not, none gel-encrusted. Pleurocystidia present only as occasional hyphidia. Pileipellis a trilaminate ixocutis; the thin (~60 µm) compact suprapellis consisting of narrow (2–3 µm diam) compact hyphae that are radially aligned, equal (2–3 µm diam), heavily gelatinized but not gel-encrusted, occasionally diverticulate, with encrusting and intercellular orange-yellow to pale orange pigments dissolving in KOH, the suprapellis separating in squash mounts to reveal colorless mediopellis below; the slightly thinner (~40 µm) compact hyaline mediopellis composed of hyphae that are unbranched, cylindrical, equal (2–3 µm diam), highly gelatinized with refractive septa, smooth and never gel-encrusted; the subpellis consisting of hyphae 4–8µm diam, both incrusted and encrusted with sordid pale yellow brown pigments in KOH. Tramal tissues gelatinized throughout, sarcodimitic in pseudorhiza and stipe, the two hyphal types represented by rigid, unbranched, long, wide, thick-walled vessel elements intermixed with less frequent flexuous, branched, shorter, narrow, thin-walled elements; the *pseudorhiza* vessel elements ≤25 µm diam with ≤2 µm thick walls, colorless or incrusted with dull orange pigments; the *stipe* vessel elements similarly wide (≤23 µm) but with slightly thinner walls (≤1.5 µm) and colorless to pale amber; in the *pileus* hyphae inflated, ≤40 µm diam with walls variably thickened up to 1µm thick, incrusted with dingy golden-orange pigments, *lamellar* central hyphae parallel, 4–6 µm diam, thin-walled, hyaline, flanked by a narrow zone of 2–3 µm diam elements giving rise to a compact subhymenium. Tibiiform diverticula numerous to frequent on pileus scales and suprapellis, frequent to abundant on stipe fibrillose patches and pseudorhizal surface, ≤25 × 1–2.5 µm with no septum between base and hypha, with/without (sub)globose head and/or apical droplet; highly refractive, colorless. Clamp connections absent in all tissues.

Syringaldazine reactivity — Negative for topotypical collections; assumed negative but not tested for type collection. Fluorescence — Under UV, young lamellae intense pale yellowish white, pileus and stipe contexts at times purplish pink or dull purple, respectively.

Ecology, range, distribution — Terrestrial and presumed mycorrhizal; gregarious in autumn in *Tsuga-Pseudotsuga* old-growth forest (holotype);

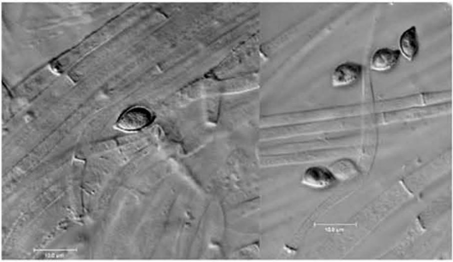


PLATE 4. *Phaeocollybia luteosquamulosa* (RLE2007-016, PNW, left) vs. *P. ochraceocana* (RLE2007-033, PNW, right). Larger basidiospore size easily differentiates *P. luteosquamulosa* from the smaller spored *P. ochraceocana*. Other diagnostic 'lut' characters include highly gel-encrusted hyphae in the pileipellis (background at left) and a possible *Abies* ectomycorrhizal association. Both species exhibit similar basidiome colors, variable thin-walled cheilocystidia, and a trilaminate pileipellis structure.

Sequoia also present at one site. Known from 15 collections from Oregon (Coos, Douglas, Lane, and Polk counties) and California (Del Norte County).

ADDITIONAL *P.* OCHRACEOCANA COLLECTIONS EXAMINED — **U.S.A. CALIFORNIA: Del Norte Co.** JEDEDIAH SMITH SP, Stout Grove (124.1°W 41.8°N) — densely gregarious under old-growth *Pseudotsuga menziesii* & *Sequoia sempervirens* 28.X.1971 *Ammirati6018* by JMTrappe (MICH). **OREGON: Coos Co.** MYRTLEWOOD RNA, — in soil, 4.XI.2003 *DR-F13-03w [iPP2004-02-09-COOS-GBph; Norvell017e-213]* by DRoediger (OSC). **Douglas Co.** MEDFORD BLM GLENDALE RA, Mr. Wilson sale (32S 09W 08 W) — in mixed collection with *P. kauffmanii*, both noted in humus & mineral soil in OG *Pseudotsuga menziesii* & *Tsuga heterophylla* with *Rhododendron* sp., *Gaultheria shallon* 7.XI.2000 *DGoldenberg11-07-00b** (OSC). **Lane Co.** SIUSLAW NF NEAR PREACHER'S CRK & GREEN RIVER, CVS plot 2097050 — 21.XI.2000 *YDWolfe11210011‌4** (OSC). **Polk Co.** PEDEE BLM RESERVE CHRONOSEQUENCE STUDY (123.4885°W, 44.7913°N) 1770' elev. — solitary to gregarious in humic soil >150yo (virgin?) *Tsuga heterophylla, Pseudotsuga menziesii, Acer circinatum, Polystichum munitum, Hylocomium splendens, Kindbergia oregana a19912O2o1-02* by LLN, RLE & SARedhead; *a20010180o1-19,22,29, a20011010o2-31, a20011150o2-01, a20110170o1-02, a2061114o1F* by LLN & RLE (PNW); 4.X.2007 *RLE2007-009*; 16.X.2007 *RLE2007-057*.

COMMENTS — As noted above, *Phaeocollybia ochraceocana* and *P. luteosquamulosa* share many field characters: large size and robust stature; pileus, stipe, and pseudorhizal morphology; ochraceous colors, and – most striking

— a pileus that is non-viscid and fibrillose/squamulose. Subtle distinguishing field characters for *P. luteosquamulosa* include the more or less uniformly yellow-ochre colors of pileus and stipe, a pileus that is never subviscid with squamules that are more sparsely scattered and more closely appressed (rarely uplifted in the field). Anatomical differences between the two species are more pronounced but still subtle — with the obvious exception of the wildly different spore sizes (Plate 4).

In *P. ochraceocana* the trilaminate pileipellis has similar pigment topographies in all three layers, but the colored suprapellis is highly compact, extending over the entire pileus surface with hyphae that are as gelatinized and similarly shaped as those of the colorless mediopellis. The pigments in both suprapellis and subpellis appear slightly darker and have an orange component in KOH that *P. luteosquamulosa* lacks, and the gelatinized hyphae of both suprapellis and mediopellis are smooth, lacking the spirally gel-encrusted roughened surfaces observed within *P. luteosquamulosa*. Cheilocystidial abundance, shape, and dimensions are similar, but *P. luteosquamulosa* elements regularly produce apical extensions if stored. The fact that apical outgrowths are rarely seen in *P. ochraceocana* may be attributed to the young age and prompt processing of the type locality specimens. It is noteworthy, however, that no apical outgrowths were found in the first collected, obviously old and damaged, specimen (a19912020l-02; see Plates 2a and 3c). Added to these dissimilarities, the spore size difference is sufficient to support recognition of a new taxon. Both taxa have 4-spored basidia, yet 'luteosquamulosa' spores are consistently larger (~10 × 6 µm or overall range for all collections examined 8.7–12 × 5–7.2) than 'ochraceocana' (median range for all 15 cited collections 7–7.8 × 4.5–5 µm; overall range 5.8–8.9 × 3.8–5.6 µm).

Reevaluation of previously cited and newly collected *P. luteosquamulosa* specimens reveals that except for one collection, the larger-spored species is found in forests where *Abies* is present; thus, differing mycorrhizal hosts may serve a helpful diagnostic character separating *P. luteosquamulosa* from *P. ochraceocana*. Both species were collected by the authors during October, 2007 in species-specific habitats. Initially, specimens from a 400 year-old mixed *Abies amabilis-Tsuga heterophylla* forest on Saddlebag Mountain (Lincoln Co.) so resembled the *P. ochraceocana* holotype that both authors assumed the collection represented that species until the large spores and gel-encrusted pileipellis hyphae diagnosed *P. luteosquamulosa*. After comparing habitats for both species, we find that five of the six known 'luteosquamulosa' sites lie either in *Abies-Tsuga* forests (i.e., Oregon's Larch Mountain, Mary's Peak, Saddlebag Mountain; Washington's Barlow Pass) or in a mixed forest containing *Abies, Tsuga, Pseudotsuga,* and *Sequoia* (California's Jackson State Forest). None of the five known *P. ochraceocana* sites contains *Abies;* there, *Pseudotsuga-Tsuga* or

Pseudotsuga are the cited associates. Data on collections from the new 2007 *P. luteosquamulosa* sites follow.

> NEW *P.* LUTEOSQUAMULOSA COLLECTIONS EXAMINED — **U.S.A. OREGON: Benton Co.** MARY'S PEAK SBA, forest surrounding first meadow N Mary's Pk summit (12S 7W 20SE WM) 3500' — in needle duff and soil with 100+yo *Abies procera* 16.X.2007 *RLE2007-050& -051; LLN2071029-24,-33,-43 & -46* by LLN RLE; W of main road W of Conner's Camp (12S 7W 28SENW) 2750' — in duff with 200+yo *Pseudotsuga menziesii, Tsuga heterophylla RLE2007-125.* **Lincoln Co.** SALEM/MARY'S PEAK RNA, Saddlebag Mtn (7S 9W 3NW SE, WM) 3000' — in needle duff and soil with 200+yo *Abies amabilis, Tsuga heterophylla, Gaultheria shallon* 10.X.2007 *RLE2007-016.*

No other *Phaeocollybia* except *P. luteosquamulosa* combines the robustness, pigment topography, cuticular structure, and spore shape & ornamentation that diagnose *P. ochraceocana*. Of the other 14 species with pileal scales worldwide, only two — *P. coniuncta* E. Horak and *P. caudata* E. Horak & Halling — have similarly colored pilei. Horak (1980) described the Indian *P. coniuncta* as small with dirty yellow-brown colors, a slender hollow stipe, and cylindrical cheilocystidia. The Costa Rican *P. caudata is* easily differentiated by an abruptly tapering thread-like pseudorhiza, brittle hollow stipe, and smaller (5-6 x 3-4 μm), minutely verruculose ovoid to pip-shaped basidiospores (Horak & Halling 1991, Norvell pers. obs.).

The *Phaeocollybia kauffmanii complex*

Its stature, general morphology, and anatomical characters place *P. ochraceocana* with a group of agarics allied with *P. kauffmanii*. Norvell (2000) erected the morphological complex to accommodate *P. kauffmanii* and four other western North American species once referred to *P. kauffmanii* based on their robust stature and affinity with that species:

> Comparisons eventually led to the hypothesis that there are at least five morphologically distinct taxa characterized by robust stature, viscid brown pilei, thick fleshy cartilaginous stipes, vertical-monopodial pseudorhizae, large (>8 x 5 μm) verrucose, beaked basidiospores, and thin-walled clavate cheilocystidia (Norvell & Ammirati 1993). This hypothesis is supported by ITS length polymorphisms, RFLPs, and restriction loci. Integration of morphological, chemical, and molecular data suggests three close species (*P. kauffmanii, P. benzokauffmanii, P. redheadii*) and two relatively distant (*P. ammiratii* and *P. luteosquamulosa*).

Addition of the smaller spored *P. ochraceocana* to this complex requires a modification of the above paragraph, which — given the dry to moist ochraceous (rarely brown) pileus of *P. luteosquamulosa* — was inaccurate even when published. Redefined in the STRICT SENSE, the 'kauffmanii' complex covers *Phaeocollybia* species represented by basidiomes combining: (i) large size and robust stature; (ii) fleshy lubricous to glutinous conic-campanulate pilei with ochraceous, tawny, brown or drab colors; (iii) thick firmly stuffed cartilaginous stipes that are never hollow; (iv) vertical-monopodial pseudorhizae; (v) amber,

Table 2. Diagnostic characters used to differentiate species within the *Phaeocollybia kauffmanii* complex (in the broad sense).

SPP. *	PILEUS		SYRINGALDAZINE RXN ^	CLAMPS	SPORES		CHEILOCYSTIDIA		PILEIPELLIS		
	Color (yg)	Surface			Shape	Median (range)	Wall	Form	Layer#	Suprapellis	'Pigment topography
AMM	tawny yellow > yell. brown	viscid smooth	only psr magenta	present	limoniform beaked	9 × 5.5 µm (8.4-10× 5-6.5)	thin	clavate: cylindrical > narrow	2	thick, loose in gel hyaline	*[sub]* diff, parietal
BEN	drab > purpBrn	viscid smooth	rapidly magenta	absent	limoniform beaked	9 × 5.5 µm (8–10 × 4.9-6)	thin	clavate: narrow > medium	2	mod. thick, compact in gel, hyaline	*[sub]* diff, cellular
GRE	tan > or. brown	viscid smooth	negative/ psr sl magenta	absent	limoniform beaked	9.8 × 6 µm (9–10.5× 5-6)	thin	clavate: narrow, strangulated	2	mod. thick, loose in gel hyaline	*[sub]* diff, cellular
KAU	orange > or. brown	viscid smooth	rapidly magenta	rare	limoniform beaked	8.5 × 5 µm (7.5-10× 4-6)	thin	clavate: narrow > medium	2	thick, loose in gel,hyaline	*[sub]* enc & diff parietal
LIL	tawny > dark brown (gills lilac!)	viscid smooth	gills only magenta	absent	limoniform beaked	8 × 5 µm (8-9× 4.5–5.5)	thin	clavate: narrow > medium	2	thick, loose in gel,hyaline	*[sub]* enc & diff parietal
LUT	ochre	dry/moist appressed scaly	negative	absent	limoniform beaked	9.8 × 6 µm (9-11× 5-6.8)	thin	hyphidia & clavate:	3	thin, compact, br. yellow, gel encrusted	*[sub&sup]* enc & diff, parietal
OCH	tawny	oily subvisc. scaly	untested	absent	limoniform beaked	7.3 × 4.6µm (6.5–7.9× 4.1-5.4)	thin	hyphidia & clavate: some globose	3	thin, compact, or. yellow, smooth	*[sub&sup]* encr & diff parietal
ORE	drab > gray	viscid smooth	rapidly magenta	absent	ellipsoid small callus	6.8 × 4 µm (6.3–7.2× 3.6–4.1)	thin	hyphidia & narr. clavate	2	thick, loose in gel, hyaline	*[sub]* enc, diff parietal
RED	pale red brown	viscid smooth	rapidly magenta	rare	limoniform beaked	10.5 × 6 µm (8.5-12× 5–7)	thin	subglobose subcapitate pedicellate	2	thick, loose in gel, hyaline	*[sub]* encr, diff parietal
SPD	gray brown > black-brown	viscid smooth	only psr magenta	absent	limoniform beaked	8 × 5 µm (6–9 × 4–5.5)	thick w thin	tibiiform & clavate	2	thick, loose in gel, hyaline	[sub] cellular, parietal
TIB	orange > or. brown	viscid smooth	rapidly magenta	absent	limoniform beaked	8 × 4.5 µm (7.5–9 × 4–5.2)	thick w thin	tibiiform & clavate	2	thick, loose in gel, hyaline	*[sub]* encr, diff

*Species included are *P. ammiratii* (AMM), *P. benzokauffmanii* (BEN), *P. gregaria* (GRE), *P. kauffmanii* (KAU), *P. lilacifolia* (LIL), *P. luteosqumulosa* (LUT), *P. ochraceocana* (OCH), *P. oregonensis* (ORE), *P. redheadii* (RED), *P. spadicea* (SPD), *P. tibiikauffmanii* (TIB). ^A positive (magenta) reaction to syringaldazine indicates the presence of laccase in the tissues.

' sub = subpellis; sup = suprapellis; encr = encrusting; diff = diffuse verruculose to verrucose, limoniform basidiospores; and (vi) thin-walled generally clavate cheilocystidia.

Phaeocollybia gregaria and *P. lilacifolia,* which manifest all six criteria, are also added to the complex 'sensu stricto.' Other species (such as *P. oregonensis, P. spadicea,* and *P. tibiikauffmanii*) that possess only the first four characters belong to the complex in the BROAD SENSE. The following artificial key and Table 2 cover eleven species that share similar field characters but represent two different subgenera (Bandala & Muñoz 1994) and four different sections (Singer 1970, 1986; Bandala & Muñoz 1994, Norvell 2004).

While currently a term of convenience only for Pacific Northwest species, the complex name could easily accommodate other species from Mexico, Central America, South America, Asia, and Australasia.

Revised key to the *Phaeocollybia kauffmanii* complex (sensu lato)

NOTE — *Phaeocollybia* is notoriously difficult to key to species using only field characters. Nonetheless, the artificial key below is designed to aid field identification and so macroscopic characters are listed first whenever possible. The key, modified to incorporate data from non-type collections and incorporate additional species, corrects and supplements the 'natural' microscopical key of Norvell (2000).

1a. Pileus surface appressed-scaly, dry to lubricous (never viscid or glutinous), ochraceous to tawny; pileipellis trilaminate, with a colorless gelatinized mediopellis sandwiched between a pigmented suprapellis above and subpellis below 2

1b. Pileus surface glabrous (never fibrillose or scaly), viscid to glutinous, with or without ochraceous or tawny tones; pileipellis bilaminate, with a colorless suprapellis and pigmented subpellis 3

2a. Basidiospores large (~10 × 6 µm); hyphae of the pileipellis roughened by gel incrustations; *Abies* usually present in area........ *P. luteosquamulosa*

2b. Basidiospores small (~7.4 × 4.6 µm); hyphae of the pileipellis smooth; *Abies* absent from area .... *P. ochraceocana*

3a (1b). Pileus dull pinkish, drab, or purplish-brown 4

3b. Pileus ochraceous, orange, pale tawny, butterscotch, or any shade of brown (yellow, orange-, red-) that lacks purple or drab tones 6

4a. Pileus gray-brown (drab tones rarely present) to dark date brown; cheilocystidia primarily thick-walled with narrow refractive necks, lageniform or tibiiform (frequent thin-walled filamentous to narrowly clavate elements intermixed) .... *P. spadicea*

4b. Pileus dull pinkish, drab, or purple-brown; cheilocystidia thin-walled, filamentous to narrowly clavate (no thick-walled elements intermixed) 5

5a. Basidiospores small (~6.8 × 4 µm), ellipsoidal to bullet shaped with very slight apical callus, minutely punctate-roughened .... *P. oregonensis*

5b. Basidiospores large (~9 × 5.5 µm), limoniform with pronounced apical beak, verruculose .... *P. benzokauffmanii*

6a (3b). Young lamellae bluish white to intense lilac colored . . . . *P. lilacifolia*

6b. Young lamellae creamy to orange buff, never lilac 7

7a. Cheilocystidia of two types, thick-walled tibiiform elements with refractive necks intermixed with less frequent thin-walled filamentous to narrowly clavate elements. 8

7b. Cheilocystidia variably formed but uniformly thin-walled 9

8a. Pileus orange to tawny; pileus and stipe context soon insect infested; encrusting pigments present in the pileipellis; odor farinaceous; all tissues turning rapidly magenta in syringaldazine; basidiospores sublimoniform (narrow), ~8 × 4.5 µm . . . . *P. tibiikauffmanii*

8b. Pileus gray brown to dark date brown; context rarely insect infested; encrusting pigments lacking in the pileipellis; odor vaguely floral, never farinaceous; only pseudorhiza magenta in syringaldazine; basidiospores limoniform (moderately wide) ~8 × 5 µm . . . . *P. spadicea*

9a (7b). Pileus tawny yellow to orange butterscotch, drying to metallic coppery gold; clamp connections frequent throughout (notably conspicuous on the supra-pellicular hyphae and cheilocystidia, inconspicuous at basidial bases); pseudorhiza pellis weakly magenta after 30 min in syringaldazine; lamellae fluoresce bright mustard yellow under UV . . . . *P. ammiratii*

9b. Pileus orange, tawny, or red brown; clamp connections absent in supra-pellicular hyphae, cheilocystidia, and basidial bases but sometimes present in stipitipellis; tissues variably reactive in syringaldazine; lamellae fluoresce or not under UV 10

10a. Pileus tan to medium to dark yellow brown, drying to a metallic bronze; stipes shiny, smooth, relatively slender; clamp connections absent in all tissues; syringaldazine reaction variable: stipe apex frequently producing yellow-green exudate; pseudorhiza strongly to weakly magenta or negative; young lamellae do not fluoresce under UV . . . . *P. gregaria*

10b. Pileus orange, tawny, or red-brown, drying to red to orange copper; stipes matte, longitudinally lined, relatively robust; clamp connections occasionally present in stipitipellis; syringaldazine reaction strong magenta; young lamellae fluoresce brilliant yellow white to mustard yellow under UV 11

11a Young pileus pale tawny, darkening in age to red- or medium dark brown, occasional drab tones developing in very old specimens; basidiospores large (~10.5 × 6 µm); cheilocystidia pedicellate, inflated clavate to subcapitate (sub-globose apices frequent) . . . . *P. redheadii*

11b. Young pileus bright to dull orange, darkening in age to tawny or orange-brown; basidiospores moderately large (~8.5 x 5 µm); cheilocystidia irregularly cylindrical to narrowly clavate, rarely pedicellate or subcapitate . . . . *P. kauffmanii*

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Gilbertella persicaria (*Mucorales*): a new record from Brazil

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Abstract — *Gilbertella persicaria* was isolated for the first time in Brazil, from tapir (*Tapirus terrestris*), white donkey (*Equus asinus*) and elk (*Cervus elaphus*) dung collected at the Reserva Ecológica de Dois Irmãos (8°7'30" S and 34°52'30" W), located in Recife, State of Pernambuco, Northeast Brazil.

Key words — *Zygomycetes*, *Gilbertellaceae*, herbivores, taxonomy

Introduction

Gilbertella persicaria belongs to the class *Zygomycetes* and has been described as a storage-rot microorganism (Papp et al. 2001). It is characterized by producing sporangia with a persistent wall with a longitudinal suture where it separates into two more or less equal halves (Benny 1991). The sporangiospores bear hyaline appendages and the zygospores are *Mucor*-type. This species was originally described as *Choanephora* (Eddy 1925) because of the choanephoraceous sporangia and sporangiophore with polar, hyaline appendices. Hesseltine (1960) was the first to include *Gilbertella* in the *Mucoraceae* based on the production of *Mucor*-type zygospores. Later, several authors (Mehrotra & Mehrotra 1964, Benny 1982, Hawksworth et al. 1983, Kirk 1984) also included *Gilbertella* in the *Mucoraceae*. Benny (1991) introduced *Gilbertellaceae* as a new monogeneric family based only on morphological characters. Papp et al. (2003), based on molecular analyses of species of *Mucor*, *Rhizomucor*, *Blakeslea*, *Choanephora*, *Poitrasia* and *Gilbertella*, affirmed that *Gilbertellaceae* occupies an intermediate position between *Choanephoraceae* and *Mucoraceae*.

Material and methods

The samples of tapir (*Tapirus terrestris*), white donkey (*Equus asinus*) and elk (*Cervus elaphus*) dung were collected at Reserva Ecológica de Dois Irmãos

(8°7'30"S and 34°52'30"W), which includes a Zoological Park and is located in Recife, State of Pernambuco, Northeast Brazil. The area contains 387 ha and is an Atlantic Forest Ecological Reserve.

The samples of dung were collected with a sterilized spatula, placed in plastic bags, taken to the laboratory and incubated in moist chamber.

Fragments of mycelium were removed directly from the samples at the stereomicroscope and transferred to the surface of the M agar (O'Donnell 1979) plus chloranphenicol medium. The identification was made based on macroscopic (color, aspect and diameter of the colonies) and microscopic (microstructures) aspects according to Benny (1991) and Mehrotra & Mehrotra (1963). After identification, *G. persicaria* was transferred to V8 juice agar (Benny & Benjamin 1991) medium.

Taxonomy

Gilbertella persicaria (E.D. Eddy) Hesselt.,
Bull. Torrey Bot. Club 87:24.1960. Fig. 1 a-f

Colony on V8 juice agar, 9cm diam in 72 hour at 25°C. White at first, later covered with black sporangia, especially in the peripheral regions of the culture. **Sporophores** simple, erect, some bending in the apex, 12.5-35 µm diam. **Sporangia** 32–175 µm diam, yellow when young and dark brown at maturity, subglobose to globose, slightly flattened, with a persistent wall and covered with crystalline spines; mature sporangia with a longitudinal suture, the sporangium separating into two halves. **Columellae** subglobose, obovoid, pyriform and ellipsoid, some with a truncate base, 21–93 × 22.5–55 µm in diam with smooth wall and distinct basal collar. **Sporangiospores** hyaline, smooth-walled, subglobose to ellipsoid or fusiform, some irregular in shape, 5.5–12 × 4.5–7.5 µm, with 2-7 hyaline appendages arising from the ends of each spore. **Chlamydospores** hyaline, smooth-walled, globose to subglobose or cylindrical to doliiform, 17.5-27.5 × 12.5–20 µm. Zygospores not observed.

Habitat: tapir (*Tapirus terrestris*), white donkey (*Equus asinus*) and elk (*Cervus elaphus.*) dung.

Distribution: India (Mehrotra & Mehrotra 1963, 1964; Mehrotra 1966), China (Cheng & Hu 1964) and North America (Butler et al. 1960, Hesseltine 1960). This is the first report in Brazil.

Remarks: The characteristics of the strains of *G. persicaria* reported here show a close similarity with the descriptions of Benny (1991) and Mehrotra & Mehrotra (1963). Further, Benny (1991) cited a radial growth of 8.5 cm in 3 days, a black colony color, and rare branched sporophores. However, Mehrotra & Mehrotra (1963) reported colonies with brown coloration and described a

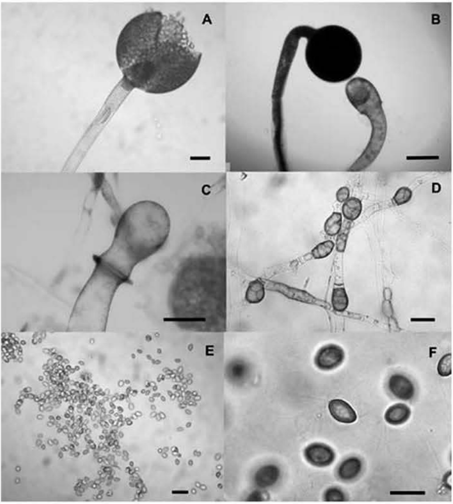

Fig. 1. *Gilbertella persicaria* A) Sporophore with mature sporangia; B) Sporophore with immature sporangia and columellae: C) Columellae; D) Chlamydospores; E, F) Sporangiospores.
Scale bars: A=25 µm; B=50 µm; C=50 µm, D=25 µm; E=25 µm; F=10 µm.

new variety, *G. persicaria* var. *indica*, with a slow growth rate (5.4 cm diam in 8 days) and branched sporophores. According to Benny (1991), this variety is a synonym of *G. persicaria*.

Although *G. persicaria* sporangiospores appear to be smooth under LM, ultrastructural observations of Bracker (1966), O'Donnell (1979), and Whitney & Arnott (1988) showed that they are longitudinally striate. According to Benny (1991), 'the ornaments are below the limits of resolution except during the most optimal conditions.'

This paper reports the first occurrence of *G. persicaria* for tapir (*Tapirus terrestris*), white donkey (*Equus asinus*) and elk (*Cervus elaphus*) dung, contributing to the knowledge of *Mucorales* diversity on these substrata. Isolation of *G. persicaria* from dung was reported by Cheng & Hu (1965). From herbivore dung in Brazil, only species of *Mucor* (Batista et al. 1961a, b, c; Trufem 1984, Trufem & Viriato 1985, Alves et al. 2002) *Absidia* (Batista et al. 1961a, b, c; Trufem & Viriato 1985), *Circinella* (Trufem & Viriato 1985), *Rhizopus* (Batista et al. 1961a), *Syncephalastrum* (Trufem 1984, Viriato & Trufem 1985b) and *Phycomyces* (Trufem & Viriato 1985) had been previously isolated. Species of *Pilobolus* (Trufem 1984, Viriato & Trufem 1985a), *Pilaira* (Trufem 1984, Viriato & Trufem 1985a), *Syncephalis* (Trufem 1984, Viriato & Trufem 1985b), *Piptocephalis* (Trufem 1984, Viriato & Trufem 1985b) and *Dispira* (Viriato & Trufem 1985b) were also reported, but not isolated, from dung in Brazil.

Gilbertella persicaria may also be isolated from tomato (Mehrotra 1963), apple, pear (Mehrotra & Mehrotra 1963), peach (Hesseltine 1960, Mehrotra 1966, Ginting et al. 1996), and soil (Mehrotra & Mehrotra 1964).

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Redescription of *Phytophthora melonis*

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Abstract — *Phytophthora melonis* was erected by Katsura (1976) to accommodate the causal agent of foot rot of cucumber in Japan. It was characterized by the production of semipapillate sporangia and chlamydospores. However, a reexamination of the type culture and other isolates from cucurbits showed that the sporangia are nonpapillate with internal proliferation, and chlamydospores are absent. The species is hereby redescribed to facilitate accurate identification of *P. melonis*.

Key words — *Oomycetes, Cucumis sativa, Cucurbitaceae, Phytophthora sinensis, Phytophthora drechsleri*

A severe disease known as foot rot of cucumber (*Cucumis sativa* L.) was first described in Japan around 1948 and the causal agent was identified as *Phytophthora melonis* (Katsura 1968, 1971), which was later formally described as a valid new species characterized by homothallism, amphigynous antheridia, semipapillate sporangia, and the production of chlamydospores (Katsura 1976). All plant parts were susceptible, and infection often resulted in rapid wilting and death of the whole plant. Since then a similar disease recognized as dieback, root rot or crown rot, was reported on cucumber and other cucurbits in mainland China, Taiwan, Iran, Egypt, Turkey, Korea, and India. Isolates from all these countries were similar to *P. melonis* except that the sporangia were non-papillate and proliferated internally; also, chlamydospores were not found. The latter isolates have been identified as *P. melonis* (Wong & Jiang 1980, Lu & Gong 1982, Kao et al. 1982, Jee et al. 2000, Guharoy et al. 2006),

Table 1. Origin of *Phytophthora* isolates used in this study

SPECIES	ISOLATE	MATING TYPE[1]	HOST	LOCATION	SOURCE[2]
P. DRECHSLERI	23J6	A^1	Ornamental	Israel	OR (Israel 2)
	1D5	A^1	Irrigation water	USA	
	1E6	-	Irrigation water	USA	SV (GLN10-5)
P. MELONIS	32F6	A^1	*Cucumis sativus*	China	MC (P1371)
	33C9	A^2	*Trichosanthes dioica*	India	SG (Pg-9)
	41B2	—	*C. melo*	Iran	ZB (PH.6.17.82)
	41B3	—	*C. sativus*	Iran	ZB (MC1)
	41B4	—	*C. sativus*	Iran	ZB (PH.6.42.92)

[1] "—"=data not available

[2] "MC"=Michael Coffey, University of California at Riverside, USA; "OR"=Olaf Ribeiro, Ribeiro Plant Labs at Bainbridge Island, USA; "SG"=Sanjoy Guha Roy, University of Kalyani, India; "SV"=Sharron von Broembesen, Oklahoma State University, Stillwater, USA; "ZB"=Zia Banihashemi, Shiraz University, Iran.

or as *P. drechsleri* (Ershad & Mostowfipoor 1969, Alavi & Stange 1979, Maden & Karahan 1980, Ho et al. 1984, 1995). One isolate causing cucumber blight in China was treated as a new species: *P. sinensis* (Yu & Zhuang 1982). Ho (1986) restudied the type cultures of *P. melonis*, *P. sinensis* and cucurbit isolates identified as *P. drechsleri* under similar cultural conditions and found they were all similar in cultural, morphological and physiological characteristics. It was suggested that *P. melonis* and *P. sinensis* should be treated as synonyms of *P. drechsleri*, which had nomenclatural priority.

The conspecificity of *P. sinensis* and *P. melonis* was not surprising because the former was actually a subculture of one of the *P. melonis* isolates from cucurbits in the culture collection at Nanjing Agricultural University. It was sent to the Academia Sinica in Beijing for confirmation of its identity. Yu & Zhuang (1982) considered *P. sinensis* different from all known *Phytophthora* species based solely on the information from published literature. After having a chance to examine the type culture of *P. melonis*, they finally conceded that there was no difference between the two species and subsequently *P. sinensis* was excluded from the list of *Phytophthora* species found in China (Zheng 1997). Yu (1998) treated *P. sinensis* as synonymous with *P. drechsleri* in China, and this is further supported by the mtDNA RFLP and isozyme pattern data of Mills et al. (1991) and the sequence comparison of internal transcribed spacer (ITS) regions of rDNA (Cooke et al. 2000, Mirabolefathy et al. 2001). Phylogenetic analysis based on both mitochondrial and nuclear DNA sequences showed that *P. sinensis* is distinct from *P. drechsleri* (Kroon et al. 2004).

