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Taxonomic studies on *Ustilaginomycetes* - 27

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Abstract — The smut fungi of *Acanthaceae, Eleusine, Eragrostis, Limnanthemum, Paspalum, Setaria,* stripe smuts of *Calamagrostis,* and others have been studied. New species include *Entyloma heterothecae, Franzpetrakia phaceluri, Restiosporium guringaliae, Sporisorium myanmarense, Tilletia melicae, T. setariae-parviflorae, T. setariae-pumilae, T. shivasii, T. thailandica, Ustilago planetella.* New names (*Macalpinomyces patilorum, Sporisorium muticae*) and new combinations (*Doassansiopsis limnanthemi, Heterodoassansia khandalensis, H. ranunculina, Sporisorium chrysopogonis-fulvi, S. magnusianum, S. paspali, S. setariae-mombassanae, S. tembuti, Tilletia beckerae, T. sleumeri, T. sphaerocarpa, Urocystis pedicularis, Ustilago glabra*) are proposed. Twenty-nine taxa are placed in synonymy. *Ustilago panici-latifolii* and *U. pertusa* are excluded from the smut fungi. *Ustilago crameri* is neotypified, and *Doassansia opaca* and *U. eleusines* Syd. are lectotypified. Keys to *Franzpetrakia, Sporisorium* (on *Ischaemum*), *Tilletia* (on *Arundinella,* on *Poa,* in vegetative host tissues), the smut fungi of *Acanthaceae, Eragrostis, Limnanthemum, Paspalum, Setaria,* and the stripe smuts of *Calamagrostis* are also provided.

The smut fungi of *Paspalum* (*Poaceae*)

Paspalum L., with c. 330 species, predominantly in the New World, belongs to the subfamily *Panicoideae,* tribe *Paniceae,* subtribe *Setariinae* (Clayton & Renvoize, 1986:287). On *Paspalum* at least 25 smut taxa have been published. Some of them were invalidly published, e.g. *Ustilago linderi* and *U. microspora* var. *paspalicola.* Others are not smut fungi, e.g. *Thecaphora inquinans* = *Epicoccum andropogonis; Poikilosporium* (*Thecaphora*) *bogoriense* = insect frass. Others were found to be synonyms, e.g. *Sorosporium paspali* and its var. *verrucosum* are *Sporisorium paspali-thunbergii,* and *Ustilago verrucosa* J. Schröt. is *Moesziomyces bullatus.* The host plant of *Ustilago microspora* J. Schröt. & Henn., is not "*Paspalum* sp." but *Stenotaphrum* sp., and the smut is *Ustilago affinis.* The host plant of *Ustilago royleani* is *Digitaria stricta.* On *Paspalum* the following eight smut fungi could be recognised, some of them with doubt:

1. *Moesziomyces bullatus* (J. Schröt.) Vánky, Bot. Not. 130:133, 1977.

Sorosporium bullatum J. Schröt., Abh. Schles. Ges. Vaterl. Cult., Abth. Naturwiss. 1869/72:6, 1869. — Lectotype on *Panicum crus-galli* L., Germany, Schlesien, near Lignitz [= Poland, Legnica], (design. by Vánky, 1977:133) IX.1869, G.W. Schneider, HUV 2442!; isolectotypes in Rbh., Fgi. eur. no. 1489.

Ustilago verrucosa J. Schröt., in Hennings, Hedwigia 35:214, 1896. (not *U. verrucosa* Vestergr., 1897). — Type on *Paspalum distichum* L., Brazil, Estado de Sta. Catharina, Itajahy, I.1886, E. Ule 1619, HBG! (syn. nov.).

Tolyposporium evernium Syd., in Sydow & Ahmad, Ann. Mycol. 37:443, 1939. — *Tolyposporidium evernium* (Syd.) Thirum. & Neerg., Friesia 11:180, 1978('1977'). — Type on *Paspalum distichum* L., Pakistan, Punjab, Akalgarh, VIII.1938, S. Ahmad 105. (syn. by Vánky, 1986a:68).

Tolyposporium paspali Langdon, Univ. Queensland Dept. Biol. Pap. 2:4, 1948. — Type on *Paspalum distichum* L., Australia, Queensland, Brisbane, Ashgrove, Enoggera Creek, 2.III.1943, R.F.N. Langdon, BRIP 7987; isotype HUV 2481! (syn. by Vánky, 1986a:68).

For further synonyms, description, literature and illustrations see Vánky, 1994:163-166.

On *Poaceae*: *Echinochloa, Leersia, Panicum, Paspalum, Pennisetum, Polytrias* and *Uranthoecium* species; Cosmopolitan.

In the short original Latin description of *Ustilago verrucosa,* the sori are in some ovaries, are swollen, brown. The spores are 7-9 × 8-12 µm, ellipsoidal or subglobosely angular, subolivaceous, with pale brown, thick, densely verrucose wall. The German text states that the spores have cylindrical, flattened or globoid warts. These "warts" are actually the connecting processes between neighbouring spores. The "densely verrucose" spore wall in the original description is misleading. However, all sori in the type specimen contain the same fungus, *Moesziomyces bullatus.*

2. *Sporisorium paspali* (Speg.) Vánky, **comb. nov.**

MycoBank510377.

Basionym: *Ustilago paspali* Speg., Anales Mus. Nac. Buenos Aires, Ser. 2, 6:209, 1899. — Type on *Paspalum* sp., Argentina, near Tucumán, I.1895, C. Spegazzini, LPS 3030 (probably lost).

Ustilago paspali-notati Henn., nom. herb. (in Herb. Holway). — *Sphacelotheca paspali-notati* Henn. ex G.P. Clinton, J. Mycol. 8:140, 1902 [as '(Henn.) Clint. n. sp.']. — *Sporisorium paspali-notati* (Henn.) M. Piepenbr., Ecol. Bolivia 37:54, 2002, comb. invalid, based on a nomen nudum. — Type on *Paspalum notatum*, Mexico, Guadalajara, 15.IX.1899, BPI 165251!; isotype BPI 165250. (syn. by Ciferri & Herter, 1932:534).

Ustilago aristidicola Henn., Hedwigia 47:266, 1908a. — *Sporisorium paspalicola* M. Piepenbr., Flora Neotropica 86:122, 2003. — Type on "*Aristida* sp." (= misnamed *Paspalum brunneum*, det. H. Scholz, B), Brazil, Estado de Bahia, Maracás, IX.1906, E. Ule 3316, HBG 3316!; isotypes BPI 157312!, 196307!, FH (syn. by Vánky, 2001:311, as *Sporisorium microsporum*).

Sori destroying the racemes, transforming them into cylindrical bodies, 1-2 × 15-40 mm, sometimes comprising also the distal part of the floral axis, at first covered by a thick, brown peridium which ruptures irregularly, flakes away disclosing the blackish-brown, powdery mass of spores intermixed with groups of sterile cells surrounding a stout, bifurcate or ramified columella corresponding to the raceme axes, often with numerous, short lateral branches at its distal part. *Spores* when mature single, globose, subglobose, ellipsoidal to slightly irregular, (5.5-)6-8 × (6-)6.5-9(-9.5) µm, yellowish-brown; wall even, c. 0.5 µm thick, finely, densely punctate to verrucose-echinulate, spore profile smooth. *Sterile cells* in irregular groups, collapsed in old specimens, single cells variable in shape and size, 5-12 µm long, hyaline; wall thin (c. 0.5 µm), smooth.

On *Paspalum brunneum* Mez, *P. dilatatum* Poir., *P. notatum* Flüggé, *P. plicatulum* Michx., *P. proliferum* Arech., *P. urvillei* Steud., *P. vaginatum* Sw.; N., C. & S. America.

Spegazzini (1899:209), publishing *Ustilago paspali*, gave a very short, incomplete description. He wrote that the spores are small, smooth, in face view discoid, in side view convex-concave. For the spore measurements, Spegazzini gave 6-7 × 2-2.5 µm. Later Spegazzini (1925:155), based on material collected around La Plata, on *Paspalum dilatatum*, modified his description of this smut, giving 6-8 µm for the spore measurements and saying that some of the spores are minutely echinulate. Ciferri & Herter (1932:534) considered *Ustilago paspali* to be a synonym of *Sphacelotheca microspora* (Henn.) Cif. They considered that the shape and size of the spores, given by Spegazzini in his original description, are caused by observation and measurements of old, dried and shrivelled spores.

This smut fungus has been misnamed *Ustilago microspora* J. Schröt. & Henn. (*Sporisorium microsporum* (J. Schröt. & Henn.) M. Piepenbr.). Piepenbring (2002a:54) demonstrated that the host plant of the type is not „*Paspalum* sp." but *Stenotaphrum* sp., and the fungus is *Ustilago affinis* Ellis & Everh. Consequently, the next valid name should be applied for this smut, which is Spegazzini's *U. paspali*, belonging to the genus *Sporisorium*.

3. *Sporisorium paspali-thunbergii* (Henn.) Vánky, Publ. Herb. Ustilag. Vánky (HUV) 3:9, 1986.

Ustilago paspali-thunbergii Henn., Hedwigia 43:140, 1904. — *Sorosporium paspali-thunbergii* (Henn.) S. Ito, Trans. Sapporo Nat. Hist. Soc. 14:94, 1935. — Type on *Paspalum thunbergii*, Japan, Honshu, Nikko, IX.1902, S. Kusano 373.

Sorosporium paspali McAlpine, The smuts of Australia:180, 1910. — Type on *Paspalum scrobiculatum*, Australia, Queensland, coll. F.M. Bailey (syn. by Ito, 1935:94).

Sorosporium paspali var. *verrucosum* Thirum. & Pavgi, Mycopathol. Mycol. Appl. 7:283, 1956. — Type on *Paspalum scrobiculatum*, India, Bihar, Netarhat, 28.VIII.1952, M.J. Thirumalachar, HCIO 20992; isotypes IMI, HUV 17295! (syn. nov.).

Sori destroying the whole inflorescence, long cylindrical, 1.5-3(-4) mm × 5-15 cm, often twisted, partly hidden by the terminal leaf sheath, at first covered by a thick, greyish to brown peridium which ruptures irregularly, flakes away disclosing the blackish-brown mass of spore balls and spores surrounding a long, filiform, often undulate columella, sometimes with short lateral branches on its distal part. Rarely, the sori are restricted to the spikelets only. *Spore balls* globose, ovoid, to long ellipsoidal or slightly irregular, 25-40 × 30-60 µm, dark reddish-brown, composed of (5-)8-40 or more? spores which separate easily. *Spores* subglobose, ellipsoidal, usually slightly subpolyhedrally irregular, (8-)9-12(-14.5) × (10.5-)13-17(-20) µm, reddish-brown; wall uneven, thickest at the angles, 0.5-1.5(-2) µm, from apparently smooth to punctate or finely, densely verruculose, especially on the free surface of the spores, spore profile smooth. *Sterile cells* absent.

On *Paspalum conjugatum* P.J. Bergius, *P. dilatatum* Poir., *P. orbiculare* G. Forst., *P. scrobiculatum* L., (*P. commersonii* Lam.), *P. thunbergii* Kunth; Africa, S. & E. Asia, Philippines, Australia, Hawaii.

There are variations in the spore measurements between different collections, even on the same host plant from the same country, e.g. spores on *Paspalum orbiculare* L. from India may have a length of 10.5-14.5 µm or 12-19 µm. However, soral and other spore characters are identical, hence I am considering the difference in spore measurements as variation within the same species.

In the original description of *Sorosporium paspali*, the spores are given as smooth. (McAlpine 1910:180). The very fine verrucae, especially on the free surface of the spores, were not seen by McAlpine. In several specimens, collected in India, these were noticed by Thirumalachar & Pavgi (1956:283), who considered the fungus to be a new variety. Study of the type of *Sorosporium paspali* var. *verrucosum*, revealed that it is identical with *Sorosporium paspali* = *Sporisorium paspali-thunbergii*.

4. *Tilletia rugispora* Ellis, J. Mycol. 7:275, 1893.

Type on *Paspalum plicatulum*, USA, Texas, Brazos Co., College Station, 1889, T.L. Brunk. Topotypes in Ellis & Ev., N. Amer. fgi. no. 2704, HUV 2376!

Tilletia ulei J. Schröt. & Henn., in Hennings, Hedwigia 35:218, 1896. — Type on *Paspalum* cfr. *scrobiculatum*, Brazil, St. Catharina, coll. E. Ule 1616. (syn. by Schröter, in Hennings, 1896:218).

Sori in ovaries, rather inconspicuous, showing between the spreading floral envelopes as subglobose to ovoid, 1-1.5 × 1.5-2 mm bodies covered by the pericarp which ruptures irregularly disclosing the black, powdery mass of spores and sterile cells. *Spores* globose, subglobose, ovoid, broadly ellipsoidal, occasionally irregular, 17-22 × 18.5-24(-26) µm, yellowish- to reddish-brown, provided with conical 1.5-3 µm high warts. In surface view, the bases of the warts give the illusion of irregular, polyangular areolae. *Sterile cells* variable, mostly irregular to occasionally subglobose or lacrymiform, 15-27(-33) µm long, subhyaline, content granular; wall 3-5.5 µm thick, indistinctly laminated. Intermediate forms ("immature spores") subhyaline, pale yellow or golden-brown, sparsely papillose. *Spore germination* (Durán 1987:162, 192, Pl. 88) results in holobasidia producing apically many mononucleate basidiospores which may fuse in pairs.

On *Paspalum convexum* H. & B., *P. floridanum* Michx., *P. paniculatum* L., *P. plicatulum* Michx., *P. scrobiculatum* L., *P. virgatum* L.; N., C. & S. America. Introduced to New Zealand (eradicated).

5. *Ustilago holwayana* Henn., in Holway, Bot. Gaz. (Crawfordsville) 28:274, 1899.

Type on *Paspalum velutinum* (= misnamed *P.* cf. *tenellum* A. Chase, in Zundel, 1953:166), Mexico, Michoacan, Patzcuaro, 19.X.1898, E.W.D. Holway, BPI 160912, BPI 160913! (ex Herb. Holway; scanty material).

Sori destroying the whole inflorescence, long cylindrical, 2 cm or more in length, first covered by a pale grey peridium which ruptures disclosing the dark brown, powdery mass of spores surrounding remains of inflorescence as a columella. *Spores* ellipsoidal, ovoid, rarely subglobose or slightly irregular, 11-14.5 × 13-16 µm, medium dark yellowish-brown; wall even, 1-1.5 µm thick (including ornamentation), prominently, moderately densely echinulate, spore profile serrate. *Sterile cells* absent.

On *Paspalum tenellum* Willd. (as *Paspalum velutinum* Trin. ex Nees = *P. urvillei* Steud.); N. America (Mexico). Known only from the type collection.

The host plant of *Ustilago holwayana* is uncertain. Originally, it was given as *Paspalum velutinum*. According to Chase (Zundel 1953:166), it is not *P. velutinum*, it may be *P. tenellum*. The very scanty type specimen I have seen, does not permit a host plant identification.

6. *Ustilago paspali-dilatati* Henn., in Brefeld, Unters. Gesammtgeb. Mykol. 12:122, 1895.

Type on *Paspalum dilatatum*, Brazil, near Blumenau, coll. Möller.

Sori destroying the whole inflorescence. *Spores* large, 12-15 µm, without ornamentation. *Spore germination* (Brefeld, 1895:123, Pl. VII, figs. 23, 24) results in 4-celled basidia producing large basidiospores or, after conjugation, hyphae.

On *Paspalum dilatatum* Poir.; S. America (Brazil).

The original description of this species is very short and incomplete (see above). No material was available for study.

7. *Ustilago schroeteriana* Henn., Hedwigia 35:215, 1896.

Type on *Paspalum* sp., Brazil, St. Catharina, near Itajahy, XI.1885, E. Ule 1615. Holotype in HBG; isotypes NHES, BPI 166243, 166244, 166245, 194460, HUV 16460!

Ustilago eriochloae L. Ling, Lloydia 14:103, 1951. — Type on "*Eriochloa punctata* (L.) Desv." = misnamed *Paspalum* cf. *paniculatum* (teste M. Piepenbr., 1996:134), Costa Rica, Turrialba, 29.IX.1947, F.L. Wellman, BPI 160383! (syn. by Piepenbring, 1996:136, confirmed).

Tilletia paspali Zundel, Mycologia 23:299, 1931. — Type on *Paspalum millegranum*, Brazil, Bahia, Mata de São João, 3.I.1925, A. Chase 8140½, BPI 60385 = 195169! (syn. by M. Piepenbring, 2003:184, confirmed).

Sori usually destroying all spikelets of an inflorescence, c. 1 × 1-2 mm, sometimes extending to the raceme rachis, olivaceous- to dark brown, powdery, finally remaining behind only remnants of host plant tissues on the raceme axis. *Spores* globose, subglobose, ovoid to broadly ellipsoidal, 12-18.5 × 13.5-20 µm, yellowish-brown; wall even, 1-2 µm thick, moderately densely punctate-verruculose, spore profile smooth to finely wavy.

On *Paspalum botteri* (E. Fourn.) Chase, *P. conjugatum* P.J. Bergius, *P. conspersum* Schrad. ex Schult., *P. costaricense* Mez, *P. intermedium* Munro ex Morong & Britton, *P. millegranum* Schrad. ex Schult., *P. paniculatum* L., *P. plicatulum* Michx., *P. repens* P.J. Bergius (*P. paniculatum* Walter), *P. turriforme* R.W. Pohl, *P. urvillei* Steud., *P. virgatum* L.; N., C. & S. America.

8. *Ustilago venezuelana* Syd. & P. Syd., Ann. Mycol. 14:73, 1916.

Type on *Paspalum* sp., Venezuela, Rio Cuquenan, II.1910, E. Ule 3333 (type where?).

Sori in the ovaries, totally occupying and destroying the spikelets, soon becoming naked, powdery, dark brown, *Spores* globose or subglobose, 7-9 µm in diam., yellowish-brown, densely, minutely verruculose.

On *Paspalum* sp.; S. America (Venezuela).

Material not seen. The type is probably lost. Recollection is desired. Description taken from the original.

Doubtful, invalid or excluded species, or not on *Paspalum*

Juliohirschhornia linderi (Hirschh.) Hirschh., Ustil. Fl. Argent.:530, 1986.

Invalid name, based on *Ustilago linderi* Hirschh., Omagiu lui T. Săvulescu:311, 1959. Invalidly published, no type indicated (ICBN (Vienna) 37.1). — On *Paspalum notatum* Flüggé, "*P. paludivagum*" (=? *Paspalidium paludivagum* (Hitchc. & Chase) Parodi), *P. plicatulum* Michx., *P. vaginatum* Sw., *Paspalum* sp., Argentina.

Poikilosporium bogoriense Racib., Parasitische Algen und Pilze Java's, Part 2:39, 1900.

The name *Poikilosporium* Dietel is a synonym of *Thecaphora* Fingerh. The identity of *P. bogoriense* is uncertain. It is not known where the type specimen is deposited. In BPI 179089, there is a specimen under this name, on *Paspalum scrobiculatum* L., Indonesia, Java, coll. M. Raciborski, ex KRA. Its study revealed only insect excrements. However, in the original description, the host plant is given as *Panicum* sp. Raciborski (1900:39) himself doubted that his species belongs to the smut fungi. Further studies are needed to elucidate its identity.

Thecaphora inquinans Berk. & Broome, J. Linnean Soc. Bot 14:94, 1873('1875').

Type on *Paspalum scrobiculatum* L., Sri Lanka [Ceylon], Dolosbagey, V.1868, BPI 179274!

It is *Epicoccum andropogonis* (Ces.) Schol-Schwarz (Vánky, 1990:275).

Ustilagopsis deliquescens Speg., Anales Soc. Ci. Argent. 10:6, 1880.
Type on *Paspalum platense* Spreng., Argentina, „in agro Banaerense", I-IV.1880.

It is *Claviceps deliquescens* (Speg.) Hauman. Excluded by Hauman-Merck and also others (comp. Farr, 1973:1601).

Ustilago garcesii Zundel, Mycologia 37:372, 1945 (as '*garcesi*').
Type on "*Paspalum saccharoides* Nees", Colombia, Valle, Palmira, Estacion Experimental, 13.XII.1940, C. Garces O., in Fungi of Colombia no. 1281, BPI 160488!

It is *Sporisorium panici-leucophaei* (Bref.) M. Piepenbr. (comp. Piepenbring, 2002b:110). The identity of the smut indicates that the host plant, which on the original label is given with a question mark, is most probably *Digitaria insularis* (L.) Fedde (*Trichachne sacchariflora* (Raddi) Nees).

Ustilago microspora var. ***paspalicola*** Hirschh., Omagiu lui T. Săvulescu:310, 1959. Invalid name (ICBN (Vienna) Art. 37.1).
On *Paspalum dilatatum* Poir., *P. notatum* Flüggé, *P. quadrifarium* Lam., *Paspalum* sp.; S. America (Argentina, Uruguay).

Ustilago royleani Syd., P. Syd. & E.J. Butler, Ann. Mycol. 4:426, 1906.
Type on *Paspalum royleanum* Thwaites, which is a synonym of *Digitaria royleana* (Thwaites) Prain (= *D. stricta* Roth ex Roem. & Schult.), India, Dehra Dun, 10.X.1903, E.J. Butler, HCIO 444; isotypes BPI 166095-166098, HUV 16456!

Key to the smut fungi of *Paspalum*

1. Sori in ovaries 2
– Sori in spikelets, racemes or inflorescence 3
2. Spores 18.5-26 µm long, single .... ***Tilletia rugispora***
– Spores 7-13 µm long, forming permanent spore balls .... ***Moesziomyces bullatus***
3. Sori in whole inflorescence 4
– Sori in racemes or spikelets 6
4. Spores 10.5-20 µm long, punctate-verruculose .... ***Sporisorium paspali-thunbergii***
– Spores 12-16 µm long 5
5. Spores echinulate .... ***Ustilago holwayana***
– Spores smooth .... ***Ustilago paspali-dilatati***
6. Sori in racemes; sterile cells present; spores 6-9.5 µm long .... ***Sporisorium paspali***
– Sori in spikelets; sterile cells absent 7
7. Spores 13.5-20 µm long .... ***Ustilago schroeteriana***
– Spores 7-9 µm long .... ***Ustilago venezuelana***

The smut fungi of *Setaria* (*Poaceae*)

Setaria P. Beauv., in the subfamily *Panicoideae,* tribe *Paniceae,* subtribe *Setariinae,* is a genus of about 100 species, mainly in the tropics and subtropics (Clayton and Renvoize, 1986:290). It is closely related to *Panicum.* It is not surprising that several smut fungi may occur on members of both these genera. The smut fungi of *Panicum* have been revised by me (Vánky, 2005:217-250) and recognised forty-one species. The following ***Conidiosporomyces*** and ***Tilletia*** species of *Setaria* were studied earlier (Vánky, 2001:313-319), recognising nine species: **1. *C. ayresii*** (Berk.) Vánky, **2. *C. echinospermus*** (Ainsw.) Vánky, **3. *C. verruculosus*** (Wakef.) Vánky, **4. *Tilletia setariae*** L. Ling, **5. *T. setariae-palmifoliae*** Mishra, **6. *T. setariae-viridis*** Vánky, **7. *T. setariicola*** Pavgi & Thirum., **8. *T. thirumalacharii*** Gandhe, and **9. *T. zundelii*** Hirschh. Two additional new species are described below. Further recognised smut fungi of *Setaria* are:

10. *Macalpinomyces neglectus* (Niessl) Vánky, Mycotaxon 89:106, 2004.

Ustilago neglecta Niessl, in Rabenhorst, Fgi. eur. no. 1200, 1868. — *Sporisorium neglectum* (Niessl) Vánky, Symb. Bot. Upsal. 24(2):119, 1985. — Type on *Setaria glauca* (= *S. pumila*), Austria, Steiermark, near Graz, coll. G. Niessl; isotypes in Rbh., Fgi. eur. no. 1200, HUV 4156!

Erysibe panicorum var. *panici-glauci* Wallr., Flora Cryptogamica Germaniae, 2::216, 1833. — *Ustilago panici-glauci* (Wallr.) G. Winter, Rabenh. Krypt.-Fl., 2 Aufl., 1(1):97, 1881. — Type on *Panicum glaucum* (= *S. pumila*), Germany, near Halle.

Sori in all florets of an inflorescence, ovoid, usually acuminate, 2-4 mm in length, partly enclosed by the glumes, covered by a thin, greyish peridium of fungal and host origin which ruptures irregularly to expose the dark brown, powdery mass of spores intermixed with irregular groups of sterile cells. Columella short, ovoid, formed of host tissues and fungal cells. *Spores* subglobose, ovoid, elongated to slightly irregular, 8-11 × 9.5-14 µm, medium dark reddish-brown, prominently and abundantly echinulate; wall even, c. 0.8 µm thick, spore profile finely serrulate, in SEM the area between the spines with small, rounded, sparsely situated warts. *Sterile cells* in groups or solitary (in some specimens scanty), smaller than the spores (5-12 µm long), globoid or slightly irregular, collapsed in old specimens, hyaline, usually with a light-refractive droplet.

On *Brachiaria brizantha* (A. Rich.) Stapf, *Setaria geniculata* (Lam.) P. Beauv., *S. grisebachii* Fourn., *S. pumila* (Poir.) Roem. & Schult. (*Panicum glaucum* L.; *S. glauca* auct. non (L.) P. Beauv.; *S. lutescens* (Weigel) F.T. Hubb.), *S. liebmanni* Fourn., *S. sphacelata* (Schum.) Stapf & C.E. Hubb., *S. ustilata* De Wit, *S. viridis* (L.) P. Beauv.; Europe, Africa, Asia, Australia, N. & S. America.

11. *Macalpinomyces sharmae* Vánky, Mycotaxon 54:223, 1995.

Type on *Panicum sumatrense*, India.

For description and illustrations see Vánky (1995a:223-225, 2005:220).

On *Panicum sumatrense* Roth ex Roem. & Schult. (*P. miliare* Lam.), *Setaria pumila* (Poir.) Roem. & Schult. (*S. pallide-fusca* (Schum.) Stapf & C.E. Hubb. ex Moss), *S. surgens* Stapf; S. Asia (India), Australia.

12. ***Macalpinomyces tanakae*** (S. Ito) Vánky, Mycotaxon 69:112, 1998.

Ustilago tanakae S. Ito, Trans. Sapporo Nat. Hist. Soc. 14:87, 1935. — *Sphacelotheca tanakae* (S. Ito) Zundel, Ustil. World:208, 1953. — Type on *Setaria italica* var. *germanica*, Japan, Hokkaido, Ishikari Prov., Maruyama near Sapporo, 24.IX.1927, I. Tanaka.

Sori in scattered ovaries, inconspicuous, hidden by the floral envelopes, ovoid, c. 1-1.5 × 2 mm, covered by a brown peridium which ruptures irregularly disclosing the dark reddish-brown, granular mass of irregular groups of spores intermixed with sterile cells. *Spores* subglobose, ovoid to usually subpolyhedrally irregular, 8-10 × 9-12 µm, yellowish-brown; wall even, c. 1 µm thick, including the densely situated, evident, c. 0.5 µm high spines. *Sterile cells* single or in small groups, subglobose, ellipsoidal to irregular, collapsed in old specimens, (10-)12-28 µm long, hyaline to pale yellow; wall thin (0.5-1 µm), smooth.

On *Brachiaria brizantha* (A. Rich.) Stapf, *Setaria italica* (L.) P. Beauv., *S. italica* var. *germanica* (Mill.) Schrader, *S. viridis* (L.) P. Beauv.; Africa (Zambia), E. Asia (China, Japan).

13. ***Sporisorium kenyanum*** M. Piątek, see ADDENDA (this volume, pp. 63–64)

14. ***Sporisorium magnusianum*** (A.A. Fisch. Waldh.) Vánky, **comb. nov.**
MycoBank 510388

Basionym: *Tilletia magnusiana* A.A. Fisch. Waldheim, Aperçu Syst. Ustil.:47, 1877. — *Sphacelotheca magnusiana* (A.A. Fisch. Waldh.) Cif., Trans. Brit. Mycol. Soc. 18:262, 1934. — Type on *Panicum geniculatum* (= *Setaria geniculata*), no further data are given, probably West Indian Antilles Islands, Guadeloupe. Type probably lost.

Ustilago pamparum Speg., Anales Soc. Ci. Argent. 17:89, 1884, nom. nud.; Bol. Acad. Nac. Ci. Cordoba 11:28, 1887. — *Sphacelotheca pamparum* (Speg.) G.P. Clinton, J. Mycol. 8:140, 1902. — *Sporisorium pamparum* (Speg.) Vánky, in Vánky & Guo, Acta Mycol. Sinica, Suppl. I:234, 1987('1986'). — On *Setaria* sp., Argentina, LPS 3738?, in Fungis Arg. pug. I, no. 4 (as *Ustilago setariae* Niessl). (Syn. by Ciferri, 1934:262).

Ustilago kolaczekii J.G. Kühn, in Rabenhorst., Fgi. eur. no. 3401, 1886. — Type on *Setaria geniculata*, Germany, Berlin, Botanical Gardens, Autumn 1884, P. Hennings (of seeds originating from Chile); isotypes in Rbh., Fgi. eur. no. 3401, HUV 1982! (Syn. by Ciferri, 1934:263).

Sori in all spikelets of an inflorescence, ovoid to short cylindrical, 1-1.5 × 1.5-3.5 mm, comprising the innermost floral organs of which remnants are often present on the covering thick, pale brown peridium. The peridium ruptures irregularly from its apex disclosing the dark brown, semiagglutinated to powdery mass of loose spore balls, spores and sterile cells surrounding a stout, irregular columella of the length of the sorus, often with short thorn-like apical branches. *Spore balls* variable in shape and size, subglobose, ellipsoidal, elongated or irregular, 40-110 × 50-130 µm, reddish-brown, composed of tens of spores which separate easily by pressure. *Spores* globose, subglobose, ovoid, ellipsoidal to slightly irregular, 9-11.5 × 9-14 µm; yellowish-brown; wall even, c. 0.8 µm thick, finely, moderately densely echinulate, spore profile wavy to finely serrulate. *Sterile cells* few, solitary, globose to ellipsoidal, 5.5-14.5 µm long, hyaline; wall c. 0.5 µm thick, smooth.

On *Panicum amazonicum* Scribn. & Merr., *P. fasciculatum* Sw., *Setaria genuculata* (Lam.) P. Beauv. (*Panicum geniculatum* Lam.), *S. parviflora* (Poir.) Kerguélen, *Setaria* sp.; Asia (China), N. America (Mexico, USA), S. America (Argentina).

When Spegazzini (1884:89) published the name *Ustilago pamparum* he failed to provide a description. He only mentioned that "ab *Ustilago setariae* Niessl longe abhorrens", which cannot be considered a description and a valid publication. The earliest valid name for this smut is *Tilletia magnusiana*. According to Ciferri (1934:262) it is identical with *Ustilago pamparum*. The types of both names are apparently lost. Description above is based on the isotype of *Ustilago kolaczekii* from HUV.

The spores of *Sporisorium magnusianum* are rather similar to those of *Macalpinomyces neglectus*. However, the two are markedly different especially in sorus characters and also in the morphology of the sterile cells.

15. *Sporisorium setariae* (McAlpine) Vánky & R.G. Shivas, Fungal Diversity 14:263, 2003.

Sorosporium setariae McAlpine, The smuts of Australia, etc.:183, 1910. — Type on *Setaria glauca* (= *Setaria pumila* subsp. *pumila*), Australia, Queensland, 20 miles S of Cloncurry, 10.V.1909, G.H. Robinson 203/9, VPRI 2980a; isotypes BRIP 26796, VPRI 2981a, HUV 20121!

Sori destroying some or all spikelets in the inflorescence, ovoid to short cylindrical, 1-2 × 2-5 mm, partly hidden by the floral envelopes, first covered by a pale brown peridium which ruptures from its apex disclosing the black, granular-powdery mass of spore balls and sterile cells surrounding several, rather stout, irregular columellae of the length of the sorus, often with short apical branches. *Spore balls* variable in shape and size, subglobose, ellipsoidal, elongated or irregular, 25-70(-110) × 40-100(-170) µm, dark reddish-brown, composed of tens to hundreds of spores which separate by pressure. *Spores* variable in shape and size, subglobose, ellipsoidal to usually subpolyhedrally irregular, dimorphic, (6.5-)7-12 × (7.5-)8-13(-14.5) µm; outer spores dark yellowish-brown, wall slightly uneven, 0.5-1 µm thick, free surface densely, finely verrucose-echinulate, spore profile wavy to finely serrulate; inner spores pale yellowish-brown, wall c. 0.5 µm thick, apparently smooth to finely, densely punctate. *Sterile cells* few, globose to ovoid, 6-10 µm long, hyaline; wall 1-2 µm thick, smooth.

On *Setaria apiculata* (Scribn. & Merr.) Vickery, *S. pumila* subsp. *pumila* (*S. glauca* (L.) P. Beauv.), *S. surgens* Stapf; Australia.

16. *Sporisorium setariae-mombassanae* (L. Ling) Vánky, **comb. nov.**
MycoBank 510379
Basionym: *Ustilago setariae-mombassanae* L. Ling, Lloydia 16:181, 1953. — Type on *Setaria mombassana*, Nyasaland (= Malawi), Chitala to Samlima Road, 22.III.1949, P.O. Wiehe 69, IMI 34947; isotypes BPI 166391, HUV 17397!

Sori in some spikelets ("ovaries") of an inflorescence, globoid, 3-4 mm in diam., showing between the outer floral envelopes, first covered by a thick, brown peridium which ruptures irregularly from its apex into lobes, disclosing the dark brown, powdery mass of spores surrounding a short, stout central columella, simple or with 2-3 short apical branches. *Spores* when mature single, globose, subglobose, ovoid to ellipsoidal, 5.5-7 × 6-9 µm, pale olivaceous-brown; wall even, c. 0.5 µm thick, sparsely echinulate, spore profile sparsely, finely serrulate, in SEM between the spines finely verrucose. *Sterile cells* not seen.

On *Setaria mombassana* Herrm.; SE. Africa (Malawi). Known only from the type.

17. *Sporisorium setariicola* (Thirum. & Safeeulla) Bag & D.K. Agarwal, Indian Phytopathol. 54:224, 2001 (as '*setaricolum*').
Sorosporium setariicola Thirum. & Safeeulla, Sydowia 5:439, 1951 (as '*setaricolum*'). — Type on *Setaria pallide-fusca* (= *S. pumila*), India, Karnataka, Coorg, Makut, 15.VIII.1950, K.M. Safeeulla, HCIO 23711 (type lost); isotype BPI 180320 (lacking sori).

According to the original description: "*Sori* in ovaries, infecting all the spikelets in the inflorescence and converting them into loose, powdery spore mass, partially enclosed by the glumes. *Spore balls* subglobose to irregular, dark brown to opaque, up to 70 µm in diam. *Spores* firmly united, subglobose to spherical, reddish-brown, 8.5 to 13.5 µ in diam. with a mean of 9.1 µ, epispore moderately thick, verruculose. Spores germinating by promycelium bearing lateral and terminal sporidia."

On *Setaria pumila* (Poir.) Roem. & Schult. (*S. pallide-fusca* (Schumach.) Stapf & C.E. Hubb. ex Moss), *Setaria* sp.; S. Asia (India).

No specimen of *Sporisorium setariicola* is available in HCIO (D.K. Agarwal, in litt.). The isotype in BPI is lacking sori. Its description is very similar to the description, and may represent a synonym of ***Tolyposporium setariicola*** Syd. & P. Syd (Sydow & Sydow 1912:77; = *Sporisorium*), type on *Setaria aurea* A. Br., Camerun, Sidderiberg, 30.VII.1909, C. Ledermann 4803. Type where?

18 *Tilletia setariae-parviflorae* Vánky & R.G. Shivas, **sp. nov.**
MycoBank 510356.
Typus in matrice Setaria parviflora *(Poir.) Kerguélen (det. H. Scholz, B), Thailand, Sakon Nakhon Prov., Phu Phan Distr., 27 km SW of Sakon Nakhon, 17°03'02.7" N, 103°58'18.0" E, alt. 279 m.s.m., 20.XII.2005, leg. R.G. Shivas, P. Athipunyakom, S. Likhitekaraj, W. Butranu, C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 20209; isotypus in BRIP 47735.*

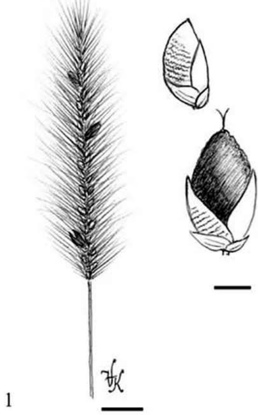

Fig. 1. Sori of *Tilletia setariae-parviflorae* in some ovaries of *Setaria parviflora* (type). Habit, and enlarged a sorus and a healthy spikelet.
Bars = 1 cm for habit, and 1 mm for detail drawings.

Sori in ovariis nonnullis inflorescentiae eiusdem, ovoideae vel ellipsoidales, 1,5-2,5 × 2-4 mm, inter involucris floralibus distantibus conspicuis, peridio crasso, nigrobrunneo cooperti, quo in maturitate rupto massam nigram, pulveream sporarum et cellularum sterilium ostendentes. Sporae globosae, subglobosae usque ellipsoidales, raro parum irregulares, 21-28 × 24-32 µm, atrobadiae usque opacae, verrucis dense distributis, 2-4 µm altis, cylindricis, apice rotundis, in visu superficiali sicut maculae atrae, irregulariter polyangulares apparentibus, 6-8(-9) in diametro sporae, in visu opticali mediano 24-34 in circumferentia aequatoriali. Vagina hyalina absens. Cellulae steriles forma et magnitudine variae, plerumque collapsae, subglobosae, ellipsoidales vel irregulares, 7-30 × 13,5-36 µm, pallide vel mediocriter flavidobrunneae; pariete 1-2 µm crasso, conspicue levi vel plerumque disperse, leniter vel grosse verrucoso.

Sori (Fig. 1) in some ovaries of an inflorescence, ovoid or ellipsoidal, 1.5-2.5 × 2-4 mm, showing between the spreading floral envelopes, covered by a thick, blackish-brown peridium which ruptures at maturity disclosing the black, powdery mass of spores and sterile cells. *Spores* (Figs. 4, 5) globose, subglobose to ellipsoidal, rarely slightly irregular, 21-28 × 24-32 µm, dark chocolate-brown to opaque, provided with densely situated, 2-4 µm high cylindrical warts with rounded tip, in surface view appearing as dark, irregularly polyangular spots, 6-8(-9) per spore diam., in optical median view 24-34 on the equatorial circumference. Hyaline sheath absent. *Sterile cells* (Figs. 4, 5) of varying shape and size, usually collapsed, subglobose, ellipsoidal or irregular, 7-30 × 13.5-36 µm, pale to medium dark yellowish-brown; wall 1-2 µm thick, apparently smooth or usually sparsely, finely or coarsely verrucose.

On *Setaria parviflora* (Poir.) Kerguélen; S.E. Asia (Thailand). Known only from the type locality.

Tilletia setariae-parviflorae differs from the twelve *Tilletia* species that occur on the closely related *Panicum* (comp. the key in Vánky, 2005:248).

19 *Tilletia setariae-pumilae* Vánky & N.D. Sharma, **sp. nov.**, see ADDENDA (this volume p. 64)

20. *Ustilago crameri* Körn., Verh. Naturhist. Vereins Preuss. Rheinl. Westphalens 29:192, 1872; in Fuckel, Jahrb. Nassauischen Vereins Naturk. 27-28:11, 1873.

Holotype and isotypes, supposedly from year 1872, were lost in Berlin (B). There also is not any collection from year 1872 in the original collection of Körnicke, deposited in B since 1983. Topotype on *Setaria italica*, Germany, (= neotype; designated here) Poppelsdorf near Bonn., IX.1873, cultivated by F. Körnicke, of material originating from Switzerland, Kt. Zürich, near Zürich, Strickhof, IX.1871, C. Cramer, HUV 7297! Isoneotypes in Fuckel, Fgi. rhenani exs. no. 2511, HUV 9285!, in Rbh., Fgi. eur. no. 1900, HUV 3561!, in Thümen, Herb. myc. oecon. no. 108, HUV 9284!

Sori in all spikelets of an inflorescence destroying the ovaries and the basal part of the inner floral envelopes which become bullate, while the upper parts of the envelopes and the two glumes are normally developed, at first covered by a green, yellow or silvery peridium of host origin which ruptures irregularly disclosing the dark brown, powdery mass of spores. *Spores* extremely variable in shape, subglobose to elongate, slightly bent, irregular, subpolyhedral, pyriform, lemon- or drop-shaped, sometimes with an acute tip, (6-)7-9.5 × 8-12(-15) µm, medium dark reddish-brown; wall even, c. 0.5 µm thick, smooth; in SEM smooth or with sparsely situated, low warts.

On *Setaria decipiens* C. Schimper (*Setaria ambigua* Guss.), *S. faberi* Herrman, *S. italica* (L.) P. Beauv., *S. verticillata* (L.) P. Beauv., *S. viridis* (L.) P. Beauv.; Europe, Africa, Asia, Australia, N. America. Cosmopolitan.

21. *Ustilago striiformis* (Westend.) Niessl, Hedwigia 15:1, 1876.

Uredo striiformis Westend., Bull. Acad. Roy. Sci. Belgique 18:406, 1851. — Lectotype on *Holcus lanatus* L., (design. by Zundel, 1953:205) Belgium, «environs de Courtrai», coll. G.D. Westendorp; isolectotypes in Herb. crypt. Belg. no. 677, HUV 9453.

Ustilago taenia Cif., Fl. Ital. Crypt., Pars I. Fungi, Fasc. 17:346, 1938. — Type on *Setaria italica* (L.) P. Beauv., Italy, Vercelli, coll. V. de Cesati (n.v.).

For further synonyms, literature, description see Vánky, 1994:377-379 & 435-436.

On a great number of grass genera such as *Agropyron, Agrostis, Alopecurus, Ammophila, Anthoxanthum, Arrhenatherum, Avenula, Beckmannia, Brachypodium, Bromus, Calamagrostis, Cynosurus, Dactylis, Deschampsia, Deyeuxia, Elymus, Festuca, Helictotrichon, Hierochloe, Holcus, Hordeum, Hystrix, Kengia, Koeleria, Lolium, Melica, Milium, Pennisetum, Phalaris, Phleum, Poa, Polypogon, Puccinellia, Sesleria, Setaria, Sitanion, Trisetum*; cosmopolitan.

22. *Ustilago trichogena* Vánky, Mycotaxon 95:54, 2006.

Type on *Setaria setosa* var. *leianthina*, Bolivia, Dept. Tarija, Tarija, 6.II.1902, R.E. Fries 271, S; isotype HUV 5214!

For its description and illustration see Vánky, 2006b:54.

On *Setaria setosa* var. *leianthina* Hack.; S. America (Bolivia). Known only from the type collection.

Invalid names, doubtful or excluded species, or not on *Setaria*

Ustilago catherinae Zambett., Bull. Soc. Mycol. France 95:408, 1980('1979'). Invalid name, no type indicated (ICBN (Vienna) 37.1).

On *Setaria sulcata* (Bertol.) Raddi, Congo, Mukule-Mokoto, 19.XII.1914, Mission Bequert no.6326, BR 360, and on *S. chevalieri* Stapf, Congo, Mission Vanderyst, Flore du Victoriat apostoloque du Kwango, BR 363.

Sori in the "ovaries", 2-4 × 10-15 mm, protruding between the glumes, first covered by a brown peridium which later ruptures disclosing the powdery mass of spores. *Spores* single, globose, 6-8 µm in diam., pale brown; wall c. 1 µm thick, sparsely but well-visible punctate.

Ustilago darjeelingensis Bag & D.K. Agarwal, Indian Phytopathol. 54:223, 2001.

Type on *Setaria* sp., India, W.B., Darjeeling, IV.1999, M.K. Bag, HCIO 43169 (not deposited).

According to the original description: *Sori* in the ovaries, covered by glumes, composed of black, dusty mass of spores. *Spores* irregularly globose, polygonal to elongate, amber brown in colour, 8.5-9.3 × 10.2-13.6 µm in size. Epispore thick with rough edge. SEM studies showed verrucose spore wall ornamentation.

On *Setaria* sp.; S. Asia (India). Known only from the type collection.

The short and incomplete description of *U. darjeelingensis* does not permit its comparison with other similar species, and does not permit its inclusion in the key. Type specimen appears never to have been deposited in HCIO (D.K. Agarwal, in litt.), nor in any other herbarium.

Ustilago panici-latifolii is an Ustilaginoidea

Ustilago panici-latifolii Henn., Hedwigia 35:216, 1896. — Type on *Panicum latifolium* L., Brazil, St. Catharina, near Tubarão, III.1890, E. Ule 1331; isotypes BPI 165081!, 165082! This is an *Ustilaginoidea* sp. (anamorphic ascomycete), as noted also by M. Piepenbring in the BPI specimens. (excluded here).

Ustilago pertusa is an Ustilaginoidea

Ustilago pertusa Tracy & Earle, Bull. Torrey Bot. Club 22:175, 1895. — Type on *Setaria "macrochaeta"* (= misprint for *S. macrostachya* H. B. & K.; comp. McAlpine, 1910:159), Australia, Queensland, 1890, F.M. Bailey, VPRI 3519a, BPI 165438!

Both the VPRI and BPI specimens are lacking sori. However, there are a few spores on the envelopes which could be studied and revealed that it is an *Ustilaginoidea*, corresponding with the original description of this species. (excluded here).

Ustilago setariae = ?

Ustilago setariae Rabenh. ex A.A. Fisch. Waldheim, Aperçu Syst. Ustil.:24, 1877. — Type on *Setaria* sp., no further details indicated. Description very poor: *Sori* in the panicle, destroying it, black. *Spores* globose or ellipsoidal, 10-12 µm, olivaceous-brown, epispore with very short spines.

The very short and incomplete original description, and lack of type specimen, do not allow its identification.

Ustilago setariae-aureae is an Ustilaginoidea

Ustilago setariae-aureae Henn., in Wildeman, Ann. Mus. Congo, Sér. 5, Bot. 2:86, 1907. — Type on *Setaria aurea* A. Br. (= *S. sphacelata* var. *aurea* (A. Br.) W.D. Clayton), Congo, Leopoldville Prov., Dembo, VI.1906, H. Vanderyst B28, BR; isotypes in BPI 166389!, 166390!, 194472!, HUV 17147! (excluded by Vánky, 1999:160).

Ustilago urbanii is Sclerospora graminicola

Ustilago urbanii Magnus, Verh. Bot. Vereins Prov. Brandenburg 20:52, 1878 (as '*urbani*'). — Type on *Setaria viridis* (L.) P. Beauv., Germany, near Berlin, Lichterfelde, 1875, I. Urban, BPI 168728.

It is *Protomyces graminicola* Sacc. = *Sclerospora graminicola* (Sacc.) J. Schröt.

Ustilago viridis is Ustilaginoidea setariae

Ustilago viridis Ellis & Everh., J. Mycol. 3:56, 1887. — Type on Setaria sp., USA, Louisiana, St. Bernard Parish, Shell Beach, 8.X.1885, A.B. Langlois 56, BPI 183713; isotypes BPI 169494, 183712.

It is *Ustilaginoidea setariae* Bref. (excluded by Clinton, 1902:130).

Key to the smut fungi of *Setaria*

1. Sori on leaves forming striae .... *Ustilago striiformis*
– Sori elsewhere, not so 2
2. Sori in distal part of sterile shoots, up to 7 cm or longer? *Sporisorium kenyanum*
– Sori in the ovaries or spikelets, much shorter 3
3. Conidia present between the spores; sori thick, sack-like, opened 4
– Conidia absent between the spores; sori not so 6
4. Spore mass grey to pale chestnut-brown; immature spores and conidia between the spores abundant 5
– Spore mass reddish-brown; immature spores and conidia relatively few; spores coarsely conical-echinulate .... *Conidiosporomyces verruculosus*
5. Spores 13-17 µm long, predominantly verrucose or verrucose-echinulate, warts 1-2 µm high, often flattened .... *Conidiosporomyces ayresii*
– Spores (14.5-)16-20(-23) µm long, predominantly filamentously verrucose, warts 1.5-3(-5) µm high .... *Conidiosporomyces echinospermus*
6. Spores over 13 µm long 7
– Spores less than 13 µm long 14
7. Sori pubescent 8
– Sori smooth to rough, not pubescent 9
8. Spores reticulate, 18-23 µm long .... *Tilletia setariicola*
– Spores finely, densely verrucose, 13-18 µm long .... *Tilletia zundelii*
9. Spores 13-19(-22) µm long; warts c. 1 µm high, blunt .... *Tilletia thirumalacharii*
– Spores larger; warts higher 10
10. Spores 16-24 µm long; warts delicate, 2-4 µm high, subacute .... *Tilletia setariae-palmifoliae*
– Spores larger 11
11 Spores 18.5-25(-26) µm long; warts 1.5-2.5 µm high, cylindrical or subpyramidal, with a flattened or rounded tip, 6-11 per spore diam.... *Tilletia setariae-pumilae*
– Spores larger 12
12 Spores 22.5-28 µm long; warts delicate, acute, 1.5-2.5 µm high, 11-17 per spore diam. .... *Tilletia setariae-viridis*
– Spores larger 13
13 Spores 20-30(-33) µm long; warts subconical or cylindrical, 1.5-3 µm high, 8-13 per spore diam.; hyaline sheath present .... *Tilletia setariae*
– Spores 24-32 µm long; warts cylindrical, 2-4 µm high, 6-8(-9) per spore diam.; hyaline sheath absent .... *Tilletia setariae-parviflorae*
14(6) Columella several; spores dimorphic .... *Sporisorium setariae*
– Columella one or lacking; spores not dimorphic 15
15. Sori bullate at their basal part; spores smooth .... *Ustilago crameri*
– Sori not bullate; spores ornamented 16
16. Sori hispid .... *Ustilago trichogena*
– Sori not hispid 17

17.	Sori in some ovaries or spikelets of an inflorescence	18
–	Sori in all ovaries or spikelets of an inflorescence	20
18.	Spores 6-9 µm long, sparsely echinulate	***Sporisorium setariae-mombassanae***
–	Spores larger	19
19.	Spores 7-10.5(-11) µm long, finely, densely punctate-verruculose	***Macalpinomyces sharmae***
–	Spores 9-12 µm long, densely echinulate	***Macalpinomyces tanakae***
20.	Spores firmly united in balls	***Sporisorium setariicola***
–	Spores single or in loose balls	21
21.	Columella stout, irregular, often with short apical branches	***Sporisorium magnusianum***
–	Columella short, ovoid	***Macalpinomyces neglectus***

The smut fungi of *Eragrostis* (*Poaceae*)

Eragrostis Wolf is a large and variable genus with about 350 species in the tropics and subtropics of the world. It belongs to the subfam. *Chloridoideae*, tribe *Eragrostideae*, subtribe *Eleusininae* (Clayton & Renvoize 1986:215, 218). On *Eragrostis* at least 18 smut fungi have been described. Of these ***Sorosporium turneri*** McAlpine (The smuts of Australia:185, 1910) is not on *Eragrostis nigra* var. *trachycarpa* Benth. but on *Panicum* cf. *effusum* R. Br. (teste L.A.S. Johnson, in herb.). In contrary, the host plant of the type of ***Ustilago pimprina*** is not *Arundinella* sp. but *Eragrostis* sp. Several of the published names proved to be synonyms. ***Tilletia bangalorensis*** is ***T. transvaalensis***, ***T. durangenis*** Durán is ***T. baldratii***, ***Ustilago strangulans*** Issatsch. is ***Sporisorium montaniense***. Furthermore, ***U. kusanoana*** Henn., ***U. orientalis*** W.Y. Yen, ***U. eragrostidis-japonicana*** Zundel, ***Sphacelotheca cheoana*** Zundel, and ***Sporisorium eragrostidis-viscosae*** are synonyms of ***Macalpinomyces spermophorus***, and ***U. spermophoroides***, and ***U. pimprina*** are synonyms of ***U. egenula*** (see below).

On *Eragrostis* nine smut fungi could be recognised, including two new species.

1. ***Macalpinomyces spermophorus*** (Berk. & M.A. Curtis ex De Toni) Vánky, Fungal Diversity 14:210, 2003.

Ustilago spermophora Berk. & M.A. Curtis ex De Toni, in Saccardo, Sylloge fungorum, etc., 7:466A, 1888. — Type on *Eragrostis poaeoides* var. *megastachya* (= *E. cilianensis*), USA.

Sporisorium eragrostidis-viscosae A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34:782, 2004. — Type on *Eragrostis viscosa*, India, Maharashtra State, Kolhapur, 12.XII.1997, M.S. Patil, HCIO 42846; isotypes Kolhapur W.I.F. 1535, HUV 21263. (syn. nov.). Presence of spore balls in the type collection is result of insect work.

For further nomenclatural and taxonomic synonyms, types, description and illustrations see Vánky (1994:376, 435; 2003b:210-212).

On *Bouteloua aristidoides* (Kunth) Griseb., *B. chondrosioides* (Kunth) Benth. ex. S. Watson, *B. filiformis* (Fourn.) Griff., *B. gracilis* (Kunth) Lag. ex Steud. (*B. oligostachya* Torr.), *B. hirsuta* Lag., *B. repens* (Kunth) Scribn., *B. rothrockii* Vasey, *B. simplex* Lag. (*Chondrosium simplex* (Lag.) Kunth), *Cathestecum erectum* Vasey & Hack., *Ca. prostratum* Presl, *Eragrostis cilianensis* (All.) Lutati (*E. poaeoides* var. *megastachya* (Link) A. Gray; *E. major* Host; *E. megastachya* (Koeler) Link), *E. ferruginea* (Thunb.) P. Beauv., *E. japonica* (Thunb.) Trin., *E. mexicana* (Hornem.) Link, *E. minor* Host (*E. poaeoides* P. Beauv.), *E. pilosa* (L.) P. Beauv., *E. tenuifolia* Hochst., *E. tremula* Hochst. ex Steud. (*E. rachitricha* Hochst. ex Miq.), *E. secundiflora* Presl, *E. simplex* Scribn., *E. tenuifolia* Hochst. ex Steud., *E. tremula* Hochst. ex Steud., *E. viscosa* (Retz.) Trin., *Hilaria belangeri* var. *longifolia* (Vasey) Hitchc., *Panicum* sp., *Sporobolus australasicus* Domin; cosmopolitan.

2. *Sporisorium montaniense* (Ellis & Holw.) Vánky, Symb. Bot. Upsal. 24(2):118, 1985 (as '*montaniensis*').

Type on Muhlenbergia glomerata, USA.

For synonyms, types, description and illustrations see Vánky, 1994:203 & 215.

On *Eragrostis arida* Hitchc., *E. diffusa* Buckl., *E. mexicana* (Hornem.) Link, *E. minor* Host (*E. poaeoides* P. Beauv.), *E. neomexicana* Vasey, *E. pectinacea* (Michx.) Nees, *Muhlenbergia asperifolia* (Nees & Meyen ex Trin.) O. Matthei, *M. cuspidata* (Torr.) Rydb., *M. glomerata* (Willd.) Trin., *M. pulcherrima* Scribn., *M. racemosa* (Michx.) Britton, Sterns & Poggenb.; cosmopolitan.

3. *Tilletia baldratii* Montem., Boll. Stud. Inform. Reale Giardino Colon. 13:44, 1934.

Type on *Poa abyssinica* (= *Eragrostis tef*), Africa, Eritrea, comm. I. Baldrati. (Type where? It is not in FT or FI (C. Nepi, in litt.).

For synonyms, types and description see Vánky, 2004:113.

On *Eragrostis mexicana* (Hornem.) Link, *E. tef* (Zucc.) Trotter (*Poa abyssinica* Jacq.); N. Africa, N. America.

4. *Tilletia eragrostidis* G.P. Clinton & Ricker, in Ricker, J. Mycol. 11:111, 1905.

Type on *Eragrostis glomerata*, USA, Mississippi, Yazo City, 8.IX.1904, S.M. Tracy, BPI 172896; isotypes BPI 172894, 172897, HUV 15350.

Sori in some ovaries of an inflorescence, showing between the spreading floral envelopes as ovoid, inconspicuous, 0.3-0.8 × 0.8-1.4 mm small bodies, first covered by the thin pericarp which ruptures irregularly disclosing the blackish-brown, semiagglutinated to powdery mass of spores and sterile cells. *Spores* globose, subglobose, ovoid to ellipsoidal, 25-36 × 28-40 μm, yellowish- to dark reddish-brown, in some collections to opaque; wall 3.5-7 μm thick, including the 2.5-5.5 μm high, truncate warts which in surface view appear as darker, densely situated, irregularly polygonal areas, 6-10 per spore diam. *Sterile cells* globose to ellipsoidal, 14-24 × 16-28 μm, subhyaline to pale yellowish-brown; wall 3-4 μm thick, smooth to finely punctate.

On *Eragrostis glomerata* (Walt.) L.H. Dewey, *E. japonica* (Thunb.) Trin., *E. tenellula* (Kunth) Steud.; C. Africa, Australia, N. America.

5. *Tilletia kenyana* Vánky, Mycotaxon 89:80, 2004.

Type on *Eragrostis caespitosa*, Kenya.

For description and illustrations see Vánky, 2004:80, 83 & 90.

On *Eragrostis caespitosa* Chiov.; Africa. Known only from the type locality.

6. *Tilletia thailandica* Vánky & R.G. Shivas, **sp. nov.**

MycoBank510357.

Typus in matrice Eragrostis amabilis *(L.) Wight & Arn. (det. H. Scholz, B), Thailand, Loei Prov., Dan Sai Distr., 75 km E urbe Loei, 17°18'20.9" N, 101°12'09.2" E, alt. 487 m.s.m., 22.XII.2005, leg. R.G., M.D.E., A.J. & G.E. Shivas, P. Athipunyakom, S. Likhitekaraj, W. Butranu, C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 21206, isotypus in BRIP 48134.*

Tilletia thailandica distincta a specie simili T. kenyana *Vánky (Mycotaxon 89:80, 2004, typus in matrice Eragrostis caespitosa, Kenya) magnitudine, colore et ornamentatione sporarum. Sporae speciei* T. thailandica *17,5-21,5 µm longae, flavido- usque atro-rubrobrunneae, verrucis 2-2,5 µm altis, apice depressis raro subacutis, 21-29 in circumferentia aequatoriali, vagina hyalina absens. Sporae speciei* T. kenyana *13-19 µm longae, pallide flavae vel pallide flavobrunneae, verrucis 1,5-2,5(-3) µm altis, obtusis, subpyramidalibus, 17-21 secundum circumferentiam aequatorialem, in vagina hyalinae inclusae.*

Sori (Fig. 2) in some ovaries of an inflorescence, inconspicuous, ovoid or ellipsoidal, 0.3-0.5 × 0.4-1 mm, more or less hidden by the floral envelopes, at first covered by a thin, dark greyish peridium of the pericarp which ruptures irregularly disclosing the black, semiagglutinated to powdery mass of spores and sterile cells or the sori disintegrate into small pieces. *Spores* (Figs. 6, 7) globose, subglobose to broadly ellipsoidal, 16-21 × 17.5-21.5 µm, yellowish- to dark reddish-brown; wall even, provided with 2-2.5 µm high warts with flattened, rarely subacute tip, in surface view appearing as densely situated, irregularly polyangular, dark spots, 5-7 per spore diam., separated by regularly narrow, bright lines, in median view 21-29 warts on the equatorial circumference, hyaline sheath absent. *Sterile cells* (Figs. 6, 7) varying in size, colour and ornamentation, globose, subglobose to ellipsoidal, 8-23 × 9.5-25 µm, subhyaline to pale yellowish-brown; wall even, 0.5-1.5 µm thick, smooth, finely, regularly, sparsely verrucose or with irregularly grouped, large, cylindrical warts.

On *Eragrostis amabilis* (L.) Wight & Arn.; S.E. Asia (Thailand). Known only from the type locality.

Tilletia thailandica differs from the similar *T. kenyana*, in which the spores are 13-19 µm long, pale yellow or pale yellowish-brown, and are provided with 1.5-2.5(-3) µm high, blunt, subpyramidal warts, 17-21 on the equatorial circumference, embedded in a hyaline sheath.

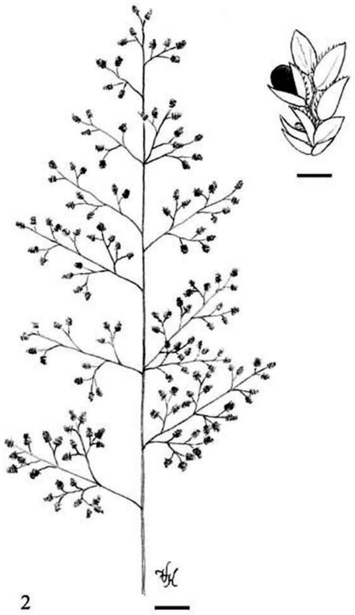

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Fig. 2. Sori of *Tilletia thailandica* in some ovaries of *Eragrostis amabilis* (type). Habit, and enlarged a spikelet with a sorus. Bars = 1 cm for habit, and 1 mm for detail drawing.

7. *Tilletia transvaalensis* Zundel, Mycologia 23:299, 1931.

Type on *Eragrostis aspera*, South Africa, Transvaal, Zebediela Distr., Mucklenburg, 6.VI.1913 (on the label 6.VI.1930), G.W. Wearing, PREM 25463; isotypes BPI 173907, BPI 195171, HCIO 10144, HUV 15416.

Tilletia bangalorensis Pavgi & Thirum., in Thirumalachar & Pavgi, Mycopathol. Mycol. Appl. 7:285, 1956. — Type on *Eragrostis tenuifolia*, India, Bangalore, 15.X.1952, H.C. Govindu, HCIO 20998; isotypes IMI, BPI, HUV 16002. (syn. by Durán & Fischer, 1961:113, confirmed).

Sori in ovaries, infecting some or all of a spikelet, ovoid or ellipsoidal, 0.5-1 × 1-1.5 mm, more or less hidden by the floral envelopes and covered by a greyish-brown membrane of the pericarp, which ruptures irregularly, disclosing the dark brown, semiagglutinated to powdery mass of spores and sterile cells. *Spores* globose or subglobose, rarely broadly ellipsoidal, 17-21.5 × 18-25 µm, pale yellowish-brown to yellowish-brown, provided with densely situated, large, pyramidal, pointed spines, 2.5-4 µm wide, polyangular at the base, 2.5-4 µm high, which project to the margin of the gelatinous sheath, in surface view appearing as darker, polyangular areas, 3-5 per spore diam. *Sterile cells* numerous, globose, subglobose or ellipsoidal, 10-18 × 12-22 µm, subhyaline to yellowish-brown tinted; wall 1.5-6 µm thick, smooth, content granular.

On *Eragrostis aspera* (Jacq.) Nees, *E. plumosa* Link, *E. tenuifolia* Hochst. ex Steud.; S. Africa, S. Asia.

8. *Ustilago egenula* Syd., P. Syd. & Butler, Ann. Mycol. 10:251, 1912.

Type on *Eragrostis nutans*, India, Bihar, near Pusa, 8.XII.1910, E.J. Butler 1429, HCIO 1429; isotypes HUV 15659, 17335, and in Vánky, Ust. exs. no. 872.

Ustilago spermophoroides Y. Ling & T.L. Chen, Res. Bull. Inst. Zool. Bot. Fukien Acad. 1:5, 1945. — Type on *Eragrostis japonica*, China, Fukien, Shahsien, 10.X.1942, T.L. Chen 301 (syn. nov.). Ling (1953b:324) considered it a synonym of *U. spermophora*. According to the original description, *U. spermophoroides* differs from *U. spermophora* by larger and darker spores.

Ustilago pimprina Thirum. & Pavgi, Sydowia 22:251, 1968(1969). — Type on "*Arundinella* sp." (= misnamed *Eragrostis* sp., teste K. Vánky, based on the illustrations), India, Puna, at Pimpri, X.1955, M.J. Thirumalachar, (type where?). (Syn. by Vánky, 2004:93).

Sporisorium eragrostidis A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34:782, 2004. — Type on *Eragrostis japonica*, India, Maharashtra State, Kolhapur, Shivaji University Campus, 7.I.1998, M.S. Patil, HCIO 42867; isotypes Kolhapur W.I.F. 1534, HUV 21262. (syn. nov.).

Sori in some ovaries of an inflorescence, inconspicuous, subglobose, ellipsoidal, ovoid or usually lemon-shaped, 0.2-0.7 × 0.3-1 mm, partly hidden by the floral envelopes and covered by the thin pericarp which may rupture irregularly from its apex, disclosing the blackish-brown, semiagglutinated to powdery mass of spores and sterile cells, or the sori fall off the plant unopened. *Spores* varying in shape, size and appearance, slightly compressed, in side view more or less elliptic, 8-12 µm wide, in face view circular, broadly elliptic or subpolyangularly

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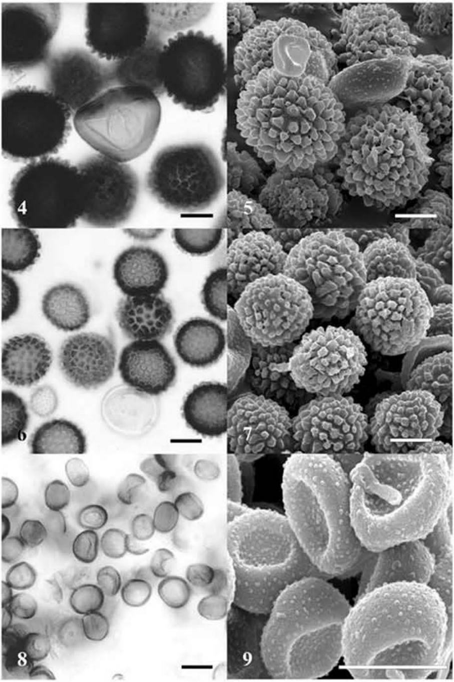
Fig. 3. Sori of *Ustilago planetella* in some ovaries of *Eragrostis japonica* (type). Habit, and enlarged a few spikelets with sori. Bars = 1 cm for habit, and 2 mm for detail drawing.

Figs. 4, 5. Spores and sterile cells of *Tilletia setariae-parviflorae* on *Setaria parviflora* in LM and in SEM (type).

Figs. 6, 7. Spores and sterile cells of *Tilletia thailandica* on *Eragrostis amabilis* in LM and in SEM (type).

Figs. 8, 9. Spores of *Ustilago planetella* on *Eragrostis japonica* in LM and in SEM (type). Bars = 10 µm.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irregular, 9.5-13 × 10-14(-16) µm, medium dark yellowish-brown, in some of the spores more or less expressed, one or several, regularly situated, bright, circular spots are present, 0.5-0.8 µm in diam., up to 4-8 per spore diam.; spore wall uneven, 0.5-1 µm thick, thinner on the flattened sides, surface finely, densely, uniformly verrucose-echinulate, spore profile nearly smooth to finely serrulate. *Sterile cells* in irregular groups or solitary, single cells globose, subglobose to broadly ellipsoidal, rarely with a flattened side, 5.5-13.5 × 5.5-14.5 µm, hyaline, content homogenous; wall even, c. 0.5 µm thick, smooth.

On *Eragrostis diplachnoides* Steud., *E. japonica* (Thunb.) Trin., *E. nutans* (Retz.) Nees ex Steud., *E. tenella* (L.) P. Beauv. ex Roem. & Schult. (*E. plumosa* (Retz.) Link); S., E. & S.E. Asia (China, India, Pakistan, Thailand).

Presence of sterile cells between the spores is typical for the genera *Macalpinomyces* or *Sporisorium* rather than for *Ustilago*. Discordant results obtained by morphological and molecular methods for members of these genera indicate that it is best not to recombine this species at the moment.

Ustilago egenula differs from the polyphageous *Macalpinomyces spermophorus*, in which the top of the sori usually have a hard, yellowish-brown, acute body, the remnant of the caryopsis, and the spores are smaller (6.5-9(-10) × 8-11(-13) µm), lighter brown in colour and without bright spots.

9. *Ustilago planetella* Vánky & R.G. Shivas, **sp. nov.**

MycoBank 510364.

Typus in matrice Eragrostis japonica (*Thunb.*) *Trin.* (*det. H. Scholz, B*), *Thailand, Uttaradit Prov., Tron Distr., cca. 12 km SE urbe Uttaradit, 17°33'18.4" N, 100°10'17.8" E, alt. 116 m.s.m., 23.XII.2005, leg. R.G., M.D.E., A.J. & G.E. Shivas, P. Athipunyakom, S. Likhitekaraj, W. Butranu, C. & K. Vánky. Holotypus in Herbario Ustil. Vánky, HUV 21205, isotypi in BPI 872195, in BRIP 47749 et in Herb. M. Piątek* (*HeMP-114*).

Ustilago planetella *distincta a specie* Ustilago spermophora *Berk. & M.A. Curtis ex De Toni, in Saccardo, Sylloge fungorum, etc., 7:466, 1888 [=* Macalpinomyces spermophorus*], penuria residui caryopsidis in apice sori et praecipue ligamento typico atriore aequatoriali sporarum maturarum areisque 2 pallidioribus parietis tenuibus polaribus, et absentia cellularum sterilium. Apex sori speciei* Macalpinomyces spermophorus *corpore duro flavidobrunneo, acuto et sporae uniformiter pigmentatae, sine areis polaribus pallidioribus, cellulae steriles inter sporas praesens.*

Sori (Fig. 3) in some spikelets of an inflorescence destroying the innermost floral organs, inconspicuous, globose, ovoid or broadly ellipsoidal, 0.2-0.5 × 0.2-0.6 mm, more or less hidden by the glumes, at first covered by a thin, greyish peridium which ruptures irregularly at maturity disclosing the dark brown, powdery mass of spores. *Spores* (Figs. 8, 9) slightly compressed or not, in side view circular to elliptic, 7-10 µm wide, with two, thin-walled, subhyaline polar areas and a wide, darker equatorial band, in face view spores circular, subcircular or broadly elliptic, 8-10.5 × 9-12 µm, pale yellowish-brown with a round, paler, central spot, 3-5 µm in diam., corresponding to the polar area;

spore wall uneven, c. 1 µm thick at the darker, equatorial band, and c. 0.5 µm at the polar areas, surface apparently smooth to finely, sparsely to moderately densely punctate-verruculose, spore profile smooth to finely wavy at the polar areas. *Sterile cells* not seen.

On *Eragrostis japonica* (Thunb.) Trin.; S.E. Asia (Thailand). Known only from the type locality.

Etymology: The specific epithet refers to the smut genus *Planetella* Savile, with its type *P. lironis* Savile, on *Carex* spp., in which the spores also have a dark, equatorial band and two, paler polar areas. It is important to note that the immature spores are uniformly pale yellowish-brown pigmented, thin-walled. The typical darker, equatorial band is present in mature spores only.

Ustilago planetella differs from *Ustilago spermophora* [= *Macalpinomyces spermophorus*] by the lack of a caryopsis remnant on the top of the sori, by mature spores with a typical, dark equatorial band and two, paler, thin-walled polar areas, and absence of sterile cells. In *M. spermophorus* has usually a hard, yellowish-brown, acute body on the top of the sori spores that are uniformly pigmented, lacking paler polar areas, and sterile cells between the spores.

The ITS 1 and ITS 2 regions of the rDNA including the 5.8S rDNA (ITS) and the 5′-end of the nuclear large subunit ribosomal DNA (LSU) of *Ustilago planetella* were sequenced by Dr. M. Lutz. [GenBank accession numbers: EF040584 (ITS), EF040583 (LSU)]. Molecular phylogenetic analyses using the dataset of Stoll et al. (2005) revealed a position within *Ustilago* s.l. in a cluster together with *U. calamagrostidis, U. cynodontis, U. sparsa, U. striiformis,* and *U. xerochloae.*

Melanotaenium eragrostidis is *Jamesdicksonia tremuli*

Melanotaenium eragrostidis A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34:82, 2004, type on "*Eragrostis pilosa* (L.) P. Beauv.", India, Maharashtra State, Kolhapur, Shivaji University Campus, 24.VII.1997, M.S. Patil, HCIO 42799; isotypes Kolhapur W.I.F. 1513, HUV 21254. The host plant turned out to be a *Sporobolus* sp. (conf. H. Scholz, B), as it can be seen also on fig. 33, in Patil et al. (2004b:843).

Of the three *Jamesdicksonia* ("*Melanotaenium*") species on *Sporobolus, M. eragrostidis* fits with *J. tremuli* Vánky (Vanky 2003:209), type on *Sporobolus tremulus*, India, hence they are considered synonyms.

Sori forming lead-coloured, rounded, or ellipsoidal pustules on the leaves, 0.5-2 mm long, or longer by confluence, covered by the epidermis which later ruptures longitudinally, revealing the black, agglutinated spore mass embedded in the leaf tissue. *Spores* agglutinated into irregular groups, single spores extremely variable in shape and size, usually irregular, with one or several flattened sides, often elongated, broadly subfusiform or also triangular, with one or several acute or subacute tips, 9-15 × 11-20(-28) µm, dark olivaceous-brown; wall two-layered, endospore even, thin, c. 0.5 µm, exospore uneven, 1.5-7(-8) µm thick, smooth.

On *Poaceae*: *Sporobolus diander* (Retz.) P. Beauv., *S. tremulus* Kunth, *S. wallichii* Munro; S. Asia (India, Nepal).

Key to the smut fungi of *Eragrostis*

1. Sori on the top of shoots, up to 2-3 cm long.......... ***Sporisorium montaniense***
– Sori in spikelets or ovaries, much smaller..................................2
2. Sori in spikelets; spores with a darker equatorial band....... ***Ustilago planetella***
– Sori in ovaries; spores without a darker equatorial band......................3
3. Spores over 17.5 µm long..4
– Spores less than 19 µm long..7
4. Spores reticulate .... ***Tilletia baldratii***
– Spores with pointed, subacute or truncate pyramidal or cylindrical warts......5
5. Spores 28-40 µm long, warts 2.5-5.5 µm high.............. ***Tilletia eragrostidis***
– Spores less than 25 µm long, warts lower...................................6
6. Warts 2-2.5 µm high, flattened, 5-7 per spore diam.......... ***Tilletia thailandica***
– Warts 2.5-4 µm high, pointed, pyramidal, 3-5 per spore diam... ***T. transvaalensis***
7(3) Spores with 1.5-2.5(-3) µm high, subpyramidal warts........... ***Tilletia kenyana***
– Spores punctate, verruculose or finely echinulate 8
8. Sori often with an acute remnant of the caryopsis; spores 8-11(-13) µm long; wall even, c. 0.5 µm thick, without brighter spots .... ***Macalpinomyces spermophorus***
– Sori without an acute remnant of the caryopsis; spores 10-14(-16) µm long; wall uneven, 0.5-1 µm thick, often with brighter spots............. ***Ustilago egenula***

The smut fungi of *Eleusine* (*Poaceae*)

Eleusine Gaertn., in the subfam. *Chloridoideae*, tribe *Eragrostideae*, subtribe *Eleusininae*, has nine species, mostly in E and NE tropical Africa. *E. coracana* is widely grown as a cereal in Africa, India and China. *Eleusine* is linked with *Dactyloctenium* (Clayton & Renvoize, 1986:222). Several smut fungi have been described on *Eleusine*. Some of them are actually on *Dactyloctenium*, such as *Tilletia eleusines* Syd., type on *Eleusine aegyptia* (L.) Desf. (= *Dactyloctenium aegyptium* (L.) P. Beauv.), or *Ustilago idonea*. *Ustilago pavginensis* and *U. coelachyri* were found to be identical with *U. eleusines* Kulk.

Ustilago eleusines Kulk., Ann. Appl. Biol. (India) 9:184, 1922 (as ,*eleusinis*').

Melanopsichium eleusines (Kulk.) Mundk. & Thirum., Mycol. Pap. 16:1, 1946 (as ,*eleusinis*').

— Type on *Eleusine coracana*, India, Bombay Presidency (= Maharashtra State), Malkapur, X.1918, G.S. Kulkarni, HCIO 100093; isotype IMI. Topotypes: 26.X.1920, HCIO 22662, HUV 17336!

Ustilago pavginensis Gandhe, Smuts of Maharashtra. Doctoral Thesis, University of Poona:34, 1978 (invalidly published, typewritten, ICBN (Vienna) 29.1, 30.5). — On *Eleusine coracana*, India, Maharashtra State, Kolhapur, 15.X.1976, V.A. Kambale, HCIO 33480; isotypes Herb. Gandhe, and HUV 17545! (syn. nov.).

Ustilago coelachyri A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34:842, 2004 (as '*coelachyrae*'). — Type on *Coelachyrum lagopoides* (*Eleusine brevifolia*), India, Tamil Nadu, Madurai, 19.XI.1987, S.R. Yadav, HCIO 42831; isotypes Kolhapur W.I.F. 1571, HUV 18315 & 21270! (syn. nov.).

Sori in some spikelets of an inflorescence, destroying the ovaries and also the inner floral organs, often in groups and may be confluent, globose, ellipsoidal or lobed, 1-2(-3) mm in length, first green later dark brown, covered by a thin peridium and partly hidden by the glumes. Spore mass blackish-brown, semiagglutinated to powdery. *Spores* globose, ovoid or ellipsoidal, (7-)8-10.5 × 9-12(-13) µm, yellowish-brown; wall even, 0.5-0.8 µm thick, finely, moderately densely echinulate, spore profile nearly smooth to very finely serrulate. *Spore germination* (Kulkarni, 1922:184-185) results in septate basidia with ellipsoidal or fusiform basidiospores produced laterally and terminally.

On *Coelachyrum lagopoides* (Burm. f.) Senaratna (*Eleusine brevifolia* (Willd.) R. Br. ex Hook. f.), *Eleusine coracana* (L.) Gaertn., *E. indica* (L.) Gaertn.; Africa, S. & E. Asia.

Another smut fungus described on "*Eleusine*" is ***Ustilago eleusines*** Syd., Ann. Mycol. 27:421, 1929. — Type on "*Eleusine indica* Gaertn." (= misnamed *Digitaria* sp., teste K. Vánky), China, Kiangsu Prov., Nanking, X.1928, F.L. Tai 2249. Holotype in B (lost); isotype (= lectotype, designated here) BPI 160347!

The difference between the names "*eleusines*" and "*eleusinis*" is small. The second name is a result of a grammatical error which must be corrected to *eleusines* [ICBN (Vienna) Article 32.7] resulting in homonymy. Mundkur (1940:333) recognised the homonymy and, without seeing the type, renamed Sydow's species as *Ustilago sydowiana* Mundk. At the same time, Mundkur (1940:333) considered *U. eleusines* Syd. to be identical with the fungus collected by S. Ahmad in Punjab on *Dactyloctenium sindicum,* which is erroneous. The original description of *U. eleusines* by Sydow (1929:421) is clearly different from the smut of *D. sindicum,* described by Sydow as *Ustilago idonea* Syd. (Sydow & Ahmad, 1939:432), type on *Eleusine aristata* Ehrenb. (= *Dactyloctenium sindicum* Boiss.), India, Punjab, Sheikhupura, coll. S. Ahmad 71.

The type of *U. eleusines* Syd. was lost in B (Berlin, H. Scholz, pers. comm.). Fortunately, there is an isotype ("cotype") of it preserved in BPI 160347, which is proposed as lectotype. Some smutted inflorescences bear remnants of spikelets on their distal parts. Their study surprisingly revealed that the host plant is not *Eleusine indica* but a species of *Digitaria,* and the smut proved to be identical with *Ustilago syntherismae*. Consequently, *Ustilago sydowiana* Mundk. (*U. eleusines* Syd., non Kulk.) is a synonym of *U. syntherismae* (Schwein.) Peck on *Digitaria* sp. (syn. nov.).

The smut fungi of *Limnanthemum* (*Menyanthaceae*)

Winter (1885:102) described ***Doassansia decipiens*** on the leaves of *Limnanthemum lacunosum*, from USA, with the remarks: "This is a very interesting but doubtful species". Clinton (1902:154) placed it under *Burrillia*, because "The spore-balls of this species have no definite cortical layer". Study of the type specimen revealed a thin cortical layer, and a ball structure typical for *Doassansia*.

Doassansia decipiens G. Winter, J. Mycol. 1:102, 1885.

Burrillia decipiens (G. Winter) G.P. Clinton, J. Mycol. 8:154, 1902. — Type on *Limnanthemum lacunosum*, USA, New Jersey, Morri Co., Green Pond, 7.VIII.1883, E.A. Rau, BPI 178283!

Sori forming circular to slightly irregular, yellowish-brown spots on the adaxial side of the leaves, 1.5-2 mm in diam., with numerous spore balls embedded in the host tissue appearing as closely clustered, minute, dark brown elevations. *Spore balls* globose, subglobose, ellipsoidal to irregular, 80-160 µm long or longer by confluence, pale brown, composed of a central mass of tightly packed spores surrounded by a thin cortical layer of sterile cells. *Spores* subglobose, ovoid, ellipsoidal to irregular by slightly flattened sides, 7-12 × 8-13.5 µm, pale yellowish-brown; wall even, c. 0.5 µm thick, smooth. *Cortex* continuous or sometimes interrupted, composed of one or several layers of tangentially flattened, irregular, empty cells, 1-5 × 3-10.5 µm, slightly darker than the spores; wall c. 0.5 µm thick, smooth.

On *Limnanthemum lacunosum* (Vent.) Griseb. (*Nymphoides lacunosa* (Vent.) Kuntze), *L. trachyspermum* A. Gray, *Nymphoides cordata* (Ell.) Fernald; N. America (Canada, USA).

Ciferri (1931:22) described ***Burrillia limnanthemi*** on the leaves of *Limnanthemum humboldtianum*, from the Dominican Republic. The type seems to be lost. However, based on the description (reproduced below), it is a *Doassansiopsis* as:

Doassansiopsis limnanthemi (Cif.) Vánky, comb. nov.

MycoBank 510380.

Basionym: *Burrillia limnanthemi* Cif., Ark. Bot. 23 A:22, 1931. — Type on *Limnanthemum humboldtianum*, Dominican Republic, Prov. Santo Domingo, Llano Costero, between Guerra and Cuenca, VIII.1929, R. Ciferri 2531 (type where?).

Sori on the leaves forming irregular, scattered, yellowish spots, 2-3 mm in diam., with an indefinite discoloured margin. *Spore balls* embedded in the host tissue, formed of a central mass of parenchymatous fungal cells surrounded by a layer of radially elongated spores. *Spores* subpolyhedrical, elongated, 4-6 × 15-19 µm, light yellowish; wall rather thick (c. 2 µm), smooth. *Sterile cells* subpolyhedical, 37-45 × 44-52 µm, light yellowish-brown.

On *Limnanthemum humboldtianum* (Kunth) Griseb., ?*Nymphoides cordata* (Ell.) Fernald; N. America (Canada, USA), Antilles (Dominican Republic).

Key to the smut fungi of *Limnanthemum*

- Spores radially elongated, 15-19 µm long, surrounding a central mass of sterile, parenchymatous cells . . . . **Doassansiopsis limnanthemi**
- Spores rounded, 8-13.5 µm long, filling the balls, surrounded by a thin cortex of flattened sterile cells . . . . **Doassansia decipiens**

The smut fungi of *Acanthaceae*

On the nearly 3000, mostly tropical species of *Acanthaceae* only four smut fungi have been described, all belonging to the order *Doassansiales* R. Bauer & Oberw., and all are from India, on aquatic or paludal plants. These are: *Burillia kamatii, Doassansia hemigraphiae, D. hygrophilae,* and *D. khandalensis.* Of these, *Burillia kamatii* is a *Doassansia,* whereas *Doassansia hygrophilae* and *D. khandalensis* belong to the genus *Heterodoassansia.* (For the characters of *Burillia, Doassansia* and *Heterodoassansia* see Vánky, 2002). The recognised four species are:

1. *Doassansia kamatii* (S.B. Thakur) Vánky, Sydowia 34:170, 1981.

Burrillia kamatii S.B. Thakur, Current Sci. 44:482, 1975. — Type on *Hygrophila serpyllum,* India, Maharashtra State, Kandala near Bombay, 26.VI.1972, S.B. Thakur, AMH 1005 (published as no. "1905"); isotypes IMI 178884, HUV 6457.

Sori on the leaves forming rounded or ellipsoidal, flat, first yellowish later brownish spots, 2-6 mm in diam. or larger by confluence, with spore ball in the host tissue appearing as minute, dark brown dots especially on the abaxial side of the leaves. *Spore balls* subglobose to broadly ellipsoidal, 100-180 × 110-200 µm, orange red tinted pale yellowish-brown, composed of a central mass of spores surrounded by a thin cortical layer of sterile cells. *Spores* varying in shape and size, rounded subpolyhedrally irregular, rarely elongated, 6-12 × 8-16 µm, pale cinnamon-yellow; wall even, c. 0.5 µm thick, smooth. *Cortex* 4-8 µm thick, medium dark cinnamon-yellow, composed of 1-2(-3) layers of tangentially flattened, empty cells, 5-20 µm long; wall c. 0.5 µm, smooth. *Spore germination* (Thakur, 1975:482; 1976:167) results of holobasidia with an apical whorl of 4-7 basidiospores which may conjugate in situ.

On *Acanthaceae: Hygrophila serpyllum* T. Anders.; S. Asia (India).

Study of the type specimen of *Doassansia khandalensis* on *Hemiadelphis* (*Acanthaceae*) showed that it belongs to the genus *Heterodoassansia,* as does *D. hygrophilae,* on *Hygropyhla* (*Acanthaceae;* comp. Vánky, 2006b:56). A further species, *D. hemigraphidis* on *Hemigraphis latebrosa* Nees (*Acanthaceae*) from India (see below), could not be investigated due to the absence of type (*D. 'hemigraphiae'*) and other specimens.

2. ***Doassansia hemigraphidis*** B.V. Patil & Thirum., Sydowia 20:49, 1968('1966'; as '*hemigraphiae*').

Type on *Hemigraphis latebrosa* Nees, India, Maharashtra, Khandala, 20.IX.1959, B.V. Patil (type where?).

According to the original description "*Sori* foliicolous, forming yellow spots which enlarge to brownish patches, 6 to 10 mm diam. *Spore balls* permanently embedded in the mesophyll, globose to polygonal due to mutual compression on the sides, 100 to 250 µ in diameter. *Sterile* outer layer of cells hyaline to pale brown, smooth, rectangular, 9-14 × 14-21 µ, outer wall thickened, up to 2 to 4.5 µ. Inner fertile *spores* pale yellow, subglobose to polygonal, measuring 9-15 × 14-18 µm, chiefly 10-15 µm in diameter, thin-walled, smooth".

On *Acanthaceae: Hemigraphis latebrosa* Nees; S. Asia (India). Known only from the type locality.

No specimen of *Doassansia hemigraphiae* was available for study. A thorough study of the type or authentic material may show that it also belongs to the genus *Heterodoassansia*, similarly to the other two smuts on *Acanthceae, H. hygrophilae* and *H. khandalensis*. In support of this assumption is the description "2-4.5 µm thick outer wall" of the sterile cells, which probably refers to the tangentially flattened, narrow layer of small, empty, sterile cells, covering the large (ornamented?, inner layer of) sterile cells.

3. ***Heterodoassansia hygrophilae*** (Thirum.) Vánky, Mycotaxon 95:56, 2006.

For synonymy and description see Vánky (2006b:56).

4. ***Heterodoassansia khandalensis*** (S.D. Patil & Gandhe) Vánky, **comb. nov.**

MycoBank 510381.

Basionym: *Doassansia khandalensis* S.D. Patil & Gandhe, Maharashtra Vidnyan Mandir Patrika 10:33, 1975. — Type on *Hemiadelphis polysperma*, India, Maharashtra State, Khandala, 5.X.1971, S.D. Patil, HCIO 32495; isotype HUV 15472! Topotype ibidem, on IX.1976, L.N. Nair, AMH, HUV 17457.

Sori on the leaves forming circular, elliptic or irregular spots, 1-5 mm in diam., first yellow, later pale brown, with spore balls embedded in the host tissue showing as minute, dark brown, hypophyllous dots. *Spore balls* globose, subglobose, broadly ellipsoidal, rarely irregular, 90-140 × 110-160 µm, or larger by confluence, orange tinted pale yellowish-brown, composed of a central mass of spores surrounded by a cortex of empty, sterile cells. *Spores* rounded subpolyhedrally or polyhedrally irregular, varying in size, 7-10.5(-12) × 9-13.5 µm, subhyaline or very pale yellowish-brown; wall even, c. 0.5 µm thick, smooth. *Cortex of sterile cells* of two kinds: an inner layer of larger, globoid, ellipsoidal, radially elongated or irregular cells, measuring 5-15 × 8-20 µm, pale yellowish-brown; wall even, c. 0.5 µm thick, sparsely to moderately densely, finely, low verrucose-echinulate on its inner surface. The second, outermost layer of the cortex is formed of small, radially flattened, irregular cells of the same colour and wall thickness as the inner layer but lacking ornamentation. *Spore germination* (Patil & Gandhe, 1976:31) results in holobasidia with an apical whorl of 4-8 basidiospores which produce secondary sporidia or, after conjugation, dicaryotic hyphae.

On *Acanthaceae*: *Hemiadelphis polysperma* Nees; S. Asia (India).

Heterodoassansia khandalensis differs from the closely related *H. hygrophilae* by having smaller spore balls, spores and cortical cells, by more finely ornamented cortical cells, and by different host plant genera. It is likely they represent the same species (molecular biology?).

Key to the smut fungi of *Acanthaceae*

1. Cortex of spore balls composed of one kind of sterile cells 2
– Cortex of spore balls composed of two kind of sterile cells 3
2. Cortical layer thin (4-8 μm)............................. ***Doassansia kamatii***
– Cortical layer thick (14-21 μm).................... ***Doassansia hemigraphidis***
3. Spore balls 110-200 μm long; spores 9-16 μm long; sterile cells finely, low verrucose-echinulate.................................. ***Heterodoassansia khandalensis***
– Spore balls 110-160 μm long; spores 9-13 μm long; sterile cells with 0.5-1 μm high spines .... ***Heterodoassansia hygrophilae***

Tilletia species on *Poa* (*Poaceae*)

Poa L., in the subfamily *Pooideae*, tribe *Poeae*, with c. 500 species throughout the world, is an extremely uniform genus (Clayton & Renvoize, 1986:101). On *Poa* only five *Tilletia* species are recognised. Some of them, very typical ones, occur also on other un-related host genera. Several *Tilletia* species on *Poa* have been collected once or a few times only. They can be overlooked but in some cases they seems to be geographically restricted (e.g. *T. togwateei*).

1. *Tilletia cathcartae* Durán & G.W. Fisch., The genus Tilletia: 44, 1961.

Type on *Poa caespitosa* G. Forst., Australia, New South Wales, Cathcart, 14.I.1940, J. Vickery, NSW 9039; isotypes BRIP 7807!, WSP 48366, HUV 18645!

Sori in all ovaries of an inflorescence, inconspicuous, hidden by the floral envelopes, ovoid to broadly fusiform, c. 0.5 × 1-1.5 mm, at first covered by the pericarp which ruptures disclosing the reddish-brown, powdery spore masses intermixed with sterile cells. *Spores* globose, subglobose to broadly ellipsoidal or slightly irregular, 30-36 × 32-42 μm, golden-brown; wall 4-5 μm thick including the 3-4 μm high, flattened verrucae which may give the spore surface an areolate aspect. *Sterile cells* few, globose, irregular or angular, 18-30 μm in diam., hyaline; wall 3.5-5 μm thick, smooth.

On *Poa caespitosa* G. Forst., *Poa clivicola* Vickery, *Poa ensiformis* Vickery, *Poa pusilla* Bergg.; Australasia (Australia, New Zealand).

2. *Tilletia paradoxa* Jacz., Zap. Naucno-Prikl. Otd. Tiflisk. Bot. Sada 5:169, 1926.

Type on *Phleum* sp. Russia, Transcaucasia, between Ipchreuli and Dioban, 19.VIII.1910, H. Popov; isotypes AA! (originating from Tiflis), HUV 12133!

Tilletia transiliensis Kuznetzova & Schwarzman, in Schwarzman, Fl. spor. rast. Kazakhstana 2:240, 1960. — Type on *Poa nemoralis* L., Kazakhstan, Reg. Alma-Ata, Mt. Zailijskij Alatau, valley Kazachki, 8.X.1957, S.R. Schwarzman, AA!; isotype HUV 12132! (syn. by Vánky, 1988a:403).

Tilletia sabaudiae H. Zogg, Botanica Helvetica 93:91, 1983. — Type on *Poa nemoralis* L., France, Savoie Prov., "in Alpibus Sabaudiae" [= Savoier Alpen], 1851, J. Müller-Argoviensis, NEU; isotype HUV 10918! (syn. by Vánky, 1988a:403).

Sori in all ovaries of an inflorescence, as minute, dark bodies, partially hidden by the glumes and covered by a delicate pericarp which ruptures disclosing the black, granular-powdery mass of spores and sterile cells. *Spores* globose, subglobose, ovoid to occasionally ellipsoidal, opaque, dark reddish-brown, very large, 37-52 × 37-58 µm, including the 4-6 µm high corona (measured in lactophenol); wall in LM appear obscurely reticulate, 6-10 meshes per spore diam., meshes irregularly polyhedral to subpolyhedral, 1.5-5.5 µm in diam., muri finely verruculose, 0.5-1.5 µm high. Corona around the spores yellow-tinted, with ridges that are erect or curved in one direction (optical phenomenon?). In SEM the spores appear with dense, often narrow tubercules. *Sterile cells* globose to ovoid, variable in size, smaller than the spores (10-30 µm long), with granular contents; wall hyaline with a yellowish tint, smooth, sometimes unevenly thickened, 3-7 µm wide.

On *Phleum* sp., and *Poa nemoralis* L.; Europe, Asia.

3. *Tilletia poae* Nagorny, Sci. Papers Appl. Sec. Tiflis Bot. Gard. 5:170, 1926.

Type on *Poa nemoralis* var. *svanetica* Hack., Russia, Caucasia, Svanetiya, Dongusorum Glacier, 16.VIII.1925, N. Ketzchoveli, ?

Sori in ovaries, more or less hidden by the enveloping glumes, first covered by the pericarp which ruptures exposing the dark brown, semi-powdery, foetid mass of spores. *Spores* globose, subglobose, 24-27 × 25-29 µm in diam., including the 2-2.5 µm thick sheath, light olivaceous-brown; wall with complete or incomplete reticulum, 6-8 meshes per spore diam., often with a tuberculum in the interspace. *Sterile cells* globose to ovoid, smaller than the spores (mostly 12-17 µm long), hyaline, with granular content and a smooth, 1-2 µm thick wall.

On *Poa nemoralis* L., *P. nemoralis* var. *svenetica* Hack.; Europe, Asia.

The spores of *T. poae* were originally described as measuring 30-35 µm. Having not seen the type of *T. poae*, I based my description on a specimen collected NE of Moscow (Yaroslavskaya Region, Galich Raion, near Mateevo, 28.VII.1928, M. Makaveev, LEP). A specimen in AA, labelled as *T. poae*, collected by Nagorny in the type locality but one year later (1926), contains typical *T. paradoxa* (wrongly labelled or mixed specimen ?).

4. *Tilletia sterilis* Ule, Verh. Bot. Vereins Prov. Brandenburg 5:214, 1884.

Ustilago sterilis (Ule) Nannfeldt, in Lindeberg, Symb. Bot. Upsal. 16(2):151, 1959. — Lectotype (designated by Liro, 1938:75) on *Koeleria cristata* (L.) Pers., p.p. (= *K. pyramidata* (Lam.) P. Beauv.), Germany, Bavaria [= Bayern], Coburg, Rögener Berg, VII.1879, E. Ule; isolectotypes in Rbh. Fgi. eur. no. 3605, HUV 2425!

Tilletia scrobiculata G.W. Fisch., Res. Stud. St. Coll. Wash. 20:6, 1952. — Type on *Poa secunda* J. Presl, USA, Idaho, McCall, 1.VIII.1948, G.W. Fischer, R. Sprague & J.P. Meiners; isotypes in Fischer, Gramin. smuts N. Amer. no. 221, HUV 10003! Paratype: Idaho, Latah Co., 5.VII.1950, R. Sprague & G.W. Fischer; isoparatypes in Fischer, Gramin. smuts N. Amer. no. 268, HUV 10004! (syn. by Vánky, 1994:252).

Sori in leaves, sheaths and culms as long, inconspicuous striae between the veins which may cover the whole leaf surface, initially yellowish-grey, later reddish-brown or dark brown. Attacked plants dwarfed and usually not flowering. Spore mass golden-brown, agglutinated to semi-powdery, foetid. *Spores* globose, subglobose, ovoid to slightly irregular, 17-24 × 19-30 µm, light golden- to medium dark brown, with granular contents; wall two-layered, endospore 0.5-1 µm thick, exospore obscurely reticulate, often appearing as pitted or papillate, 8-20 meshes per spore diam., muri 1-2.5 µm high. *Sterile cells* rare, globose to irregular, smaller than the spores, hyaline to yellow tinted; wall thin (0.5-1.5 µm). *Germination* of *Tilletia* type (Meiners, 1957:528; Dumitraş, 1971:187).

On *Festuca ovina* L., *F. valesiaca* Schleich. ex Gaudin, *Festuca* sp., *Koeleria pyramidata* (Lam.) P. Beauv. (*K. cristata* (L.) Pers., p.p.), *Poa nemoralis* L., *Poa secunda* J. Presl; Europe, N. America.

5. *Tilletia togwateei* Guillem., Mycologia 80:284, 1988 (as '*togwatii*').

Type on *Poa reflexa* Vasey & Scribn., USA, Wyoming, Togwatee Pass, 12.VIII.1948, G.W. Fischer, WSP 85654. Topotype: 4.VIII.1992, P. Gray & L. Carris, WSP 85654, isotopotype HUV 18090!

Sori in the ovaries, infecting all in the inflorescence, ovoid with acute tip, 0.5-0.7 × 1-2 mm, more or less hidden by the floral envelopes, covered by the thin, brown pericarp which ruptures irregularly disclosing the almost black, powdery, foetid mass of spores and sterile cells. *Spores* subglobose, ovoid, ellipsoidal to slightly irregular, 17.5-24 × 21-28 µm, yellowish- to medium dark brown; wall reticulate, very often incompletely so, often appearing cerebriform, 7-12 meshes per spore diam. (spores with cerebriform ornamentation not counted), muri 1-2.5 µm high, in optical median view blunt or acute. *Sterile cells* subglobose, ovoid, ellipsoidal to subpolyhedrally slightly irregular, 9-16 × 11-18(-21) µm, hyaline to subhyaline; wall even, 1.5-3 µm thick, smooth.

On *Poa reflexa* Ell. ex Scribn.; N. America (USA).

In the collection (BPI 172694), the spores are small (18.5-25 µm long) and the muri are low (0.8-1.5 µm high) and blunt.

Key to the *Tilletia* species of *Poa*

1.	Sori in the leaves or stems forming inconspicuous striae	*T. sterilis*
–	Sori in the ovaries	2
2.	Spores 37-58 µm long	*T. paradoxa*
–	Spores smaller	3
3.	Spores 32-42 µm long, with 3-4 µm high, flattened verrucae	*T. cathcartae*
–	Spores between 21-29 µm long, reticulate, often incompletely	4
4.	Meshes 6-8 per spore diam.	*T. poae*
–	Meshes 7-12 per spore diam., surface often cerebriform	*T. togwateei*

Stripe smuts of *Calamagrostis* (incl. *Deyeuxia; Poaceae*)

Calamagrostis Adans. and *Deyeuxia* P. Beauv. are two closely related genera in the subfam. *Pooideae*, tribe *Aveneae*, subtribe *Alopecurinae*. Clayton & Renvoize (1986:135) considered they were synonyms. Several smut fungi producing long striae on the leaves, leaf sheaths, culms and even in the inflorescence have been described on various species of *Calamagrostis*. Of these, ***Urocystis calamagrostidis*** (Lavrov) Zundel (Zundel 1953:312), is characterised by spore balls in which the spores are surrounded by sterile cells. ***Ustilago*** species, possessing single spores, reported on *Calamagrostis* (and *Deyeuxia*) are: **1. *U. calamagrostidis*** (Fuckel) G.P. Clinton (Clinton 1902:138), **2. *U. corcontica*** (Bubák) Liro (Liro 1924:383), **3. *U. deyeuxiae*** L. Guo (Guo 1993:51), **4. *U. deyeuxiicola*** Vánky & L. Guo (Vánky & Guo 2001:262), **5. *U. scrobiculata*** Liro (Liro 1924:68), **6. *U. striiformis*** (Westend.) Niessl (Niessl 1876:1). These species can be differentiated by spore morphology (For descriptions and illustrations of most of these species see Vánky, 1994). The main distinctive characters are shown in a key below. The single problem is presented by no. 2 and 6 (*U. corcontica* and *U. striiformis*). Bubák (1912, 1916) recognised three species: no. 1, 2 and 6 (all as '*Tilletia*'). Nannfeldt (Lindeberg, 1959:154-156) studied in detail the stripe smuts of *Calamagrostis* and concluded that, at least in Europe, only three species occur: no. 1, 2 and 5. At the same time, he wrote that he was unable to find no. 6.

U. striiformis sensu latissimo is a polyphageous, cosmopolitan species infecting a large number of host plants in at least 40 genera, between them also *Calamagrostis*. There are certainly specialised forms confined to certain host species or genera. Moreover, spore shape, size and ornamentation also vary markedly between specimens infecting different host genera, the same host genus (comp. also Mäkinen, 1963), or even the same host species. Due to the lack of a comparative study of this group, and because of the presence of intermediate forms, I treated *U. striiformis* in a broad sense (Vánky, 1985:237-241; 1994:377-379) and included in it *U. corcontica*. In a recent paper, Spooner & Legon (2006:92-93) considered *U. corcontica* as a separate species, "closely akin to *U. calamagrostidis*". For the length of the spores they gave 12-16(-19) µm (without ornament), and c. 0.8-1 µm high spines. I strongly suspect that this species, on *Calamagrostis canescens*, is actually *U. calamagrostidis*. Study of the whole complex of *U. striiformis* s. lat. by modern methods, i.e. morphological characters combined with molecular ones, related to host plants, certainly will reveal several, more or less well-delimited taxa.

Key to the stripe smuts of *Calamagrostis* (incl. *Deyeuxia*)

1. Spores in balls surrounded by sterile cells............ ***Urocystis calamagrostidis***
– Spores single, sterile cells absent..2
2. Spores 12-19 µm long, coarsely ornamented 3
– Spores smaller, more finely ornamented 4
3. Spores with irregular warts, the bases of which are confluent into irregular, interrupted meshes..................***Ustilago scrobiculata*** (incl. ***U. deyeuxiae***)
– Spores with regular, isolated spines, up to 1 µm long .. ***Ustilago calamagrostidis***
4. Spores 9-15(-16) µm long, densely echinulate; spore profile serrulate ....***Ustilago striiformis*** (incl. ***U. corcontica***)
– Spores 6.5-10 µm long, finely verruculose; spore profile smooth .... ***U. deyeuxiicola***

New species

Two new species of *Tilletia*

Cîrțu et al. (1974) published several microfungi from Romania, inclusing also «*Tilletia melicae* Lagerh., in Sacc. Syll. Fung. VII, 2, 490, 1888 on *Melica cilata* L. subsp. *transsilvanica* (Schur) Husnot". Neither Lagerheim, nor anyone else appears to have published this name. Thirty years ago, Dr. Cîrțu sent me a small part of the collection, preserved in his herbarium. A study of the fungus revealed that it represents a new species:

Tilletia melicae Vánky, sp. nov.

MycoBank 510358

Typus in matrice Melica transsilvanica *Schur, Romania, Oltenia, Comit. Dolj, prope pag. Dilga, in silvis, alt. cca. 100 m.s.m., 16.VIII.1966, leg. D. et M. Cîrțu. Holotypus in Herbario Ustil. Vánky, HUV 2355!, isotypus in Herb. Cîrțu.*

Sori in ovariis omnibus(?) eiusdem inflorescentiae, ovoideae vel ellipsoidales, cca. 1 mm longi, involucris floralibus perfecte occulti, primo pericarpio tenui cooperti, quo irregulariter rupto massam proprie foetidam, rubrobrunneam, pulveream sporarum et cellularum sterilium ostendentes. Sporae globosae, subglobosae usque late ellipsoidales, 16-20 × 16-21,5 µm, pallide flavidobrunneae, reticulatae; maculis raro incomplete polyangularibus 4-7 per diametrum sporae, muri etiam in visu opticali mediano conici, 1-1,5 µm alti, acuti, 18-24 in circumferencia aequatoriali. Cellulae steriles globosae, ellipsoidales usque parum irregulares, 8-15 × 9-17 µm, subhyalinae vel flavide tinctae; pariete 1-2 µm crasso, levi vel cum spuris ornamenti.

Sori in all(?) ovaries of an inflorescence, ovoid or ellipsoidal, c. 1 mm long, completely hidden by the floral envelopes, first covered by the thin pericarp which ruptures irregularly disclosing the foetid, reddish-brown, powdery mass of spores and sterile cells. *Spores* (Figs. 10, 11) globose, subglobose to broadly ellipsoidal, 16-20 × 16-21.5 µm, pale yellowish-brown, reticulate, meshes polyangular, rarely incomplete, 4-7 per spore diam., muri in optical median view conical, 1-1.5 µm high, acute, 18-24 on the equatorial circumference. *Sterile cells* (Fig. 10) globose, ellipsoidal to slightly irregular, 8-15 × 9-17 µm, subhyaline or with a yellow tint; wall 1-2 µm thick, smooth or with a trace of ornament.

On *Poaceae: Melica transsilvanica* Schur: Europe (Romania). Known only from the type locality.

Typical for *Tilletia melicae* are: host plant in the tribe *Meliceae* (of the subfam. *Pooideae*), the reticulated spores with conical, 1-1.5 µm high, acute muri, 18-24 on the equatorial circumference. It differs mainly from the similar *T. contraversa*, in which the muri are 1.5-3 µm high, embedded in a hyaline sheath, from *T. caries*, with 5-8 meshes per spore diam., muri 0.5-1.5 µm high, blunt or subacute, and from *T. bromi*, in which the muri are 1.5-2.5 µm high, 21-29 on the equatorial circumference.

Tilletia shivasii Vánky, **sp. nov.**

MycoBank 510359

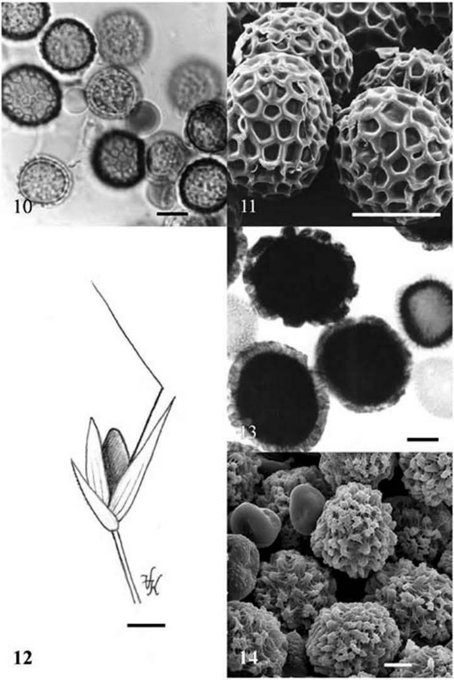
Typus in matrice Arundinella nepalensis *Trin., Australia, Northern Territory, 13 km W urbe Batchelor, 13°03'09" S, 130°54'51" E, alt. cca. 140 m.s.m., 8.VI.2006, leg. M.J. Ryley, M.D.E. & R.G. Shivas. Holotypus in BRIP 47951, isotypus in Herbario Ustil. Vánky, HUV 21367! (unacum* Macalpinomyces arundinellae-setosae *R.G. Shivas & Vánky).*

Sori in ovariis nonnullis eiusdem inflorescentiae, ovoidei, 0,8-1 × 1,5-2 mm, inter involucris floralibus patentibus conspicui, primo peridio laeve, pallide brunneo, origine hostali cooperti, quo irregulariter rupto massam nigram, semiagglutinatam usque pulveream sporarum cellulis sterilibus intermixtam ostendentes. Sporae globosae, subglobosae usque late ellipsoidales, 28-36 × 30-40 µm, atro-badiae usque opacae, cum grossis projecturis cylindricis irregularibus, 3,5-6,5 µm longis, in aspectu superficiali sicut maculae atrae, irregulares, polyangulares, in diametro sporae 8-10, in aspectu medio opticali cylindricis, apice rotundatis, complanatis vel parum dilatatis, 28-40 in circumferentia aequatoriali. Cellulae steriles globosae, ovoideae, ellipsoidales usque parum irregulares, 12-28 × 13,5-29 µm, pallide olivaceobrunneae; pariete aequali, 2,5-6 µm crasso, multistratoso, levi vel verruculoso, saepe cum appendice breve hyphali.

Figs. 10, 11. Spores and sterile cells of *Tilletia melicae* on *Melica transsilvanica* in LM and in SEM (type). Bars = 10 µm.

Fig. 12. A sorus of *Tilletia shivasii* in the ovary of *Arundinella nepalensis* (type). Bar = 1 mm.

Figs. 13, 14. Spores and sterile cells of *Tilletia shivasii* on *Arundinella nepalensis* in LM and in SEM (type). Bars = 10 µm.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Sori (Fig. 12) in some ovaries of an inflorescence, ovoid, 0.8-1 × 1.5-2 mm, showing between the spreading floral envelopes, at first covered by a pale brown, smooth peridium of host origin which ruptures irregularly disclosing the black, semiagglutinated to powdery mass of spores intermixed with sterile cells. *Spores* (Figs. 13, 14) globose, subglobose to broadly ellipsoidal, 28-36 × 30-40 µm, dark chocolate-brown to opaque, provided with coarse, 3.5-6.5 µm long, irregularly cylindrical projections, in surface view showing as dark, irregular, polyangular spots, 8-10 per spore diameter, in optical median view appearing cylindrical, with rounded, flattened or slightly widened tip, 28-40 on the equatorial circumference. *Sterile cells* (Figs. 13, 14) globose, ovoid, ellipsoidal to slightly irregular, 12-28 × 13.5-29 µm, pale olivaceous-brown; wall even 2.5-6 µm thick, multilayered, smooth or verruculose, often with a short hyphal appendage.

On *Poaceae*: *Arundinella nepalensis* Trin.; Australia. Known only from the type locality.

Etymology: This species is named after Dr. Roger G. Shivas (Brisbane, Australia), the most active investigator of the smut fungi of Australia, passionate collector of microfungi in many countries wordwide, author of numerous new species and genera, co-author of the monograph of the smut fungi of Australia, who also collected this smut fungus.

Key to the *Tilletia* species of *Arundinella*

1. Sori 10-30 mm long, hispid; spores with 1-1.5(-2) µm high warts .... *T. chiangmaiensis*
– Sori up to 5 mm long, smooth; spores with higher warts 2
2. Sori obovoid, with two longitudinal stripes; spores 20-27(-30) µm long; warts 1.5-2.5 µm high .... *T. lineata*
– Sori ovoid, without longitudinal stripes; spores larger; warts higher 3
3. Spores 22-33(-37) µm long; warts 1.5-3 µm high .... *T. arundinellae*
– Spores 30-40 µm long; warts 3.5-6.5 µm high .... *T. shivasii*

A new species of *Restiosporium* on *Guringalia* (*Restionaceae*)

Some smutted *Guringalia dimorpha* are preserved in DAR. The smut was studied and compared to the 20 known *Restiosporium* species on *Restionaceae* (comp. Vánky, 2006a) revealing a new species:

Restiosporium guringaliae Vánky & R.G. Shivas, **sp. nov.**

MycoBank 510362.

Typus in matrice Guringalia dimorpha *(R. Br.) B.G. Briggs & L.A.S. Johnson, Australia, New South Wales, Sydney, North Bondi, Williams Park, 33°52' S, 151°16' E, 23.VI.1960, leg. O.D. Evans & E.F. Constable. Holotypus in DAR 7048, isotypi in BRIP 48219 et in HUV 21278. Paratypus in matrice* Guringalia dimorpha*, Australia, New South Wales, Sydney, Bondi, 25.X.1916, leg. A.A. Hamilton, DAR 2201.*

Sori inconspicui, semina destruentes, capsulas massa nigra, granuloso-pulverea glomerulorum sporarum complementes. Infectio systemica; capsulae omnes plantes eiusdem affectae. Glomeruli sporarum globosi, ovoidei-ellipsoidales vel parum irregulares, 40-100 × 50-120(-150) µm, atro-olivaceobrunnei usque opaci, e sporis pluries decem usque pluries centum pressu leviter separabilibus compositi. Sporae rotundatae usque elongatae, subpolyedrice vel polyedrice irregulares, 7,5-10,5 × 9-14(-16) µm, pallidee olivaceo-brunneae cum lineis atrioribus correspondentibus marginibus laterium contactorum; pariete aequali, cca. 0,5 µm crasso, in LM levi, in SEM superficies libera sporarum maxime externarum glomeruli aspera, cum verrucis humilibus, irregularibus, rotundatis, confluentibus instructa.

Sori (Fig. 15) inconspicuous, destroying the seeds, filling the capsules with a black, granular powdery mass of spore balls. Infection systemic; all capsules of a plant are affected. *Spore balls* (Figs. 17, 18) globose, ovoid ellipsoidal or slightly irregular, 40-100 × 50-120(-150) µm, dark olivaceous-brown to opaque, composed of tens to hundreds of spores which separate easily by pressure. *Spores* (Figs. 17, 18) rounded to elongated, subpolyhedrally or polyhedrally irregular, 7.5-10.5 × 9-14(-16) µm, pale olivaceous-brown with darker lines corresponding to the edges of contact sides; wall even, c. 0.5 µm thick, in LM smooth, in SEM the free surface of the outermost spores in a ball is rough, provided with low, irregular, rounded, confluent warts.

On *Restionaceae*: *Guringalia dimorpha* (R. Br.) B.G. Briggs & L.A.S. Johnson (*Restio dimorphus* R. Br.), Australia. Known only from the type collections.

The differentiating morphological characters of the *Restiosporium* species are often small. It seems that there is a host specificity (Vánky, 2006a:20). *R. guringaliae* differs from *R. anarthriae* Vánky (on *Anarthria*) in which the spore balls are smaller (40-80 µm long), the spores are paler, and their wall is thicker (0.5-1 µm); from *R. baloskionis* Vánky & R.G. Shivas (on *Baloskion*) in which the spores are larger (9-17(-20) µm); from *R. chaetanthi* Vánky (on *Chaetanthus*) in which the spore balls are more persistent and paler, the spore wall is slightly uneven, 0.5-1 µm thick; from *R. flexuosum* Vánky (on *Desmocladus*) in which the spore balls are ephemeral, and the spore wall is thicker (0.5-1.5 µm); from *R. pallentis* Vánky & R.G. Shivas (on *Baloskion*) in which the spore balls are smaller (30-90(-100) µm long) and the spore walls uneven, 0.5-1 µm thick; from *R. sphacelatum* Vánky (on *Chordifex*) in which the spore balls are more persistent, the spores more rounded and uniformly pigmented. *R. guringaliae* morphologically is closest to *R. meneyae* Vánky (on *Lyginia*) which has spores that appear in SEM smooth or extremely finely, sparsely, low verruculose.

A new species of *Franzpetrakia* on *Phacelurus* (*Poaceae*)

A peculiar smut fungus was collected by M.S. Pavgi in India on *Microstegium* sp., destroying the whole inflorescence. The spore mass is powdery, interwoven by numerous long, slender, fragile chains of sterile fungal cells, the spores are

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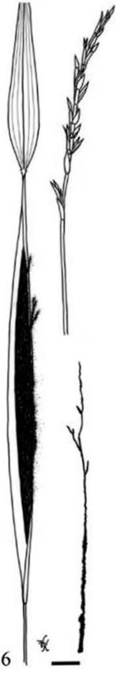

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Fig. 15. Sori of *Restiosporium guringaliae* on *Guringalia dimorpha* (type). Habit, and enlarged an opened capsule. Bars = 1 cm. for habit, and 2 mm for detail drawing.

Fig. 16. *Franzpetrakia phaceluri* on *Phacelurus latifolius* var. *monostachyus* (type). Habit, and a healthy inflorescence. Bar = 1 cm.

characteristically reticulate. A new genus, ***Franzpetrakia*** Thirum. & Pavgi (Pavgi & Thirumalachar 1957:2) was proposed to accommodate it, with the type *F. microstegii* Thirum. & Pavgi. The genus was studied and emended by Guo et al. (1990:58), when a second species was added, ***F. okudairae*** (Miyabe) L. Guo et al. on *Coix lacryma-jobi* L., from Japan and China. Smutted *Phacelurus latifolius* var. *monostachyus* was collected in China by L. Guo, and later by R.G. Shivas. Based only on the original description, this specimen was provisionally identified by Guo et al. (1990) as *F. microstegii*. A comparison with the type was not possible, because it is apparently lost. Recently, smutted *Microstegium vagans* (Nees ex Steud.) A. Camus was collected in Thailand, Kanchanaburi Prov., 13 km SE of Sangkhla Buri, alt. 325 m, 16.XII.2005, leg. R.G., M.D.E., A.J. & G.E. Shivas, P. Athipunyakom, S. Likhitekaraj, A. Somrith, T. Bashabutra, C. & K. Vánky, BRIP 47760, HUV 21217. A comparison of this specimen with that on *Phacelurus latifolius* from China revealed that they are different. The specimen on *Microstegium vagans* is considered to be *F. microstegii*, whereas the smut on *Phacelurus* is described as a new species:

Franzpetrakia phaceluri Vánky, R.G. Shivas & L. Guo, **sp. nov.**

MycoBank510361

Typus in matrice Phacelurus latifolius var. monostachyus (det. Zhou Gen-sheng), China, Yunnan Prov., Kunming, Hot Springs, 28.IX.1987, leg. L. Guo. Holotypus in HMAS 58388, isotypus in Herbario Ustil. Vánky, HUV 13861. Paratypus ibidem, 3.XI.2002, leg. R.G. Shivas & H.E.C. Evans, BRIP 39203, isoparatypus HUV 20192.

Franzpetrakia phaceluri *a specie simili* F. microstegii *sporis aliquantum majoribus (13-18,5 µm longis), et charactere muri latioris (0,5-1,5 µm), reticulis parvis plerumque multis, muris 12-18 in aequatoriali circumferentia distincta. Catenae cellularum sterilium etiam latiores (8-14 µm), saepe cellulis 2 vicinis compositae. Sporae* F. microstegii *12-16 µm longae, muri reticuli cca. 0,5 µm lati, raro reticulo pusillo, 10-15 in aequatoriali circumferentia. Catenae cellularum sterilium 5,5-11 µm latae, e serie singulo cellularum compositae.*

Sori (Fig. 16) destroying the whole inflorescence, fusiform, 0.5-2 × 5-10 cm, at first concealed by the uppermost leaf sheath, later protruding as dark brown, powdery mass of spores intermixed with numerous slender, filiform chains of sterile fungal cells surrounding a central, ramified columella of host origin. *Spores* (Figs. 19, 20) globose, ovoid or ellipsoidal, 11-17.5 × 13-18.5 µm, olivaceous-brown, reticulate, meshes complete, rarely incomplete, polyangular or subpolyangular, (2-)3-4 per spore diam., muri 0.5-1.5 µm wide, (1-)1.5-2.5(-3) µm high, with flattened tip, 12-18 on the equatorial circumference, in SEM muri wide, often with numerous minute, irregular meshes in groups, evident especially in SEM. *Chains of sterile cells* (Figs. 19, 20) 8-14 µm wide, several mm long, composed usually of a single, not rarely also a double row of fungal cells. Cells of the chains variable in shape and size, oblong with both ends truncate, subtetrahederal or subglobose, 5-9 × 8-12 µm, subhyaline or with a pale yellowish-brown tint; wall 0.5-1 µm thick, apparently smooth, in SEM free surface finely verruculose.