Ho et al. (1984) noticed a slight difference in the electrophoresis patterns of soluble proteins of the isolates from cucurbits in China and *P. drechsleri* but considered this difference insignificant in comparison with the morphological similarities with *P. drechsleri*, which was adopted as the name for the cucurbit isolates. However, Mostowfizadeh-Ghalamfarsa et al. (2005) were able to differentiate *P. melonis* from *P. drechsleri* based on its inability to incite pink rot in potato tubers. Studies based on the ITS sequence analysis of rDNA have demonstrated that *P. melonis* occupies a phylogenetic clade different from *P. drechsleri* and should be retained as a genetically distinct species (Mills et al. 1991, Cooke et al. 2000, Hong et al. 2000, Kroon et al. 2006). We also conducted single-strand conformation polymorphism (SSCP) analysis of ribosomal DNA for five isolates of *P. melonis* along with three of *P. drechsleri* using the protocol of Kong et al. (2003).

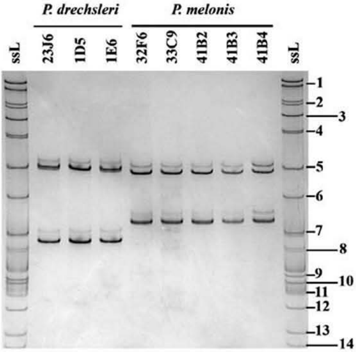


Figure 1. Polyacrylamide gel electrophoresis of amplified ribosomal DNA using forward primer ITS 6 and reverse primer ITS 7 to show the differences in single-strand conformation polymorphism (SSCP) pattern between isolates of *Phytophthora melonis* and *P. drechsleri*. A single-stranded DNA ladder was included in the left and right lanes.

P. melonis produced a SSCP pattern distinct from that of *P. drechsleri* (Figure 1) while isolates of the same species had identical patterns. We also sequenced the ITS regions of isolate 32F6 with forward primer DC6 and reverse primer ITS4, and deposited the sequences in the Genbank (accession #: EU088256). Erwin & Ribeiro (1996) pointed out that "technically, the original description of semipapillate sporangia by Katsura (1976) is erroneous" and they echoed the suggestion by Mills et al. (1991) that "if maintained as a species, *P. melonis* should be redescribed". Mirabolfathy et al. (2001) also urged the redefinition of *P. melonis* to include the *P. drechsleri*-like isolates causing pistachio gummosis in Iran. We thus hereby redescribe *P. melonis* to facilitate accurate identification of the species.

Phytophthora melonis Katsura, Trans. Mycol. Soc. Japan 17:238. 1976;
emend. H.H. Ho, Gallegly & C.X. Hong FIGS. A-J
=*Phytophthora sinensis* Y.N. Yu & W.Y. Zhuang. Mycotaxon 14:183. 1982

Colonies on clarified Campbell V-8 agar medium to slightly radiate to rosette with scant to abundant aerial mycelium. Main hyphae tubular, nonseptate, smooth, 4–6 µm wide, branching freely but becoming irregular with age. Hyphal swellings occasionally produced in water, spherical to oval (under 25 µm), terminal, intercalary or in small networks. Sporangia sparse on agar but abundant in water. Sporangia single, terminal, noncaducous, on long, mostly unbranched or lax sympodially branched undifferentiated sporangiophores, ovoid to ellipsoidal, av. (35–)50–59(–84) × (14–) 28–34 (–44) µm; length/breadth ratio (1.4–)1.5–1.8(–3.1); nonpapillate, internal proliferation dominant. Empty sporangia partially collapsed after zoospore release with exit pores 10–15 µm wide. Encysted zoospores 8.3–9.4 µm diam. Repeated emergence of zoospores not observed.

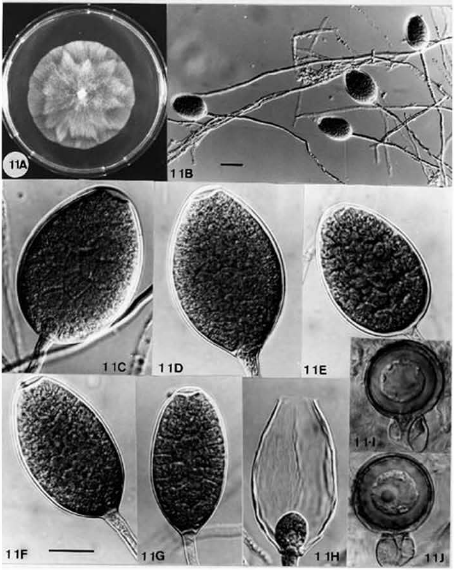
Heterothallic, with abundant sex organs produced when A^1 and A^2 light types are paired on V8C or hemp seed agar. Also, they are produced when *P. melonis* is paired with opposite types of *P. drechsleri*, *P. nicotianae*, *P. palmivora* or *P. meadii*. Selfed sex organs are formed when polycarbonate membranes separate the mating strains, or sparsely in single aged cultures. Oogonia yellow to golden brown, globose, smooth , (26–)31–37(–49) µm diam. Oospores single, globose, hyaline, plerotic to slightly aplerotic, (19–)25–33(–42) µm diam. Oospore wall 2–4 µm thick. Antheridia amphigynous, cylindrical to oval, unicellular but sometimes bicellular, 16–18 × 16–17 µm. Chlamydospores not observed. Cardinal temperatures 10–13, 27–28 and 36–37 C. Daily growth rate on V-8C: 5.5–mm at 25C.

Habitat: stems, leaves, roots and fruits of members of *Cucurbitaceae* in Japan, mainland China, Taiwan, Iran, Egypt, Turkey and India causing blight, dieback, root rot, foot rot and crown rot; roots and crowns of *Pistacia vera* L. in Iran resulting in gummosis.

Ex-type: ATCC 52854 from *Cucumis sativa*, Japan

Paratype: UCR P1371 from *Cucumis sativa*, China

Accession #: EU088256



Figures A-J. *Phytophthora melonis*. A. Colony, B-H. Sporangia, I, J. Oogonia and antheridia. Scale bars: 20 µm. All at same magnification except A and B.

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(Shiraz University, Iran) for providing the isolates of *P. melonis* and *P. drechsleri*. We thank Patricia A. Richardson and Dr. Ping Kong for technical assistance as well as Drs. D.C. Erwin and W.H. Ko for reviewing the manuscript.

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***Anthostomella* and *Fasciatispora* species (*Xylariaceae*) from palms including *F. ujungkulonensis* sp. nov.**

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Abstract — We report on collections of *Anthostomella* and *Fasciatispora* from decaying fronds of palms collected in Indonesia and Thailand, including five species of *Anthostomella* and two species of *Fasciatispora*. One taxon, *Fasciatispora ujungkulonensis* is new to science. Three species of *Anthostomella* and one species of *Fasciatispora* are new records for Thailand. Two species of *Anthostomella* are new records for Indonesia. *Anthostomella puiggarii* and *Fasciatispora petrakii* are reported associated with *Wallichia siamensis* for the first time.

Key words — *Arecaceae*, *Ascomycetes*, biodiversity, taxonomy

Introduction

Anthostomella Sacc. (Saccardo 1875) is one of the largest genera in the *Xylariaceae* with 90 species (Lu & Hyde 2000, Taylor & Hyde 2003). The genus is characterized by ascomata immersed beneath a clypeus, broadly cylindrical unitunicate asci usually with an amyloid ascus ring, and aseptate brown ascospores usually with a germ slit (Francis 1975, Lu & Hyde 2000). The genus is widely distributed in tropical, subtropical, and temperate regions.

In a comprehensive world monograph of *Anthostomella*, Lu & Hyde (2000) examined more than 2600 specimens, including the types of most described taxa and representatives of similar genera. Lu & Hyde (2000) accepted 86 species of *Anthostomella* and provided a key to accepted species. They emphasized on the position of ascomata, morphology of ascus ring (presence or absence, amyloidity, and shape), and morphology of ascospores (shape, size, presence or absence of dwarf cell(s) and germ slit) as important characters (Lu & Hyde 2000). Ascomatal shape and ascus ring structures were also considered important for distinguishing *Anthostomella* from similar genera. Sixty species of palms were reported as hosts of *Anthostomella* and similar genera (Lu & Hyde 2000). Taylor & Hyde (2003) introduced four new species of *Anthostomella* from palms.

Observation and examination of *Anthostomella* species from palms were reported by Hyde (1996) who accepted 27 species associated with 29 species of palms. In other publications, he proposed several new genera similar to *Anthostomella*, such as *Fasciatispora* K.D. Hyde (Hyde 1991) *Nipicola* K.D. Hyde (Hyde 1992), *Pandanicola* K.D. Hyde (Hyde 1994), *Sabalicola* K.D. Hyde (Hyde 1995a), and *Cocoicola* K.D. Hyde (Hyde 1995b).

Fasciatispora was introduced by Hyde (1991) to accommodate taxa with unicellular ascospores with a pallid central band, a distinct character that differentiates the genus from other genera in *Xylariaceae*. Hyde & Wong (1999) placed *Fasciatispora* in the family *Xylariaceae* based on the morphology of the ascus ring at the ultrastructural level. *Fasciatispora* comprises 7 species (Hyde 1995c, Lu & Hyde 2000, Kirk et al. 2001).

The present study is concerned with the examination of *Anthostomella* and *Fasciatispora* species associated with decaying palms. Collections were made in 2005 and 2006 in Indonesia and Thailand. In this paper, we report new records of these two genera, including one new species of *Fasciatispora,* from the two countries. The new species is described and illustrated.

Materials and methods

A sharp one-sided razor blade was used to carefully remove the tops of the fruiting bodies. If the contents were wet, they were extracted using a pair of Inox 5 fine forceps. If the contents were dry or crystalline they were rehydrated using distilled water or KOH 5% before extraction. The specimens were observed using an Olympus BX 50 photomicroscope system equipped with differential interference contrast microscopy. Ascomatal sections of 10 µm thick from rehydrated fruiting structures were made with a Micron HM505E cryostat microtome. Materials were mounted in water for examination, spore measurement, and most microphotographs. For each specimen, 25 asci and 30 ascospores were measured. Melzer's reagent was used to investigate any reactions in the asci. Lactophenol was added to the slides for permanent fixation. Dried herbarium specimens were deposited at Mushroom Research Centre Herbarium, Chiang Mai, Thailand.

Results

1. *Anthostomella frondicola* K.D. Hyde, J. Fröhl. & Joanne E. Taylor

Specimen examined — INDONESIA, West Java, Cisimping, Ujung Kulon National Park, on decaying fronds of *Daemonorops* sp. (*Arecaceae*), 1 April 2006, Dewi and Iman Hidayat FIH 208 (Mushroom Research Centre Herbarium 00628).

Notes — Six species of *Anthostomella*, *A. clypeoides* Rehm, *A. colligata* K.D. Hyde & B.S. Lu, *A. frondicola*, *A. rehmii* (Thüm.) Rehm, *A. sepelibilis* (Berk. & M.A. Curtis) Sacc., and *A. triangularis* S.M. Francis & Millar are characterized by an amyloid ascal ring, a hyaline dwarf cell on the ascospore, lack of an ascospore germ slit, and a mucilaginous sheath surrounding the ascospore (Lu & Hyde 2000). Of these taxa, only *A. frondicola* is characterized by verruculose ascospores (Lu & Hyde 2000), which was not mentioned by Hyde et al. (1998) in the protologue. This specimen is typical for *A. frondicola* in not only having verruculose ascospores with a thick mucilaginous sheath, but also having subglobose ascomata and amyloid ascal apical ring (Lu & Hyde 2000). This is the first report of *A. frondicola* from Indonesia, and *Daemonorops* sp. is a new host record.

2. *Anthostomella leptospora* (Sacc.) S.M. Francis

Specimen examined — THAILAND, Chiang Mai, Doi Inthanon, on decaying pinnae of *Borassus flabellifer* L. (*Arecaceae*), 4 August 2005, Iman Hidayat FIH 056 (Mushroom Research Centre Herbarium 00623).

Notes — This is the first record of *A. leptospora* from Thailand.

3. *Anthostomella nitidissima* (Durieu & Mont.) Sacc.

Specimen examined — THAILAND, Chiang Mai, Bahn Pha Deng, A. Mae Taeng, T. Pa Pae, on decaying fronds of *Cocos nucifera* L. (*Arecaceae*), 20 July 2005, Iman Hidayat FIH 028 (Mushroom Research Centre Herbarium 00624).

Notes — This is the first record of *A. nitidissima* from Thailand.

4. *Anthostomella oblongata* B.S. Lu & K.D. Hyde

Specimen examined — INDONESIA, West Java, Cisimping, Ujung Kulon National Park, on decaying fronds of *Arenga pinnata* Merr. (*Arecaceae*), 29 March 2006, Dewi and Iman Hidayat FIH 214 (Mushroom Research Centre Herbarium 00625).

Notes — *Anthostomella oblongata*, a species introduced by Lu & Hyde (2000), has previously only been found in Brunei Darussalam on unidentified wood. Therefore, this is the first record of *A. oblongata* from Indonesia, and *Arenga pinnata* is a new host. The specimen has similar morphological characteristics mentioned in the protologue, including the wedge-shaped in amyloid ascus ring, oblong-ellipsoidal ascospores with a germ slit which is shorter than the ascospores, and a thin mucilaginous sheath (Lu & Hyde 2000).

5. *Anthostomella puiggarii* Speg.

Specimens examined — THAILAND, Chiang Mai, Suthep-Pui National Park, on decaying pinnae of *Wallichia siamensis* Becc. (*Arecaceae*), 16 October 2005, Iman Hidayat FIH 146 (Mushroom Research Centre Herbarium 00626); THAILAND, Chiang Mai University, Faculty of Agriculture, Chiang Mai, on necrotic lesions of pinnae of

Livistona sp. (*Arecaceae*), 14 October 2006, Iman Hidayat & Tatiya Takaew FIH 324 (Mushroom Research Centre Herbarium 00627).

NOTES — This is the first report of *A. puiggarii* from Thailand, and *Wallichia siamensis* is a new host.

6. ***Fasciatispora petrakii*** (Mhaskar & V.G. Rao) K.D. Hyde

Specimen examined — THAILAND, Chiang Mai, Suthep-Pui National Park, on decaying fronds of *Wallichia siamensis* (*Arecaceae*), 16 October 2006, Iman Hidayat FIH 147 (Mushroom Research Centre Herbarium 00629).

NOTES — This is the first report of *F. petrakii* from Thailand, and *Wallichia siamensis* is a new host.

7. ***Fasciatispora ujungkulonensis*** Hidayat, **sp. nov.** FIGURES 1–3

MYCOBANK MB 510855

Ascomata immersa, circumglobata, clypeata, apparatus leviter elatus et ostiolatus, 115–300 µm diam × 50–120 µm alta, subglobosa, basi planissimus, perithecium, medium ostiolatum. Peridium 7.5–15 µm crassum. Paraphysae 1–2.5 µm, numerosae, filamentae, septatae et hyalinae. Asci 43–81 × 4.5–9.5 µm, unitunicati, 8-spori, cylindrici, apicis rotundi, apicale apparatu discoidae, J+, 2–2.5 µm diam, 1–1.5 µm alta praediti. Ascosporae 6–12 × 4.5–7.5 µm, uniseriatae, ellipsoideae, aseptatae, brunneae, fascia aequatoris pallidus vel latus, tunica gelatinosa praeditae.

Etymology — Refers to the place where the specimen was collected.

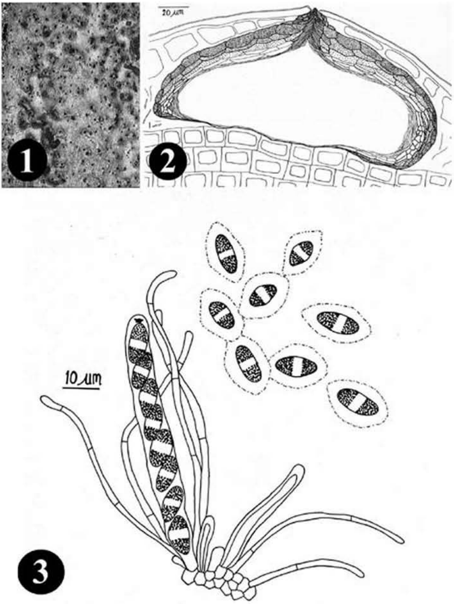
ASCOMATA immersed, clustered, clypeate, visible as a slightly raised, ostiolar, dome-shaped areas on the host surface, in section 115–300 µm diam × 50–120 µm high, subglobose, with a flattened base, and only covered by epidermal tissue of the host, with a central ostiole. PERIDIUM 7.5-15 µm thick, composed inwardly of 1–2 layers of compressed, hyaline cells, and externally of 2–3 layers of compressed, angular brown-walled cells. PARAPHYSES 1–2.5 µm wide, numerous, filamentous, septate, hyaline. *Asci* 43–81 × 4.5–9.5 µm ($\bar{x}$ = 62.5 × 6.5 µm, n = 25), unitunicate, 8-spored, cylindrical, short pedicellate, apically rounded, with J+, and non-refractive discoid subapical ring, 2–2.5 µm diam × 1–1.5 µm high. ASCOSPORES 6–12 x 4.5–7.5 µm ($\bar{x}$ = 10.5 × 5.5 µm, n = 30), overlapping uniseriate, ellipsoidal, aseptate, brown with a wide equatorial pallid band, and surrounded by a wide mucilaginous sheath, ca 2.5–10 µm from the ascospore proper.

Specimen examined — INDONESIA, West Java, Tanjung Lame, Ujung Kulon National Park, on decaying fronds of *Caryota* sp. (*Arecaceae*), 29 March 2006, Dewi and Iman Hidayat FIH 195 (Mushroom Research Centre Herbarium 00630: **Holotype**).

ANAMORPH — Unknown.

HABITAT — Associated with decaying fronds of *Caryota* sp. (*Arecaceae*).

DISTRIBUTION — Indonesia.



Figs. 1-3. Drawing pictures of *Fasciatispora ujungkulonensis* (from holotype).
1. Appearance of ascomata on host surface. 2. Vertical section of ascoma.
3. Ascus, ascus ring, Paraphyses, and ascospores with mucilagenous sheath.

Table 1. A comparison of the dimension and characters of *Fasciatispora ujungkulonensis* with similar species (data from Hyde, 1995c)

Characters	*F. UJUNGKULONENSIS*	*F. PETRAKII*	*F. BICINCTA*
Stromata	Clypeus	Clypeus	Clypeus
Ascomata size	115–300 µm diam, 50–120 µm high	260–330 µm diam, 65–120 µm high	260–440 µm diam, 100–200 µm high
Ascus size	43–81 × 4.5–9.5 µm	84–94 × 8–12 µm	75–100 × 12–20 µm
Ascal ring shape	Discoid	Discoid	Wedge-shaped
Ascal ring size	2–2.5 µm diam, 1–1.5 µm high	ca 2.5 µm diam, ca 1.2 µm high	ca 4 µm diam, ca 2 µm high
Ascospore size	6–12 × 4.5–7.5 µm	10–14 × 5.5–8 µm	14–20 × 8–12 µm
Ascospore shape	Ellipsoidal	Ovoid or almost rhomboid	Ellipsoidal or ovoid
Ascospore ornamentation	Mucilaginous sheath	Mucilaginous sheath	Torulose mucilagenous sheath
Pigmentation	Brown	Brown	Pale brown
Host	*Caryota*	*Calamus,* *Cyrtostachys,* *Daemonorops,* *Elaeis, Livistona,* *Metroxylon,* *Oncosperma, Sabal*	*Caryota, Elaeis,* *Sabal, Smilax*

Discussion

There have been relatively few studies on the fungi associated with decaying palms in Indonesia or Thailand (Penzig & Saccardo 1904, Pinnoi et al. 2004, 2006; Pinruan et al. 2007). Pinnoi et al. (2004) reviewed the literature relating to palm fungi in Thailand, although most of the data were from unpublished thesis. Hidayat et al. (2006), who studied the biodiversity of palmicolous fungi in northern Thailand, reported one *Oxydothis* species from Chiang Mai, northern Thailand and discussed phylogenetic relationships, while Pinnoi et al. (2006) listed 462 fungal records associated with *Eleiodoxa conferta* from peat swamp forest, Narathiwat, southern Thailand. In the present study we report two palmicolous genera in *Xylariaceae*, *Anthostomella* and *Fasciatispora*, which were collected from Chiang Mai, Thailand and Ujung Kulon, Indonesia.

Fasciatispora ujungkulonensis is similar to *F. petrakii* in being a terrestrial saprobe on palms and in having ascospores shorter than 14 µm (Hyde 1995c). Ascospores of *F. ujungkulonensis*, however, are distinct from those of *F. petrakii* in being ellipsoidal with blunt ends (6–12 × 4.5–7.5 µm, $\bar{x}$ = 10.5 × 5.5 µm, n = 30); those of *F. petrakii* (10–14 × 5–5.8 µm) are ovoid to almost rhomboid with acute ends (Hyde 1995c). Furthermore, a mucilaginous sheath which surrounds the ascospores of *F. ujungkulonensis* is relatively wide (ca 2.5–10 µm from the ascospore proper), compared with that of *F. petrakii* which is fairly thin. Asci of *F. ujungkulonensis* are also shorter and narrower than those of *F. petrakii* (43–81 × 5–9.5 µm vs 84–94 × 8–10 µm of *F. petrakii*) (Hyde 1995c). *Fasciatispora ujungkulonensis* is also distinct from *F. bicincta* (Syd. & P. Syd.) K.D. Hyde in having a discoid ascus ring; that of *F. bicincta* is wedge-shaped. Besides *F. bicincta* has larger ascospores (14–20 × 8–12 µm) and larger asci (75–100 × 12–20 µm). A synopsis of characters of *F. ujungkulonensis*, *F. petrakii* and *F. bicincta* is given in Table 1. Numerous attempts were made to grow single spore isolates of *F. ujungkulonensis* in culture, but each time they proved unsuccessful.

Key to *Fasciatispora* species (modified from Hyde 1995c)

1a. Ascal ring J- .... *F. melanosticta* (Ellis & Everh.) K.D. Hyde
1b. Ascal ring J+ 2

2a. Marine saprotrophs on palms or other timber 3
2b. Terrestrial saprotrophs on palms 4

3a. Ascospores with polar cap-like appendages .... *F. nypae* K.D. Hyde
3b. Ascospores surrounded by a mucilagenous sheath .... *F. lignicola* Alias et al.

4a. Ascospores mostly shorter than 14 µm 5
4b. Ascospores mostly longer than 14 µm 6

5a. Ascospores ellipsoidal, asci 43–81 × 4.5–9.5 µm .... *F. ujungkulonensis*
5b. Ascospores ovoid to rhomboid, asci 84–94 × 8–12 µm .... *F. petrakii*

6a. Ascospores pale brown, ellipsoidal to ovoid,
with a swollen equatorial pallid band .... *F. bicincta*
6b. Ascospores brown to dark brown, ellipsoidal,
without a swollen equatorial pallid band 7

7a. Ascospores dark brown, asci 90–118 × 15–19 µm .... *F. pandanicola* K.D. Hyde
7b. Ascospores brown, asci 120–170 × 12–16 µm .... *F. sabalicola* K.D. Hyde

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Mycofalcella iqbalii, a new aquatic hyphomycete, and a discussion about the generic concept of *Anguillospora* and similar genera

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Abstract — A new aquatic hyphomycete, *Mycofalcella iqbalii*, is described and illustrated from canal water in Pakistan. The conidia have been detected in water throughout the year, but sporulation on randomly collected leaves more commonly occurred between August and December. The generic affinity of the new species is debated in the context of a general discussion about the generic concepts of the complex of hyphomycetes resembling *Anguillospora*, *Anguillosporella*, *Mycofalcella*, and aquatic species of *Mycocentrospora*. It is proposed to confine *Anguillospora* to species with unilocal conidiogenous cells and rhexolytic conidial secession, and to widen the concept of *Pseudoanguillospora* to include taxa with unilocal, determinate or percurrent to multilocal, sympodial conidiogenous cells and schizolytic conidial secession.

Key words — anguillospora-like hyphomycetes, aquatic fungi, mitosporic fungi, systematics

Introduction

During a study of aquatic hyphomycetes in canal water in Pakistan, a new species of *Mycofalcella* Marvanová et al. (Marvanová et al. 1993) was found. The search for an appropriate genus for the new species caused some problems because various morphologically similar genera of aquatic hyphomycetes as well as the confusable genus *Mycocentrospora* Deighton were involved. Therefore, a careful reassessment of the whole generic complex was necessary.

Materials and methods

Uninfected dried culms of *Saccharum munja* were cut into 10 cm pieces and sewn in nylon bags of 2 mm mesh size. These bags were tied to an iron rod and immersed horizontally in water of the canal. A restricted range of hyphomycetes having sigmoid conidia, including the new species, was found on the culms that were periodically retrieved. The conidia appearing on culms of *Saccharum munja*, incubated in sterile distilled water at 25 °C, were picked up on a flamed needle and transferred to 2% tap water agar. Before autoclaving, the pH of agar was brought to 5.0 using a dilute solution of HCl acid. Conidia readily germinated at 25 °C on 2% malt extract agar (MA) in Petri dishes. Actively growing hyphal tips were transferred to fresh MA in Petri dishes. Conidia were formed on MA culture slices submerged in distilled water in flasks after aeration for 48 h, at 20 ± 2 °C. A simple air pump was used to aerate the cultures.

Taxonomy

Mycofalcella iqbalii Firdaus-e-Bareen & U. Braun, **anam. sp. nov.** Fig. 1, A–X

MycoBank MB 511113

Mycofalcellae calcaratae *similis, sed conidiis angustioribus, cellulis centralibus 5.5–7.5 µm latis, saepe 3-septatis.*

Etymology: Named after S.H. Iqbal, Pakistani mycologist.

Colonies on MA slow growing, reaching 3 cm diam after one wk, pale gray in early stages, becoming grayish black at maturity; aerial mycelium brownish black in old cultures. Mycelium submerged, dark brown; hyphae septate, thin-walled, smooth, 2.5 µm wide. Sporulation abundant on MA slices submerged in sterile distilled water and aerated for 48 h. Conidiophores simple or sparsely branched, 50–200 µm long and 2.5–3.0 µm wide, thin-walled, smooth, pluriseptate, pale brown. Conidiogenous cells integrated, terminal, unilocal, with a single terminal slightly swollen conidiogenous locus, 4–5 µm diam (Fig. 1 H), proliferation percurrent (Fig. 1, I–O). Conidia solitary, lunate (Fig. 1, P–X), 50–180 µm long, the two central cells 14.0–22.0 × 5.5–10.0 µm, at maturity commonly 3-septate, hyaline, thin-walled, smooth, the upper curved cell attenuated, 13–78 µm long, a sword-like appendage, 18–55 µm long, often formed near the base just before conidial release.

TYPUS: PAKISTAN. Lahore, Quaid-e-Azam Campus, Lahore branch of the BRB Canal, a single conidium isolated from submerged decaying culm of *Saccharum munja* Roxb. (*Poaceae*), 15.VIII.1992, coll. Firdaus-e-Bareen. HOLOTYPE: CBS-H 5579 (ex type cult. CBS 400.93).

Comments: The Lahore Branch of the BRB Canal is one of the channels of the canal irrigation system in the Punjab. It is lined by several tree species, the most common of which are *Populus* ×*canadensis* [= *P.* "*euramericana*"], *Salix babylonica* and *Eucalyptus camaldulensis* (Iqbal & Firdaus-e-Bareen 1991). Water in the canal has a higher temperature than shallow clear water streams of temperate areas and it is a massive body of turbid water (Firdaus-e-Bareen & Iqbal 1994).

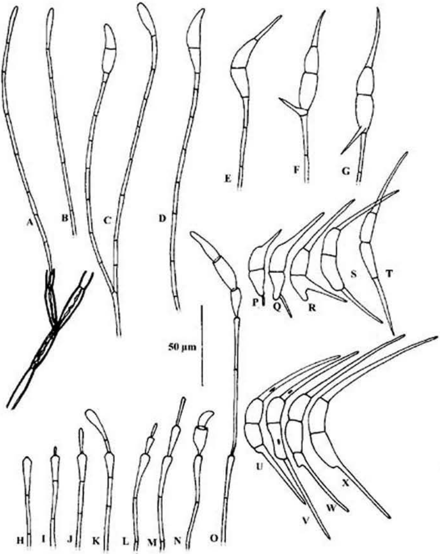

Fig. 1. *Mycofalcella iqbalii*. A. Conidiophore originating from the cut end of the cell in a culture strip. B-G. Progressive stages in conidium development (C. Branched conidiophore; F and G. Formation of a basal conidial appendage). H. Conidiogenous locus left following conidial dehiscence. I-O. Progressive stages in proliferation of the conidiogenous locus and subsequent conidial development. P-X. Mature detached conidia.

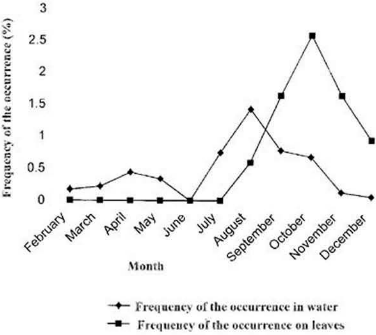

Fig. 2. Distribution of *Mycofalcella iqbalii* in the Lahore Branch of the BRB Canal in 1992.

The average temperature in the canal water normally ranges from 10 to 26 °C. During August the average temperature was 24 ± 1 °C. Because the canal water represents a semi-tropical freshwater habitat, the presence of new species of hyphomycetes was not unexpected. *Mycofalcella iqbalii* was frequently observed on dried culms of *Saccharum munja* used as bait.

On randomly sampled decaying submerged leaves, this fungus was also detected from August to December, especially on leaves of *Populus* ×*canadensis* and grass blades and culms of *Cenchrus setigerus*. This fungus was detected throughout the year by the membrane filtration technique of Iqbal & Webster (1973), although in very low quantity. The maximum frequency of occurrence of *M. iqbalii* was observed during July to December (Fig. 2), a period coinciding with rainfall, and possibly with increased water turbulence. The frequency of occurrence was calculated as percent of the total number of leaf discs observed or as total number of conidia present in the water sample.

Mycofalcella iqbalii is morphologically similar to *M. calcarata* Marvanová et al. (Marvanová et al. 1993), but differs in having mostly 3-septate, much narrower conidia, 5.5–7.5 µm in the broadest central cells (versus 4–6(–8)-septate and 6–13 µm wide in *M. calcarata*). The conidiophore morphology of the new species and the pigmented mycelium is reminiscent of *Mycocentrospora aquatica* (S.H. Iqbal) S.H. Iqbal (Iqbal 1974), which, according to Marvanová et al. (1992) and Marvanová (1996), belongs probably to *Filosporella* Nawawi. In its conidial dimensions, *Mycofalcella iqbalii* is somewhat reminiscent of *Mycocentrospora acerina* (R. Hartig) Deighton, which differs, however, in having much longer and wider conidia (up to 290 × 18 µm), with (1–)6–12(–24) septa (Braun 1995). *Sporidesmium flexum* Matsush. (Matsushima 1975) is a similar dematiaceous hyphomycete, also with percurrent conidiogenous cells. It also has curved conidia with larger median cells, but lacks basal extensions. Moreover, the conidia (80–110 × 10–13 µm) are smaller than in *M. iqbalii.*

Discussion of generic concepts within the *Anguillospora, Pseudoanguillospora, Mycofalcella* and *Mycocentrospora* complex

The new species fits well into the genus *Mycofalcella*, and agrees well with *M. calcarata*, the type species, by having falcate hyaline conidia, formed singly, with a basal, sword-like appendage and percurrent conidiogenous cells. A phialidic microconidial state, as formed in cultures of *M. calcarata*, was, however, not produced in vitro by *M. iqbalii*. The taxonomy of the new species was discussed with M. Marvanová, author of *Mycofalcella* and expert for aquatic hyphomycetes, who advised the inclusion of this fungus in the latter genus. *Mycofalcella* and *Mycocentrospora* are morphologically very close to each other. Marvanová et al. (1993) mainly distinguished *Mycofalcella* from *Mycocentrospora* based on its percurrently proliferating conidiogenous cells. However, the mode of proliferation of the conidiogenous cells, percurrent or sympodial, is often unreliable and not relevant at generic rank, as pointed out by several authors in revisions of hyphomycete genera, based on molecular sequence data [e.g., in cercosporoid hyphomycete genera (Crous et al. 2001) and fusicladium-like anamorphs of the *Venturiaceae* (Beck et al. 2005)]. On the other hand, Deighton (1971) and Braun (1993) excluded solely aquatic *Mycocentrospora* spp. from this genus, although *M. acerina*, the type species, has a wide ecological amplitude, ranging from biotrophic, saprobic to aquatic. The main reasons for the exclusion of the aquatic *Mycocentrospora* spp. were obvious differences in the structure of the conidiogenous cells and loci, which are strongly sympodial, zigzag-like, with flat, broad, slightly thickened scars (Braun 1995). Marvanová (1996) discussed the circumscription of *Mycocentrospora*, including 'aquatic species', and maintained this genus in its broad concept. We follow, however, the narrowed concept of *Mycocentrospora*, and accept *Mycofalcella* as a similar, but separate genus. A complete revision of *Mycocentrospora*, including aquatic species like *M. angulata* (R.H. Petersen) S.H. Iqbal, *M. aquatica*, *M. clavata* S.H. Iqbal, *M. filiformis* (Greathead) S.H. Iqbal (Iqbal 1971) as well as *M. varians* Sinclair & Morgan-Jones (Sinclair & Morgan-Jones 1979), is necessary. Such a revision should include re-examination of type collections, cultures and, if possible, molecular sequence analyses. Without comprehensive revisions, any taxonomic changes within this complex are not advisable.