On *Poaceae*: *Phacelurus latifolius* var. *monostachyus* Keng; S.E. Asia (China). Known only from the type locality.

Franzpetrakia phaceluri differs from the similar *F. microstegii* (type on *Microstegium* sp., India), by having larger spores, less meshes per spore diam., and by wider muri with numerous small reticula, as well as by wider chains of sterile cells, often composed of two cells side by side. In *F. microstegii* the spores are 12-16 µm long, with 2-5 meshes per spore diam., the muri of the reticulum are c. 0.5 µm wide, rarely with small reticula, the chains of sterile cells are 5.5-11 µm wide, composed of a single row of cells.

Key to the species of *Franzpetrakia*

1. Spores often incompletely reticulate; muri on the equatorial circumference 14-23; sterile cells 8-17.5 µm wide. On *Coix*. . . . . ***F. okudairae***

– Spores rarely incompletely reticulate; muri on the equatorial circumference less; sterile cells smaller. Not on *Coix*. 2

2. Muri on the equatorial circumference 12-18, 0.5-1.5 µm wide, with flattened tip, often with numerous, minute reticula; sterile cells 8-12 µm wide. On *Phacelurus* . . . . ***F. phaceluri***

– Muri on the equatorial circumference 10-15, c. 0.5 µm wide, with rounded tip, rarely with minute reticula at the angles; sterile cells 5.5-7(-10.5) µm wide. On *Microstegium* . . . . ***F. microstegii***

A new species of *Sporisorium* on *Ischaemum* (*Poaceae*)

Samples of *Ischaemum indicum*, infected by a *Sporisorium* sp., were collected in Myanmar (Burma) by Dr. R.G. Shivas (Brisbane, Australia). The fungus differs from all ten known *Sporisorium* species on *Ischaemum* (comp. Vánky, 2004:94-102), including the recently published *S. ischaemianum* A.R. Patil et al. (Patil et al. 2004a:783). It is described as:

Sporisorium myanmarense Vánky & R.G. Shivas, **sp. nov.**

MycoBank 510363.

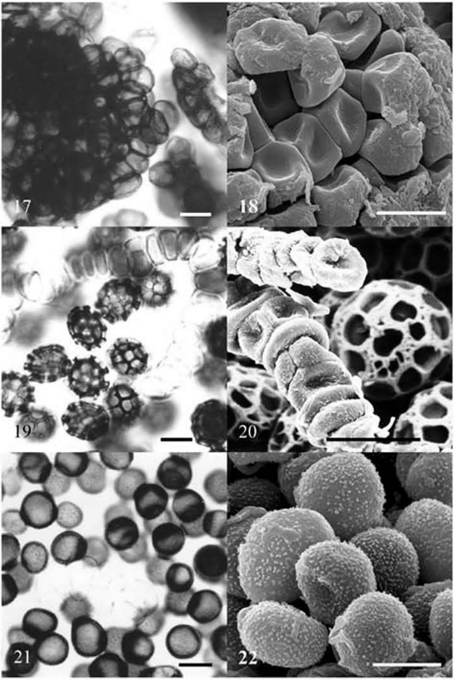
Typus in matrice Ischaemum indicum (*Houtt.*) *Merr.* (*det. H. Scholz, B*), *Myanmar* (*Burma*), *Yangon* (*Rangoon*), *ad lacum Inaya, 16°50'12.7" N, 96°09'15.7" E, 23.III.2006, leg. R.G. Shivas. Holotypus in HUV 21333, isotypus in BRIP 47943.*

Sori in spiculis omnibus eiusdem inflorescentiae, ovoidei vel ellipsoidales, 1,5-2 mm longi, primo peridio pallide brunneo cooperti, quo irregulariter rupto, massam atrobrunneam,

Figs. 17, 18. Spore balls and spores of *Restiosporium guringaliae* on *Guringalia dimorpha* in LM and in SEM (type).

Figs. 19, 20. Spores and chains of sterile cells of *Franzpetrakia phaceluri* on *Phacelurus latifolius* var. *monostachyus* in LM and in SEM (type).

Figs. 21, 22. Spores of *Sporisorium myanmarense* on *Ischaemum indicum* in LM and in SEM (type). Bars = 10 µm.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pulveream sporarum cellulis sterilibus intermixtam, columellam crassam, centralem decrescentem, saepe ramulis 1-2, brevibus, spiniformibus apicalibus instructam cingentem ostendentes. Sporae maturae singulae, globosae, subglobosae, ovoideae vel late ellipsoidales, non subpolyangulares, magnitudine variae, 8-12 × 9-14,5(-16) µm, mediocriter atro-flavidobrunneae; pariete aequali, 0,5-1 µm crasso, leniter, aliquantum dense echinulato, imago obliqua sporarum leniter dense serrulata. Cellulae steriles in turmis parvis irregularibus vel raro in catervis brevibus, cellulae singulae hemigloboideae, subcuneiformes vel irregulares cum latere uno vel lateribus nonnullis depressis, raro ellipsoidales, 7-16 µm longae, hyalinae; pariete cca. 0,5 µm crasso, levi.

Sori (Fig. 23) in all spikelets of an inflorescence, ovoid or ellipsoidal, 1.5-2 mm long, at first covered by a pale brown peridium which ruptures irregularly disclosing the dark brown, powdery mass of spores intermixed with sterile cells, surrounding a stout, central, narrowing columella often with 1-2 short, thorn-like, apical branches. *Spores* (Figs. 21, 22) when mature single, globose, subglobose, ovoid or broadly ellipsoidal, not subpolyangular, varying in size, 8-12 × 9-14.5(-16) µm, medium dark yellowish-brown; wall even, 0.5-1 µm thick, finely, rather densely echinulate, spore profile finely, densely serrulate. *Sterile cells* (Fig. 21) in small, irregular groups or rarely in short chains, single cells hemigloboid, subcuneiform or irregular, with one or several flattened sides, rarely ellipsoidal, 7-16 µm long, hyaline; wall c. 0.5 µm thick, smooth. *S. myanmarense* differs from *S. ischaemi* (L. Ling) Vánky (type on *Ischaemum rugosum* Salisb., India), in which the sori are 4-6 mm long, furthermore loose spore balls are present, and the 9-13 µm long spores are often subpolyhedral. *S. myanmarense* differs also from *S. tonglinense* (Tracy & Earle) Rifai (type on *I. ciliare* Retz., = *I. indicum* (Houtt.) Merrill, Singapore), in which the spores are 9-12 µm long, and more pronouncedly echinulate.

Key to the *Sporisorium* species of *Ischaemum*

1.	Sori in the spikelets	2
–	Sori in the whole inflorescence	8
2.	Sori in some spikelets of an inflorescence	*S. semisagittatum*
–	Sori in all spikelets of an inflorescence	3
3.	Spore balls ephemeral	4
–	Spore balls not ephemeral, separate by pressure	*S. furcatum*
4.	Spores 8-10 µm long	*S. hainanae*
–	Spores larger	5
5.	Spores 10.5-15 µm long; wall unevenly thick	*S. ischaemicola*
–	Spores smaller or larger; spore wall evenly thick	6
6.	Spores prominently echinulate, profile serrate	*S. tonglinense*
–	Spores finely echinulate, profile finely serrulate	7
7.	Sori 4-6 mm long; spores mostly subpolyhedral	*S. ischaemi*
–	Sori 1.5-2 mm long; spores globose to broadly ellipsoidal	*S. myanmarense*

8(1). Spores 5-7 µm long, flattened on one side, apparently smooth to very finely punctate .... *S. ischaemi-anthephoroidis*
– Spores larger, not flattened on one side, evidently ornamented 9
9. Columellae several, filiform; spores dimorphic; no sterile cells . *S. ischaemianum*
– Columella one; spores not dimorphic; sterile cells present 10
10. Columella long, flagelliform; spores 12-19 µm long .... *S. flagellatum*
– Columella stout, with bifurcate tip; spores 11-13.5 µm long .. *S. ischaemi-rugosi*

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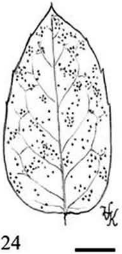

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Fig. 23. Sori of *Sporisorium myanmarense* in the spikelets of *Ischaemum indicum* (type). Habit, and enlarged a sorus. Bars = 1 cm for habit, and 2 mm for detail drawing.
Fig. 24. Sori of *Entyloma heterothecae* on a leaf of *Heterotheca subaxillaris* (type). Bar = 1 cm.

A new species of *Entyloma* on *Heterotheca* (*Asteraceae*)

The large species complex of *Entyloma compositarum* Farl., on *Asteraceae*, was subsequently split into numerous species, based partly on morphological characters but mostly on host plant taxonomy (host genera) and recently also on molecular biological results. The smut on *Heterotheca* is described as:

Entyloma heterothecae **Vánky, sp. nov.**

MycoBank 510360.

Typus in matrice Heterotheca subaxillaris (*Lam.*) *Britton & Rusby, USA, Kansas, Rooks Co., Alcona, near Stockton, 21.VIII.1895, E. Bartholomew, holotypus BPI 175026, isotypi BPI 175025, 175027, 175028* (*ut* Entyloma compositarum).

Sori in foliis maculas parvas, polyangulares, diametro 0,5-1 mm, vel propter confluentiam earum majores, pallide brunneas, in statu juniore in latere abaxiale albas formantes. Sporae globosae, subglobosae, ovoideae vel parum irregulares, 8-11 × 9-12(-13) µm, subhyalinae usque pallide flave suffusae; pariete aequali, cca. 0,5 µm crasso, levi. Anamorpha praesens.

Sori (Fig. 24.) on leaves forming small, polyangular spots, 0.5-1 mm in diam., or larger by confluence, pale brown, when young white on the abaxial side. *Spores* (Fig. 25) globose, subglobose, ovoid or slightly irregular, 8-11 × 9-12(-13) µm, subhyaline to pale yellow tinted; wall even, c. 0.5 µm thick, smooth. *Anamorph* present.

On *Asteraceae*: *Heterotheca subaxillaris* (Lam.) Britton & Rusby (*Inula subaxillaris* Lam.; *Heterotheca lamarckii* Cass.). Known only from the type locality.

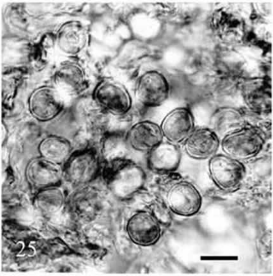

Fig. 25. Spores of *Entyloma heterothecae* on *Heterotheca subaxillaris* in LM (type). Bar = 10 µm.

New names

Macalpinomyces patilorum Vánky & A.R. Patil, **nom. nov.**

MycoBank 510366

Replacing *Macalpinomyces digitariae* A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34:838, 2004 (later homonym, non *M. digitariae* Vánky & R.G. Shivas, 2003). — Type on *Digitaria ternata*, India, Maharashtra State, Kolhapur, Shivaji University Campus, 21.IX.1995, M.S. Patil, HCIO 42826; isotypes Kolhapur W.I.F. 1504, HUV 21251.

Sori in some ovaries of an inflorescence, inconspicuous, 3-4 mm long, more or less hidden by the floral envelopes, at first covered by a thick, dark brown peridium which ruptures irregularly disclosing the dark brown, semiagglutinated to granular-powdery mass of (pseudo) spore balls and spores intermixed with sterile cells. *Spore balls* extremely variable in shape and size, composed of tens or hundreds of spores which separate easily by pressure. *Spores* subglobose, ovoid, ellipsoidal to usually rounded subpolyhedrally irregular, 6.5-9 × 7-12 µm, yellowish- to reddish-brown; wall even, c. 0.5 µm thick, from apparently smooth to finely, rather densely verrucose or verrucose-echinulate, spore profile smooth to finely wavy. *Sterile cells* single, globose or subglobose, 10-28 µm long, subhyaline to pale yellowish-brown; wall even, c. 0.5 µm thick, smooth.

On *Poaceae*: *Digitaria ternata* Stapf; S. Asia (India). Known only from the type collection.

Macalpinomyces patilorum differs from *M. digitariae* Vánky & R.G. Shivas (type on *Digitaria gibbosa* (R. Br.) P. Beauv., Australia), especially in the sterile cells. These in the Australian species are in irregular groups or single, measuring 7-13 × 8-14 µm, are pale yellowish-brown, with a 1-1.5(-2) µm thick wall.

Etymology: This species is named in honour of the two eminent mycologists from Kolhapur (M.S., India), Prof. M.S. Patil, and the late Prof. T.M. Patil, authors of numerous mycological papers, in which a great number of new taxa of various microfungi have been described, including also this smut fungus.

Sporisorium muticae Vánky & A.R. Patil, **nom. nov.**

MycoBank 510365

Replacing *Sorosporium apludae-muticae* A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34:839, 2004 (later homonym, non *Sporisorium apludae-muticae* L. Guo, 1999). — Type on *Apluda mutica*, India, Maharashtra State, Kolhapur, Shivaji University Campus, 13.XII.1985, S.C. Pardeshi, HCIO 42840; isotypes Kolhapur W.I.F. 1520, HUV 21256.

Sori destroying the whole racemes, cylindrical, c. 0.5 × 8-10 mm, partly hidden by the uppermost leaf sheath, first covered by a yellowish-brown peridium which ruptures irregularly disclosing the dark brown, powdery mass of spore balls and spores surrounding a long, simple, narrow columella. *Spore balls* variable in shape and size, usually irregular, 30-100 × 50-160 µm, dark reddish-brown to opaque, composed or tens or hundreds of spores which separate easily by pressure. *Spores* dimorphic. Outer spores subglobose, ovoid, ellipsoidal to irregular, 8-14.5 × 11-16 µm, dark reddish-brown; wall uneven, 1-2 µm thick, finely punctate-verruculose, spore profile smooth. Inner spores irregular, subpolyhedral, elongated, usually with undulate outline, 7-10.5 × 8.5-14.5 µm, yellowish-brown; wall even, c. 0.5 µm thick, apparently smooth.

On *Poaceae*: *Apluda mutica* L.; S. Asia (India). Known only from the type collection.

Sporisorium muticae differs from the closely related *S. apludae-muticae* L. Guo especially by larger outer and inner spores. These in *S. apludae-muticae* are 7-12, and 5-10.5 µm long, respectively.

New combinations

What is *Sorosporium pedicularis*?

A smut fungus on *Pedicularis* was published first by Gutner (1941:182, invalidly, without Latin diagnosis) under the name of *Sorosporium pedicularis* Golovin, later validly by Golovin (1950:11), under the same name. Its generic position is questionable. The genus *Sorosporium* F. Rudolphi was merged with *Thecaphora* Fingerh. (comp. Vánky, 1998). However, the morphology of the spore balls and spores of this smut deviates much from that of *Thecaphora* species, including the colour of the spore masses and spores. Another genus, which can be taken into consideration is *Urocystis*, but sterile cells are lacking in our fungus. There are species of *Urocystis*, in which sterile cells are few or even lacking around some of the spore balls. Unfortunately, DNA isolation and molecular biological analyses were unsuccessful. Based on the dicotyledonous host plant, on the colour of the spores and morphology of the spore balls and spores, I consider that *Sorosporium pedicularis* represents an extreme case of *Urocystis*, in which the sterile cells are lacking.

Urocystis pedicularis (Golovin) Vánky, **comb. nov.**

MycoBank 510382

Basionym: *Sorosporium pedicularis* Golovin, Sredneaz. Gosud. Univ., N.S., Vyp. 14, Biol. Nauk., Kniga 5:11, 1950. — Type on *Pedicularis* sp., Tadzhikistan, East Pamir, Tschatykoj, in the valley of the Murgab River, 9.IX.1937, N. Nikiforova (type where?).

Sori in all capsules of an inflorescence, swollen, deformed, filled with blackish-brown, granular-powdery mass of spore balls. *Spore balls* subglobose, ovoid, ellipsoidal, elongated to irregular, 25-75 × 35-90 µm, reddish-brown, composed of a few to tens of spores which separate by pressure. *Spores* varying in shape and size, subglobose, ovoid, ellipsoidal, elongated, irregular, subcuneiform, 8-14.5 × 10.5-22 µm, reddish-brown; wall even, 0.5-1 µm thick, apparently smooth, in SEM very finely, low verruculose. *Sterile cells* lacking.

On *Scrophulariaceae*: *Pedicularis sibthorpii* Boiss., *Pedicularis* sp.; Asia (Iran, Tadzhikistan).

Type not seen. Description based on the Iranian specimen (HUV 15331).

Ustilago glabra (A.R. Patil, T.M. Patil & M.S. Patil) Vánky & A.R. Patil, **comb. et stat. nov.** MycoBank510436

Based on *Ustilago trichophora* var. *glabra* A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34:842, 2004. — Type on *Echinochloa crus-galli*, India, Karnataka State, Mysore, 21.XI.1987, S.R. Yadav, HCIO 43835; isotypes Kolhapur W.I.F. 1581, HUV 21271.

Sori in considerably swollen ovaries, filaments or basal part of inner floral envelopes, forming globoid, ovoid, ellipsoidal or slightly irregular bodies, 1-4 mm long, showing between the spreading outermost floral envelopes, usually several in a group, some of them bearing remnants of the stigma, sterile anthers or floral envelopes, at first covered by a smooth, hairless greyish-brown peridium which ruptures irregularly at maturity, disclosing the brown, first agglutinated, later powdery mass of spores. *Spores* globose, subglobose; ovoid, ellipsoidal, rarely elongated, 6-9 × 7-9.5(-10.5) µm, light yellowish-brown; wall even, c. 0.5 µm thick, provided with sparsely situated low spines, spore profile smooth, in SEM finely verruculose between the warts or spines.

On *Poaceae*: *Echinochloa crus-galli* (L.) P. Beauv.; S. Asia (India). Known only from the type collection.

Ustilago glabra differs from the closely related *U. trichophora*, on several *Echinochloa* species, in sorus and spore morphology. In *U. trichophora* the sori are always hispid, the spores are somewhat larger (6-11 × 7-12 µm), and more densely and coarsely echinulate, causing the spore profile a serrulate aspect.

Study of the type specimens of *Doassansia ranunculina* and *D. putkonenii*, both on *Ranunculus*, revealed that they belong to the genus *Heterodoassansia*, and also that they represent the same species. Liro (1938:215), comparing the two species wrote, that the main difference between them was that the cortical cells of *D. ranunculina* had a smooth wall whereas those of *D. putkonenii* appeared small-punctate. Mature inner cells of the cortex of both species are similarly ornamented.

Heterodoassansia ranunculina (Davis) Vánky, **comb. nov.**

MycoBank510383

Basionym: *Doassansia ranunculina* Davis, Bot. Gaz. (Crawfordsville) 19:416, 1894. — Type on *Ranunculus multifidus*, USA, Wisconsin, Racine, VIII.1894, J.J. Davis; isotypes in Ellis & Ev., N. Amer. fgi. no. 3238, HUV 9177!

Doassansia putkonenii Liro, Luonnon Ystävä 24:72, 1920 (as '*Putkoneni*'). — *Heterodoassansia putkonenii* (Liro) Vánky, Mycotaxon 48:28, 1993. — Type on *Ranunculus paucistamineus* (= *R. trichophyllus*), Finland, Åland, Eckerö island, Storby, 22.VII.1919, T. Putkonen, H! (syn. nov.).

Sori on the leaves forming circular or elliptic, indistinct to pale brown spots, 0.5-3(-5) mm in diam., or on the petioles as pustules, with numerous spore balls embedded in the host tissue showing as minute, pale or dark brown, often aggregated dots on both sides of the leaves. *Spore balls* globose, subglobose, ellipsoidal or irregular, 25-175 × 50-200 µm, orange tinted yellowish-brown, composed of a central mass of spores surrounded by a cortex of empty, sterile cells. *Spores* globose, ellipsoidal to subpolyhedrally irregular, 7-14 × 9-15 µm, pale yellowish-brown tinted; wall even, c. 0.5 µm thick, smooth. *Cortex* composed of two kinds of cells: an inner, continuous layer of usually radially elongated but also polyhedral or irregular, large, empty cells, 6-17 × 10-24 µm, flattened on their contact sides, pale yellowish-brown; wall even, c. 0.5 µm thick, finely to evidently, rather densely punctate to verrucose-echinulate on its inner surface (that toward the empty lumen) due to small or large (up to 0.5-1.5 µm high) spines or nail-headed warts. A thin, external, often incomplete layer of radially flattened, small to elongated, smooth sterile cells covers the large, ornamented cortical cells. *Spore germination* unknown.

On *Ranunculaceae*: *Ranunculus aquatilis* L., *R. limoselloides* Tourcz., *R. multifidus* Pursh, *R. trichophyllus* Chaix (*R. paucistamineus* Tausch), *R. peltatus* Schrank; Europe (Finland, Germany), N America (USA), S. America (Venezuela).

There are some differences in the size of the spore balls, spores and sterile cells, as well as in the ornamentation of the large, cortical sterile cells between collections on different host plant species, which are considered variations within the same species.

Sporisorium chrysopogonis-fulvi (A.R. Patil, T.M. Patil & M.S. Patil) Vánky & A.R. Patil, **comb. nov.** MycoBank510405

Basionym: *Sorosporium chrysopogonis-fulvi* A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34:839, 2004 (as '*chrysopogonis-fulviis*'). — Type on *Chrysopogon fulvus*, India, Maharashtra State, Kolhapur, Shivaji University Campus, 9.XII.1997, M.S. Patil, HCIO 42841; isotypes Kolhapur W.I.F. 1521, HUV 21257.

Sori in some spikelets of an inflorescence, both sessile, perfect, and pedicelled, sterile ones, cylindrical, 1-1.5 × 6-10 mm long, showing between the outermost floral envelopes, at first covered by a greyish- or pale brown peridium which ruptures at maturity from its apex, disclosing the blackish-brown, first agglutinated, later granular powdery mass of spore balls surrounding a long, filiform or band-like central columella. *Spore balls* variable in shape and size, subglobose, ellipsoidal, elongated to usually irregular, 35-110 × 40-170 µm, dark reddish-brown to opaque, composed of tens or hundreds of spores which separate by hard pressure. *Spores* dimorphic; outer spores globoid, ellipsoidal to subpolyhedrally irregular, 7-11 × 8-13.5 µm, dark reddish-brown; wall 0.5-1.5 µm thick (including ornamentation), thickest on the free surface where it is provided with rather densely situated, up to 1 µm high cylindrical warts or subacute spines, spore profile smooth to serrate on the free surface; inner spores subglobose, ellipsoidal to usually rounded subpolyhedrally irregular, pale yellowish-brown; wall even, c. 0.5 µm thick, smooth.

On *Poaceae*: *Chrysopogon fulvus* (Spreng.) Choiv. Known only from the type collection.

Tilletia beckerae (Henn.) Vánky, **comb. nov.**

MycoBank510384

Basionym: *Ustilago beckerae* Henn., in Wildeman, Ann. Mus. Congo, Sér. 5, Bot. 2:86, 1907. — Type on *Beckera* sp. (= *Snowdenia* sp.), Congo, Leopoldsville Prov., Kisantu, V.1906, H. Vanderyst 169, BR.

Sori in some, slightly swollen ovaries of an inflorescence, c. 1 × 2-3 mm, filled with a brown, semiagglutinated to powdery mass of spores and sterile cells. *Spores* globose or subglobose, rarely broadly ellipsoidal, 16-25 × 16-26 µm, pale to medium dark olivaceous-brown; wall 3-5 µm thick, including a thin endospore and the densely situated, long, filiform, nail-headed or subacute spines. These, in surface view appear as dark, small, irregularly polyangular areas, 9-16 per spore diam., in optical median view 40-50 on the equatorial circumference. *Sterile cells* subglobose, ellipsoidal or slightly irregular, varying in size, 12-24 × 13.5-28 µm, pale olivaceous brown; wall 1.5-5 µm thick, smooth. Intermediate forms, with a trace of ornamentation, are present.

On *Poaceae*: *Snowdenia* sp. (*Beckera* sp.); C. Africa (Congo). Known only from the type collection.

Tilletia sphaerocarpa (Syd. & P. Syd.) Vánky, **comb. nov.**

MycoBank510385

Basionym: *Ustilago sphaerocarpa* Syd. & P. Syd., Ann. Mycol. 15:145, 1917. — Type on *Festuca amplissima*, Mexico, Popocatepetl, 8.IX.1908, H. Schenk 371; isotypes BPI 166643!, WSP 34977.

Sori in some ovaries of an inflorescence, oblong, broadly fusiform, c. 1 × 3-5 mm, showing between the spreading floral envelopes, first covered by the pericarp which ruptures disclosing the black, powdery mass of spores intermixed with few sterile cells. *Spores* globose, subglobose, rarely broadly ellipsoidal, 14.5-18.5 × 15-20 µm, dark yellowish-brown to chocolate-brown; wall even, 2-3 µm thick, densely verrucose, spore profile wavy to finely serrulate, warts 0.5-1 µm high, in LM with rounded or flattened tip. *Sterile cells* subglobose, ovoid or slightly irregular, 20-35 µm long, subhyaline, usually collapsed; wall 1.5-2.5 µm thick, smooth or finely punctate.

On *Poaceae*: *Festuca amplissima* Rupr.; N. America (Mexico). Known only from the type locality.

Presence of sterile cells between the spores escaped the observation of earlier mycologists.

Ustilago sleumeri is a *Tilletia*

Petrak (1947:206) described *Ustilago sleumeri* on the leaves of *Alopecurus gerardii* (*Poaceae*) from Andorra. The type of *U. sleumeri* in BPI 195252 is devoid of spores. However, based on the accurate (but incomplete) original description, I have no doubt that *U. sleumeri* is a *Tilletia*.

Of the nearly 160 known species of *Tilletia,* only 11 have sori in the vegetative tissues of the host plants. These are: **1. *T. alopecuri*** (Sawada) L. Ling (type on *Alopecurus aequalis,* Taiwan), **2. *T. bolayi*** H. Zogg (type on *Bromus erectus,* Switzerland), **3. *T. brachypodii-ramosi*** H. Zogg (type on *Brachypodium ramosum* France), **4. *T. earlei*** Griffiths (type on *Agropyron occidentale,* USA), **5. *T. flectens*** Lagerh. (type on *Deschampsia flexuosa,* Sweden), **6. *T. nigrifaciens*** Langdon & Boughton (type on *Phragmites australis,* Australia), **7. *T. olida*** (Riess) J. Schröt. (type on *Brachypodium pinnatum,* Germany), **8. *T. sesleriae*** Juel (lectotype on *Sesleria caerulea,* Sweden), **9. *T. sterilis*** Ule (lectotype on *Koeleria cristata*), **10. *T. tumefaciens*** Syd. & P. Syd. (type on *Panicum antidotale,* India), and **11. *T. youngii*** G.P. Clinton & Zundel (type on *Alopecurus ramosus,* USA). A comparison of *U. sleumeri* (the description of which is based on the original) with the enumerated *Tilletia* species revealed several similarities but also differences (see the key below).

Tilletia sleumeri (Petr.) Vánky, **comb. nov.**

MycoBank 510386

Basionym: *Ustilago sleumeri* Petr., Sydowia 1:206, 1947. — Type on *Alopecurus gerardii,* Andorra, East Pyrenean Mts, between Port d'Embalire and Pic Negre, above the creek Ariège, 2200-2500, VII. H. Sleumer, BPI 195252 (lacking spores).

Sori on the leaves and leaf sheaths as rounded or elongated, up to 1 cm long greyish-green to dark grey spots formed of narrow (250-500 µm wide), parallel, slightly pustular striae between the veins, covered by the epidermis which ruptures longitudinally disclosing the olivaceous-brown, powdery mass of spores. *Spores* single, globose, ovoid, ellipsoidal to subpolyhedrally irregular, 18-24 × 19-27 µm, pale greyish- or olivaceous-brown; wall 2.5-3.5 µm thick, reticulate, meshes rather regular, penta- or hexagonal, 2-3 µm in diam.

On *Poaceae: Alopecurus gerardii* Vill.; Europe (Andorra). Known only from the type locality.

Key to the species of *Tilletia,* with sori in the vegetative tissues of the host plants

1.	Sori as witches' brooms on the stems of *Panicum* .... ***T. tumefaciens***
–	Sori not as witches' brooms; not on *Panicum* 2
2.	Sori as dark, powdery cover on the surface of the leaves of *Phragmites* .... ***T. nigrifaciens***
–	Sori not so; not on *Phragmites* 3
3.	Sori as swellings on the stems 4
–	Sori as striae on the leaves and leaf sheaths 6
4.	Sori in the upper, swollen internodes of sterile shoots of *Agropyron, Elymus* ..... ***T. earlei***
–	Sori as swellings on stems, as striae on leaves and in seeds of *Alopecurus* 5

5. Spores 17-22(-25) µm long, with 2-3 µm high warts which fuse in an irregular or cerebriform pattern .... ***T. alopecuri***
– Spores 21-24(-29) µm long, with 2.5-4 µm high spiny tubercles .... ***T. youngii***
6. On *Brachypodium*; spores reticulate..7
– Not on *Brachypodium*; spores reticulate or not..............................8
7. Muri 0.5-1(-1.5) µm high, in median view truncate .... ***T. olida***
– Muri 1-1.5(-2.5) µm high, in median view pointed....... ***T. brachypodii-ramosi***
8. Spores 25-36 µm long. On *Sesleria* .... ***T. sesleriae***
– Spores smaller. Not on *Sesleria* 9
9. Spores obscurely reticulate, 8-20 meshes per spore diam. On *Festuca, Koeleria, Poa* .... ***T. sterilis***
– Spores evidently reticulate, meshes fewer. Not on *Festuca, Koeleria, Poa*.......10
10. Spores 17-24(-27) µm long, mostly cerebriform. On *Bromus* .... ***T. bolayi***
– Spores larger, evidently reticulate. Not on *Bromus*..........................11
11. Spores 21-30 µm long, wall 2.5-4 µm thick. On *Deschampsia* .... ***T. flectens***
– Spores 19-27µm long, wall 2.5-3.5 µm thick. On *Alopecurus*......... ***T. sleumeri***

SYNONYMS

Anthracoidea haematostomae is conspecific with *A. nepalensis*

A study of some *Anthracoidea* species of *Carex*, subgen. *Carex*, sect. *Aulocystis* (= *Frigidae*), by the author and by M. Piątek (Kraków, Poland), revealed that *A. haematostomae* is identical with, and a synonym of the earlier described *A. nepalensis*:

Anthracoidea nepalensis Kakish. & Y. Ono, in Watanabe & Malla, Cryptogams of the Himalayas 1:128, 1988.

Type on *Carex nakaoana*, Nepal, Langtang valley, Kyangjin Langshisa, alt. 3900 m, 3.IX.1986, Y. Ono 86NE-234, TSH-S1025; isotypes KATH, HUV 13603.

Anthracoidea haematostomae L. Guo, Fungal Diversity 21:83, 2006. — Type on *Carex haematostoma*, China, Yunnan Prov., Deqen, alt. 2700 m, IX.1935, C.W. Wang 70101, HMAS 132709; isotype HUV 20090. (syn. nov. by Vánky & M. Piątek).

Sori in ovaries, globoid to ellipsoidal, 1.5-2 × 1.5-3.5 mm, at first covered by a thin, greyish fungal peridium, later naked, black, agglutinated with powdery surface. *Spores* small, flattened, in side view elliptic, 9.5-12 µm wide, with hyaline caps on the flat sides, in plane view circular or broadly elliptic, rarely ovoid or slightly irregular, 14.5-18.5 × 16.5-20(-21) µm, dark reddish-brown; wall even, 1.5-2.5(-3) µm thick, no internal swellings, no protuberances, no light refractive spots, surface sparsely, finely to coarsely verrucose, spore profile wavy to sparsely serrate.

On *Cyperaceae*: *Carex* (subgen. *Carex*, sect. *Aulocystis* = *Frigidae*), *C. haematostoma* Nees, *C. nakaoana* T. Koyama, *C. digyna* (Kük.) Tang & Wang, *C. sempervirens* Vill.; C., S. & E. Asia.

Cintractia obovoidea is a *Farysia* sp.

Cintractia obovoidea Togashi & Y. Maki, Ann. Phytopathol. Soc. Japan 10:139, 1940.
Anthracoidea obovoidea (Togashi & Y. Maki) Kakish., Mem. Inst. Agr. & For. Univ. Tsukuba 1:28, 1982. — Type on *Carex fernaldiana*, Japan, Hizen Prov., Karatsu, 22.V.1937, Y. Maki, BPI 195039.

According to the original description, *sori* in the ovaries, swollen, dark brown, hard, obovoid or subglobose, 1-2 mm in diam., first covered by the glumes, later naked, with powdery surface. *Spores* variable, globose or ellipsoidal, 5-10 × 6-11 µm, dark brown, verruculose.

On *Cyperaceae*: *Carex* (subgen. *Carex*, sect. *Mitratae*), *C. fernaldiana* Lév. & Vaniot; E. Asia (Japan).

The spore measurements given by Togashi & Maki (1940) are too small for an *Anthracoidea* species. Study of the extremely scanty type material in BPI 195039 revealed spores of a *Farysia* species which measure (3-)4-7 × 5-9 µm, are pale olivaceous brown, verruculose.

Doassansia disticha is a synonym of *D. opaca*

Doassansia opaca Setch., Proc. Amer. Acad. Arts 26:15, 1891.
Lectotype on *Sagittaria sagittifolia* L., USA, (designated here) Connecticut, Norwich, 14.VIII.1889, W.A. Setchell, HUV 507; isotypes in Rbh., Fgi. eur. no. 3802, BPI 178488, 178514, 178515, 195046.
Doassansia disticha S. Ito, Trans. Sapporo Nat. Hist. Soc. 14:96, 1935. — Type on *Sagittaria trifolia* var. *typica*, Japan, Honshu, Inaba Prov., Tottori, X.1930, N. Hiratsuka, BPI 178338. (Syn. nov.).

Sori as leaf spots, orbicular, slightly swollen, 2-4 mm in diam., with spore balls as pale brown dots on the abaxial surface. *Spore balls* crowded, globose, ellipsoidal to subtetragonal or cubical by mutual pressure, 90-220 µm long, pale brown, composed of a central mass of spores surrounded by a cortical layer of sterile cells. *Spores* subglobose, ovoid to usually rounded subpolyhedrally irregular, 8-12 × 9.5-14.5 µm, pale yellow tinted; wall c, 0.5 µm thick, smooth. Between the spores there are some sterile cells about the shape and size of the spores. *Cortical cells* variable in shape and size, usually radially elongated, cubical or irregular, 8-20 × 9.5-30 µm, pale yellowish-brown tinted; wall c. 0.5-1 µm thick, smooth.

On *Alismataceae*: *Sagittaria trifolia* var. *typica* Makino; E. Asia (Japan), N. America (Canada, USA).

Doassansiopsis horiana is considered to be a synonym of *D. deformans*

Setchell (1891:17) described *Doassansia deformans*, causing conspicuous swellings and distortions on *Sagittaria variabilis* in Canada. Dietel placed the fungus into the genus *Doassansiopsis*. Hennings (1906:157), described a similar fungus on *Sagittaria sagittifolia* from Japan, under the name of *Doassansia horiana*, which was placed into the genus *Doassansiopsis* by C.I.

Shen (= C.I. Chen). A comparison of the types could not reveal any essential difference between the two collections excepting somewhat larger spore balls in *D. horiana*, and somewhat larger sterile cells in *D. deformans*, which are considered variations within the same species. Consequently, they are considered synonyms as:

Doassansiopsis deformans (Setch.) Dietel, in Engler, Die Natürl. Pflanzenfam. 1(1)**:21, 1897.

Doassansia deformans Setch., Proc. Amer. Acad. Arts 26:17, 1891. — Lectotype on *Sagittaria variabilis* (= *S. sagittifolia*), (design. by Vánky, 2002:48) Canada, London, IX.1890, J. Dearness, HUV 475; isolectotypes in Ellis & Ev., N. Amer. fgi., Ser. 2, no. 2705 (as *Doassansia deformans*).

Doassansia horiana Henn., Bot. Jahrb. Syst. 37:157, 1906. — *Doassansiopsis horiana* (Henn.) C.I. Chen (as 'C.I. Shen'), Sinensia 4:319, 1934. — Type on *Sagittaria sagittifolia*, Japan, Tokyo, Nashigahara, VIII.1904, S. Hori 34, SAPA; isotypes BPI 178362, 195044, HUV 16633. (syn. nov.).

Sori in leaves, petioles, stems and inflorescence as brown, bullate pustules or swellings, often causing conspicuous distortions, from a few mm to 7-8 cm long, filled with spore balls embedded in the host tissue. *Spore balls* globose, subglobose, ovoid, elongated or irregular, 70-150(-220) × 90-180(-250) µm, pale yellowish-brown, composed of a central mass of sterile, parenchymatous, empty cells surrounded by a layer of spores and a thin cortical layer of sterile cells. *Spores* globoid, ovoid, radially elongated, usually polyhedrally irregular, 7-11 × 9-17(-20) µm, pale yellowish-brown, contents homogenous; wall c. 0.5 µm thick, smooth. *Sterile cells* variable in shape and size, rounded or elongated, polyhedrally irregular, 4-17 × 6-30 µm, empty, subhyaline to pale yellow tinted; wall c. 0.5 µm thick, smooth. *Cortical sterile cells* variable in shape and size, small, usually tangentially more or less flattened, irregularly polyhedral, 5.5-15 µm long, pale yellowish-brown, empty; wall c. 0.5 µm thick, smooth. *Spore germination* of *Tilletia*-type (Setchell, 1892).

On *Alismataceae*: *Sagittaria lancifolia* L., *S. sagittifolia* L. (*S. latifolia* Willd., *S. variabilis* Engelm.), *S. trifolia* L., *S. trifolia* var. *sinensis* (Sims.) Makino; E Asia (China, Japan), N & C America (Canada, USA, Honduras), W Indies (Cuba).

Entyloma blumeae is a synonym of *E. thirumalacharii*

The first described smut fungus on *Blumea* was ***Entyloma globigena*** Thirum. & Safeeulla (Thirumalachar & Safeeulla 1951:443), type on *Blumea* sp., India, Mysore, Coorg, 15.X.1950, K.M. Safeeulla. According to the original description, the spores are subglobose to angular, 9-18 µm, pale cinnamon-yellow, wall 1.5-2(-4) µm thick. Spore germination results in holobasidia bearing terminal cluster of 4-6 basidiospores which do not conjugate in situ.

Almost concurrently two additional new species of *Entyloma* on *Blumea* have been published: ***E. thirumalacharii*** Pavgi & R.A. Singh (Pavgi & Singh

1967:942), type on *Blumea oxydonta* DC., India, Uttar Pradesh, Varanasi, 8.IX.1964, V.P. Tewari & R.A. Singh, HCIO 29879; isotype HUV 15482!, and ***E. blumeae*** B.V. Patil & Thirum. (Patil & Thirumalachar 1968:49), type on *Blumea malcolmii* Hook. f., India, Maharashtra State, Nasik, Ratnagiri, 2.I.1961, B.V. Patil. Both are characterised by larger spores (12-20 × 14-24 µm), and thicker spore wall (1.5-6 µm). Spore germination results in holobasidia with an apical whorl of 4-8 basidiospores which fuse in pairs. These two names obviously represent the same species. *E. thirumalacharii* having priority, while *E. blumeae* is considered to be its synonym. (syn. nov.).

Entyloma wisconsiniense is considered to be *E. saccardianum*

Ciferri (1928:40) described ***Entyloma wisconsiniense*** Cif., type on *Senecio aureus* L., USA, Wisconsin, Wild Rose, 2.VII.1918, J.J. Davis, PAD! For the spore measurements, Ciferri gave 7.5-8.5(-9) µm. By study of the type specimen I obtained 9-12 × 9.5-14.5 µm, rather similar to those of ***E. saccardianum*** Scalia ex Cif. (Ciferri 1924:50), type on *Senecio leucanthemifolius* Poiret, Italy, Sicily, Catania Prov., near Ognina, II.1901, Criconi, PAD! Consequently, I consider *E. wisconsiniense* to be a synonym of *E. saccardianum*. (syn. nov.).

Melanotaenium brachiariae var. *minutum* is *Eballistra brachiariae*

Melanotaenium brachiariae var. ***minutum*** A.R. Patil, T.M. Patil & M.S. Patil, J. Mycol. Pl. Pathol. 34:841, 2004 (as '*minuta*').

Type on *Brachiaria distachya* (L.) Stapf, India, Maharashtra State, Kolhapur, Shivaji University Campus, 7.II.1996, M.S. Patil, HCIO 42797; isotypes Kolhapur W.I.F. 1510, HUV 21250.

Study of the type specimen of *M. brachiariae* var. *minutum* and a comparison of it with the type of *M. brachiariae* (= ***Eballistra brachiariae*** (Viégas) R. Bauer et al.), type on *Brachiaria plantaginea*, Brazil, could not reveal any essential difference. Hence they are considered to be synonyms.

Mycosyrinx osmundae var. *osmundae-cinnamomeae* is considered a synonym of *Exoteliospora osmundae*

One of the very few smut fungi parasitising non-flowering plants was described as *Ustilago osmundae* (Peck 1881:276), on the royal fern, *Osmunda regalis*, in the USA. Its position amongst the fungi was for a long time obscure. A variety of it was described also by Peck (1912:43) on *Osmunda cinnamomea*, in the USA, because "It differs from the typical form in the paler brown colour of the spore mass and the even surface of the spores". However, there are all intermediate forms in both colour of the spore masses and the ornamentation of the spores, from smooth to densely, prominently verrucose. The warts of the spores are loose, easily detaching of the spore surface. Therefore, it is practical, to treat both as one species:

Exoteliospora osmundae (Peck) R. Bauer, Oberw. & Vánky, Mycologia 91:675, 1999.

Ustilago osmundae Peck, Bot. Gaz. (Crawfordsville) 6:276, 1881. — *Mycosyrinx osmundae* (Peck) Peck, New York State Mus. Bull. 157:43, 1912. — Type on *Osmunda regalis*, USA, Vermont State, 27.VII.1880, C.G. Pringle 1541, NY.

Mycosyrinx osmundae var. *osmundae-cinnamomeae* Peck, New York State Mus. Bull. 157:43, 1912 (as '*Mycosyrinx osmundae cinnamomeae*') — Type on *Osmunda cinnamomea*, USA, Washington Co., Cambridge, 17.VI.1911, S.H. Burnham, NY (syn. nov.).

For its description and illustration see Bauer et al. (1999) or Vánky (2002:60-61).

On *Osmundaceae* (*Pteridophyta*): *Osmunda cinnamomea* L., *O. regalis* L., *O. regalis* var. *spectabilis* (Willd.) A. Gray; N. America (Canada, USA).

Sporisorium arundinellae-nepalensis is *S. consanguineum*

Ling (1951a:106) described *Sorosporium concelatum* on "*Arundinella nepalensis* Trin." from Australia. The place of this fungus is in the genus *Sporisorium*. Because the name *Sporisorium concelatum* (Zundel) M. Piepenbr. is already used for a smut of *Ischaemum latifolium*, a new name, *Sporisorium arundinellae-nepalensis* Vánky (2004:91) was given for it. Dr. Roger G. Shivas called my attention, that the diseased plants are not *Arundinella nepalensis* but a species of *Aristida*, as it was stated in the herbarium DAR by J.W. Vickery, and its smut is ***Sporisorium consanguineum*** (Ellis & Everh.) Vánky, type on *Aristida rusbyi* Scribn., USA. (syn. nov. by R.G. Shivas & K. Vánky).

Sporisorium themedae-triandrae is *S. exsertum*

Sporisorium themedae-triandrae A.R. Patil et al. (Patil et al. 2004a), was described on *Themeda triandra* Forssk., from India, Maharashtra State, Kolhapur, Shivaji University Campus, 12.I.1996, M.S. Patil, HCIO 42865! Study of the type specimen revealed that it is identical with, and a synonym of ***Sporisorium exsertum*** (McAlpine) L. Guo, type on *Anthistiria ciliata* L. f. (= *Themeda quadrivalvis* (L.) Kuntze), Australia (syn. nov.). The fungus is known on several *Themeda* species from Africa (South Africa, Zimbabwe), S. & E. Asia (China, India, Pakistan, Sri Lanka) and Australasia (Australia, Papua New Guinea).

In the original description of *S. themedae-triandrae* the spores are given as '11-15 × 18.5 µm', with 2-3 µm thick wall. For the spores of the type specimen I obtained 6.5-9 × 7-9.5 µm, with c. 0.5 µm thick wall. I have no explanation for the discrepancy between the description and the spore measurements of the type of *S. themedae-triandrae* found by me. The fungus fits well in all respects with *S. exsertum* (For further synonymy and detailed description of *S. exsertum* see Vánky, 1994:161).

Thecaphora viciae-amoenae is considered to be *T. viciae*

Bubák (1912:38) described ***Thecaphora viciae*** on *Vicia trifida* from the USA. The smut was found successively in the seeds of several *Vicia* species in Canada, USA and Siberia (comp. Zundel, 1953:124). Harada (1983:300) described ***Thecaphora viciae-amoenae*** on *Vicia amoena* from Japan, based on a larger number of spores in a ball than in *T. viciae,* and also on the presence of well-developed ridges ("wall-like structures") between the spores on the surface of the balls. Study of several specimens on various *Vicia* species revealed a variation and transition of the mentioned characters, which do not allow a clear delimitation. Therefore, I consider it is better to treat these two names as representing one species:

Thecaphora viciae Bubák, Arch. Přír. Výzk. Čech. 15:38, 1912.

Lectotype on *Vicia trifida* D. Dietr. (= *V. americana* Muhl.), USA, (design. by Vánky, 1985:124) Utah, Salt Lake Co, City Creek Cañon, Wasatch Mts., 7.VII.1904, A.O. Garrett, HUV 2130!; isolectotypes in Sydow, Ust. no. 368 (as *Thecaphora deformans*), and in Seymour & Earle, Econ. fgi., Suppl. C., no. 123 (as *T. deformans*), HUV 9711!

Thecaphora viciae-amoenae Y. Harada, Trans. Mycol. Soc. Japan 24:300, 1983. — Type on *Vicia amoena*, Japan, Hokkaido, Saru-gun, Biratori-cho, Nina, at the Sarugawa river, 12.IX.1981, Y. Harada 12428; isotype HUV 11580! (syn. nov.).

Sori in seeds. Pods not or only slightly deformed. Spore mass granular-powdery, reddish-brown. *Spore balls* muriform, globose, ovoid to irregularly elongated, 30-65 × 40-80(-95) µm, yellowish- to reddish-brown, composed of (10-)15-50 (or more?), rather firmly united spores. *Spores* varying in shape and size, in surface view rounded, subpolygonally irregular or elongated, 6-14 × 10-22 µm, in median view 8-20 µm long; wall on the contact surfaces smooth, c. 0.8 µm thick, on the free surface with moderately densely situated, irregular warts, up to 2.5 µm long. Warts may be absent in the centre of the ornamented area in a few spores. On the surface of the balls, a more or less well-developed ridge between the spores may be present in some or in numerous spore balls of a specimen originating from different host plant species.

On *Fabaceae: Vicia americana* Muhl. (*V. trifida* D. Dietr.), *V. amoena* Fisch., *V. caroliniana* Walt., *V. cracca* L., *V. oregona* Nutt., *Vicia* sp.; E. Asia (China, Japan, Russia), N. America (Canada, USA).

Tuburcinia secalis is *Urocystis occulta*

Uljanishchev (Steblevaja golovnya pshenitsy:5, 1939) published (invalidly, no Latin diagnosis) *Tuburcinia secalis* Uljan., on *Secale cereale* L. from Azerbajdzhan, VII.1935, isotype HUV 12350. It is identical with ***Urocystis occulta*** (Wallr.) Rabenh. ex Fuckel, type on *Secale cereale* L. (syn. nov.).

For further synonyms, description, literature and illustrations see Vánky, 1994:299 & 330.

Urocystis colchici-lutei* is a synonym of *U. colchici

Zundel (1944:411) described *Urocystis colchici-lutei* with the remarks that "it differs from *Urocystis colchici* by the smaller sorus, brighter coloured spore-balls and more spores per spore-ball." Zundel gives spore balls with 1-3(-4) spores. Checking the type specimen I found the following number of spores per spore balls: 1 = 61%, 2 = 28.5 %, 3 = 8 %, 4 = 2.5%. For *Urocystis colchici,* on *Colchicum autumnale,* I found the following values: 1 = 73.5%, 2 = 21.5 %, 3 = 4 %, 4 = 1%. Actually, Mundkur & Thirumalachar (1952:72) considered *U. colchici-lutei* a synonym of *U. colchici*, which is also my opinion.

Urocystis colchici (Schltdl.) Rabenh., Fgi. eur. no. 396, 1861.

Lectotype on *Colchicum autumnale* L., Germany, (design. by Braun, 1979:410) Hassia, near Witzenhausen, V. 1822, J.A.C. Roeper, HAL.

Urocystis colchici-lutei Zundel, Mycologia 36:411, 1944. — Type on *Colchicum luteum*, India, Abbottabad, alt. 4200 ft., 15.-18.IV.1935, R.R. Stewart, Gordon College Herbarium, Plants of Hazara N.W.F.P., Northwest Himalaya no. 14616, BPI 181997! Syn. by Mundkur & Thirumalachar (1952:72, confirmed).

For further synonyms, literature and illustrations see Vánky, 1994:289, 314, 316.

On *Liliaceae: Colchicum arenarium* Waldst. & Kit., *C. autumnale* L., *C. biebersteinii* Rouy, *C. bivonae* Guss. (*C. latifolium* Sibth. & Sm.), *C. bornmuelleri* Freyn. (cult.), *C. luteum* Baker, *C. neapolitanum* (Ten.) Ten. (cult.) (*C. orientale* Frivald. ex Kunth), *C. persicum* Baker, *C. procurrens* Baker (*Merendera sobolifera* Hort. ex Baker), *C. triphyllum* G. Kunze (incl. *C. biebersteinii* Roui), *C. turcicum* Janca, *Merendera trigyna* (Adam) Woronow (*Bulbocodium trigynum* Adam): Europe, Asia, N. America.

Urocystis hispanica* is *U. tritici

In the literature, *Urocystis* on *Aegilops* (*Poaceae*) appears either as *U. tritici* or *U. hispanica*. A comparison of the type of *U. hispanica* on *Aegilops* with several specimens of *U. tritici* on *Triticum* could not reveal any essential difference in the sorus, spore ball, spore and sterile cell morphology. Therefore, I consider them synonyms.

Urocystis tritici Körn., Hedwigia 16:33, 1877.

Type on *Triticum vulgare*, New Holland [= Australia], coll. R. Schomburgk.

Tuburcinia hispanica Syd., Ann. Mycol. 22:290, 1924. — *Urocystis hispanica* (Syd.) Zundel, Ustil. World:320, 1953. — Type on *Aegilops ovata*, Spain, Madrid, Cerro-Negro, 8.V.1921, Dr. Cogolludo & G. Hernk, MA 2981! (syn. nov.).

Sori in leaves, leaf sheaths and stems as long striae, initially lead-coloured, covered by the epidermis which ruptures longitudinally to expose the blackish-brown, powdery mass of spore balls. *Spore balls* subglobose, ovoid, ellipsoidal to elongated, 16-30 × 20-40 µm, composed of 1-3(-5) spores completely invested by a layer of sterile cells. *Spores* globose, hemiglobose, ovoid, elongate or slightly irregular, 10-15 × 12-18(-22) µm, yellowish- to reddish-brown, smooth. *Sterile* *cells* subglobose to ovoid, 5-8 × 6-13 µm, light yellowish-brown; wall c. 1 µm thick, smooth. *Spore germination* (McAlpine, 1910:199, Pl. LI, figs. 191-192; Noble, 1923; M.A. Griffiths, 1924:430, Pl. 2, figs. B-I): On the tip of an aseptate basidium (1-)2-4(-6) cylindrical basidiospores are produced measuring 3-5 × 12-30 µm. Basidiospores germinate giving rise to slender infection hyphae and/ or secondary sporidia.

On *Poaceae*: *Aegilops lorenti* Hochst. (*A. biuncialis* Vis.), *A. ovata* L., *Triticum aestivum* L. (*T. vulgare* Vill.), *T. dicoccum* Schrank, *T. durum* Desf., *T. turgidum* L.; cosmopolitan, but restricted to warm areas.

Ustilago dactylidis is *Tranzscheliella hypodytes*

Maire (1917:136) described *Ustilago dactylidis* Maire on the culms of *Dactylis glomerata* subsp. *hispanica* (Roth) Nyman, Algeria, near Alger, Pointe Pescade, sea coast, VIII.1916, R. Maire; isotype in BPI 194445!

According to Maire, *Ustilago dactylidis* differs from *U. hypodytes* (= *Tranzscheliella hypodytes* (Schltdl.) Vánky & McKenzie), type on *Leymus arenarius*, in very finely verruculose spores, whereas these in *U. hypodytes* are smooth. However, SEM pictures of both type specimens show a similar, finely verrucose spore surface. Other characters of *U. dactylidis* are also identical with the lectotype of *Tranzscheliella hypodytes*, hence they are considered synonyms. (syn. nov.).

The identity of the host plant of *U. dactylidis* could not be verified. A healthy plant is lacking.

Ustilago echinochloae is a synonym of *Sporisorium diplosporum*

The sori, spores and sterile cells of ***Ustilago echinochloae*** L. Guo & Y.C. Wang (Vánky & Guo 1987:232; type on *Echinochloa crus-galli*, China, Yunnan Prov., Reg. Xishuangbanna, 60 km W of Jinghong, near Menghai, alt. 1250 m, 25.IX.1985, L. Guo, K. Vánky & Q.-X. Wu, HMAS 50023, isotype HUV 11613!) are in all respects similar to those of ***Sporisorium diplosporum*** (Ellis & Everh.) Vánky (1999:141; type on *Panicum sanguinale*, USA, Mississippi, Holly Springs, IX.1890, S.M. Tracy 1551). Therefore they are considered to by synonyms. (syn. nov.).

Ustilago kenjiana is identical with *U. bulgarica*

Bubák (1910:53) described *Ustilago bulgarica* in the spikelets of cultivated *Sorghum bicolor* from Bulgaria. Ito (1935:87) described a similar smut, on the same host plant, from Japan, under the name of *Ustilago kenjiana*. In his description, Ito wrote that "This species is closely related to *U. bulgarica*, but it differs in the smaller size of spores as well as in powdery nature of sori.". Agglutinated or powdery mass of spores of *Ustilago* species depends on the maturity of the sori. A comparison of the morphology of the sori as well as the spores, including SEM pictures, could not reveal any essential difference between these two species, hence they are considered to be synonyms.

Ustilago bulgarica Bubák, Z. Landw. Versuchswes. Oesterr. 1910:53, 1910.

Type on *Sorghum vulgare* (= *S. bicolor*), Bulgaria, Sadovo, near Philippopolis (= Plovdiv), 8.IX.1907, F. Bubák; isotypes in Sydow, Ust. no. 386 (as *Ustilago sorghi* on *Sorghum scoparium*), HUV 3318!; Vgr., Micr. rar. sel. no. 1319 (as *Sphacelotheca sorghi* on *Sorghum scoparium*), HUV 2015!

Ustilago kenjiana S. Ito, Trans. Sapporo Nat. Hist. Soc. 14:87, 1935. — Type on *Andropogon sorghum* Brot. (= *Sorghum bicolor*), Manchuria, Koshurei, 10.IX.1916, K. Miyabe. (syn. nov.).

Sori in all spikelets of an inflorescence replacing the inner floral organs, exceeding the glumes, ovoid or horn-like, with irregularly bullate and furrowed surface, multilocular in structure, 2-3 × 3-5 mm, at first covered by a thin, greyish-brown peridium which ruptures irregularly revealing the dark brown, semiagglutinated to powdery mass of spores and few groups of sterile cells. No columella. *Spores* globose, subglobose or broadly ellipsoidal, laterally flattened, 4-5.5 µm wide, 5.5-7 × 5.5-8 µm, yellowish-brown; wall even, c. 0.5 µm thick, finely, moderately densely punctate-echinulate. *Sterile cells* in irregular groups, single cells subglobose, ovoid, ellipsoidal or irregular, larger than the spores, 10-17.5 µm long, subhyaline; wall thin, c. 0.5 µm thick, smooth.

On *Poaceae*: *Sorghum bicolor* (L.) Moench (*S. vulgare* Pers.; *Andropogon sorghum* Brot.): Europe (Bulgaria), E. Asia (China, Japan).

Ustilago bulgarica is close to *Sporisorium sorghi*, from which it differs especially by the irregular, multilocular sori, covered by a thin peridium, by lack of a columella and by the large size of sterile cells.

Ustilago trachyniae is considered to be *U. bromivora*

Uljanishchev (1948:491) described *Ustilago trachyniae*, type on *Trachynia beludshistanica* Karjagin, Beludshia Britannica [Baluchistan, Pakistan], near Mand, 8.IV.1943, V.I. Uljanishchev (type most probably lost by fire).

Trachynia is a synonym of *Brachypodium*. Neither Uljanishchev (1968:35), nor Karatygin & Azbukina (1989) mentioned *U. trachyniae*. However, the smut of *Trachynia* was considered by these authors to be *U. brachypodii-distachyi* Maire, and *U. bullata* Berk. respectively. At present, the floral smut of *Brachypodium* (*Trachynia*) is recognised as *Ustilago bromivora* (comp. Vánky, 2001:301). Consequently, *U. trachyniae* Uljan. is a synonym of *U. bromivora* (Tul. & C. Tul.) A.A. Fisch. Waldh. (type on *Bromus secalinus* L.). (syn. nov.).

The smut fungus of *Andropogon pumilus* (*Poaceae*)

Gandhe (1978:92), in his typewritten Ph.D. thesis, described (invalidly) a smut fungus on *Andropogon pumilus* Roxb. from Pune (India), under the name *Sorosporium punensis* Gandhe. Patil et al. (2004a:787) published *Sporisorium* *punense* A.R. Patil et al. sp. nov. (as '*punensis*'), collected by S.D. Patil, on *A. pumilus* in Pune, 1960. Revising the smut fungi of *Andropogon* (Vánky, 2006b:1-29), not knowing about the paper of Patil et al. (2004a), I described *Sporisorium andropogonis-pumili* sp. nov. on *A. pumilus*, collected by me in Pune, 1992. It seemed very probable that the published names represent the same species. However, between the descriptions, and especially between the illustrations published by Patil et al. (2004a) and Vánky (2006b), there are marked differences. The drawings of an infected host plant and some sori by Patil et al. (2004a:784, Figs. 50-53) do not represent *A. pumilus*. It seems more probable to be a *Chrysopogon* species. The study of a fragment of the holotype, deposited in HCIO 4286, confirmed this suspicion. The smut fungus is also different from *Sporisorium andropogonis-pumili*. The scanty type specimen in loan (a fragment of a sorus and some healthy spikelets) did not allow to identify the smut with any of the known smut fungi on *Chrysopogon*. It may represent a new smut on a wrongly identified host plant. *Sporisorium andropogonis-pumili* Vánky remains the valid name of the smut fungus of *Andropogon pumilus*.

The host range of *Sporisorium panicicola* and *S. hodsonii*

Sporisorium panicicola Vánky (type on *Panicum coloratum* L., Island of Réunion), and *S. hodsonii* (Zundel) Vánky (type on *Panicum* sp., South Africa), are two closely related species. *S. hodsonii* differs from *S. paniciola* in the varying thickness of the spore wall, resulting in darker and paler coloured areas of the spores, and the more finely ornamented spores than in *S. paniciola*.