Aquatic hyphomycetes with conidia forming basal appendages are usually referred to as *Mycocentrospora*. But several other genera of aquatic hyphomycetes are also involved in this complex. *Anguillospora* Ingold (Ingold 1942) was introduced for *A. longissima* (Sacc. & P. Syd.) Ingold. *Pseudoanguillospora* S.H. Iqbal is a genus proposed by Iqbal (1974) for *Anguillospora*-like fungi, differing in having polyblastic, sympodial conidiogenous cells and distinct scars, which, although not very evident, are indicated by the zig-zag or wavy nature of the conidiophores. Most authors followed this concept and maintained *Anguillospora* for taxa with unilocal, determinate or percurrent conidiogenous cells (Marvanová 1996). Braun (1993) suggested that the entire complex resembling *Anguillospora*, *Pseudoanguillospora* and aquatic species of *Mycocentrospora* should be reassessed. The differentiation between these genera is vague and the position of several species assigned to *Anguillospora* is rather doubtful. As stated above, several authors, based on molecular sequence analyses, found that the mode of proliferation of the conidiogenous cells, i.e. unilocal (determinate or percurrent) or multilocal (sympodial), is of little importance at the generic level. Therefore, it is doubtful whether a natural differentiation between *Anguillospora* and *Pseudoanguillospora* can be based on this feature. The mode of conidial secession (schizolytic or rhexolytic, i.e. with a separating cell) correlates well with phylogenetic analyses. These types of conidial secession are generally not mixed in a monophyletic hyphomycete genus. A revision of *Anguillospora* and *Pseudoanguillospora*, including some aquatic species of *Mycocentrospora* is, indeed, urgently necessary.

Anguillospora longissima, the type species, is characterized by unilocal conidiogenous cells and rhexolytic conidial secession, i.e., a separating cell and frill are present (Petersen 1962). Other species of *Anguillospora* have unilocal, determinate to percurrent conidiogenous cells and schizolytic conidial secession, i.e. without separating cell and frill, e.g., *A. furtiva* J. Webster & Descals (Descals et al. 1998), *A. marina* Nakagiri & Tubaki (Nakagiri & Tubaki 1983) and *A. rubescens* Gulis & Marvanová (Gulis & Marvanová 1999). *A. longissima* is an anamorph with connection to the genus *Massarina* Sacc. (*Lophiostomataceae*, *Pleosporales*, *Dothideomycetidae*; Nakagiri & Tubaki 1983, Sivanesan 1984), which has been confirmed by molecular sequence analyses (Baschien 2003). As far as known, *Anguillospora* spp. with schizolytic conidiogenesis are unrelated to *A. longissima* and have phylogenetic affinities with orders and families of the *Pezizomycotina*, *Leotiomycetidae* and *Orbiliomycetidae* (*Helotiales* = *Leotiales*, *Lulworthiales* and *Orbiliales*): *Anguillospora crassa* Ingold [*Mollisia* sp., *Dermateaceae*, *Helotiales* (Webster 1961, Webster & Davey 1984)], *A. furtiva* [*Pezoloma* sp., *Helotiales* (Webster & Descals 1981); *Rutstroemia* sp., *Rutstroemiaceae, Helotiales* (Webster 1992); *Pezoloma* sp., *Helotiales* (Descals et al. 1998)], *A. marina* [*Lindra obtusa* Nakagiri & Tubaki, *Lulworthiaceae, Lulworthiales* (Nakagiri & Tubaki 1983, Kohlmeyer et al. 2000)], *A. rosea* J. Webster & Descals [*Orbilia* sp., *Orbiliales*, previously *Helotiales* (Webster & Descals 1979, Descals et al. 1998)], *Anguillospora* sp. [*Loramyces juncicola* W. Weston, *Loramycetaceae, Helotiales* (Digby & Goos 1987)], *Anguillospora* sp. [*Tapesia* sp., *Dermatiaceae, Helotiales* (Hennebert & Bellemère 1979)]. The helotialean affinity of *Anguillospora crassa* has been proven by molecular sequence analyses (Baschien 2003). On account of the differences in the conidial secession and phylogenetic affinities, it is proposed to confine ***Anguillospora* emend.** to species with **unilocal conidiogenous cells** and **rhexolytic conidial secession,** and to widen the concept of ***Anguillosporella* emend.** to include species with **unilocal, determinate or percurrent to multilocal, sympodial conidiogenous cells** and **schizolytic conidial secession.** As already discussed, the different modes of proliferation of the conidiogenous cells proved to be a character of little importance at the generic level in numerous groups of hyphomycete genera, which is also evident in the *Anguillospora* complex. In *A. fustiformis* Marvanová & Descals (Marvanová & Descals 1996), the conidiogenous cells are monoblastic, determinate, but occasionally they proliferate percurrently or sympodially. In *A. mediocris* Gönczöl & Marvanová (Gönczöl & Marvanová 2002), they are usually percurrent, but rarely also sympodial. Formal combinations of *Anguillospora* spp. with schizolytic conidial secession into *Anguillosporella* are not proposed. This should be based on comprehensive re-examinations of the species concerned, including type and culture studies and, if possible, molecular sequence analyses.

Another problem refers to the relation between *Pseudoanguillospora* and aquatic *Mycocentrospora* spp. According to Deighton (1971), the presence of a basal appendage is an inconsistent character. He observed many conidia of *Mycocentrospora acerina* without appendages, and described three other species of *Mycocentrospora* without any conidial appendages. Sinclair & Morgan-Jones (1979) also considered the formation of appendages to be a variable character as observed in *M. aquatica* and *M. varians*. Lacking appendages could be a reason for an inclusion of *M. clavata* and *M. varians* in *Pseudoanguillospora*. However, the importance of the formation of conidial appendages as generic character remains unclear. It will barely be possible to solve this problem only based on morphological studies. Molecular sequence analyses, including *Mycocentrospora acerina*, aquatic *Mycocentrospora* spp., *Mycofalcella* and *Pseudoanguillospora* spp., are necessary to elucidate if conidial appendages are relevant to indicate phylogenetic affinities and distinct genera.

Marvanová (1988) has established the new genus *Colispora*, with *C. elongata* Marvanová as the type species. The conidiogenous cells very much resemble those of *Pseudoanguillospora*. The morphology of the conidiophores and conidia is strikingly similar to *Mycocentrospora clavata*, the only difference being in the percurrent conidiogenous cell. The genus *Colispora* is possibly also a synonym of *Pseudoanguillospora* because it has schizolytic conidial secession.

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Diagnostic cystidia observed on rhizomorphs of *Melanoleuca verrucipes*

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Abstract — Rhizomorphs of *Melanoleuca verrucipes* have been studied using light and scanning electron microscopy. This revealed an agaricoid rhizomorph type that consisted of a cortex of fine "peripheral" hyphae surrounding a medulla containing large diameter "vessel" hyphae. In addition, urticiform to ampulliform cystidia covered with crystalline material are scattered on the surfaces of the peripheral hyphae. The presence of peripheral hyphae bearing numerous cystidia is described as a new morphological characteristic of *M. verrucipes*.

Key words — mycelial cords, saprotrophic fungus, *Tricholomataceae*

Introduction

Rhizomorphs sensu Cairney et al. (1989) are produced by some saprotrophic and ectomycorrhizal basidiomycetes as they grow through soil and associated litter. Although the general pattern of hyphal organisation is similar in all rhizomorphs, interspecific differences occur in the degree of differentiation attained (Cairney 1991a, b). Recent authors (Agerer 1999, 2002; Agerer & Iosifidou 2004, Clémençon 2004, Clémençon et al. 2007) note that basidiomycete rhizomorphs offer important new characters that are potentially of great value to identification (Cairney 1991a). Although identification of rhizomorphs in the absence of basidiomata is extremely difficult, several anatomical studies of ectomycorrhizas that have included information on rhizomorph structure (Franz & Acker 1995, Raidl 1997, Agerer 1991, 1999; Hahn & Agerer 1999,

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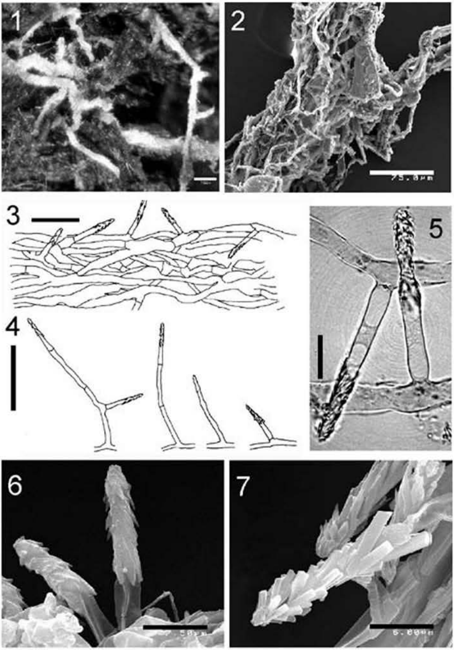
Hahn et al. 2000) have made possible identification of many fungal symbionts in the absence of fruiting structures. Unfortunately, descriptions of rhizomorph structure are available for only a few saprotrophic fungi (Townsend 1954, Cairney et al. 1989, Cairney 1990, 1991a; Agerer 2002, Clémençon 2004). Until information for many more saprotrophic species is available, assigning rhizomorphs to groupings such as order or genus based on similarities between their mature structure and that of representative members of a group offers a credible alternative (Cairney 1991a). Although many saprotrophic fungi belong to the family *Tricholomataceae*, morphological characters for identifying rhizomorphs in this family have been poorly documented. Therefore, we describe and illustrate the detailed structure of mature rhizomorphs produced by *Melanoleuca verrucipes* (Fr.) Singer, a member of *Tricholomataceae* with a tricholomatoid basidiome, and compare them with already published accounts of rhizomorphs of another species in this family, *Megacollybia platyphylla* (Pers.) Kotl. & Pouzar (Townsend 1954, Cairney et al. 1989), that produces xeruloid basidiomata.

Materials and methods

A total of 65 mature basidiomata with rhizomorphs of *M. verrucipes* were collected from the following two locations: 1) on woodchip garden mulch in Minuma Nature Park, Midori-ku, Saitama-shi, Saitama, Japan from May 2005 to June 2007; 2) on rich cultivated soil in Taira-izumizaki, Iwaki-shi, Fukushima, Japan from October 2005 to October 2006. Material examined in this study are deposited in the Mycological Herbarium of the National Museum of Nature and Science, Tokyo, Japan (TNS; accession numbers: TNS-F 16415, 16416, 16417, 16418, 16419, 16420, 16421, 16422, 16423, 16424, 16425, 16426).

Macroscopic characters were described from observations of fresh material with a stereomicroscope. For light microscopic observations, free-hand sections of rhizomorph pieces were mounted in distilled water, 3% (w/v) KOH or 1% phloxine B solution on glass slides. Pencil line drawings were made under a light microscope with 1000× magnification. Detailed rhizomorphic features were also observed through scanning electron microscopy (SEM). For SEM, small pieces (ca. 2.5 mm) of rhizomorphs were fixed with 4% glutaraldehyde solution, rinsed 2 or 3 times with distilled water, and then dehydrated in a graded acetone series. These samples were passed through amyl-acetate, dried in a Hitachi HCT-2 Critical Point Dryer (Tokyo), attached to specimen holders with double-sided adhesive tape, and coated with platinum-palladium in a Hitachi E-1030 Ion Sputter Coater (Tokyo). Samples were examined using a Hitachi S-4200 SEM (Tokyo) operating at 20 kv.

Figs. 1–7. Rhizomorphs of *Melanoleuca verrucipes*. **1:** Rhizomorphs under stereomicroscope. **2:** Loosely interweaving "peripheral" hyphae protruding from the surface of rhizomorphs (SEM). **3:** "Peripheral" hyphae with cystidia. **4, 5:** Branched, septate, and urticiform (4), and ampulliform (5) cystidia on the surface of "peripheral" hyphae with crystalline material on the apices.



6, 7: Crystalline material on the apices of cystidia (6) in broadly triangular shapes and (7) in broadly quadrilateral shapes (SEM).

Bars **1:** 10 mm, **2:** 75 µm, **3:** 50 µm, **4:** 25 µm, **5:** 10 µm, **6:** 7.5 µm, **7:** 6 µm (**1, 5** from TNS-F-16416; **2–4, 6–7** from TNS-F-16423).

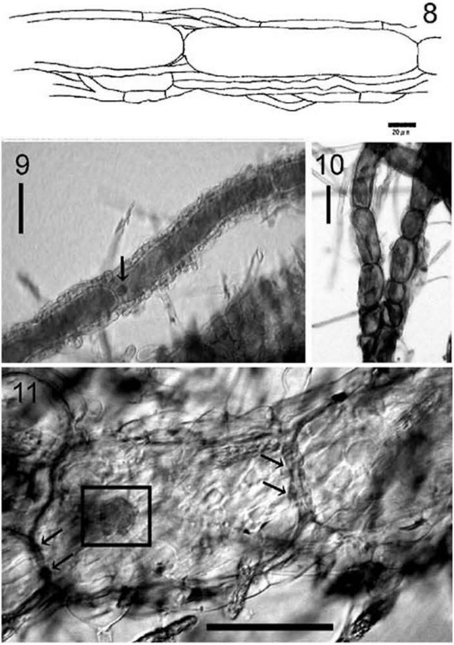
Results

The rhizomorphs of *Melanoleuca verrucipes* are pale cream to whitish in colour, profusely ramified, and up to 1.5 mm in diameter (Fig. 1). The outer rhizomorph surface is characterized by loosely interweaving "peripheral" hyphae (averaging 3.4 ± 0.1 µm diam with an overall range of 2–5.5 µm [n = 100]) with apices protruding from the surface (Fig. 2). These "peripheral" hyphae, which constitute the outer rhizomorph layer, are septate, colorless to pale brown, and thin-walled. Cystidia, which are scattered on the surface of the "peripheral" hyphae (Fig. 3), are a conspicuous feature. Cystidia are 38–135 x 3.5–9.5 µm, often dichotomously branched, septate, colorless to pale brown, urticiform to ampulliform and elongate rostriform at the apex, densely covered with crystalline material, without clamp connections, and thin-walled (Fig. 4, 5). Crystalline material on the cystidia is colorless, 20–39 x 3–5 µm, broadly triangular to quadrilaterally shaped, and spirally attached to the cystidial apices (Figs. 6, 7). The medulla is composed of predominantly large diameter "vessel" hyphae (Fig. 8) averaging 35.5 ± 0.1 µm diam with an overall range of 16.5–51.5 µm diam (n = 100) intermixed with possibly proteinaceous (Agerer 2002) octahedral crystals (Fig. 9). The "vessel" hyphae are tubular to sometimes doliate (Fig. 10), colorless to pale brown, and thin-walled. Reduced septa with dolipore junctions are frequently found (Figs. 11).

Discussion

In saprotrophic basidiomycetes, rhizomorph medullas contain large diameter "vessel" hyphae surrounded by a cortex of finer "peripheral" hyphae (Cairney et al. 1989, Cairney 1990, Agerer 2002). A similar general structural pattern is evident from anatomical studies of rhizomorphs of ectomycorrhizal basidiomycetes (Foster 1981, Franz & Acker 1995, Raidl 1997, Agerer 1999, Hahn & Agerer 1999). The rhizomorph structure of *Melanoleuca verrucipes* reported here suggests that the general structural pattern can be extended to include saprotrophic tricholomatoid fungi.

Until now, rhizomorph structure has been described for only one representative of the *Tricholomataceae* — *Megacollybia platyphylla* (Townsend 1954, Cairney et al. 1989). Although its rhizomorph morphology is similar to that of *M. verrucipes*, there are three striking differences. First, *M. verrucipes* rhizomorphs have numerous cystidia on the surface of "peripheral" hyphae, a character typical for many ectomycorrhizal basidiomycetes (Raidl 1997, Agerer 1999). However, cystidia are completely absent in case of *Meg. platyphylla* and other saprotrophic basidiomycetes. The "peripheral" hyphae with numerous cystidia that are diagnostic for *M. verrucipes* rhizomorphs represent a first report of cystidia for rhizomorph surfaces. Next, "peripheral" hyphae of *Meg. platyphylla* rhizomorphs comprise numerous fine hyphae (ca. 1 µm in diameter)



Figs. 8–11. The medulla constituted by large diameter "vessel" hyphae **8:** Tubular "vessel" hyphae. **9:** "Vessel" hyphae with possibly proteinaceous crystalline material (arrow). **10:** Doliate "vessel" hyphae with many septa. **11:** Crystalline material (in black frame) and septa with dolipore junctions (arrows). *Bars* **8:** 20 μm, **9–10:** 45 μm, **11:** 25 μm (**8–11** from TNS-F-16425).

with thick-walls and a few thin-walled hyphae (2–3 µm diam; Cairney et al. 1989) while the peripheral hyphae of *M. verrucipes* rhizomorphs are uniformly thin-walled and 2–5.5 µm diam. Finally, the *Meg. platyphylla* rhizomorph medulla is composed of both wide (4–15 µm diam) "vessel" and narrow (1–2 µm diam) hyphae (Cairney et al. 1989) while the *M. verrucipes* medulla contains only wide "vessel" hyphae (16.5–51.5 µm diam) and no narrow thin-walled hyphae.

We believe that the rhizomorph cystidia, thin-walled "peripheral" hyphae, and thick-walled "vessel" hyphae present in the *M verrucipes* specimens examined in this study represent new taxonomic characters for *M. verrucipes* rhizomorphs. As the cheilocystidia and pleurocystidia previously described for *M. verrucipes* basidiomes (Boekhout 1999, Fontenla et al. 2003) are morphologically similar to the cystidia on rhizomorph surfaces, we predict that cystidia found on rhizomorphs of other *Melanoleuca* species will resemble those found in *M. verrucipes*.

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MYCOTAXON

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Two species of *Ganoderma* new to Taiwan

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Abstract — *Ganoderma flexipes* and *G. multiplicatum* are newly recorded from Taiwan. *Ganoderma flexipes* has a small reddish brown pileus with a long and thin stipe, yellowish brown to dark brown context, and ellipsoid or ovoid basidiospores up to 11.5 µm long. *Ganoderma multiplicatum* is characterized by a rigid, sessile basidioma, duplex context, amyloid cuticle cells with apically acanthus-like lobes, and ovoid basidiospores no longer than 10 µm and with moderately conspicuous echinulae. The full descriptions of the two species are given.

Key words — *Polyporales*, taxonomy, new record, geographical distribution

中文摘要

本文首次發表彎柄靈芝（*Ganoderma flexipes*）和黃靈芝（*G. multiplicatum*）在臺灣的分佈。彎柄靈芝有紅褐色的小型菌蓋，細長的菌柄，黃褐色到深褐色的菌肉以及橢圓形或卵圓形,長達11.5 µm的擔孢子。黃靈芝以硬的無柄擔子果，雙層的菌肉，呈現澱粉質反應且頂端帶有突起的皮殼細胞以及小刺中等粗細且長度不超過10 µm的卵圓形擔孢子爲主要特徵。本文對此兩種進行了全面的描述。

Introduction

Ganoderma P. Karst. is a well-known polypore genus in Taiwan. Some of its members represent economically important medicinal fungi, but it has also been regarded as a symbol of good fortune and immortality in the Chinese literature for thousands of years. A survey of Taiwanese *Ganoderma* was initiated early in the 20th century and a total of 24 names have been recorded (Murrill 1909, Yasuda 1917, Kanehira 1918, 1923, Sawada 1931, 1959, Imazeki 1939, Hou 1950, Imazeki & Hongo 1957, Chang & Chen 1984, Hseu et al. 1989,

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Zang & Su 1990, Chang 1992, 1994, Chang et al. 2001, Wu & Zhang 2003, Chou & Chang 2005, Wang et al. 2005). Of these names, Wu et al. (1997, 2004) excluded one from *Ganodermataceae* Donk, and Wang et al. (2005) treated two as synonyms. Furthermore, nearly half of the remaining species names are probably synonyms that need further clarification. Two newly recorded species of *Ganoderma* from Taiwan are described in this study.

Materials and methods

All specimens used in this study have been deposited in the herbarium of National Museum of Natural Science of ROC (TNM). For observations of microscopic characters, 5% KOH was used as mounting medium. Melzer's reagent was employed to detect amyloidity and dextrinoidity. At least 20 basidiospores were measured from each mature specimen. The basidiospore size was given both with and without the myxosporium in the description of each species, but only spore sizes with myxosporium were used for comparisons between species. Line drawings of basidiospores and cuticle cells were made with the assistance of a camera lucida.

Taxonomy

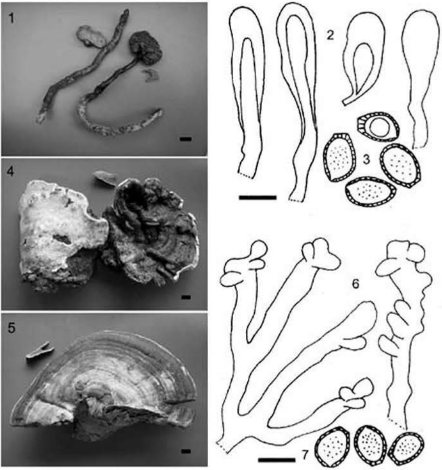
Ganoderma flexipes Pat., Bull. trimest. Soc. mycol. Fr. **23**: 75 (1907). Figs 1–3

=*Fomes flexipes* (Pat.) Sacc. & Traverso, *Syll. fung.* (Abellini) **19**: 710 (1910).

=*Polyporus flexipes* (Pat.) Lloyd, *Mycol. Writ.* 3 (Syn. Stip. Polyporoids): 104 (1912).

Basidioma annual, stipitate, corky. Pileus 0.7–2 × 1.3–2.8 cm, up to 0.8 cm thick at the base, pulvinate, subcircular or flabelliform; upper surface reddish brown, weakly to strongly laccate, finely concentrically sulcate, finely radially rugose; margin thin or obtuse, concolorous or yellowish brown, often subtruncated. Pore surface grayish to yellowish brown; tubes 2–8 mm long, yellowish brown to brown; pores 7 (–9) per mm, subcircular, 90–110 (–130) μm diam., dissepiments 25–70 μm thick. Stipe 6.2–10.5 × 0.2–0.6 cm, dorso-lateral, subcylindrical or flattened, dark reddish brown to purplish black, strongly laccate or not. Context 0.5–4 mm thick, yellowish brown to dark brown with woody lines, corky; generative hyphae 2–6.5 μm diam., colorless, thin-walled to subsolid, with clamp-connexions; skeleto-ligative hyphae 3–6.5 μm diam., pale yellow to yellowish brown in KOH, dextrinoid; binding hyphae *bovista*-type, 2 μm diam., colorless, thick-walled to solid. Basidiospores 9–11.5 × 6–7.5 μm (with myxosporium), 6.5–9.5 × 4.5–6.5 μm (without myxosporium), ellipsoid or ovoid, apically truncate or not, brown, with a dark brown eusporium bearing conspicuous echinulae or not. Cutis composed of clavate elements, 20–50 × (4–) 7.5–10.2 μm, amyloid.

Specimens examined—Taiwan: Nantou, Huisun Forestry Station, 24°04′N, 121°01′E, alt. 1650 m, on tree base, 13 Dec. 1996, W.N. Chou, *CWN 01991* (F0005615, TNM);



Figs 1–3. *Ganoderma flexipes* (CWN 01991). Fig. 1. Basidiomata; Fig. 2. Sections of cutis; Fig. 3. Basidiospores. Figs 4–7. *Ganoderma multiplicatum* (Figs 4, 6 & 7: *FL 0307-3*; Fig. 5: *CWN 05622*). Fig. 4. Basidiomata; Fig. 5. Basidioma; Fig. 6. Sections of cutis; Fig. 7. Basidiospores.
Bars: 1 cm in Figs 1, 4 & 5; 10 µm in Figs 2, 3, 6 & 7.

Lienhuachih, 23°56′N, 120°53′E, alt. 700 m, on rotten wood, 08 Jun. 1994, W.N. Chou, *CWN 00543* (F0002288, TNM).

Distribution—Vietnam (type locality), Nepal, India, Pakistan (Steyaert 1972), mainland China (Zhao & Zhang 2000), Taiwan (this study).

Notes: *Ganoderma flexipes* is easily recognized by its small reddish brown pileus, long and thin stipe, yellowish brown to dark brown context, and ellipsoid or ovoid basidiospores. The basidiospore size (9–11.5 × 6–7.5 µm) from the two Taiwanese collections falls within the range (8–9.9–13 × 5.5–6.5–8 µm, measured by Steyaert (1972) for *G. flexipes*, and fits that of the lectotype (9–11

× 6–7.5 μm, measured by Ryvarden (1983)) of this species. In addition, the features of warty, vaguely plicate basidiomata, pore diameter conspicuously larger than dissepiment thickness, corky context composed of mostly fine, and thick-walled hyphae in the collections from Taiwan resemble those of authenticated specimens and of the holotype (Steyaert 1972).

Steyaert (1972) noted that the apex of basidiospores of *G. flexipes* was permanently rounded and would not collapse. However, we have found some apically truncate basidiospores in the specimens cited above.

Ganoderma flexipes is similar to another subtropical to tropical species, *G. calidophilum* J.D. Zhao et al. The latter has a small reddish brown basidioma with a thin and long stipe, and basidiospores 10–12.1(–13) × 6.2–8.7 μm (Zhao et al. 1979). The spores are larger than those of *G. flexipes* as measured in this study but similar to those of *G. flexipes* as indicated by Steyaert (1972). The two species may be conspecific. Chou & Chang (2005) reported *G. calidophilum* from Taiwan but did not mention basidiospore measurements and specimen citation. Currently, specific delimitation between *G. flexipes* and *G. calidophilum* is not clear, and should be further studied.

Ganoderma multiplicatum (Mont.) Pat.,
Bull. trimest. Soc. mycol. Fr. 5(2,3): 74 (1889). Figs 4–7
≡*Polyporus multiplicatus* Mont., Annls Sci. Nat., Bot., sér. 4 1: 128 (1854).
≡*Fomes multiplicatus* (Mont.) Sacc., Grevillea 14(no. 69): 18 (1885).

Basidioma annual, sessile and broadly attached, woody. Pileus 6.5–10.5 × 9–18.5 cm, up to 2.2 cm thick at the base, reniform, dimidiate, flabellate; upper surface pale to deep reddish brown to purple, becoming black or brown at base, weakly to strongly laccate, concentrically sulcate or not; margin obtuse, usually white. Pore surface yellowish green, bright yellow or yellow, becoming brown when bruising; tubes up to 1.2 cm long, pale brown; pores 5–6 per mm, 100–170 μm diam., dissepiments 30–100 μm thick. Context 0.1–1 cm thick, duplex, upper layer yellowish, lower layer yellowish brown or brown, with melanoid substances or whitish filaments; generative hyphae 2.5–6 μm diam., colorless, thin-walled, clamp-connexions difficult to observe in dried specimens; skeletal hyphae 5–6.5 μm diam., abundant, arboriform, yellowish brown to reddish brown in KOH, dextrinoid; binding hyphae difficult to distinguish from broken tapering ends of skeletal hyphae. Basidiospores 8–10 × 6.5–7 μm (with myxosporium), 7–8.5 × 5.5–6.5 μm (without myxosporium), ovoid, apically truncate or not, brown, with a dark brown eusporium bearing moderately conspicuous echinulae. Cutis composed of apically acanthus-like branched cells, weakly to strongly amyloid.

Specimens examined—Taiwan: Hsinchu, Shihtaoshan, 24°39′N, 121°01′E, alt. 300 m, on trunk of dead angiosperm, 21 Aug. 2005, S.H. Wu & S.Z. Chen, *Wu 0508-22* (F0019055, TNM). Taichung, Takeng, on rotten wood, 27 Jul. 2003, M.C. Fan & S.A. Liu, *FL 0307-3*

(F0015489, TNM). **Nantou**, Lienhuachih, 23°56′N, 120°53′E, alt. 700 m, on living tree, 24 Jun. 1999, W.N. Chou, *CWN 04257* (F0013187, TNM); Lienhuachih, 23°56′N, 120°53′E, alt. 700 m, on trunk base of living tree, 06 Aug. 2002, W.N. Chou, *CWN 05622* (F0016212, TNM); Lienhuachih, 23°56′N, 120°53′E, alt. 700 m, on rotten trunk of angiosperm, 19 Jun. 1991, S.H. Wu, *Wu 910619-38* (F0015178, TNM); Lienhuachih, 23°56′N, 120°53′E, alt. 700 m, on rotten wood, 15 Jun. 2001, W.N. Chou, *CWN 05100* (F0015886, TNM).

Distribution—Pantropical (Steyaert 1980, Zhao & Zhang 2000, this study).

NOTES: *Ganoderma multiplicatum* can be characterized by its rigid, sessile basidioma, duplex context, weakly to strongly amyloid cuticle cells with scattered small protuberances, and ovoid basidiospores with moderately conspicuous echinulae. The basidiospores, measuring 8–10 × 6.5–7 µm in the Taiwanese collections, are slightly larger than those found in the holotype, the latter measured as 7–8 × 5–6 µm (Ryvarden 2000) and 7–9 × 5–6 µm (Gottlieb & Wright 1999). However, the Taiwanese spore size falls within the range (7–8.7–12 × 5–5.9–7.5 µm) of this species as indicated by Steyaert (1980). The morphology of basidiomata of the collections from Taiwan agrees well with that of the holotype as described by Gottlieb & Wright (1999) and Ryvarden (2000).

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***Athelicium hallenbergii* sp. nov. (*Basidiomycetes*) from Belarus**

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Abstract — *Athelicium hallenbergii* (*Basidiomycota*) is described as new. It was collected in 2000 and 2006 from the same locality in an oak forest in the city of Minsk, Belarus. The new taxon is the second species to be assigned to the formerly monotypic genus.

Key words — athelioid fungi, *Populus tremula*, taxonomy

Introduction

The genus *Athelicium* K.H. Larss. & Hjortstam was proposed as a monotypic genus with one species, *A. stridii* K.H. Larss. & Hjortstam (Hjortstam 1998). It is rather common in Sweden and Norway, occurring on hard, decorticated, wind-desiccated branches, stumps, and structural coniferous and angiosperm wood, including boards (Larsson & Hjortstam 1986, Domański 1988, Ryvarden et al. 2003).

In autumn 2000 a very small specimen of an athelioid fungus was collected in Drazdy forest at the north western periphery of the city of Minsk. It was found on bark at the base of a living willow. A description of this material was published as *Athelicium* sp. (Yurchenko & Kotiranta 2006).

The collection site was revisited in 2006 and the same species was collected several times, again at bases of living deciduous trees, ca 2–8 cm above the ground. The habitat is *Quercus robur* forest of the *Corylus avellana* – *Oxalis acetosella* type, with abundant *Populus tremula*, and some *Picea abies*, *Prunus avium* and *Pinus sylvestris*. At the tree bases there were as well patches of small basidiomata of two other corticioid species (*Athelia fibulata* and *Uthatobasidium fusisporum*), and often together with *Athelicium*. It is remarkable that macroscopically they are very similar to *Athelicium* and can easily be mixed with it in herbarium samples.

Species description

Athelicium hallenbergii Yurchenko & Kotir. sp. nov. Fig. 1

MycoBank MB510996

Carposomata resupinata, pelliculares, laxe adhaerentes, parva (0.5–18 mm longa), tenuissima (circa 50 µm crassa), alba. Margo indefinitus. Hymenophorum laeve, sub lente hymenium parvo poroideum. Subiculum arachnoideum. Systema hypharum monomiticum. Hyphae subiculi laxe intertextae, distinctae, modice ramosae, tenuiter tunicatae vel laeviter incrassate tunicatae, laevatae et incrustatae, hyalinae, (1.3–)2.5–4.5(–5.7) µm diam., septis fibulatis vel afibulatis. Hyphae subbasidiales partim incrustatae. Cystidia nulla. Basidia utriformia, in parte basali stipitata vel substipitata, basi fibulata, (18–)20–25 × 6.2–7.7(–8.5) µm, cum sterigmatibus 1–3 magnis, rectis, 4.2–9.4 µm longis, basi 1.8–2.2 µm crassis. Sporae ellipsoideae vel latere adaxiali leviter concavae, nonnumquam ad apicem attenuatae, cum apiculo magno, (9.2–)10–12 × (5.3–)6–7.5(–8.3) µm, laeves, laeviter incrassate tunicatae, hyalinae, IKI negativae, acyanophilae.

*Ad corticem basi caudicum vivorum et truncorum arborum frondosarum (*Populus tremula, Quercus robur, Salix caprea*).*

A. stridii *differt basidiis, quae circa duplo minora, et sesqui sporis minoribus.*

HOLOTYPE — Belarus, Minsk, Drazdy forest, in mixed forest with *Populus tremula* and *Quercus robur*, at base of living *Populus tremula*, 19.XI.2006 E.O. Yurchenko (MSK-F 6801). Isotypus: Herb. Kotiranta.

ETYMOLOGY — The species is named in honour of Professor Nils Hallenberg, an eminent Swedish specialist on corticioid fungi of Europe and southwest Asia.

BASIDIOMATA resupinate, in small patches (0.5–18 mm long), very thin (ca 50 µm), white, loosely attached, consisting of discontinuous (minutely porulose) hymenium developing on a very loose, arachnoid subiculum. Margin not differentiated. HYPHAL SYSTEM monomitic, hyphae distinct, hyaline, without oily contents, with clamped and occasional simple septa. Subicular hyphae (1.3–)2.5–4.5(–5.7) µm wide, thin-walled, moderately branched (the widest ones slightly thick-walled and sparingly branched), smooth or encrusted, with incrustations preserved in IKI and almost completely dissolved in KOH. Subhymenial hyphae thin-walled, richly branched, partly encrusted, 3 µm in diam. CYSTIDIA none. BASIDIOLES (or immature monosterigmate basidia?) with subacute tips, scattered. BASIDIA basally clamped, utriform, more or less stalked, (18–)20–25 × 6.2–7.7(–8.5) µm, with 1–3 stout, mostly straight sterigmata, 4.2–9.4 µm long and 1.8–2.2 µm wide at base. SPORES ellipsoid or broadly ellipsoid, sometimes slightly adaxially concave, amygdaloid and tapering to the apex, slightly thick-walled, (9.2–)10–12 × (5.3–)6–7.5(–8.3) µm, Q = (1.1–)1.5–2 (–2.1), inamyloid, nondextrinoid, acyanophilous, with a prominent apiculus.

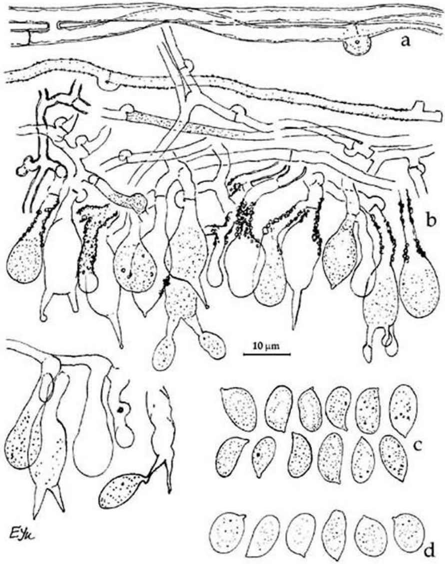

Fig. 1. *Athelicium hallenbergii* MSK 6801: a – slightly thick-walled sparingly branched subicular hyphae, b – section through basidioma, c – spores; MSK 5745: d – spores.

REMARKS — The basidia are like those of *Athelicium stridii* in being stalked and in having 2–3 (rarely 4?) stout sterigmata. In contrast to *A. stridii,* the basidia of the new species are approximately only half as long as in *A. stridii* (30–50 µm in *A. stridii*), the hyphae are narrower (3.5–5 µm in *A. stridii*), and the spores clearly smaller (15–18 × 7–10 µm in *A. stridii*; Hjortstam & Larsson, 1986).

The species in genus *Athelopsis* Oberw. ex Parmasto are somewhat similar to *A. hallenbergii*. However, basidial lengths do not reach 20 µm while old basidial remnants are visible (almost like in *Repetobasidium* J. Erikss.). Moreover, the subhymenium comprises very richly branched hyphae that form a "mess" and is quite different to that seen in *Athelicium*. Also the basidia normally bear four sterigmata and the spores are glued together in a very characteristic way as shown by Kotiranta & Saarenoksa (2005).

A small variation in size and shape of the spores was observed in *A. hallenbergii*. In holotype (Fig. 1c) the spores are (9.2–)10–12 × (5.3–)6–7(–7.5), L=11.3 µm, W=6.3 µm, Q^*= 1.8 (n = 30). In MSK 5745 (Fig. 1d) the spores are more broadly ellipsoid, sometimes basally wider (like in some *Botryobasidium* species), (9.2–) 10–12 × 6–7.5(–8.3), L=10.2 µm, W=6.5 µm, Q^* = 1.6 (n = 30).

ADDITIONAL SPECIMENS STUDIED–Belarus. Minsk, Drazdy forest, on bark at base of living *Salix caprea* and partly on living epiphytic mosses, 11.XII.2000 E.O. Yurchenko (MSK 5745, GB, H.K.); on bark at base of *Populus tremula* stump, 19.XI.2006 E.O. Yurchenko (MSK 6834, H.K.); on bark at base of living *Quercus robur*, 19.XI.2006 E.O. Yurchenko (MSK 6835, H.K.).

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Scopinella solani on graminicolous hosts in Slovakia and the Czech Republic

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Abstract—*Scopinella solani* was found on overwintered inflorescences of *Brachypodium pinnatum*, *Dactylis glomerata*, and *Elytrigia repens*. The morphological characteristics and host range of *S. solani* are described. These are the first records of *S. solani* in Slovakia and the Czech Republic.

Key words— biodiversity, graminicolous ascomycete, grasses

Introduction

The genus *Scopinella* Lév. belongs to the *Ceratostomataceae* (*Sordariales*) and is characterized by brown-black, long-necked perithecia and cylindrical, pigmented ascospores that uniquely collapse bilaterally when dried (Hawksworth 1975, Malloch 1976). The genus *Scopinella* was revised by Cannon & Hawksworth (1982) to accommodate *S. barbata* (Pers.) Lév., which was removed from *Melanospora* Corda mainly on the basis of a long-necked perithecium with quickly-evanescent asci containing cuboid-ellipsoidal spores with two prominent longitudinal germ slits. Malloch (1976) compiled a key for identification of the genus *Scopinella* containing four species. Three species produce eight-spored asci: *S. barbata*, *S. caulincola* (Fuckel) Malloch, and *S. solani*. *Scopinella sphaerophila* (Peck) Malloch is distinguished by two-spored asci. Tsuneda & Hiratsuka (1981) and Stchigel et al. (2006) described two further species, *S. musciformis* Stchigel, Umaña & Guarro and *S. gallicola* Tsuneda & Y. Hirats., respectively. They differ from previous species in their habitat, size and shape of the ascocarp, and number of spores per ascus. *Scopinella solani* has been reported in Canada on various overwintered inflorescences and stems of senescent herbaceous plants of *Oenothera biennis*, *Arctium minus*, and *Potentilla pulchella* (Malloch 1976). From the British Isles this species was recorded on a *Pinus sylvestris* cone (Cannon & Hawksworth 1982). The fungus was also found on dead and deteriorated petioles of *Dryas octopetala* in Poland (Chlebicki 2002) and on involucral bracts of *Serratula tinctoria* in Sweden (Holm & Ryman 1997).

During a survey of fungal biodiversity of overwintered inflorescences of *Brachypodium pinnatum* (L.) P. Beauv., *Dactylis glomerata* L., and *Elytrigia repens* (L.) Nevski, a species belonging to the genus *Scopinella* was found. No species of *Scopinella* has been reported previously from Slovakia (Lizoň & Bacigálová 1998). This paper documents the occurrence of *S. solani* on the previously mentioned grasses in Slovakia and the Czech Republic for the first time and presents information on the taxonomy and identification of this fungus.

Materials and methods

Material of *Brachypodium pinnatum*, *Dactylis glomerata*, and *Elytrigia repens* was collected from different parts of Slovakia during the 2005-2007 growing seasons. The morphological characteristics of *Scopinella solani* were examined from dried specimens. The ascocarps were viewed with a stereo microscope on different parts of overwintered inflorescences and collected with a sterile needle. The ascocarps and ascospores were examined microscopically (JENAMED2, Carl Zeiss Jena) by mounting them in water or in lactophenol-cotton blue. The measurements of ascocarps, asci and ascospores were recorded. Representative materials have been deposited in mycological herbarium of U.S. National Fungus Collections (BPI). The fungus was photographically documented by digital camera Olympus CAMEDIA C-4000 ZOOM.

Taxonomic description

Scopinella solani (Zukal) Malloch, Fungi Canadenses: 82, 1976

Basionym: *Melanospora solani* Zukal, Verh. K.K. Zool.-Bot. Ges. Wien 35: 340, 1885
Synonym: *Melanospora poae* Griffiths, Bull. Torrey Bot. Club 26: 433, 1899

MATERIAL EXAMINED – SLOVAKIA. On *Brachypodium pinnatum*: Chmeľov, 21 Oct. 2006 (BPI 878200); Kračúnovce, 21 Oct. 2006; Kuková, 21 Oct. 2006 (BPI 878201); Želmanovce, 16 Sep. 2006, coll. and det. M. Pastirčák. On *Dactylis glomerata*: Giraltovce, 21 Oct. 2006; Horná Ves (near Oslany), 16 Nov. 2006; Chmeľov, 21 Oct. 2006 (BPI 878199); Ivachnová, 20 Oct. 2006 (BPI 878197); Kaľnište, 21 Oct. 2006 (BPI 878193); Kapušany pri Prešove, 1 Jan. 2006 (BPI 878198); Kluknava, 28 Aug. 2006; Kostoľany pod Tribečom, 7 Apr. 2006 (BPI 878195); Kračúnovce, 21 Oct. 2006 (BPI 878194); Kuková, 21 Oct. 2006 (BPI 878192); Nitra, 23 Apr. 2006; Podhorany (near Nitra), 8 Nov. 2006 (BPI 878191); Rusovce, 8 Nov. 2006; Velčice, 12 Dec. 2006 (BPI 878196); Vígľaš-Pstruša, 16 Nov. 2006; Želmanovce, 16 Sep. 2006, coll. and det. M. Pastirčák. On *Elytrigia repens*: Kračúnovce, 21 Oct. 2006 (BPI 878203); Kuková, 21 Oct. 2006 (BPI 878202), coll. and det. M. Pastirčák.

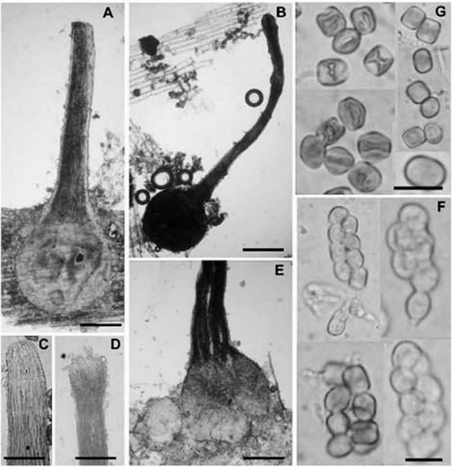

Figure 1. *Scopinella solani*. (A, B) Ascocarps of *Scopinella solani* in various stages of maturity, (C, D) Ascocarp neck, (E) Mature ascocarp with immature ascocarp on florets, (F) Asci containing eight spores in various stages of maturity, (G) Ascospores in different shape and stages of maturity. Scale bars (A-E) = 100 µm, scale bars (F-G) = 10 µm.

CZECH REPUBLIC. On *Dactylis glomerata*: Praha-Liboc, 11 Oct. 2006 (BPI 878204); Průhonice near Praha, 13 Apr. 2007 (BPI 878205), coll. and det. M. Pastirčák.

Ascocarps were found to be solitary or gregarious on host epidermis of florets. Mature perithecia measured on average 195 ± 30 µm in diameter. The ascocarp neck was yellow-brown and fimbriate at the immediate apex, composed of parallel hyphae, 480 ± 130 µm long and 51 ± 10 µm wide. Asci were clavate, short-stipitate, evanescent, on average 22.8 ± 4.7 µm long and 8.7 ± 2.2 µm wide (Figure 1). Each ascus contained eight barrel-shaped ascospores which

Table 1. Biometric characteristics of *Scopinella solani* compared with previous descriptions.

Reference	Ascoma (diam µm)	Ascocarp neck (µm)	Ascus (µm)	Ascospore (µm)
This study Average (± sd)	195 ± 30	480 ± 130 × 51 ± 10	22.8 ± 4.7 × 8.6 ± 2.2	5.6 ± 0.6 × 4.6 ± 0.6
Range (max-min)	255-150	855-225 × 90-38	29.6-17.6 × 11.8-5.9	7.4-4.5 × 6.7-2.9
Cannon & Hawksworth (1982)	(130)200-300	(300)500-600	13-25 × 7-12	(4.5-)5-6(-7) × 4-5 × 3-4.5
Malloch (1976)	130-210	300-500 × 5-77	13-25 × 7-11.5	4.5-6.5 × 3.8-5.8
Douget (1955)	160-200	—	30 × 25	5-6 × 3-4

possessed a dark brown, thick-walled median band. Spores were hyaline and thin-walled at the ends, collapsing at the ends when dried, allowing them to be bilaterally compressed and smooth. Spore dimensions averaged 5.6 ± 0.6 µm long and 4.6 ± 0.6 µm wide. No anamorph has been found.

On the basis of our biometric measurements we identified the fungus as *Scopinella solani*. Our measurements are given in Table 1 and compared with those recorded by previous authors.

Our observations confirm a wide host range for the species *Scopinella solani*. This represents a new report for *S. solani* among the mycoflora of Slovakia and Czech Republic.

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Lichenized and lichenicolous fungi from Bursa province new to Turkey

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Abstract — Seven lichenized fungi (*Acarospora oligospora, Acrocordia conoidea, Lecania olivacella, Lecania sylvestris, Micarea lignaria, Porina linearis,* and *Scoliciosporum chlorococcum*) and one lichenicolous fungus (*Dactylospora parasitica*) are reported for the first time from Turkey. Comments on the habitat and substrata and a short description are provided for each taxon.

Key words — *Ascomycota*, lichens

Introduction

Turkish lichenology has a short history with serious lichenology in Turkey since two decades. A total of 360 papers actually referred to lichens from Turkey up to the end of the 2004 (John 2004) and with publications in the last three years that were approximately 450. The history of lichenicolous fungi in Turkey is even younger (Hafellner & John 2006, Halıcı et al. 2005, 2006, 2007, Hawksworth & Halıcı 2007).

Here we aim to make a further contribution to the knowledge of the lichenized and lichenicolous fungi of Turkey.

Materials and methods

The specimens are stored in BULU (Herbarium of Uludag University, Science and Art Faculty, Bursa, Turkey). The specimens were examined with a Prior S115/S101Z model stereomicroscope, and an Olympus CH-2 microscope for external morphology and anatomical observations. Specimens were examined in water, 10% KOH, Lugol's iodine solution. Spore measurements were generally carried out in water.

Species recorded

Acarospora oligospora (Nyl.) Arnold

Detailed descriptions are provided by Clauzade & Roux (1981) and Wirth (1995).

Thallus olive brown. Algal layer continuous. Apothecia to 1 mm diam., blackish brown. Paraphyses 1.5–2 µm wide. Ascus 32- to 64-spored. Ascospores 10–12.5 × 5–6.2 µm, elipsoid. The sample from an exposed area in a valley was associated with *Lecidella carpathica* Körb. Another species of *Acarospora* with large ascospore, *Acarospora macrospora* (Hepp) Bagl., was found on calcareous rock in the same locality.

Acarospora oligospora prefers base-rich silicicolous rocks and is found from Central Europe to Submediterranean (Wirth 1995) in a holarctic-temperate distribution in Europe, Asia and North America (Nimis 1993).

> **Bursa:** Yenişehir; the northwest of Paşayaylası village, Kaymakamsuyu location, valley, 40°19′53″ N-29°22′32″ E, alt. 450 m, on siliceous rock, 19 Sep. 2004, leg. Z. Doğru, det. Ş. Güvenç (BULU 6597).

Acrocordia conoidea (Fr.) Körb.

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

Thallus pale grey and immersed. Perithecia to 1 mm diameter, semi-immersed; involucrellum spreading outwards away from the exciple. Ascospores colorless, 1-septate, 15–19 × 8.7–10 µm. Pycnidium not observed. The sample from Osmangazi was collected from a shaded calcareous rock near a dry stream and associated with *Caloplaca cirrochroa* (Ach.) Th.Fr., *Porina linearis,* and *Dirina stenhammarii* (Stenh.) Poelt & Follmann. Associated trees in this locality are *Olea europaea, Juglans regia, Morus* sp., *Populus* sp. and *Prunus* sp.

Acrocordia conoidea is distributed from the middle Europe to Mediterranean and North America. It grows on calcareous rocks in the submontane and montane areas (Wirth 1995, Purvis et al. 1992.)

> **Bursa:** Osmangazi; 1 km the northwest of Avdancık village, 40°17′ N-29°09′ E, alt. 625m, on calcareous rock, 19 July 2003, leg. Z. Doğru, det. Ş. Güvenç (BULU 6223).

Dactylospora parasitica (Flörke ex Spreng.) Zopf

Detailed descriptions are provided by Hafellner (1979) and Clauzade et al. (1989).

Apothecia to 1 mm diam., black; epithecium red brown, hypothecium colorless, K(-). Asci 8-spored, ascospores brown, 3-septate, 10–12.5 × 3.7–5 µm. This lichenicolous fungus was collected from the thallus of *Pertusaria albescens* (Huds.) M.Choisy & Werner on bark of *Carpinus* sp. in an ancient woodland.

Bursa: Orhangazi; Katırlı mountain, Karanlıkdere between Karsak and Gürle hills, mixed forestland composed of *Carpinus* sp., *Fagus orientalis* and *Pinus* sp., 40°22′40″ N-29°18′17″ E, alt. 1095m, on thallus of *Pertusaria albescens* on bark of *Carpinus* sp., 27 June 2004, leg. Z. Doğru, det. Ş. Güvenç (BULU 7622).

Lecania olivacella (Nyl.) Zahlbr.

Detailed descriptions are provided by Mayrhofer (1988) and Purvis et al. (1992).

Thallus dirty white to brown. Apothecia to 0.6 mm diam., disk orange red to dark brown, exciple blackish; hymenium colorless, 60 µm tall. Paraphyses mostly unbranched, the apices slightly swollen and pigmented. Ascospores colorless, simple or 1-septate, 12.5–15 × 5–5.5 µm.

Lecania olivacella grows on calcareous rocks throughout Europe and North Africa (Purvis et al. 1992). The samples were collected from open dry rocky slopes with scattered *Pistacia terebinthus* and *Quercus* sp. at Gürsu and Marmaracık and were associated with *Aspicilia calcarea* (L.) Mudd, *Caloplaca lactea* (A.Massal.) Zahlbr., and *Verrucaria calciseda* DC.

Bursa : Gürsu; road from Gürsu to Dışkaya village, slopes in the north of Gürsu, 40°15′35″ N-29°12′59″ E, alt. 269m, on calcareous rock, 04 June 2003, leg. Z. Doğru, det. Ş. Güvenç (BULU 7229); Yenişehir; north of Marmaracık village, rocky area, 40°14′37″ N-29°26′18″ E, alt. 264 m, on calcareous rock, 19 Sep. 2004, , leg. Z. Doğru, det. Ş. Güvenç (BULU 6547).

Lecania sylvestris (Arnold) Arnold

Detailed descriptions are provided by Mayrhofer (1988) and Purvis et al. (1992).

Thallus very thin and rimose to areolate; apothecia to 0.8 mm diam.; disk brown to dark brown, excipulum lecanorin or biatorin; epithecium brown, hymenium 45 µm tall, Ascospores colorless, 1-septate, 9–11.2 × 3.7–6 µm.

Lecania sylvestris grows on calcareous rock from the middle Europe to Mediterranean and North America (Wirth 1995). The samples from open dry rocky area at Gürsu and Osmangazi were associated with *Candelariella aurella* (Hoffm.) Zahlbr. and *Verrucaria nigrescens* Pers.

Bursa: Gürsu; north of İğdir village, 40°15′54″ N-29°12′00″ E, alt. 140m, on calcareous rock, 25 Sep. 2003, , leg. Z. Doğru, det. Ş. Güvenç (BULU 6977); Osmangazi; Demirtaş - Avdancık road, 4 km northeast of Demirtaş dam, 40°16′ N-29°07′ E, alt. 650m, on calcareous rock, 19 July 2003, , leg. Z. Doğru, det. Ş. Güvenç (BULU 6189).

Micarea lignaria (Ach.) Hedl.

Detailed descriptions are provided by Coppins (1983), Czarnota (2007) and Purvis et al. (1992).

Thallus grey-green or bluish grey, K-, C-, KC-, P + red. Apothecia black, convex to globose. Epithecium olivaceous-greenish, K-, N + red. Hymenium 75 µm tall, colorless, the upper part of hymenium olivaceous-greenish. Hypothecium brownish. Asci 8-spored; ascospores colorless, 4–5 celled, fusiform, straight or slightly curved, 25–27.5 × 7.5 µm.

Micarea lignaria is probably nearly cosmopolitan distribution, so far known from Europe, North America, temperate Asia, India and Australia (Czarnota & Coppins 2005). The sample from the vicinity of Karagöl Lake was collected on mosses within an ancient *Quercus* sp.—*Fagus orientalis* woodland. In Turkey the species has recently also been collected in Kayseri (Özdemir Türk et al. 2003). Actually there are eight species of *Micarea* known from Turkey, compared with the number of species in other countries, e.g. Europe: 45 (Coppins 1983), Poland: 34 (Czarnota 2007), Scaninavia: 47 (Santesson et al. 2004), Italy: 22 (Nimis & Martellos 2003), Russia: 21 (Andreev et al. 1998).

> **Bursa:** Gemlik; Ericek-Karagöl road, southwest of Karagöl, rocky area, 40°20′21″ N-29°16′22″ E, alt. 635m, on mosses, 01 Aug. 2004, leg. Z. Doğru, det. Ş. Güvenç (BULU 6643).

Porina linearis (Leight.) Zahlbr.

A detailed description is provided by Purvis et al. (1992). Thallus endolithic to semi-immersed, pinkish brown. Perithecia 0.2–0.4 mm diam., black, immersed to superficial. Asci 8 spored, ascospores 17.5–22.5 × 5–6.2 µm, 3-septate, elongate fusiform, straight or slightly curved.

The sample of *Porina linearis* from Osmangazi was collected from on shaded calcareous rock near a dry stream and was associated with *Acrocordia conoidea*, *Caloplaca cirrochroa*, and *Dirina stenhammarii*. Associated trees in this locality are *Olea europaea*, *Juglans regia*, *Morus* sp., *Populus* sp., and *Prunus* sp. It grows on calcareous rock from northern temperate regions (McCarthy 2000).

> **Bursa:** Osmangazi; 1 km northwest of Avdancık village, 40°27′ N-29°09′ E, alt. 625m, on calcareous rock, 19 July 2003, leg. Z. Doğru, det. Ş. Güvenç (BULU 6233).

Scoliciosporum chlorococcum (Graewe ex Stenh.) Vězda

A detailed description is provided by Brodo et al. (2001).

Thallus dark green, granular to verruculose, not sorediate. Apothecia black, 0.2 mm diameter; epithecium greenish-bluish brown; hymenium colorless, 37.5 µm tall, hypothecium colorless; Asci 8-spored, ascospores colorless, 22.5–30 × 3.7–4 µm, 5–7-septate. No lichen substances.

The sample of *Scoliciosporum chlorococcum* from Osmangazi was associated with *Amandinea punctata* (Hoffm.) Coppins & Scheid. and *Caloplaca ferruginea* (Huds.) Th.Fr. on bark of branches of *Pinus* sp. This locality is covered with mixed forest composed of *Carpinus* sp., *Fagus orientalis,* and *Pinus* sp. The macrolichens *Melanelixia subaurifera* (Nyl.) O.Blanco et al., *Pseudevernia furfuracea* (L.) Zopf, *Usnea glabrescens* (Vain.) Vain., and *U. rigida* (Ach.) Motyka growing on *Fagus* sp. and *Pinus* sp. in this forestland are revealed as typical for a moist, shaded and unpolluted location.

Bursa: Orhangazi; Katırlı mountain, the forest road of Karsak-Gürle hills, Karanlıkdere1 location, 40°22′38″ N-29°16′17″ E, alt.1036m, on *Pinus* sp., 27 June 2004, leg. Z. Doğru, det. Ş. Güvenç (BULU 7608).

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Dothiorina: taxonomic concepts and comments on its conidiogenesis

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Abstract — *Dothiorina tulasnei* was collected on bark of *Nothofagus pumilio*. It is cited and described for the first time in Argentina. This coelomycete was considered a peculiar species because of its unusual conidiogenesis; but reports on the process are contradictory and still under discussion. Here, the present circumscription of the genus and the status of all *Dothiorina* species are discussed. Also, its *Chalara*-like conidiogenesis is fully described and documented.

Keywords — mitosporic fungi, ring wall building, *Fagaceae*, *Nothofagaceae*, Patagonia

Introduction

In 1865, Tulasne & Tulasne described and illustrated a new stromatic coelomycete species as a variety of *Sphaeria moriformis* Tode but without giving it a formal name. Saccardo (1884) named this species as *Dothiorella tulasnei* and provided the formal description. In 1911, Höhnel created the new genus *Dothiorina* Höhn. and transferred this species there.

In addition to the type species, two more species were added later to the genus: *Dothiorina discoidea* (Höhnel 1925) and *D. subcarnea* (Riedl 1977).

The last contribution to the knowledge of the genus was that of Dixon (1975). Recently, *Dothiorina* was registered for the first time in Argentina (Sánchez et al. 2005). This fact gave us the opportunity to study fresh material. Also, we examined the available herbarium specimens of all the species described in the genus. In this paper, we discuss the present circumscription of the genus and provide a full description of its conidiogenesis in modern terms.

Material and methods

Recently collected materials were air-dried and are preserved in Bahía Blanca Biología Herbarium (BBB). Herbarium materials were rehydrated in tap water.

Sections were hand-made with a razor blade and were mounted in tap water or in 5% KOH with phloxine. All measurements were made in water. Herbaria are abbreviated according to Holmgren et al. (1990).

Results

Dothiorina Höhn. emend.

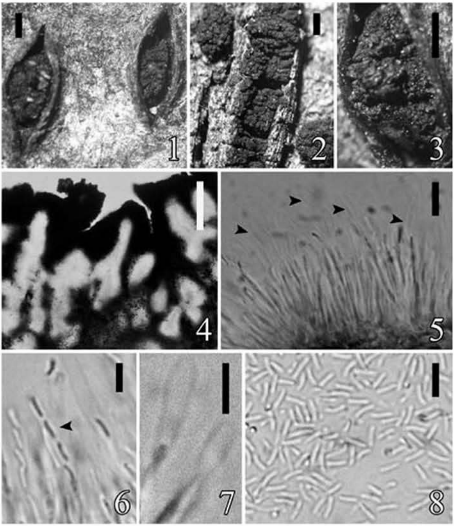
Conidiomata stromatic, plurilocular, superficial or immersed and then erumpent through the bark, subspherical to moriform, greenish to brownish and gelly when wet, becoming black and carbonaceous when dried. Locules ovoid to irregular, at different levels. Conidiophores branched, forming from the inner cells of the locular walls. Conidiogenous cells phialidic, integrated, determinate, smooth, hyaline, necks long, cylindrical, venters cylindrical to slightly ampulliform. Conidia in chains, unicellular, allantoid, smooth, hyaline, produced by **ring wall building** within phialides, forming basipetal chains of up to five conidia into the necks.

Accepted species

Dothiorina tulasnei (Sacc.) Höhn., Sitzungsber. K. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 120: 464 (1911) Figures 1–8
= *Dothiorella tulasnei* Sacc., Sylloge Fungorum 3: 239 (1884)

Conidiomata stromatic, plurilocular, subspherical to moriform, superficial to erumpent through the bark, greenish to brownish and gelatinous when wet, becoming black and carbonaceous when dried, 0.26–7 × 0.2–2.5 mm. Locules ovoid to irregular, at different levels; separated by somewhat parallel, greenish to light brown textura oblita, individual cells small, hyaline to light brown in water, dark green stained in KOH, up to 2 µm diam. Conidiophores branched, hyaline to subhyaline, covering the interior of the locules, 5–31 × 1–3 µm. Conidiogenous cells phialidic, integrated, determinate, smooth, hyaline, necks long, cylindrical, 5–20 × 1-3 µm, venters cylindrical to slightly ampulliform, 5–21.5 × 1–2 µm. Conidia in chains, unicellular, allantoid, smooth, hyaline, 2–5 × 1 µm ($\bar{x}$ = 3.8 × 1 µm), produced by ring wall building within phialides, forming basipetal chains of up to five conidia into the necks.

Specimens examined — **ARGENTINA. Chubut:** Huemules, (42°50'474"S 71°27'878"W, 1137m elevation), 20.XI.2003, on fallen branches of *Nothofagus pumilio*, leg. M. Rajchenberg *12131* (*BBB*). **Neuquén:** National Route 234 near Meliquina Lake (40°18'S 71°22'W), on log of *N. pumilio*, 16.V.2007, leg. MV Bianchinotti & RM Sánchez *569* (*BBB*). **AUSTRIA: Sonntagsberg**, "Auf *Pirus communis* Holz, *Dothiorina tulasnei* (Sacc.) v. Höhn.", Dec. 1910, leg. P. Strasser 3329, *FH 79620*, (isotype). **UNITED STATES: Connecticut**, West Haven, on alder, *Chlorosplenium aeruginosum* conidial stage, leg. R. Thaxter 194, *FH 79619*.



Figs. 1–8. *Dothiorina tulasnei* (all from MR 12131, BBB). 1–3. Conidiomata. 4. Vertical section of a conidioma. 5. Conidiophores and conidiogenous cells. Arrowheads point to empty necks. 6. Chain of conidia still into the neck of a conidiogenous cell (arrowhead). 7. Detail of conidiogenous cells. 8. Conidia. Bars: 1–3= 1 mm, 4= 100 µm, 5= 10 µm, 6–8= 5 µm.

ECOLOGY AND DISTRIBUTION — Uncommon, on pieces of branches of *Alder* sp., *Pirus communis* Holz., and on fallen branches of *Nothofagus pumilio* (Poepp. & Endl.) Krasser. Known from Argentina, Austria, USA, Venezuela.

COMMENTS — The specimens on *N. pumilio* differ from the North Hemisphere materials in several macro and microscopical features, as shown in Table 1, but conidiogenesis and conidial shape and size are the same. In all materials examined, necks of phialides are better seen in water mounts.