In BPI there is a great number of North American smut fungi on *Panicum* spp. under various names. Revision of some of them resulted in the conclusion that many of them belong to *Sporisorium hodsonii* rather than to *S. panicicola*, including the two paratypes of *S. panicicola* on *Panicum dichotomiflorum*. It seems, that the sole known host plant of *S. panicicola* is *Panicum coloratum*, whereas *S. hodsonii* occur on *Panicum agrostoides* Spreng., *P. capillare* L., *P. dichotomiflorum* Michx. (*P. proliferum* Lam.), *P. hirticaule* Presl, *P. schinzii* Hack. (*P. laevifolium* Hack.), *P. subalbidum* Kunth (*P. longijubatum* Stapf; *P. proliferum* var. *paludosum* Stapf), *P. vaseyanum* Scribn. ex Beal, *Panicum virgatum* L., *Panicum* sp.

The correct name of *Ustilago tumefaciens* Henn.

Hennings (in Engler, 1895:48) described *Ustilago tumefaciens*, a smut fungus on *Andropogon rufus* (Nees) Kunth (= *Hyparrhenia rufa* (Nees) Stapf), from Tanzania. Zundel (1930:149) transferred the name into *Sorosporium*, as *S. tumefaciens*, which is a later homonym (not *S. tumefaciens* McAlpine, 1910). Ciferri (1933:268), discovering the homonymy, named the fungus *Sorosporium zundelianum*. According to recent concept, the fungus belongs to the genus

Sporisorium. The names *Sporisorium tumefaciens* and *S. zundelianum* are both preoccupied. Therefore, I proposed the new name *Sporisorium leelingianum*. However, because there are several validly published names of this fungus, *S. leelingianum* is a superfluous name. The next valid name of this fungus is *Sorosporium tembuti*. Therefore, the name of this smut and its synonyms should be:

Sporisorium tembuti (Henn. & Pole-Evans) Vánky, **comb. nov.**

MycoBank510387

Based on *Sorosporium tembuti* Henn. & Pole-Evans, in Hennings, Botanische Jahrbücher für Systematik 41:270, 1908b. — Type on *Andropogon ?cymbarius* L. (= misnamed *Hyparrhenia tamba* (Steud.) Stapf; comp. Doidge, 1950:380), South Africa, Transvaal, Weterval Onder, 17.VI.1905, J. Burtt Davy, PREM 169; isotype HUV 17991!

Ustilago tumefaciens Henn., in Engler, Pflanzenwelt Ost-Afrikas, etc., C, p. 48, 1895. — *Sorosporium tumefaciens* (Henn.) Zundel, 1930:149, non McAlpine, 1910 (non *Sporisorium tumefaciens* (McAlpine) Vánky, 1983:328). — *Sorosporium zundelianum* Cif., 1933:268, nom. nov. (not *Sporisorium zundelianum* Vánky, 1995b:207) — *Sporisorium leelingianum* Vánky, 2003a:190, nom. nov. superfluum pro *U. tumefaciens*. — Lectotype (designated by Vánky, 2003a:190) on *Andropogon rufus* (Nees) Kunth (= *Hyparrhenia rufa* (Nees) Stapf), Tanzania, Kilimandscharo, Rombo Mku, alt. 1450 m, VI.1893, S. Volkens 397 K! (syn. nov.).

Sorosporium healdii Zundel, Mycologia 22:147, 1930. — Type on *Andropogon cymbarius* L. (= *Hyparrhenia* sp.; comp. Doidge, 1950:379), South Africa, Transvaal, Pretoria, 7.V.1916, I.B. Pole-Evans (PREM 9732; isotype HUV 17997!) (syn. by Ling, 1951a:108, as *Sorosporium tembuti*, confirmed).

Sorosporium clintonii Zundel, Mycologia 22:153, 1930. — Type on *Andropogon cymbarius* L. (= misnamed *Hyparrhenia* cf. *tamba* (Steud.) Stapf, det. L. C. in PREM; comp. also Doidge, 1950:378), South Africa, Pretoria, Waterkloof, 14.IV.1916, I.B. Pole-Evans, PREM 9693; isotype HUV 1652! (syn. by Ling, 1951a:108, confirmed).

Sorosporium proliferatum Zundel, Mycologia 22:150, 1930. — Type on *Andropogon hirtus* L. (= misnamed *Hyparrhenia aucta* (Stapf) Stapf ex Stent; comp. Doidge, 1950:380; and/or *H. tamba* (Steud.) Stapf, teste K. Vánky), South Africa, Transvaal, Waterval Boven, 29.XI.1918, I.B. Pole-Evans, PREM 11336; isotype HUV 18006! (syn. by Ling, 1951a:108, confirmed).

For a description, illustrations, host plant range, distribution and comments see Vánky (2003a:190-192).

Addenda

After this manuscript was finished, I obtained from M. Piątek the galley proof of a paper, in which he describes a new species on *Setaria* that could be included in detail only here.

13. *Sporisorium kenyanum* M. Piątek, Polish Bot. J., 51:160, 2006.

Type on on *Setaria pallide-fusca* (= *S. pumila*), Kenya, sine loco, coll. P.J. Greenway, IMI 68621.

Sori in distal parts of sterile shoots, preventing development of inflorescences, cylindrical and twisted, up to 7 cm (or more?) long, partly enclosed by healthy leaf sheaths. At first, spore balls and spores embedded in the parenchymatous tissues between the veins, later disclosed by rupturing the epidermis and leaving the fascicles of vascular bundles. *Spore balls* subglobose, ellipsoidal, oblong to irregular, 14-50 × 16-80 µm, dark yellowish-brown, composed of tens to hundreds of spores, permanent when young, later separating. *Spores* globose, subglobose to slightly subpolyhedrally irregular, 4.5-5.5(-6.0) × 5.0-6.0(-6.5) µm, yellowish to pale brown; wall even, c. 0.5 µm thick, surface in LM finely, moderately densely punctate, spore profile smooth, surface in SEM finely verrucose-echinulate. *Sterile cells* absent.

On *Setaria pumila* (Poir.) Roem. & Schult. (*S. pallide-fusca* (Schumach.) Stapf & C.E. Hubb. ex Moss); Africa (Kenya). Known only from the type collection..

An additional new *Tilletia* species was recently collected in India which is described as:

19 *Tilletia setariae-pumilae* Vánky & N.D. Sharma, **sp. nov.**

MycoBank 510406.

Typus in matrice Setaria pumila *(Poir.) Roem. & Schult., India, Madhya Pradesh, Mandla, Kanha National Park border, 22°07' N, 80°26' E, alt. cca. 700 m.s.m., 8.X.2006, leg. N.D. Sharma. Holotypus in Herbario Ustil. Vánky, HUV 21399!, isotypus in HCIO.*

Sori in ovariis nonnullis eiusdem inflorescentiae, globoidei, ovoidei vel ellipsoidales, 1,5-2 x 2-4 mm, saepe cum parte basali subacuta, inter involucra basalia distantia floralia conspicui, peridio crasso atrobrunneo cooperti, quo mature irregulariter rupto, massam nigram, pulveream sporarum cellularumque sterilium ostendentes. Sporae globosae, subglobosae, raro late ellipsoidales, 18,5-24(-25) × 18,5-25(-26) µm, pallide usque atro-olivaceobrunneae, raro subopacae, cum verrucis 1,5-2,5 µm altis, cylindricis vel subpyramidalibus cum typo depresso vel rotundato, in visu superficiali sicut puncta atra, irregulariter polygonalia apparentia, in diametro sporae 6-11, in circumferentia aequatoriali 21-40, in vagina hyalina inclusa. Cellulae steriles subglobosae, ellipsoidales usque parum irregulares, 10,5-17 × 11-24 µm, subhyalinae usque pallide flavidobrunneo tinctae; pariete 1,5-3 µm crasso, levi vel cum vestigiis ornamenti, contentu granuloso.

Sori in some ovaries of an inflorescence, globoid, ovoid or ellipsoidal, 1.5-2 x 2-4 mm, often with subacute basal part, showing between the spreading floral envelopes, covered by a thick, dark brown peridium which ruptures irregularly at maturity disclosing the black, powdery mass of spores and sterile cells. *Spores* globose, subglobose, rarely broadly ellipsoidal, 18.5-24(-25) × 18.5-25(-26) µm, pale to dark olivaceous-brown, rarely subopaque, provided with 1.5-2.5 µm high cylindrical or subpyramidal warts with a flattened or rounded tip, in surface view appearing as darker, irregularly polygonal spots, 6-11 per spore diam., 21-40 on the equatorial circumference, embedded in a hyaline sheath. *Sterile cells* subglobose, ellipsoidal to slightly irregular, 10.5-17 × 11-24 µm, subhyaline to pale yellowish-brown tinted; wall 1.5-3 µm thick, smooth or with a trace of ornament, content granular.

On *Poaceae: Setaria pumila* (Poir.) Roem. & Schult.: S Asia (India). Known only from the type locality.

Tilletia setariae-pumilae differs from *T. setariae* in having smaller spores, lower warts, and more warts per spore diam. The spores of *T. setariae* measure 20-28 × 20-30(-33) µm, the warts are 1.5-3 µm high, 8-13 per spore diam., 27-45 on the equatorial circumference.

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Preliminary checklist of macromycetes of the East and Middle Black Sea Regions of Turkey

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Abstract – This study is based on macromycete specimens collected from the East and Middle Black Sea Regions of Turkey in 2002-2005. As a result of field and laboratory studies, 213 taxa were identified. The complete checklist is available on:
http://www.mycotaxon.com/resources/weblists.html.

Key words – fungal diversity, mushrooms

Introduction

Turkey is divided into seven geographic regions and each region has different types of landscape and climate. The Black Sea Region extends from the border of Georgia in the east to the eastern edge of the Adapazari plain in the west. The region is divided into east, middle and west sections based on their geographical characteristics.

Turkey displays a great variation in topography and special land-forms. In the north, the East-West oriented, parallel ranges of the Northern Anatolian Mountains run in the southern part of the Black Sea. These coastal mountain ranges are the broadest and the highest in their eastern section, attaining elevations of over 3000 m. In the middle and west only a few peaks exceed 2500 m. The lower parts of the northern regions of Turkey are under the mild and humid climatic conditions. Cold and humid-per humid climate is dominant in the higher parts of this region. Northern Anatolian mountains form a barrier between the Black Sea and inland part of Central Anatolia. Yearly precipitation of the north-facing slopes of Eastern Black Sea Mountains is above 2000 mm (Atalay 1994).

Many studies on the mycota of Turkey have been carried out. Contemporary knowledge of the diversity of Turkish macromycetes is based on 90 years of investigations. The total number of macrofungal species recorded from Turkey

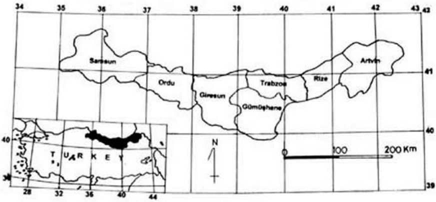

Fig.1. Location of the sampling area.

is 1601 (Sesli & Denchev 2005). Sesli & Baydar (1995, 1996) presented the first macromycete checklists, including the *Russulaceae* and *Agaricales*. Wood decaying macrofungi of the western Black Sea Region of Turkey were studied by Afyon et al. (2005).

The present study was based on specimens collected from the East and Middle Black Sea Regions of Turkey (Fig. 1). The aim of the present study is to examine the mycobiota of these regions of Turkey.

Materials and methods

The material for this study was collected during field trips to the East and Middle Black Sea Regions of Turkey between 2002 and 2005. The color, odor and other apparent properties of the macrofungi and vegetation were noted in the field. Photographs of specimens were taken using Fujicolor negative film and a macroobjective of normal focal length with an extension tube. The macrofungi collected from the study area were kept completely separate and were examined in the laboratory as soon as possible after collection. Spore prints were made to determine the color of the spores and spores from the prints were then used for the measurements. All spore measurements and length/width ratios were calculated from at least 20 spores. Microscopical examinations were performed using Nikon research microscopes. All the instruments were equipped with low voltage illumination. Excised pieces of pilei were moistened by adding a few drops of Clémençon's solution and placed in a damp chamber to soften completely. After being given some time to dry, they were sectioned. The sections were made with a previously unused razor blade under a binocular loupe. The sections were then transferred to a 3 % KOH solution to induce expansion. They were subsequently stained with ammoniated Congo red. The drawings were made using an apparatus that facilitated work according to precisely fixed magnifications (Sesli et al. 2000).

The specimens were identified using Corner (1966, 1968), Phillips (1981), Moser (1983), Breitenbach & Kränzlin (1984-2000), Singer (1986), Bresinsky & Besl (1990), Stamets (1996), Bessette et al. (1997), Læssøe (2000) and McKenny et al., (1987) and deposited at Fatih Education Faculty Herbarium at Karadeniz Technical University in Trabzon (SES), Turkey.

Results

213 taxa belonging to 55 families of the Ascomycota and Basidiomycota were identified and are listed on the following web page: http://www.mycotaxon.com/resources/weblists.html. Habitats, collecting sites, dates and herbarium accession numbers at SES are also given. Abbreviations of authors of fungal names are given according to Kirk & Ansell (1992). The systematics of the taxa are in accordance with Index Fungorum (URL1 2007).

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A new species and two new records of *Erysiphe* emend. from China

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Abstract—A new species of *Erysiphe* sect. *Uncinula*, *Erysiphe yanshanensis* on *Hydrangea bretschneideri* (*Hydrangeaceae*) is described, illustrated and compared with the morphologically similar *E. hydrangeae*. Two new records for China, *E. indigoferae* (*Erysiphe* sect. *Microsphaera*) on *Indigofera kirilowii* (*Fabaceae*) and *E. plectranthi* (*Erysiphe* sect. *Erysiphe*) on *Rabdosia japonica* var. *glaucocalyx* (*Lamiaceae*) are reported.

Key words—powdery mildew fungi, *Erysiphales*, taxonomy

In a series of previous papers (Liu 1998, Liu et al. 2002a,b, 2004; Liu & Wang 2004), information was published on the diversity of powdery mildew fungi (*Erysiphales*) in the Chifeng region of Inner Mongolia, China. However, because of taxonomic uncertainties and similarities to allied species, some collections were misidentified. On the basis of reexamination of problematic collections, the new species *Erysiphe chifengensis* T.Z. Liu & U. Braun was published recently (Liu & Braun 2006). It was noted that specimens on *Hydrangea bretschneideri* should be described as a new species, easily distinguishable from *E. hydrangeae*. Furthermore, it was determined that the collections included two new records for China, *E. indigoferae* on *Indigofera kirilowii* and *E. plectranthi* on *Rabdosia japonica* var. *glaucocalyx*, hitherto only known from Korea (Shin & La 1989a,b). Consistent with current taxonomy of the powdery mildew fungi, the three species are included in *Erysiphe* DC. emend. U. Braun & S. Takam. [sections *Erysiphe*, *Microsphaera* (Lév.) U. Braun & Shishkoff and *Uncinula* (Lév.) U. Braun & Shishkoff] (Braun & Takamatsu 2000, Braun et al. 2002). The materials studied are deposited at the Mycological Herbarium of the Chifeng College, Inner Mongolia, China (CFSZ), and the Herbarium of the Martin-Luther-University, Halle (Saale), Germany (HAL).

Erysiphe yanshanensis T.Z. Liu & U. Braun **sp. nov.** Fig. 1

(belonging in *Erysiphe* sect. *Uncinula*)

MycoBank, MB 510339

Differt a E. hydrangeae appendicibus brevioribus, 50-137(-220) µm, 0-2(-3)-septatis.

Mycelium amphigenous, mostly epiphyllous, effuse, forming thin white patches, irregular, evanescent or subpersistent; **hyphae** hyaline, 3-6.5 µm wide; **appressoria** lobed; **conidiophores** erect, 45-80 µm long, foot-cells cylindrical, 14-29 × 6.5-10 µm, followed by 1-2 cells; **conidia** formed singly, ellipsoid or doliiform-cylindrical, 21-30(-35) × 10-16(-22) (average 26.5 × 14) µm; **ascomata** (chasmothecia) scattered to gregarious, dark brown, depressed globose, 87-137 (average 120) µm diam.; **wall cells** irregularly polygonal, 8-32 µm diam.; **appendages** 5-23, equatorially arising, simple, straight or flexuous, undulate, rarely geniculate, 0.5-1(-1.8) times as long as the ascomatal diam., 50-137(-220) µm long, increasing in width from base toward apex, or width subuniform throughout, but outline sometimes somewhat irregular, with constrictions, sometimes with swellings, 5-10 µm wide near the base, 6.5-13(-16) µm wide above, thin-walled, thick-walled towards the base, smooth or verruculose below, 0-2(-3)-septate, hyaline or pigmented in the lower half, yellowish to brown, paler upwards, hyaline in the upper part, simply uncinate to loosely helicoid at the apex; **asci** (3-)4-9(-11), oval or oblong, short-stalked to sessile, 45-67 × 26-50 µm (average 60 × 38); **ascospores** (2-)5-7(-8) per ascus, ellipsoid or ovoid, yellowish, 15-26 × 10-15 (average 23 × 13) µm.

Material examined: On *Hydrangea bretschneideri* (*Hydrangeaceae*), China, Inner Mongolia: Chifeng, Ningcheng County, Heilihe, ca. 1500 m alt., 5 IX 1997, leg. T.Z. Liu, CFSZ 97057 (holotype); HAL 1938 F (isotype); 3 IX 1997, T.Z. Liu, CFSZ 97049; 25 VIII 1998, T.Z. Liu, CFSZ 98011; 22 VIII 2000, T.Z. Liu, CFSZ 00015; 21 VIII 2006, T.Z. Liu, CFSZ 06088; 22 VIII 2006, T.Z. Liu, CFSZ 06092 (paratypes).

Notes: *Erysiphe hydrangeae* (Z.X. Chen & R.X. Gao) U. Braun & S. Takam. (≡ *Uncinula hydrangeae* Z.X. Chen & R.X. Gao), known on *Hydrangea paniculata* from the Chinese Province Fujian (Chen et al. 1984, 1987; Chen & Yao 1993, Braun 1987) and Hokkaido in Japan (Braun 1987, Nomura 1997), is the only powdery mildew species of *Erysiphe* sect. *Uncinula* previously described from a host of this genus. This species is characterized by having chasmothecia with consistently long, pluriseptate appendages [1-4 times as long as the ascomatal diam., 0-9(-12)-septate]. Several collections of chasmothecia on *Hydrangea bretschneideri* from the Inner Mongolia Autonomous Region in the northeastern part of China are easily distinguishable from *E. hydrangeae* by

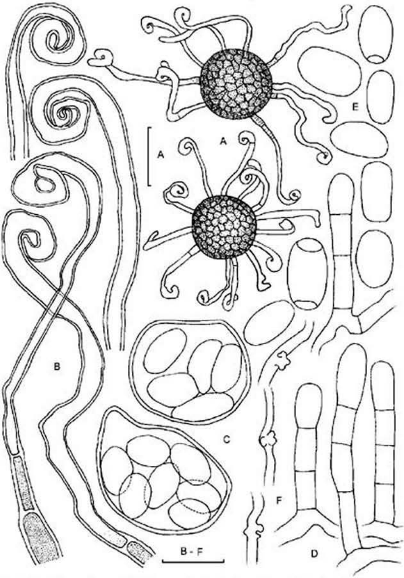

Fig. 1. *Erysiphe yanshanensis* A. Chasmothecia, B. Appendages, C. Asci and ascospores, D. Conidiophores, E. Conidia, F. Hyphae with appressoria.
Bar = 100 µm (A), 25 µm (B-F).

having very short appendages, only 0.5-1(-1.8) times as long as the ascomatal diam., with few septa [0-2(-3)-septate]. Based on the common host genus, Liu et al. (2004) tentatively assigned collections on *Hydrangea bretschneideri* to *E. hydrangeae*.

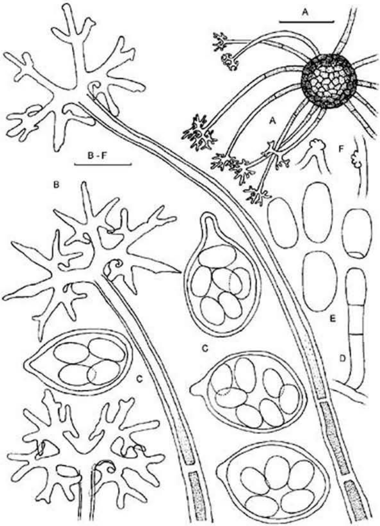

Fig. 2. *Erysiphe indigoferae* A. Chasmothecium, B. Appendages, C. Asci and ascospores, D. Conidiophore, E. Conidia, F. Hyphae with appressoria.
Bar = 100 µm (A), 25 µm (B-F).

Erysiphe indigoferae (H.D. Shin & Y.J. La) U. Braun & S. Takam., Schlechtendalia 4: 9, 2000 **Fig. 2**

≡ *Microsphaera indigoferae* H.D. Shin & Y.J. La, Korean J. Pl. Pathol. 5: 258, 1989
(belonging in *Erysiphe* sect. *Microsphaera*)

Mycelium amphigenous, mostly epiphyllous, effuse, forming thin white patches, evanescent to subpersistent; **hyphae** hyaline to subhyaline, 3-7 µm wide, smooth; **appressoria** lobed; **conidiophores** erect, foot-cells cylindrical, flexuous at the base, 16.5-23 × 5-7 µm, followed by 1-2 cells (only few conidiophores observed); **conidia** formed singly, ellipsoid or doliiform-cylindrical, 20-28 × 10-16 µm; **ascomata** (chasmothecia) scattered to subgregarious, dark brown, depressed globose, 82-116 µm diam.; **wall cells** irregularly polygonal, 10-23(-30) µm diam.; **appendages** 7-15, equatorially arising, straight or curved, flaccid, occasionally long and short appendages mixed on the same ascoma, (1-)1.5-3.3 times as long as the ascomatal diam., (95-)140-275 µm long, 7-10(-11.5) µm wide at the base, narrower upwards, thin-walled, thick-walled towards the base, smooth or rarely verruculose below, (0-)1-2-septate, brown or light brown below the septum, paler upwards, hyaline in the upper part, apex (3-)4-6 times dichotomously branched, mostly rather regular and compact, sometimes primary branches elongated, branchings looser, tips of the ultimate branchlets straight, subacute, obtuse to subtruncate, ultimate tips rarely recurved; **asci** 4-8, oval, oblong-oval or irregularly shaped, short-stalked to subsessile, 43-63 × 30-46 µm; **ascospores** 4-7 per ascus, ovoid or ellipsoid, yellowish, 15-20 × 10-13 µm.

Material examined: On *Indigofera kirilowii* (*Fabaceae*), China, Inner Mongolia: Chifeng, Aohan Qi, Daheishan, 13 VIII 1996, T.Z. Liu, CFSZ 96019.

Notes: Because of similarities in the manner of appendage branching and hosts of the same plant family, Liu (1998) identified the fungus on *Indigofera kirilowii* as *Erysiphe robiniicola* U. Braun & S. Takam. (≡ *Microsphaera robiniae* F.L. Tai). Critical re-examination of the collection concerned, however, revealed its identity with *Erysiphe indigoferae* (Shin & La 1989b). This is the first record of this powdery mildew fungus from China.

Erysiphe plectranthi H.D. Shin & Y.J. La, Korean J. Pl. Pathol. 5: 180, 1989 Fig. 3
(belonging in *Erysiphe* sect. *Erysiphe*)

Mycelium amphigenous, mostly epiphyllous, persistent or subpersistent on the upper surface of leaves, forming thin white patches and occupying the whole leaf surface, effuse on the lower surface of leaves, subevanescent; **hyphae** hyaline, 3-7 µm wide; **conidiophores** erect, (58-)80-134 µm long, foot-cells cylindrical, (22-)32-58 × 8-11 µm, followed by 1-2 cells, shorter to longer; **conidia** formed singly, ellipsoid to doliiform-cylindrical, 22-32(-38) × 13-16(-21) µm; **ascomata** (chasmothecia) scattered to subgregarious, dark brown, depressed globose, (70-)80-120(-130) µm diam.; **wall cells** irregularly polygonal, 8-26 µm diam.; **appendages** 10-30, arising from the lower portion of the ascoma, mostly simple, sometimes with short branchlets, rarely with long irregular branches, often undulate to tortuous, sometimes strongly geniculate, (1-)3-6 times as long as the ascomatal diam., (90-)275-685 µm long, 2.5-8(-10) µm wide, thin-walled, smooth to somewhat verruculose, (1-)2-5(-7)-septate, yellowish to pale brown in the basal half, paler towards the apex, hyaline at

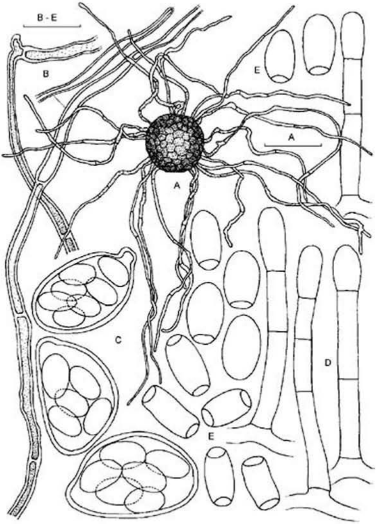

Fig. 3. *Erysiphe plectranthi*
A. Chasmothecium, B. Appendages, C. Asci and ascospores, D. Conidiophores, E. Conidia.
Bar = 100 µm (A), 25 µm (B-E).

the upper portion; **asci** 3-11, oval, oblong-oval or irregularly shaped, sessile or short-stalked, 42-67 × 29-45 µm; **ascospores** (4-)5-7(-8) per ascus, ovoid or ellipsoid, yellowish, 16-22 × 10-13 µm.

Material examined: On *Rabdosia japonica* var. *glaucocalyx* [≡ *Isodon glaucocalyx*; ≡ *Plectranthus glaucocalyx*] (*Lamiaceae*), China, Inner Mongolia: Chifeng, Songshan District, Wushijiazi, 23 IX 2001, T.Z. Liu & J. Ao, CFSZ 01036, HAL 1936 F.

Notes: Compared to the original description of *Erysiphe plectranthi* (Shin & La 1989a), the appendages in the present collection from China are more numerous

(10-30 per chasmothecium) and (1-)2-5(-7)-septate [versus 8-18 appendages per chasmothecium, and (1-)2-3-septate], the asci are (4-)5-7(-8)-spored, and the ascospores are smaller, 16-22 × 10-13 µm [versus 6-8-spored and 22-27 × 12-15 µm]. However, these differences are regarded as modifications in *E. plectranthi*. This powdery mildew fungus is new to China, with *Rabdosia japonica* var. *glaucocalyx* a new host plant for this fungus.

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Two new *Alternaria* species from selenium-rich habitats in the Rocky Mountain Front Range

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Abstract—Two new small-spored species, *Alternaria seleniiphila* and *Alternaria astragali*, are described.

Key Words— *Astragalus*, Colorado, selenium tolerance, *Stanleya*, Wyoming

Introduction

Alternaria is a large and diverse genus of important plant and animal pathogens, endophytes, and plurivorous saprobes. Based on morphology as well as sequence analysis, *Alternaria* has several close relatives including *Embellisia, Ulocladium, Stemphylium* (Simmons 1967, 1983; Chou & Wu 2002). Our current concepts of these genera originated with E. G. Simmons' classic paper (Simmons 1967) that updated and recognized *Alternaria, Stemphylium,* and *Ulocladium*. *Alternaria* is separated into 14 species groups based on conidial morphology, catenation and the overall 3-D structure of the conidiophore (Simmons 1992). Distinct morphological species-groups (Simmons & Roberts 1993), e.g. the *alternata* group or the *arborescens* group, place similar species into recognizable subgeneric groups that can be separated morphologically, molecularly (Roberts et al. 2000) and chemically (Andersen et al. 2002).

Some members of *Alternaria, Embellisia,* and *Ulocladium* have been found in "toxic" habitats containing high levels of metal or metalloid elements such as zinc, lead and selenium (David et al. 2000, Thompson-Eagle et al. 1989) as well as other extreme environments including high salinity and low temperatures (Guiraud et al. 1995, Simmons 1983). The current paper describes two new small-spored *Alternaria* species that were isolated from the roots of plants that hyperaccumulate selenium (Se). These plants are known as "indicators" for soils derived from seleniferous parent material and are found throughout the central and western USA (Beath et al. 1939).

Materials and methods

Stanleya pinnata (Pursh) Britton and *Astragalus bisulcatus* (Hook.) A. Gray were collected from Pine Ridge Natural area in Fort Collins, CO (40°32.70 N, 105°07.87 W, 5177 ft)[a] and a private ranch in Laramie, WY (42°51.17 N, 106°31.07 W, 5561 ft)[a], respectively. One-cm cuttings of the feeder roots were surface disinfested by immersion for 10 seconds in 10% (v/v) household bleach solution (6% sodium hypochlorite), rinsed in sterile water and placed in plastic Petri dishes containing 0.5 strength Malt Extract Agar (0.5 MEA, Difco, Detroit, MI, USA) with either 10 mg L^{-1} Se (*S. pinnata*) or without Se (*A. bisulcatus*), supplied as sodium selenate, Na_2Se0_4 (Sigma Chemical, Chicago IL, USA). The Petri dishes were sealed and incubated at 22 C under continuous fluorescent light. The resulting cultures were subsequently single-spored and maintained on 0.5 MEA at 22 C under continuous light in sealed Petri dishes.

Morphological examination

A 2mm cube from each maintenance culture was transferred to the surface of V-8 juice agar (800 mL H_2O, 200 mL V-8 juice, 3 g $CaCO_3$, 15 g agar) and incubated at 22 C in unsealed Petri dishes under fluorescent light with 8 hour day/16 hour night cycle for 4 days. Additionally, to observe the undisturbed conidiophores, 1 × 1.5 cm agar plugs were inoculated in the center, placed between a glass slide and cover slip on top of a wet filter paper disk within a sealed plate, and incubated as above.

DNA extraction, PCR amplification, sequencing and sequence analysis

A 2mm cube from each maintenance culture was transferred to 30 mL of Czapek-Dox broth (Difco, Detroit, MI, USA) and grown at 22 C for 5 days under continuous light; a 1 cm diameter colony was harvested for DNA isolation. DNA was extracted with a MasterPure Yeast DNA purification kit and amplified with a FailSafe PCR System (Epicentre Biotechnologies, Madison, WI, USA) using primers ITS1 and ITS4 (White et al. 1990). The PCR products (approx. 540 bp) were purified and the ITS region (ITS1+5.8S+ITS2) was sequenced by Macrogen (Rockville, MD, USA). Sequences were deposited in GenBank (accessions EF110522 and EF110523).

[a]global positioning system coordinates

Taxonomic description

Alternaria astragali Wangeline & E.G. Simmons **sp. nov.** Figure 1 (A-C)

MycoBank #: MB510572

Ex cultura in agaro V-8 descripta. Hyphae in superficie agari distincte radiales. Conidiophora primaria fusca, erectiuscula, ad ca. 250-400 × 3-5 µm. Conidia ovoidea vel longiellipsoidea, 10-35 × 5-7 µm, 0-7 transverse septata, longiseptis nullis vel 1-longiseptata in 1 segmento transverso, dilute vel modice brunnea, laevia, 4-10-catenulata. Conidiophora secondaria nunc unicellularia, ca. 3 × 3 µm, nunc 30-100 × 3-4 µm, nunc conspicue ad 250-300+ µm longa.

Habitatio typi in radice Astragalus bisulcatus, *coll. A. Wangeline, 8 June 2002, Laramie, Wyoming, U.S.A. Holotypus: pars ex cultura E.G.S. 52.122 (ex isol. A. Wangeline A-3, 12 June 2002) desiccata et in BPI 872198 conservanda.*

Etym: L., Astragalus (as host source)

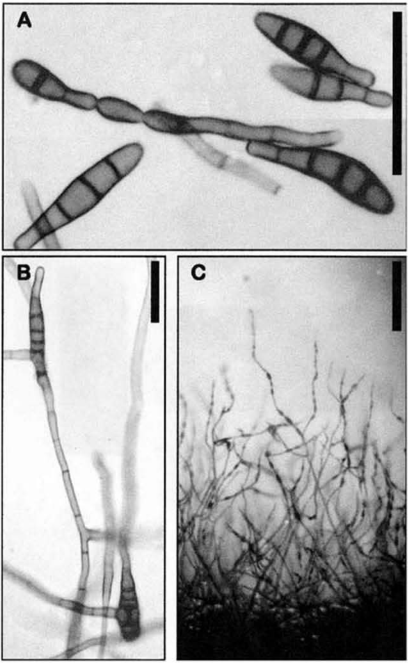

Figure 1. *Alternaria astragali*. Conidia (A), conidiophore showing secondary branching (B), and whole conidiophores (C) exhibiting characteristic sporulation pattern.
Bars = 20μm for A and B, and 200μm for C.

On V-8 agar: **colony** of radiating surface hyphae bearing abundant, crowded, semi-erect primary conidiophores; **primary conidiophores** of variable length, commonly 250-400 × 3-5 µm usually unbranched with an apical chain of 4-10 conidia; **conidium bodies** ovoid or predominantly long-ellipsoid, 10-35 × 5-7 µm, with 0-7 transverse septa and usually no longitudinal septa, or occasionally with a single longiseptum in one of the widest transverse segments, dilute to medium dull brown, septa slightly darker, outer wall appears smooth; **secondary conidiophores** are usually a single apical cell but in most chains at least one, sometimes two conidia produce longer secondary conidiophores 30-100 µm long, in addition, a very high percentage of small conidia produce an apical secondary conidiophore that is 250-300 µm or more in length.

Comments—The strikingly long secondary conidiophores are diagnostic of the taxon; they are intermixed with the even longer primary conidiophores, yielding a tangled thicket of dark, erect or variously twisted elements that bear the inconspicuous chains of small spores.

Alternaria seleniiphila Wangeline & E. G. Simmons **sp. nov.** **Figure 2 (A-C)**

MycoBank #: MB510571

Ex cultura in agaro V-8 descripta. Conidiophora primaria fusca, erectiuscula vel diverse torta, plerumque sine ramis, 80-250 × 4-5 µm. Conidia ovoidea vel ellipsoidea, ad 20-40 × 8-12 µm, 1-7 transverse septata, 1-longi- vel oblique septata in 1-3 segmentis transversis, dilute vel modice brunnea, laevia vel punctata, 3-6-catenulata. Conidiophora secondaria vulgo 1-5-cellularia, 3-30 × 3 µm, etiam plerumque conspicue 50-110 µm longa.

Habitatio typi in radice Stanleya pinnata, *coll. A. Wangeline, 19 June 2002, Fort Collins, Colorado, U.S.A. Holotypus: pars ex cultura E.G.S. 52.121 (ex isol. A. Wangeline A-1, 20 June 2002) desiccata et in* **BPI** *872197 conservanda.*

Etym.: NL, selenium + -phila (having a strong affinity for selenium)

On V-8 agar: **colony** of abundant but not densely crowded long, erect or variously twisted primary conidiophores, 80-250 × 4-5 µm at maturity; **primary conidiophores** are simple or occasionally branched near the point of origin from surface vegetative hyphae usually unbranched within their aerial length, occasionally 1-2 geniculate conidiogenous extensions near apex, each simple conidiophore bears a short, usually unbranched apical chain of 3-6 conidia, occasionally a lateral secondary conidiophore and 1-2 conidia produced by an intercalary conidium in a chain; conidia produced in close succession with short 1-5-celled secondary conidiophore connectives ca. 3-30 × 3 µm, very long **secondary conidiophore** commonly produced from individual conidia in the chain terminating in 1-3 small conidia, these conspicuous secondary conidiophores are 50-110 µm long; **conidium bodies** are ovoid to ellipsoid without distinctive beak portion, maximum size range of ca. 20-40 × 8-12 µm at maturity, with 1-7 transverse septa and one longitudinal or oblique septum

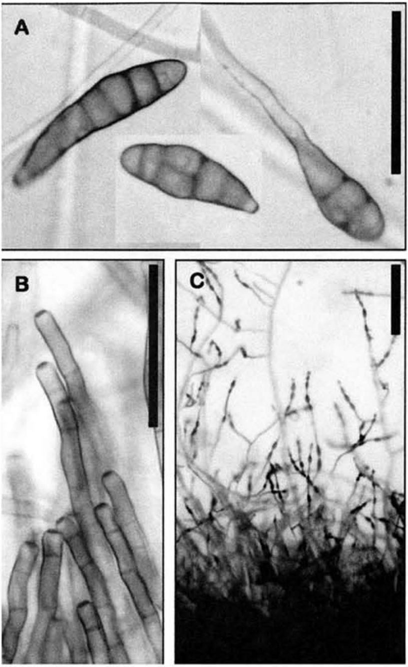

Figure 2. *Alternaria seleniphila.* Conidia (A), conidiophore tips (B), and whole conidiophores (C) exhibiting characteristic sporulation pattern. Bars = 20µm for A and B, and 200µm for C.

in 1-3 of the transverse segments of some conidia, dilute to medium tan with slightly darker septa, outer wall smooth to evenly punctate.

Comments—Various researchers have demonstrated that conidial size is an ineffective identification criterion when used alone to distinguish small-spored species of *Alternaria* (Simmons 1967, Andersen et al. 2002) and misuse of this feature has lead to rampant misidentification, especially in the case of *A. alternata*. There are standardized methods that should be used for morphological identification (Simmons 1992, Roberts et al. 2002) including observation of the appearance and branching habit of the distinct conidiophores of the small-spored *Alternaria* species. *A. astragali* and *A. seleniiphila* have unique conidiophore sporulation patterns specifically in relation to the length of their secondary conidiophores that are diagnostic for each taxon and which differ from that described for *A. alternata* (Simmons 1967, 1992).

A. astragali and *A. seleniiphila* exhibit Se tolerance, showing no visible effects when grown on agar containing 10mg L^{-1} Se and grow to 0.95 and 0.61, respectively, of control cultures after 5 days on agar containing 600mg L^{-1} Se. This ability is not unexpected due to their origin from seleniferous host material, as well as the presence of *Alternaria* and related genera in a variety of harsh environments. The ability of the described species to tolerate Se will likely contribute to further taxonomic distinction under metabolite examination. Furthermore, due to the frequent misidentification of *A. alternata*, as well as its reported association with toxic Se environments, it is possible that previous reports of Se tolerant *Alternaria* could be isolates of one of these newly described species (Thompson-Eagle et al.1989).

The ITS region (ITS1+5.8S+ITS2) of both *A. astragali* and *A. seleniiphila* were sequenced and submitted to GenBank for reference, but should not be used for identification purposes since this gene does not resolve closely related species in this group (Andersen et al. 2002).

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Three new lichen species from the French Antilles

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Abstract — *Fuscopannaria caribbea, Lecanora legalloana* and *Sporopodium leprosum* from the French Antilles are described as new to science.

Key words — West Indies, taxonomy

Introduction

The number of lichen species reported from the West Indies now exceeds 1800 (Imshaug 1957, Breuss 1999). However, many groups have not been critically revised, so that the number of reported species may ultimately be reduced even though some taxa have yet to be described. A comprehensive list of the lichens of Guadeloupe is currently being prepared (Øvstedal in prep.). Most of the material examined in the present study was collected by the French botanist C. Le Gallo in Guadeloupe and St. Barthelemy during 1956-58. Part of his herbarium was purchased by Henry Imshaug and deposited in MSC (Fryday pers. comm.), while his other collections are present in various herbaria (e.g. PC, US). During our study of the lichens from these islands several new species were discovered and they are described here.

Materials and methods

The specimens studied are deposited in MSC or BG. The lichen specimens were examined using a Zeiss Stemi 2000C stereo microscope and a Zeiss Axiolab compound microscope. Chemical constituents were identified by thin layer chromatography (Elix & Ernst-Russell 1993), high performance liquid chromatography (Elix et al. 2003) and comparison with authentic samples.

Taxonomic descriptions

Fuscopannaria caribbea Øvstedal, **sp. nov.** Fig. 1

MB 510342

Thallus squamulosus, fusco-brunneus, marginis coeruleis. Apothecia cupuliformes, pallide brunnescens. Prothallus et hypothallus nullus. Ascosporae 9–10 x 4–5 µm. Acida lichena ignota.

Etymology: The specific epithet derives from the occurrence of this species on the Caribbean island of Guadeloupe.

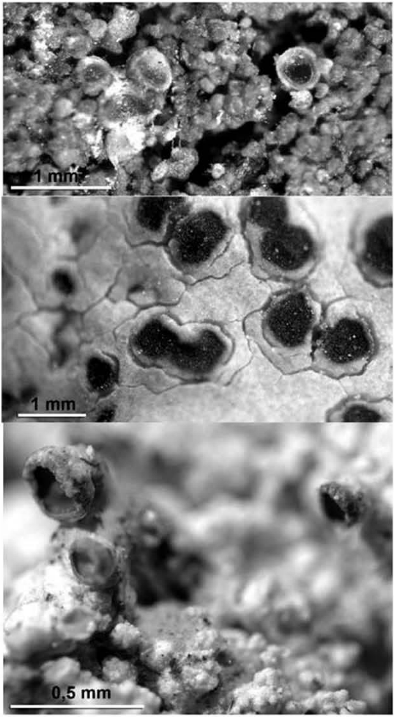
Holotype: GUADELOUPE, French Antilles, Trois Rivières, sur un gros rocher, *C. Le Gallo*, 25 Nov. 1956; MSC 61008.

KEY CHARACTERS — **Thallus** squamulose, 4-5 cm wide. Photobiont *Nostoc*, in clumps. Squamules overlapping and partly coalescing, individual squamules subterete, ascending, isidioid, to 0.3 mm long and 0.1 mm broad, olivaceous brown, with bluish, fluffy tips. Squamules at the thalline margin up to 0.7 mm wide, fan-shaped, procumbent, with bluish, swollen, fluffy margins. No prothallus or hypothallus observed. **Apothecia** scattered, sessile, lecanorine, cupuliform, pale brown, up to 0.4 mm wide. In vertical section the thalline exciple is filled with clumps of *Nostoc*, and comprises a thin cortex of weakly differentiated pseudoparenchymatous tissue, and a very narrow, colourless, true exciple. Hypothecium colourless. Hymenium 50-60 µm high, K/I + pale blue-green changing to pale reddish. Ascospores 8 per ascus, 9-10 x 4-5 µm, rugulose. **Chemistry** — K–, C–, KC–, Pd–; no lichen substances detected by TLC.

Distribution and Ecology — At present this species is known only from the type locality on Guadeloupe where it grows on organic material (fibrous remains of ferns).

COMMENTS — Previously *F. leucosticta* (Tuck.) P. M. Jørg. was the only *Fuscopannaria* known from the Caribbean region [Cuba] (P. M. Jørgensen pers. comm.). This new species is unique within the genus because of its small, cupular apothecia and readily detached lobe-ends that function as dispersal units (P. M. Jørgensen pers. comm.). Diverse types of vegetative diaspores are known in the genus. For example, *F. albomaculata* P. M. Jørg. from China has marginal lobes that are inrolled and tubiform and easily detached, while *F. granulifera* P. M. Jørg. & Upreti from the Himalayas has granules on the margins (Jørgensen 2004). Further, the recently described *F. venusta* P.M. Jørg. & Sipman from New Guinea has isidia-like outgrowths (Jørgensen & Sipman 2006), while numerous species are sorediate.

Figures 1-3. New species from the French Antilles: 1, *Fuscopannaria caribbea* (holotype); 2, *Lecanora legalloana* (lectotype); 3, *Sporopodium leprosum* (holotype).


1 mm
1 mm
0,5 mm

Lecanora legalloana Elix & Øvstedal, **stat. & nom. nov.** Fig. 2
MB 510343

Basionym: Lecanora prosecha var. *rubescens* Vain., Journ. Bot. 34: 5 (1896).

Lectotype here designated: Dominica, Souffrière, 2.7.1892, *W. R. Elliott* (TUR-VAIN 05078).

Etymology: named in honour of the French lichen collector C. Le Gallo.

KEY CHARACTERS — **Thallus** crustose, flat, continous to rimose-areolate, smooth, yellowish white, epruinose, 150-200 µm thick; with an indistinct, ca. 10 µm thick cortex of pseudoparenchymateous tissue below which lies a fairly compact medulla containing algae and some vertical rows of large, colourless crystals. Soralia absent. Prothallus thin, black, delimiting the thalli by dark lines. **Apothecia** immersed in the thallus, to 0.8 mm wide, disc mid- to dark red-brown, epruinose. Epihymenium red-brown, K–, N–, C–. Hymenium hyaline, 40-45 µm high. Hypothecium and subhymenium colourless. Paraphyses thin, slightly branched, strongly adglutinated, apical cells thickened, to ca. 2 µm wide. Ascospores 8 per ascus, simple, colourless, thick-walled, ellipsoid, 7-9 x 4-5 µm. **Chemistry** — K+ yellow, C–, Pd+ yellow, pigmented part of medulla K+ red-violet; containing atranorin (major), skyrin (major), rugulosin (minor) and traces of diploicin, caloploicin and 4,5-dichlorolichexanthone (most probably the result of contamination from other lichen thalli on the same rock).

Distribution and Ecology — At present this species is known from Guadeloupe, Dominica and St. Vincent where it grows on volcanic rocks.

COMMENTS — *Lecanora legalloana* is characterized by the conspicuous, immersed, aspiciloid apothecia, and the presence of atranorin, skyrin and rugulosin in the medulla. The pigmented areas of the medulla appear as irregular spots which react K+ intense red-violet. Morphologically *L. legalloana* closely resembles the pantropical species, *L. subimmersa* (Fée) Vain. (Lumbsch 1994), but the ascospores of the latter species are much larger (8.5-14.5 x 4.5-5.5 µm cf. 7-9 x 4-5 µm) and it contains atranorin (major), chloroatranorin (minor) and zeorin (major). The closely related *L. subimmersa* subsp. *ramboldii* Lumbsch & Elix, which is recorded from the Caribbean (Guderley 1999), contains additional xanthones (Lumbsch 1994).

Vainio (1896) described this taxon as *Lecanora prosecha* Ach. var. *rubescens* but overlooked the fact that the type of *L. prosecha* was sorediate and described a sorediate form of this species (*L. prosecha* f. *granulifera* Vain.) in the same paper. The type of *L. prosecha* (St. Barthelemy, H-ACH 1173) contains atranorin (major), chloratranorin (minor), arthothelin (minor), skyrin (minor) and 4,5-dichloronorlichexanthone (trace), while the type of *L. prosecha* var. *granulifera* (Dominica, Soufrière, *W.R. Elliott*, TUR-VAIN 06754) contains atranorin (major), chloroatranorin (trace), arthothelin (submajor), 4,5-

dichloronorlichexanthone (trace) and 2,5-dichloronor-lichexanthone (trace). Both *L. legalloana* and *L. prosecha* occur in the same lichen community on Guadeloupe. To add to the confusion, a third whitish, sorediate, sterile lichen often co-occurs with them. This latter was identified as *Caloplaca diplacioides* (Vain.) Zahlbr. and contains diploicin (major), atranorin (minor), caloploicin (minor), fulgidin (trace) and norcanesolide (trace) [fertile specimen: Guadeloupe, Gourbeyre, *C. Le Gallo,* 22 May 1958 (MSC)].

SPECIMENS EXAMINED— Dominica, Souffrière, *W. R. Elliott,* 2 Jul. 1892 (TUR-VAIN 05078, lectotype). Guadeloupe, Afstricto, *C. Le Gallo, sine dato* (MSC); Basse-Terre, rivière Sence, sur rochers, *C. Le Gallo,* 19 Mar. 1957 (MSC).

Sporopodium leprosum Øvstedal & Elix, sp. nov. Fig. 3

MB 510341

Thallus crustaceus, albus, leprosus, cum campylidis. Acida diversa continens (vide infra). Apothecia non vidi.

Etymology: the epithet derives from the leprose upper surface of the thallus.

Holotype: GUADELOUPE, French Antilles, Basse-Terre, Mamelle de Petit-Burg, on undetermined tree, *D. O. Øvstedal,* 28 Nov. 1988: BG.

KEY CHARACTERS— **Thallus** leprose, thick, white, with campylidia. **Campylidia** opening sideways, with a single cavity (like a ship's ventilator), ca. 0.3 mm wide and high, surface as for the thallus; cavity concave, smooth, brown. In vertical section the inner and lower parts of a campylidium are composed of pseudoparenchymatous tissue, but towards the surface of the cavity the hyphae become elongated and encrusted with small crystals, terminating in elongate, conidiophorous hyphae. Conidia colourless, simple, filiform, nonseptate, broader in the middle, 18-22 x 1-2 µm, encrusted with minute crystals. No apothecia or pycnidia seen. **Chemistry** — K–, C+ orange, KC+ orange, Pd–; containing methyl barbatate (major), chodatin (minor), isoarthothelin (minor), 5,7-dichloro-3-*O*-methylnorlichexanthone (minor), 3-*O*-methylasemone (minor), 5,7-dichlorolichexanthone (minor), 2,4,5-trichlorolichexanthone (minor), 4,5,7-trichlorolichexanthone (minor), 2,5-dichlorolichexanthone (trace).

Distribution and Ecology — At present this species is only known from the holotype specimen which was found growing on the trunk of an unidentified tree.

COMMENTS — As the specimen described above lacks apothecia, we have based its generic identity primarily on the morphology of the campylidia and the medullary chemistry. The campylidia and crustose thallus indicate that this species could belong to the *Ectolechiaceae*. Although the campylidia do not agree exactly with any of the types reported by Sérusiaux (1986), they appear very similar to those of the genus *Sporopodium* Mont. em. R. Sant. Furthermore, chlorinated xanthones are common in this genus (Elix et al. 1992, 1995). Up to the present time at least 12 species have been included in this genus (Elix et al. 1995, Lücking et al. 2000, Lücking & Santesson 2002, Santesson 1952), and although all are epiphyllous, many genera are now known to comprise both epiphyllous and corticolous species (Kalb & Vězda 1987). Molecular studies or apothecia (if found), will ultimately reveal more definitive information about the relationships of this taxon.

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Biogeography and hosts of poroid wood decay fungi in North Carolina: species of *Abortiporus, Bondarzewia, Grifola, Heterobasidion, Laetiporus* and *Meripilus*

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Abstract—Distribution and host plants are provided for two species of *Abortiporus*, three species of *Laetiporus* and one species each of *Bondarzewia, Grifola, Heterobasidion* and *Meripilus*. County distribution maps are provided for each species as well. A complete checklist can be found at: www.mycotaxon.com/resources/weblists.html.

Keywords—fungus distribution, polypores

Introduction

The importance of biodiversity and biogeography of fungi in ecosystems was addressed in previous studies by Grand & Vernia (2004a). Previous studies of poroid wood decay fungi in North Carolina have reported the occurrence of selected genera and host plants (Jung 1987, Vernia & Grand 2000, Grand & Vernia 2002, 2003, 2004a, b, 2005a, b). These studies have greatly expanded the range and host plant reports of many species of poroid wood decay fungi in the southern region of the United States. This report is the fifth in a continuation of a long-term study of poroid wood decay fungi in North Carolina.

Materials and methods

Poroid wood decay fungi were intensively collected in North Carolina from 1997–2006. Data from other studies (Jung 1987, Grand et al. 1975), collections in the Mycological Herbarium (NCSC), North Carolina State University, and records of the Plant Disease and Insect Clinic, Plant Pathology Department, North Carolina State University, were used in developing distribution maps. Other sources for distribution and host plant data are noted in the species checklist.

Collections were obtained for all species of *Abortiporus, Laetiporus, Bondarzewia, Grifola, Heterobasidion*, and *Meripilus* on unusual hosts. Specimens were placed in paper bags in the field with a sample of decayed wood with most collections and field notes for all collections. Specimens were examined in the laboratory and identified using existing taxonomic treatments (Gilbertson & Ryvarden 1986, 1987; Larsen & Lombard 1988; Overholts 1953). Nomenclature and authorities are from Gilbertson & Ryvarden (1986, 1987) and IPNI (2006) for fungi and Kartesz & Kartesz (1980) or IPNI (2006) for host plants.

The majority of collection sites were in state parks, game lands and natural areas, Nantahala, Pisgah, Croatan and Uwharrie National Forests and the Blue Ridge Parkway and Great Smoky Mountains National Parks. A county distribution map is provided for each species (Figs. 1–9).

Results and discussion

Abortiporus biennis (Bull. : Fr.) Singer (Fig. 1) and *A. fractipes* (Berk. & M.A. Curtis) Gilb. & Ryvarden (Fig. 2) appear to be widespread in North Carolina. Collections of both species were made in the Mountain, Piedmont and Coastal Plain provinces. Both species were associated with deciduous tree species plant debris. *Abortiporus biennis* was observed to fruit abundantly on recently dead trees but basidiocarps occurred infrequently after three to four years. *Abortiporus fractipes* was found most frequently on dead branches, often buried in soil, in flood plains.

Bondarzewia berkeleyi (Fr.) Bondartsev & Singer (Fig. 3) was found in the mountains although several collections were made in Wake Co., a Piedmont site. Except for *Prunus pennsylvanica*, all collections of *B. berkeleyi* were at the base of living trees in the genus *Quercus*.

Heterobasidion annosum (Fr. : Fr.) Bref. (Fig. 5) is widespread in North Carolina and was recorded in all three physiographic provinces. *Heterobasidion annosum* is represented by numerous records primarily because it causes an economically important root rot (Woodward et al. 1998).

Meripilus sumstinei (Murrill) M.J. Larsen & Lombard (Fig. 9) was collected in mountain and Piedmont sites. All collections were made at the base of large, still living, oak species.

Three species of *Laetiporus* were found or reported in North Carolina. Early reports (Grand et al. 1975) and herbarium collections (NCSC) that were identified as *L. sulphureus* (Bull. : Fr.) Murrill undoubtedly included *L. cincinnatus* (Morgan) Burds. et al., *L. persicinus* (Berk. & M.A. Curtis) Gilb. and *L. huroniensis* Burds. & Banik. Burdsall & Banik (2001) provided evidence for a species concept in the genus and recognized six species and one variety. Following their study, *L. cincinnatus* (Fig. 6), *L. persicinus* (Fig. 7) and *L. sulphureus* (Fig. 8) were identified. A specimen from Graham County on *Tsuga canadensis* is identified as *L. sulphureus* in the present study but is almost certainly *L. huroniensis*. This collection was on an old, large-diameter, fallen hemlock and fits the description by Burdsall & Banik (2001). *Laetiporus* species in North Carolina need to be studied further to account for their distribution.

Grifola frondosa (Dicks. : Fr.) Gray (Fig. 4) was not collected frequently enough to determine a distributional trend.

Fig. 1. Distribution of *Abortiporus biennis* in North Carolina.

Fig. 2. Distribution of *Abortiporus fractipes* in North Carolina.

Fig. 3. Distribution of *Bondarzewia berkeleyi* in North Carolina.

Fig. 4. Distribution of *Grifola frondosa* in North Carolina.

Fig. 5. Distribution of *Heterobasidion annosum* in North Carolina.

Fig. 6. Distribution of *Laetiporus cincinnatus* in North Carolina.

Fig. 7. Distribution of *Laetiporus persicinus* in North Carolina.

Fig. 8. Distribution of *Laetiporus sulphureus* in North Carolina.

Fig. 9. Distribution of *Meripilus sumstinei* in North Carolina.

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The *Cladoniaceae* of Navarino Island (Prov. Antártica Chilena, Chile)

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Abstract—Forty two taxa of *Cladoniaceae* are reported from Navarino Island, Chile. *Cladonia acuminata* and *C. cryptochlorophaea* are new to Chilean flora, and eighteen taxa are new reports for Navarino Island. The chemical variation of the taxa is reported. New chemotypes in *C. bellidiflora* with fumarprotocetraric, thamnolic and usnic acids, and *C. ustulata* with thamnolic, barbatic and squamatic acids are reported. A phytogeographic distribution pattern of the taxa with data on their habitat and frequency is presented.

Key words—lichens, biogeography, southern South America

Introduction

Navarino Island is a Chilean territory located in Tierra de Fuego, and belongs to the Comuna de Cabo de Hornos in the XII Region, Magallanes and Antártica Chilena. It is the southernmost American territory that has permanent human settlements. In June 2005, it was named Cape Horn Biosphere Reserve as an area of great importance for conservation of natural resources.

The 2900 km^2 island is situated between 54°45' - 55° 15'S and 69°-67°W. It lies between the Beagle Channel to the north and Nassau Bay to the south close to the Wollaston Islands where Cape Horn is located. The island is made of igneous rocks (gabbros, diorites, hornblendites and granitoids) from the late Mesozoic times, belonging to the Patagonian Batholith, and covered during late Jurassic to early Cretaceous by sedimentary and volcanic rocks (Hervé et al. 1984). It has a rugged topography shaped by volcanism and extreme weather, the highest peak reaching 1118 m above sea level at Cordillera de los Dientes.

At Port Williams, the capital, the mean annual rainfall is 467 mm. The rain is uniformly distributed throughout the year and part of it falls as snow. The annual mean temperature is 6 °C, the warmest month presenting a mean temperature of 9.6ºC (January) and the coldest one 1.9ºC (July). Another important climatic factor is the westerly wind blowing all the year, lowering the summer temperatures and increasing the winter temperatures. This wind is the long-distance dispersal vehicle for many organisms in the south of the Southern Hemisphere such as lichens (Muñoz et al. 2004).

The Island has an extraordinary biota. From sea level up to 500-600 m altitude the Magellanic deciduous forest covers the area, almost in pristine condition, and it is constituted by coihue (*Nothofagus betuloides*), lenga (*N. pumilio*) and ñirre (*N. antarctica*). Above timberline the Andean tundra is dominating. It constitutes of pulvinate shrubs of *Bolax gummifer* and *Azorella selago* mixed with the lichens *Pseudocyphellaria freycinetii*, *P. endochrysea* and *Peltigera rufescens*, and the Antarctic lichen tundra at greater altitude with several *Usnea* species, *Cetraria islandica*, and *Thamnolia vermicularis* in a colouring mosaic. In the most humid sites with bad drainage the Tundra sphagnosa with *Sphagnum magellanicum*, *Marsippospermum grandiflorum* and *Empetrum rubrum* occupies vast territories.

The Chilean *Cladoniaceae* have received considerable attention during recent decades (Ahti & Kashiwadani 1984, Galloway 1998, Galloway & Quilhot 1998, Stenroos 1995, Stenroos & Ahti 1990, Stenroos et al. 1992). Other important publications in adjacent areas are those on the Falkland Islands (Stenroos & Ahti 1992), Neotropical territories (Ahti 2000) and the Antarctic and peri-Antarctic regions (Stenroos 1993, Øvstedal & Lewis Smith 2001), and Argentina (Calvelo & Liberatore 2002), which have strong floristic relationships with Navarino Island.

The family *Cladoniaceae* is characterized by a composite thallus of varied morphology with two main structures, primary thallus and podetia, the latter of which are not always present (Stenroos et al. 2002). The aim of this investigation was to extend the previous lichenological knowledge of the *Cladoniaceae* in this Chilean insular region.

Material and methods

The present study is based on about 600 specimens of fresh material collected in January-February 2005 during a Spanish fieldwork expedition. The material studied is deposited in MACB as well as in the Magallanes University, UMAG, Chile. The species were determined by their morphological and chemical characters. The specimens were analysed by thin-layer chromatography (TLC), using a standardized procedure (White & James 1985).