Table 1. Comparison among the examined collections of *Dothiorina tulasnei*

DIMENSIONS	FH 79619	FH 79620	BBB MR 12131 MVB 569
CONIDIOMATA (mm)	0.4–1.2 × 0.3–1	0.26–1.7 × 0.2–0.9	1–7 × 0.5–2.5
LOCULES (µm)	30–100 × 20–62.5	37.5–112.5 × 25–62.5	61–207.5 × 20–125
CONIDIOPHORES (µm)	5–14.5 × 1–2	5–8.5 × 1–2	6–31 × 1.5–3
CONIDIOGENOUS CELLS			
NECKS (µm)	5–15.5 × 1–2	8–14.5 × 1–2	8–20 × 2–3
VENTERS (µm)	5–13.5 × 1–2	5–13.5 × 1–2	8–21.5 × 1–2
CONIDIA (µm)	2–5 × 1	3–5 × 1	3–5 × 1

Excluded species

Dothiorina discoidea (Berk. & Broome) Höhn.,
Mitt. Bot. Inst. Techn. Hochsch. Wien 2: 63 (1925) FIGURES 9–15
= *Psilonia discoidea* Berk. & Broome, Ann. Mag. Natur. Hist., 3 Ser., 18: 122 (1866)
= *Volutella discoidea* (Berk. & Broome) Sacc., Sylloge Fungorum 4: 687 (1886)

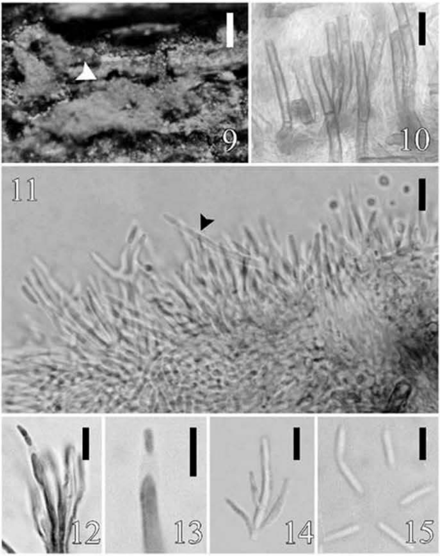
CONIDIOMATA stromatic, multilocular, cup shaped, superficial, light brown to orange, setose, 0.26–2.04 × 0.2–1.2 mm; SETAE cylindrical, light brown to orange, often can produce conidiogenous cells, 11–21 × 3 µm. LOCULES irregularly disposed. CONIDIOPHORES covering the interior of the locules, branched, hyaline, 5–9.2 × 1–2 µm. CONIDIOGENOUS CELLS phialidic, integrated, determinate, rarely percurrent, smooth, hyaline, necks short, cylindrical, with periclinal thickening, 1–3 × 1–1.5 µm, venters cylindrical to slightly ampulliform, 4–20 × 1–2 µm. CONIDIA solitary, unicellular, allantoid, smooth, hyaline, 4–8 × 1–1.5 µm ($\overline{x} = 6 \times 1.2$ µm).

SPECIMENS EXAMINED– **United Kingdom:** Wiltshire, Langley, "in ligno putrido", January 1866, C. E. Broome (W 1075; isotype).

ECOLOGY AND DISTRIBUTION– Rare, on rotten wood of a unknown tree species (probably oak). United Kingdom.

COMMENTS — Unlike *D. tulasnei* when mounting *D. discoidea* on KOH no change on colouration was observed.

The combination of setose, cupuliform conidiomata, phialides with periclinal thickening and solitary conidia, led us to affirm, in agreement with Dixon (1975), that *D. discoidea* is not congeneric with *D. tulasnei*. It comes close to *Hainesia* Ellis & Sacc., but more material is needed in order to properly establish its generic disposition.



Figs. 9–15. *Dothiorina discoidea* (from W 1075). 9. Conidiomata (arrowhead). 10. Peripheral setae surrounding conidioma. 11–14. Conidiophores and conidiogenous cells. Arrowhead points to still unbranched conidiophore. 15. Conidia. Bars: 9= 250 µm, 10–11= 10 µm, 12–15= 5 µm.

Doubtful species

Dothiorina subcarnea Riedl, Sydowia 29: 151 (1977)

This species was described as follows:

> *Stromata semiglobosa vel irregulariter tuberculoso-convexa, carneo-brunnea, consistentia cerea, 300–350 µ in diam., rare confluentia; parietes exterior et interloculares e hyphis*

> *tenuibus, densissime intertextis, e cellulis brevibus, 0.5–0.7 μ fere longis, stratis extremis hypharum paulo obscurius coloratis; loculi irregulariter dispositi, aut poro ad superficiem superiorem stromatis, aperti aut profundius positi conidia in canalem stroma per altitudinem percurrentem diffundentes. Conidiophori 6–15 μ longi, usque ad 1 μ ad summum lati, fasciculati, parietes dense tegentes, interdum et in superficie stromatum evoluti, sed ibi plerumque steriles, rare conidia nonnula proferentes. Conidia apice conidiophori phialidei in catenis evoluta, mox loculos omnino complentia, minuta, oblonga vel oblongo-ellipsoidea, rare breviter bacillaria, 2–2.5 μ longa, 0.5 μ fere lata.*

COMMENTS– The holotype was deposited at Wien. It could not be located there and it is considered lost (Dr. Passauer, Curator of Cryptogams, Wien Herbarium, in lett.). Unfortunately, Riedl (1977) did not provide any drawings of the species so it is not possible to give a critical opinion about it. Until authenticated material can be studied, the identity of this species must remain in doubt.

Discussion

In 1865, Tulasne & Tulasne described a pulvinate and globose structure, with rugose but glabrous surface; comprised of several locules separated by light green parenchymatic tissue, covered internally with short, filiform and ramified conidiophores that originate very small, linear, straight and continuous conidia. The illustration they provided is considered the iconotype of *D. tulasnei* (Riedl 1977). Since its redescription (Riedl 1977) *Dothiorina* contained three species. We examined the existing types and we concluded that *D. discoidea* is not congeneric with *D. tulasnei* on the basis of the morphology of conidiomata and conidiogenesis. The third species, *D. subcarnea* must be considered a doubtful taxon as the type material is lost and no conclusion can be arrived through its protologue. So, taking into account the features of the conidiomata and the peculiar conidiogenesis, we consider that *Dothiorina* should be restricted to a single species, *D. tulasnei*.

Dothiorina tulasnei has been repeatedly considered the anamorphic state of *Chlorociboria aeruginascens* (Nyl.) Kanouse ex C.S. Ramamurthi et al. (Dixon 1975, Gamundí et al. 2004, Nag Raj 1977, Sutton 1980). The relationship was only based on the proximity of apothecia and conidiomata on natural substratum but it has never been demonstrated in culture. Saccardo (1884) doubted about the connection of the two fungi. However he was questioned by Höhnel (1911) who stated that Brefeld in 1891 obtained "rod conidia" in his cultures from *Chlorosplenium aeruginosum* (J. Koenig) De Not. ascospores. Dixon (1975) discredited Brefeld´s results because of the lack of sterile and pure culture techniques in the 19th century and also because of the "poor quality of his illustrations". Berthet (1964) also described a conidial stage obtained in culture from ascospores of an indeterminate species of *Chlorociboria*, but the phialides are very different from those found by us in *Dothiorina*. In their recent monograph of *Chlorociboria*, Johnston & Park (2005) do not mention any connection to an imperfect state. Thus, we consider that the conidial stage obtained by Berthet does not represent a *Dothiorina* species. Until now, our attempts to obtain cultures have been unsuccessful. Future research will focus on obtaining isolates of both genera and to study them with molecular techniques.

The lack of detail regarding the conidiogenesis of *Dothiorina* has generated controversy about this process. Höhnel (1911) briefly described conidiophores as simple or branched, thread-shaped, densely covering the interior of locules. Dixon (1975: 205, fig. 27) illustrated conidiogenous cells as cylindrical to flask-shaped phialides bearing chains of three or four conidia in the long necks but he did not describe the process. Nag Raj (1977) described and illustrated blastic phialidic conidiogenous cells, with long necks, but with solitary conidia. Riedl (1977) mentioned long phialides and catenate conidia but did not provide illustrations. Sutton (1980) on the other hand, described "normal phialides" with minute channels and collaretes. He emphasized Berthet's (1964) description and pointed out the need to confirm Dixon's observations because of what he considered to be the scarcity of "*Chalara*-type" conidiogenesis among coelomycetes.

The differences between the conidiogenesis described by Berthet (1964) and our observations suggest there is no strong evidence that *Dothiorina* is related to *Chlorociboria*.

Our observations on type material and on the recently collected ones agree with the illustrations made by Dixon (1975). We have seen chains of three to five conidia in the long necks of the phialides. This conidiogenesis agrees with that described by Nag Raj & Kendrick (1993) as "*Chalara*-like". In this type of conidiogenesis there is no periclinal thickening in the phialides and the conidiogenous cells appear to undergo no modification between the production of successive conidia. "*Chalara*-like" conidiogenesis is widespread among unrelated genera of ascomycetes [viz. *Ceratocystis* s. str. (*Microascales*), some species of *Ceratocystiopsis* (*Ophiostomatales*), *Cryptendoxyla hypophloia* (*Sordariales*), *Quasiconcha reticulata* (*Hysteriales*) and *Pyxidiophora* (*Pyxidiophorales*)], all their mitosporic states being hyphomycetes (Nag Raj & Kendrick 1993). Our observations confirm the presence of true chains of basipetous conidia developed by a determinate conidiogenous cell in *D. tulasnei*. This is considered a strong evidence of ring wall-building activity (Nag Raj & Kendrick 1993).

We have also observed that the long necks of the phialides are easily visible in water but not in KOH. Care needs to be taken with the mounting medium used for studying conidiogenesis under light microscopy, a fact that is seldom mentioned in the literature.

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Contributions to the lichenized and lichenicolous fungal biota of Turkey

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Abstract — Eleven species of lichenicolous fungi (*Cercidospora caudata, Dactylospora homoclinella, Endococcus pseudocarpus, Lichenodiplis lichenicola, Phaeospora rimosicola, Polycoccum marmoratum, Pyrenidium actinellum, Scoliciosporum intrusum, Toninia episema, Unguiculariopsis groenlandiae,* and *Verrucaria aspiciliicola*) and three taxa of lichenized fungi (*Aspicilia cheresina* var. *microspora, Caloplaca latzelii,* and *Melanolecia transitoria*) are reported for the first time from Turkey. An additional species, *Lecanora marginata*, is confirmed from Turkey. Comments on their habitats and substrata and a short diagnosis are provided for each taxon.

Key words — Aladağlar, *Ascomycota*, coelomycetes, lichens

Introduction

During the project "Lichens and lichenicolous fungi of Aladağlar National Park (Adana, Niğde, Kayseri)", we collected specimens of many lichenicolous and lichenized fungi from 90 different localities within the study area. Some of the records have already been published or are in press (Halıcı et al. 2006, Halıcı et al. 2007a). One new genus, *Gemmaspora* (Hawksworth & Halıcı 2007) and five new species: *Weddellomyces turcicus* (Halıcı et al. 2005a), *Stigmidium johnii* (Halıcı & Hawksworth 2007), *Endococcus variabilis* (Halıcı et al. 2007b), *Polycoccum acarosporicola* and *Polycoccum aksoyi* (Halıcı et al. 2007c) were described from the study area in separate papers.

After Hafellner & John (2006) compiled the information of lichenicolous fungi in Turkey recognizing 63 taxa, some further additions have been made

(Halıcı et al. 2007d-f, Halıcı & Candan 2007), and the number of infrageneric lichenicolous fungal taxa reached 99. With this study the number of lichenicolous fungi taxa reached to 110. It is obvious that this number is too small when compared with other European countries (Faltynowicz 2003, Hawksworth 2003, Scholz 2000) and at least 250 might be expected (Halıcı et al. 2007f).

In-depth studies on lichens in Turkey have an extremely short history, but there are already 360 papers referring to lichens from the country (John 2004). In the last five years, intensive lichenological studies have yielded numerous new records for the country in Turkey (e.g. Öztürk & Güvenç 2003, Breuss & John 2004, John & Breuss 2004, Karabulut et al. 2004, Çobanoğlu & Akdemir 2004, Halıcı et al. 2005b, Tufan et al. 2005, Güvenç et al. 2006, John & Türk 2006, Halıcı & Aksoy 2006, Halıcı et al. 2007d). However, much needs still to be done, and, by comparison with data from other countries (Will-Wolf et al. 2004), at least 2000 lichenized fungal species might reasonably be expected to be present in the country, considering its size, diversity of phytogeographical regions, and habitats.

Here we make a further contribution to the knowledge of the lichenicolous and lichenized fungi of Turkey, with notes on 15 taxa, collected mainly in the Aladağlar National Park (Adana, Niğde, Kayseri).

Materials and methods

The specimens detailed here are all stored in the herbarium of Erciyes University, (Science and Art Faculty, Kayseri, Turkey); their accession numbers are given in parentheses after the locality details. Specimens were examined in water, 10% KOH, Lugol's and Metzler's iodine solutions, or lactofuchsin. Spore measurements were generally carried out in KOH, but in the case of thin-walled spores the dimensions were also checked in water. TLC was carried out to determine the compounds in *Aspicilia cheresina* var. *microspora* in Solvent System C (Orange et al. 2001). The lichenized fungi new to Turkey here were compared with the specimens of the same species deposited in the Lichen Section of The Natural History Museum, London (BM). The descriptive notes included below are from the Turkish specimens examined.

Species recorded

Aspicilia cheresina var. ***microspora*** (Arnold) Clauzade & Cl. Roux 1974

A detailed description is provided by Clauzade & Roux (1985).

The specimen was collected on calcareous rocks at 1915 m. This species starts its life- cycle as a parasite on *Aspicilia calcarea* and related species (Nimis 1993). The presence of *A. calcarea* on the same rock on which this variety was collected supports this opinion. Thallus rimose–areolate, somewhat thin, chalky white, K + blood red. Asci 8-spored, ascospores colourless, simple, 10–14 × 6–8 µm. Only norstictic acid detected by TLC. The var. *justii* contains stictic and norstictic acids while var. *microspora* contains only norstictic acid. *Aspicilia cheresina* var. *cheresina*, described from Eygpt, is K – and does not appear to contain either stictic or norstictic acid when studied by TLC (Nimis 1993).

This species is known in the Mediterranean belt of southern Europe (Clauzade & Roux 1985, Nimis 1993) and Slovenia (Mayrhofer et al. 2006).

KAYSERI: Yahyalı, Aladağlar Milli Parkı, Köşkderesi 37° 58' N, 35° 17' E, alt. 1915 m, on exposed calcareous rocks, 03 Oct. 2004, *M. G. Halıcı & A. Aksoy* (MGH 0.1963).

Caloplaca latzelii (Servazzi) Clauzade & Cl. Roux 1985

Detailed descriptions are provided by Clauzade & Roux (1985) and Wasser & Nevo (2005).

The specimen was collected on calcareous rocks at 690 m. Thallus very thin, continuous, pale yellow, 8 mm diam., K + violet. Apothecia ~ 0.4 mm diam, ± immersed, epithecium yellow-orange, hymenium ~ 80 µm, hypothecium pale yellow. Ascospores similar in shape to the Mischoblastia-type spores of *Rinodina*; 16–18 × 9–10 µm. Variability of ascospore shapes in the genus *Caloplaca* including this species was discussed by Navarro-Rosinés & Hladun (1992). Wasser & Nevo (2005) treated *Caloplaca dalmatica* as a synonym of *C. latzelii*; Clauzade & Roux (1985), however, regarded *C. dalmatica* as distinct from *C. latzelii* and discussed it under the name *C. velana* var. *dalmatica*.

This species is also reported from Serbia and Montenegro (Clauzade & Roux 1985) and Israel (Wasser & Nevo 2005).

KAYSERI: Yahyalı, Aladağlar Milli Parkı, Kapuzbaşı, 37° 46' N, 35° 23' E, alt. 690 m, on calcareous rocks under shade, 14 May 2005, *M. G. Halıcı & A. Aksoy* (MGH 0.2421).

Cercidospora caudata Kernst. 1895

A detailed description is provided by Hafellner (1987).

We collected this species on the thalli of *Caloplaca aurantia* and *C. chalybaea*, and the apothecia of *C. flavescens*. It seems commensalistic as no damage was observed in the host lichens. Ascomata perithecia, ascospores colourless, 1-septate, with the lower cell elongated and curved, 24–28 × 6–7 µm. This species is easily recognized within the genus by its ascospores (Hafellner 1987).

This species is also known from Austria on *Caloplaca* sp., from Italy on *C. ferruginea* (Hafellner 1987), and from North America on *C. modesta* (Navarro-Rosinés et al. 2004).

KAYSERI: Yahyalı, Aladağlar Milli Parkı, Ulupınar Village, Emin Kadı Bridge, 37° 52' N, 35° 22' E, alt. 1240 m, on apothecia of *Caloplaca flavescens* on calcareous rocks, 09 Aug. 2006, *M. G. Halıcı & A. Aksoy* (MGH 0.2513).

NIGDE: Sokullupınar, Aladağlar Milli Parkı, 37°49' N, 35°07' E, alt. 2030 m, on thallus of *Caloplaca aurantia* and *C. chalybaea* on calcareous rocks, 30 Aug. 2005, *M. G. Halıcı & A. Aksoy* (MGH 0.2110, 0.2111).

Dactylospora homoclinella (Nyl.) Hafellner 1979

A detailed description is provided by Hafellner (1979).

This species was collected by us on the thallus of *Aspicilia contorta* subsp. *hoffmanniana* growing on calcareous rocks. It seems commensalistic as no damage was observed on the host lichens. Ascomata apothecia, black, shiny. Epihymenium and exciple brown. Hymenium K/I + blue. Asci 8-spored. Ascospores brown, 1-septate, 8–11 × 4.5–5 µm.

This widespread lichenicolous fungus has a wide range and is common in Finland, Sweden, and Italy growing on *Lecanora atrynea*, *L. cenisia*, *L. riparti*, and *Tephromela atra* (Hafellner 1979).

KONYA: Derebucak, Çamlık Village, Kızıldağ, West of Üçoluk position 37°21' N, 31° 39' E, alt. 1750 m, on thallus of *Aspicilia contorta* subsp. *hoffmanniana* on calcareous rocks, 20 Sep. 2005, *M. G. Halıcı, M. Kocakaya & A. Aksoy* (MK 0.0121). Derebucak, Çamlık Village, Kızıldağ, under the summit 37°21' N, 31°40' E, alt. 1750 m, on thallus of *Aspicilia contorta* subsp. *hoffmanniana* on calcareous rocks, 20 Sep. 2005, *M. G. Halıcı, M. Kocakaya & A. Aksoy* (MK 0.0163).

Endococcus pseudocarpus Nyl. 1873

A detailed description is provided by Vouaux (1912).

The specimen was collected on *Collema* sp. on calcareous rocks. Ascomata perithecia, black, ± immersed in the host thallus, ~ 150 µm diam. Ascospores brown, 1-septate, 13–15 × 5.5–6 µm. Another member of the genus described on *Collema* sp., *Endococcus caudisporus* (David & Etayo 1995), differs from this species in having caudate lower cells to the ascospores. The hymenial gel turns red with Lugol's iodine solution without pre-treatment with K. The species seems to be commensalistic as no damage was evident on the host.

Endococcus pseudocarpus is also known from Austria on *Collema* sp. (Hafellner 1994), on *Lecidea*, *Rhizocarpon* and *Lecanora* (Keissler 1930), and the Czech Republic on *Peltula euploca* (Kocourková 2000).

NIGDE: Cevizlik Mahallesi, Aladağlar Milli Parkı, Mazmılı Yayla, 37°40' N, 35°01' E, alt. 1310 m, on exposed calcareous rocks, 10 Sep. 2006, *M. G. Halıcı & A. Aksoy* (MGH 0.2713).

Lecanora marginata (Schaer.) Hertel & Rambold 1985

Detailed descriptions are provided by Purvis et al. (1992) and Wirth (1995).

The specimen was collected on calcareous rocks at high altitudes in the Aladağlar National Park. Thallus very well developed, greyish white, K + yellow. Prothallus visible, white. Although Purvis et al. (1992) pointed out that the thallus has a yellowish tinge, in the specimens we collected we didn't observe this. Ascomata apothecia, 0.8 – 1.5 mm diam, sessile, thalline exciple becoming excluded, disc black and flat, epruinose. Ascospores colourless, simple, 8–10 × 5 µm. Pycnidia frequent; conidia arc-like, 13–15 × 1 µm. The shapes and measurements of the ascospores, conidiogeneous cells, and conidia, aggree with those Hertel & Rambold (1985).

Lecanora marginata is known on calcareous rocks in the UK (Scotland), Central Europe, and Scandinavia (Purvis et al. 1992). According to Nimis (1993), in Italy the distribution is restricted to the alpine belt of the Alps but should be sought for in the Mediterranean regions. From Turkey it is recently reported by Kınalıoğlu (2007) from three localities over 2500 m altitude. Our findings confirm his hypothesis as this species is also very common at higher localities in the Aladağlar National Park on calcareous rocks.

KAYSERI: Yahyalı, Aladağlar Milli Parkı, South of Delikkaya, 37° 55' N, 35° 13' E, alt. 3000 m, on exposed calcareous rocks, 03 Sep 2004, *M. G. Halıcı & A. Aksoy* (MGH 0.2004), Yahyalı, Aladağlar Milli Parkı, Alagöl, 37° 57' N, 35° 12' E, alt. 2880 m, on exposed calcareous rocks, 02 Aug 2005, *M. G. Halıcı & A. Aksoy* (MGH 0.2118), Yahyalı, Aladağlar Milli Parkı, Ulupınar Village, Emin Kadı Bridge, 37° 52' N, 35° 22' E, alt. 1240 m, on exposed calcareous rocks, 09 Aug 2006, *M. G. Halıcı & A. Aksoy* (MGH 0.2371), Yahyalı, Aladağlar Milli Parkı, Karaboyunlar, 37° 52' N, 35° 15' E, alt. 2795 m, on exposed calcareous rocks, 25 Aug 2006, *M. G. Halıcı & A. Aksoy* (MGH 0.2491).

NIGDE: Elekgölü Village, Aladağlar Milli Parkı, Kızılıntaşı Hill, 37° 45' N, 35° 02' E, alt. 1310 m, on exposed calcareous rocks, 10 Sep. 2006, *M. G. Halıcı & A. Aksoy* (MGH 0.2731).

Lichenodiplis lichenicola Dyko & D.Hawksw. 1979

A detailed description is provided by Hawksworth & Dyko (1979).

This species was collected by us in the apothecia of *Rinodina pyrina* on *Quercus* sp. bark It seems mildly pathogenic as the ascospore production of the host in the infected apothecia is suppressed. Conidiomata pycnidia, arising singly, immersed at first, becoming erumpent, globose, 50–60 µm diam. Conidia brown, 1–septate, smooth walled, with a truncate base, 10–12 × 4 µm.

Lichenodiplis lichenicola is known from Norway in the apothecia of *Rinodina septentrionalis* (Hawksworth & Dyko 1979), the UK (Hawksworth 2003), and also in the apothecia of *Rinodina septentrionalis* and *R. sophodes* in Sweden (Santesson et al. 2004), and on the apothecia of *Rinodina* sp. in Portugal (Hafellner 1995).

KONYA: Derebucak, Çamlık Village, Kızıldağ, South of Kirazbükü, 37° 20' N, 31° 39' E, alt. 1470 m, on apothecia of *Rinodina plana* on *Quercus* sp., 20 Sep. 2005, *M. G. Halıcı, M. Kocakaya & A. Aksoy* (MK 0.0087).

Melanolecia transitoria (Arnold) Hertel 1981

Detailed descriptions are provided by Hertel (1977), Poelt & Vězda (1981), Clauzade & Roux (1985), and Brodo et al. (2001).

We collected this arctic-alpine species at 3160 m in the Aladağlar National Park. Thallus endolithic. Ascomata apothecia, immersed in pits of the calcareous rock, black, ~ 0.5 mm diam. Epihymenium blue-greenish, hypothecium dark brown, hymenium ~ 40–50 µm tall, true exciple well-developed. Ascospores colourless, simple, 8–10 × 4–5 µm. The ascospores of the Turkish specimen are a little shorter and narrower than given for this species by Poelt & Vězda (1981; 10–15 × 5–7 µm), and the measurements given by Brodo et al. (2001) for North American material are much longer and wider (13–28 × 7–14 µm). However, the Turkish measurements are within the range given by Hertel (1977; 8.5–14 × 4.5–7.5 µm).

Melanolecia transitoria is rare in alpine and snow belts of the Alps (Poelt & Vězda 1981), and also known from China (Hertel 1977) and North America (Brodo et al. 2001).

KAYSERI: Yahyalı, Aladağlar Milli Parkı, Yedigöller, 37°48' N, 35° 11' E, alt. 3160 m, on calcareous rocks, 26 Aug 2006, *M. G. Halıcı & A. Aksoy* (MGH 0.2563).

Phaeospora rimosicola (Leight. ex Mudd) Hepp ex Stein 1879

A detailed description is provided by Hawksworth (1985).

This species was found growing on a brown crustose areolate thallus that lacked ascomata on calcareous rocks: we suspect the host to be *Staurothele areolata*. This is the first report of *P. rimosicola* on a host other than *Rhizocarpon* or *Porpidia*. Ascomata perithecia, ~ 90–100 µm diam. Interascal elements absent. Ascospores 3-septate, pale brown, constricted at the septa, 18–22 × 7–9 µm, with a gelatinous sheath.

Phaeospora rimosicola is also known on *Rhizocarpon petraeum* in the Czech Republic (Kocourková 2000), on *R. hochstetteri* in Belgium (Diederich & Sérusiaux 2000), on *R. umbilicatum* in Sweden and Norway (Santesson 1993), and on *R. concentricum* in the UK (Hawksworth 1985). Horákova & Alstrup (1994) have shown that *P. rimosicola* on *Arctoparmelia centrifuga* as reported from Greenland by Alstrup & Hawksworth (1990) refers instead to *P. arctica*.

KAYSERI: Yahyalı, Aladağlar Milli Parkı, Ulupınar Village, Kartaltepesi, 37°51' N, 35° 19' E, alt. 2210 m, on thallus of a brown crustose thallus. on calcareous rocks, 24 Aug. 2006, *M. G. Halıcı & A. Aksoy* (MGH 0.2387).

Polycoccum marmoratum (Kremp.) D.Hawksw. 1980

A detailed description is provided by Hawksworth & Diederich (1988)

This species was collected on an endolithic *Verrucaria* sp. on calcareous rocks.

Ascomata perithecia, immersed first, then superficial, black, ~ 220 µm diam. Hamathecial filaments present, ~ 2.5 µm wide. Hymenium I (Metzler's) + blue. Asci 4–6–8 spored, 50–55 × 24–25 µm. Ascospores brown, 1-septate, the lower cell larger, 24–27 × 10–13 µm.

Polycoccum marmoratum has a wide distribution on pyrenocarpous and crustose lichens growing on limestone in Europe; e.g. in the UK (Hawksworth 2003), on *Polyblastia hyperborea* and a sterile lichen (Santesson 1993) and possibly *Lecania thallophila* in Sweden (Alstrup 1991), and on *Verrucaria* sp. over calcareous rocks in Belgium (Diederich & Sérusiaux 2000)

KAYSERI: Yahyalı, Aladağlar Milli Parkı, Ulupınar Village, Köşkderesi, 37° 58' N, 35° 17' E, alt. 1915 m, on *Verrucaria* sp. on calcareous rocks, 03 Oct. 2005, *M. G. Halıcı & A. Aksoy* (MGH 0.2387).

Pyrenidium actinellum Nyl. 1865

Detailed descriptions are provided by Hawksworth (1980, 1983).

We collected this species on a brown crustose areolate thallus without any ascomata (probably *Staurothele areolata*) growing on calcareous rocks. It is highly pathogenic as bleaching occurs in the infected areoles of the host. Ascomata perithecia, black. Hamathecium of branched and anastomosing pseudoparaphyses. Asci 4-spored. Ascospores 2(–3)-septate (all but one of those we observed were 2-septate; only one 3-septate was seen), 27–31 × 11–12 µm, the end cells are paler.

This common pathogenic species is known on a wide range of hosts in Europe, such as *Aspicilia calcarea*, *Baeomyces rufus*, *Diploschistes caesioplumbeus*, *Massalongia carnosa*, several *Peltigera* species, *Solorina crocea*, *S. saccata*, and *Toninia squalida* (Hawksworth 1980).

KAYSERI: Yahyalı, Aladağlar Milli Parkı, Akçay tombs, 37° 51' N, 35° 12' E, alt. 2900 m, on thallus of a brown crustose thallus. on calcareous rocks, 26 Aug. 2006, *M. G. Halıcı & A. Aksoy* (MGH 0.2403).

SPECIMENS COMPARED: Dorset: Wareham, SY924872, on mortar of south facing wall by river, on *Caloplaca teicholyta*, 1982, V. Giavarini (hb. Giavarini); Combretum, Zambia: Victoria Falls, 900 m, 1 Jul 1979, M.R.D.Seaward (IMI 240794).

Scoliciosporum intrusum (Th.Fr.) Hafellner 2004

Detailed descriptions are provided by Wirth (1995) and Hafellner (2004).

This species, commonly named as *Carbonea intrusa* in European checklists, was transferred to *Scoliciosporum* by Hafellner (2004) because of its non-carbonised exciple composed of intricately interwoven hyphae, the hardly pigmented hypothecium, and the ramified and anastomosing paraphyses. We collected this species on the thallus of *Rhizocarpon geographicum* on siliceous rocks. This species grows mostly on crustose lichens such as *Rhizocarpon* *geographicum*, and *Lecidea lapicida* on siliceous rocks, or directly on siliceous rocks, but is always in close contact with these species (Hafellner 2004). The Turkish specimen has a dark olive grey thallus, apothecia which are emarginate; a hypothecium that is K+ violet; and ascospores that are colourless and simple, 11–15 × 5 µm.

Scoliciosporum intrusum has a wide distribution in Europe, Asia, and North America (Hafellner 2004).

ADANA: Aladağlar Milli Parkı, Acıman Yaylası, Turhasan Tepesi, 37°44′ N, 35° 16′ E, alt. 2050 m, on thallus of *Rhizocarpon geographicum*. on siliceous rocks, 31 Aug. 2005, *M. G. Halıcı & A. Aksoy* (MGH 0.2142).

Toninia episema (Nyl.) Timdal 1991

A detailed description is provided by Timdal (1991).

This non-lichenized species was collected on *Aspicilia coronata* on calcareous rocks. Ascomata apothecia, ~ 0.5 mm diam, epruinose. Epihymenium olivaceous green, K -, N + violet, hymenium ~ 50 µm, hypothecium reddish brown. Asci 8-spored; ascospores constantly 1-septate; 11–14 × 4–5 µm. Timdal (1991) reported that this species can be confused with *T. subfuscae* but differs in having exclusively 1-septate ascospores and the host selected. *T. subfuscae* grows on *Lecanora campestris*, *Lecidella scabra* and *Protoparmeliopsis muralis* and was reported from Turkey on an unidentified host by Hafellner & John (1996) and on *Protoparmeliopsis muralis* by Halıcı & Candan (2007).

T. episema was reported on the thallus of *Aspicilia calcarea* on calcareous rocks and walls in western and southern Europe, Cyprus, and northern Africa (Timdal 1991). It was also reported from China on *A. tortuosa* (Hawksworth & Cole 2003) and from Belgium and France on *A. calcarea* over hard calcareous rocks (Diederich & Sérusiaux 2000). Timdal (1991) reported that *T. episema* is an apparently lowland species; we, however, collected this species at 2200 m in Aladağlar National Park.

NIĞDE: Aladağlar Milli Parkı, Narpuz Valley, Entrance to 2. Narpuz. 37°49′ N, 35° 07′ E, alt. 2200 m, on thallus of *Aspicilia coronata*. on calcareous rocks, 30 Aug. 2005, *M. G. Halıcı & A. Aksoy* (MGH 0.1976).

Unguiculariopsis groenlandiae (Alstrup & D.Hawksw.) Etayo & Diederich 2000

Detailed descriptions are provided by Alstrup & Hawksworth (1990) and Diederich & Etayo (2000).

We collected *U. groenlandiae* on the apothecia of *Caloplaca lactea* at 2050 m. Ascomata apothecia, ~ 0.3 mm diam, exciple purplish, lacking excipular hairs; hypothecium reddish, epithecium indistinct; hymenium ~ 70 µm tall. Asci 8-spored; ascospores colourless, simple and consistently 2-guttulate; 9–10 × 3 µm. This species is the only member of the genus with reduced excipular hairs (Diederich & Etayo 2000).

Unguiculariopsis groenlandiae was reported on *Caloplaca citrina* and *Lepraria neglecta* from Greenland by Alstrup & Hawksworth (1990), but the record on *Lepraria neglecta* proved to be typical *Rhymbocarpus neglectus* on *Lepraria cacuminum* (Kümmerling et al. 1993). *U. groenlandiae* is also known from the UK on a sterile thallus of *Fulgensia bracteata* (Hawksworth 2003), from Greenland, and on *F. fulgens* from Sweden (Diederich & Etayo 2000). It is a new record for Asia.

ADANA: Aladağlar Milli Parkı, Acıman Yaylası, Turhasan Tepesi, 37° 44' N, 35° 16' E, alt. 2050 m, on apothecia of *Caloplaca lactea*. on calcareous rocks, 24 Aug. 2006, *M. G. Halıcı & A. Aksoy* (MGH 0.2196).

Verrucaria aspiciliicola R.Sant. 1984

Detailed descriptions are provided by Zehetleitner (1978) and Purvis et al. (1992).

V. aspiciliicola was found on *Aspicilia contorta* subsp. *hoffmanniana* on calcareous rocks. Thallus dark greyish, areolate. Ascomata perithecia, immersed. Ascospores colourless, simple, 23–27 × 7–8 µm.

V. aspiciliicola is known from the UK, southern Europe, Sweden and Hungary, and occurs on *Aspicilia calcarea*, *A. caesiocinerea*, and *Hymenelia lacustris* (Purvis et al. 1992, Zehetleitner 1978).

KAYSERI: Aladağlar Milli Parkı, Yahyalı, Kapuzbaşı, Tekeboynu, 37° 46' N, 35° 19' E, alt. 1270 m, on thallus of *Aspicilia contorta* subsp. *hoffmanniana*. on calcareous rocks, 31 Aug. 2005, *M. G. Halıcı & A. Aksoy* (MGH 0.2101).

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A new polypore *Irpex cremicolor* described from North Europe

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Abstract — *Irpex cremicolor*, a poroid basidiomycete, is described as new based on collections from old-growth forests in northern Finland and Norway. It is characterised by a resupinate habit, lacerate pores, and a dimitic hyphal system. Most of the septa are simple, but scattered clamps are present. The species reminds of the North American *Oxyporus similis*, which is re-described and compared to the closely reminiscent *O. obducens*. These two are often considered synonyms, but they are kept separate here on account of minor differences in their hyphal and spore characteristics.

Key words — *Irpex lacteus, Oxyporus populinus, O. schizoporoides, Polyporaceae*, taxonomy

Introduction

Basidiomycetes of North Europe have been studied for over 200 years, and they are among the best known globally. Polypores belong to the intensively investigated groups of the basidiomycetes, about 255 polypore species being known from Finland, Norway and Sweden (Ryvarden et al. 2003, Niemelä 2005, Fungus Info 2007). Anyhow, species new to science are found from this area almost annually, and not only through splitting of old taxa.

One such distinctive new species is described here based on three specimens collected within the last ten years. The collections were made during polypore inventories. For an experienced collector, the species does not readily remind of other polypores known from this area when observed with the naked eye and even less so microscopically. The two Finnish collectors, Matti Kulju and Mariko Lindgren, were struck by the odd combination of characters of their specimens that did not fit to any of the known species. Thus the specimens were sent to the Botanical Museum of the University of Helsinki (H) for further scrutiny. Also the third collection from Norway by Gunnar Kristiansen was similarly forwarded to the University of Oslo (O).

The new species with its dimitic, nearly clampless hyphal structure, club-like and eventually thick-walled cystidia, and thin-walled spores is currently best placed in the genus *Irpex* Fr. According to Polypores of North America (Gilbertson & Ryvarden 1986, 1987), the new species keys out as *Oxyporus similis*, a North American taxon with uncertain delimitation towards the European species *Oxyporus obducens* (Pers.) Donk. We provide a description of *O. similis* as well, based on authentic material, and a comparison between the three species.

Materials and methods

During microscopic studies the basic mountant medium used was Cotton Blue (CB), but also Melzer's reagent (IKI) and 5% KOH was used. Spore and other measurements were made and illustrations were drawn in CB. Entry CB+ means cyanophily, CB(+) weak but distinct cyanophilous reaction, CB– acyanophily; IKI– means neither amyloid nor dextrinoid reaction; KOH– means that hyphae were left almost unchanged. Measurements were done using ×1000 or ×1250 magnification and phase contrast illumination; eyepiece scale bar with 1-µm-grid was used, and dimensions were estimated subjectively with an accuracy of 0.1 µm (see Miettinen et al. 2006 for further detail).

The following symbols are used for spore measurements: L = mean length, W = mean width, Q = L/W, i.e. average length divided by average width, Q' = length/width ratio of individual spores, n = number of spores measured from given number of specimens, for instance 90/3 means 90 spores measured from 3 specimens. In presenting the variation of spore size and Q', the whole range is given in parentheses. The 90% range excluding the extreme 5% of values from both ends is given without parentheses. In case the 5% limit falls between two values, the one further from the median was chosen to represent the 5% tail. Whenever the figures within and outside parentheses are identical, parentheses are omitted.

Species description

Irpex cremicolor Miettinen, Niemelä & Ryvarden, sp. nov. Fig. 1
MycoBank MB505111

Basidioma resupinatum, cremeo-album, poris laceritis, 2–4 per mm. Systema hypharum dimiticum, hyphis efibulatis; cystidia clavata, basidiosporae ellipsoideae, tenuitunicatae, 3.8–5×2.4–3.2 µm.

Holotype—Norway. Nord-Nordland: Narvik, Prestjord, riverine deciduous natural forest, on *Alnus incana*, 15.X.1999 G. Kristiansen (O, isotype H).

Etymology—*Cremicolor* (Lat.): cream-coloured, referring to the colour of the basidiocarps.

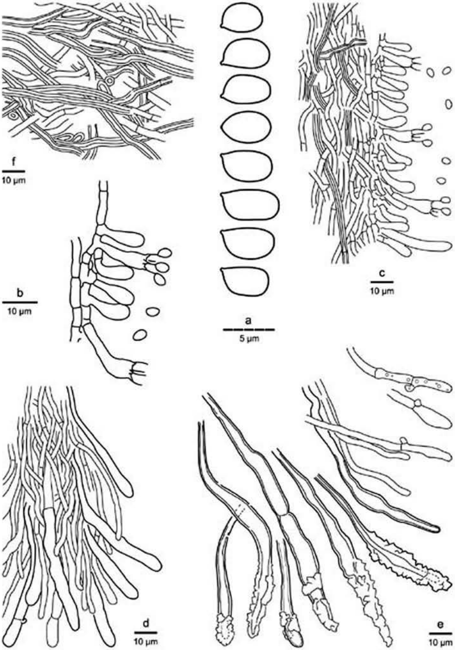

Fig. 1. *Irpex cremicolor*, a) spores, b) hymenial cells, c) tube trama and hymenium, d) hyphae from young tube orifices with juvenile cystidia e) hyphae from tube orifice, mature basidiocarp: cystidia, regular hyphae and hyphal tips with clamps, f) subiculum from mature basidiocarp.

Drawn from isotype, except d) from Kulju 1004.

Basidiocarp resupinate, pure white to cream-coloured in older parts and when dry, size in the magnitude of 10 cm² or larger, 1–4 mm thick. Tubes rather thin-walled, soon splitting, approaching lacerate, orifices irregular, tube layer 1–3 mm thick; pores labyrinthine, 2–4 per mm. Subiculum of the same colour, 0.2–2 mm thick. Margin thin, irregular but sharply delimited, sterile part typically several to ten millimetres wide, sometimes almost rhizomorphic.

Hyphal system dimitic, skeletals few in young basidiocarps but in old specimens dominating throughout except at tube mouths. Distinction between generative and skeletal hyphae is indistinct particularly in subiculum, where intermediary hyphae, i.e. thick-walled but branching and septate, occur. The dimitic structure is clearest in the upper tube trama. Hyphae slightly amyloid in mass, CB(+) to CB–, part of the generative and skeletal hyphae swelling noticeably in KOH. Generative hyphae thin- to slightly thick-walled, (1.8–)2.2–3.4(–5) µm in diameter, clamps mostly absent but rare scattered clamps found throughout the basidiocarp, most frequently close to tube mouths. Subicular skeletals somewhat twisted, occasionally branched, (2.2–)2.6–3.6(–5) µm, (2.5–)3.6–5(–5.8) µm in KOH, with a clear lumen, in mature skeletals a third or less of the width. Tramal skeletals similar, interwoven to subparallel, (2–)2.5–3(–3.7) µm.

Cystidia common, thin- to thick-walled, long tubular and slightly constricted, with a wide lumen and occasional septa at lower parts, born deep in trama, occasionally projecting through tube mouths and hymenium, old cystidia encrusted in the apical part with crystal lumps, (35–)60–170×(5.4–)6–8(–13.5) µm excluding encrustation, up to 16 µm wide if measured with crystals. The cystidia are born on generative hyphae. In subiculum there are embedded, cystidia-like, partially swollen hyphae, occasionally branched and sometimes bearing similar encrustation as in tramal cystidia. They have clearly similar origin, but unlike the cystidia in trama, which are always terminal cells of hyphae, some of the subicular cystidia are long, swollen, thick-walled intercalary sections in the middle of normal hyphae, i.e. not terminal. Prominent, thick-walled cystidia appear rather late in the development of the basidiocarps; before maturing they appear as thin-walled, swollen terminal hyphae at tube mouths.

Hymenium. Basidia cylindrical to clavate, 11–16(–23)×4–5.5(–6) µm, usually with 4 sterigmata but occasionally with 1 or 2, mostly without a basal clamp, but a few seen on basidioles so probably also basidia are occasionally clamped. Cystidioles not present.

Basidiospores ellipsoid, thin-walled, smooth, CB–, IKI–, (3.6–)3.8–5(–5.9) × (2.3–)2.4–3.2 µm, L=4.25 µm, W=2.67 µm, Q'=(1.3–)1.4–1.8(–2.0), Q=1.59, n=120/3.

Distribution. The three collections all originate from the northern and middle boreal zones (Ahti et. al. 1968) in Northwest Europe (Finland and Norway).

Ecology. The Norwegian specimen was collected from *Alnus incana* whereas the Finnish specimens are from *Betula pubescens* decayed by *Phellinus igniarius* (L.) Quél. coll. It is possible that the species is a successor (cf. Niemelä et al. 1995) of *Phellinus* spp., but this has to be confirmed. All the collections derive from moist, mesic sites, in natural or semi-natural deciduous or spruce-dominated old-growth forests in landscapes with a rather high percentage of natural forests. The species might well be an old-growth forest specialist.

Remarks. *Irpex cremicolor* has an unusual combination of characters for a polypore. Its hyphal system could be described as dimitic with somewhat unclear distinction between generative and skeletal hyphae. In young basidiocarps (Kulju 1004, Lindgren 9849) most of the hyphae are fairly thin-walled, but wall thickness increases with age and finally thick-walled hyphae dominate (type). Also the thick-walled cystidia develop late, bearing only sparse encrustation if any.

The most peculiar feature is the partial formation of clamps in the basidiocarps, seen in all three specimens. Scattered clamps are known to occur in predominantly clampless polypores (e.g. *Flabellophora, Heterobasidion*), hydnaceous fungi (*Hydnellum*) and in several genera of corticioid basidiomycetes (e.g. *Athelia, Coniophora, Phanerochaete*), but such intermediary cases are nevertheless a small minority. A large number of clamps in *I. cremicolor*, perhaps majority, are somehow malformed, either abnormally swollen and septate, or looking as if the development of clamp had ceased prematurely in the middle, before anastomosis. In such cases, the clamp has not merged with the adjoining previous cell as supposed to, i.e. the clamp is left as an open, backward-pointing hook, even though clearly identifiable as a clamp (Fig. 1).

These characters, together with resupinate habit and thin-walled spores define the species from other slightly similar ones in *Irpex, Oxyporus* and *Rigidoporus*. Pertinent keys would place *I. cremicolor* close to *Oxyporus similis*. Both share the resupinate habit, similar-sized pores, encrusted cystidia and thin-walled, ellipsoid spores. Closer scrutiny shows that *O. similis* is distinctly monomitic without any clamps at the septa, its cystidia are shorter and much more heavily encrusted, and its spores are slightly broader than in *I. cremicolor* (Tab. 1). The pores of *O. similis* are regular as opposed to lacerate, and smaller than those of the new species. *Oxyporus obducens* is very similar to *O. similis*, and differences to *I. cremicolor* hold also for that species.

Oxyporus schizoporoides Zmitr. & Spirin was recently described from Northwest Russia. The species is probably a synonym of *O. obducens* with which it shares such essential characters as monomitic hyphal structure, short encrusted cystidia, and cyanophilous, small spores (Tab. 1). *Oxyporus schizoporoides* does not have truly split tubes, and the above mentioned microscopic characters are not shared with *I. cremicolor*.

Oxyporus spiculifer (G. Cunn.) P.K. Buchanan & Ryvarden from New Zealand has lacerate tubes of roughly the same pore size (1–2 per mm) as *I. cremicolor* (Cunningham 1965, Buchanan & Ryvarden 1988). *Oxyporus pellicula* (Jungh.) Ryvarden from Java has often lacerate tube orifices as well. Both species have a monomitic hyphal structure with heavily encrusted cystidia unlike *I. cremicolor.*

Irpex lacteus (Fr.) Fr. differs from *I. cremicolor* in being usually pileate and by the nature of its cystidia which are more finely and heavily encrusted, and by its longer, curved cylindrical spores (5.8×2.5 µm in average, Tab. 1).

Finally, the appearance of *I. cremicolor* with its almost rhizoid margin and similar-sized, somewhat lacerate tubes may bring in mind *Junghuhnia lacera* (P. Karst.) Niemelä & Kinnunen. These two species share the dimitic hyphal structure and both bear encrusted cystidia. Generative hyphae of *J. lacera* always bear clamps at septa, cystidia are carrot-shaped rather than cylindrical, and spores are subglobose.

Oxyporus similis (Bres.) Ryvarden, Persoonia 7:20, 1972.

Basionym: *Poria similis* Bres., Mycologia 17:76, 1925. Lectotype: USA. Idaho: Bonner County, Coolin, on *Populus trichocarpa*, 18.IX.1919 Weir US242516 (BPI, studied). Selected as type by Lowe (1966:21).

Basidiocarp resupinate, pore surface straw-coloured, contrasting with the white margin, patches from 10 cm² to at least the size of a palm, 0.2–2(–3) mm thick. Consistency rather tough when dry. Pores regular, thin-walled, 4–6 per mm, tube layer up to 2 mm thick. Subiculum cream-coloured, but towards substratum turning into a brownish, woolly basal layer, usually just a thin line. Margin sharply delimited, thinning out, sterile part 0.5–0.2 mm wide.

Hyphal system monomitic, hyphae rather uniform throughout the basidiocarp, yellowish in mass, CB(+), IKI–, KOH–, commonly septate, clamps absent. Subicular hyphae thick-walled, (2.2–)3.2–4(–5) µm, with a wide lumen and walls up to 1 µm thick. Tramal hyphae thin- to slightly thick-walled, parallel to subparallel, tissue rather dense, (2–)2.5–3.2(–4.2) µm.

Cystidia abundant in trama, clavate, projecting through hymenium, heavily encrusted, 20–40(–70)×(5.5–)7.5–10(–13) µm, including crystal cover. Young cystidia thin-walled, apically encrusted hyphal ends, older ones eventually thick-walled. They are born in trama or subhymenium but bend through hymenium, occasionally projecting a little.

Hymenium. Basidia few in the studied material, cylindrical or clavate, with 4 sterigmata, 8–15×4.5–5.6 µm.

Basidiospores ellipsoid to broad cylindrical, thin-walled, smooth, CB–, IKI–, (3.8–)4.2–5.5(–6.3) × (2.4–)2.7–3.5(–4.2) µm, L=4.72 µm, W=3.10 µm, Q'=(1.3–)1.4–1.8(–1.9), Q=1.52, n=122/4.

Table 1. Spore measurements of studied specimens of *Irpex* spp. and *Oxyporus* spp. Combined statistics for each species are printed in bold.

Specimen	Length (µm)	L	Width (µm)	W	Q'	Q	n
Irpex cremicolor	**(3.6–)3.8–5.0(–5.9)**	**4.25**	**(2.3–)2.4–3.2**	**2.67**	**(1.3–)1.4–1.8(–2.0)**	**1.59**	**120/3**
Isotype	(3.6–)3.7–4.8(–5.3)	4.21	2.5–3.1(–3.2)	2.79	1.3–1.7(–1.9)	1.51	30
Kalju 1004	(3.7–)3.8–4.6(–4.9)	4.12	(2.3–)2.4–3.0(–3.1)	2.64	(1.3–)1.4–1.7(–1.8)	1.56	60
Lindgren 9849	3.9–5.6(–5.9)	4.58	2.3–3.1(–3.2)	2.61	1.6–2.0	1.76	30
Irpex lacteus	**(4.5–)4.9–6.9(–8.1)**	**5.81**	**(2.0–)2.2–2.8(–2.9)**	**2.45**	**(1.9–)2.1–2.7(–2.8)**	**2.38**	**90/3**
Haikonen 21980	(4.5–)4.6–6.5(–6.8)	5.60	(2.0–)2.1–2.5(–2.6)	2.29	(2.1–)2.2–2.7(–2.8)	2.44	30
Kotiranta 11786	(4.7–)4.8–7.9(–8.1)	5.71	2.2–2.8(–2.9)	2.38	(1.9–)2.0–2.8	2.40	30
Kotiranta 21291	(5.2–)5.4–6.9(–7.8)	6.14	2.5–2.8(–2.9)	2.67	(2.0–)2.1–2.7(–2.8)	2.30	30
O. obducens	**(3.3–)3.5–4.7(–5.3)**	**4.07**	**(2.3–)2.5–3.3(–4.0)**	**2.98**	**(1.1–)1.2–1.5(–1.8)**	**1.37**	**160/4**
Miettinen 2323	3.7–4.3	3.94	2.8–3.2	2.97	1.2–1.5	1.33	30
Niemelä 1699	3.3–4.2	3.65	2.3–3.0(–3.1)	2.67	(1.2–)1.3–1.5	1.37	30
Niemelä 1702	(3.7–)3.8–4.9(–5.3)	4.31	2.7–3.7(–4.0)	3.12	(1.1–)1.2–1.5(–1.7)	1.38	70
Niemelä 5729	(3.4–)3.5–4.5(–4.9)	4.04	2.7–3.2(–3.3)	2.98	(1.2–)1.3–1.5	1.36	30
O. populinus	**(3.3–)3.4–4.7(–4.8)**	**4.14**	**(2.8–)3.0–4.2(–4.5)**	**3.65**	**1.1–1.3(–1.4)**	**1.14**	**90/3**
Askola 1886	4.0–4.4(–4.5)	4.18	3.0–4.0(–4.1)	3.78	1.1–1.2(–1.3)	1.11	30
Miettinen 10522.1	(4.0–)4.1–4.8	4.41	3.4–4.4(–4.5)	3.91	1.1–1.2	1.13	30
Niemelä 4.VII.1966	3.3–4.3	3.83	(2.8–)3.0–3.8(–3.9)	3.26	1.1–1.3(–1.4)	1.18	30
O. schizoporoides	**(4.0–)4.1–5.0**	**4.49**	**2.6–3.2(–3.3)**	**2.94**	**1.4–1.6**	**1.53**	**30**
O. similis	**(3.8–)4.2–5.5(–6.3)**	**4.72**	**(2.4–)2.7–3.5(–4.2)**	**3.10**	**(1.3–)1.4–1.7(–1.9)**	**1.52**	**122/4**
Weir X.1915	(4.0–)4.2–5.0(–5.2)	4.55	2.7–3.4	2.97	(1.3–)1.4–1.8	1.53	30
Weir IX.1915	(4.1–)4.3–5.2	4.80	(2.5–)2.6–3.4	3.14	1.4–1.7	1.53	30
Weir VIII.1917	(4.2–)4.3–5.0(–5.8)	4.72	(2.2–)2.7–3.4(–3.5)	3.06	1.4–1.8	1.54	30
Weir 12.X.1920	(3.8–)4.0–6.3	4.79	2.7–3.9(–4.2)	3.22	1.3–1.7(–1.9)	1.49	32

Distribution. The type material and other specimens studied here come from the Pacific Northwest of the United States.

Ecology. All the specimens studied have been collected from *Populus trichocarpa*.

Remarks. The lectotype has virtually no hymenium or spores left (a few collapsed and bloated were seen), but is otherwise in a tolerable condition. The other contemporary specimens attached to the same herbarium sheet have been collected from the same region by the same collector, J.R. Weir. They clearly represent the same species as the lectotype and have been utilised in composing the present description and for spore measurements. As the type, they are not in the best condition either, lacking proper hymenium.

Oxyporus similis is characterised by a resupinate habit, heavily encrusted tramal cystidia and thin-walled, acyanophilous, ellipsoid spores. Several other species of *Oxyporus* share similar characters.

Vampola (1992) considered *O. similis* as a synonym of *O. obducens*, described from Germany. Donk (1967) placed *O. obducens* in synonymy with *Oxyporus populinus* (Schumach.) Donk. The current concepts clearly treat *Oxyporus populinus* and *O. obducens* as two distinct species: the pileate, perennial *O. populinus* with subglobose spores versus resupinate, annual, thin *O. obducens* with ellipsoid spores. Here we discuss *O. obducens* as regarded by European authors (e.g. Ryvarden & Gilbertson 1994).

Although *O. similis* and *O. obducens* are rather similar, we prefer to keep them apart for the moment. They share similarly shaped spores, hyphal structure and deep-rooting, heavily encrusted tramal cystidia. There are nevertheless minor differences. Spores in the specimens of *O. obducens* studied here were in average slightly shorter (4.1×3.0 µm, Tab. 1) than those of *O. similis* (4.7×3.1 µm). The spores of *O. obducens* are also slightly thick-walled and weakly cyanophilous, similar to those of *Hyphodontia sambuci* (Pers.) J. Erikss. but unlike *O. similis*. The hyphae of *O. obducens* are more or less homogenous throughout the basidiocarp and clearly thick-walled in trama, (1.8–)2.6–3.2(–4) µm in diameter. In *O. similis* the tramal hyphae are thin- to slightly thick-walled, and they contrast to the thick-walled and broader subicular hyphae.

We have not studied the North American material of *O. similis* extensively and can not state if it is homogenous or if *O. obducens* is also present in North America. Comprehensive research on these taxa, based on fresh material, would be needed to answer such questions, and also to confirm the status of *O. similis*.

Oxyporus corticola (Fr.) Ryvarden and *Oxyporus latemarginatus* (Durieu & Mont.) Donk are fairly similar to *O. similis* macroscopically. Microscopically, their larger, cyanophilous spores and cystidia, which are hymenial and not arising in the trama as in *O. similis*, separate them from *O. similis*.

Oxyporus pellicula was described from Java and has pellicular basidiocarps with irregular, often dentate shallow pores quite unlike those of *O. similis*. Other resupinate *Oxyporus* and *Rigidoporus* species differ in the nature of their cystidia, shape or size of the spores, or by having thick-walled and cyanophilous spores.

Discussion

The genus name *Irpex* has been in use for over 180 years, and has traditionally been kept as a morphologically defined genus including species with split tubes or spinose hymenophore. To date, 200 species have been combined to *Irpex* (Index Fungorum 2007), but views differ on how to define the genus. Maas Geesteranus (1974), Ryvarden (1991) and Niemelä (2005) accept only one or a few species in the genus, whereas Kotiranta & Saarenoksa (2002) included the related *Junghuhnia* (polypores) and *Steccherinum* (hydnoid fungi) in *Irpex*.

Comprehensive sequencing of numerous species currently placed in the genus is necessary to settle the taxonomic position and extent of the genus. In its wide sense *Irpex* is clearly unnatural as it has been used as a "dumping ground" for almost any hydnoid or lacerate wood-inhabiting basidiomycete.

Irpex lacteus is the type species of *Irpex*. Since the new species reminds it more than any other polypore or hydnaceous fungus, *Irpex* is the most suitable genus for placing the new species.

SPECIMENS STUDIED—*Irpex cremicolor*. **Finland.** Kainuu: Kuhmo, Pitkävaara, spruce-dominated old-growth forest, on fallen *Betula* with *Phellinus cinereus*, 1.X.1997 M. Lindgren 9849 (H). Kuusamo: Taivalkoski, Metsäkylä, Aitto-oja, rich, paludified semi-natural spruce forest, on *Betula* with *Phellinus igniarius*, 21.IX.2004 M. Kulju 1004 (H, O). **Norway** (see type).

Irpex lacteus. **Finland.** Etelä-Häme: Lahti, Ahtiala, on *Acer platanoides*, 28.X.2002 V. Haikonen 21980 (H); Luhanka, Lempää, on *Sorbus aucuparia*, 21.V.2006 H. Kotiranta 21291 (H). **Russia.** Sverdlovsk: Kirovgrad NW, Visim Nat. Res., on *Salix caprea*, 17.IX.1994 H. Kotiranta 11786 (H).

Oxyporus obducens. **Finland.** Varsinais-Suomi: Turku, Ruissalo Nat. Res., on *Quercus robur*, 29.IX.1993 T. Niemelä 5729 (H); 28.X.2000 O. Miettinen 2323 (H). **Germany.** Hessen: Schauenburg-Elmshagen, on *Fagus sylvatica*, 7.IX.1979 T. Niemelä 1699, 1702 (H); Nordrhein-Westfalen: Kerpener Broich Nat. Res., on *Populus*, 22.X.1967 H. Gorholt (H).

Oxyporus populinus. **China.** Jilin: Antu, Erdao Bai He, on *Acer?*, 26.VIII.2005 O. Miettinen 10522.1 (H). **Finland.** Varsinais-Suomi: Turku, Kupittaa, on *Populus*, 11.X.1887 O. Karsten (H); Uusimaa: Helsinki, Pikku-Huopalahti, 5.XI.1900, E. Häyrén (H); Kaivopuisto, on *Acer*, 4.VIII.1966 T. Niemelä (H). Nurmijärvi, on *Quercus*, 22.X.1985 P. Askola 1886 (H).

Oxyporus pellicula. **Indonesia.** Java. *'Polyporus pellicula'*, F.W. Junghuhn 17, (type, L0053199).

Oxyporus schizoporoides. **Russia.** St. Petersburg, Rzhevka (59°58' N, 30°30' E), 1.VI.2004 I. Zmitrovich (H).

Oxyporus similis. **USA.** Idaho: Bonner County, Priest River, IX.1915 J.R. Weir US242517; X.1917 J.R. Weir US242515; 12.X.1920 J.R. Weir US242514; see lectotype. Montana: Missoula, X.1915 J.R. Weir US0242518.—All specimens grew on *Populus trichocarpa* and are deposited in BPI.

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Rick's species revision 2: *Lycoperdon benjaminii* recombined in *Morganella*

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Abstract — Continuing the study of J. Rick's species, we consider *Lycoperdon benjaminii* as an authentic member of *Lycoperdaceae* and propose its transference to the genus *Morganella*. Description and illustrations of the holotype and SEM images of the basidiospores are given, as well as an updated key for the South American species of the genus.

Key words — gasteromycetes, neotropical fungi, nomenclature, taxonomy

Introduction

Morganella Zeller is a gasteroid genus of *Lycoperdaceae* Chevall. recognized by its epigeous basidiomes that generally do not exceed 3 cm in diam., have a double peridium with a velutinous, furfuraceous, granular-verrucose, or spinose exoperidium, dehisce by an apical irregular mouth, and produce a gleba with or without a true capillitium but with an abundant paracapillitium (Kreisel & Dring 1967, Suárez & Wright 1996, Krüger & Kreisel 2003).

Zeller (1948) separated *Morganella* from *Lycoperdon* Pers. based mainly on the nature of the capillitium. However, the generic concept of *Morganella* was modified by Kreisel & Dring (1967), Ponce de Leon (1971), and more recently by Krüger & Kreisel (2003). Krüger & Kreisel (2003) detailed the morphological and molecular basis for the current concept of the genus and recognized two subgenera: *Apioperdon* Kreisel & D. Krüger and *Morganella* Zeller – the latter with two sections, *Morganella* Zeller and *Subincarnata* P. Ponce de León.

Continuing the revision of the gasteroid fungi described by J. Rick (Baseia et al. 2006), we found under the name *Lycoperdon benjaminii* an authentic member of the genus *Morganella* in the current concept. The formal transference of this name to *Morganella* is the subject of the present paper.

Materials and methods

Macroscopic characters were examined following usual techniques utilized in taxonomic studies of gasteroid fungi, as well as the original description of the holotype by Rick (1961). Color codes are those of Kornerup & Wanscher (1978). Microscopic characters were determined according to Miller & Miller (1988). Basidiospores were examined using a Philips XL 20 Scanning Electron Microscope (SEM).

Taxonomy

Morganella benjaminii (Rick) Cortez, Calonge & Baseia, **comb. nov.** Figs. 1-3

Mycobank MB 511078

Basonym: *Lycoperdon benjaminii* Rick, Iheringia Sér. Bot. 9: 462, 1961, as '*benjamin*'.

Basidiomes grayish orange (KW 5B4), globose, sessile, 0.5-1 cm diam.; sterile base rudimentary; exoperidium composed of minute spines, adhered to the endoperidium; endoperidium smooth, formed by thick-walled hyphae, fragile, dehiscing by an apical stoma; paracapillitium colorless, 2-4 µm diam., thin-walled, more or less branched, smooth, septate; eucapillitium absent; spores 2.5-3.5 µm diam., globose, verrucose, with a pedicel < 1.5 µm long.

Material studied: BRAZIL. Rio Grande do Sul State: municipality of São Salvador, 1943, *leg. J. Rick* (PACA 13.806, **holotype**).

Remarks: This species was described in Rick (1961), a posthumous work compiled by Father B. Rambo. In the protologue it appears graphed as *Lycoperdon 'Beniamin'*. As Rick do not explained the etymology of this new species, we suppose that he dedicated it to somebody called Benjamin, however this name is not familiar to the present authors. The specific epithet has been corrected to *benjaminii* in accordance with current nomenclatural rules.

The holotype of *M. benjaminii* was collected growing among fallen leaves, as indicated by Rick (1961), "inter folia gregarium", which is another distinct feature of the species, given that most species of the genus are lignicolous.

There are four *Morganella* species from South America: *M. costaricensis* M.I. Morales, *M. fuliginea* (Berk. & M.A. Curtis) Kreisel & Dring [= *M. puiggarii* (Speg.) Kreisel & Dring; *M. mexicana* Zeller], *M. pyriformis* (Schaeff.: Pers.) Kreisel & D. Krüger and *M. velutina* (Berk. ex Massee) Kreisel & Dring (Suárez

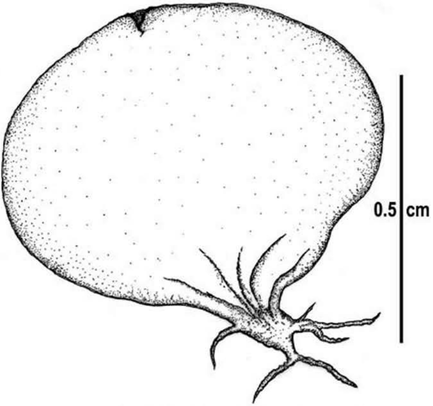
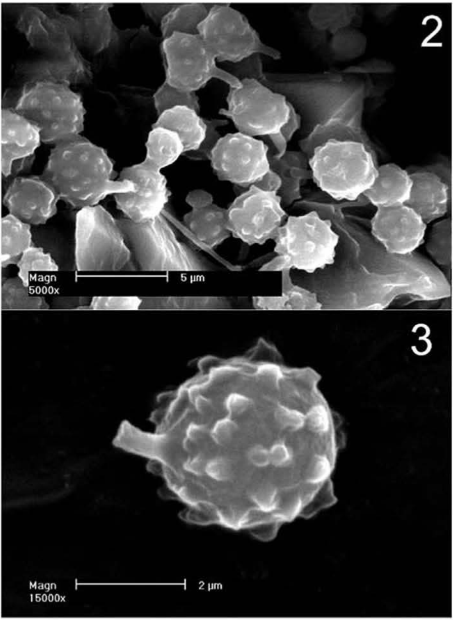


Figure 1: *Morganella benjaminii* (PACA 13.806, holotype): mature basidiome.