The exact situation and dominant vegetation types of the major localities studied are as follows:

Antarctica Chilena Province: Navarino Island: —Caleta Honda, 20 m altitude, 54° 55' 50.2" S, 68° 17' 02.2" W, a very old and moist *Nothofagus betuloides* forest. —Caleta Honda-Caleta Mejillones, 0-10 m altitude, 54° 54' 18.6" S, 68° 07' 00.1" W. *N. pumilio* forest. —Caleta Mejillones, 10 m altitude, 54° 53' 59.4" S, 68° 00' 10.1" W, *N. pumilio* and

N. betuloides forests. —Caleta Pantalón, 10 m altitude, 54° 54' 49.1" S, 67° 50' 51.8" W, sea cliffs with *N. pumilio* forest. -Mladineo Pass, 650 m altitude, peat bogs with *Sphagnum magellanicum*. —Puerto Navarino, 0-50 m altitude, 54° 58' 23.2" S, 67° 40' 59.8" W, *N. betuloides* forest. —Puerto Williams, Ukika valley, 50-160 m altitude, 54° 57' 38.5" S, 67° 37' 49.4" W, *N. betuloides* and *N. pumilio* forests. —Wiew point in the way to La Bandera peak, 280 m altitude, 54° 57' 36" S, 67° 37' 37.5" W, *N. pumilio* forest. —La Bandera peak, 550 m altitude, 54° 57' 38.5" S, 67° 37' 49.4" W, Andean tundra grassland. —Popi forest, 200-300 m, *N. pumilio* forest. —Róbalo lake, camp site, 290 m altitude, 54° 58' 23.3" S, 67° 40' 59.9" W, *N. pumilio* forest. —Róbalo lake, 420 m altitude, 54° 58' 40.0" S, 67° 41' 24.7" W, *N. betuloides* forest. —Laguna del Salto, Lake of the Waterfall, Róbalo valley, 500 m, peat bogs. —Róbalo peak at the base, 510 m altitude, 54° 58' 15.3" S, 67° 41' 30.9" W, *N. antarctica* shrubs. —Way to Lum, 400 m altitude, 54° 57' 44.4" S, 68° 05' 40.3" W, peat bogs with *Sphagnum magellanicum*. —Lake down Dientes de Navarino, 600 m altitude, 54° 59' 52.3" S, 67° 41' 50.5" W. —Holguer Islands: Sea shore rocks.

Última Esperanza Province: Puerto Natales: —río Serrano, close to Milodón Cave, 51° 34' 03.8" S, 72° 37' 10.8" W, *N. antarctica* shrubs. —Hacienda Perales, seno Última Esperanza, *N. betuloides* forest.

Results

A total of 40 taxa were identified plus two more taxa have been reported in previous studies. *Cladonia acuminata* and *C. cryptochlorophaea* are new to the Chilean flora, and 18 taxa are new records for Navarino Island. This is a high number of taxa because Stenroos et al. (1992) reported 52 species from the whole Tierra del Fuego, and Stenroos (1995) 58 taxa from Chile, which comprises an area of considerable extension.

In our studies on the chemical variation of the taxa we found a new chemotype with fumarprotocetraric, thamnolic and usnic acids in *Cladonia bellidiflora*, and a new chemotype with thamnolic, barbatic and squamatic acids in *C. ustulata*. Our indication of frequency with the terms common, scattered and rare is primarily based on the number of specimens recorded but also our field observations.

Taxonomy

* = species reported as new to Navarino Island, ** = species new to Chile.

* ***Cladia aggregata*** (Sw.) Nyl.

Chemistry: Thallus Pd–, K–, C–. Barbatic and 4-O-demethylbarbatic acids.

Habitat and distribution: In peat bogs. Scattered. Austral.

Representative specimens: Antarctica Chilena Province: Navarino Island: Caleta Wulaia, 10 m, *Vilches*, MACB 92069. Caleta Wulaia to Puerto Inútil, *Vilches*, MACB 92070. Dientes de Navarino, 400-600 m, *Popi*, MACB 92068. Última Esperanza Province: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92071.

** ***Cladonia acuminata*** (Ach.) Norrl.

Chemistry: A chemically variable species in southern South America (Stenroos et al. 1992). Thallus Pd+ yellow, K+ yellow to reddish, C–. Our samples have atranorin, connorstictic and norstictic acids.

Habitat and distribution: On soil. Rare. Bipolar distribution. New to the Chilean flora.

Representative specimens: Antarctica Chilena Province: Navarino Island: Popi forest, *Vilches*, MACB 92066. Way to Lum, 400 m, *Vilches*, MACB 92067.

Cladonia arbuscula (Wallr.) Flot. subsp. ***arbuscula*** s. lat.

Chemistry: Thallus Pd+ red, K– or K+ brownish, C–. Fumarprotocetraric acid complex, usnic and isousnic acids.

Habitat and distribution: On peat bogs. Rare. Bipolar.

Representative specimens: Antarctica Chilena Province: Navarino Island: Laguna del Salto, Róbalo valley, 500 m, *Raggio*, MACB 91910.

Cladonia asahinae J.W. Thomson

Chemistry: Thallus Pd+ red, K– or K+ brownish, C–. Fumarprotocetraric acid complex, rangiformic and norrangiformic acids.

Habitat and distribution: On humous soil. Scattered at lower altitudes common at higher altitudes. Bipolar.

Representative specimens: Antarctica Chilena Province: Navarino Island: Puerto Navarino, 20 m, *Vilches*, MACB 91979. Puerto Williams, Ukika valley, 40-80 m, *Burgaz*, MACB 91980. Way to Lum, 400 m, *Vilches*, MACB 91983. Róbalo lake, 420 m, *Vilches*, MACB 91984. Laguna del Salto, Róbalo valley, 500 m, *Raggio*, MACB 91981. Róbalo peak, 500 m, *Vilches*, MACB 91982. Dientes de Navarino, 900 m, *Vilches*, MACB 91985.

Cladonia bacilliformis (Nyl.) Glück

Chemistry: Thallus Pd–, K–, C–. Barbatic, 4-O-demethylbarbatic and usnic acids.

Habitat and distribution: On rotting wood. Rare. Bipolar, with a boreal distribution in Northern Hemisphere and antiboreal in Southern Hemisphere.

Representative specimens: Antarctica Chilena Province: Navarino Island: Popi forest, 400 m, *Vilches*, MACB 92065. Última Esperanza Province: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92061. Ibidem, Serrano river, *Burgaz* 92139.

Cladonia bellidiflora (Ach.) Schaer.

Chemistry: Thallus Pd+ yellow or Pd+ red, K– or K+ yellow to brownish, C–. A chemically variable species with several chemotypes in the area. I: Fumarprotocetraric acid. II: Fumarprotocetraric and usnic acids, chemotype found in Antarctic and peri-Antarctic material (Stenroos 1995). III: Fumarprotocetraric, thamnolic and usnic acids, new chemotype. IV: Thamnolic acid.

Habitat and distribution: On soil. Rare at sea level, common at 400-750 m. Bipolar.

Representative specimens: Antarctica Chilena Province: Navarino Island: I: Puerto Williams, Róbalo valley, 30 m, *Burgaz*, MACB 92064. II: Dientes de Navarino, 400-600 m, *Popi*, MACB 92062. Róbalo peak, 500 m, *Vilches*, MACB 92059. Ibidem, 750 m, *Raggio*, MACB 92060. III: Popi forest, 400 m, *Vilches*, MACB 92075. Róbalo lake, 420 m, *Vilches*, MACB 92063. IV: Róbalo peak, 500 m, *Vilches*, MACB 92140.

* ***Cladonia borealis*** S.Stenroos

Chemistry: Thallus Pd–, K–, C–. Barbatic, 4-O-demethylbarbatic and usnic acids.

Habitat and distribution: On humous soil. Common. Bipolar distribution.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Puerto Navarino, 20 m, *Vilches*, MACB 92197. Caleta Wulaia, 10 m, *Vilches*, MACB 92054. Caleta Honda, 20 m, *Vilches*, MACB 92196. Popi forest, *Vilches*, MACB 92193. Laguna del Salto, Róbalo valley, 500 m, *Raggio*, MACB 92195. Róbalo peak, 500 m, *Vilches*, MACB 92053. La Bandera peak, 590 m, *Burgaz*, MACB 92052. Róbalo peak, 750 m, *Raggio*, MACB 92194. Dientes de Navarino, 900 m, *Vilches*, MACB 92018. ÚLTIMA ESPERANZA PROVINCE: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92019. Ibidem, río Serrano, *Burgaz*, MACB 92020.

Cladonia carneola (Fr.) Fr.

Chemistry: Thallus Pd–, K–, C–. Barbatic, 4-O-demethylbarbatic, usnic, isousnic acids and zeorin.

Habitat and distribution: On rotting wood. Common. Bipolar.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Puerto Williams, Róbalo valley, *Burgaz*, MACB 92055. Ibidem, Ukika valley, 40-80 m, *Burgaz*, MACB 91933. Caleta Wulaia to Puerto Inútil, *Vilches*, MACB 91934. Way to Lum, 400 m, *Vilches*, MACB 91938. Róbalo lake, 420 m, *Vilches*, MACB 92056. Róbalo peak, 500 m, *Vilches*, MACB 91021. Ibidem, 750 m, *Raggio*, MACB 92057. ÚLTIMA ESPERANZA PROVINCE: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92022. Ibidem, Río Serrano, *Burgaz*, MACB 91935.

* ***Cladonia cenotea*** (Ach.) Schaer.

Chemistry: Thallus Pd– or Pd+ yellow, K– or K+ yellow, C–. Two chemotypes in the area: I: Squamatic and consquamatic acids. II: Thamnolic acid.

Habitat and distribution: On rotting wood. Scattered. Bipolar distribution.

Representative specimens: I: ANTARCTICA CHILENA PROVINCE: Navarino Island: Caleta Mejillones, 30 m, *Burgaz*, MACB 91942. Caleta Wulaia to Puerto Inútil, *Vilches*, MACB 91941. Way to Lum, 400 m, *Vilches*, MACB 91940. II: Puerto Williams, Ukika valley, 40-80 m, *Burgaz*, MACB 91943.

* ***Cladonia cervicornis*** subsp. ***mawsonii*** (C.W.Dodge) S.Stenroos & Ahti

Chemistry: Thallus Pd+ red, K– or K+ brownish, C–. Fumarprotocetraric acid complex.

Habitat and distribution: On soil. Common in open areas between *Nothofagus antarctica* shrubs. Subantarctic and Antarctic endemic.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Puerto Williams, Ukika valley, 40-80 m, *Burgaz*, MACB 91953. Caleta Mejillones, 20 m, *Vilches*, MACB 92200. Popi forest, *Vilches*, MACB 92201. Dientes de Navarino, 900 m, *Vilches*, MACB 91951. Ibidem, 850 m, *Etayo*, MACB 92199. Way to Lum, 400 m, 26-I-2005, *Vilches*, MACB 91952. ÚLTIMA ESPERANZA PROVINCE: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92198.

Cladonia chlorophaea (Flörke ex Sommerf.) Spreng.

Chemistry: Thallus Pd+ red, K–, K+ brownish or K+ yellowish, C–. Atranorin (rare), fumarprotocetraric acid complex and quaesitic acid (rare).

Habitat and distribution: On humous soil. Common. Cosmopolitan.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Puerto Williams, Róbalo valley, 30 m, *Burgaz*, MACB 92002. Ibidem, Ukika valley, 40-80 m, *Burgaz*, MACB 92001. Caleta Mejillones, 30 m, *Burgaz*, MACB 92007. Caleta Honda, 20 m, *Vilches*, MACB 92004. Caleta Pantalón, *Gómez-Bolea*, BCC. Caleta Wulaia, 10 m, *Vilches*, MACB 92008. Róbalo peak, 500 m, *Vilches*, MACB 92003. La Bandera peak, 590 m, *Burgaz*, MACB 92000. Ibidem, 1000 m, *Vilches*, MACB 92012. Última Esperanza Province: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92009. Ibidem, Laguna Amarga, *Burgaz*, MACB 92010. Ibidem, río Serrano, *Burgaz*, MACB 92011.

Cladonia cornuta (L.) Hoffm.

Chemistry: Thallus Pd+ red, K− or K+ yellow or K+ brownish, C−. Atranorin (rare), fumarprotocetraric acid complex.

Habitat and distribution: On humous soil. Common in open areas. Subcosmopolitan.

Representative specimens: Antarctica Chilena Province: Navarino Island: Puerto Willimas, Ukika valley, 40-80 m, Burgaz, MACB 92204. Caleta Wulaia, 10 m, *Vilches*, MACB 92013. Caleta Mejillones, 30 m, *Burgaz*, MACB 92076. Caleta Honda, *Vilches*, MACB 92202. Way to Lum, 400 m, *Vilches*, MACB 92058. Última Esperanza Province: *Puerto Natales*, Hacienda Perales, *Burgaz*, MACB 92203. Ibidem, río Serrano, *Burgaz*, MACB 92077.

** ***Cladonia cryptochlorophaea*** Asahina

Chemistry: Thallus Pd− or Pd+ red, K− or K+ brownish, C−. Fumarprotocetraric acid complex and cryptochlorophaeic acid.

Habitat and distribution: On humous soil. Rare. Cosmopolitan. New to the Chilean Flora.

Representative specimens: Antarctica Chilena Province: Navarino Island: Róbalo peak, 500 m, *Vilches*, MACB 91987. Rocky outcrops away La Bandera peak, 1000 m, *Vilches*, MACB 91988.

* ***Cladonia farinacea*** (Vain.) A.Evans

Chemistry: Thallus Pd+ red, K−, K+ yellow or K+ brownish, C−. Atranorin (inconstant) and fumarprotocetraric acid complex.

Habitat and distribution: On humous soil. Scattered at lower altitudes. Southern South America, eastern North America, East and Central Asia.

Representative specimens: Antarctica Chilena Province: Navarino Island: Puerto Williams, Ukika valley, 40-80 m, *Burgaz*, MACB 92078. Caleta Wulaia, 10 m, *Vilches*, MACB 92141. Caleta Mejillones, 30 m, *Burgaz*, MACB 92142.

Cladonia fimbriata (L.) Fr.

Chemistry: Thallus Pd+ red, K−, K+ yellow or K+ brownish, C−. Atranorin (inconstant), fumarprotocetraric acid complex and quaesitic acid (rare).

Habitat and distribution: On humous soil. Common. Cosmopolitan.

Representative specimens: Antarctica Chilena Province: Navarino Island: Ukika village, Puerto Williams, 10 m, *Burgaz*, MACB 91959. Ibidem, Ukika valley, 40-80 m, *Burgaz*, MACB 91958. Caleta Honda, 20 m, *Vilches*, MACB 91957. Caleta Wulaia, 30 m, *Vilches*, MACB 91989. Popi forest, *Vilches*, MACB 92144. Wiew point in the way to La Bandera peak, 295 m, *Burgaz*, MACB 91991. Way to Lum, 300 m, *Vilches*, MACB 91990. Róbalo lake, 420 m, *Vilches*, MACB 91960. Dientes de Navarino, 400-600 m, *Popi*, MACB 92143. Róbalo peak, 750 m, *Raggio*, MACB 92145. Última Esperanza Province: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92206.

* ***Cladonia furcata*** (Huds.) Schrad.

Chemistry: Thallus Pd+ red, K–, K+ yellow or K+ brownish, C–. Fumarprotocetraric acid complex.

Habitat and distribution: On humous soil. Rare. Cosmopolitan.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Róbalo peak, 500 m, *Vilches*, MACB 91986.

Cladonia gracilis (L.) Willd. subsp. ***gracilis***

Chemistry: Thallus Pd+ red, K–, K+ yellow or K+ brownish, C–. Atranorin (rare), fumarprotocetraric acid complex and quaesitic acid.

Habitat and distribution: On soil and peat bogs. Common. Bipolar distribution.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Puerto Williams, Ukika valley, 40-80 m, on soil, *Burgaz*, MACB 91963. Canal Murray, 30 m, *Izaguirre & Suberbiola*, MACB 91962. Way to Lum, 400 m, on peat bogs, *Vilches*, MACB 91964. Róbalo lake, 420 m, *Vilches*, MACB 92205. Dientes de Navarino, 400-600 m, *Popi*, MACB 92146. *Holguer Islands*: on sea shore rocks, *Izaguirre & Suberbiola*, MACB 91961.

Cladonia gracilis subsp. ***elongata*** (Wulfen) Vain.

Chemistry: Thallus Pd+ red, K–, K+ yellow or K+ brownish, C–. Atranorin (rare), fumarprotocetraric acid complex and quaesitic acid.

Habitat and distribution: On humous soil. Common at higher altitudes. Subcosmopolitan.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: La Bandera peak, 590 m, *Burgaz*, MACB 92149. Way to Lum, 400 m, on peat bogs, *Vilches*, MACB 92150. Dientes de Navarino, 400-600 m, *Popi*, MACB 92147. Róbalo lake, 420 m, *Vilches*, MACB 92148. ÚLTIMA ESPERANZA PROVINCE: Puerto Natales, Hacienda Perales, Última Esperanza, 50 m, *Burgaz*, MACB 92151. Ibidem, Serrano river, *Burgaz*, MACB 92152.

* ***Cladonia humilis*** (With.) J.R.Laundon

Chemistry: Thallus Pd+ red, K– or K+ brownish, C–. Only the chemotype with fumarprotocetraric acid complex and bourgeanic acid was found.

Habitat and distribution: On soil and open areas. Rare. Cosmopolitan.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Puerto Navarino, 20 m, *Vilches*, MACB 92024. ÚLTIMA ESPERANZA PROVINCE: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92023.

Cladonia laevigata (Vain.) Gyeln.

Chemistry: Thallus Pd+ red, K– or K+ brownish, C–. Fumarprotocetraric acid complex and usnic (rarely absent) acid (Stenroos et al. 1992).

Habitat and distribution: A rare Subantarctic endemic reported by Stenroos at al. (1992), growing in peat bogs at middle altitudes in Navarino Island. Not found.

Cladonia lepidophora Ahti & Kashiw.

Chemistry: Thallus Pd+ red, K–, K+ yellow or K+ brownish, C–. A chemically variable species with three chemotypes in the area. I: Squamatic, consquamatic and usnic acids, it is the most common chemotype. II: Fumarprotocetraric acid complex, usnic and quaesitic acids. III: Fumarprotocetraric acid complex and quaesitic acid.

Habitat and distribution: On soil. Common. Austral.

Representative specimens: ANTARCTICA CHILENA PROVINCE: I: Navarino Island: Caleta Pantalón, *Gómez-Bolea*, BBC. Puerto Navarino, 20 m, *Vilches*, MACB 92046. Caleta Honda, 20 m, *Vilches*, MACB 91945. Popi forest, Guanaco valley, 400 m, *Vilches*, MACB 91946 TLC 31. *Holguer Islands*: on sea shore rocks, *Izaguirre & Suberbiola*, MACB 92025. II: Navarino Island: Caleta Honda, 20 m, *Vilches*, MACB 92050. Laguna del Salto, Róbalo valley, 500 m, *Raggio*, MACB 92026. III: Navarino Island: Caleta Honda, 20 m, *Vilches*, MACB 92047.

Cladonia luteoalba Wheld. & A.Wilson

Chemistry: Thallus Pd+ red, K– or K+ brownish, C–. Fumarprotocetraric acid complex, usnic and quaesitic acids.

Habitat and distribution: On rotting wood. Rare. Subcosmopolitan.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Dientes de Navarino, 400-600 m, 19-I-2005, *Popi*, MACB 92051.

* ***Cladonia macilenta*** Hoffm.

Chemistry: Thallus Pd– or Pd+ yellow, K– or K+ yellow, C–. There are two chemotypes in the area. I: Barbatic, 4-O-demethylbarbatic acids. II: Thamnolic and barbatic acids.

Habitat and distribution: On rotting wood. Scattered. Cosmopolitan.

Representative specimens: I: ANTARCTICA CHILENA PROVINCE: Navarino Island: Puerto Williams, Ukika valley, 40-80 m, *Burgaz*, MACB 91973. Popi forest, 400 m, *Vilches*, MACB 92048. ÚLTIMA ESPERANZA PROVINCE: Puerto Natales, Serrano river, *Burgaz*, MACB 92049. II: ANTARCTICA CHILENA PROVINCE: Navarino Island: Caleta Wulaia, 10 m, *Vilches*, MACB 91944. Wiew point in the way to La Bandera peak, 295 m, *Burgaz*, MACB 92079.

* ***Cladonia macrophyllodes*** Nyl.

Chemistry: Thallus Pd+ red, K+ yellow, C–. Atranorin, fumarprotocetraric acid complex and quaesitic acid.

Habitat and distribution: On rocky outcrops. Rare. Bipolar.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Dientes de Navarino, 400-600 m, *Popi*, MACB 92014.

Cladonia mitis Sandst.

Chemistry: Thallus Pd–, K–, C–. Rangiformic, norrangiformic, usnic and isousnic acids.

Habitat and distribution: On peat bogs and soil. Common. Bipolar.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Puerto Williams, Róbalo valley, 30 m, *Burgaz*, MACB 91912. Puerto Navarino, 20 m, *Vilches*, MACB 91914. Way to Lum, 400 m, *Vilches*, MACB 91915. Bosque Popi, 400 m, *Vilches*, MACB 92074. Róbalo lake, 420 m, *Vilches*, MACB 92073. Róbalo peak, 500 m, *Vilches*, MACB 91911. Dientes de Navarino, 400-600 m, *Popi*, MACB 92072. *Holguer Islands*: on sea shore rocks, *Izaguirre & Suberbiola*, MACB 91913.

* ***Cladonia novochlorophaea*** (Sipman) Brodo & Ahti

Chemistry: Thallus Pd– or Pd+ red, K– or K+ brownish, C–. Fumarprotocetraric acid complex, sekikaic and homosekikaic acids.

Habitat and distribution: On peat bogs. Rare. Bipolar.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Way to Lum, 400 m, *Vilches*, MACB 92015.

Cladonia ochrochlora Flörke

Chemistry: Thallus Pd+ red, K–, K+ yellow or K+ brownish, C–. Atranorin (rare), fumarprotocetraric acid complex and quaesitic acid (rare).

Habitat and distribution: On rotting wood. Common. Cosmopolitan.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Puerto Williams, Ukika village, 10 m, *Burgaz*, MACB 91993. Ibidem, Ukika valley, 40-80 m, *Burgaz*, MACB 91994. Caleta Wulaia, 10 m, *Burgaz*, MACB 91999. Wiew point in the way to La Bandera peak, 295 m, *Burgaz*, MACB 91992. Way to Lum, 300 m, *Vilches*, MACB 91998. Róbalo lake, 420 m, *Vilches*, MACB 91997. Róbalo peak, 500 m, *Vilches*, MACB 91996. ÚLTIMA ESPERANZA PROVINCE: Puerto Natales, Serrano river, *Burgaz*, MACB 92207.

* ***Cladonia phyllophora*** Hoffm.

Chemistry: Thallus Pd+ red, K–, K+ yellow or K+ brownish, C–. Atranorin (rare), fumarprotocetraric acid complex and quaesitic acid.

Habitat and distribution: On soil. Rare. Bipolar.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Róbalo peak, 500 m, *Vilches*, MACB 92042. ÚLTIMA ESPERANZA PROVINCE: Puerto Natales, Hacienda Perales, Última Esperanza, 50 m, *Burgaz*, MACB 91972.

* ***Cladonia pleurota*** (Flörke) Schaer.

Chemistry: Thallus Pd–, K–, C–. Usnic, isousnic acids and zeorin.

Habitat and distribution: On humous soil. Rare at sea level but scattered at middle altitude. Bipolar.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Caleta Wulaia, 10 m, *Vilches*, MACB 91948. Way to Lum, 400 m, *Vilches*, MACB 92044. Popi forest, Guanaco valley, 400 m, *Vilches*, MACB 92045. Róbalo lake, 420 m, *Vilches*, MACB 92219. Róbalo peak, 500 m, *Vilches*, MACB 92043. Mladineo Pass, 650 m, *Vilches*, MACB 91947.

* ***Cladonia pocillum*** (Ach.) Grognot

Chemistry: Thallus Pd+ red, K– or K+ brownish, C–. Fumarprotocetraric acid complex and quaesitic acid (rare).

Habitat and distribution: On soil and dry peat bogs. Rare. Cosmopolitan.

Representative specimens: ANTARCTICA CHILENA PROVINCE: Navarino Island: Caleta Mejillones, 30 m, *Burgaz*, MACB 92208. Way to Lum, 400 m, *Vilches*, MACB 91965. Róbalo peak, 500 m, *Vilches*, MACB 92208. Ibidem, 750 m, *Raggio*, MACB 91966.

* ***Cladonia pyxidata*** (L.) Hoffm.

Chemistry: Thallus Pd+ red, K– or K+ brownish, C–. Fumarprotocetraric acid complex.

Habitat and distribution: On soil. Scattered. Cosmopolitan.

Representative specimens: Antarctica Chilena Province: Navarino Island: Caleta Wulaia to Puerto Inútil, *Vilches*, MACB 91970. Caleta Mejillones, 20 m, *Vilches*, MACB 92210. Puerto Williams, Ukika valley, 40-80 m, *Burgaz*, MACB 91969. Popi forest, *Vilches*, MACB 92211. Wiew point in the way to La Bandera peak, 295 m, *Burgaz*, MACB 91968. Rocky outcrops close to La Bandera peak, 1000 m, *Vilches*, MACB 91971. Última Esperanza Province: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92027.

Cladonia rangiferina (L.) F.H.Wigg.

Chemistry: Thallus Pd+ red, K+ yellow, C–. Atranorin, fumarprotocetraric acid complex.

Habitat and distribution: In peat bogs and tundra scrubs. Common. Cosmopolitan.

Representative specimens: Antarctica Chilena Province: Navarino Island: Caleta Mejillones, 20 m, *Vilches*, MACB 91920. Caleta Honda, 20 m, *Vilches*, MACB 92155. Popi forest, *Vilches*, MACB 92156. Róbalo lake, 420 m, *Vilches*, MACB 92154. Róbalo peak, 500 m, *Vilches*, MACB 91917. Ibidem, 750 m, *Raggio*, MACB 91921. Blue Lake, 575 m, *Vilches*, MACB 91918. La Bandera peak, 590 m, *Burgaz*, MACB 92153. Dientes de Navarino, 400-600 m, *Popi*, MACB 92083. Mladineo Pass, 650 m, *Vilches*, MACB 92084. Way to Lum, peat bogs, 400 m, *Vilches*, MACB 92085. Holguer Islands: on sea shore rocks, *Izaguirre & Suberbiola*, MACB 91919. Última Esperanza Province: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 91922.

Cladonia rigida (J.D. Hooker & Taylor) Hampe

Chemistry: Thallus Pd+ yellow, K+ yellow, C–. Thamnolic acid (Stenroos at al. 1992).

Habitat and distribution: An austral species, common in Australasia, very rare in South America, reported by Stenroos at al. (1992), growing on rotting wood at lower altitudes in Navarino Island. Not found.

Cladonia sarmentosa (Hook.f. & Taylor) C.W.Dodge

Chemistry: Thallus Pd+ red, K+ yellow or K+ brownish, C–. Atranorin, fumarprotocetraric acid complex and quaesitic acid.

Habitat and distribution: On humous soil. Rare. Austral element.

Representative specimens: Antarctica Chilena Province: Navarino Island: Mladineo Pass, 650 m, *Vilches*, MACB 92041.

* ***Cladonia scabriuscula*** (Delise) Nyl.

Chemistry: Thallus Pd+ red, K–, K+ yellow or K+ brownish, C–. Atranorin (rare) and fumarprotocetraric acid complex.

Habitat and distribution: On soil. Scattered. Cosmopolitan.

Representative specimens: Antarctica Chilena Province: Navarino Island: Caleta Honda, 20 m, *Vilches*, MACB 91976. Puerto Williams, Ukika valley, 40-80 m, *Burgaz*, MACB 91975. Popi forest, 400 m, *Vilches*, MACB 91977. Way to Lum, 400 m, *Vilches*, MACB 92212. Róbalo peak, 500 m, *Vilches*, MACB 92157. La Bandera peak, 590 m, *Burgaz*, MACB 91974.

Cladonia squamosa (Scop.) Hoffm.

Chemistry: Pd– or Pd+ yellow, K– or K+ yellow. There are two chemotypes. I: Squamatic acid. II: Thamnolic acid. The second chemotype was considered as var. *subsquamosa* but there are not morphological variations to distinguish it. This chemotype is the commonest in the Island.

Habitat and distribution: Humous soil. Scattered. Subcosmopolitan.

Representative specimens: Antarctica Chilena Province: I: Navarino Island: Caleta Honda, 20 m, *Vilches*, MACB 91924. Way to Lum, peat bogs, 400 m, *Vilches*, MACB 91925. Holguer Islands: on sea shore rocks, *Izaguirre & Suberbiola*, MACB 91923. II: Navarino Island: Caleta Wulaia, 10 m, *Vilches*, MACB 91932. Róbalo lake, 420 m, *Vilches*, MACB 91928. Róbalo peak, 500 m, *Vilches*, MACB 91926. Dientes de Navarino, 400-600 m, *Popi*, MACB 92039. Mladineo Pass, 650 m, *Vilches*, MACB 91930.

* ***Cladonia subchordalis*** A.Evans

Chemistry: Thallus Pd–, K–, C–. Usnic and isousnic acids.

Habitat and distribution: On soil. Rare. South American endemic.

Representative specimens: Última Esperanza Province: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92028. Ibidem, río Serrano, *Burgaz*, MACB 92040.

Cladonia subsubulata Nyl.

Chemistry: Thallus Pd+ yellow, K+ yellow, C–. Thamnolic acid.

Habitat and distribution: On humous soil. Rare. Austral.

Our samples have brownish white podetia and the lower parts are not blue-blackened.

Representative specimens: Antarctica Chilena Province: Navarino Island: Caleta Mejillones, 30 m, *Burgaz*, MACB 92138.

* ***Cladonia subulata*** (L.) F.H.Wigg.

Chemistry: Thallus Pd+ red, K– or K+ brownish, C–. Fumarprotocetraric acid complex and quaesitic acid.

Habitat and distribution: On soil. Scattered. Cosmopolitan.

Representative specimens: Antarctica Chilena Province: Navarino Island: Puerto Williams, Ukika village, 10 m, *Burgaz*, MACB 92218. Ibidem, Ukika valley, 40-80 m, *Burgaz*, MACB 92215. Caleta Wulaia, 10 m, *Vilches*, MACB 92081. Caleta Wulaia to Puerto Inútil, *Vilches*, MACB 92158. Caleta Honda, 20 m, *Vilches*, MACB 92217. Way to Lum, 300 m, *Vilches*, Róbalo lake, 420 m, *Vilches*, MACB 92080.

Cladonia sulphurina (Michx.) Fr.

Chemistry: Thallus Pd–, K–, C–. Squamatic, consquamatic and usnic acids.

Habitat and distribution: On rotting wood. Scattered. Bipolar.

Representative specimens: Antarctica Chilena Province: Navarino Island: Calta Wulaia to Puerto Inútil, *Vilches*, MACB 92213. Puerto Williams, Ukika valley, 40-80 m, *Burgaz*, MACB 92038. Way to Lum, 400 m, *Vilches*, Róbalo lake, 420 m, *Vilches*, MACB 91949. Róbalo peak, 500 m, *Vilches*, MACB 92036. Dientes de Navarino, 400-600 m, *Popi*, MACB 92037. La Bandera peak, 590 m, *Burgaz*, MACB 92034. Mladineo Pass, 650 m, *Vilches*, MACB 92035.

Cladonia symphycarpa (Flörke) Fr.

Chemistry: Thallus Pd+ yellow, K+ yellow, C–. Atranorin, psoromic and conpsoromic acids.

Habitat and distribution: On soil. Rare. Northern Hemisphere and southern South America.

Representative specimens: Última Esperanza Province: Puerto Natales, Hacienda Perales, 50 m, *Burgaz*, MACB 92016. Laguna Amarga, *Burgaz*, MACB 92017.

Cladonia ustulata (Hook.f. & Taylor) Leight.

Chemistry: Thallus Pd– or Pd+ yellow, K– or K+ yellow, C–. There are three major chemotypes. I: Thamnolic, ± usnic acids. II: Squamatic, ± barbatic acids. III: Thamnolic, ± barbatic and squamatic acids, a new chemotype.

Habitat and distribution: On rotting wood. Common. Austral.

Representative specimens: Antarctica Chilena Province: I: Navarino Island: Caleta Honda, 20 m, *Vilches*, MACB 91905. Puerto Williams, Ukika valley, 40-80 m, *Burgaz*, MACB 91901. Caleta Wulaia to Puerto Inútil, *Vilches*, MACB 92082. Wiew point in the way to La Bandera peak, 295 m, *Burgaz*, MACB 92029. Way to Lum, 300 m, *Vilches*, MACB 91902. Ibidem, 400 m, *Vilches*, MACB 91900. Popi forest, 400 m, *Vilches*, MACB 91906. Róbalo lake, 420 m, *Vilches*, MACB 92031. Róbalo peak, 500 m, *Vilches*, MACB 92030. II: Navarino Island: Puerto Williams, Ukika village, 10 m, *Burgaz*, MACB 91909. Ibidem, Ukika valley, 40-80 m, *Burgaz*, MACB 91907. Caleta Wulaia, 10 m, Vilches, MACB 91899. Caleta Wulaia to Puerto Inútil, *Vilches*, MACB 91898. Popi forest, 400 m, *Vilches*, MACB 91903. Dientes de Navarino, 400-600 m, *Popi*, MACB 91904. Última Esperanza Province: Puerto Natales, Río Serrano, *Burgaz*, MACB 91908. Antarctica Chilena Province: III: Navarino Island: Popi forest, *Vilches*, MACB 92033.

Discussion

The *Cladoniaceae* are widely distributed in the studied territory. Nevertheless, affinities of the taxa to different habitats are found. A small number of species are restricted to sea level (alt. 10-80 m): *Cladonia farinacea, C. humilis, C. subsubulata* and *C. symphycarpa*. Many only grow above timberline (alt. over 600 m): *Cladonia acuminata, C. arbuscula, C. cryptochlorophaea, C. furcata, C. luteoalba, C. macrophyllodes, C. novochlorophaea,* and *C. sarmentosa*. Most of the species grow in various forest habitats (alt. 10-600 m): *Cladia aggregata, Cladonia bacilliformis, C. cenotea, C. cornuta, C. gracilis, C. lepidophora, C. macilenta, C. mitis, C. ochrochlora, C. phyllophora, C. pleurota, C. rangiferina, C. scabriuscula, C. squamosa, C. subulata, C. sulphurina* and *C. ustulata*. Species with the widest altitudinal range, from sea level to 700-900 m altitude, are: *Cladonia asahinae, C. bellidiflora, C. borealis, C. carneola, C. cervicornis* subsp. *mawsonii, C. chlorophaea, C. fimbriata, C. pocillum* and *C. pyxidata*.

A phytogeographic study of the taxa indicates that widespread species dominate. Most are cosmopolitan or subcosmopolitan (17 taxa, 41%) and bipolar (15 taxa, 37%) while the austral element only comprise a 22% (9 taxa); among the latter group it is important to indicate the existence of two subantarctic endemic taxa and one southern South American endemic taxa.

Altogether 36% (15 taxa) of the species are common and abundant. These are *Cladonia asahinae, C. bellidiflora, C. borealis, C. carneola, C. cenotea, C. cervicornis* subsp. *mawsonii, C. chlorophaea, C. cornuta, C. fimbriata, C. gracilis, C. gracilis* subsp. *elongata, C. lepidophora, C. mitis, C. ochrochlora, C. rangiferina* and *C. ustulata*. 40% (17 taxa) are considered rare, viz. *Cladonia acuminata, C. arbuscula, C. bacilliformis, C. cryptochlorophaea, C. furcata, C. humilis, C. laevigata, C. luteoalba, C. macrophyllodes, C. novochlorophaea, C. phyllophora, C. pocillum, C. rigida, C. sarmentosa, C. subchordalis, C. subsubulata* and *C. symphycarpa*. The remaining 24% (10 taxa) are species with a scattered occurrence, such as: *Cladia aggregata, Cladonia cenotea, C. farinacea, C. macilenta, C. pleurota, C. pyxidata, C. scabriuscula, C. squamosa, C. subulata* and *C. sulphurina*.

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Cercospora habenariicola sp. nov. and some new records of cercosporoid fungi from Thailand

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Abstract — Several cercosporoid hyphomycetes were found during field examinations in northern Thailand, including the new species *Cercospora habenariicola* as well as *Passalora atrides*, *P. centrosematis* and *Pseudocercospora cupheae*, which are new to Thailand.

Key words — leaf spots, plant pathogenic fungi, taxonomy.

Introduction

Since the introduction of *Cercospora* by Fresenius (1863), the number of species assigned to this genus increased to more than 5,500 (Crous & Braun 2003). Most of the species are known to be plant pathogens causing leaf spots or leaf blight. The genus was divided into several segregate genera based on criteria mainly introduced by Deighton (1967, 1971, 1973, 1974, 1976, 1979, 1983, 1987), including the structure of conidiomata, conidiophores, conidiogenous cells and conidia. Recently Crous & Braun (2003) altered the concept and circumscription of cercosporoid genera, based on molecular sequence analyses and a reassessment of morphological characters. However, little is known about the species of *Cercospora* and allied genera in Thailand. Sontirat et al. (1980) enumerated 22 species, while Petcharat & Kanjanamaneesathian (1989) reported 48 species of *Cercospora* from southern Thailand, based on the previous criteria of *Cercospora* sensu lato. The present work was initiated to reveal the diversity of *Cercospora* and allied genera in Thailand, and to re-describe the previously known species according to the current taxonomic concepts of cercosporoid hyphomycetes.

In November 2004, September 2005 and November 2005, the Queen Sirikit Botanic Garden (QSBG) in the Chiang Mai Province of northern Thailand was scrutinized with regard to cercosporoid fungi. Four cercosporoid hyphomycetes were found, including one new species and three species new to Thailand.

Materials and methods

Specimens were collected after observing symptoms of cercosporoid fungi on leaves using a 10× magnifying glass. 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 400×. Dried herbarium specimens were deposited at CMU Herbarium, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand.

Results

A new species of *Cercospora*

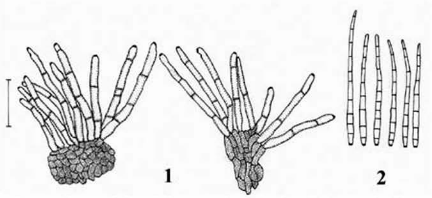
Cercospora habenariicola Meeboon, Hidayat & C. Nakash. **sp. nov.**

MycoBank #: MB 510367 — Figs. 1-2

Maculae amphigenae, circulares vel subcirculares, 15-30 mm diam., primo pallide viridulae, ochraceae, deinde brunneae vel atro-brunneae, ultimo centro griseo-brunneo, margine fusco vel brunneo cinctae. Coloniae amphigenae, ochraceae, velutinae. Stromata substomatalia vel intraepidermalia, subglobosa, 25-75 μm diam., brunnea vel atro-brunnea. Conidiophora laxe vel dense fasciculata, numerosa, simplicia, raro ramosa, recta, subcylindrica, geniculata vel sinuosa, erecta vel decumbentia, 50-285 × 7.3-7.5 μm, interdum ad 952 μm longa, laevia, pallide olivacea vel pallide brunnea, 2-9-septata. Cellulae conidiogenae integratae, terminales, sympodiales. Loci conidiogeni conspicui, incrassati, fuscati, 2.4-3.6 μm diam. Conidia solitaria, obclavata vel subaciculares, recta, 75-110 × 4.9-5 μm, hyalina, 6-10-septata, laevia, apice subacuto, basi obconice truncata, hila incrassata et fuscata, 1.2-2.9 μm diam.

Etymology — *habenariicola*, from the genus name of the host plant.

Leaf spots amphigenous, circular or subcircular, 15-30 mm diam., at first pale greenish to ochraceous, later brown to dark brown, finally with grayish brown centre, surrounded by a dark margin or brown halo. Colonies amphigenous, ochre yellow, velvety. *Stromata* intraepidermal, well-developed, subglobose, brown to blackish brown, 25-75 μm diam. *Conidiophores* loosely to densely fasciculate, numerous, arising from stromata, simple, straight, rarely branched, subcylindrical, geniculate to sinuous, erect to decumbent, 50-285 × 7.3-7.5 μm, occasionally up to 952 μm long, smooth, pale yellow to pale brown, 2-9-septate. *Conidiogenous cell* integrated, terminal, sympodially proliferating.



Figs. 1-2. *Cercospora habenariicola* sp. nov. 1. Stromata and conidiophores. 2. Conidia. (Scale bar = 40 µm).

Conidiogenous loci conspicuous, thickened, darkened, 2.4-3.6 µm diam. *Conidia* solitary, narrowly obclavate to subacicular, straight, 75-110 × 4.9-5 µm, hyaline, 6-10-septate, smooth, apex subacute, base obconically truncate, hilum thickened and darkened, 1.2-2.9 µm diam.

Specimen examined — On leaves of *Habenaria susannae* (L.) R. Br. (*Orchidaceae*), Queen Sirikit Botanic Garden, Chiang Mai Province, Thailand, 14 July 2006, Jamjan Meeboon (JM 155) (CMU 27883: Holotype).

Comments — Because of pigmented conidiophores, thickened and darkened conidiogenous loci, hyaline scolecoid conidia, the new species on *Habenaria susannae* belongs in *Cercospora* s. str. (Crous & Braun 2003). It is easily distinguishable from the plurivorous *C. apii* s. lat. by having well-developed stromata and obclavate conidia with obconically truncate bases (Crous & Braun 2003).

On orchids numerous species of *Cercospora* s. lat. are known, including *C. cypripedii* Ellis & Dearn., *C. dendrobii* H.C. Burnett, *C. odontoglossi* Prill. & Delacr. and *C. peristeriae* H.C. Burnett, which have been excluded and reallocated to the genus *Pseudocercospora* Speg. (Crous & Braun 2003). *Cercospora angraeci* Feuilleaub. & Roum., described from orchids, is an insufficiently known species of unclear generic affinity (Crous & Braun 2003), but based on the original description *C. habenariicola* differs from *C. angraeci* in having much longer, occasionally branched conidiophores (Chupp, 1954). *Cercospora cephalantherae* Ondřej & Zavřel, a genuine species of *Cercospora* s. str., is characterized by having very short, narrow conidiophores (10-25 × 3.5 µm) and relatively short, narrow conidia [40-80(100) × 2-3(3.5) µm] (Ondřej & Zavřel 1971). *Cercospora habenariicola* is morphologically fairly very close to *C. epipactidis* C. Massal. However, the latter species has consistently unbranched, small conidiophores (10-45 × 4-6 μm), and short, narrow conidia [30-130 × 3.5-5 μm] (Chupp 1954). *Cercospora eulophiae* M.S. Patil is another cercosporoid fungus on an orchid (*Eulophia* sp.), but this species was described having straight to flexuous, smaller condiophores, and pigmented conidia [75-250 × 3.2-4 μm] (Patil 1978).

New *Passalora* and *Pseudocercospora* records from Thailand

Passalora atrides (Syd. & P. Syd.) Y.L. Guo, Fung. Sci. 17: 27, 2002.

= *Cercospora atrides* Syd. & P. Syd., Ann. Mycol. 20: 65, 1922.

= *Cercosporidium atrides* (Syd. & P. Syd.) Goh & W.H. Hsieh, in Hsieh & Goh, *Cercospora* and similar fungi from Taiwan: 115. 1990.

= *Passalora atrides* (Syd. & P. Syd.) Poonam Srivast., J. Living World 1: 112. 1994 (nom. inval.).

Specimen examined — On leaves of *Bridelia ovata* Decne. (*Euphorbiaceae*), Queen Sirikit Botanic Garden, Chiang Mai Province, Thailand, 18 November 2005, Jamjan Meeboon (JM 054) (CMU 27881).

Hosts and distribution — *Bridelia balansae* Tutcher, *B. micrantha* Baill., *B. monoica* Merr., *B. ovata* (*Euphorbiaceae*), China, Sierra Leone, Taiwan (Crous & Braun 2003, Guo & Liu 2003), Thailand.

Comments — *Pseudocercospora aberrans* (Petr.) Deighton (Deighton 1987) is another cercosporoid hyphomycetes recorded on *Bridelia* spp. However, the present specimen was identified as *Passalora atrides*, based on pigmented, ellipsoid-ovoid conidia and conspicuous, thickened, darkened conidiogenous loci.

Passalora centrosematis N. Pons, U. Braun & Crous, in Crous & Braun, *Mycosphaerella* and its anamorphs: 1. Names published in *Cercospora* and *Passalora*: 114. 2003.

= *Cercospora centrosematis* Chupp & A.S. Mull., Bol. Soc. Venez. Ci. Nat. 8: 40. 1942 (nom. inval.).

Specimen examined — On leaves of *Centrosema pubescens* Benth. (*Fabaceae*), Queen Sirikit Botanic Garden, Chiang Mai Province, Thailand, 21 November 2004, Jamjan Meeboon (JM 065) (CMU 27882).

Hosts and distribution — *Centrosema pubescens*, *C. virginianum* (L.) Benth., *Centrosema* sp. (*Fabaceae*), Philippines, Puerto Rico and Venezuela (Crous & Braun 2003), Thailand.

Comments — This is the first record of this species from Thailand.

Pseudocercospora cupheae (Syd.) U. Braun, Schlechtendalia 2: 14. 1999.

= *Cercospora cupheae* Syd., Ann. Mycol. 37: 428. 1939.

Specimen examined — On leaves of *Cuphea hyssopifolia* Kunth, Queen Sirikit Botanic Garden, Chiang Mai Province, Thailand, 21 November 2004, Jamjan Meeboon (JM 074) (CMU 27884).

Hosts and distribution — *Cuphea hyssopifolia*, *C. parsonsia* R. Br. ex Steud., *C. strigulosa* Kunth (*Lythraceae*), Dominican Republic, Ecuador, Mexico (Crous & Braun 2003), Thailand.

Comments — This is the first record of *Cuphea hyssopifolia* as host of *Pseudocercospora cupheae*.

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Taxonomic reassessment of two taxa of helotialean fungi

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Abstract — Species of the genera *Calycina*, *Hymenoscyphus*, *Dicephalospora*, *Lambertella*, *Lanzia*, *Rutstroemia*, *Ciboria*, *Dumontinia*, *Monilinia*, and *Rhizoscyphus* often share a similar ectal excipular structure but differ in many other aspects when morphological features are concerned. A neighbor-joining tree containing the above mentioned genera based on sequence analysis of the ITS regions was established with *Lachnum spartinae* and *L.* cf. *pygmaeum* as outgroup. Three major clades were recognized. One clade contains most species of *Hymenoscyphus* (except for *Hymenoscyphus rhodoleucus*) as well as *Lanzia microserotina*; the second consists of only the *Ericaceae*-associated genus *Rhizoscyphus*; and the third includes the genera currently treated in the *Sclerotiniaceae* and *Rutstroemiaceae*, as well as two species, *Hymenoscyphus rhodoleucus* and *Calycina herbarum*. *Lanzia microserotina* is not closely related to *Lanzia* spp. but to *Hymenoscyphus serotinus*. *Lanzia huangshanica* f. *aurantiaca* is recognized at species level. New combinations in *Hymenoscyphus* and *Lanzia* are proposed based on the morphological and molecular data. Placement of *Calycina herbarum* and of *Hymenoscyphus rhodoleucus* are noted.

Key words — ITS1-5.8S-ITS2, *Hymenoscyphus microserotinus*, *Lanzia aurantiaca*

Introduction

The type of ectal excipular structure has long been used as an important character in taxonomy of different groups of helotialean cup-fungi (Le Gal 1953, Korf 1973, Spooner 1987). "Textura prismatica" and "textura angularis" are regularly found in the *Helotiaceae*, *Hyaloscyphaceae*, *Leotiaceae*, *Rutstroemiaceae*, and *Sclerotiniaceae*. Members of the genera *Calycina* and *Hymenoscyphus* (*Helotiaceae*), *Dicephalospora*, *Lambertella*, *Lanzia* and *Rutstroemia* (*Rutstroemiaceae*), *Ciboria*, *Dumontinia* and *Monilinia* (*Sclerotiniaceae*), and *Lachnum* (*Hyaloscyphaceae*), as well as *Rhizoscyphus*, often share a similar excipular structure. Other morphological features, such as presence or absence

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Table 1. Material used in this study

Species	Source of the Chinese material	GenBank Acc no.
Calycina herbarum (Pers.) Gray	1549, HMAS* 77056 Jiangxi	AY348594
Ciboria betulae (Woronin ex Navashin) W.L. White		Z81427
Ciboria caucus (Rebent.) Fuckel		Z73766
Dicephalospora rufocornea (Berk. & Broome) Spooner	2652, HMAS 75519 Guangdong	**DQ986480****
Hymenoscyphus caudatus (P. Karst.) Dennis	1105, HMAS 82057 Anhui	AY348576
	1354, HMAS 82060 Beijing	AY348577
	1459, HMAS 82063 Jiangxi	AY348578
	1578, HMAS 82073 Jiangxi	AY348579
H. epiphyllus (Pers.) Rehm ex Kauffman	1489, HMAS 82075 Jiangxi	AY348580
	1491, HMAS 82076 Jiangxi	AY348581
H. fructigenus (Bull.) Gray		AJ430396
H. cf. *fructigenus*	2247, HMAS 75877 Sichuan	AY348582
H. fucatus (W. Phillips) Baral & Hengstm.	2178, HMAS 75902 Sichuan	AY348583
H. immutabilis (Fuckel) Dennis	1274, HMAS 71809 Beijing	AY348584
H. lasiopodius (Pat.) Dennis	1221, HMAS 71820 Beijing	AY348585
	1255, HMAS 71821 Beijing	AY348586
	0242, HMAS 75878 Beijing	AY348587
H. cf. *menthae* (W. Phillips) Baral	0015, HMAS 75934 Sichuan	AY348588
Hymenoscyphus rhodoleucus (Fr.) W. Phillips		AJ430395
H. scutula (Pers.) W. Phillips		
	3546, HMAS 82092 Jilin	AY348589
	3548, HMAS 82093 Jilin	AY348590
H. serotinus (Pers.) W. Phillips	1278, HMAS 82098 Beijing	AY348591
H. globus W.Y. Zhuang & Yan H. Zhang	1544, HMAS 82122 Jiangxi	AY348592
Lachnum cf. *pygmaeum* (Fr.) Bres.	1558, HMAS 82107 Jiangxi	AY348593
Lachnum spartinae S.A. Cantrell		AJ430215
Lambertella sp.		AF422970
Lanzia huangshanica W.Y. Zhuang & Korf f. *huangshanica*	3176, Yunnan	AY348595
	3683, HMAS 81363 Hainan	**DQ986483**
	3881, HMAS 81364 Hainan	**DQ986484**
Lanzia huangshanica f. *aurantiaca* W.Y. Zhuang	1878, HMAS 74836 Guangxi	**DQ986485**
	1082, HMAS 61850 Anhui	**DQ986486**
Lanzia microserotina W.Y. Zhuang		
	1142, HMAS 68520 Anhui	**DQ986481**
Rhizoscyphus ericae (D.J. Read)	1147, HMAS 68521 Anhui	**DQ986482**
W.Y. Zhuang & Korf		AF069440
Hymenoscyphus sp. G1		AF069505
Rutstroemia bolaris (Batsch) Rehm		AJ292199
Rutstroemia firma (Pers.) P. Karst.		Z80894
		Z80893

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** Numbers in boldface indicating the newly submitted sequences.

of sclerotia or substratal stromata, gelatinization of apothecial tissues, color and septation of ascospores, and color of hymenial surface, as well as apothecial gross morphology, are also critical in taxonomy of the helotialean fungi at either generic or species level. In order to weigh the excipular structure and a few other morphological features commonly applied in taxonomy from a phylogenetic point of view, ITS regions of the above mentioned genera were used to construct a phylogenetic tree. Judging from both morphological and molecular data, the taxonomic positions of a few previously identified inoperculate cup-fungi are reexamined here.

Materials and methods

For morphological and anatomic studies, dried apothecia were rehydrated and sectioned by a freezing microtome at a thickness of 15–20 µm. Measurements were taken from the sections mounted in cotton blue-lactophenol solution and from squash mounts.

For investigation of the taxonomic and phylogenetic positions of the helotialean fungi, total DNAs of taxa in the genera *Dicephalospora* and *Lanzia* (Table 1) were extracted from dried fungal specimens using the protocols of Doyle (1991). The sequences of ITS1-5.8S-ITS2 regions were obtained by using ITS4 and ITS5 as primer pairs (White et al. 1990) and amplified on a GeneAmp PCR System 2400 (Perkin Elmer) using the following parameters: denaturation at 94°C for 4 min., then with 35 cycles of 50 sec at 94°C, 45 sec at 55°C and 1 min 30 sec at 72°C, and a final extension at 72°C for 7 min. PCR products were purified by using the 3S Spin PCR Product Purification Kit (Shenergy Biocolor for Life Science Co., Ltd.), then sequenced by Shanghai Genecore Biotechnologies Co., Ltd. The sequences were aligned together with those of the related fungi from GenBank (Table 1) by Clustal X (Thompson et al. 1994), positions with gaps were treated as missing data, and a neighbor-joining tree was created with *Lachnum* cf. *pygmaeum* and *L. spartinae* as the outgroup and with bootstrap values from 1000 replicates by PAUP 4.0b10 (Swofford 2002).

Results and discussion

Three major clades were recognized in the neighbor-joining tree (Fig. 1). One clade includes mainly genera in the *Sclerotiniaceae* and *Rutstroemiaceae* as well as *Hymenoscyphus rhodoleucus* and *Calycina herbarum*. The second clade consists of only the *Ericaceae*-symbiotic genus *Rhizoscyphus*. The third clade contains most species of *Hymenoscyphus* investigated and *Lanzia microserotina*. Among the helotialean fungi tested in this study, the type of ectal excipular structure did not provide phylogenetic information at the family level, whereas it might be informative at generic and species ranks.

On hymenium color in taxonomy

Dicephalospora was established and originally treated as a member of the *Sclerotiniaceae* in a broad sense (Spooner 1987) and one of its species, *D. rufocornea*, is very common throughout the world tropics (Dumont 1980, Zhuang 1998a, b, 1999). Morphologically, *Lanzia huangshanica* and *Dicephalospora*

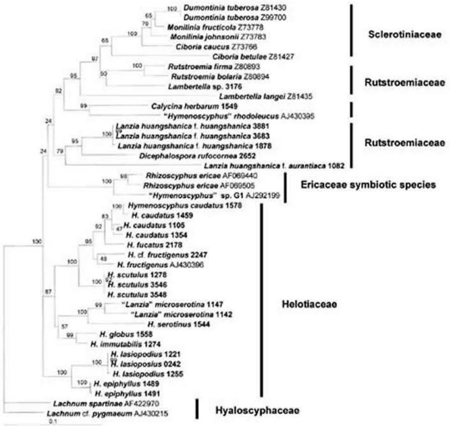
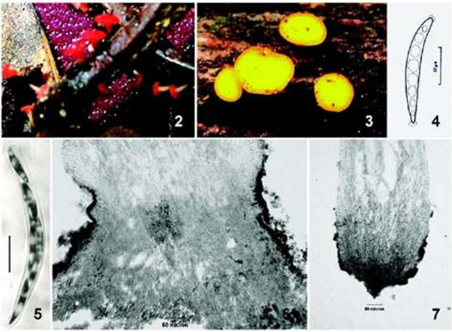


Fig. 1. Neighbor-joining tree showing phylogenetic relationships of some helotialean cup-fungi inferred from the ITS1-5.8S-ITS2 region, with *Lachnum spartinae* and *L.* cf. *pygmaeum* as outgroup with bootstrap values from 1000 replicates.

rufocornea share many similarities in the stromatized apothecial stipe base at attachment to substrates (Figs. 2–3, 6–7), excipular structure, ascus iodine reaction, and the fusoid ascospores. However, *D. rufocornea* is characterized by the much longer ascospores with a gel cap at each end and larger apothecia (Spooner 1987, Zhuang 1995a) (Figs. 4–5).

The petiole-inhabiting fungi *Lanzia huangshanica* forma *aurantiaca* and *L. huangshanica* forma *huangshanica* are very similar in apothecial shape, size and anatomy; ascospore shape, size and guttulation; as well as paraphysis shape and width; the former has an orange-yellow hymenial color in fresh condition and the latter has a dark red color. A very slight difference in spore length (21-26 × 4-4.8 µm *vs.* 18-26 × 4-5 µm) was also detected. Since intermediate apothecial color was never found within collections, two formae of the same species were distinguished (Zhuang 1995a).



Figs. 2-7. Morphology of *Dicephalospora* and *Lanzia* spp.: **2.** Fruitbodies of *Lanzia huangshanica* on nature substrates, HMAS 97515; **3.** Fruitbodies of *Dicephalospora rufocornea*, from Wang and Wu (1997); **4.** An ascospore of *Dicephalospora rufocornea* with a gel cap at both ends, HMAS 61840; **5.** An ascus with ascospores of *Lanzia aurantiaca*, HMAS 61847, bar = 20 µm; **6.** Longitudinal section of *Lanzia huangshanica* showing stromatized (blackened) apothecial stipe base, HMAS 81364; **7.** Longitudinal section of *Dicephalospora rufocornea* showing stromatized (blackened) apothecial stipe base, HMAS 81349.

In the current study, a close relationship has been shown between *D. rufocornea* and the two formae of *L. huangshanica*; they formed a separate cluster with 79% bootstrap support (Fig. 1). *Lanzia huangshanica* f. *huangshanica* is more closely related to *D. rufocornea* (with 95% bootstrap value) than to *L. huangshanica* f. *aurantiaca*; and *L. huangshanica* f. *aurantiaca* joins them with 79% bootstrap support (Fig. 1). *Lanzia huangshanica* f. *huangshanica* possesses a dark red hymenium; *D. rufocornea* has an orange red, orange-yellow to dirty yellow one; and *L. huangshanica* f. *aurantiaca* appears purely orange-yellow. Our results suggest that hymenial color, a phenotypic character, carries phylogenetic information. *Lanzia huangshanica* f. *aurantiaca* should stand at species rank instead of as a forma of *L. huangshanica*. A new combination is thus proposed.

Lanzia aurantiaca (W.Y. Zhuang) W.Y. Zhuang, **stat. & comb. nov.**

MycoBank # MB510590

= *Lanzia huangshanica* f. aurantiaca W.Y. Zhuang, Mycosystema 7: 14 [1994], 1995.

As mentioned above, hymenial color may carry phylogenetic information in the same genus. Another fungus, *Lanzia phaeoparaphysis* W.Y. Zhuang, having a dirty orange to black hymenium and somewhat smaller ascospores is similar to *L. aurantiaca* and *L. huangshanica* in apothecial size, spore shape, and excipular structure (Zhuang 1995b), and should be closely related. Apothecial color is a useful criterion in taxonomy and phylogeny of certain groups of cup-fungi.

The genus *Dicephalospora* has been accepted as a member of the *Sclerotiniaceae* since its establishment (Spooner 1987, Kirk et al. 2001). From the morphological point of view and results of this study (Fig. 1), the genus should presumably be placed in the *Rutstroemiaceae* (Holst-Jensen et al. 1997). Further work is needed. New questions that need to be answered include: are *Dicephalospora rufocornea*, *Lanzia huangshanica* and their relatives too close to be placed in separate genera? Does the one character, presence of ascospore gel caps, carry phylogenetic information?

Placement of *Lanzia microserotina*

As indicated by our previous study, the correct genus for accommodating *Lanzia serotina* (Pers.) Korf & W.Y. Zhuang should be *Hymenoscyphus* and the correct name of the fungus is *H. serotinus* (Zhang & Zhuang 2004). Another fungus occurring on leaf blades, petioles and herbaceous stems, similar to *H. serotinus* in many aspects, and described as *Lanzia microserotina*, is distinguishable from the former by the reduced sizes in each part of the apothecia, especially the much shorter asci and ascospores (Zhuang 1996). The taxonomic position of *L. microserotina* was re-investigated in this study. Our results indicate that it is very closely related to *H. serotinus* based on both morphological and molecular data. *Lanzia microserotina* resolves among species of *Hymenoscyphus* and groups together with *H. serotinus* with 100 % bootstrap support (Fig. 1). Their excipular structure, ascus shape, and spore shape are very similar (Figs. 8–9). The main reason that they both were considered previously as members of *Lanzia* is their slightly colored apothecial stipe base (Korf & Zhuang 1985, Zhuang 1996), but the apothecia do not arise from stromatized plant tissues. When additional collections were examined, this character became unstable among individuals (Zhuang 1998c), i.e. color change at the stipe base is not always detectable in different collections of the same species. *Lanzia microserotina* is clearly congeneric with *Hymenoscyphus serotinus* and a formal transfer of the fungus to ***Hymenoscyphus*** is here proposed.