& Wright 1996, Krüger & Kreisel 2003). However, none of these are close to *M. benjaminii*, which differs from the other South American *Morganella* species fundamentally by the distinct basidiospore morphology: in *M. costaricensis*, the basidiospores are almost smooth under light microscope (Morales et al. 1974); *M. fuliginea* has strongly echinate basidiospores; *M. velutina* presents echinate basidiospores and a setose exoperidium; and finally, *M. pyriformis* presents little warted basidiospores, but differs from all above cited species on the presence of eucapillitium.

In the infra-generic classification of the genus, *M. benjaminii* is placed in subgen. *Morganella* sect. *Morganella* due to the presence of paracapillitum, eucapillitium absent, and non-chambered subgleba (Krüger & Kreisel 2003).

We propose the following updated key for the determination of the South American species of the genus, which was modified after the monograph of Suárez & Wright (1996) and the recent work by Krüger & Kreisel (2003). Except for *M. costaricensis*, the remaining species occurs in Brazil.



Figures 2-3: *Morganella benjaminii* (PACA 13.806, holotype): basidiospres under SEM.

Key to the South American species of *Morganella*

1a. Paracapillitium and eucapillitium present .... ***M. pyriformis***
1b. Only paracapillitium present **2**
2a. Exoperidium formed by setose, thick-walled hyphae .... ***M. velutina***
2b. Exoperidium formed by chains of slightly thick-walled hyphae 3
3a. Basidiospores smooth under light microscopy (echinulate under SEM) .... ***M. costaricensis***
3b. Basidiospores verrucose or echinate under SEM and light microscopy 4
4a. Basidiospores verrucose .... ***M. benjaminii***
4b. Basidiospores strongly echinate .... ***M. fuliginea***

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BOOK REVIEWS AND NOTICES

Compiled by

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GENERAL

Nuevo Diccionario Ilustrado de Micología. By Miguel Ulloa & Richard T. Hanlin. 2006. American Phytopathological Society Press, 3340 Pilot Knob Road, St Paul, MN 55121, USA. Pp. 672, figs 1766 (637 halftone drawings, 1129 black and white photographs). ISBN-10: 0-89054-341-0, ISBN-13: 978-0-89054-341-2. Price US $99.

A dictionary is a work that comprises the significance of the vocabulary or all the words of a language. The history of dictionaries is very old. The primitive forms were born with the first civilizations who knew only handwriting in Mesopotamia and Egypt, from the second millennium BC. In the West, they were born later, during the development of the Greek-Latin civilization. Dictionaries may include the words and meanings of a language, the words of a specific area of knowledge, or the terms from a scientific discipline. The first mycological dictionaries were born nested inside botanical ones. One of the first botanical dictionaries in Spanish was the *Principios de Botánica* from Barnades in 1767. Today, and without any doubt, the most complete and famous botanical dictionary in Spanish is the one compiled and directed by Font Quer (1982). That dictionary includes around 18 000 words with a thousand drawings to illustrate the meanings. Within this cumulus of botanical words there are terms of chemistry, edaphology, and others related to botany, such as herbarium acronyms.

The first *Ainsworth & Bisby's Dictionary of the Fungi* appeared in 1943, and as Ainsworth himself wrote in the Preface of the 7th edition (Hawksworth et al. 1983), the idea was born from the 6th edition of J. H. Willis's *A Dictionary*

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[1] Books for consideration for coverage in this column should be mailed to the Book Review Editor at P.O. Box 152, Ashtead, Surrey KT21 9BB, UK (e-mail: d.hawksworth@nhm.ac.uk) in the first instance. All unsigned entries are by the Book Review Editor.

of the Flowering Plants and Ferns. So far, nine editions of *Ainsworth & Bisby's Dictionary of the Fungi* have been published, the last one in 2001 with more than 20 500 entries (Kirk et al. 2001). In Mexico, the history of mycological dictionaries is, in part, the academic life of Miguel Ulloa. The origin of the *Nuevo Diccionario Ilustrado de Micología* is the book *El Reino de los Hongos* (Herrera & Ulloa 1990). In this wonderful book, an index-glossary was included, with a large number of definitions. From this glossary, it became evident the need for a more complete one. When Miguel Ulloa realized that there was nothing similar in Spanish, he decided to undertake the enterprise with the diligence that characterizes him. Then appeared the *Diccionario Ilustrado de Micología* (Ulloa 1991), published by the Universidad Nacional Autónoma de México. That dictionary has been out of print for along time, but comprised more than 2000 terms with 769 figures. Because of the success that this 1991 dictionary had, Ulloa, in collaboration with Richard T. Hanlin prepared the English version, the *Illustrated Dictionary of Mycology* (Ulloa & Hanlin 2000), published by the APS Press. Compared with the original, this was longer and included more than 3800 entries and 1300 figures.

The *Nuevo Diccionario Ilustrado de Micología*, published by the APS Press in 2006, includes around 5000 entries and 1766 illustrations (1129 half-tone photographs and 637 line drawings). When I had the book in my hands for the first time, some aspects captured my attention at once. First of all, it is a monumental work, not only for it size and weight, but also for its content and meticulous editing. The illustrations are, in the majority of the cases, excellent, both for their quality and as the precise figure for the term being defined. In few cases, I would like to see a better example of the term, as in the case of "pleurocystidium". Each entry has the word in Spanish, its translation in English, its etymology, a complete definition, and in many cases one or more examples where it can be observed or applied. At the end of the book, the authors include: (1) the orders and classes in which the genera, used as examples, are included; (2) the classification system used in the book; (3) the phylum *Ascomycota* classification of Eriksson (2005); and (4) the systematic arrangement of fungi from kingdoms to class according to Kirk et al. (2001). These lists help to clarify the taxonomic position of the groups included. At the beginning, I was confused when I saw in the second list the obsolete terms *Aphyllophorales*, *Gasteromycetes* and *Deuteromycetes*, but after analyzing the content of the other lists, I realized that it was very useful and didactic.

Being the two major dictionaries covering fungi, one is tempted to contrast the *Nuevo Diccionario Ilustrado de Micología* with *Ainsworth & Bisby's Dictionary of the Fungi*. Even though both have the term "dictionary" in the title, they are different because their objectives are different. *Ainsworth & Bisby's Dictionary* has a strong emphasis on taxonomic aspects, giving more emphasis to the genera and upper taxon entries. Indeed, its original goal was to supply a list of genera, with their taxonomic position, size, and geographic distribution. The *Ainsworth & Bisby's Dictionary of the Fungi* also has a glossary, which offers brief meanings. In contrast, the *Nuevo Diccionario Ilustrado de Micología* approaches more to the definition of the dictionary as already mentioned (i.e. a book that covers the meanings of the vocabulary), and more specifically of a glossary (i.e. a dictionary that contains words that may be very little known from a particular discipline). A similar book is *A Glossary of Mycology* from Snell & Dick (1971), which comprises around 7000 terms with their meaning, some with their etymology, and a very few illustrated. The main differences with the book I am commenting on here are the fewer number of illustrations and the inclusion of terms not strictly from mycology, like colors, as "Raspberry Red", "Sunflower Yellow", or 12 variants of "blue" or "bluish", more suitable for a specific guide of the discipline.

For both native and non-native Spanish speakers, the utility of the *Nuevo Diccionario Ilustrado de Micología* is unquestionable. It is a key book that will be used every time we approach a new group and serve as a compulsory reference when we work with our specialist taxonomic group. I asked one of my students (Mary Herrera) to spend a morning reviewing taxonomic works and consulting it for words unfamiliar to her. She reviewed eight works, both papers and books, from discomycetes, pyrenomycetes, *Uredinales*, *Mucorales*, conidial fungi, and foliicolous fungi. Mary had a very instructive and enjoyable morning, and she checked that every unknown word to her (more than 30) was defined in the dictionary, from "acropleurogenous" through "geniculate" to "valsoid". It is to be expected that in a book with around 5000 terms and almost 1800 illustrations, Ulloa & Hanlin would have forgotten some mycological terms. Indeed, two missing terms I found were "plage" and "subhymenium".

In Latin America, we commonly face spelling problems. For instance, how to spell in correct Spanish a technical word or a neologism that we read in papers or books written in other language, mainly in English. For example, "hymenophoral trama" used to be translated into Spanish as "trama himenoforal" but thanks to Ulloa (1991) and Ulloa & Hanlin (2006) we know the correct term in Spanish is "trama himeniifera". Ulloa & Hanlin have made this a colossal work in every sense. The details have been taken care of, from the mycological definitions to the semantic, artistic, editing, and printing.

Eriksson, O. E. (2005) Outline of *Ascomycota* – 2005. Myconet 11: 1-113.

Font Quer, P. (1982) *Diccionario de Botánica*. Labor, Barcelona.

Hawksworth, D. L., Sutton, B. C. & Ainsworth, G. C. (1983) *Ainsworth & Bisby's Dictionary of the Fungi*. 7th edn. CAB International, Farnham Royal, Slough.

Herrera, T. & Ulloa, M. (1990) *El reino de los hongos. Micología básica y aplicada*. Universidad Nacional Autónoma de México & Fondo de Cultura Económica, México, D. F.

Kirk, P. M., Cannon, P. F., David, J. C. & Stalpers, J. A. (2001) *Ainsworth & Bisby's Dictionary of the Fungi*. 9th edn. CABI Publishing, Wallingford.

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The Identification of Fungi: an illustrated introduction with keys, glossary, and guide to literature. By Frank M. Dugan. 2006. American Phytopathological Society Press, 3340 Pilot Knob Road, St Paul, MN 55121, USA. Pp. vi + 176, figs approx. 520. ISBN 0 89054 336 4. Price: US $ 65.

This spiral-bound guide is very much an introduction as the focus is identification down to family rather than genera and species. The classification adopted is unfortunately very dated. The author recognizes that he has used an artificial system to reflect traditional groupings, and stresses that users must go elsewhere for treatments of modern fungal systematic and evolutionary information. The result is that not only are names such as *Discomycetes* and *Plectomycetes* adopted, there are still *Coelomycetes* and *Hyphomycetes* and ordinal names like *Melanconiales* and *Sphaeropsidales*. It is most unfortunate that the chance was not taken to adopt a modern treatment as using such obsolete classifications only serves to perpetuate them. Diagnoses of higher taxa are provided and example genera are cited. Keys down to families are incorporated, but exclude lichen-forming groups. Numerous sketchy line drawings are provided for examples of named species, though without any indications of scale. Of especial value, however, are the literature citations given after diagnoses which are split into two, with one labeled "Contemporary research". The full list of references runs to 44 pages, but I did not note any dated later than 2004. I also wondered why the last "Outline of *Ascomycota*" cited was from 1998 and not even the 2004 edition. The book also has an illustrated glossary, a section on life-cycles, and an especially useful summary of key literature for the identification of fungi in particular habitats and on selected host plants (mainly crop plants). This is definitely not a book for use in modern mycological courses, though regrettably I am sure it will become widely used in plant pathology courses in North America.

MycoKey 2.1. By Thomas Læssøe & Jens H. Petersen. 2006. ISBN 87 984481 5 3. System requirements: optimized for Macintosh OSX (10.3-ff), Windows XP, with display width of at least 1024 pixels and 800Mb of free hard drive space. Price: as a download 49 € (+ VAT), or as a DVD 55 € including shipping (+ VAT); 5- and 10-license educational discounts available.

What a delight this interactive computer program is! It provides keys to 850 genera of discomycetes and basidiomycetes from Northern Europe, compiled by two of Denmark's best taxonomists. The keys are easy to use, called here synoptical keys, a construct that I tried to introduce to mycologists (as synoptic keys) in my presidential address to the Mycological Society of America 36 years ago (Korf 1972), long before computers became widespread. For the computer naturally became the ideal tool for such keys, obviating the need to write down a series of numbers on a slip of paper and crossing off numbers that did not fit the next character choice. Synoptic keys are far more useful than the common dichotomous keys we all still use.

Generic descriptions are provided for 850 genera, and for the very great majority at least one elegant picture of a representative species is displayed. Lists of the species for which illustrations are provided are listed in pull-down menus, and often several fine illustrations of any given species are provided, mostly photographs, but sometimes plates from books or journal articles or even line drawings, depicting significant features. Over 3600 illustrations are here. I found it particularly exciting to discover coverage of many discomycetes with tiny apothecia, certainly a rarity in floristic treatments. The genera accepted are the most modern I have seen in any current treatment providing keys. The fifteen thousand literature references give more than ample access to those who wish to follow up on what is presented. Given that the coverage is that of northern Europe, one cannot expect to find any treatment of genera known only from extra-European areas, but this should not deter one from using this amazing source for attempting to identify discomycetes and basidiomycetes from any region in the world.

It seems clear that the authors are keen on increasing their coverage and including more and even better illustrations as their databases grow. I cannot in honesty give only my enthusiastic praise, for I was disappointed by some of their decisions. For example, they include 8 photographs of *Psilopezia babingtonii*, 3 fine ones of apothecia, and 5 of sections showing the hymenium, asci (including the diffuse iodine reaction), and ascospores, but there is no illustration of its most diagnostic character, the globose basal excipular cells with their hair-like outgrowths. A copy of the plate in Boudier's *Icones Mycologicae* of this species would have been far more instructive, to my mind.

In summary, this is an outstanding work to which all mycology teachers should provide access for their students. The cost is not prohibitive considering the wealth and quality of the information. Check for updates at <www.mycokey.com>.

Korf, R. P. (1972) Synoptic key to the genera of the *Pezizales*. Mycologia 64: 937-994.

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Introduction to Fungi. By John Webster & Roland W. S. Weber. 2007. Cambridge University Press, The Edinburgh Building, Cambridge CB2 2RU, UK. 3rd edn. Pp. xiv + 841, illustrated. ISBN 0 521 80739-5 (hardback), ISBN 0 521 01483 2 (paperback), Price: £ 75, US $ 140 (hardback); £ 38, US $ 75 (paperback).

A much-expanded third edition of this well-respected textbook, which was first published in 1970, with an expanded second edition in 1980. This is mentioned briefly here as, while it is not a taxonomic work, the book has a systematic structure and will be of value in advanced systematic mycology courses. The classification system is admittedly conservative in this changing field, but does include conidial fungi within the sexually defined phyla apart from some ecological groupings. As in the previous editions, there is a great deal of information on selected examples of different fungal groups that can be studied in laboratory sessions, including much on their biology and ecology. The whole is very well illustrated, with particularly clear line drawings, and for the first time a signature of coloured photographs is included. Also of value is the huge number of references that run to 114 pages, so keen students can get straight to primary research papers. This will be an especially valuable resource for all who teach mycology classes, or for students undertaking master's programmes in mycology.

Continental Antarctic Fungi. By Silvano Onofri, Laura Zucconi & Solveig Tosi. 2007. IHW-Verlag, Postfach 1119, D-85378 Eching bei München, Germany (e-mail: dr.schmid@e-gig.de). Pp. 247, figs 115 (35 in colour). ISBN 978 3 930167 67 8. Price: £ 59.

A synthesis of the available information on Antarctic fungi has long been needed as a basis for those working on Antarctic ecology. This is far from an easy task as the literature is so dispersed and not all taxa have been studied in recent times, but Silavno Onofri was well-placed to tackle the problem as he holds perhaps the most important collection of living cultures of Antarctic fungi in his laboratory at the University of Tuscia, Viterbo, Italy.

While the major part of the work is systematic, 40 pages are devoted to an account of the climate and habitats in continental Antarctica as well as discussions of microfungi known from the maritime Antarctic, which are unfortunately not treated in the main body of the work. The lichen fungi, which have been treated by Øvstedal & Smith (2001), are not considered, although it was pleasing to see some lichenicolous taxa included. This means that the proportions of fungal phyla given (Fig. 15) seriously underestimate the diversity of the ascomycetes in the continent; their omission should perhaps have been stressed more in the paragraph explaining the coverage of the systematic part (p. 47). Interestingly the only non-fossil basidiomycetes reported are yeasts. There are discussions of adaptations to low temperatures, low water availability, and high UV radiation.

Cryptoendolithic communities receive welcome detailed attention, which will be of wide interest to fungal ecologists.

The authors indicate that 144 genera and 251 species of fungi (including fossils) have been reported from continental Antarctica, and the accounts of these form the main body of the book. No keys are provided, but for each species there is a detailed description, including cultural features where known, discussion of the Antarctic records, and in many cases line drawings. Places of publication of scientific names and their synonyms are provided, though it is unclear how many of these have been verified by the authors. I was also somewhat amused to see Dennis C. Lindsay incorrectly given as the author of the name *Microthelia rugulosaria*; it should be William L. Lindsay, a pioneer of the study of lichenicolous fungi and the first to coin the word "lichenicolous" in 1869! In general the nomenclature is up-to-date, though the study of Hawksworth & Iturriaga (2006), which revised the antarctic lichenicolous fungi described by Carroll W. Dodge, evidently appeared too late to be accommodated.

While this will be far from the last word on the fungi from this most extreme part of the Earth, it should provide a major impetus both to the further exploration of microfungi in Antarctica and facilitate their incorporation into broader microbiological and ecological research projects in the continent. The authors are to be congratulated on the achievement of this synthesis.

Hawksworth, D. L. & Iturriaga, T. (2006) Lichenicolous fungi described from Antarctica and the subantarctic Islands by Carroll W. Dodge (1895-1988). Antarctic Science 18: 291-301.

Øvstedal, D. O. & Smith, R. I. L. (2001) *The Lichens of Antarctica and South Georgia: a guide to their identification and ecology.* Cambridge University Press, Cambridge, UK.

Fungi of the Protected Landscape Area of Vihorlat. By Soňa Ripková, Slavomír Adamčik, Viktor Kučera and Ladislav Palko. 2007. Institute of Botany of the Slovak Academy of Science, Dúbravská 14, SK-845 23 Bratislava, Slovak Republic (e-mail: eva.zaletova@savba.sk). Pp. 148, with accompanying CD. ISBN 978 80 969721 3 5. Price: not indicated (available for exchange).

There are no illustrations in this little book save the four on the cover and spine, illustrating the enticing research area and three photogenic fungi. The text, however, leaves no doubt that this is a major work of love by a group of Slovak mycologists dedicated to the area, to the macrofungi occurring there, and to the ecology of this eastern portion of their country. It is based on extensive collecting in 2001-2003, in 18 selected localities, each carefully described and located on maps. For each of the taxa recorded in the Annotated List of Known Macromycetes the localities, collection dates, ecological entries, and herbaria of deposit are noted. Recorded are 517 taxa (77 of *Ascomycota*, 440 of *Basidiomycota*). Detailed study of the literature previously published showed that 14 of 29 previously recorded *Ascomycota* and 101 of 233 previously recorded *Basidiomycota* were not confirmed during their research. About 200 specimens of the genera *Amanita, Cortinarius, Galerina,* and *Scutellinia* and of aphyllophoraceous fungi remain unidentified "because of difficulties in taxonomy or lack of monographs." The text (other than the Annotated List) appears in two columns, the left in English, the right in Slovak. Each species in the Annotated List has up-to-date nomenclators, details of the collection areas and collection dates, and is provided with ecological notes, and not infrequently with rather lengthy taxonomic or ecological comments on that species and its allies. I have only two minor criticisms: (i) some of the English translations could have used the help of a native speaker, and (ii) the title does not reveal that only macrofungi are covered.

What a font of information this book contains. Ecological tables on occurrence and succession of lignicolous fungi on *Fagus, Quercus, Carpinus,* and *Salix* are highly informative. Comments and generic listings appear on other hosts with fewer species involved and on herbicolous, muscicolous, fungicolous, coprophilous, and terrestrial fungi. A large table of the mycorrhizal fungi and their associated trees is also provided. This is no mere checklist, but a major contribution to a small but obviously diverse area. It will whet the appetite of many to visit there and will serve as a model of efficiency for those who design such projects in the future.

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Houby, Lišejníky a Mechorosty Národního Parku Podyjí. By Vladimír Antonín, Bronislav Gruna, Zbyněk Hradílek, Alois Vágner & Antonín Vězda. 2000. Masarykova Univerzita v Brně, Brno, Czech Republic. Pp. 222 pp., 1 map. ISBN 80-210-2391-0. Price not indicated.

Although published in 2000, this work is included here as my aim has been to make this section of *Mycotaxon* as complete as possible from that year, when I inherited the role of Book review Editor. This book covers the macromycetes, lichens and bryophytes of the Podyjí-Thayathal National Park in the Czech part of the western Carpathian mountains.

The macromycete section (pp. 29-95) by Vladimír Antonín and Alois Vágner treats 828 macromycetes, of which almost half are agarics. Three species are additions to the Czech Republic, two are new for the region, and some rarely reported fungi were found (e.g. *Ascotremella faginea, Biscogniauxia simplicior,* and *Marasmius limosus*). Information on ecology and fruiting times is included, but not the sources of all records. The lichen section (pp. 97-160), by Antonín Vězda and Bronislav Gruna, covers 396 lichens species, almost 100 more than listed by Jindrich Suza from the region in 1933. Full information on the sources of lichen records is provided and some entries are quite extensively annotated. Synopses of earlier investigations in the region are also included.

The main text is in Czech, but summaries of the introductory chapters and an overall summary are given in German. The publication cost was paid for from a grant that also covered the survey work, and only 500 copies were printed. Those wishing to secure a copy would be well-advised to try and secure one promptly as stocks are surely already severely depleted.

ZYGOMYCETES

Fungi of Egypt I. *Zygomycetes*. By Abdel-Wahid Fahim Moustafa. 2006. Assiut University Mycological Centre (AUMC), Assiut, Egypt (fax: 20 88 2342708). Pp. 34. [AUMC Descriptions No. 1.] ISBN not indicated. Price: not indicated.

Housed in a purpose-built building, the Assiut University Mycological Centre is now becoming the main focus for systematic mycology in Egypt. It is the vision of A. H. Moubasher, a leading specialist on the isolation and identification of soil fungi in desert regions, and courses which the centre has been running are now being complemented by identification aids. This first booklet has been prepared by Abdel-Wahid Fahim Moustafa who originally studied in Assiut but is now based at the Suez Canal University in Ismailia. It deals with 33 species belonging to either *Mucorales* or *Zoopagales*, nine of which are first records for Egypt, and all but four of which have been isolated by the author. Ten of the species are represented in the Assiut genetic resources collection. Following an introduction covering techniques for isolation and substrate preference, keys to orders and families are presented. The genera are arranged by family, and the accounts include diagnostic descriptions, keys to species, and in most cases original line drawings. Somewhat surprisingly, however, there is no information on the localities in Egypt from which the individual species have been found. The booklet is, apart from a translation into Arabic of the Foreword, entirely in English; this means that it is likely to be used outside Arabic-speaking countries by soil mycologists able to obtain a copy. I congratulate Professor Moubasher on this initiative and will be interested to see what group of fungi is tackled in No.2.

BASIDIOMYCETES

***Ramaria* of the Pacific Northwestern United States.** By Ron L. Exeter, Lorelei Norvell & Efrén Cázares. 2006. Bureau of Land Management, Salem District, 1717 Fabry Road SE, Salem, OR 97306, USA (e-mail: Ronald_Exeter@blm.gov). ISBN-13: 978-0-9791310-0-4, ISBN-10: 0-9791310-0-6. Pp. 156 pp. Price: US $ 27.

There are least four reasons to obtain this guidebook, and none to inhibit its place on appropriate bookshelves.

First; the temperate climate seems to include ecomycological "hot spots" – areas that seem unusually speciose in certain groups of mushrooms and their relatives. For the colorful, attractive coral fungi, the temperate rainforest of western North America is certainly one. Others, like western China-Himalaya south slope, central Europe (over the last 30 years the number of described ramarias has doubled!) and perhaps the Caucasus Mountains (including Georgia) have been far less investigated and for them no such single publication is available.

Here are presented thumbnail descriptions, multiple color photos, commentary, and pertinent literature citations for 90 taxa, representing all four subgenera. The lion's share is of subgen. *Laeticolora*, those often brightly colored, coralloid ectotrophic associates of conifers. Following Corner's lead, these are divided into those with clamped basidia versus those of which basidia lack the clamp connection. For the other subgenera (a total of 27 taxa), comprehensive keys plus descriptions and photos suffice. But it is the photos, often of type material in color for the first time and many volunteered by other workers, which make the work both attractive and sensational. In addition, there is a primer for methodology, numerous supplementary keys, a glossary and bibliography.

A second reason to own the book is to help identify what you *don't* have in your local mycobiota. How many concepts of *Ramaria subbotrytis*, *R. gelatinosa*, *R. flava*, etc. occur worldwide, of which almost none are correct? By accurately portraying this local assemblage, the authors have narrowed numerous diagnoses and demonstrate what might be and what is *not* present in other ecological hot spots.

The third reason: to see what can be done with a single genus (albeit an attractive one) in a limited area (albeit extremely rich in higher fungi). The original rationale for the book was the high percentage of *Ramaria* in the mycobiota thought to characterize "old growth forest" (the conserved habitat of the threatened Spotted owl). If *Ramaria* was an indicator group, then at least it should be accurately inventoried. An old story for some enlightened countries – a new idea for the United States.

Finally, the book can serve as a model for similar guidebooks. Such a series for agarics of the same general region was envisioned by the late Alexander Smith but was never commenced. Lately, Europe has seen increasing generic summaries, often with excellent illustrations, but the *Ramaria* guidebook is a unique model. I recommend it to all students of larger fungi and to other denizens of the forest.

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***Boletaceae* (I).** Edited by Mu Zang. 2006. Science Press, Beijing, China. [Flora Fungorum Sinicorum Vol. 22.] Pp. xix + 215, 60 figs (4 in colour). ISBN not indicated. Price: not indicated.

Before starting this review I must admit that I had shown little interest in the *Boletaceae* species of the Far East; things soon changed when I began working through this volume. The title page reads, "A Major Project of the Knowledge Innovation Program of the Chinese Academy of Sciences", followed by "A Major Project of the National Natural Science Foundation of China". This illustrates the vast task that has been undertaken by the Chinese; this book is part of the series.

The introduction contains a "Brief History of research of *Boletus* in China". Research has shown that *Boletus* records go back as early as the Ming dynasty (Lan Mao's 1397-1476) as they were at that time looking extensively for medicinal cures and soothing remedies, there are fascinating hints and explanations of the shapes and colours to look out for. Missionaries travelling from many countries to China also took interest in the genus, primarily to send samples back to their own lands. I found these few pages of historical facts quite fascinating, informative and very enjoyable to read.

Over 280 *Boletaceae* taxa are described within the volume; these include subspecies and forms. It is very apparent how much has been accomplished by the author Zang Mu and other Chinese mycologists. The layout is admirable and the descriptions are accompanied by excellent line drawings. Regrettably the volume contains only four colour plates and these are not of the best quality. A comprehensive set of keys is included: these are easy to use and are in English and Chinese, but sadly for westerners the descriptions are only in the latter.

The paper used and the printing is what we have come to expect from China, but for a project of this kind I would have hoped for better, as so much thought and planning has gone into the preparation of this well produced series. My hope is that one day we will see it fully translated into English; this would contribute to greater understanding of the Chinese mycobiota and would allow non-Chinese speakers an opportunity to research their own genera more effectively by relating it to the context of international collections.

In the meantime anyone who is really interested in this genus the volume is a must and worth a place on your bookshelf.

It has been a challenge for me to review this volume but also an advantage, as I have made some Chinese friends who have been coerced into reading and translating some of the passages for me.

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***Phyllachoraceae* of Australia.** By Ceridwen A. Pearce & Kevin D. Hyde. 2006. Fungal Diversity Press, School of Biological Sciences, University of Hong Kong, Pokfulham Road, Hong Kong S.A.R., Peoples' Republic of China (e-mail: kdhyde@hkucc.hku.hk; www.fungaldiversity.org/fdp/fdp.htm). Pp. 308. [Fungal Diversity Research Series no. 17.] ISBN 962 86765 04. Price: US $ 80.

This book contains an account of the *Phyllachoraceae* of Australia, prepared as part of the Australian Biological Resources Study initiative. It covers 87 species identified from over 1100 specimens studied in herbaria or collected especially for the project. Five species proved to be undescribed, in addition to a number previously published at earlier stages of the study. The work builds on studies made by another Australian mycologist, Doug Parbery, who published seminal accounts of *Phyllachora* on grasses in the 1960s and 1970s.

Following a wide-ranging introduction that details the history of taxonomic and ecological research in the *Phyllachoraceae*, a chapter on materials and methods and a key to genera and host index, the main body of the book provides descriptive accounts of the species collected by host family. Research was based entirely on morphological studies without a molecular phylogeny component, rather a shame as the *Phyllachoraceae* has hardly been studied using DNA sequences. Each species is generously illustrated with black and white photographs. Many of these are of good quality, but are exclusively of water mounts which do not always effectively show details such as ascus rings.

The final chapter, though short, is of particular interest as it addresses the potential conservation status of the Australian *Phyllachoraceae*. Microfungi are woefully neglected in conservation studies, and studies such as these have an important role in bringing fungi onto the conservation agenda. Thirteen of the 87 species are considered to be Endangered or Vulnerable, and it is to be hoped that their protection will be actively pursued by the authorities in Australia.

The work is not perfect – for example two of the six new taxa have incorrectly formed Latin names, a third is dubiously coined and a fourth is a later homonym. I would have preferred to see keys to species within each host family in addition to the tables of characters, which are restricted in scope and sometimes poorly formatted. However, the book represents by far the most detailed account to date of the *Phyllachoraceae* on a geographical basis, and will be a valuable resource for further research into conservation. There are not many publishers who will accept book-length manuscripts on such specialized topics these days, and *Fungal Diversity Press* should be congratulated for making this work accessible to the mycological community.

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***Mycosphaerella* and its Anamorphs: 2. Conspectus of *Mycosphaerella*.** By André Aptroot. 2006. Centraalbureau voor Schimmelcultures, PO Box 815167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl; www.cbs.knaw.nl). Pp. vi + 231, figs 989. [CBS Biodiversity Series No.5.] ISBN 10: 90 70351 60 9, 13: 978 90 70351 60 1. Price: 50 €.

This is a companion volume to that of names in *Cercospora* and *Passalora* (Crous & Braun 2003; see *Mycotaxon* 89: 518, 2004), and deals with all species epithets proposed in both *Mycosphaerella* and *Sphaerella*. According to the Introduction and History (p. 2) the number of taxa to be considered is about 3000, and the total number of scientific names is close to 10 000. This is an extremely important reference for all future work on this most important group of fungi, as it has involved not only a compilation but examining type material, proposing name changes and synonymies, and checking the nomenclatural status of the names. The species are arranged alphabetically by epithet, with all homotypic names treated together. Information on the type material is given, but it is not always clear whether it has been studied or not, though a clue is that "full details are given usually only when the type has actually been studied" (p. 24). But this is not just a nomenclator as there is a welcome key to 17 genera and some species "often confused" with *Mycosphaerella*, and also keys to the morphospecies accepted in both *Davidiella* (28 spp.) and *Mycosphaerella* (25 spp.). The species separations are difficult in this group to say the least, and in the key to *Davidiella* there is what may be a world first – a polytomy with 20 choices in the second couplet.

Fifty-four new names or combinations are made, of which 26 are into *Davidiella*. Somewhat controversially, *Mycosphaerella ascophylli* is transferred to the lichenicolous genus *Stigmidium*, a genus which is indicated to differ from *Mycosphaerella* primarily by the presence of periphyses in the ostiolar neck and periphysoids in the upper part of the ascoma. This means that *Mycophycias* (consistently spelled as *Mycosphycias* by Aptroot) would become a synonym of *Stigmidium*, but the differences in how the internal filamentous tissues develop stressed by Kohlmeyer & Volkmann-Kohlmeyer (1998) are not discussed. This conclusion clearly needs to be verified by molecular phylogenetic methods. The inclusion of the fungicolous (on *Godronia fuliginosa*) *Mycosphaerella parasitica* in *Stigmidium* is also of note, as is the recognition that *M. pneumatophorae* as an additional species of *Collemopsidium* on pneumatophores of the mangrove *Avicennia nitida*. Attention to nomenclatural and bibliographical details is a particular feature of this work, though the author does seem to have misunderstood Art. 59 in declaring *Sphaeropsis lichenoides* var. *buxicola* and its homotypic names all "illegitimate" as based on an anamorphic type; in fact the names are legitimate but not available for use as teleomorph names unless epitypified by a specimen with the teleomorph.