Hymenoscyphus microserotinus (W.Y. Zhuang) W.Y. Zhuang, **comb. nov.**

MycoBank # MB510596

≡ *Lanzia microserotina* W.Y. Zhuang, Mycosystema 8–9: 32, 1996.

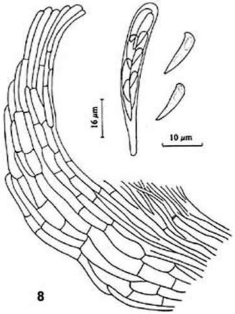


Fig. 8. *Hymenoscyphus microserotinus*: ectal excipular structure, an ascus with ascospores, and two free ascospores, HMAS 71812; from Zhuang (1998c).

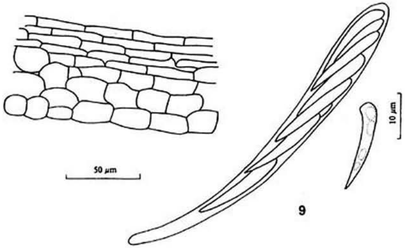


Fig. 9. *Hymenoscyphus serotinus*: ectal excipular structure, an ascus with ascospores, and a free ascospore, HMAS 75941; from Zhuang (1998c).

Placement of *Calycina herbarum* and of *Hymenoscyphus rhodoleucus*

Quite unexpected in our studies was the position of them in our phylogenetic tree (Fig. 1), nestled in the midst of rutstroemiaceous genera. *Calycina herbarum* is a relatively common fungus and widespread on herbaceous stems, while *Hymenoscyphus rhodoleucus* is not as common and appears to be restricted to stems of *Equisetum*. Dennis (1968) and Breitenbach & Kränzlin (1984) provided descriptions and colored illustrations of both fungi. The descriptions of *H. rhodoleucus* by both authors are identical but the illustrations provided are not exactly the same. Breitenbach & Kränzlin (1984) took pictures of the fungus on its natural substrate, which showed clearly darkened areas of host tissues on which apothecia grew. Is the darkened host tissue stromatized? If so, the position of *H. rhodoleucus* in our phylogenetic tree is reasonable, i.e., the species is rutstroemiaceous (Fig. 1). But the color illustration by Dennis (1978) showed that the plant tissue on which apothecia occurred appeared normal in color. If this is the case, position of *H. rhodoleucus* among the rutstroemiaceous fungi remains questionable. *Calycina herbarum* is different. The species is now placed in the genus *Calycina* due to its excipular structure differing from that commonly observed in taxa of *Hymenoscyphus*, but some authors disagree. The descriptions and illustrations of the species by both authors are more or less the same (Dennis 1978, Breitenbach & Kränzlin 1984), as well as what we observed in Chinese material. There is no sign of any stromatized substrates or substratal stromata to which apothecia are attached. Since available sequences of these two species are very limited, future studies need to be undertaken that might explain our results.

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Taxonomic studies of *Alternaria* from China X. Two new species on *Polygonum*

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Abstract—Two new species of the genus *Alternaria*, *A. polygoni* and *A. dissitiflori*, are reported. They are different from *A. rumicicola* reported on the genus *Rumex* in *Polygonaceae*. Type specimens are deposited in the Herbarium of Shandong Agricultural University: Plant Pathology (HSAUP).

Key words—taxonomy, hyphomycetes, plant pathogens, leaf spots

In the course of a survey of mitosporic fungal pathogens of important weeds, two new taxa of *Alternaria* on *Polygonum* in Xinjiang and Shandong were found. We describe them as follows.

Alternaria polygoni Meng Zhang & T.Y. Zhang, **sp. nov.** FIGURE 1

MycoBank # MB510403

Maculae orbiculares vel suborbiculares, griseo-brunneae, 2–3mm diam. Ex cultura in agaro PCA–charta filtra descripta. Conidiophora solitaria, infuscata, erecta, non ramosa, 14.0–60.0 × 3.0–4.5µm. Catenae conidiorum constatae ex conidiis 4–8, recta vel ramulis brevibus. Conidia ovoidea, obpyriforma vel obclavata, medio–brunnea vel brunnea, 4–10 transverse septata, 2–8 longitudinaliter vel oblique septata, constricta ad plures septata, plures septata distincte crassata, atro–brunnea, 19–54 × 10–22µm, av. 39 × 17µm. Pseudorostra pallide infuscata vel subhyalina, (0–) 4.5–15 (–32) × 3.5–4.5µm.

Holotype: on leaf spots of *Polygonum*. sp.: Urlumqi, Xinjiang Uighur Autonomous Region, 2000, Coll. M. Zhang., *HSAUP* Ⅱ$_0$ *0993* (=*ZM* Ⅱ$_0$ *0593)*. Dried ex-type cultures on PCA in *HSAUP* Ⅱ$_0$ *0993.*

Leaf spots circular or subcircular, greyish brown, 2–3mm in diameter. Colonies on PDA grey to greyish black, velvety, effuse; most conidia becoming chlamydospores. Colonies on PCA grey, velvety, effuse, sporulating sparsely.

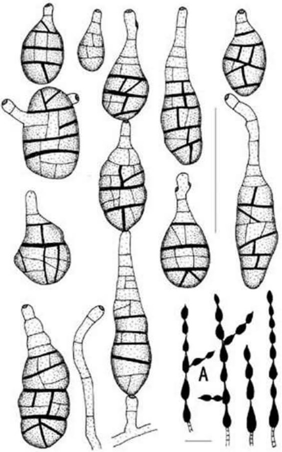

FIGURE1 *Alternaria polygoni*
Conidia, conidiophores and sporulation patterns (A) on PCA + filter paper.
(ex holotype, all bars=50μm)

On PCA + filter paper sporulating freely. Conidiophores arising singly or in groups terminally or laterally from hyphae, simple, straight or curved, smooth-walled, septate, pale brown, paler toward the apex, 14–60 × 3–4.5μm. Chains of 4–8 conidia often unbranched or with short branches (1–3 conidia). Conidia ovoid, obpyriform or obclavate, medium brown to brown, smooth-walled, with 4–10 transverse septa and 2–8 longitudinal or oblique septa, some septa are constricted, thicker and darker, 19–54 × 10–22μm, av. 39 × 17μm. Pseudorostrum straight, apex sometimes geniculate, subhyaline to pale brown, septate, (0–) 4.5–15 (–32) × 3.5–4.5μm.

Alternaria dissitiflori Meng Zhang & T.Y. Zhang, **sp. nov.** **FIGURE 2**
MYCOBANK # MB510404

Maculae irregularis, pallide brunnea. Ex cultura in agaro PCA descripta. Conidiophora solitaria, erecta, simplicia vel ramosa, ad 21–52 × 2.5–3.5µm. Catenae conidiorum constatae ex conidiis 7–10, ramulis brevibus. Conidia obclavata, pallide brunnea, 3–6 transverse septata, 0–2 longitudinaliter vel oblique septata, constricta ad plures septata, 13–33– × 5–10µm, av. 21 × 7µm. Pseudorostra subhyalina, apica inflata, 2.5–36– × 2.5–4.5µm.

Holotype: on leaf spots of *Polygonum dissitiflorum* Hemsl.: Taian, Shandong Province, 2003, Coll. M. Zhang., *HSAUP* $_{03}$ *0134* (=*ZM* $_{03}$ *0134)*. Dried ex-type cultures on PCA in *HSAUP* $_{03}$ *0134*.

Leaf spots irregular, pale brown. Colonies on PCA grey, velvety, effuse. Conidiophores arising singly terminally or laterally from hyphae, simple, or branched, straight or curved, smooth-walled, septate, pale brown, paler towards

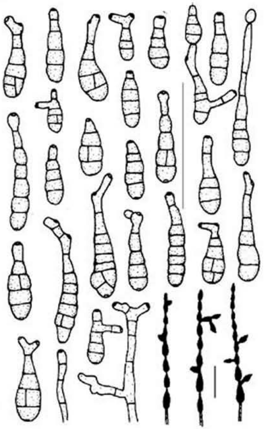

FIGURE 2 *Alternaria dissitiflori*
Conidia, conidiophores on PCA and sporulation patterns on PCA + filter paper.
(ex holotype, all bars=50µm)

the apex, 21–52 × 2.5–3.5µm. Chains of 7–10 conidia often with short branches (1–3 conidia). Conidia obclavate, pale brown, smooth-walled, with 3–6 transepta and 0–2 longitudinal or oblique septa, some septa constricted, 13–33 × 5–10µm, av. 21 × 7µm. Pseudorostra straight, sometimes apex geniculate and inflate, subhyaline to pale brown, septate, 2.5–36 × 2.5–4.5µm.

Only one *Alternaria* species has been reported on plants of *Polygonaceae* namely *Alternaria rumicicola* R.L. Mathur et al. (with conidia 19–84 × 7–14µm, av. 49 × 10.5µm). The conidia of the two new taxa on *Polygonum* are obviously smaller than the described species and their shape and size are different from each other. The sporulation patterns of the two new species are somewhat close to those of *A. tenuissima* (Kunze) Wiltshire, but they can be easily distinguished by their conidial shape, septation and size.

Acknowledgments

The authors are grateful to Drs. B. Kendrick, Canada and Prof. Y.L. Guo, Institute of Microbiology, Academia Sinica for reviewing the manuscript.

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MYCOTAXON

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Taxonomic studies of *Helminthosporium* from China III. Three new species in Guangdong Province

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Abstract—Three new species of the genus *Helminthosporium* are reported. They are *Helminthosporium multiseptatum, Helminthosporium subhyalinum* and *Helminthosporium constrictum*. Type specimens are deposited in the Herbarium of Shandong Agricultural University: Plant Pathology (HSAUP).

Key words—taxonomy, hyphomycetes, saprophytes

In the course of a survey of *Helminthosporium* species in China, three new taxa were found from Guangdong Province. We describe them as follows.

Helminthosporium multiseptatum Meng Zhang, T.Y. Zhang & W.P. Wu, **sp. nov.**
MYCOBANK MB510407 FIGURE 1

Mycelium immersum. Stromata partim superficialia, partim immersa, atro-brunnea, pseudoparenchymatica, usque ad 20 µm alta, usque ad 25 µm lata. Conidiophora singularia, erecta, subcylindrica, recta vel parce flexuosa, septata (cellulis 17–47 µm longis), levia, brunnea vel atro-brunnea, interdum apicem versus pallidiora, 390–650 µm longa, basi 10–14 µm crassa, apice 7–9 µm crassa, poris conidiiferis ad apicem et infra 1–3 septa supera praedita. Conidia per poros ad apicem conidiophori et lateraliter infra septa supera oriunda, recta vel leviter flexuosa, tenuiter obclavata vel subflagelliformis, levia, pallide brunnea, apicem versus pallidiora, 13–25 (av. 20) pseudoseptata, 78–192 (av. 149) µm longa, 11–16 (av. 13) µm crassa, apicem versus ad 3–6 µm gradatim attenuata, basi cicatrice atra praedita.

On dead branches of unidentified plant, Guangdong Province, China, Coll. Wenping Wu. 9 Oct. 1998, *HSAUP* o_1*356 (=WWP 2207)*, holotype.

Etym.: L., referring to the multiseptate conidia.

**Corresponding author

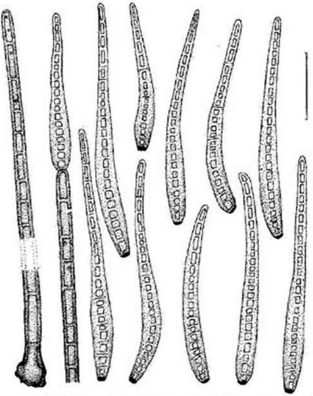

FIGURE 1 *Helminthosporium multiseptatum* (ex holotype, Bar=50 µm)

Mycelium immersed in the substratum. Stromata partly superficial, partly immersed, dark brown, pseudoparenchymatous, up to 20 µm high, 25 µm wide. Conidiophores arising singly from the upper cells of the stromata, simple, subcylindrical, straight or slightly flexuous, septate, smooth-walled, brown to dark brown, paler towards the apex, 390–650 µm long, 10–14 µm wide at the base, 7–9 µm wide at the apex, with 1–3 well defined, small pores (conidiogenous loci) at the apex and a few formed laterally beneath the upper 1–3 septa. Conidia tretic, arising through pores at the conidiophore apex, and laterally beneath the upper septa, straight or slightly flexuous, thinly obclavate or nearly whip-like, smooth-walled, pale brown, paler toward the apex, 13–25 (av. 20) pseudoseptate, 78–190 (av. 149) µm long, 11–16 (av. 13) µm thick in the widest part, narrowing toward the apex to 3–6 µm, with a dark blackish-brown scar at the base.

The new taxon is close to *Helminthosporium longisinuatum* Matsush. in conidial size, but the conidia of the latter are thinner and S-shaped. The multiseptate, long, thin tapered conidia and tall, slender conidiophores are useful in distinguishing this species from the others in the genus *Helminthosporium*.

Helminthosporium subhyalinum Meng Zhang & T.Y. Zhang, sp. nov.

MycoBank MB510408 FIGURE 2

Ex specimine descripta. Mycelium immersum. Stromata absentia. Conidiophora singularia vel fasciculata, erecta, subcylindrica, recta vel flexuosa, septata, levia, brunnea, interdum apicem versus pallidiora, 120–200 µm longa, ad basim ad 10–12 µm inflata, supra basim 6–8.5 crassa, apice interdum inflata, poris conidiiferis 1–3 ad apicem et infra septa supera praedita. Conidia per poros ad apicem conidiophori et lateraliter infra septa supera oriunda, recta vel leviter flexuosa, tenuiter obclavata, levia, maxime pallentia, 6–9 pseudoseptata, 72–125 (av. 100) µm longa, 9.0–11.5 (av. 10.6) µm crassa, apicem versus ad 2.5–5 µm gradatim attenuata, apicem fuscatis, basi cicatrice atra praedita.

Ex culture descripta. Coloniae in agaro TWA+W velutinae, griseae vel brunneae, effusae. Conidia absentia. In agaro PDA-Charta filtra, sporulantes libere. Mycelium ex hyphis subhyalinis vel brunneis levibus septatis fuscatis 1.5–6.0 µm crassis compositum. Conidia 7–10-pseudoseptata, 54–100 (av. 86) µm longa, 8–10 (av. 8.6) µm crassa, apicem versus ad 2.5–5 µm gradatim attenuata, apicem fuscatis, basi cicatrice atra praedita.

On living leaves of *Phoenix hanceana* Naud., Guangdong Province, China, Coll. Xiu-Guo Zhang, 9 Oct. 1999, *HSAUP 991137*, holotype.

Etym.: L., referring to the colour of conidia.

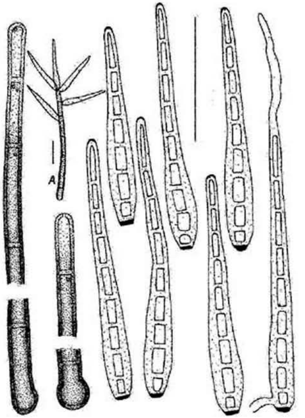

FIGURE 2 *Helminthosporium subhyalinum* (ex holotype, Bar=50 µm). A: Low-power drawing.

Mycelium immersed in the substratum. Stromata not formed. Conidiophores single or in fascicles, simple, subcylindrical, straight or flexuous, septate, smooth-walled, brown, paler towards the apex, 120–200 µm long, 6–8.5 µm wide above the base which is swollen to 10–12 µm wide, sometimes slightly inflated at the tip, with 1–3 well-defined, small pores at the apex and a few formed laterally beneath the upper septa. Conidia tretic, arising through pores at the apex and laterally beneath the upper septa, straight or flexuous, thinly obclavate, smooth-walled, subhyaline, 6–9 pseudoseptate, 72–125 (av. 100) µm long, 9.0–11.5 (av. 10.6) µm thick in the widest part, narrowing towards the apex to 2.5–5 µm, black at the tip, with a dark blackish-brown scar at the base.

Colonies in tap water agar + wheat straw (TWA+W) grey to brown, velvety, effuse, conidia not formed. In PDA–filter paper, sporulating freely. Mycelium subhyaline to brown, septate black, branched, smooth-walled. 1.5–6 µm thick. Conidia straight or flexuous, thinly obclavate, smooth-walled, 7–10-pseudoseptate, 54–100 (av. 86) µm long, 8–10 (av. 8.6) µm thick in the widest part, narrowing towards the apex to 2.5–5 µm, black at the tip, with a dark blackish-brown scar at the base.

In conidium morphology, the new taxon is close to *Helminthosporium chlorophorae* M.B. Ellis and *Helminthosporium kakamegense* Siboe et al. However, *H. chlorophorae* has stromata, the tips of its conidiophores are swollen. The conidia of *H. kakamegense* are obviously smaller. The new taxon can be separated from other species in the genus *Helminthosporium* by its subhyaline, black-tipped conidia. The typically thin-obclavate conidium shape is also very helpful in distinguishing it from other species in the genus with obclavate, obpyriform or ovoid conidia.

Helminthosporium constrictum Meng Zhang, T.Y. Zhang & W.P. Wu, **sp. nov.**

MYCOBANK MB510409 **FIGURE 3**

Mycelium immersum. Stromata partim superficialia, partim immersa, atro-brunnea, pseudoparenchymatica, usque ad 12 µm alta, usque ad 34 µm lata. Conidiophora singularia, erecta, subcylindrica,recta vel parce flexuosa, septata (cellulis 13–20 µm longis) levia, brunnea vel atro-brunnea, interdum apicem versus pallidiora, 88–205 µm longa, basi 5.0–8.0 µm crassa, apice 5–7 µm crassa, poris conidiiferis ad apicem et infra 1–3 septa supera praedita. Conidia per poros ad apicem conidiophori et lateraliter infra septa supera oriunda, recta vel leviter flexuosa, obclavata, levia, brunnea, apicem versus pallidiora, 9–15-pseudoseptata, interdum constrictae ad septa, 57–120 (av. 86) µm longa, 9–12 (av. 10) µm crassa, apicem versus ad 2.5–5.0 µm gradatim attenuata, basim truncatum.

On dead branches of *Trachycarpus fortunei* (Hook.) H.Wendl., Dinghushan, Guangdong Province, China, 9 Oct. 1998, leg. Wenping Wu, *HSAUP o_{I}374(=WWP 1892b)*, holotype.

Etym.: L., referring to the constricted septa of conidia.

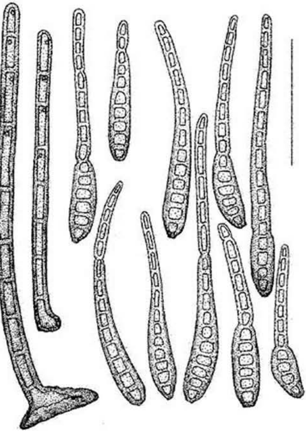

FIGURE 3 *Helminthosporium constrictum* (ex holotype, Bar=50 μm)

Mycelium immersed in natural substratum. Stromata partly superficial, partly immersed, dark brown, pseudoparenchymatous, up to 12 μm high, 34 μm wide. Conidiophores arising singly from the upper cells of the stromata, simple, subcylindrical, straight or slightly flexuous, septate, smooth-walled, brown to dark brown, paler towards the apex, 88–205 μm long, 5.0–8.0 μm wide at the base, 5–7 μm wide at the apex, with well-defined, small pores at the apex and a few formed laterally beneath the upper 1–3 septa. Conidia tretic, arising through pores at the apex and laterally beneath the upper septa, straight or slightly flexuous, obclavate, smooth-walled, pale brown, paler toward the apex, 9–15-pseudoseptate, sometimes obviously constricted at one or two septa, 57–120 (av. 86) μm long, 9–12 (av. 10) μm thick in the widest part, narrowing toward the apex to 2.5–5 μm, abruptly tapered to a truncate base.

The species closest in conidial morphology to our new taxon is *Helminthosporium dalbergiae* M.B.Ellis. However, the conidia of *H. dalbergiae* are thicker (12–14 µm), have a large dark blackish-brown scar at the base, are not constricted at any septa, and are paler than those of the new species. The conidiophores of *H. dalbergiae* are also larger (300–1300 µm long, 10–15 µm thick).

Acknowledgments

We are grateful to Dr. X.G. Zhang for collecting some specimens and to Mr. Y.M. Wu for inking the drawings. Thanks are also expressed to Drs. B. Kendrick, Canada and Prof. Y.L. Guo, Institute of Microbiology, Academia Sinica for reviewing the manuscript.

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MYCOTAXON

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Taxonomic studies of *Curvularia* from China III. Two new species on *Poaceae*

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Abstract—Two new species of the genus *Curvularia* on *Poaceae* are reported. They are *Curvularia pseudorobusta* and *Curvularia graminis*. Type specimens are deposited in the Herbarium of Shandong Agricultural University: Plant Pathology (HSAUP).

Key words—taxonomy, hyphomycetes, plant pathogens

Introduction

In the course of a survey of *Curvularia* species in China, two taxa on grasses in Beihai, Guangxi Province and Hangzhou, Zhejiang Province were found. They are different from previously reported species of *Curvularia* and we describe them as follows.

Taxonomic description

Curvularia pseudorobusta Meng Zhang & T. Y. Zhang **sp. nov.**

MYCOBANK # MB510414 FIGURE 1

Mycelium in substrato immersum vel partim superficialia, ex hyphis ramosis septatis pallide brunneis levibus vel verruculosis 2–8 µm crassis compositum. Conidiophora ex apice lateribusque hypharum oriunda, singularia vel fasciculata, simplicia, recta vel flexuosa, interdum geniculata, septata, pallide brunnea, apicem versus pallidiora, levia, 100–240 µm longa, cellula basali ad 17 µm inflata, supra basim 7–12 µm crassa, apice 4–5 µm crassa. Conidia acropleurogena, levia, fusiformis vel clavata, gibbosa, inaequilateralia vel curvata, 3–4 (plerumque 4)-septata, cellula media inflata, globosa, brunnea, cellulis extimis pallide brunneis, hilo non protrudenti; in agaro TWA+W: 22–33×11–16 µm, av. 27×13 µm, in substrato naturali: 23–31×11–17 µm, av. 26×14 µm.

On living leaves of an undetermined plant in *Poaceae*, Beihai, Guangxi Province, China, coll. Guo-Zhu Zhao, 13 Nov.1999, *HSAUP 992347-2*, holotype.

**Corresponding author*

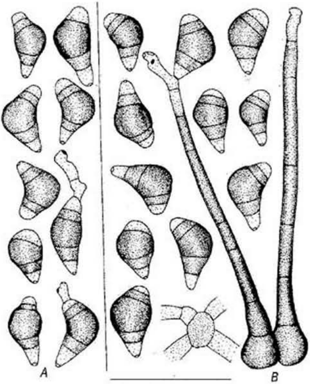

FIGURE 1 *Curvularia pseudorobusta*
A: Conidia in TWA+W. B: Conidia and conidiophores in natural substratum.
(ex holotype, Bar=50 μm)

Colonies in tap water agar+wheat straw (TWA+W) grey to greyish brown, cottony, effuse, sporulating freely. Stromata not formed. Mycelium partly immersed in the substratum, pale brown to mid brown, septate, branched, smooth or verruculose, 2–8 μm thick, sometimes swollen to 12 μm thick. Conidiophores arising singly or in groups terminally or laterally from hyphae, simple, straight or slightly curved, smooth-walled, apex sometimes geniculate, septate, mid brown, paler toward the apex, on natual substrata 100–240 μm long, swollen at the basal cell upto 17 μm thick, 7–12 μm thick just above the basal swelling, 4–6 μm thick at the apex, in culture, length variable, 3.5–6 μm thick, base thinner. Conidia acropleurogenous, typically 4-septate, smooth-walled, broadly fusiform to clavate, gibboue, and inequilateral to strongly curved. The central cell was greatly inflated, nearly globose, apex rounded, basal cell obconic, middle cells brown, the two end cells paler. Some conidia can sporulate secondarily. In natural substratum: 23–31×11–17 μm, av. 26.5×14.5 μm, in TWA+W: 22–33×11–16 μm, av. 27.6×13.5 μm.

Conidial morphology in *Curvularia pseudorobusta* resembles that in *C. robusta* Kilp. & Luttr., but conidia of *C. robusta* are larger (on natural substratum 39–56×21–27 µm, in culture 25–76×15–26 µm; Kilpatrick & Luttrell 1967). Conidia of *C. pseudorobusta* also resemble those of *C. senegalensis* (Speg.) Subram., but conidia of the latter are narrower (10–14 µm), not as strongly curved, and the central cell not so conspicuously inflated. Conidia of *C. senegalensis* do not produce secondary conidia (Ellis 1966).

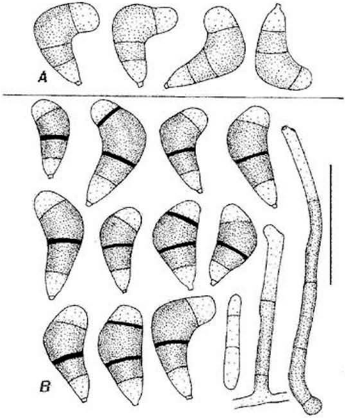

FIGURE 2 *Curvularia graminis*
A: Conidia in TWA+W. B: Conidia and conidiophores in natural substratum. (ex holotype, Bar=50 µm)

Curvularia graminis Meng Zhang & T.Y. Zhang, **sp. nov.**
MYCOBANK #MB510415 **FIGURE 2**

Coloniae in agaro (TWA+W), griseae vel brunneae, effusae, stromata absentia. Sporulantes libere. Mycelium in substrato plerumque immersum, ex hyphis ramosis septatis subhyalinis vel pallide brunneis levibus 1.0–4.5 µm crassis compositum. Conidiophora ex apice lateribusque hypharum oriunda, singularia vel fasciculata, divergentia, simplicia, recta vel flexuosa, interdum geniculata, septata, medio-brunnea, apicem versus pallidiora, levia, *in substrato naturali: 39–125 µm longa, 4.5–7 µm crassa. Conidia acropleurogena, laevia, curvata, in agaro TWA+W plerumque geniculata, 3–septata, septis fuscatis, cellula tertia ventricosae, atro rufo–brunnea, cellulis ceteris dilutioribus, in agaro TWA+W: 29–46×15–19 µm, av. 37.6×16.8 µm; in substrato naturali: 32–46×13–19 µm, av. 38.2×16.5 µm. Hilo protrudente.*

Habitat: on living leaves of an undetermined plant in *Poaceae*, Hangzhou, Zhejiang Province, China, coll. Hui Deng, 9 Aug. 2000, *HSAUP $II_0$4504 (=DH $II_0$0504)*, holotype.

Colonies in tap water agar+wheat straw (TWA+W) grey to brown, effuse, sporulating freely. Stromata not formed. Mycelium immersed in the substratum, subhyaline to pale brown, septate, branched, smooth, 1.0–4.5 µm thick. Conidiophores arising singly or in fascicles, terminally or laterally from hyphae, smooth, simple, straight or flexuous, septate, middle brown, paler towards the apex, in natural substratum, 39–125 µm long, 4.5–7 µm thick. Conidia acropleurogenous, 3-septate, in TWA+W the third cell from the base greatly inflated, mostly inequilateral to strongly curved, middle cells pale brown to mid-brown, the end cells paler: 29–46×15–19 µm, av. 37.6×16.8 µm; in natural substratum the second and third septa from the base often darker and thicker, curved, apex rounded, basal cell obconic, middle cells medium to dark reddish brown, the end cells paler: 32–46×13–19 µm, av. 38.2×16.5 µm. Hilum protruding and consisting of a small appendiculate cell. First septum laid down in the conidia is median, second septum is distal or in the base.

The conidial sizes of the new species are similar in natural substratum and in culture, but the conidial color becomes paler in culture. The most similar species in conidial morphology is *Curvularia trifolii* (Kauffmann) Boedijn, but its conidia are smaller (20–38 × 8–16 µm; Ellis 1966). The new species also resembles *Curvularia heteropogonis* Alcorn in the size of conidia, but the conidia of that species are clavate to obovoid and not so strongly curved (Alcorn 1990). Furthermore, the second and third septa from the base of the conidia of the new taxon are often darker and thicker, which is a striking character helping to distinguish it from other species.

Acknowledgments

We are grateful to Dr. Guo–Zhu Zhao and Miss Hui Deng for collecting some specimens and to Mr. Yue–Ming Wu for inking the drawings. The authors are grateful to Drs. B. Kendrick, Canada and Prof. Y.L. Guo, Institute of Microbiology, Academia Sinica for reviewing the manuscript.

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MYCOTAXON

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Agarics on elephant dung in Kerala State, India

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Abstract—Nineteen species representing twelve genera and five agaric families were found associated with elephant dung and are documented here along with a key to the species. The agarics are: *Agrocybe guruvayoorensis, Bolbitius coprophilus, Conocybe brunneoaurantiaca, C. pseudopubescens, C. volvata, Copelandia cyanescens, Entoloma anamikum, Macrocybe gigantea,* cf. *Panaeolina rhombisperma, Panaeolus antillarum, P. rickenii, Pholiotina indica, Psilocybe coprophila, Ps. pegleriana, Ps. subaeruginascens, Ps. subcubensis, Stropharia bicolor, S. rugosoannulata,* and *Volvariella volvacea*. Of the species encountered during the study, *Agrocybe guruvayoorensis, Conocybe volvata, Conocybe pseudopubescens, Pholiotina indica, Stropharia bicolor* are known to grow only on elephant dung.

Key words—coprophilous fungi, *Basidiomycota, Agaricales*

Introduction

Compared to other groups of fungi, basidiomycetes, with the exception of the "Coprini" and a few related genera, are rather rarely seen on dung. This is because dung, being an ephemeral substratum in most cases, cannot support long-life-cycled and large-fruit-bodied basidiomycetes. Elephant dung is an exception here because the droppings are comparatively more massive and composed mostly of ligno-cellulosic materials, and it takes almost a year before they are fully disintegrated. These features favor the colonization and development of agarics on elephant dung.

In the literature, however, only a few agarics have been reported to grow on elephant dung, e.g., *Conocybe corneri* Watling (Watling 1979), *Agrocybe stercoraria* Pegler, *Bolbitius vitellinus* (Pers.) Fr., *Coprinus sterquilinus* (Fr.) Fr., *Panaeolus antillarum, Psilocybe pseudobullacea* (Petch) Pegler, *Stropharia bicolor* (Pegler 1977) and *Psilocybe rostrata* (Petch) Pegler (Pegler 1986). However, during our studies on agarics of Kerala, we found several agarics growing on elephant dung. This prompted us to give an exclusive account of the agarics (except the "Coprini") associated with elephant dung in this region. As far as we know, this is the first comprehensive account in the world on agarics associated with elephant dung.

Materials & methods

Agarics were collected from dung of both wild and domesticated elephants. Conventional mycological techniques for examination of agaric specimens were used in the study. Acronyms of herbaria are according to Holmgren et al. (1990). Collections cited that are not followed by herbarium acronyms are in first author's personal herbarium.

Results

Nineteen species belonging to twelve genera representing five agaric families were found associated with elephant dung. The families, genera, and species encountered are listed in Table 1.

Table 1: List of agaric families, genera, and species seen on elephant dung in Kerala, India

Families	Genera	Species
Bolbitiaceae	*Agrocybe*	*A. guruvayoorensis**#
	Bolbitius	*B. coprophilus*
	Conocybe	*C. brunneoaurantiaca**
		*C. pseudopubescens**#
		*C. volvata**#
	Copelandia	*C. cyanescens*
	cf. *Panaeolina*	cf. *P. rhombisperma*
	Panaeolus	*P. antillarum*
		P. rickenii
	Pholiotina	*P. indica**#
Entolomataceae	*Entoloma*	*E. anamikum**
Pluteaceae	*Volvariella*	*V. volvacea*
Strophariaceae	*Psilocybe*	*P. coprophila*
		P. pegleriana
		P. subaeruginascens
		P. subcubensis
	Stropharia	*S. bicolor*#
		S. rugosoannulata
Tricholomataceae	*Macrocybe*	*M. gigantea*

* species known only from Kerala; # species known to grow only on elephant dung

Key to the agarics on elephant dung in Kerala

1. Spore-print cream-coloured or pink to dull pink 2
1. Spore-print black or some shade of brown 4

2. Spore-print cream-coloured; basidiomata very large and initially entirely whitish; spores 6–7.5 × 4–5 µm .... *Macrocybe gigantea*
2. Spore-print pink to dull pink; basidiomata not very large and not entirely whitish; spores larger 3

3. Spores angular, with 5–7 flat or concave facets, 9–13 × 7–9.5 µm; lamellar trama subregular to almost regular; volva absent .... *Entoloma anamikum*
3. Spores not angular, 8–9 × 6–6.5 µm, ellipsoid to subglobose; lamellar trama inversely bilateral; volva present .... *Volvariella volvacea*

4. Pileipellis neither a hymeniform layer nor an epithelium 5
4. Pileipellis a hymeniform layer or rarely an epithelium 10

5. Chrysocystidia present; pileus mostly not hygrophanous 6
5. Chrysocystidia absent; pileus mostly hygrophanous. 7

6. Pileus strongly glutinous; annulus fugacious; spores ovo-ellipsoid, limoniform or subhexagonal in face-view, 10.5–14.5 × 7.5–10 × 6.5–8.5 µm .... *Stropharia bicolor*
6. Pileus subviscid; annulus thick, fleshy, strongly striate; spores ovo-ellipsoid in face view, 10–14.5 × 7–9.5 × 6.5–8.5 µm . . *Stropharia rugosoannulata*

7. Basidiomata staining blue. 8
7. Basidiomata not staining blue. 9

8. Spores subrhomboid or limoniform in face view, 8–11 × 6–8.5 × 5–7µm .... *Psilocybe subaeruginascens*
8. Spores subhexagonal in face view, 11–15 × 7.5–10 × 7–8.5 µm . . *Psilocybe subcubensis*

9. Annulus present; pleurocystidia absent; spores 8–12 × 6.5–8.5 × 5.5–7 µm .... *Psilocybe pegleriana*
9. Annulus absent; pleurocystidia present, scattered; spores 10.5–15.5 × 7.5–9.5 × 7–9 µm .... *Psilocybe coprophila*

10. Spores mostly black, rarely purplish brown or dark fuscous brown 11
10. Spores never black but argillaceous brown, ochraceous brown or rust brown 14

11. Spores rhomboid to nodulose-subangular, dark-brown, partially discolored by concentrated H_2SO_4 10–12.5 × 8–11.5 µm ..... cf. *Panaeolina rhombisperma*
11. Spores not rhomboid to nodulose-subangular, blackish, not discolored by concentrated H_2SO_4 12

12. Metuloids present on the lamellae, spores 11–16.5 × 9–11.5 × 6.5–8.5 µm .... *Copelandia cyanescens*
12. Metuloids absent on the lamellae. 13

13. Basidiomata medium-sized to somewhat large; pileus white to cream-white; spores 12–16 × 9--11 × 7.5–9 µm; chrysocystidia present. . *Panaeolus antillarum*
13. Basidiomata small to medium-sized; pileus brownish with a distinct whitish margin; spores 8–12 × 6.5–9 × 4.5–7.5 µm; chrysocystidia absent . . . . *Panaeolus rickenii*

14. Pileus viscid and soon putrescent; pileus light orange to pastel red at the centre, fading centrifugally; hygrophanous and becoming greyish orange all over, sulcate-striate to the centre; lamellae free or nearly so; spores 9.5–13.5 × 6.5–9 × 6–8 µm . . . . *Bolbitius coprophilus*
14. Pileus not viscid and putrescent; lamellae not free 15

15. Stipe with an annulus 16
15. Stipe without an annulus 17

16. Basidiomata medium-sized to large, often fleshy; pileus light yellow to yellowish white; annulus median, evanescent; spores 9–13.5 × 6.5–9 × 6–8 µm . . . . *Agrocybe guruvayoorensis*
16. Basidiomata small to medium-sized, usually fragile; pileus reddish brown to pale orange; annulus central to superior, persistent, movable; spores 7–9 × 4.5–6 × 4–5.5 µm . . . . *Pholiotina indica*

17. Basidiomata volvate, medium-sized with pileus diameter more than 15 mm; spores 9.5–14.5 × 7–9 × 6–8 µm . . . . *Conocybe volvata*
17. Basidiomata not volvate, small with pileus diameter less than 15 mm 18

18. Spores 7–11 × 6.5–8 × 5–6.5 µm; lamella-edge heteromorphous . . . . *Conocybe brunneoaurantiaca*
18. Spores 11.5–17.5 × 7.5–12 × 7–10 µm; lamella-edge sterile . . . . *Conocybe pseudopubescens*

Documentation of Species

1. *Agrocybe guruvayoorensis* K.A. Thomas & Manim., Mycotaxon 86: 330 (2003).

SEL. DESCR. & FIGS. Thomas & Manimohan, Mycotaxon 86: 330–332 (2003).

Pale yellow pileus, an evanescent but distinct median annulus, spores that are 9–13.5 µm long and with a truncate germ-pore, sphaeropedunculate to vesiculose cheilocystidia, infrequent pleurocystidia that are similar to cheilocystidia, and caulocystidia restricted to the upper part of stipe are the characteristic features of this species.

Specimens examined: India, Kerala State, Thrissur District, Guruvayur: 14 July 1999, K. A. Thomas T316; 16 July 1999, K. A. Thomas T316b; 21 July 1999, K. A. Thomas T316c; 18 October 1999, K. A. Thomas T316d (all at herb. L).

2. *Bolbitius coprophilus* (Peck) Hongo, Mem. Fac. Lib. Arts. Educ., Shiga Univ. Nat. Sci. 9: 82 (1959).

SEL. DESCR. & FIGS. Thomas et al., Öst. Z. Pilzk 10: 88–90 (2001).

Bolbitius coprophilus is characterized by medium-sized, pinkish basidiomata; distinctly sulcate-striate, rather viscid pileal surface; adnexed or almost free lamellae; and lageniform to utriform cheilocystidia. The hymeniform elements of the pileipellis are dispersed in a gelatinous matrix.

Specimens examined: India, Kerala State, Thrissur District, Guruvayur: 11 June 1999, A. Thomas T312; 17 June 1999, A. Thomas T312b; Kasaragod District, Adhoor: 16 September 2000, A. Thomas T312c (all at herb. WU).

3. *Conocybe brunneoaurantiaca* K.A. Thomas, Hauskn. & Manim., Öst. Z. Pilzk. 10: 90 (2001).

SEL. DESCR. & FIGS. Thomas et al., Öst. Z. Pilzk 10: 89–92 (2001).

Conocybe brunneoaurantiaca is characterized by small, brownish orange basidiomata; small lemon-shaped spores; lecythiform cheilocystidia with small capitula and long necks; and clavate or cylindric-flexuose caulocystidia in fascicles.

Specimens examined: India, Kerala State, Malappuram District, Nilambur: 24 August 2002, Nisha NVS122.

4. *Conocybe pseudopubescens* K.A. Thomas, Hauskn. & Manim., Öst. Z. Pilzk 10: 92 (2001).

SEL. DESCR. & FIGS. Thomas et al., Öst. Z. Pilzk 10: 92–94 (2001).

Small, thin-fleshed basidiomata; total absence of velar remnants; brownish, hygrophanous and pellucid striate pileus; large lentiform spores with very thick wall; and versiform caulocystidia that are never lecythiform are the characteristic features of this species.

Specimens examined: India, Kerala State, Wayanad District, Muthanga: 25 June 1997, A. Thomas T84; 25 May 1999, A. Thomas T84b (all at herb. WU).

5. *Conocybe volvata* K.A. Thomas, Hauskn. & Manim., Öst. Z. Pilzk. 10: 101 (2001).

SEL. DESCR. & FIGS. Thomas et al., Öst. Z. Pilzk 10: 101–103 (2001).

Conocybe volvata is characterized by small to medium-sized basidiomata; brown, hygrophanous, finely pellucid-striate pileus often with an obtuse umbo; very long stipe with a bifid, non-fragile, membranous volva; lentiform spores; distinct pavement cells in the hymenium, and versiform caulocystidia.

Specimens examined: India, Kerala State, Thrissur District, Guruvayur: 11 June 1999, A. Thomas T302b; 17 June 1999, A. Thomas T302c; 14 July 1999, A. Thomas T302d; 21 August 2000, A. Thomas T302e (all at herb. WU).

6. *Copelandia cyanescens* (Berk. & Broome) Singer, Lilloa 22: 473 (1951).

SEL. DESCR. & FIGS. Pegler, Kew Bull., Addit. Ser. 12: 377–379 (1977).

Small to medium-sized basidiomata discoloring blue when bruised; parabolic to campanulate, whitish pileus; large, lenticular, limoniform spores; versiform cheilocystidia; and metuloidal pleurocystidia are diagnostic of this species.

Specimens examined: India, Kerala State, Malappuram District, Angadipuram: 12 August 2002, Nisha NVS107; Thrissur District, Guruvayur: 9 September 2002, Nisha NVS128.

7. *Entoloma anamikum* Manim., A.V. Joseph & Leelav., Mycol. Res. 99 (9): 1091 (1995).

SEL. DESCR. & FIGS. : Manimohan et al., Mycol. Res. 99 (9): 1091 (1995).

Entoloma anamikum has small to medium-sized, whitish to pale brown basidiomata; infundibuliform pileus; deeply decurrent lamellae; heterodiametric-ovate spores with 5-7 flat or depressed sides; and occasional cheilocystidia.

Specimens examined: India, Kerala, Thrissur District, Guruvayur: 28 October 2002, Nisha NVS136; 2 July 2003, Nisha NVS136c. Malappuram District, Nilambur: 28 June 2003, Nisha NVS136b.

8. *Macrocybe gigantea* (Massee) Pegler & Lodge, Mycologia 90 (3): 497 (1998).

SEL. DESCR. : Pegler et al., Mycologia 90 (3): 497–498 (1998).

Macrocybe gigantea can be identified by very large, fleshy, heavy, whitish basidiomata; smooth, glabrous, estriate pileus; straw-yellow lamellae lacking both cheilocystidia and pleurocystidia; and ovo-ellipsoid to subglobose spores.

Specimens examined: India, Kerala, Thrissur District, Guruvayur: 27 May 1999, P. Manimohan, M750a; 17 June 1999, P. Manimohan, M750a. (Unfortunately these collections were lost subsequently.).

9. cf. *Panaeolina rhombisperma* Hongo, Mem. Shiga Univ. 23: 38 (1973).

SEL. DESCR. & FIGS. Hongo, Mem. Shiga Univ. 23: 38–39 (1973).

This fungus is similar to *Panaeolina rhombisperma* from Japan in almost all characters and particularly so in its rhomboid to subangular-tetrahedric spores. However, there is some difficulty in placing the present fungus in the genus *Panaeolina* because the colour of the spores of our collections fades in H_2SO_4, a feature that is used to separate *Panaeolina* from rough-spored species of *Coprinus* and *Psathyrella*.

Specimens examined: India, Kerala state, Wayanad district, Ponkuzhy: 17 October 1999, K.A. Thomas, T338a; 18 October 1999, K.A. Thomas T338 b; 28 October 1999, K.A. Thomas T338c; 31 October 1999, K.A. Thomas T 338d (all at herb. L).

10. *Panaeolus antillarum* (Fr.) Dennis, Kew Bull. 15: 124 (1961).

SEL. DESCR. & FIGS. Pegler, Kew Bull., Addit. Ser. 6: 412–415 (1977).

Panaeolus antillarum is characterized by medium-sized basidiomata, whitish pileus that is slightly sticky when moist, solid stipe devoid of an annulus, presence of chrysocystidia, and spores that are somewhat hexagonal in outline with a truncate germ-pore.

Specimens examined: India, Kerala State, Malappuram District, Ramapuram: 16 August 2002, Nisha NVS109; 18 August 2002, Nisha NVS109b; Thrissur District, Guruvayur: 28 October 2002, Nisha NVS109c; 9 March 2003, Nisha NVS109d; 11 April 2003, Nisha NVS109e.

11. *Panaeolus rickenii* Hora, Trans. Brit. Mycol. Soc. 43: 454 (1960).

SEL. DESCR. & FIGS. Pegler, Kew Bull., Addit. Ser. 6: 410–413 (1977).

Panaeolus rickenii is a slender agaric with long stipe lacking annulus, dark brown hygrophanous pileus, lenticular spores with limoniform outline in face view, crowded versiform cheilocystidia, and numerous pileocystidia.

Specimens examined: India, Kerala State; Thrissur District, Guruvayur: 9 September 2002, Nisha NVS129; Malappuram District, Ramapuram: 22 October 2002, Nisha NVS133; 11 November 2002, Nisha NVS133b.

12. *Pholiotina indica* K.A. Thomas, Hauskn. & Manim. Öst. Z. Pilzk. 10: 109 (2001).

SEL. DESCR. & FIGS. Thomas et al., Öst. Z. Pilzk 10: 109–112 (2001).

Pholiotina indica has reddish brown to pale orange pileus, a distinct movable annulus, spores that are less than 10 µm long and with a distinct germ-pore, and versiform cheilocystidia and caulocystidia that are never capitate.

Specimens examined: India, Kerala State, Wayanad District, Muthanga: 1 October 1997, A. Thomas T179; 30 June 1998, A. Thomas T179b; 9 June 1999, A. Thomas T179f; 4 July 1997, A. Thomas T96; 18 August 1997, A. Thomas T96c; Ponkuzhy: 13 October 1998, A. Thomas T179c; 27 October 1998, A. Thomas T179d; 19 November 1998, A. Thomas T179e; Idukki District, Munnar: 11 October 1999, A. Thomas T179h; 12 October 1999, A. Thomas T179i (all at herb. WU).

13. *Psilocybe coprophila* (Bull.) P. Kumm., Fuhr. Pilzk.: 71 (1871).

SEL. DESCR. & FIGS. Guzmán, *Psilocybe*: 224–228 & Figs. 383–387 (1983); Thomas et al., Mycotaxon 83: 201–202 (2002).

Psilocybe coprophila has small basidiomata; subviscid, reddish brown, hygrophanous pileus; broadly adnate lamellae; non-annulate stipe; lentiform spores that are subhexagonal in face-view; versiform cheilocystidia; and rarely pleurocystidia similar to cheilocystidia.

Specimens examined: India, Kerala State, Idukki District, Munnar: 28 August 1997, A. Thomas T149 (at herb. XAL with part at herb. L).

14. *Psilocybe pegleriana* Guzmán, Doc. Mycol. 29 (116): 43 (2000).

SEL. DESCR. & FIGS. Guzmán, Doc. Mycol. 29 (116): 43 (2000); Thomas et al., Mycotaxon 83: 203–204 (2002).

Psilocybe pegleriana has small basidiomata; smooth, subviscid, brownish pileus that is obtusely umbonate when young; adnate to subdecurrent lamellae; annulate stipe; lentiform spores that are limoniform to subhexagonal in face-view; and versiform cheilocystidia. It is macroscopically very similar to *Psilocybe pseudobullacea* but the latter has pleurocystidia, larger spores and subcellular hypodermium.

Specimens examined: India, Kerala State, Thrissur District, Guruvayur: 11 June 1999, A. Thomas T 311; 17 June 1999, A. Thomas T 311b; 14 July 1999, A. Thomas T 311c; 18 October 1999, A. Thomas T 311e; Palakkad, District, Nelliyampathy: 30 August 1999, A. Thomas T 311d; Kasaragod District, Adhoor: 16 September 2000, A. Thomas T311e (all at herb. XAL with part of each collection at herb. L).

15. *Psilocybe subaeruginascens* Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 123(1): 78 (1914).

SEL. DESCR. & FIGS. Guzmán, *Psilocybe*: 216–219 & Figs.215–223 (1983); Thomas et al., Mycotaxon 83: 204–205 (2002).

Psilocybe subaeruginascens has small, bluing basidiomata; conic to conico-convex, subviscid, olive brown, hygrophanous pileus; broadly adnate to adnexed lamellae; annulate stipe; lentiform spores that are limoniform to subrhomboid in face-view; crowded sublageniform cheilocystidia; and scattered pleurocystidia similar to cheilocystidia.

Specimens examined: India, Kerala State, Calicut District, Vellarimala: 19 September 1997, A. Thomas T170; 20 September 1997, A. Thomas T170b; 8 November 1999, A. Thomas T170c (all at herb. XAL with part of each collection at herb. L).

16. *Psilocybe subcubensis* Guzmán, Mycotaxon 7: 248 (1978). **Figure 1**

SEL. DESCR. & FIGS. Guzmán, *Psilocybe*: 249–251 & Figs.427–429 (1983); Thomas et al., Mycotaxon 83: 205–206 (2002).

Psilocybe subcubensis has medium-sized, readily-bluing basidiomata; conic to convex, subviscid, reddish brown, hygrophanous pileus; adnate to adnato-adnexed lamellae; annulate stipe; lentiform spores that are subhexagonal in face-view; crowded ventricose cheilocystidia; and scattered pleurocystidia that are often mucronate.

Specimens examined: India, Kerala State, Wayanad District, Muthanga: 17 June 1997, A. Thomas T76; 25 June 1997, A. Thomas T76b; 4 July 1997, A. Thomas T76c; 19 August 1997, A. Thomas T76d; 1 October 1997, A. Thomas T76e; 26 October 1997, A. Thomas T76f; 25 May 1999, A. Thomas T76g; 21 July 1999, A. Thomas T76h (all at herb. XAL with part of each collection at herb. L); Malappuram District, Nilambur: 28 June 2003, Nisha NVS142.

17. *Stropharia bicolor* Pegler, Kew Bull., Addit. Ser. 6: 463 (1977).

SEL. DESCR. & FIGS. : Pegler, Kew Bull., Addit. Ser. 6: 463–465 (1977).

Constant association with elephant dung, very thick glutinous covering over both the pileus and stipe, tuberculate-punctate lamella-edge, fugacious annulus, lenticular spores that are ovo-ellipsoid to limoniform or subhexagonal in face-view, cylindrical basidia with a median constriction, and narrowly cylindrical cheilocysidia often with a subcapitate apex are characteristic features of this species.

Specimens examined: India, Kerala State, Idukki District, Munnar: 29 August 1997, A. Thomas T152; Palakkad District, Nelliyampathy: 29 August 1999, A. Thomas T152b; 30 August 1999, A. Thomas T152c (all at herb. L).

18. *Stropharia rugosoannulata* Farl. ex Murrill, Mycologia 14: 139 (1922).

SEL. DESCR. & FIGS. Noordeloos, Flora Agaricina Neerlandica 4: 61 (1999).

Stropharia rugosoannulata has medium-sized to large basidiomata; subviscid, reddish brown pileus surface; and ovo-ellipsoid spores. A superior, thick, persistent annulus that is deeply sulcate above and with triangular segments at margin is a diagnostic feature of this species.

Specimens examined: India, Kerala State, Wayanad District, Muthanga: 17 June 1997, A. Thomas T75; 25 June 1997, A. Thomas T75b; 4 July 1997, A. Thomas T75c; 21 July 1999, A. Thomas T75e; 25 July 1999, A. Thomas T75f; Palakkad District, Nelliyampathy: 15 August 1997, A. Thomas T75d (all at herb. L).

19. *Volvariella volvacea* (Bull.) Singer, Lilloa 22: 401 (1951).

SEL. DESCR. & FIGS. : Pegler, Kew Bull., Addit. Ser. 6: 260–263 (1977).

Volvariella volvacea is a medium-sized species with grayish brown, radially fibrillose pileus; brownish, saccate, 2-3 lobed volva; and ellipsoid spores that are less than 10 µm long.

Fig. 1: *Psilocybe subcubensis* growing on elephant dung.

Specimens examined: India, Kerala, Malappuram District, Ramapuram: 11 November 2002, Nisha NVS137; 13 November 2002, Nisha NVS137b; Thrissur District, Guruvayur: 11 April 2003, Nisha NVS137c; 2 July 2003, Nisha NVS137d.

Discussion

The genus with the highest number of species encountered on elephant dung in Kerala was *Psilocybe* (four spp.) closely followed by *Conocybe* (three spp.). In Kerala, the following species have so far been seen only on elephant dung: *Agrocybe guruvayoorensis, Bolbitius coprophilus, Conocybe volvata, C. pseudopubescens, Copelandia cyanescens, Panaeolus antillarum, Panaeolus rickenii, Pholiotina indica, Psilocybe coprophila, Ps. pegleriana, Ps. subaeruginascens, Stropharia bicolor,* and. *Stropharia rugosoannulata*. The following five species are known to grow only on elephant dung: *Agrocybe guruvayoorensis, Conocybe volvata, C. pseudopubescens, Pholiotina indica, Stropharia bicolor*; except for *Stropharia bicolor,* the other four species are to this date known only from Kerala. *Stropharia bicolor* was described by Pegler (1977) from East Africa where also it was constantly associated with elephant dung. *Bolbitius coprophilus, Psilocybe subcubensis,* and *Ps. pegleriana* are coprophilous species known to grow on dung of other animals as well. Other species are known from various substrata including dung of various animals.

This is the first record of *Entoloma anamikum, Macrocybe gigantea,* and *Volvariella volvacea* growing on elephant dung. *Macrocybe gigantea* is remarkable in that it produced the largest basidiomata. This agaric was never observed in isolated droppings in the wild but only on large heaps of dung of tamed elephants in captivity. This is understandable from the huge size of the basidiomata of this agaric which only a large substratum can support. *Entoloma anamikum* was originally described as growing on decaying rice straw (Manimohan et al. 1995) and all our subsequent spottings of this species in Kerala were on ligno-cellulosic material. It seems to be an obligate lignicolous species. Macroscopically, the Kerala collections of *Stropharia rugosoannulata* are indistinguishable from those illustrated by Imazeki et al. (1988) from Japan. To this date, however, *S. rugosoannulata* was known mostly from temperate and occasionally from subtropical localities of the world growing on rotting straw, mulch, etc. Cortez & Coelho (2004) found it growing on soil and litter in subtropical Brazil. Remarkably, all the Kerala collections of *S. rugosoannulata* were found growing on elephant dung.

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Pyrenomycetes of the Russian Far East 2. *Mollicamarops stellata* gen. et sp. nov.

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Abstract–*Mollicamarops stellata* is described from decaying wood. It was collected in the Bastak Nature Reserve (Jewish Autonomous Region, Russia), and is known only from this locality. The description and illustration of this fungus are provided.

Key words–*Boliniaceae*, *Camarops*, eastern Russia, systematics

Introduction

Since publication of the monograph "*Pyrenomycetes* and *Loculoascomycetes*" (Vasilyeva 1998) in the series "Lower plants, fungi, and bryophytes of the Russian Far East," a number of taxa have been described from this region, including the new species *Daldinia singularis* Ju et al. (1999) and *Pyrenomyxa morganii* Stadler et al. (2005), and new monotypic genera (Vasilyeva 2000, 2001) for *Actidiographium orientale* Lar. N. Vassiljeva and *Rossmania ukurunduensis* Lar. N. Vassiljeva. This is the second publication in the series of additions and corrections to the *Pyrenomycetes* and *Loculoascomycetes* of the Russian Far East (see Vasilyeva, 2001).

The Bastak Nature Reserve (Jewish Autonomous Region, Russia), which is in the Russian Far East, was visited for only few days in August 2004 but the few collections that were made then were highly interesting, among them *Hypocrea megalosulphurea* Yoshim. Doi and *Podostroma giganteum* S. Imai. Both of these members of the *Hypocreales* were previously known only from Japan, and are recorded here for the first time in Russia. One intriguing specimen also appeared to be a member of the *Hypocreales* because of its fleshy, brightly colored stroma but its paraphysate hamathecium, darkly pigmented ascospores and black perithecial walls indicated that it is a member of the *Boliniaceae*, a pyrenomycete family of uncertain position. This specimen represents an undescribed species in a new genus. The description of this fungus follows.

Taxonomy

Mollicamarops Lar. N. Vassiljeva, **gen. nov.**
MycoBank # MB510602

Stromata late effusa, tenuata, mollia et colorata; perithecia semiimmersa, ostioli stellati praedita. Asci cylindrici, longe pedicellati, octospori, apparatus apicalis indistinctus et in liquore iodato Melzeri haud caerulescentis; paraphyses abundans et filiformes. Ascosporae uniseriatae, unicellulares, ellipsoideae, brunneae.

Species typica: Mollicamarops stellata sp. nov.

Etymology: from Latin, *mollis* = soft, referring to the consistence of stromata, and *Camarops*, referring to the most similar genus.

Stromata widely effused, thin and soft, colored; perithecia semi-immersed, with black stellate ostioles. **Asci** cylindrical, long-stalked, 8-spored, with indistinct apical apparatus which does not stain in Melzer's iodine reagent. **Paraphyses** abundant and filiform. **Ascospores** uniseriate, unicellular, ellipsoid, brown.

Mollicamarops stellata Lar. N. Vassiljeva, **sp. nov.** Figs. 1–3
MycoBank # MB510603

Stromata late effusa, tenuata, mollia, ochracea vel fulva; perithecia 250–300 µm diam., semiimmersa, parieti nigri et ostioli stellati praedita. Asci cylindrici, octospori, p. sp. 40–55 × 4.5–5 µm, stipitibus 48–65 µm longitudine, apparatus apicalis indistinctus et in liquore iodato Melzeri haud caerulescentis; paraphyses abundans et filiformes, 140-160 µm longis, medio ca. 2 µm latis, apice ad 4-6 µm incrassatis. Ascosporae uniseriatae, unicellulares, ellipsoideae, pallide brunnea, 5–7 × 3.5–4 µm.

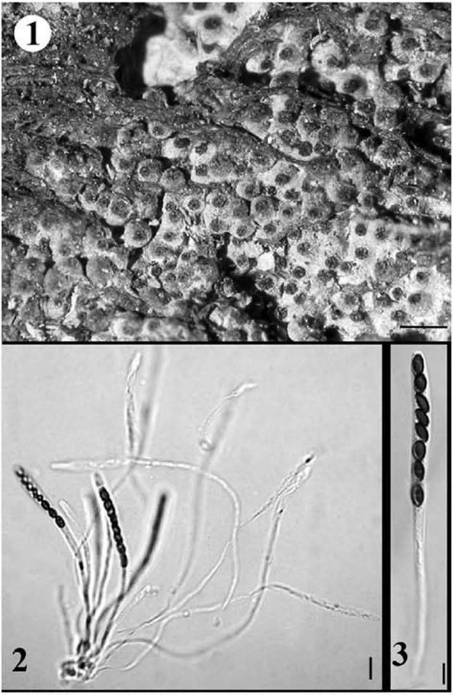
Holotype: Russia, Jewish Autonomous Region, Bastak Nature Reserve, on decaying wood of a deciduous tree, 18 August 2004, leg. Larissa N. Vasilyeva (VLA).

Stromata widely effused, thin and soft, ochreous or fulvous; perithecia 250–300 µm diam., semi-immersed, walls black, ostiolar region conspicuously stellate or furrowed. **Asci** cylindrical, 8-spored, the spore-bearing parts 40–55 x 4.5–5 µm, stipe 48–65 µm, apical apparatus indistinct, KOH-. **Paraphyses** abundant among mature asci, narrow, 140-160 µm long, ca. 2 µm thick in the middle, reaching 4–6 µm at the tip, sinuous. **Ascospores** ellipsoidal, 5–7 × 3.5–4 µm, light brown, unicellular.

Discussion

The dark, stellate perithecial apex that stands out against the brightly colored stroma allows easy recognition of this species. Similar stellate ostiolar regions are also found in the *Diatrypaceae*. I do not see a close relationship between *Mollicamarops* and the *Diatrypaceae* despite this remarkable morphological convergence.

Mollicamarops stellata is somewhat similar to *Camarops flava* Samuels & J. D. Rogers, stromata of which are described as being thin and yellow to tan;



FIGS. 1-3. *Mollicamarops stellata* (VIA, holotype, light microscopy). Fig. 1. Stroma. Fig. 2. Asci and paraphyses. Fig. 3. Ascus and ascospores (scale bars:1 = 2 mm, 2 = 10 µm, 3 = 5 µm).

but the latter species differs in having punctuate, non-stellate ostioles and ornamented ascospores (Samuels & Rogers 1987). *Camarops flava* grows on the pore surface of a decaying polypore and is only known from New Zealand, while *Mollicamarops stellata* occurs on wood in a very distant geographical area. The phenotype of *C. flava* suggestes that it could represent a second species of *Mollicamarops*. The reasons for dividing *Camarops* into several genera on the basis of stromatal type, which parallels the delineation of genera in the families *Diatrypaceae* and *Xylariaceae*, were discussed when the genus *Camaropella* Lar. N. Vassiljeva was established (Vasilyeva 1997).

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Macrofungi of Aydın Province, Turkey

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Abstract — In this study, 2037 specimens of macrofungi were collected from different localities in Aydın province, west Anatolia, between the years 2002 and 2005, particularly during the autumn and spring seasons. As a result of the field and laboratory studies, 226 taxa belonging to 103 genera, and 48 families. Of the two classes represented, 25 taxa belong to *Ascomycetes* and 201 taxa to *Basidiomycetes*. The full checklist is available at http://www.mu.edu.tr/departments/biyoloji/_private/ozgecmisler/hakanalli/macrofungi_aydin.pdf

Key Words — Turkish fungi, macromycota, taxonomy

Introduction

In their paper on past macromycete research conducted in Turkey during 1932–2005, Sesli & Denchev (2005) state that about 1900 macrofungal taxa have thus far been reported from Turkey. However, present studies show that many of the mushroom taxa inhabiting different parts of Turkey have not yet been identified. Our study is the first to report on the macromycota of Aydın province.

Materials and methods

During field trips in the area (Figure 1), morphological and ecological characteristics of the macrofungi were recorded and collections were photographed in their natural habitats before being taken to the laboratory for identification. Specimens were identified by examining their macroscopic and microscopic features, using references by Breitenbach & Kränzlin (1984, 1986, 1991, 1995, 2000), Capelli (1984), Ellis & Ellis (1990), Marchand, (1971, 1973, 1975, 1977, 1980, 1982, 1983, 1986), Moser (1983), Orton & Watling (1979), Orton (1986), Phillips (1981), Watling (1982), and Watling & Gregory (1987, 1989). All collected specimens are now deposited in the fungarium of Muğla University.

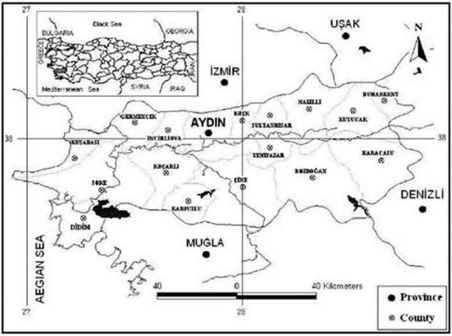

Figure 1. Map of Aydın province, west Anatolia, Turkey. Black indicates the study areas.

Results

In the present study, 226 taxa belonging to 48 families were recovered. Our complete report lists the taxa in alphabetical order. The distribution of the taxa in their families are: *Discinaceae* 2, *Helvellaceae* 7, *Morchellaceae* 9, *Pezizaceae* 4, *Pyronemataceae* 3, *Agaricaceae* 21, *Astraeaceae* 1, *Auriculariaceae* 2, *Bankeraceae* 1, *Bolbitiaceae* 13, *Boletaceae* 4, *Clavulinaceae* 2, *Cortinariaceae* 6, *Entolomataceae* 1, *Ganodermataceae* 5, *Geastraceae* 3, *Gloeophyllaceae* 3, *Gomphidiaceae* 1, *Gyroporaceae* 1, *Hapalopilaceae* 1, *Hydnangiaceae* 2, *Hygrophoraceae* 2, *Hygrophoropsidaceae* 1, *Hymenochaetaceae* 9, *Lycoperdaceae* 10, *Marasmiaceae* 13, *Meruliaceae* 1, *Nidulariaceae* 2, *Omphalotaceae* 1, *Paxillaceae* 1, *Phallaceae* 2, *Phanerochaetaceae* 2, *Pleurotaceae* 3, *Pluteaceae* 17, *Polyporaceae* 17, *Psathyrellaceae* 3, *Rhizopogonaceae* 2, *Russulaceae* 10, *Schizophyllaceae* 1, *Schizoporaceae* 1, *Sclerodermataceae* 3, *Sparassidaceae* 1, *Stereaceae* 6, *Strophariaceae* 10, *Suillaceae* 3, *Tremellaceae* 1, *Tricholomataceae* 10 and *Tulostomataceae* 2.

Discussion

In this study 226 taxa of macrofungi were collected from the study area, of which 25 belong to *Ascomycotina* and 201 to *Basidiomycotina*. There have been some similar studies on the neighborhood regions; Işıloğlu & Watling (1992), Işıloğlu & Öder (1995), Solak et al. (1999), Solak & Yılmaz (2003), Afyon et al. (2005). This is the first detailed study for the region. There are some similarities between this study and mentioned former studies. The reason for these similarities is that four areas have similar habitats and flora. On the other hand, this study is a contribution to Turkish macromycota.

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The discovery of *Amanita lilloi* in Brazil

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Abstract— *Amanita lilloi*, an interesting and rare species is reported for the first time from Brazil.

Key words—*Lepidella*, *Vittadiniae*, taxonomy

Introduction

Amanita Pers. is a well-established genus that is well supported by morphological, biochemical, and molecular data (Weiß et al. 1998, Drehmel et al. 1999, Moncalvo et al. 2000). The main anatomical characterization of this pallid-spored genus is the presence of both bilateral lamella trama and longitudinally acrophysalidic stipe tissue (Bas 1969). Alternatively, schizohymenial development (Reijnders 1963, Bas 1969, Yang & Oberwinkler, 1999) of the basidioma characterizes the genus, in which all structural elements develop within a solid primordium and are separated by development of gelatinizing or friable intermediary tissues allowing edges of lamellae to separate from a partial veil or stipe surface, and hymenial surfaces of lamellae to be segregated from each other (Bas 1969).

The earliest record of this genus in Brazil was given by Rick (1906, 1937), who reported *A. pantherina* (DC. : Fr.) Krombh., *A. spissa* (Fr.) P. Kumm., *A. strobiliformis* (Paulet ex Vittad.) Bertill., *Armillaria bresadolae* Rick (=*Amanita bresadolae* (Rick) Rick nom. inval.) and *Amanitopsis plumbea* Rick, non

(Schaeff.) J. Schröt. from Rio Grande do Sul State. However Rick's publications and remaining material do not support interpretation at present, and these names are currently considered nomina dubia (Singer 1953, Bas 1978). Other authors recorded more species of *Amanita* from some Brazilian States: Homrich (1965) and Sobestiansky (2005) from Rio Grande do Sul; Grandi et al. (1984) and Pegler (1997) from São Paulo; Capelari & Maziero (1988) from Rondônia; Bas & de Meijer (1993), Stijve & de Meijer (1993) and de Meijer (2001) from Paraná and Giachini et al. (2000, 2004) from Santa Catarina.

This paper presents an unreported species of *Amanita* found in the Northeastern Brazilian State of Pernambuco.

Materials and Methods

We follow the methodology of Tulloss (1993). At the beginning of a set of spore data, the notation "[*a*/*b*/*c*]," where *a*, *b*, and *c*, are integers, is to be read "*a* spores were measured from *b* basidiomata taken from *c* collections." When ranges are provided in spore data in the form "(*m*-) *n*–*o* (-*p*)," where *m*, *n*, *o*, and *p* are integers, the values given are to be understood as follows: *m* is the smallest value observed or calculated and *p* is the largest value observed or calculated. In the range of values observed or calculated, the 5th percentile is *n*; and the 95th percentile is *o*.

A summary of definitions of biometric variables follows:

$\mathbf{w}_{cs}$ = breadth of central stratum of lamella

$\mathbf{w}_{st}$- **near** = distance from one side of central stratum to nearest base of basidium

$\mathbf{w}_{st}$- **far** = distance from one side of central stratum to most distant base of basidium on the same side of the central stratum

L, **(W)** = the range of average lengths (widths) of spores of each basidioma examined

L′, **(W′)** = the average of all lengths (widths) of spores measured

Q = the ratio of length to width of a spore or the range of such ratios for all spores measured

Q = the average of **Q** computed for all basidiomata examined

Q′ = the average of all **Q** values computed for all spores measured.

Authorial citations follow Kirk & Ansell (1992). Herbarium codes used follow Holmgren et al. (1990) with the exception of "RET", the private herbarium of Tulloss. Color naming and color codes follow Maerz & Paul (1930).

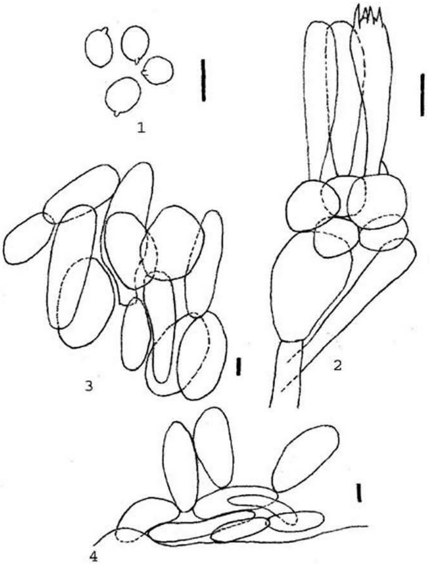
Exsiccata were deposited in the Herbarium of the Mycology Department of the Universidade Federal de Pernambuco (URM), with duplicate material deposited in "RET", the private herbarium of R. E. Tulloss. Generic and infrageneric names and concepts follow Corner & Bas (1962) and Bas (1969).

Taxonomy

Amanita lilloi Singer, in Singer & Digilio, Lilloa 25: 245. 1952 ('1951'). FIGS. 1–5

Pileus: (14–) 20–40 mm wide, subglobose or hemispheric, then expanding to plano-convex and finally plano-concave in some old specimens, white or somewhat light beige ("Putty, Seed Pearl, Cambridge Buff" 11B2); *margin* entire, not striate, appendiculate; *universal veil* as numerous white then cream or yellow ochre (11L7) but rarely beige ("Putty, Seed Pearl, Cambridge Buff" 11B2) pyramidal warts up to 2 mm high in young specimens and having cottony aspect (under 10× lens), becoming scarce in mature specimens and concentrated mainly over disc; *context* fleshy, up to 5 mm thick at center, thinning toward margin, white, unchanging. **Lamellae:** narrowly adnexed in young basidiomata then free, moderately crowded, white then cream-colored and rarely pale yellowish cream (9B1) or more paler than "Polar Bear" (9B2) when fresh, ochraceous in exsiccata, up to 6 mm broad with concolorous edge; *lamellulae* attenuate to subtruncate, evenly distributed. **Stipe:** (16–) 23–50 × (2–) 4–6 mm, cylindrical, white with rather small and sometimes indistinct concolorous squamules; *bulb* radicating 10-20 × 2-9 mm, elongate-fusiform (mainly in young basidiomata) then elongate-radicating, sinuous in some specimens; *context* fleshy, white, unchanging, solid; *partial veil* superior to subsuperior, white, membranous, moderately thick, with verrucose white squamules on margin of lower surface, occasionally deciduous; *universal veil* very scarce or as remnants scattered over surface. **Odor** and **taste,** unpleasant. **Macrochemical spot tests,** none performed.

Basidiospores: [100/5/2] (7–) 7.5–9.5 (–10.5) × (6–) 6.5–7.5 (–8) µm, (**L** = 8–8.6 µm, **L'** = 8·3 µm; **W** = 6.8–7 µm, **W'** = 7 µm; Q = (1.11–) 1.14–1.36 (–1.43); **Q** = 1.16–1.22, **Q'** = 1.2), amyloid, colorless, hyaline, smooth, thin walled, subglobose to broadly ellipsoid occasionally ellipsoid, usually or at least somewhat adaxially flattened; apiculus lateral; contents guttulate; white in deposit. **Basidia:** 32–41 × 9–12 µm, 4-sterigmate, with sterigmata up to 5–7 µm long, clamps present at base, but scarce. **Subhymenium:** up to 23 µm thick, as 2–4 layers of more or less isodiametric cells (e.g., 13.5 × 12.3 µm); w_{st}-near = (29–) 44–69 µm (with some basidia appearing to arise directly from uninflated hyphae of the subhymenial base); w_{st}-far = 66–86 µm. **Lamella trama:** bilateral, with divergence of elements from the central stratum rather abrupt; w_{cs} = 38–57 µm; filamentous undifferentiated hyphae up to 2.5–4 µm wide, usually branched; slightly inflated terminal cells up to 12 µm wide; vascular hyphae 5–6 µm wide, very scarce. **Pileus context:** filamentous undifferentiated hyphae 2.5–5 µm wide, commonly branched, interwoven, forming a loose matrix where other elements occur; acrophysalides 47–54 x 30–37 µm; vascular hyphae 3–14 µm wide, unbranched, with irregular outline in some regions. **Stipe context:**



Figures 1–4. *Amanita lilloi* (from F. Wartchow 2/2005). 1. Basidiospores. 2. Basidium and subhymenium. 3. Elements of the wart (tip). 4. Elements of the wart (base). Scale bar is 10 µm.

longitudinally acrophysalidic; acrophysalides (e.g.) 141 × 20 µm; filamentous undifferentiated hyphae 2.7–6.7 µm wide, branched; vascular hyphae 2–13 µm wide, unbranched. **Pileipellis:** difficult to distinguish. **Universal veil:** *On pileus*: filamentous undifferentiated hyphae 3.5–7.5 µm wide, unbranched, scarce; with elongate-fusiform slender elements at base of warts (42–108 × 12.5–28

Figure 5. *Amanita lilloi*. Basidiomata of the collection F. Wartchow 01/2006.

µm) arising from the pileus context and periclinal orientation near context, becoming anticlinal upward; inflated cells becoming more common toward tips of warts, with cells 61–110 × 23–42 µm, subparallel ascendant, broadly fusoid and clavate, with infrequent ovoid and subglobose cells, hyaline, thin-walled; vascular hyphae not observed; clamps occasional. *On stipe:* scarce, with elements arising from context, similar to cells of universal veil on pileus surface, with inflated cells 40–148 × 15–35 µm. **Partial veil:** undifferentiated hyphae 2-6 µm wide, interwoven, plentiful; inflated cells 10–15 µm wide, infrequent; vascular hyphae 2.5–7.5 µm wide, unbranched, occasional; with elements of universal veil present on lower side, fusiform-elongate 42–111 × 12–45 µm or ovoid (e.g., 23–42 × 16–25 µm), hyaline; clamps rare.

Habitat: On soil in lawn, with some basidiomata at least 1 m from the nearest tree base (*Ficus* sp. - *Moraceae*).

Material examined: BRAZIL. Pernambuco: Recife, Campus UFPE (Reitores Avenue), 05.iv.2005 F. Wartchow 2/2005 (URM 78685, RET); same locality, 28.iii.2006, F. Wartchow 1/2006 (URM 78713, RET).

Additional material examined: ARGENTINA. Buenos Aires: Av. Alvear al 2900, 1949 J. E. Wright B-762 (BAFC); Locality not given, 10.i.1951, R. Singer s.n. (BAFC 30606).

Remarks: *Amanita lilloi* is a typical species of *Amanita* [subgenus *Lepidella* (Roze) Veselý emend. Corner & Bas (1962), section *Lepidella*, subsection *Vittadiniae* Bas (1969), stirps *Vittadinii* (Bas 1969: 347–349)] due to its subglobose to broadly ellipsoid amyloid spores; a non-striate and appendiculate pileus margin; lack of membranous volval limb at the stipe base; the dominance of concatenated, hyaline, elongate-fusiform cells in the universal veil; the frequent presence of clamps at the bases of basidia; and the distribution of volval remnants over the elongated basal part of stipe. Within this stirps, only two unpigmented species belong to the group with spore length under 9.5 µm: *A. lilloi*, originally described from Argentina (Singer & Digilio 1952), and *A. boliviana* Bas nom. prov., known from Bolivia (Bas 1969).

The present collection agrees in several points with *A. lilloi* as characterized by Singer & Digilio (1952) and Bas (1969): (1) the large, white and densely placed floccose pyramidal volval remnants on the pileus; (2) the adnexed lamellae in young basidiomata; (3) and the occurrence in gardens or lawns [although sometimes near woody plants in lawns (according to the annotation of J. E. Wright B-762 in BAFC, and in the case of our collections)]. On the other hand, our material differs from the original description of *A. lilloi* in the present species' (1) the smaller basidiomata, (2) slightly larger basidiospores [an isotype of *A. lilloi* had basidiospores [25/1/1] (6.5–) 7–8.5 × (5.5–) 6–7 µm according to Bas (1969)] and (3) its less squamulose stipe. The amount of volva on the stipe can be easily altered by environmental factors and handling prior to storage in a herbarium. Therefore we further examined the question of spore size.

The examination of some authentic material of *A. lilloi* from Argentina produced spore measurements (from the few undamaged mature spores) having ranges of length, width, and **Q** that contain the ranges of those variables as reported by Bas (above) and are more similar to the spore data reported for the Brazilian material: [39/3/2] (6.5–) 6.7–9 (–10.5) × 5–7 (–8) µm, (**L** = 7.2–8 µm; **L'** = 7.8 µm; **W** = 5.9–6.2 µm; **W'** = 6 µm; **Q** = (1.08–) 1.14–1.49 (–1.5); **Q** = 1.22–1.35 µm; **Q'** = 1.29 µm). We believe that the remaining differences between Argentine and Brazilian material can be attributed to the poor quality of preservation in the BAFC material.

Recently *A. lilloi* was reported again from Argentina, but there appears to have been a misdetermination: the accompanying illustration shows exclusively sub globose elements in the volval remnants (Wright & Albertó 2002: 120-121), which cannot occur in subsection *Vittadiniae* by its definition.

The Brazilian collection of *A. lilloi* resembles *A. boliviana* in the size of its basidiospores [(7.5–) 8–9.5 × 6.5–7.5 (–8.5) µm in *A. boliviana*], but the latter species has smaller squamules on the pileus and an exannulate stipe (Bas 1969).

Moreover, the sole collection of *A. boliviana* comes from a forest habitat.

Species of *Amanita* usually have an ectomycorrhizal relationship with one or more of a large variety of tree species (Trappe 1962, Smith & Read 1997), but there is no record suggesting any mycorrhizal symbiont for *A. lilloi* (see Singer & Digilio 1952, Bas 1969), which appears to occur commonly without or with few woody plants in the vicinity.

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A new species of *Perenniporia* (*Basidiomycota, Aphyllophorales*) from eastern China

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Abstract — A new poroid wood-inhabiting basidiomycete, *Perenniporia rhizomorpha*, collected in Anhui and Fujian Province, eastern China, is described and illustrated. The new species has an annual growth habit, resupinate basidiocarps with a cream buff to yellow buff pore surface, and a cream to buff coloured margin to which rhizomorphs are joined. Microscopically it is characterized by encrusted contextual skeletal hyphae. The basidiospores are ellipsoid, not truncate, dextrinoid and cyanophilous, 5.3–6.5 × 4.1–5.2 µm.

Key words — polypore, taxonomy, wood-rotting fungi

Introduction

Perenniporia Murrill is a large, cosmopolitan genus. According to the modern definition it is characterized by ellipsoid to distinctly truncate basidiospores, which usually are thick-walled, and have a cyanophilous and variably dextrinoid reactions; its hyphal structure is di- to trimitic with clamp connections on generative hyphae, and its vegetative hyphae are cyanophilous, and variably dextrinoid (Decock & Stalpers 2006). Until now 88 species have been described in the genus, and most of them occur in the tropics or subtropics. Extensive studies of the genus have been recently undertaken by Dai et al. (2002), Decock (2001a, b), Decock & Ryvarden (1999a, b, 2000, 2003a, b), Decock et al. (2000, 2001), and Hattori & Lee (1999).

Knowledge of *Perenniporia* in China was summarized by Dai et al. (2002). Recently, two more species of *Perenniporia* new to China were reported by Cui et al. (2006), and altogether 24 species have been recorded from the country. During an investigation of wood-inhabiting fungi in eastern China, an additional undescribed species of *Perenniporia* was found, and it is described here.

Materials and methods

The studied specimens are deposited at the Herbarium of the Institute of Applied Ecology, the Chinese Academy of Sciences (IFP). Measurements and drawings were made from slide preparations stained with Cotton Blue and Melzer's reagent. The microscopic routine used in the study fellow Dai & Niemelä (1997). Spores were measured from sections cut from the tubes. IKI = Melzer's reagent, KOH = 5% potassium hydroxide, and CB = Cotton Blue. CB+ = cyanophilous, CB– = acyanophilous, and IKI– = both inamyloid and indextrinoid reaction. In expressing variation in size of spores, 5% of measurements were excluded from each end of the size range, and are given in parentheses. In the text the following abbreviations are used: L = mean spore length (arithmetic mean of all spores), W = mean spore width (arithmetic mean of all spores), Q = variation in the L/W ratios between the specimens studied (quotient of the mean spore length and the mean spore width), n = number of spores measured from a given number of specimens. The width of a basidium was measured at the thickest part, and the length was measured from the apex (sterigmata excluded) to the basal septum. 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 colour terms are from Petersen (1996) and Anonymous (1969).

Description

Perenniporia rhizomorpha B.K. Cui, Y.C. Dai & Decock, **sp. nov.** Fig. 1

Mycobank # mb510573

Carpophorum annuum, resupinatum. Facies pororum cremeo-bubalina vel luteola, pori rotundi vel angulati, 4–6 per mm. Systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae skeletales subiculi 2.3–4.2 μm in diam. Sporae hyalinae, ellipsoideae, dextrinoideae, CB+, 5.3–6.5 × 4.1–5.2 μm.

Type. — **China.** Anhui Province, Huangshan County, Yellow Mountains National Park, on fallen angiosperm trunk, 13.X.2004 Dai 6165 (holotype in IFP, isotype in HMAS & H).

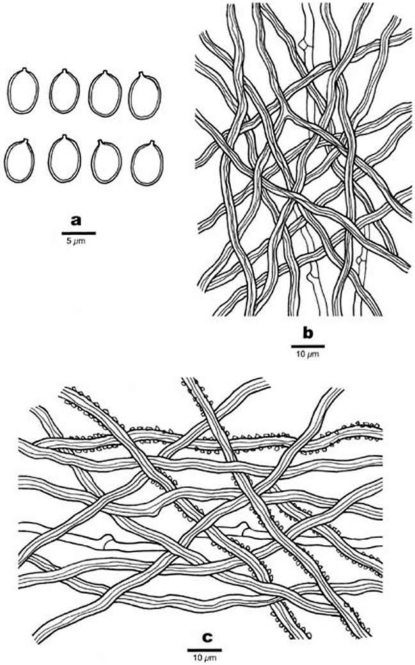

Fig. 1. Microscopic structures of *Perenniporia rhizomorpha* (drawn from the holotype). —a: Basidiospores. —b: Hyphae from trama. —c: Hyphae from subiculum.

Etymology. — *rhizomorpha* (Lat.): referring to the rhizomorphic character of basidiocarps.

Fruitbody. — Basidiocarps annual, resupinate, adnate, corky, without odour or taste when fresh, becoming corky to leathery upon drying, up to 15 cm long, 4 cm wide, and 3 mm thick at centre. Sterile margin distinct, cream buff or yellow-buff to yellowish orange, up to 1 mm wide, usually with cream to buff coloured rhizomorphs. Pore surface cream buff to yellowish buff when fresh, becoming buff to buff-yellow upon drying; pores round to angular, 4–6 per mm; dissepiments thin, entire. Subiculum cream to buff, corky, azonate, up to 1 mm thick. Tubes concolorous with the pore surface, corky to leathery, up to 2 mm long.

Hyphal structure. — Hyphal system dimitic; generative hyphae with clamp connections; skeletal hyphae dextrinoid, CB+, tissue unchanged in KOH.

Subiculum. — Generative hyphae infrequent, hyaline, thin-walled, rarely branched, 1.5–3.3 µm in diam; skeletal hyphae dominant, hyaline, thick-walled with a distinct lumen, rarely branched, interwoven, usually encrusted with fine crystals, 2.3–4.2 µm in diam.

Tubes. — Generative hyphae infrequent, hyaline, thin-walled, occasionally branched, 1.4–3 µm in diam; skeletal hyphae dominant, hyaline, thick-walled with a narrow lumen to subsolid, occasionally branched, strongly interwoven, 1.6–3 µm in diam. Cystidia and cystidioles absent; hymenia collapsed, basidia and basidioles not seen.

Spores. — Basidiospores ellipsoid, not truncate, hyaline, thick-walled, smooth, dextrinoid, CB+, (5–)5.3–6.5(–7) × (4–)4.1–5.2(–6) µm, L = 5.96 µm, W = 4.78 µm, Q = 1.22–1.28 (n = 90/3).

Additional specimens (paratypes) examined. — **China.** Anhui Province, Huangshan County, Yellow Mountains National Park, on fallen angiosperm trunk, 13.X.2004 Dai 6166 (IFP); Fujian Province, Wuyishan County, Wuyishan Nature Reserve, on fallen angiosperm branch, 19.X.2005 Dai 7248 (IFP).

Type of rot. — White rot.

Remarks — Macroscopically, *Perenniporia rhizomorpha* is characterized by an annual growth habit, resupinate basidiocarps with cream to buff coloured rhizomorphs, and a cream-buff to yellow-buff pore surface. Microscopically it is characterized by non-truncate and ellipsoid basidiospores, and by encrusted contextual skeletal hyphae.

Two other *Perenniporia* species produce rhizomorphs at their margins, viz. *P. japonica* (Yasuda) T. Hatt. & Ryvarden (Núñez & Ryvarden 2001) and *P. aurantiaca* (A. David & Rajchenb.) Decock & Ryvarden (Decock & Ryvarden 1999a).

Perenniporia japonica differs from *P. rhizomorpha* by having a whitish to isabelline pore surface, and ellipsoid to truncate and smaller basidiospores (4–5.2 × 3–3.9 µm, Dai et al. 2002).

Perenniporia aurantiaca is distinguished from *P. rhizomorpha* by having a bright orange pore surface, smaller pores (7–8 per mm), and typically truncate and smaller basidiospores (4.2–5.5 × 3–4 µm). Furthermore, the species is endemic to neotropical areas (Decock & Ryvarden 1999a), while *P. rhizomorpha* is from warm- temperate China.

Macroscopically, *Perenniporia rhizomorpha* looks similar to *P. subacida* (Peck) Donk, sharing resupinate, cream to yellowish basidiocarps, and similar pores (4–6 per mm). The unbranched, strongly dextrinoid skeletal hyphae together with non-truncate basidiospores also resemble those of *P. subacida* and both species in all probability belong to the same complex. *P. subacida*, however, lacks rhizomorphs, and its basidiospores are smaller (4.3–5.4 × 3.2–4.1 µm, Dai et al. 2002). In addition, its tramal hyphae are parallel along the tubes, rather than strongly interwoven as in *P. rhizomorpha*.

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A new species of *Haploporus* (*Basidiomycotina*) from China

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Abstract — *Haploporus latisporus* from Central China is described and illustrated as new. It is characterized by small and thin basidiocarps, distinctly thick basidiospores, and by twigs of *Pinus* as substrate. All known species of *Haploporus* are surveyed, and a key for all species in the genus is provided. In addition, based on examination of specimens, spore dimensions of each species are supplied in the key.

Key words — *Aphyllophorales*, polypores, taxonomy

Introduction

Haploporus Bondartsev & Singer (*Polyporaceae*, *Aphyllophorales*) is characterized by a di-trimitic hyphal structure with cyanophilous skeletal hyphae, generative hyphae bearing clamp connections, and by thick-walled, ornamented, cyanophilous basidiospores. The genus is very closely related to *Pachykytospora* Kotl. & Pouzar (Kotlaba & Pouzar 1963), and the latter was merged with *Haploporus* by Dai et al. (2002).

During investigation of wood-inhabiting fungi in Henan Prov., central China, two poroid, resupinate specimens were collected on fallen twigs of *Pinus*. These two specimens have a dimitic to trimitic hyphal structure with generative hyphae bearing clamp connections; skeletal hyphae are cyanophilous, basidiospores are thick-walled, ornamented with warts and cyanophilous. These features are characteristic of *Haploporus*. After checking all species in the genus (Dai & Li 2002, Dai et al. 2002, Hattori 2002, Natarajan & Kolandavelu 1993, Piątek 2005), we could not find an existing name, and the species is here described as new. In addition, after studying all known species of *Haploporus*, a key to species was prepared. Sixty spores or more were measured from each species, and statistical variation of the spore dimensions of each species is included in the key.

Materials and methods

Those specimens collected by the present authors are deposited at the Herbarium of the Institute of Applied Ecology, the Chinese Academy of Sciences (IFP). To support our research specimens from Europe and Africa were also studied. All specimens examined are listed below. Spores were measured and drawn from slide preparations stained with Cotton Blue and Melzer's reagent. Abbreviations: IKI = Melzer's reagent, KOH = 5% potassium hydroxide, CB = Cotton Blue, CB+ = cyanophilous reaction, CB– = acyanophilous, while IKI– = both inamyloid and indextrinoid. At least 60 spores were measured from each species, and statistical variations of spore dimensions of each species are included in the key; 5% of measurements were excluded from each end of the size range and are given in parentheses. In the text the following abbreviations are used: L = mean spore length (arithmetic mean of all spores), W = mean spore width (arithmetic mean of all spores), Q = variation in the L/W ratios between the specimens studied (quotient of the mean spore length and the mean spore width), n = number of spores measured from a given number of specimens. The width of basidia and cystidioles was measured at the thickest part, and the length was measured from the apex (sterigmata excluded) to the basal septum. 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 colour terms are from Petersen (1996) and Anonymous (1969).

Description

Haploporus latisporus Juan Li & Y.C. Dai, **sp. nov.** Fig. 1

MYCOBANK # MB510574

Carpophorum annuum, resupinatum; facies pororum albida vel cremea; pori rotundi vel angulati, 2–3 per mm. Systema hypharum dimiticum vel trimiticum, hyphae generatoriae fibulatae, hyphae skeletales subiculi 1.5–2.4 µm in diam. Sporae hyalinae vel pallide aureae, oblongo-ellipsoideae vel ellipsoideae, crassitunicatae, 13–16.5 × 8–10 µm.

Type. — China. Henan Prov., Xinyang, Jigongshan, on fallen twig of *Pinus*, 23.VIII.2005 Li 131 (Holotype in IFP, isotype in H).

Etymology — *latisporus* (Lat.): referring to the wide spores.

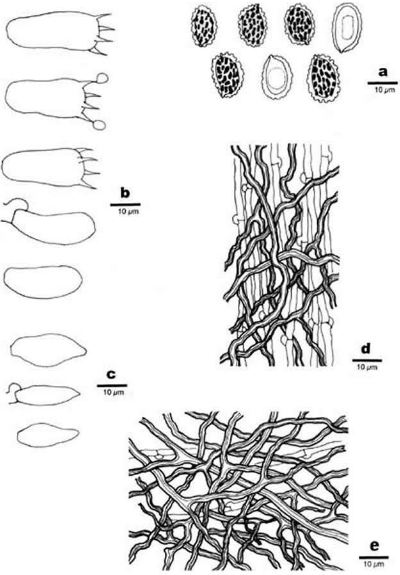

Fig. 1. Anatomical details of *Haploporus latisporus* (drawn from the holotype).
— a: Basidiospores. — b: Basidia and basidioles. — c: Cystidioles.
— d: Hyphae from trama. — e: Hyphae from subiculum.

Fruitbody — Basidiocarps annual, resupinate, mostly in small patches, difficult to separate from the substrate, soft corky when fresh, becoming corky upon drying, single patch up to 2 cm long, 1.5 cm wide and 1 mm thick at centre. Pore surface white to cream, becoming cream to buff-yellow upon drying, sterile margin almost lacking; pores round to angular, (1–)2–3 per mm; dissepiments thin, slightly lacerate. Subiculum white, corky, very thin, almost lacking. Tubes concolorous with pore surface, corky, about 1 mm long.

Hyphal structure — Hyphal system dimitic to trimitic; generative hyphae bearing clamp connections, hyaline, thin-walled; skeletal hyphae dominant, thick-walled, frequently branched, IKI– or very weakly dextrinoid, CB+, tissue unchanged in KOH.

Subiculum — Subicular hyphae tightly interwoven; generative hyphae hyaline, thin-walled, rarely branched, 1.8–3 µm in diam.; skeletal hyphae hyaline, thick-walled with a narrow lumen, flexuous, often branched, 1.5–2.4 µm in diam.; branched hyphae thick-walled with a narrow lumen to subsolid, flexuous, 0.7–2 µm in diam.

Tubes — Tramal hyphae interwoven; generative hyphae frequent, hyaline, thin-walled, rarely branched, 1.5–3.2 µm in diam.; skeletal hyphae thick-walled with a narrow lumen, occasionally branched, 1.8–3.8 µm in diam. Cystidioles present, fusiform, 24–32 × 7–9 µm. Basidia broadly clavate or barrel-shaped with 4-sterigmata and a basal clamp connection, 24–40 × 12–16 µm; basidioles similar in shape to basidia, but slightly smaller.

Spores — Basidiospores oblong-ellipsoid to ellipsoid, hyaline to pale yellowish, thick-walled, ornamented with warts (warts to almost 2 µm length), IKI–, CB+, 13–16.5(–17) × (7.5–)8–10 µm, L = 14.3 µm, W = 8.67 µm, Q = 1.64–1.66 (n = 80/2).

Additional specimen (paratype) examined — China, Henan Prov., Xinyang, Jigongshan, on fallen twig of *Pinus*, 23.VIII.2005 Li 120 (IFP).

The new species is distinguished from other species of *Haploporus* by big, distinctly broad spores (up to 10 µm in width). The pale yellowish spores are unique in the genus, and the ornamentation of the spores extends to 2 µm thick. All previously recorded species of *Haploporus* are found on angiosperm wood, but *H. latisporus* seems to be restricted to pine wood.

Haploporus latisporus has similar pore size to that of *Haploporus thindii* (Natarajan & Koland.) Y.C. Dai (Natarajan & Kolandavelu 1993), *H. papyraceus* (Schwein.) Y.C. Dai & Niemelä (Ryvarden & Johansen 1980), and *H. tuberculosus* (Fr.) Niemelä & Y.C. Dai (Ryvarden & Gilbertson 1994), but the spores of these latter three species are distinctly narrower (less than 8 µm in width), and they are hyaline rather than pale yellowish. In addition, mature basidiocarps of these three species are more than 2 mm thick.

Key to worldwide species of *Haploporus*

(Statistical variation of spore dimensions is included for each species)

1. Basidiospores < 7 μm in length 2
1. Basidiospores > 7 μm in length... 3

2. Basidiocarps pileate, with a strong anise odour when fresh, known from circumboreal forests............... *H. odorus* (Sommerf.) Bondartsev & Singer
(4–)4.5–6(–6.5) × (3.1–)3.7–4.6(–5.5) μm,
L = 5.18 μm, W = 4.05 μm, Q = 1.24–1.32 (n = 120/4)

2. Basidiocarps resupinate, without any odour when fresh, known from tropical African forests............... *H. nanosporus* (A. David & Rajchenb.) M. Piątek
(4.3–)4.5–6(–6.8) × 3–4 μm,
L = 5.33 μm, W = 3.39 μm, Q = 1.51–1.63 (n = 60/2)

3. Basidiospores mostly > 8 μm wide, on gymnosperm................. *H. latisporus*
13–16.5(–17) × (7.5–)8–10 μm,
L = 14.3 μm, W = 8.67 μm, Q = 1.64–1.66 (n = 80/2)

3. Basidiospores mostly < 8 μm wide, on angiosperm.............................. 4

4. Basidiocarps perennial, > 5 mm thick when mature, known from temperate forests . 5

4. Basidiocarps annual, < 3 mm thick when mature, known from subtropical and tropical forests... 7

5. Pores1–2 per mm; skeletal hyphae dextrinoid .... *H. tuberculosus*
(9.9–)10.5–14.8(–15) × (5.1–)5.3–7.9(–8) μm,
L = 12.3 μm, W = 6.35 μm, Q = 1.94 (n = 73/2)

5. Pores 3–4 per mm; skeletal hyphae non-dextrinoid.............................. 6

6. Generative hyphae scanty in subiculum; skeletal hyphae partly amyloid............ .... *H. subtrameteus* (Pilát) Y.C. Dai & Niemelä
(7.9–)8.1–11(–13.7) × (4.7–)4.8–6.3(–6.8) μm,
L = 9.42 um, W = 5.5 μm, Q = 1.68–1.75 (n = 60/2)

6. Generative hyphae abundant in subiculum; skeletal hyphae IKI–......... *H. thindii*
(10.4–)10–16 ×(5.1–)6–7(–7.2) μm,
L = 13.38 μm, W = 6.27 μm, Q = 2.11–2.15 (n = 60/2)

7. Pores 4–5 per mm; dendrohyphidia present at dissepiment edges ....*H. alabamae* (Berk. & Cook) Y.C. Dai
(8–)8.3–12.5(–12.9) × (4–)4.2–6.8(–7) μm,
L = 10.49 μm, W = 5.54 μm, Q = 1.84–1.98 (n = 60/2)

7. Pores 2–3 per mm; dendrohyphyphidia absent .... *H. papyraceus*
(10.5–)11–15(–15.1) × (5.5–)5.6–7(–7.4) μm,
L = 12.56 μm, W = 6.25 μm, Q = 1.92–2.11 (n = 60/2)

Specimens examined. — *H. alabamae*. China. Hainan Prov., Ledong County, Jianfengling Nat. Res., on angiosperm twig, 21.XI.2002 Dai 4363 (IFP). Jiangxi Prov., Wuyishan Nat. Res., 6.VII.1994 Abe (IFP, dupl.). Sichuan Prov., Ermeishan County, Ermei Mts., on fallen angiosperm branch, 19.X.2002 Dai 4285 (IFP). USA. Florida, Gainesville, H.W. Ravenel

Fungi Amer. Exs 110 (isotype, K). — *H. nanospora*. Gabon. Makokou, 5.V.1976 LYAD 2044 (BAFC). Libreville, 20.XI.1977 LYAD 2368 (BAFC). 5.V.1976 LYAD 2044 (BAFC). — *H. odorus*. China. Heilongjiang Prov., Yichun County, Fenlin Nat. Res., on living tree of *Syringa*, 8.IX.2002 Dai 3673 (IFP). Hubei Prov., Shengnongjia Nat. Res., Jinhouling Mts., on fallen angiosperm trunk, 5.IX.2005 Dai Li 595 (IFP). Jilin Prov., Antu County, Changbaishan Nat. Res., on dead tree of *Syringa*, 7.IX.1993 Y.C. Dai 1138; Dunhua County, Huangnihe, on rotten wood of *Salix*, 8.VIII.1997 Dai 2303 (IFP). Shannxi Prov., Mei County, Taibaishan Nat. Res., on living tree of *Salix*, 5.VIII.2006 Dai 7665 (IFP). Finland. Koillissmaa, Oulanka National Park, on living tree of *Salix*, 18.IX.1997 Dai 2693 & Niemelä (IFP). — *H. papyraceus*. China. Hubei Prov., Shengnongjia Nat. Res., Jinhouling Mts., on fallen angiosperm branch, 24.IX.2004 Dai 5865 (IFP). Guangdong Prov., Huidong County, Gutian, on dead branch of living *Rosa*, 24.IX.1986 Zheng 11078 (GDGM). Sichuan Prov., Aba County, Jiuzhaigou Nat. Res., dead tree of *Betula*, 12.X.2002 Dai 4052 (IFP). Taiwan, Pingtung, Payuchi, on angiosperm branch, 18.I.1995 Chen 265 (IFP). USA. North Carolina, Durham, Duke Forest, on muscadine grape stem, 24.XII.1946 Wolf (H). —*H. subtrameteus*. China. Liaoning Prov., Qingyuan County, Dasuhe Forest Farm, on rotten angiosperm trunk, 23.X.2003 Wei 1180 (IFP). Russia. Primorye Terr., Teruci, Sichote-Alinicum, Maisa, on *Padus*, 12.IX.1976 Parmasto (TAA 52498). — *H. thindii*. China. Xizang Autonomous Region, Bayi County, on fallen branch of *Lonicera*, 3.VIII.2004 Dai 5641, Yu & Wang (IFP); on rotten wood of *Lonicera*, 3.VIII.2004 Dai 5651, Yu & Wang (IFP). Linzhi County, Sejila Mts., on dead tree of *Acer*, 31.VIII.2004 Dai 5435, Yu & Wang (IFP). — *H. tuberculosus*. Austria. Ostalpen, Grazer Bergland, Steiermark, *Quercus*, 30.III.1978 Riedl (H). Sweden. Halland, Släp, Särö Västerskog, on dead branches of *Quercus*, 20.VIII.1996 Dai 2252 & Niemelä (H); 6.X.1970 Niemelä (H).

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MYCOTAXON

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A new species of *Hygroaster* (*Hygrophoraceae, Agaricales*) from Colombia

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Abstract—A new taxon of *Hygroaster* is proposed as *H. cleefii*. The collections representing this species were found in tropical lowland forests in the Departments of Caquetá and Chocó and on the Gorgona Islands of Colombia. The small size, the dark color of the basidiocarps and the translucent pileus surface are the macroscopic features that characterize this species. *Hygroaster cleefii* has smaller spores with longer spines than the other darkly pigmented species, *H. nodulisporus*. The presence of clamp connections differentiates *H. cleefii*, from the neotropical species of the genus.

Key words—dipterocarp forest, *Hygrocybe*, *Hygrophorus*, *Omphaliaster*.

Introduction

The genus *Hygroaster* Singer belongs to the family *Hygrophoraceae*, and was segregated from the genus *Hygrophorus* based on the spore morphology and the combination of the presence of divergent lamellar trama and hyphae without clamp connections (Singer 1955). The genus was emended by Ludwig (1997) to include species having clamp connections and subregular hymenophoral trama. Based on the Index fungorum list (http://www.indexfungorum.org/Names/Names.asp), the genus contains six species: *H. nodulisporus*, *H. albellus*, *H. lacteus*, *H. iguazuensis*, *H. agumbensis*, and *H. trachysporus*.

Hygroaster nodulisporus (Dennis) Singer, described from Trinidad (a continental island between Venezuela and the Lesser Antilles), is the type species of the genus and is characterized by having medium-sized basidiocarps and inamyloid, subglobose and stellate spores, 8.5–11 × 7.5–9.5 µm, with ornamentation consisting of obtuse conical spines up to 1.5 µm long (Singer 1955, Pegler 1983). *Hygroaster albellus* Singer, described from Brazil, is a white species characterized by having small basidiocarps and spores 10–14 × 9.5–

13.5 µm, with ornamentation consisting of conical and acute spines up to 3.5 µm long (Singer 1989). *Hygroaster lacteus* E. Ludw. & Ryberg, described from Sweden, is also a white species characterized by having globose to ellipsoid and nodulose spores of 7–10.5(–12) × 7–10.5 µm (including ornamentation), subregular hymenophoral trama, and clamp connections (Ludwig 1997). The most deviant species are *H. iguazuensis* B.E. Lechner & J.E. Wright, recently described from subtropical Argentina, which is characterized by having small and bright orange basidiocarps and polygonal nodulose spores of 5–7 × 3.7–4.5 µm (Lechner et al. 2005), *H. agumbensis* Sathe and S.M. Kulk., described from India, characterized by having pale vinaceous brown pileus and nodulose or angular spores of 6–9 × 5–7.5 µm (Sathe & Kulkarni 1980), and *H. trachysporus* Z.S. Bi, described from China, characterized by having yellow to pinkish basidiocarps, rugulose spores of (9–)11–13(–16) × 6.5–7.2(–8.5) µm, irregular hymenophoral trama and clamp connections (Bi & Li 1988).

Methods

Specimens were collected, documented, photographed, and dried according to Halling (1996), Lodge et al. (2004), and Franco-Molano et al. (2005). Color designations within parentheses are from Kornerup & Wanscher (1983). Line drawings were made with the aid of a drawing tube. All micromorphological structures were measured in 3% KOH. Letter abbreviation describing basidiospore size are n = number of spores measured, Q = mean length/with ratio.

Taxonomy

Hygroaster cleefii Franco-Molano & López-Quintero **sp. nov.**
MycoBank # MB510469 **Figs. 1 & 2.**

Hygroaster cleefii, species distinguenda ab aliis speciebus generis basidiomatibus parvis, obscure olivaceo-brunneis vel brunneo-griseis translucentibus et fibulis praesentibus.

Etymology: Named after Antoine Cleef, who has supported the Botanical and Mycological Research in the Middle Caquetá of Colombia by funding support through international programs for studies in tropical areas.

COLOMBIA. DPTO CAQUETA: Araracuara about 50 km downstream on the Río Caquetá, near Peña Roja, ca 0° 34' S, 79° 08 W at 200-300 m elevation, 3 Sep. 1999, Carlos Lopez-Q. 226 (**Holotype:** HUA). DPTO DE CHOCO: Municipio of Istmina, along of Panamerican Highway, 5 km W of Puerto Nuevo, 13 May 1991, Ana E. Franco-M. 651 (**Paratype:** HUA). PARQUE NATURAL NACIONAL ISLA GORGONA, Margarita Pulido 3330 (**Paratype:** COL).

Pileus: 0.2–1.0 cm in diam., convex to plane-convex, slightly depressed at the center; surface moist, glabrous, translucent, olive-brown (4C4), yellowish brown (5F4) or brownish gray-brown (9F2) overall; margin incurved. **Context:** less than 1 mm thick, concolorous with pileus surface. Odor and taste not

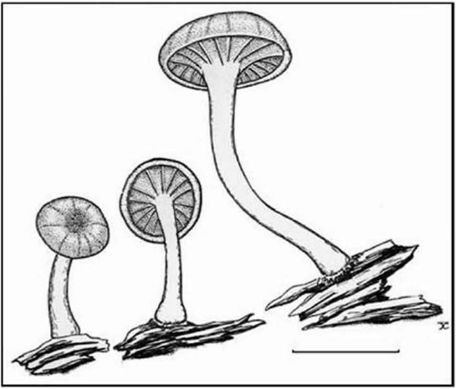

Fig. 1. Habit of *Hygroaster cleefii*. Scale bar = 1 cm.

distinctive. **Lamellae:** up to 0.5 mm broad, concolorous with pileus surface, adnate to slightly subdecurrent, distant. **Stipe:** 0.5–1.5 cm in length, up to 0.12 cm diam. near the apex, central, bulbous at base; surface moist, glabrous, translucent, smooth, concolorous with pileus surface. Basal mycelium poorly developed, white if present. Growing on decayed wood.

Spore print: not obtained. **Basidiospores** (Fig. 2a.): **(7–)8–10 × (5.2–)5.5–7.2** µm (n = 25, Q = 1.35 µm), broadly ellipsoid to subglobose, hyaline in KOH, inamyloid in Melzer's reagent, acyanophilic in Cotton blue; ornamentation consisting of broad conical spines with blunt apices up to 3.2 µm long. **Basidia** (Fig. 2b)**:** 44–65 × 6.5–12 µm, subcylindric to narrowly clavate, four-sterigmate. **Hymenial cystidia:** absent, but sterile, cylindrical to capitate cells, 13.5–17 × 3.2–5.6 µm are often observed (Fig. 2c). **Hymenophoral trama:** divergent from a mediostratum. The mediostratum is composed of parallel hyphae up to 12 µm wide giving rise to diverging hyphae, slightly gelatinized. **Subhymenium:** poorly differentiated. **Pileipellis** (Fig. 2d)**:** formed by an epicutis of subparallel to interwoven hyphae embedded in a gelatinized matrix; hyphae cylindrical to inflated, 5–11.5 µm wide, thin-walled, and frequently filled with light brown

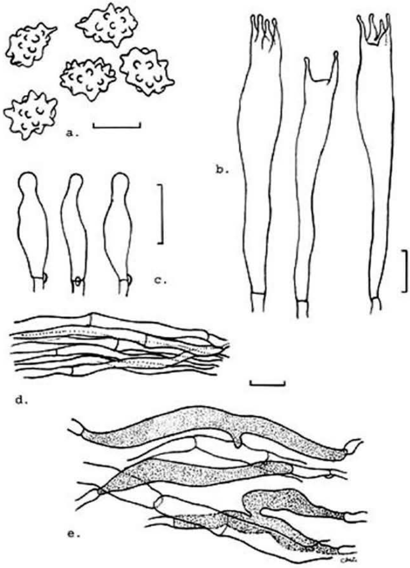

Fig. 2. Microscopic features of *Hygroaster cleefii*.
a. Spores; b. Basidia; c. Hymenial sterile cells; d. Hyphae of pileipellis; e. Oleiferous elements.
Scale bars 10 µm.

content. **Pileal trama:** of interwoven, cylindrical to inflated hyphae, 3.2–12 µm in wide, thin-walled, often branched. Oleiferous elements (Fig. 2e) present but not abundant, sparingly branched and refractive in KOH mounts. **Stipitipellis:** composed of vertically oriented and parallel cylindrical hyphae; hyphae 3.2–7.2 µm wide, thin walled. **Clamp connections:** frequently present.

Discussion

Hygroaster has a tropical and subtropical distribution in the Americas and Asia; the species described from Europe probably belongs somewhere else. *Hygroaster cleefii* constitutes the seventh member for the genus. The proposed species shares with others in the genus most of the macroscopic and microscopic features but differs from them in the combination of small, dark, and translucent basidiocarps, divergent hymenophoral trama and the presence of clamp connections. Besides the combination of size and color of the basidiocarps, *Hygroaster cleefii* can be differentiated from other species of *Hygroaster* by spore size and ornamentation. *Hygroaster cleefii* has smaller spores and longer spines than the other darkly pigmented species, *H. nodulisporus*. The spores of *H. cleefii* are smaller than those of *H. albellus* and have blunt vs. the acute spines in the latter species. *Hygroaster lacteus* also with clamp connections, differs from *H. cleefii* in having white basidiocarps and globose and bigger spores but the former species probably belongs to *Omphaliaster* due to its subparallel hymenophoral trama and because it was growing on mosses. Spores of *H. iguazuensis* are smaller than those of *H. cleefi*, are more elongated, and have a polygonal outline. Spores of *H. iguazuensis* more closely resemble those of spiny-spored forms of *Hygrocybe anomala* from Australia (Young 2005) and *H. insipida* from Europe (Boertmann 1995). Furthermore *Hygroaster iguazuensis* has bright orange basidiocarps, more suggestive of *Hygrocybe* than *Hygroaster*. *Hygroaster trachysporus* with bigger and rugulose spores of (9–)11–13 × 6.5–7.2(–8.5) µm, numerous cheilocystidia and big, yellow to pinkish and glutinous basidiocarps, probably also belongs to *Hygrocybe*. The other species of *Hygroaster*, *H. agumbensis* with pale vinaceous brown pileus, and nodulose or angular spores of 6–9 × 5–7.5 µm is a dubious species poorly described and illustrated that probably belongs to a genus within *Entolomataceae*.

Hygroaster is closely related to *Omphaliaster* Lamoure (Singer 1986) however there are differences between these two genera. The *Hygroaster* species are characterized by their macroscopic appearance to other members of *Hygrophoraceae* and because microscopically the species of this genus have divergent and somewhat gelatinized hymenophoral trama and lack pseudocystidia. Furthermore, basidiocarps of species of *Hygroaster* seem to be restricted to tropical areas growing on soil or on decaying wood. Members of *Omphaliaster* are characterized by an omphalinoid habit with dry pileus surface.

Microscopically the species of this genus are characterized by having regular to irregular not gelatinized hymenophoral trama and by having pseudocystidia as a prolongation of the conducting system into the hymenium. *Omphaliaster* seems to be a temperate to boreal genus and its members grow associated with mosses.

Key to Neotropical species of *Hygroaster*

1. Clamp connections absent. 2
1. Clamp connections present. 3

2. Basidiocarps medium sized and pileus darkly pigmented; spores stellate, 8.5–11 × 7.5–9.5 µm, with ornamentation consisting of obtuse conical spines up to 1.5 µm long. .... *H. nodulisporus*
2. Basidiocarps small and white overall; spores 10–14 × 9.5–13.5 µm, with ornamentation consisting of conical and acute spines up to 3.5 µm long. .... *Hygroaster albellus*

3. Basidiocarps small and darkly pigmented; spores 8–10 x 5.4–7.2 µm with an ornamentation consisting of broad conical spines with blunt apices up to 3.2 µm long. .... *H. cleefii*
3. Basidocarps small and white; spores of 7–10.5(–12) µm (including ornamentation), ornamentation consisting of broad conical spines with blunt apices up to 2.3(–3) µm long. .... *H. lacteus* (probably an *Omphaliaster*, not found in the Neotropics)

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Two new records of *Entyloma* (*Entylomatales*) from China

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Abstract—A new Chinese record, *Entyloma ranunculi-repentis* on *Ranunculus japonicus*, and a new Asian record, *Entyloma erodii* on *Geranium* sp. are described. These specimens were collected in Xinjiang Uygur Autonomous Region, Northwestern China.

Key words—*Ustilaginomycetes*, smut fungi, taxonomy

A specimen of *Entyloma* on *Ranunculus japonicus* was collected from Xinjiang Uygur Autonomous Region, Northwestern China in 2003. This species is parasitic on the leaves, causing round or angular spots. The host plant belongs to the family *Ranunculaceae*. So far, 5 species of the genus *Entyloma* on *Ranunculus* have been recognized: 1) *Entyloma microsporum* (Unger) J. Schröt. (Rabenhorst 1874), 2) *Entyloma ficariae* A.A. Fisch. Waldh. (Fischer von Waldheim 1877), 3) *Entyloma verruculosum* Pass. (Passerini 1877), 4) *Entyloma ranunculi-repentis*, and 5) *Entyloma ameghinoi* Speg. (Spegazzini 1902). The specimen from China is identified as *Entyloma ranunculi-repentis*, which is new to China.

Entyloma ranunculi-repentis Sternon, L'hétérogenité du genre Ramularia p. 34, 1925. **Figs. 1-2**

Sori in leaves as round or angular spots, 1–5 mm in diam., pale yellow. Ustilospores globose, subglobose, ovoid, sometimes slighty irregular, 8–15 x 8–12.5 µm, light yellowish-brown; wall smooth, even, 1–1.5(–2) µm thick.

Specimen examined—On *Ranunculus japonicus* Thunb. (*Ranunculaceae*), Xinjiang: Burqin, Hemuxiang, alt. 1100 m, 15 VIII 2003, L. Guo & H.C. Zhang 2148, HMAS 161138.

*corresponding author

Entyloma ranunculi-repentis is similar to *Entyloma ficariae* from which it differs in the smaller ustilospores and thinner walls, while *Entyloma ficariae* has larger ustilospores, 10.5–16(–20) x 10–14.5 µm and thicker walls, 1–2.5(–3) µm (Vánky 1994).

A specimen of *Entyloma* on *Geranium* sp. was collected from Xinjiang Uygur Autonomous Region, Northwestern China in 2003. This species is parasitic on leaves, causing round or irregular spots. The host plant belongs to *Geraniaceae*. So far, only two species of *Entyloma* have been recognized on *Geraniaceae* in the world: *Entyloma erodii* on *Erodium laciniatum* Willd. distributed in Tunisia and *Entyloma atlanticum* Massenot on *Geranium* distributed in North Africa and Southwest Asia. The specimen of China is identified as *Entyloma erodii*, which is new to China and Asia. It is the first smut species on the family *Geraniaceae* from China.

Entyloma erodii Vánky, Mycotaxon 40: 159, 1991. **Figs. 3-4**

Sori in leaves, forming round, irregular, slightly pustular, pale brown spots, 1–5 mm in diam. Ustilospores most globose, subglobose, ovoid, ellipsoid, sometimes subpolygonally irregular, 8–14.5 x 7.5–12.5 µm, subhyaline or pale yellowish-brown; wall smooth, most evenly thickened, a few unevenly thickened at the angles, 0.5–1(–1.5) µm.

Specimen examined—On *Geranium* sp. (*Geraniaceae*), Xinjiang: Yining, Qapqal, alt. 520 m, 13 VIII 2003, L. Guo & H.C. Zhang 2213, HMAS 162296.

According to Vánky (2002) about 180 species of *Entyloma* have been found on plants belonging to 25 families. Tai (1979) listed 7 *Entyloma* species in China, but two of them have recently been shown to belong to other genera: *Entyloma oryzae* Syd. & P. Syd. (≡ *Eballistra oryzae*; Bauer et al. 2001) and *Entyloma eleocharidis* L. Ling (≡ *Jamesdicksonia eleocharidis*; Vánky 2004). So far, only 7 species (including the two species reported in this paper) of *Entyloma* have been recognized in China. They are *Entyloma australe* Speg., *Entyloma compositarum* Farl., *Entyloma dahliae* Syd. & P. Syd., *Entyloma guaraniticum* Speg. and *Entyloma microsporum*. Certainly, there are many *Entyloma* species still to be discovered from China.

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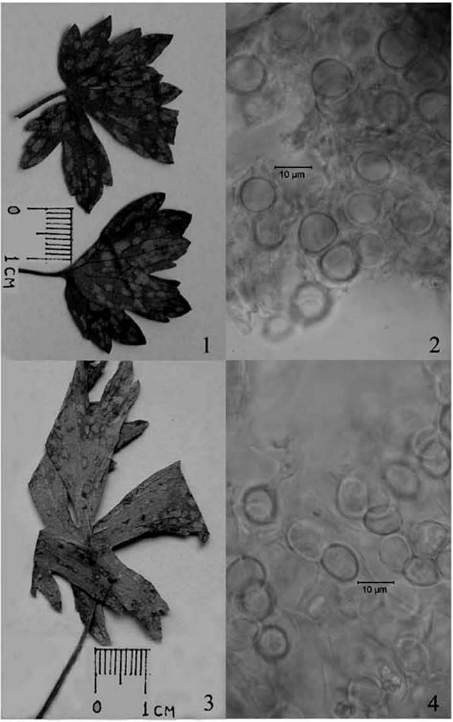
Figs. 1-2. *Entyloma ranunculi-repentis* on *Ranunculus japonicus* (HMAS 161138). Fig. 1. Sori. Fig. 2. Ustilospores as seen by LM (light microscopy). Figs. 3-4. *Entyloma erodii* on *Geranium* sp. (HMAS 162296). Fig. 3. Sori. Fig. 4. Ustilospores as seen by LM.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New records of pyrenocarpous lichenicolous fungi from Turkey

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Abstract—This study reports eight species of lichenicolous fungi from Turkey. Five of these taxa, *Endococcus propinquus*, *E. rugulosus*, *Polycoccum cartilaginosum*, *P. crassum* and *Stigmidium psorae* are new records for Turkey. The others, *Arthonia epiphyscia*, *Stigmidium tabacinae* and *Weddellomyces turcicus*, are only recorded for the second time from Turkey. Comments on habitat, substrata and ascospore structures are given for each taxon with a short description. More detailed information is given for *Weddellomyces turcicus*, which was described from only one specimen.

Key words—*Ascomycota*, pyrenocarpous fungi, lichens

Introduction

Many fewer taxa of lichenicolous fungi have been reported from Turkey when compared to other countries in Europe (Faltynowicz 2003, Hawksworth 2003, Scholz 2000). Hafellner & John (2006) reported that 63 infrageneric taxa of lichenicolous fungi were known in Turkey. With recent publications that were not included in that paper, the number of lichenicolous fungi taxa reached 68 (Halıcı et al. 2005, 2006). To make contribution for the determination of the lichenicolous fungi flora of Turkey, the part of the lichen collection in the ANES (Herbarium of Anadolu University, Science Faculty, Eskişehir, Turkey) was reinvestigated with collaboration of MGH. This paper is a result of this study. This contribution reports five more species of lichenicolous fungi as new records for Turkey and three species as second records.