Also included in the work are the outlines of single ascospores from 961 taxa, which extend over a massive 11½ pages. This is a most welcome feature, but it would have been much more helpful to have several ascospores in each case, and perhaps also the asci illustrated, as was done by Tomilin (1979) in a previous major compendium of *Mycosphaerella* names. However, there are also some beautiful coloured photographs of asci and ascospores on p. 23, unfortunately not labeled on the page, and with Figs 978-979 missing. It is a pity many more such photomicrographs could not have been included.

The book concludes with a single index that gives host generic names and then the epithets of the accepted fungal species known from them. This is most useful but could have been complemented by an index to the generic names of fungi mentioned in the epithet treatments; at present they can only be located by scanning page by page.

The whole is very well produced and laid out, but I did find it irritating that it was produced softbound and at A4, whereas the companion volume by Crous & Braun (2003) is hardbound and octavo.

While this is only a step on the road to a full treatment of *Davidiella* and *Mycosphaerella*, and it will be fascinating to see how the morphospecies concepts adopted fare in future molecular phylogenetic studies, it is an incredible painstaking compilation which probably only an Aptroot would attempt. All future workers on these fungi will be indebted to him for undertaking something they would not have the time, determination, or broad nomenclatural and taxonomic knowledge to do.

Crous, P. W. & Braun, U. (2003) *Mycosphaerella and its Anamorphs: 1. Names published in Cercospora and Passalora.* [CBS Biodiversity Series No. 1.] Centraalbureau voor Schimmelcultures, Utrecht.

Kohlmeyer, J. & Volkmann-Kohlmeyer, B. (1998) *Mycophycias*, a new genus for the mycobionts of *Apophlaea*, *Ascophyllum*, and *Pelvetia*. Systema Ascomycetum 16: 1-7.

Tomilin, B. A. (1979) *Opredelitel Gribov Roda Mycosphaerella Johans.* Nauka, Leningrad.

***Hypocrea* and *Trichoderma* Studies marking the 90th Birthday of Joan M. Dingley.** Edited by Walter Gams. 2006. Centraalbureau voor Schimmelcultures, PO Box 815167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl; www.cbs.knaw.nl). Pp. x + 179, illustrated (some in colour). [Studies in Mycology No. 56.] ISBN 10: 90 70351 64 1, 13: 978 90 70351 64 9. Price: 60 €.

Joan Dingley was one of the pioneers in elucidating relationships between *Hypocreales* species and their anamorphs. This is therefore a most fitting tribute to her on the occasion ofhe 90th birthday. The issue comprises four contributions: Systematics of *Hypocrea citrina* and related taxa (Barrie E. Overton et al.; pp. 1-38), Taxonomy and phylogenetic relationships of nine species of *Hypocrea* with anamorphs (Overton et al.; pp. 39-65), the *Trichoderma koningii* aggregate species (Gary J. Samuels et al.; pp.67-133), and *Hypocrea rufa*/*Trichoderma* *viride*: a reassessment and description of five closely related species with and without warted conidia (Walter M. Jaklitsch et al.; pp. 135-177).

All four contributions combine molecular phylogenetic studies with critical microscopic examination and cultural studies, and are illustrated to superb standards. The main results show the *H. citrina* group to comprise 11 species (one newly described and one raised in rank), that there are nine *Hypocrea* species with anamorphs in *Trichoderma* section *Hypocreanum* (two newly described and one given a new name), that the *T. koningii* aggregate comprises 12 species and two varieties (seven newly described), and *H. rufa* is confirmed as relatively rare in a group of six species (of which five are newly described). In all cases traditional keys are provided, and there are orange-edged pages with tabular compilations of a wide range of characters for the species discussed.

Having once had the role of identifying *Trichoderma* isolates submitted to the International Mycological Institute, having studied a microscopic preparation from the original Persoon material of *T. viride* personally, and also collected these fungi from the field, I cannot but applaud the progress made over recent years by Walter Gams, Gary Samuels, Christian Kubicek, Irina Druzhinina and their co-workers in elucidating species concepts in these fungi. My one regret in this work is the perpetuation of the use of both anamorph and teleomorph names, and further the introduction of new anamorph names where the teleomorph is known, something contrary to what is recommended in the current *Code*. The sooner we can reach the nomenclatural position of being able just to use *Trichoderma* (syn. *Hypocrea*) for the holomorphs the better . . . . There is surely more than enough to do in describing the novel taxa that are coming to light, without unnecessarily inflating the catalogues of names.

Phylogenetic Classification of *Cordyceps* and the Clavicipitaceous Fungi. By Gi-Ho Sung, Nigel L. Hywell-Jones, Jae-Mo Sung, J. Jennifer Luangsa-ard, Shusham Shrestha & Joseph W. Spatafora. 2007. Centraalbureau voor Schimmelcultures, PO Box 815167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl; www.cbs.knaw.nl). Pp. iv + 63, figs 12 (some in colour), tables 1. [Studies in Mycology No. 57.] ISBN 978 90 70351 66 3. Price: 40 €.

With over 400 described species, revising *Cordyceps* using modern molecular phylogenetic approaches was never going to be easy. These authors, from Korea, Thailand and the USA, have collaborated to assess the relationships of 162 taxa using nucSSU, nucLSU, tef1, rpb1 rpb2, β-tubulin, and mtATP6 gene sequences. Three clades are supported, and the monophyly of *Cordyceps* with the *Clavicipitaceae* is rejected. Further, many of the characters used in the classification, such as aggregation of perithecia and ascospore fragmentation proved not to be informative phylogenetically, though the texture, pigmentation and morphology of the stromata were. Two families are recognized, *Cordycipitaceae* which is validated, and *Ophiocordycipitaceae* which is described as new; these have brightly coloured and soft vs dark and often tough stromata respectively. The new genus *Elaphocordyceps* is described for species on *Elaphomyces* truffles and *Metacordyceps* for teleomorphs of *Metarhizium*. And as to the *Clavicipitaceae* itself, that ends up as pretty well restricted to grass symbionts, which makes much ecological sense, but plus the entomogenous *Hypocrella* and its allies, which does not. The accepted names in the various genera are all summarized and numerous new combinations are made, but there are no keys to species. The proposed changes will take much getting used to, as while *C. militaris* remains in *Cordyceps*, *C. sinensis* which is much-used in Chinese medicine is combined into *Ophiocordyceps*; this will not be popular amongst the applied community, and I do wonder if a more prudent course might have been to conserve *Cordyceps* with *C. sinensis* as type. This would also have made sense as it is *Ophiocordyceps* that emerges as by far the most speciose genus in the complex. Sadly now this has been published, I fear that a formal proposal to change the type would be unlikely to succeed. Notwithstanding this nomenclatural quibble, this is a landmark contribution in our understanding of the relationships of these fungi and again shows the power of having teams of researchers combining to address major questions.

Checklist of Polish Larger Ascomycetes. By Maria Alicja Chmiel. 2006. W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-Kraków, Poland (e-mail: ed-office@ib-pan.krakow.pl). Pp. 152. [Biodiversity of Poland Vol. 8.] ISBN 83 89648 46 6, 978 83 89648 46 4. Price: not indicated.

This checklist accepts 785 species in the three orders of *Leotiomycetidae* (i.e. *Helotiales*, *Rhytismatales*, and *Theleobolales*). For each species, as well as the scientific names with authorities, the Polish name is given where available, followed by synonyms, information on the substrate, and also references to the Polish records. Pleasingly, the list is totally alphabetical, with synonyms cross-referenced in the same alphabetical sequence, but printed in smaller type – a very pleasing format. The reference list extends over 18 pages, and there is an appendix providing full authors' names with their dates of birth and death. There are few points that might be commented, for example the absence of dates of publication of accepted names and synonyms, which would have been a bonus, and the incorrect citation of authors of species names when referring to infraspecific taxa. The whole has clearly been painstakingly produced and will be of value to mycologists wishing to identify material from Poland as well as to those wanting to know if particular species occur in the country (e.g. pathogenic species of *Lophodermium*). The author should take pride in this achievement.

Rare or Noteworthy *Helotiales*. By Ain Raitviir. 2006. Edizioni Candusso, Via Ottone Primo 90, I-17021 Alassio (SV), Italy (e-mail: maxcandusso@librero.it). Pp. 57, illustrated (12 pp. in colour). [Fungi Non Delineati Pars 31.] ISSN 1128-6008. Price: not indicated.

This, probably Raitviir's last publication before his untimely death, has been prepared to the highest standards. It deals with 17 species from four families which are described in detail and illustrated by a combination of line drawings and superb colour habit photographs taken by Jens H. Petersen or Riccardo Galán. One new genus is introduced, *Lasiomollisia,* for the single new species, *L. phalaridis,* discovered on dead culms and leaves of *Phalaris* in Sweden, which has whitish discs and densely white fimbriate margins; molecular work revealed *Sarconiptera vinacea* as the nearest taxon in GenBank. *Trichopeziza iberica* is described as new from dead leaves of *Lygeum spartum* and *Stipa tenacissima* in Spain, and two new combinations into *Incrucipulum* are made. This will be valued by all discomycete specialists.

LICHEN-FORMING FUNGI

Opuscula Philolichenum. Edited by James C. Lendemer. 2004-07. James C. Lendemer, c/o Department of Botany, The Academy of Natural Sciences of Philadelphia, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103, USA (e-mail: lendemer@acnatsci.org; http://clade.acnatsci.org/lendemer/opus.html). 4 vols. ISSN not indicated. Price: PDF files free.

It is a rare event to record the launch of a new lichenological journal. This one, now in its fourth year, is the brainchild of its editor, who is the curator responsible for lichens in The Academy of Natural Science of Philadelphia; the journal is, however, "not to be considered affiliated in any respect with The Academy", as made clear in the preliminary statement printed in each issue. The journal, which is issued annually, "is intended to provide an outlet for the publication of short papers in lichenology, especially small floristic works, checklists, modest taxonomic revisions". The papers are available from the internet in PDF format completely free of charge, and a limited number of hard copies are printed each year so that new nomenclatural acts are effectively published under the *Code.* Papers are peer reviewed, and to judge from the names of the referees cited this policy is rigorously adhered to. The accepted papers are formatted by the editor, very well laid out, and line drawings, half-tones, and in the more recent numbers colour photographs are also included. This is essentially an electronic open access publication with a hard-copy back-up, and something that is sure to become more popular in future. The individual issues (volumes) are 50-80 pages in length, and contain 7-11 contributions. The contributions mainly focus on the USA, and are essentially a mixture of regional or site lists and taxonomic notes. Examples are a checklist of the lichens of New York (1: 55-74, 2004), name changes in *Porina* s. lat. (2: 15-16, 2005), the resurrection of *Myriospora* (3: 1-4, 2006), *Maronea* in North America (3: 65-68, 2006), new lichenicolous heterobasidiomycetes (4: 11-22, 2007), *Lepraria* in the Great Smoky Mountains National Park (4: 51-54, 2007), and schedae to the editor's exsiccate "Lichens of Eastern North America" (now at 250 released numbers). Most issues also include new combinations or newly described species, but not with MycoBank numbers assigned; that is something that needs to considered for future issues as availability of the key nomenclatural and descriptive information through that database would be very much in the spirit of the new journal. *Opuscula Philolichenum* clearly meets a need amongst North American lichenologists, and James C. Lendemer should be well-pleased with the result.

Central European Lichens – diversity and threat. Dedicated to Ivan Pišút. Edited by Ana Lackovičová, Anna Guttová, Eva Lisická & Pavel Lizoň. 2006. Mycotaxon, P.O. Box 264, Ithaca, NY 14841-0264, USA [for orders contact Eva Zaletova, Institute of Botany, Slovak Academy of Sciences, Dubravska cesta 14, 845 23 Bratislava, Slovakia (e-mail: eva.zaletova@savba.sk)]. Pp. 364. ISBN 0-930845-14-5 (hardbound), 0-930845-15-3 (softbound). Price: for exchange only.

Lichenology in Slovakia is strongly connected with the name of Ivan Pišút not only because of his many papers on the topic but also because he was the first Slovak spending his professional career completely with lichenology in his home country, first in the National Museum and later in the Slovak Academy, by this creating the backbone for lichenology in the country. Now his colleagues from the academy and many of his friends produced a fine Festschrift on occasion of his 70th birthday in 2005.

The volume contains, after a nicely illustrated dedication, 21 scientific papers by 33 authors coming from 7 countries. The volume starts with two papers focusing on European species in general. Hannes Hertel's paper *World distribution of species of* Lecidea (Lecanorales) *occurring in Central Europe* accepts 38 species of *Lecidea* s.str. to occur in Europe and presents maps of the world distribution for 36 of them. An identification key for the species of cetrarioid lichens in Europe is given by Tiina Randlane and Andres Saag. The following papers concentrate on floristics in Slovakia and neighboring countries. There are seven contributions from Poland, five from Slovakia, four from the Czech Republic and one each from Austria and Slovenia. The genera especially involved include *Gyalecta*, *Lepraria*, *Leptogium*, *Rinodina* and *Verrucaria*. Finally one paper concentrates on morphometric and chemical evaluation of *Solenopsora carpatica*, a species described by Ivan together with Anton Vězda, which is also depicted as cover illustration.

All papers are in English and offer a lot of new information on lichen diversity in Central Europe especially in Slovakia and surrounding countries. There are no taxonomic novelties introduced here but an index of all lichens and lichenicolous fungi is certainly of great help for many users. Congratulations to Ivan and to the producers of the very appropriate volume dedicated to him.

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The Lichen Genus *Micarea* (*Lecanorales, Ascomycota*) in Poland. By Paweł Czarnota. 2007. W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-Kraków, Poland (e-mail: ed-office@ib-pan.krakow.pl). Pp. 199, figs 61 (some in colour). [Polish Botanical Studies No.23.] ISBN 978 83 89648 8. Price: not indicated.

This is a traditional carefully prepared monograph that accepts 34 species in Poland, two of which are described as new to science, and one of which is a first record for Poland. Some new distinctions are made, for example in the separation of *Micarea micrococca* from *M. prasina* on the basis of the secondary chemistry; some new synonymies are proposed; and three species prove to have been incorrectly reported from the country.

There are superb colour pictures illustrating the habit and colours in vertical sections of the apothecia as well as of asci, ascospores and — in many cases — conidia. Full information on synonyms and types is provided, with detailed descriptions, information on habitats and distributions (with maps), notes, and lists of specimens examined. There is also an index to exsiccates studied.

As this is entirely in English and such a carefully executed study it will come to be widely alongside the monograph of Coppins (1983) as a key work for the identification of these lichens in north-temperate regions and not only in Poland.

Coppins, B. J. (1983) A taxonomic study of the lichen genus *Micarea* in Europe. Bulletin of the British Museum (Natural History), Botany 11: 17-214.

***Lecanorales, Bacidiaceae* I. *Bacidia* y *Bacidina*.** By Esteve Llop. 2007. Sociedad Española de Lichenología, Barcelona, Spain (e-mail: ellop@ub.edu). Pp. 48, figs 5 (3 in colour). [Flora Liquenológica Ibérica.] ISSN 1696-0513. Price: 10 €.

This book is the third in this series. It deals with the genera *Bacidia* and *Bacidina* (*Bacidiaceae*) in the Iberian Peninsula. There are keys to the 18 genera of the family *Bacidiaceae*, 25 species of *Bacidia*, and 11 species of *Bacidina*.. Information on the nomenclature, detailed descriptions, habitat and distributional information, and also other observations are given for all the taxa treated. The descriptions of the genera are based on all known species of the genera in the world, but those of the species are based on specimens studied from the Iberian Peninsula.

The illustrations include microphotographs showing the thallus layers, exciple structures, and disposition of crystals in the exciple and epithecium of two species, and there are 11 fine macrophotographs of *Bacidia* and *Bacidina* species. I believe that all these photographs will be very useful to readers in identifying the species. There are also ascospore drawings of 15 *Bacidia* and four *Bacidina* species. As is well-known, ascospore septation and shape is very important in the family *Bacidiaceae* for species separations, and I have no doubt that these nice and informative drawings will also be very useful to lichenologists.

Although the keys and the descriptions are in Spanish, they are easy to understand with the aid of a small Spanish dictionary, and these will be very useful to all lichenologists studying European, and especially Mediterranean, lichens.

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Taxonomic Studies on Saxicolous Species of the genus *Rinodina* (Lichenized Ascomycetes, *Physciaceae*) in the Southern Hemisphere with emphasis on Australia and New Zealand. By Michaela Kaschik. 2006. J. Cramer in der Gebrüder Borntraeger Verlagsbucchandlung, D-14129 Berlin, Germany (e-mail: mail@schweizerbart.de). Pp. 162, figs 89, tables 15. [Bibliotheca Lichenologica No. 93.] ISBN 10: 3 443 58072 6, 13: 978 3 443 58072 8. Price: 64 €.

This study, which has been undertaken with the supervision of the world's leading authority on the genus, Helmut Mayrhofer (Graz), takes a traditional approach, but also includes some molecular phylogenetic information. The bulk of the work, based on 814 collections many of which were made by Mayrhofer, comprises descriptions, distribution maps, photomicrographs of the ascospores that are so important in the genus, and lists of specimens examined. Full bibliographic and type information is supplied. In all 21 taxa are recognized in the region, of which four are described as new to science; some new synonymies are proposed, and some names are excluded for different reasons. Particular attention was paid to the pigments, using HPLC and HPTLC as well as traditional TLC. The molecular studies, based on freshly sequenced material and also data downloaded from GenBank, used ITS rRNA sequences showed ascus types and hypothecium pigmentation to be highly conserved features, corroborating the recognition of "*Physcia*-" and "*Buellia*-type" groups within the "genus". The genus is paraphyletic with the sister groups often foliose or fruticose genera, but the ascospore types do not support larger monophyletic groups. In due course it is inevitable that formal taxonomic changes will be made amongst these lichens, but that should await the analysis of many more specimens on a worldwide scale. For the moment, however, the author has produced a revision that will enable these taxa to be reliably identified for the first time.

Lundy Lichens. By Ann Allen. 2007. Lundy Field Society, c/o Ms Frances Stuart, 3 Lower Linden Road, Clevedon, Somerset BS21 7SU, UK (e-mail: alan.rowland@morwenstow.freeserve.co.uk; www.lundy.org.uk). Pp. 48, illustrated. ISBN 0 9530532 9 6, 13: 0 978 0 9530532 9 2. Price: £ 9.99.

This delightful little spiral-bound book provides an introduction to the lichens of this island in the Bristol Channel. It discusses what lichens are and the species that are notable in different habitats on this windswept island. It is well-illustrated by photographs by the author and Barbara Hilton and should do much to encourage the awareness of lichens amongst the bird-watchers and other naturalists that visit it. Passing references to previous publications on the lichens of the island are made, but sadly without full bibliographic details. Lichens are a conspicuous feature of the island's wildlife, and Lundy is especially well known for the abundance of *Teloschistes flavicans* (featured on the front cover) but is known to support around 350 species as a result of the studies by Peter W. James, Barbara Hilton, and the author. The enthusiasm of the author both for lichens and for the island permeates the text and photographs which clearly have been lovingly prepared. If such guides were available for many other sites, I am sure it would help boost interest amongst naturalists for the oft-neglected lichens.

CONIDIAL FUNGI

The *Fusarium* Laboratory Manual. By John F. Leslie & Brett A. Summerell, with photographs by Suzanne Bullock. 2006. Blackwell Publishing, 2121 State Avenue, Ames, IA 50014-8300, USA (e-mail: orders@ames.blackwellpublishing.com). Pp. 400, figs 73. ISBN 13: 978 0 8138 1918 8, 10: 0 8138 1919 9. Price: £ 75.

Species of the genus *Fusarium* comprise very important toxin producers and pathogens of plants, and sometimes humans and animals. Needless to say, an accurate identification of the species is crucial for communicating new findings and disclosing the information associated with a name. Works that are helpful for reliable identifications are needed. The taxonomy of *Fusarium* is in a phase of rapid development, mainly thanks to molecular phylogenetic studies, and the number of recognized species increases every year. Therefore, new textbooks are needed at regular intervals. Experts generally agree that *Fusarium* taxonomy more or less started in 1935 with *Die Fusarien* by Wollenweber & Reinking, the founders of the Berlin school that has retained its continuity until the retirement of Helgard Nirenberg very recently. Accurate observations were first based on cultures grown on six different media, including barley ears as the most natural substrate on which sporulation was developed in a most characteristic way. Later, the meagre SNA medium of Nirenberg, besides the American carnation leaf agar (CLA), came into use that permitted the fungi to rapidly develop their most characteristic morphology ("Hochkultur").

Around 1945, the American authors Snyder & Hansen, who used Wollenweber & Reinking's cultures in a mainly degenerated condition grown on potato-dextrose agar (PDA), were unable to distinguish the numerous taxa distinguished in Berlin; they dogmatically insisted in recognizing only nine species. It was a major breakthrough in *Fusarium* taxonomy when in 1983 Nelson et al. reverted from this unfortunate, misleading classification to a Wollenweber-like system and recognized 30 well-documented besides 16 "insufficiently documented" species. Nevertheless, some resentment between the two major schools has persisted until these days. There are objective criteria about species distinction and nomenclatural rules that determine the names to be used, which will reconcile conflicting views. Species concepts are discussed also in the present work, including criteria of morphology and molecular analyses. Consequently, species are to be recognized as distinct if differences in DNA sequences are also reflected in at least one of the disciplines: morphology, pathogenicity, ecology, or the spectrum of secondary metabolites. The type (or ex-type culture) determines the application of a name. Working with numerous isolates is not necessarily a criterion of species recognition, but is an advantage. The rules of nomenclature must be adhered to in selecting the correct and legitimate names. Thus *F. crookwellense* is preceded by *F. cerealis*, which is the name of choice; the name *F. semitectum*, the type of which shows a different fungus, cannot be upheld, while *F. pallideroseum* and *F. incarnatum* are available for fungi of this complex. Simply stated, synonymy must be taken seriously. When Fries sanctioned a name, this is to be indicated with ": Fr.", not "ex Fr." as done in this text for *F. heterosporum*. A streamlining of the information along these lines would have clarified and simplified the text.

The present volume is written by two experts from the American-Australian school: John Leslie, an experienced geneticist, and Lester Burgess's student, Brett Summerell, who did much ecological fieldwork in Australia and has described some new taxa. After Nelson et al.'s 1983 treatment, Burgess et al. produced a laboratory manual for *Fusarium* research, which saw its 3rd edition in 1994. This is the basis for the present volume. This book is intended for practitioners who need to identify *Fusarium* species by morphological methods. Molecular approaches are described in detail, but the results, mainly phylogenetic trees, are missing. Some trees would have been valuable to illustrate the natural affinities of taxa that are now only listed in alphabetic order. This is regrettable because the original subdivision of the genus into sections, though admittedly unnatural, is often helpful in identification. Apart from incidental notes, too little information is given on the taxonomic context of the species treated.

The chapters are: Techniques and methods (media, isolation, maintenance, vegetative compatibility, fertility, nucleic acids); Taxonomy and identification (brief history of *Fusarium* taxonomy, species concepts, teleomorphs, practical approaches to identification); and Species descriptions (morphological characters, individual species descriptions). A remarkable feature is the impressive list of 2425 references, which is not quite complete for taxonomy, but includes many titles dealing with metabolites and phytopathological aspects (species treated are sometimes listed in parentheses; the meaning of the associated figures is unfortunately not explained). Several taxonomic titles, like the book edited by Chelkowski (1989) containing a useful key to common species by Nirenberg, are missing. Among the media described in Chapter 2, CLA and SNA appear at equal level, but in the individual descriptions only observations on CLA and PDA are described. I sorely miss a warning against PDA as a preservation medium, which usually leads to a rapid degeneration of cultures and irreversible loss of important features. I also miss a warning against using near-UV irradiation in species like *F. avenaceum* where it overstimulates sporulation and irreversibly degenerates the culture. Observation of dark-cultured strains can also give additional morphological features. The methods described here deviate significantly from the highly standardized procedure used by Nirenberg & O'Donnell in 1998 to distinguish some difficult taxa of the *Gibberella fujikuroi* complex, which the present authors usually regard as morphologically indistinguishable. Apart from a brief introductory text and photograph, teleomorph features are not described. *Cosmospora* is omitted altogether. The morphological features of the macroconidia are described as the most important feature, followed by those of microconidia and chlamydospores. Features of conidiophores and phialides are not outlined in the general introduction but briefly mentioned in the special part under microconidia. I regret the use of the terminology of macro-, micro- and mesoconidia in preference to the more adequate distinction between primary (conidia in aerial mycelium) and secondary (sporodochial, conidia produced at the agar surface) conidiophores and conidia.

The core of the work is Chapter 13, comprising descriptions of 70 recognized species. A listing of remaining species, including well-known taxa like *F. coeruleum*, *F. coccidicola* or *F. flocciferum*, with sequences obtainable in GenBank, is given on p. 71. This documentation is reasonably up-to-date until 2004, but *F. zealandicum* 2000, *F. commune* 2003, *F. matuoi* 2004, and *F. brasiliense*, *F. cuneirostrum* and *F. gaditjirrii* from 2005 cannot be traced even in the Index. Each species is dealt with using the subheadings: Sexual stage, Common synonyms, Reported geographic and host distribution, Media to examine (CLA, PDA) and key features (macroconidia, microconidia, chlamydospores), Taxonomy, pathology and ecology, and Current species description. Teleomorph names are correctly cited, but the anamorph name is consistently given as the main header. What is listed under Common synonyms (without author and date) is often confusing; *F. subglutinans* appears as synonym under *F. sacchari* (this could only be permitted as a misapplication) and as a separate species; similarly, *F. tricinctum* is listed as a synonym under the highly toxic *F. sporotrichioides* and as a good, non-toxic species. Under *F. sambucinum* appear *F. torulosum* and *F. venenatum* as synonyms, which are certainly not correct, and these species are also treated separately. With each species a photographic plate illustrates several groups of macro- and microconidia with consistent 720 × magnification in Nomarski interference contrast, and laudably aerial hyphae with conidiophores and microconidia in an undisturbed state at lower magnification. This is often more informative than the brief description (with no measurements!) in the text. When several frames illustrate very similar (groups of) conidia, it is not clear whether different isolates or different culture conditions have been used. A documentation of the material illustrated would have greatly increased the value; reliably identified standard strains are often indispensable for identification of new isolates. On the whole I prefer the illustrations in Nelson et al.'s 1983 work which contain more numerous conidia to show some variation. Inclusion of drawings would have been very valuable to illustrate some fine morphological details. Under Taxonomy, the authors occasionally give some information about the classification in sections or clades. Similar species are mentioned but generally with too brief details to be helpful. The voluminous compilation on secondary metabolites for each species from the scattered literature is to be applauded, whilst the correct identification of the species involved may need some critical evaluation. The header Current species description mostly refers to standard works like Gerlach & Nirenberg, Nelson et al., or a later protologue, while other publications would often give more detailed information.

REMARKS ON THE TREATMENT OF SOME SPECIES: *F. anthophilum* was most clearly differentiated by Nirenberg in 1976, and *F. avenaceum* by Schneider (1958) and in some recent molecular studies. For *F. circinatum*, the characteristic circinate vegetative hyphae are correctly illustrated, but under *F. pseudocircinatum* and *F. sterilihyphosum* ordinary hyphal coils are photographed as they can occur in the most divergent hyphal fungi. The photograph of *F. equiseti* seems to illustrate a species of the *F. scirpi* complex rather than *F. equiseti* as it has been neotypified by Holubová-Jechová et al. in 1994; this complex of species still requires a critical revision. The synonymy of *F. graminum* with *F. heterosporum* is debatable, and so is that of the coffee pathogen *F. stilboides* with the still quite heterogeneous *F. lateritium*. In *F. merismoides* some varieties have been distinguished, which according to O'Donnell all deserve species rank; that some old authorities did not recognize these varieties has no significance at all. An illustration of *F. langsethiae* separate from *F. poae* is not strictly necessary if the distinctive features (aerial mycelium, absence of macroconidia) are at least properly described in words. The morphological distinction of *F. pseudograminearum* from *F. graminearum* has been worked out in drawings by Aoki & O'Donnell published in 1999, but here the photographs of both are perfectly identical. In *F. redolens* only two of the four illustrated macroconidia show the most characteristic feature of the species, the greatest width near the uppermost septum. The teleomorph name for *F. sacchari* in *Gibberella* is illegitimate being a homonym. With *F. sambucinum,* it should be mentioned that this name has been conserved against the older *F. roseum. F. equiseti* var. *bullatum* is by no means a synonym of *F. scirpi*, but probably a very good separate species. That *F. solani* still is a very heterogeneous complex of more than 30 species cannot be sufficiently emphasized. Some of these taxa have already been disentangled by Nirenberg and Samuels, but are not mentioned at all. In the strict sense, *F. solani* is not the anamorph of *Haematonectria haematococca.* In the photographs the conidia of *F. venenatum* are not distinguishable from those of *F. sambucinum.*

This book will fulfill the needs of Fungal Diversity Research Series no. 17, a guide for courses in *Fusarium* identification for beginners. However, lacking a framework of taxonomic connections by sections or clades, users will have difficulty memorizing the individual species. The greatest defect is the lack of analytical keys, whether dichotomous or synoptic. I still believe in the possibility of reliable identifications on a morphological basis, but more care is needed in describing and illustrating the discriminant features on paper or using interactive media. Thus, much scope is left for a critical up-to-date generic monograph, but at the moment no better general survey is available than the present book.

References not listed in the book:

Chelkowski, J., ed. (1989) *Fusarium: mycotoxins, taxonomy and pathogenicity.* Elsevier, Amsterdam.

Schneider, R. (1958) Untersuchungen über Variabilität und Taxonomie von *Fusarium avenaceum.* Phytopathologische Zeitschrift 32: 95-126.

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Helicosporous Hyphomycetes from China. By Guozhu Zhao, Xinbgzhong Liu & Wenping Wu. 2007. Fungal Diversity Press, School of Biological Sciences, University of Hong Kong, Pokfulham Road, Hong Kong S.A.R., Peoples' Republic of China (e-mail: kdhyde@hkucc.hku.hk; www.fungaldiversity.org/fdp/fdp.htm). Pp. 222, figs 95, many in colour. [Fungal Diversity Vol. 26 (2).] ISSN 1560-2745. Price: US $ 50.

This separately printed and hard-bound monograph will be of interest worldwide as it is the most substantial work on fungi producing coiled conidia to date. It treats 71 species in 14 genera found in China in detail, with full descriptions, information on cultural charactersistics, synonymy, and superb half-tone and colour photographs and drawings, but also does much more than that. For the genera, there are checklists of the known world species and a summary of where other names referred to them have been redisposed. There are keys to the species known in China or in some cases the world, and in other instances tables summarize the features of the known species instead.

A synopsis of all known helicosporous genera with the number of species indicated is provided, *Drepanospora* is regarded as a synonym of *Helicosporium*, and both *Helicosporina* and *Troposporella* are dealt with as synonyms of *Helicosporium*. However, while specimens from China that have been studied are detailed, it is unclear in most cases whether type or authentic material has been examined. In most instances the identifications and dispositions seem to have been based on published descriptions and illustrations; these are referred to in the accounts of the species known from China. The extent to which many of the genera are monophyletic will have to await more molecular work; *Xenosporium* in particular seems unlikely to be a phylogenetic unit in view of the differences amongst the conidia of the included species. Some fieldwork was undertaken as a part of the study, and as a result nine species are described as new to science; two new combinations are also made.

The whole is well-produced, but it must have been frustrating for the authors to find Figs 26 and 27 both printed twice on different pages. It is pleasing to see this work issued separately as it will be required by all mycologists who specialize in hyphomycetes or work on the ecology of fungi in streams and other wet habitats in which these beautiful fungi are found.

Nomenclatural novelties proposed in Mycotaxon 102

Acrodictys irregularis R.F. Castañeda, Gusmão & Guarro, p. 92
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Cladobotryum novovarium K. Põldmaa, p. 186
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Cubasina microspora M.F.O. Marques, Gusmão & R.F. Castañeda, p. 18
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Diplocladiella cornitumida F.R. Barbosa, Gusmão & R.F. Castañeda, p. 43
Diplococcium verruculosum A.C. Cruz, Gusmão & R.F. Castañeda, p. 34
Fasciatispora ujungkulonensis Hidayat, p. 350
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Reviewers, Volume One Hundred Two

The Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers appearing in this volume.

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ERRATA

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