Materials and methods

The specimens are stored in ANES (Herbarium of Anadolu University, Science Faculty, Eskişehir, Turkey) and their herbarium numbers are given in parentheses after the locality details. The specimens were examined with a Leica MZ6 model stereo, and an Olympus BX51 microscopes. Specimens were examined in water, 10% KOH, Lugols iodine solution or lactofuchsin. Spore measurements were generally carried out in KOH, but in the case of thin walled spores these were also checked in water.

Species recorded

Arthonia epiphyscia Nyl. 1875

Detailed descriptions are provided by Santesson (1960: 500-501), Vězda (1970: 221), Hawksworth (1975: 186) and Alstrup (1981: 121-122).

The specimen was collected from the thallus of *Phaeophyscia orbicularis* on bark of *Pyrus* sp. This species seems to be commensalistic as no damage or discolorations were observed in the host thallus. Ascomata arthonioid, exciple absent, paraphyses branched and anastomosed. Asci broadly clavate, 8-spored. Ascospores all 1-septate, hyaline, 10–13 × 4–5 µm diam. Hypothecium dark brown and hymenium I + red (without pre-treatment with K).

In Turkey, previously recorded only from İzmir (Hafellner & John 2006). New record for Manisa province.

Known from Greenland on thalli of *Physcia* spp., *Phaeophyscia* spp., *Caloplaca saxicola*, *Xanthoria parietina* and *Phaeorrhiza nimbosa* (Alstrup & Hawksworth 1990) and South America on thalli of *Physcia caesia* (Wedin 1994).

MANISA: Kula, Northwest of Kula Town, 38° 34' N, 28° 38' E, alt. 680 m, on thallus of *Phaeophyscia orbicularis* on *Pyrus* sp., 14 Aug. 2006, M. Candan (ANES 10156).

Endococcus propinquus (Körb.) D.Hawksw. 1979

Detailed descriptions are provided by Hawksworth (1979: 285) and Rambold et al. (1990).

The specimen was collected from the thallus of an unidentified brown crustose lichen. Our specimen of this species seems to be pathogenic as ascomata production is suppressed, but no bleaching or discolorations were observed in the host thallus. According to Alstrup & Hawksworth (1990), the host apothecia of lichens which are infected by this species may be suppressed. Our observation confirms this data. Ascomata perithecioid, ~200 µm. Wall around ostiolum has brown hyphae over its surface, long celled hyphae. Hamathecium with broad periphysoids. Asci 8-spored, ascospores 1-septate, brown, 9–11 × 6–7 µm diam, spore wall with a smooth epispore.

New record for Turkey. Known also from Europe, Greenland and N. America on a wide range of crustose, saxicolous lichens (Alstrup & Hawksworth 1990) and worldwide in suitable habitats on *Amygdalaria*, *Koerberiella*, *Porpidia* and *Stenhammarella* (Rambold et al. 1990).

ADIYAMAN: Sincik, Southwest of Sincik, 38° 01'04" N, 38° 37'14" E, alt. 1300 m, on an unidentified brown crustose lichen on calcareous rocks, 29 Jul. 2004, M. Candan (ANES 10157).

Endococcus rugulosus (Borrer ex Leight.) Nyl. 1855

A detailed description is provided by Hawksworth (1979: 287-288).

The specimen was collected from the thallus of an unidentified *Aspicilia* which shows a K – reaction, on siliceous rocks. This species seems to be pathogenic as apothecia production is suppressed in the host lichen and also bleaching is observed in the infected areas of the host thallus. Ascomata perithecia; ± immersed, 180–220 µm diam. Asci 8-spored, ascospores with both ends rounded and not constricted at the septum, 11–15(–16) × 5–7 µm.

New record for Turkey. Known worldwide on a wide range of saxicolous, crustose species (Alstrup & Hawksworth 1990).

MALATYA: North of Tokluca Village, 38° 17'38" N, 38° 31'04" E, alt. 1104 m, on thallus of *Aspicilia* sp. on siliceous rocks, 24 Aug. 2003, M. Candan (ANES 10158).

Polycoccum cartilaginosum (Arnold) D.Hawksw. 1985

A detailed description is provided by Hawksworth & Diederich (1988: 297).

The specimen grows on the thallus of *Acarospora cervina*. It seems to be commensalistic as no damage, bleaching or discolorations were observed in the host thallus. Ascomata perithecia; immersed in the host thallus and ~ 200 µm diam. Hamathecial gelatine I –. Asci 8-spored first, 4-spored when mature, ascospores dark brown, 1-septate, verruculose, 27–33 × 8–9 µm.

New record for Turkey. Known also from Italy on an unknown host (Hawksworth & Diederich 1988).

MALATYA: Hekimhan, East of kurşunlu Village, 38° 40' N, 37° 52' E, alt. 1820 m, on thallus of *Acarospora cervina* on calcareous rocks, 19 Aug.2005, M. Candan (ANES 9837).

Polycoccum crassum Vězda 1970

A detailed description is provided by Hawksworth & Diederich (1988: 300).

The specimen was collected from the lower side of *Peltigera* sp. thallus. It seems to be commensalistic as no damage, bleaching or discolorations were observed in the host thallus. Ascomata erumpent, obpyriform, ~ 400 µm diam. Hymenial gelatine I + orange-red. Asci 4-spored, ascospores ± uniseriately arranged, cells ± equal in size, 25–30 × 8–10 µm. 1–2 guttules are often present in the ascospores.

New record for Turkey. Known also from the British Isles, Czechoslovakia and Luxembourg on several *Peltigera* species (Hawksworth & Diederich 1988).

MALATYA: Doğanşehir, near the border of Malatya-Adıyaman Provinces, 37° 54' N, 37° 48' E, alt. 870 m, on thallus of *Peltigera* sp. on soil, 14 Aug.2005, leg. M. Candan (ANES 10154).

Stigmidium psorae (Anzi) Hafellner 1984

Detailed descriptions are provided by Triebel (1989) and Calatayud & Triebel (1999).

The specimen was collected from the thallus of *Psora decipiens* growing on gypsum. As the infected parts of the host thallus are bleached, this species seems to be weakly pathogenic despite the reports of this species as commensalistic on the host thalli (Calatayud & Triebel 2003). Ascomata perithecia; globose, 125–150 µm diam., erumpent. Hymenial gelatine I –, Asci Lugole's I + red (without pre-treatment with K), 8-spored, 49–52 × 19–20 µm. Ascospores 1-septate, hyaline, 15–16 × 5–6 µm.

New record for Turkey. Known also from Spain and Austria on *Psora crenata*, *P. decipiens* and *P. saviczii* (Calatayud & Triebel 2003).

ANKARA: *Polatlı, 129th km of Eskişehir-Ankara highway, alt. 750 m, on thallus of Psora decipiens on gypsum, 6 Jul. 2004, A. Türk & V. John (ANES 10144).*

Stigmidium tabacinae (Arnold) Triebel 1989

A detailed description is provided by Triebel (1989).

The specimen was collected from thalli of *Toninia sedifolia* on calcareous rocks. The species seems to be commensalistic as no damage was observed in the host thalli. Ascomata perithecia; 65 × 75 µm diam. Ascospores hyaline, 1-septate, 10–16 × 3 µm.

In Turkey, previously recorded from İzmir (Hafellner & John 2006). New record for Elazığ and Manisa provinces.

Known also from Spain and Great Britain on thalli of *Toninia tristis*, *T. toepfferii*, *T. sedifolia* and *Lecania olivacea* (Triebel 1989).

ELAZIĞ: Southwest of Hıdırbaba Village, 38° 45' N, 39° 00' E, alt. 1120 m, on thallus of *Toninia sedifolia* on calcareous rocks, 04 Aug.2004, M. Candan (ANES 10158).

MANISA: Kula, North of Sandal Village, 38° 35' N, 28° 34' E, alt. 692 m, on thallus of *Toninia sedifolia* on calcareous rocks, 15 Aug. 2006, M. Candan (ANES 10152).

Weddellomyces turcicus Halıcı & Orange 2005

A detailed description is provided by Halıcı et al. (2005).

The original description of this species was based on only one specimen, collected from the thallus of an unidentified grey placodioid *Acarospora* in Turkey. This species differs from other species of the genus in the asci being 2-spored when mature. Ascospore sizes are given as 50–55.*6*–61(–69) × (16.5–)18.5–*19.9*–21.5(–22) µm (Halıcı et al. 2005). The second collection of this species from the thallus of *Acarospora cervina* shows all characteristics of the holotype with 2-spored asci when mature but ascospores are 34–43 × 15–16 µm. Halıcı et al. (2005) reported that this species is likely to be pathogenic, as it occurs on two small, bleached areas of host thallus. The second collection shows that this species can also be commensalisitic as well, because no bleaching was observed in the host thallus.

New record for Malatya province.

> MALATYA: South of venk Village, North skirts of Bey (Şilan) Mountain, 38° 19' N, 38° 22' E, alt. 1450 m, on thallus of *Acarospora cervina* on calcareous rocks, 21 Jul.2005, M. Candan (ANES 10146).

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Entophlyctis luteolus in the Brazilian Atlantic Rainforest

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Abstract—We found *Entophlyctis luteolus* on cellulosic baits placed with water and soil samples collected from the Brazilian Atlantic Rainforest. Although we were unable to isolate this species into pure culture because of contaminants, its morphology matches that of the type. We describe and illustrate Brazilian examples of this chytrid, which occurred in 26% of our baited samples, and describe germination of resistant sporangia.

Key words—Brazil, *Chytridiomycota*, *Fungi*

Introduction

Entophlyctis luteolus is the most recently described (Longcore 1995) species of the genus *Entophlyctis* A. Fisch., which includes nineteen species (Kirk et al. 2001), some of which may be more properly placed in *Powellomyces* (*Spizellomycetales*) (Longcore et al. 1995) or other chytridialean genera, e.g., "*Entophlyctis* development" (James et al. 2000) and *E. apiculata* (A. Braun) A. Fisch. (Shin et al. 2001) have zoospore features or molecular signatures that place them outside of the *Chytridiaceae*. This species was isolated from moribund plant material collected from aquatic habitats in the states of Maine and Michigan (U.S.A.) (Longcore 1995). The species is characterized by hyaline, spherical zoosporangia that are formed endogenously or exogenously. Zoosporangia usually have two rhizoidal axes, the bases of which are slightly swollen. Zoospores with single lipid globules discharge en masse after the deliquescence of the tip of the discharge tube. Asexually developed resistant sporangia are yellow with smooth walls and granular contents; their germination was not observed (Longcore 1995). As determined by analyses of its combined partial SSU and LSU rRNA gene sequences, *E. luteolus* groups phylogenetically in a clade of cellulosic chytrids within the *Chytridiaceae* sensu Letcher et al. (2005). This species has not been reported since its original description; we herein record its frequent occurrence from samples collected from the Brazilian Atlantic Rainforest of São Paulo State, Brazil and illustrate the heretofore unreported germination of the resistant sporangia.

Material and methods

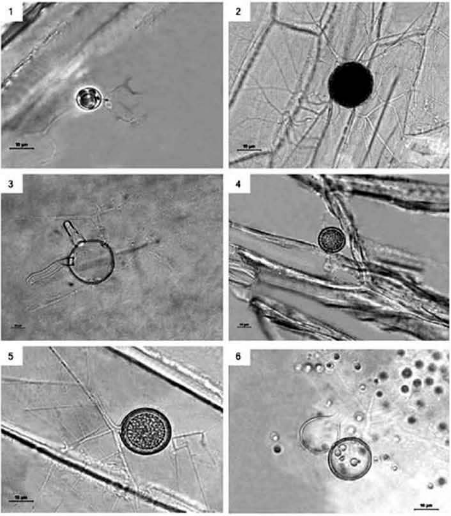
We collected water and soil samples from Brazilian Atlantic Rainforest sites in São Paulo State (Reserva Biológica de Paranapiacaba - 23°46'S 46°18'W every three months from November 2003 to November 2004, and monthly from June 2005 to June 2006 from Parque Estadual da Serra da Cantareira - 23° 32'36"S 46°37'59"W. In the laboratory we baited samples with the multiple baiting technique of Milanez (1989) to study the diversity of zoosporic fungi. We identified chytrids with the specific literature (Sparrow 1960, Booth 1971, Karling 1977, Longcore 1995), and have placed slides preserved with lactophenol-cotton blue in the fungal herbarium of the Instituto de Botânica de São Paulo (SP).

Results and Discussion

Entophlyctis luteolus specimens grew on cellulosic baits (onion skin and corn straw) and occurred in 69 (26%) of 262 baited water and soil samples. The description of the Brazilian specimens below was based on the organism growing in onion skin used as bait because the presence of contaminants made obtaining pure cultures impossible. In this substrate, zoosporangia and resistant sporangia formed abundantly after one week and rhizoids were easily observed (Figs. 1, 2, 5). The characteristics of rhizoids and zoosporangia agree with those of the original description (Longcore 1995) as do the discharge tubes (Fig. 3), but the inner walls of some resistant sporangia appear irregular. Zoosporangia developed endobiotically and epibiotically on the onion skin and resistant sporangia (Figs. 4, 5) were borne like the zoosporangia. Resistant sporangia functioned as prosporangia during germination and external, thin walled zoosporangia were produced (Fig. 6).

Entophlyctis luteolus Longcore, Mycologia 87(1): 27. 1995. **Figs. 1-6**
TYPE: United States (ATCC 90967)

Thallus eucarpic, monocentric, epibiotic or endobiotic. Zoosporangium inoperculate, hyaline, formed endogenously or exogenously, spherical, 15–42.5 (–50) µm in diameter; smooth wall. Zoospores with a single lipid globule, escaping by 1–2 (–4) discharge tubes; encysted zoospore 4–5 µm in diameter. Resistant sporangia borne like zoosporangia, yellow, granular contents, spherical, 15–25 (–35) µm in diameter; outer and inner walls smooth, the inner sometimes irregular. Resistant sporangia function as prosporangia during germination forming external, thin-walled zoosporangia.



Figures 1-6. *Entophlyctis luteolus*. 1. Exogenous development. 2. Zoosporangium. 3. Empty zoosporangium with two discharge tubes. 4. Exogenous resistant sporangium. 5. Morphology of an endogenous resistant sporangium. 6. Germination of the resistant sporangium, in which it functions as a prosporangium.

REPRESENTATIVE SPECIMENS EXAMINED— **BRAZIL. São Paulo: Santo André**, Reserva Biológica de Paranapiacaba, water and soil samples, on onion skin and corn straw, (23°46'78"S 46°18'55"W, 23°46'52"S 46°18'77"W, 23°46'53"S 46°18'75"W, 23°46'53"S 46°18'69"W, 20 November 2003), (23°46'78"S 46°18'55"W, 23°46'52"S 46°18'77"W, 23°46'53"S 46°18'69"W, 23°46'77"S 46°18'56"W, 26 February 2004), (23°46'78"S 46°18'55"W, 23°46'53"S 46°18'75"W, 23°46'52"S 46°18'77"W, 23°46'77"S

46°18'56"W, 26 May 2004), (23°46'78"S 46°18'55"W, 23°46'53"S 46°18'75"W, 23°46'52"S 46°18'77"W, 23°46'53"S 46°18'69"W, 26 August 2004), (23°46'78"S 46°18'55"W, 23°46'52"S 46°18'77"W, 23°46'53"S 46°18'75"W, 18 November 2004); **São Paulo**, Parque Estadual da Serra da Cantareira, water and soil, on onion skin and corn straw, (20°00'00"S 47°48'75", 08 June 2005, 06 July 2005, 11 August 2005, 21 September 2005, 17 November 2005, 07 December 2005, 26 January 2006, 22 February 2006, 31 March 2006, 19 May 2006), *Pires-Zottarelli, C.L.A.* SP 381557.

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Two new species of *Punctelia* (*Parmeliaceae*) from southern Brazil

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Abstract—During a survey of *Parmeliaceae* species in the area of Fazenda da Estrela, in the municipality of Vacaria, Rio Grande do Sul State, we discovered two new species of *Punctelia*: *P. fimbriata* and *P. purpurascens*.

Key words—*Punctelia constantimontium*, *Punctelia bolliana*, gyrophoric acid, lecanoric acid

Introduction

The genus *Punctelia*, proposed by Krog (1982), is characterized by the pseudocyphellae on the upper surface, filiform or unciform conidia, and the presence of fatty acids, lecanoric acid, or gyrophoric acid in the medulla. Thirty *Punctelia* species have been described (Egan & Aptroot 2004); 16 species are known for Brazil (Marcelli 2004) and 13 for the Rio Grande do Sul State (Spielmann 2006). During a survey of *Parmeliaceae* in the area of Fazenda da Estrela (Canêz 2005), two new species of *Punctelia* were recognized and are formally described here. Fazenda da Estrela, with an area of 287 km^2, is situated in the Vacaria municipality, which is located on the northern highlands of Rio Grande do Sul State, southern Brazil. *Araucaria angustifolia* (Bertol.) Kuntze forests and natural fields are the predominant vegetational types.

Materials and methods

The specimens were described using standard stereoscopic and light microscopic examination. The anatomical sections, especially of apothecia and pycnidia, were made with razor blade hand sections. Spot tests were performed with potassium hydroxide (K), sodium hypochlorite (C), para-phenylenediamine (P) for all specimens. All taxa were also examined under UV light. Thin-layer chromatography (TLC) was performed using established procedures in solvents A and C (Bungartz 2001), and lichen substances were identified by consulting Huneck & Yoshimura (1996) and Orange et al. (2001).

The diagnosis refers exclusively to the holotype characters and the English descriptions to all the studied material.

The species

Punctelia fimbriata Marcelli & Canêz, sp. nov. Fig. 1

MycoBank MB 510353

Diagnosis: *Affinis Punctelia constantimontium sed margine fimbriatus, phyllidia irregularia et erecta differt.*

Holotypus– Brazil, Rio Grande do Sul State, Municipality of Vacaria, Fazenda da Estrela, open field, 28°04'15.9"S, 50°55'11.0"W, 850 m alt., on orange tree trunk in a abandoned farm, leg. *L. S. Canêz & A. A. Spielmann 977*, 12-I-2004 (SP, isotypes in B and H).

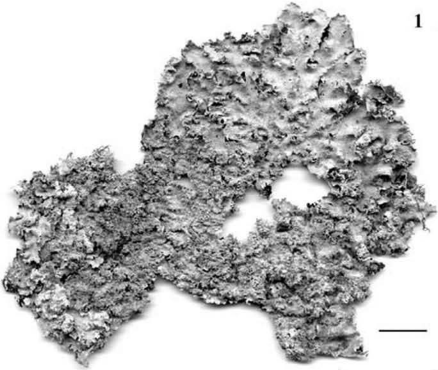
Thallus greenish gray, lobate, 10 cm in diameter; lobes irregularly branched, 1.0–5.0 mm wide, adnate, contiguous, apices rounded, sometimes pruinose, margins crenate to crenulate, with a fimbriate aspect (phyllidiate), elevated, upper surface continuous, smooth; lacinulae absent; maculae weak to distinct, punctiform, laminal; pseudocyphellae white, rounded, rarely ellipsoid, plane, less frequently marginate, 0.05–0.12 (–0.20) mm in diameter, more frequently located in the distal area, becoming densely phyllidiate in the center of the thallus; cilia absent. **Pustulae** absent. **Soralia** absent. **Isidia** absent. **Phyllidia** varying from simple to irregular and coralloid, ascending to erect, 0.2–0.5 × 0.2–0.4 mm, apices round and slightly dissected, distributed on the margins of the lobes and margins of the pseudocyphellae, the older ones becoming corticate below (lobulae) from base to apices. **Medulla** white, pigment absent. **Lower surface** black, shiny to opaque, smooth to slightly papillate; margin pale brown to rarely white, shiny, naked, 0.8–1.5 mm wide, smooth; rhizinae black, frequently with white apices, simple, 0.25–0.80 × <0.05 mm, frequent, evenly distributed. **Apothecia** absent. **Pycnidia** absent.

Spot tests: cortex K+ yellow, UV–; medulla K–, C+ rose, KC + rose, P–, UV–.

TLC: traces of atranorin (cortex) and gyrophoric acid (medulla).

Comments– *Punctelia fimbriata* is characterized by the very delicate marginal phyllidia (without lower cortex) that may become lobulate (with lower cortex) when older and so give the margin a fimbriate appearance. Frequently these phyllidia are disposed in a continuous manner and resemble a fringe surrounding the lobes. *Punctelia fimbriata* has a black lower surface and produces gyrophoric acid (C+ rose) in the medulla similar to *P. colombiana* Sérus., which has coralloid isidia. *Punctelia constantimontium* Sérus. is also similar but has phyllidia distributed all over the surface, while *P. stictica* (Del.

Figures 1-2. 1. *Punctelia fimbriata* (holotype). 2. *Punctelia purpurascens* (holotype). Bars = 10 mm.



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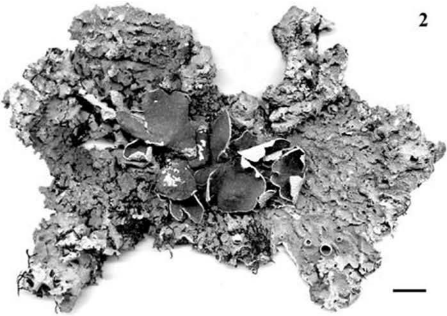

2

ex Duby) Krog produces isidioid soredia. The specific epithet refers to the characteristic phyllidia. This new species is so far known only from the type locality.

Punctelia purpurascens Marcelli & Canêz, **sp. nov.** Fig. 2

MycoBank MB 510354

Diagnosis: *Thallo ut in Punctelia bolliana sed medulla KOH purpurascens vel pallidus purpureus reagens differt; sporis 13.8–17.5 × 7.5–8.8 µm, conidiis unciformis 3.8–5.0 (–6.0) × 1.0 µm.*

Holotypus– Brazil, Rio Grande do Sul State, Municipality of Vacaria, Fazenda da Estrela, open field, 28°04′01,8″S, 50°57′45,4″W, 920 m alt., on a basaltic rock in a open place, leg. *L. S. Canêz & A. A. Spielmann 869*, 13-I-2004 (SP, isotype in B).

Thallus green or grayish green, lobate, 10–15 cm in diameter; lobes irregularly branched, 0.7–2.0 (–3.0) mm wide, loosely adnate to adnate, laterally overlapping to crowded in the center, rarely contiguous, apices round, margins crenate, rarely smooth, upper surface continuous, scrobiculate to rugose; maculae absent; pseudocyphellae conspicuous, white, marginate, less commonly plane, punctiform, 0.05–0.15 mm in diameter, or elliptic, and up to 0.3 mm long, restricted to the inter-foveolar ridges and originating cracks in the center of the thallus; cilia absent. **Pustulae** absent. **Soralia** absent. **Lobulae** or **lacinulae** present, appearing as tiny extensions of the lobes margins, 0.3–1.8 × 0.3–2.0 mm. **Medulla** chiefly white, with spots of a yellowish pigment that react K+ pale purple and/or pale orange pigment that react K+ purple, localized more frequently in the distal (marginal) parts of the lobes. **Lower surface** pale brown, slightly shiny, smooth, rarely slightly rugose; margins concolorous to center or slightly darker, shiny, rhizinate, rarely naked, 0.2–1.0 mm wide, smooth; rhizinae concolours with the lower surface, less frequently darkened, simple to irregularly ramified, frequently penicillate, with two distinct sizes, the shorter rhizinae 0.3–1.0 mm long and the longer ones 1.5–2.5 (–4.5) mm long, abundant, evenly distributed. **Apothecia** plane to slightly concave, 2.0–10.0 mm in diameter, adnate, laminal, margins smooth at first, lacerate with age, amphithecia pseudocyphellate, disc dark brown, imperforate; ascospores ellipsoid, 12.5–17.0 × 7.5–10.0 µm, epispore 1.2 µm wide. **Pycnidia** submarginal or laminal, ostiole black; conidia unciform, 4.0–6.0 µm long.

Spot tests: cortex K+ yellow, UV–; white medulla K–, C–, KC–, P– or slightly yellow, UV–; pigmented medulla K+ pale purple or rarely purple. The medulla reacts yellow/orange with the application of commercial 92.8% alcohol.

TLC: traces of atranorin (cortex), caperatic acid, skyrin? (medulla).

Paratypes — Brazil, Rio Grande do Sul State, Municipality of Vacaria, Fazenda da Estrela, riverside vegetation, 28°02′44.6″S, 51°02′01.7″W, 860 m alt., on a treelet branch in a field on the right margin of Rio Frade, leg. *L.S. Canêz & A.A. Spielmann 1247*, 11-I-2004 (SP); idem, Municipality of Herveiras, 29°25′51.9″S, 52°40′17.4″W, 570 m alt., on shrub base on a roadside steep bank, leg. *A. A. Spielmann, L. S. Canêz & C. Trentin 1007*, 24-1-2004 (SP).

Comments– This species is recognized by the conspicuous pseudocyphellae, which are visible to the naked eye and restricted to the scrobicular ridges, the pigmented part of the medulla containing a yellow or orange K+ pale purple or purple pigment, and the unciform conidia.

The holotype bears lobulae (wider than long), although the paratypes are lacinulate (longer than wide).

Punctelia bolliana (Müll. Arg.) Krog resembles *P. purpurascens* in having pale lower surface, lobulae in the central part of the thallus and unciform conidia. Although the isotype of *P. bolliana* in BM has lacinulae in the central part of the thallus, the pseudocyphellae on the thallus surface are very scant, and the medulla is entirely white.

The presence of a yellow pigment was more obvious in the distal (marginal) portions of all thalli studied. The presence of ochraceous K+ purple medullary pigment in the genus *Punctelia* was previously reported only for *P. neutralis* (Hale) Krog, an African sorediate species (Krog & Swinscow 1977).

The specific epithet refers to the peculiar K+ purple reaction of the medulla.

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MYCOTAXON

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First record of the genus *Phlebopus* (*Basidiomycotina, Boletales*) in Ecuador

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Abstract—This is the first report of the genus *Phlebopus*, represented by *P. beniensis* and *Phlebopus* sp. from Ecuador. *Phlebopus beniensis* has been previously reported from Argentina, Bolivia, Brazil, Costa Rica and Martinique in the neotropics and from Liberia in Africa.

Keywords—*Gyrodontoidae*, pantropical

Introduction

Phlebopus (R. Heim) Singer is a *Gyrodontoidae* pantropical genus. However, it seems uncommon, based in its scarce bibliographic references (Heim 1936, Heinemann 1953, Singer & Digilio 1960, Heinemann & Rammeloo 1982, Ovrebo 1983, Guzmán & Guzmán-Dávalos 1984, Singer et al. 1990). In 2004, the senior author, in collaboration with several students and colleagues of the Central University of Quito, explored both the tropical Pacific and Atlantic slopes and plains of Ecuador and did not find any species of this genus. However, Castillo-Ayoui made two collections of *Phlebopus* in the NW plains of Ecuador and because they are the first records of this boletaceous genus for the country, they are discussed here.

Materials and methods

Microscopic observations were made from sections of the dry basidiomata, mounted in 5 % KOH solution, Melzer's reagent and cotton blue in lactophenol, after a rehydration with 96 % alcohol.

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Results

Two species — one identified species and one not identified — are described. The latter is a probably a new species but immature and the material is scarce.

Phlebopus beniensis (Singer & Digilio) Heinem. & Rammeloo, Mycotaxon 15: 390, 1982. Figs. 1-5

≡ Phaeogyroporus beniensis Singer & Digilio, Lilloa 10: 150, 1960.

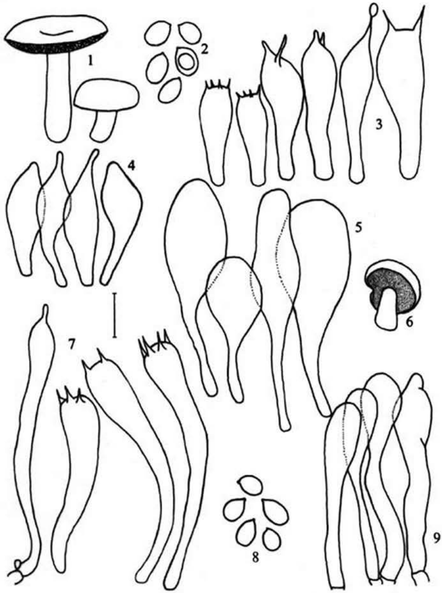
Pileus up to 70 mm diam., subconvex to plane or subconcave, dry, glabrous, yellowish to pale brown. *Hymenophore* tubulose, subadnexed, tubes up to 4 mm long, yellow, becoming bluing to greenish when cut, pores concolorous with tubes, small but visible to the eye, isodiametric, greenish to olive brown, bluing as the tubes when injured. *Stipe* up to 60 x 20 mm, uniform, glabrous, yellowish to brownish-red, mainly toward the base. *Context* yellowish, bluing to greenish when cut as the tubes. *Spore print* yellowish.

Basidiospores (5-) 6-7 x (4-) 4.5-6 µm, subglobose or subellipsoid, thin-walled, yellowish, with a subglobose refracting guttula. *Basidia* 20-35 (-47) x 8-10 (-12) µm, 1-, 2- or 4- spored, clavate sterigmata short or long and up to 10 µm long, clavate, yellowish. *Pleurocystidia* (22-) 23-29 (-32) x (6-) 6.5-9 µm, rare, ventricose-rostrate, with a narrow base and short or long subcylindrical apex, pale yellowish. *Cheilocystidia* (24-) 30-54 (-65) x (10-) 11-15 (-16) µm, shaeropedunculate or vesiculoso-pedunculate, thin-walled, pale yellowish. *Hymenophoral trama* subregular, with hyphae 3-8 µm wide, yellowish. *Pileus trama* little differentiated, with hyphae 5-12 µm wide, thin-walled, yellowish. *Pileipellis* as a trichodermium, yellowish, with some dermatocystidia-like hyphae, up to 8 µm wide. *Clamp connections* common.

Habitat and distribution–On soil, probably ectomycorrhizal with dicotyledonous trees, in a tropical forest used to culture fruit trees, at sea level. This species is known from Argentina, Bolivia, Brazil, Costa Rica and Martinique in America and Liberia in Africa, according to Heinemann & Rammeloo (1982), Singer & Digilio (1960) and Singer et al. (1990).

Specimen examined. ECUADOR, Cantón Quinindé, route Quinindé to Santo Domingo, km 200, March 1 2006, Castillo-Ayoui *s.n.* "A" (Herb. Univ. Tec. L. Vargas Torres at Esmeraldas; XAL).

The material agrees with the descriptions of Heinemann & Rammeloo (1982); they reported basidiospores 5.6-6.8 x 4.3-5.2 µm or 4.9-6.8 x 3.8-5.9 µm; also it agrees with Singer & Digilio (1960) who reported spores 6-7 x 4.2-5.5 µm, basidia 22 x 7.5 µm and cystidia 22-41 x 7-8.5 µm, and with Singer et al. (1990) who reported spores 6-7.5 x (3.5-) 4.5-6.2 µm, basidia 12-29 x (6-) 7-8 (-9) µm, 4- spored, and cystidia 14-44 x 3.5-14.5 µm.



Figs. 1-9. ***1-5.*** *Phlebopus beniensis.* 1: basidiomata, 2: basidiospores, 3: basidia, 4: pleurocystidia, 5: cheilocystidia.

6-9: *Phlebopus* sp., 6: basidioma, 7: basidia, 8: basidiospores, 9: cheilocystidia. Scale bar: 30 mm in 1, 38 mm in 6 and 10 µm in the others.

***Phlebopus* sp.** Figs. 6-9

Pileus up to 60 mm diam., convex to plane-convex, dry, glabrescent, brownish-orange to brownish-grey. *Hymenophore* tubulose, adnexed, tubes yellowish pink, up to 5 mm long, pores very small, difficult to see, orangish pink. *Stipe* up to 50 x 15 mm, subbulbous, concolorous with pileus, but with the base whitish, solid, smooth. *Context* whitish, but yellowish below the surface and reddish toward the stipe base. *Spore print* unknown.

Basidiospores (4-) 4.5-5 (-6) x 4-4.5 (-5) µm, globose, subglobose, subellipsoide or ellipsoid, thin-walled, yellowish. *Basidia* 35-55 x 6-9 µm, 1- (rare), 2-, 3-, 4-spored, short or long sterigmata, up to 10 µm long, hyaline, yellowish or yellow. *Pleurocystidia* not seen. *Cheilocystidia* (31-) 35-45 x 6-8 µm, clavate-subcylindrical, some with a narrow subglobose apex, hyaline or yellowish. *Hymenophoral trama* subregular, with hyphae 3.5-7 µm wide, thin-walled, yellowish. *Pileus trama* with repent hyphae 4-15 µm wide, thin-walled, yellowish. *Pileipellis* as a trichodermium, with hyphae 4-7 µm wide, thin-walled, hyaline or yellowish. *Oleiferous hyphae* 3-7 (-11) µm wide, yellow. *Clamp connections* common.

Habitat: On soil, probably ectomycorrhizal with some dicotyledonous trees, tropical forest with cultured fruit trees, sea level.

Specimen examined. ECUADOR, Cantón Quinindé, route Quinindé to Santo Domingo, km 200, January 10, 2006, *Castillo-Ayoui s.n.* "*B*" (Herb. Univ. Téc. L. Vargas Torres at Esmeraldas; XAL).

The material does not agree with any of the species considered by Heinemann & Rammeloo (1982) and Singer et al. (1990). The only species of the 12 considered by Heinemann & Rammeloo (1982) with a pileipellis as a trichodermium is *P. beniensis*, which presents large spores. Singer et al. (1990) only considered *P. beniensis* and *P. portentosus* (Berk. & Broome) Boedijn with trichodermium, the latter known from Mexico and Costa Rica, with an ixotrichodermium, but with spores 5.5-9.5 x 4.8-6.8 µm. It is probably that the Ecuadorian *Phlebopus* here discussed is a new species, but the poor quality of the herbarium material along with its immature condition make it difficult to present a good description.

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A new bluing species of *Psilocybe*, section *Stuntzii*, from New Mexico, U.S.A.

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Abstract—*Psilocybe mescaleroensis* is described as a new species from Sierra Mescalero, in New Mexico, U.S.A. It is a bluing mushroom, belonging to section *Stuntzii*, where all the species seem to have hallucinogenic properties. This is the first record of a caerulescent *Psilocybe* from New Mexico.

Keywords— *Basidiomycotina, Agaricales, Strophariaceae*

Introduction

The monograph of The Genus *Psilocybe* (Guzmán 1983), along with its supplement (Guzmán 1995), are both out of print, but since these publications, the senior author continued to study the genus (e.g. Guzmán 2004, 2005; Guzmán & Trappe 2005, Gándara & Guzmán 2006) and he is currently amassing information for the second edition of the monograph. During the review of a material collected by Walstad and colleagues in New Mexico, U.S.A., the authors found a new bluing species that is described herein.

Materials and methods

Microscopic observations were made through sections of the basidiomata, mounted in 5% KOH, 10% NH_4OH and Congo red, previously treated with 96% alcohol for rehydration. Spore dimensions indicate length, width, and thickness. The colors of the basidiomata are based upon Wanscher and Kornerup (1991).

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Figs. 1-10. *Psilocybe mescaleroensis* (from holotype). 1-7: Basidiomata (observe the development of the ephimerous annulus in 1 & 2 from an adherent membrane in 6 and its absence in 3-5 & 7. Also observe the subradicating and strigose stipe base in 5, the lobulate pileus in 7 and the hygrophanous pileus in 1 & 4). 8: Basidiospores; 9: Basidia, 10: Cheilocystidia (those branched are rare).

Scale bar 20 mm in 1-7; 10 µm in 8-10.

Psilocybe mescaleroensis Guzmán, Walstad, E. Gándara & Ram.-Guill., **sp. nov.**
MycoBank MB 510461 **Figs. 1-10**

Etymology. From Mescalero which is the name of both Indians and mountains where the species was found.

Pileus (20-) 30-45 (-60) mm latus, convexus vel subumbonatus, frequens undulatus, brunneolus flavidus vel subobscurus, frequens apex subaurantiacus, hygrophanous, pellicula gelatinous disjungere. Lamellae adnatae vel annexa, subalbida vel brunneolus vel roseous-brunneolus, vel cacainus, marginis concolor. Annulus breviter membranaceous, caducus. Stipes (50-) 60-70 (-100) x 5-8 (-20) mm, albidus vel inaequalitas subaurantiacus, basis subrhizomorpha, strigosa. Sporae (9-) 10-11 (-13) x 6-7 (-8) x 6-7 µm, subrhomboideus vel subovoid, pariete 0.8-1 µm crassis, brunneolus, poro germinali lato. Pleurocystidia absentia. Cheilocystidia (16-) 19-27 (-30) x 5-8 µm, hyaline, fusiformis, interdum sublageniform. Subhymenium subcellularis. Pileipellis instar ixocutis. Fibulae communis. United States, New Mexico, Mezcalero Mons, Lincoln prope, ad Mezcalero oppidum, Julius 2004, Walstad, holotype (XAL).

Pileus (20-) 30-45 (-60) mm diam, convex to subumbonate, margin frequently wavy, pale brownish-yellow (4A3-4) to darker (4B5-7), frequently with the disc more orange (4A7-8), hygrophanous, changing to pale brownish (close to 9E2), translucent striate when wet, pellicle gelatinous, separable. *Lamellae* adnate to adnexed, dirty whitish (4A2) to pale brownish-gray (4B4-5) or brownish-rose (6A3), finally dark chocolate (7E4-5), edges concolorous. *Annulus* close joined to the surface of the stipe, slightly membranaceous, white or getting the color of the spore print on the upper surface, ephemeral. *Context* whitish to pale grayish (4A2-3), with slight farinaceous odor and taste. *Stipe* (50-) 60-70 (-100) x 5-8 (-20) mm, cylindrical, equal or thicker toward the apex, flexuous, fibrillose, solid to hollow, whitish to irregularly orange (5A7) or orangish-pink (close to 7A3-4), base somewhat rhizomorphic, frequently strigose. All the basidioma *bluing*, except lamellae. *Spore print* dark chocolate (7E-4).

Basidiospores (9-) 10-11 (-13) x 6-7 (-8) x 6-7 µm, subrhomboid or subovoid in face-view, subovoid in side-view, thick-walled, wall up to 1 µm thick, yellowish-brown, with a distinct and broad germ pore at distal pole and a short asymmetric appendage in the other. *Basidia* 35-39 x 7.5-9 µm, 4-spored, subclaviform, hyaline. *Pleurocystidia* absent. *Cheilocystidia* (16-) 19-27 (-30) x 5-8 µm, hyaline, fusiform, ventricose-rostrate, regular or irregularly in shape, rarely irregularly branched. *Hymenophoral trama* regular, hyphae 4-5 µm wide, thin-walled, hyaline to yellowish. *Pileipellis* an ixocutis up to 155 µm thick, hyphae 2-5 µm wide, thin-walled, hyaline. *Subhymenium* subcellular, hyaline to yellowish. *Clamp connections* present.

Habitat and distribution—Rarely solitary, frequently scattered to gregarious, also caespitose on rich soil or decaying grasses, in grasslands near to a *Pinus ponderosa* Douglas ex C. Lawson forest, commonly associated with the holes of gophers. Observed in summer and autumn. Known only from the type locality.

Studied Material. UNITED STATES, New Mexico: Mescalero Range, Sierra Blanca, Lincoln Co., near town Mescalero, July 2004, *Walstad* s.n. (holotype XAL, isotype NY).

Discussion– This new species belongs to section *Stuntzii* Guzmán (Guzmán 1983), because of the subrhomboid, thick-walled basidiospores, presence of an annulus, and the bluing feature. It differs from *P. stuntzii* Guzmán & J. Ott (Guzmán 1983, Guzmán & Ott 1976) for its more robust basidiomata with subradicating and strigose stipe bases and cheilocystidia lacking elongate and flexuous necks. *Psilocybe stuntzii* has a (5-) 10-20 (-35) mm diam pileus and lageniform cheilocystidia with long necks (Guzmán & Ott 1976, figs. 7 and 8). Also, *P. stuntzii* is known only from the Pacific regions of Canada and the U.S.A. Although information gathered by Walstad and friends is somewhat confusing, it is probable that *P. mescaleroensis* had or still has a sacred use among the Indians.

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Anthracoidea setschwanensis sp. nov. (*Ustilaginales*) and a new record of *Anthracoidea* from China

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Abstract—A new species, *Anthracoidea setschwanensis* on *Kobresia setschwanensis*, is described, which was collected in Gongga Mountain of Sichuan Province, China. *Anthracoidea irregularis* on *Carex lanceolata* and *C. quadriflora* is new to China, which was collected from Inner Mongolia Autonomous Region and Hebei Province.

Key words—*Ustilaginomycetes*, smut fungi, taxonomy

A new species of *Anthracoidea* on *Kobresia setschwanensis* was discovered in the Herbarium of the Institute of Botany, Chinese Academy of Sciences (PE) on *Kobresia setschwanensis*. The specimen was collected in Gongga Mountain of Sichuan Province at 4500 m altitude in 1981. The host plant, in the section *Elyna* of the genus *Kobresia*, is an endemic Chinese species distributed in eastern Xizang Autonomous Region, southeastern Qinghai Province, western and northern Sichuan Province and northwestern Yunnan Province (Dai & Liang 2000). The new species is quite different from *Anthracoidea xizangensis* L. Guo (Guo 2006a), *A. bistaminatae* L. Guo (Guo 2006b) and *A. mulenkoi* M. Piątek (Piątek 2006) in section *Elyna* by having larger ustilospores (see below). The new species is described as:

Anthracoidea setschwanensis **L. Guo, sp. nov.** **Figs. 1-2**
MYCOBANK MB510470

Sori in ovariis, ovoidei, 1.8–2.2 mm longi, 1.5–2 mm lati, primum membrana cinerascenti fungali cooperti, deinde expositi. Massa sporarum nigra, semiagglutinata. Ustilosporae a fronte subglobosae, ellipsoideae, ovoideae vel leviter irregulares, 18.5–27.5(–30) x 16–25.5 µm, ab acie 12–16 µm latae, flavidobrunneae vel rubrobrunneae; pariete aequaliter incrassato, 1–2.5(–3.5) µm crasso, interdum hyalinae calyptrae, tumores interni desunt, regiones lucem repercutientes desunt, superficie minute et dense verruculoso, verrucis interdum confluentibus sub SEM.

Sori in ovaries, ovoid, 1.8–2.2 mm long, 1.5–2 mm wide, at first covered by a grayish fungal membrane, later becoming exposed. Spore mass black, semi-agglutinated. Ustilospores in plane view subglobose, ellipsoidal, ovoid or slightly irregular, 18.5–27.5(–30) x 16–25.5 µm, in side view 12–16 µm wide, yellowish-brown or reddish-brown; wall evenly thickened, 1–2.5(–3.5) µm, occasionally with hyaline caps on the flat sides, no internal swellings, no light reflective areas, surface minutely and densely verruculose, sometimes the warts confluent as seen by SEM.

On *Kobresia setschwanensis* Hand.-Mazz. (*Cyperaceae*, Sect. *Elyna*), China: Sichuan, Daocheng, Gongga Mt., alt. 4500 m, 30 VIII 1981, Qinghai-Tibet expedition 5831, HMAS 143945 (holotype), HUV 21414 (isotype)

Key to the *Anthracoidea* species on section *Elyna* of genus *Kobresia*

1. Ustilospores smooth, 17–22(–25) x (14–)15–18.5 µm, walls 1–2.5(–3) µm thick .... *A. elynae*
1. Ustilospores verruculose 2
2. Ustilospores large, 18.5–27.5(–30) x 16–25.5 µm. .... *A. setschwanensis*
2. Ustilospores smaller 3
3. Ustilospores 15–20 x 12.5–18 µm, surface punctate on the flat sides, profile verruculose as seen by SEM, walls 1–1.5(–2) µm thick .... *A. bistaminatae*
3. Ustilospores verruculose on whole surface 4
4. Ustilospores densely verruculose, 17–22.5 x 15–18 µm, walls 1.5–2 µm thick .... *A. xizangensis*
4. Ustilospores sparsely verruculose, 18–23(–25) x 16–20(–22) µm, walls 1–3 µm thick .... *A. mulenkoi*

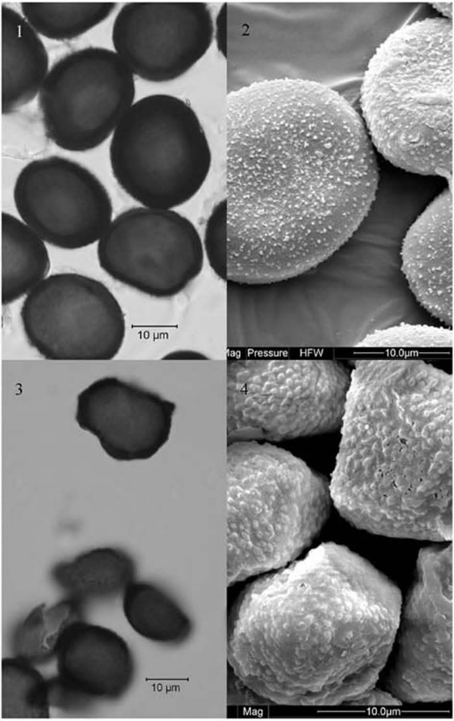
Anthracoidea irregularis (Liro) Boidol & Poelt, Ber. Bayer. Bot. Ges. 36: 23, 1963. **Figs. 3-4**

Sori in ovaries, subglobose, 2–3 mm in diam., at first covered by a grayish, fungal membrane, later becoming exposed. Spore mass black, semi-agglutinated. Ustilospores in plane view irregular, polygonal, subglobose, ellipsoidal or ovoid, (13–)16–30(–37) x (12.5–)16–23 µm, in side view 9–15 µm wide, dark reddish-brown; wall unevenly thickened, 1–2.5(–3.5) µm, with numerous protuberances, 1–3 internal swellings, and light reflective areas, surface verruculose.

On *Carex lanceolata* Boott (*Cyperaceae*, Sect. *Digitatae*), China: Inner Mongolia, Xilinhot, Huitengcaoyuan, alt. 1380 m, 18 VII 2003, L. Guo, W. Li & H.C. Zhang 2096, HMAS 164225.

On *Carex quadriflora* (Kük.) Ohwi (*Cyperaceae*, Sect. *Digitatae*), China: Hebei, Wulingshan, alt. 1000 m, 17 V 2004, L. Guo & H.C. Zhang 2541, HMAS 165043.

Figs. 1-2. *Anthracoidea setschwanensis* on *Kobresia setschwanensis* as seen by LM and SEM (HMAS 143945, holotype). Figs. 3-4. *Anthracoidea irregularis* on *Carex quadriflora* as seen by LM and SEM (HMAS 165043).


1
10 µm
2
Mag Pressure HFW
10.0µm
3
10 µm
4
Mag
10.0µm

So far, four species of *Anthracoidea* on the section *Elyna* of *Kobresia* and five species of *Anthracoidea* on the section *Digitatae* of *Carex* have been reported from China (Guo 2000, 2004, 2006ab: Zhang & Guo 2004).

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MYCOTAXON

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Antrodiella semistipitata (*Basidiomycetes, Polyporales*), a new species from Italy

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Abstract — *Antrodiella semistipitata* is described as a new species and its main differentiating characters are outlined. Figures, descriptions and a key to European *Antrodiella* species are provided.

Key words — polypores, taxonomy

Introduction

The genus *Antrodiella* Ryvarden & I. Johans. was described in 1980 (Ryvarden & Johansen 1980) to include seven polypores with basidiomata almost wax-like when fresh, becoming dense, hard and semitranslucent when dry, and generally with small pores and basidiospores (usually less than 5 µm). Later, many species were described or transferred to the genus (Niemelä 1982; Ryvarden 1984, 1987, 1990, 1992; Ryvarden & Gilbertson 1984, 1993; David & Tortić 1986; David & Lecot 1990; Gilbertson & Ryvarden 1986; Buchanan & Ryvarden 1988, 1993; Vampola 1991; Hattori & Ryvarden 1993, 1994). Vampola & Pouzar (1996) emended the genus, accepted 35 species, and described four new species, two of which are now considered synonyms of *Antrodiella pallescens* (Pilát) Niemelä & Miettinen.

Recently, Johannesson et al. (2000) reported on ca. ten European species forming a monophyletic group, Piątek (2001) provided a survey of the genus in Poland, and Miettinen et al. (2006) treated the Northern *Antrodiella* species in connection with studies in the *A. semisupina*-complex, additionally introducing some name changes that are incorporated in the key given below. Currently approximately 40 species of *Antrodiella* are accepted (CBS 2006). Of the 10-15 registered in Europe (Ryvarden & Gilbertson 1993, CBS 2006), nine occur in Italy (Bernicchia 2005).

European *Antrodiella* species are usually resupinate or pileate-sessile, occasionally flabelliform, fan- or fingernail-shaped (as in *A. pallasii*, *A. faginea* and *A. pallescens*), or rarely with a contracted base (as in *A. canadensis*). Some substipitate specimens collected in 1991 near Val di Genova (Trento, North Italy) and neglected for almost 15 years have now been rediscovered and are here described as a new species.

Taxonomic Description

Antrodiella semistipitata Bernicchia & Ryvarden **sp. nov.**

MycoBank #MB510492

Basidiomata annua, cremea, semistipitata, semicirculata, sed iuxtim coalita, fragilia post siccationem, usque ad 20mm lata, ad 25mm alta, guepinioidea forma. Pori rotundati, 4-7 per mm, cremei, margine glabro, inclinato deorsum subtile. Subiculum cremeum, subtilissimum, tubuli 0.5mm crassi. Hypharum structura dimitica: hyphae hyalinae, haud amyloideae, haud dextrinoideae; hyphae generativae parietibus subtilibus, ramosae, fibulatae, 1.5-2.5 µm diametro. Hyphae skeletales sinuosae, intextae, parietibus crassioribus, 1.5-4 µm diametro, in tubulorum stratu rara crystalla. Cystidia absunt, cum cystidiola adsint, 20-25 µm longa et 4.2-5 µm lata. Basidia hyalina, clavae forma, tetrasterigmatica, fibulata, 8-9 µm longa et 4.5-5 µm lata, sterigmata 3 µm longa. Basidiosporae hyalinae, laeves, subtilibus parietibus, cylindratae, subcylindratae, haud amyloideae, haud dextrinoideae, acyanophilae, (2.8-) 3-4 (-4.2) µm longae et 1.8-2 (-2.3) µm latae.

Holotypus: *Italy, Trento, (North Italy) Val di Genova, on small branch of Corylus avellana, alt 1100m 3.IX.1991, leg. A. Bernicchia et A. Contestabile, HUBO 7824 (isotype in O).*

Etymology: The name points out the particular shape of basidiomata.

Basidiomata annual, semistipitate, fan-shaped, single but pilei closely attached to each other in a group of four basidiomata, whitish when fresh, cream and fragile when dried; 20 mm long, 25 mm wide, 0.6 mm thick, with a contracted base that provides the semistipitate aspect. Margin entire, refolded towards the bottom to form a cercine. Pore surface whitish to cream, pores small, regular, round, 4-7 per mm, decurrent to the pseudostipe. Margin smooth, entire, sharp and bent down. Subiculum very thin, cream; tubes concolorous, 0.5 mm deep.

Hyphal system dimitic, hyphae hyaline, IKI-; generative hyphae few, branched, clamped, thin-walled, 1.5-2.5 µm in diam.; skeletal hyphae predominant, straight to slightly sinuous, thick-walled, interwoven, 1.5-4 µm in diam, crystalline clumps rare. **Cystidia** absent, cystidioles clavate, sinuous, 18-20 x 4.2-5 µm. **Basidia** hyaline, clavate, with basal clamp, 8-10 x 4.5-5 µm, 4 sterigmata, 3 µm long. **Basidiospores** hyaline, smooth, thin-walled, cylindrical to sub-cylindrical, IKI-, acyanophilous, (2.8-) 3-4 (-4.2) x 1.8-2 (-2.3) µm (Fig. 2).

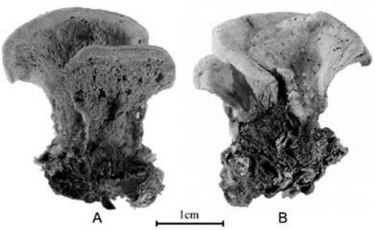

Figure 1. Basidiomata of *Antrodiella semistipitata*.
A: hymenophore surface, B: sterile upper surface

Substrata — Known only from deciduous wood.

Distribution — Known only from the type locality.

Comments — Although the material available is scarce, the remarkable shape of the basidiomata and the microscopical characteristics, seem clearly to indicate that the collection represents a new species. Among the European pileate species of the genus, *A. canadensis*, *A. pallescens*, *A. pallasii* and *A. faginea* may have a contracted base, but the former has ellipsoid to ovoid basidiospores, and is found only on *Picea* and *Pinus*, while *A. faginea* has ellipsoid basidiospores and grows on a number of deciduous trees; *A. pallescens* has short-cylindrical or ellipsoid basidiospores and grows both on coniferous and deciduous trees, while in *A. pallasii* they are ellipsoid, and the species is found on coniferous trees.

Key to the European species of *Antrodiella*

1a. Basidiomata mainly on coniferous trees 2

1b. Basidiomata on deciduous trees 5

2a. Basidiomata distinctly pileate, upper surface grey to brown with radial lines, basidiospores subglobose to drop-shaped, 3.1-3.9 x 2.4-3.0 µm ... ***A. canadensis***

2b. Basidiomata resupinate to fan-shaped, basidiospores differently shaped 3

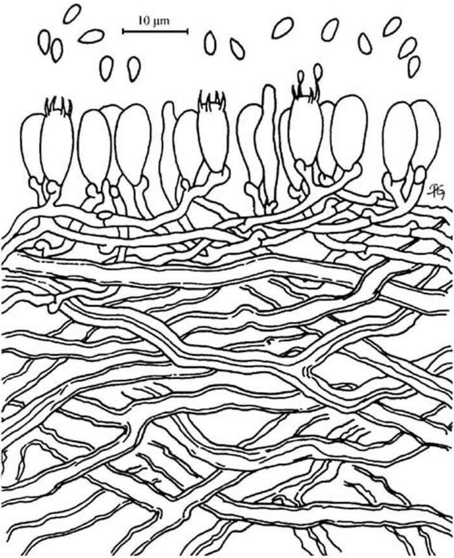

Figure 2. Hymenial elements of *Antrodiella semistipitata*

3a. Basidiomata often fan-shaped, basidiospores ellipsoid, 3-3.7 x 1.8-2.1 µm, boreal Fennoscandian species, strictly follower of *Trichaptum* spp. . . . . ***A. pallasii***

3b. Basidiomata resupinate, cystidia present or absent 4

4a. Pore surface citric yellow, growing on wood previously rotted by *Fomitopsis pinicola*, cystidia absent, basidiospores subglobose, 2.9-3.4 x 2.1-2.6 µm; also collected also *Betula* and *Alnus*, apparently resctricted to boreal coniferous forest. ***A. citrinella***

4b. Pore surface white to cream, growing on or close to *Trichaptum abietinum*, smooth cystidia present, basidiospores mainly ellipsoid, 3.3-4.0 x 2.2-2.9 µm, Central European species .... ***A. parasitica***

5a. Basidiomata pileate 6

5b. Basidiomata resupinate 14

6a. Basidiomata semistipitate, fan-shaped or with a contracted base, margin refolded forming a cercine, basidiospores cylindrical to subcylindrical, 3-4 x 1.8-2.0 µm, on *Corylus*. .... ***A. semistipitata***

6b. Basidiomata pileate, effused-reflexed, fingernail shaped or sessile, with different margin 7

7a. Sterile surface yellow, fading when dry, finely hirsute to distinctly warted, usually growing on or close to *Inonotus radiatus*. .... ***A. serpula*** (syn. *A. hoehnelii*)

7b Sterile surface differently coloured, glabrous to finely velutinate, smooth to slightly zonate 8

8a. Hymenophore lacerate to almost hydnoid .... ***A. foliaceodentata***

8b. Hymenophore poroid.. 9

9a. Pileus cinnamon to pale orange, with strong scent of coumarin when fresh, basidiospores ovoid, 3-4 x 2-3 µm .... ***A. fragrans***

9b. Pileus whitish to ochraceous, no particular scent when fresh, basidiospores ellipsoid, cylindrical to allantoid.. 10

10a. Basidiomata pileate, effused-reflexed, fingernail-shaped to flabelliform, rarely resupinate, basidiospores ellipsoid....................................... 11

10b. Basidiomata pileate, effused-reflexed, basidiospores cylindrical 13

11a. Basidiomata pileate, sterile surface, when present, apricot to orange when fresh, drying pale brown; basidiospores 1.5-2.2 µm wide; smooth cystidia. occasionally present .... ***A. fissiliformis***

11b. Basidiomata effused-reflexed, fingernail-shaped to flabelliform, sterile surface different, gloeocystidia present or mostly absent 12

12a. Gloeocystidia mostly absent, basidiospores short cylindrical to ellipsoid, 3.0-4.1 x 1.7-2.0 µm, growing on or close to *Fomes fomentarius* .... ***A. pallescens***

12b. Gloeocystidia present, basidiospores ellipsoid, 2.8-3.7 x 1.8-2.2 µm, successor species of some *Hymenochaetaceae* .... ***A. faginea***

13a. Generative hyphae with simple septa, basidiospores 3.2-4.5 x 1.5-1.9 µm

.... ***A. onychoides***

13b. Generative hyphae with clamps, basidiospores 1-1.5 µm wide

.... ***A. leucoxantha*** (syn: *A. genistae*)

14a. Pores angular, 2-3 per mm, with lacerate orifices, basidiospores 3.2-4.4 x 1.9-2.3 µm, usually on or close to *Hymenochaete* spp. .... ***A. americana***

14b. Pores round, 3-8 per mm, with no lacerate orifices, on dead wood or old polypores 15

15a. Basidiomata growing on dead polypores of *Hymenochaetaceae*, gloeocystidia present, basidiospores 1.8-2.2 µm wide .... ***A. faginea***

15b. Basidiomata growing on dead wood, cystidia present or absent 16

16a. Basidiospores straight, cylindrical, 4.3-5.2 x 1.9-2.2, cystidia absent .... ***A. ichnusana***

16b. Basidiospores shorter, ellipsoid, cystidia present or absent 17

17a. Pore surface cream to pale straw-coloured, cystidia absent, basidiospores 3.4-4.4 x 2.3-2.9 µm .... ***A. romellii***

17b. Pore surface cream to pale yellowish brown, cystidia occasionally present, basidiospores 3.0-4.0 x 1.5-2.2 µm .... ***A. fissiliformis***

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NATS truffle and truffle-like fungi 15: *Genea balsleyi* sp. nov. (*Pyronemataceae*), a new hypogeous ascomycete from New Jersey

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Abstract — *Genea balsleyi* is described from New Jersey, USA. This new species is compared morphologically to other known species of *Genea*, with an emphasis on those from Eastern North America.

Introduction

Genea species are hypogeous, ectomycorrhizal *Pyronemataceae* that produce small dark-colored, globose to irregular ascomata with ellipsoid to subglobose, ornamented ascospores (Moreno-Arroyo et al. 2005, Maia et al. 1996, Pfister 1984, Fontana & Centrella 1967, Gilkey 1939). They are abundant and diverse in Mediterranean oak woodlands and other xeric biomes (Smith et al. 2006, Alvarez et al. 1993, Moreno et al. 1991) but can also be found in mesic forest types (Tedersoo et al. 2006). Of the 13 currently recognized *Genea* species from North America, six have been reported east of the Rocky Mountains: *G. thaxteri* Gilkey, *G. macrosiphon* Gilkey, *G. echinospora* Gilkey, *G. brachytheca* Gilkey, *G. anthracina* Heblack & E.L. Stewart and *G. hispidula* Berk. Most of these taxa appear to be rare and are known from only one or a few specimens, but this apparent rarity is probably due to the small size and cryptic nature of *Genea* ascomata. Collections of a *Genea* species associated with *Quercus rubra* in New Jersey did not match the descriptions of any known taxa; I describe it here as *Genea balsleyi* sp. nov.

Materials and methods

Macroscopic characters, including colors, were described from dried material, notes, and photographs provided by the collector, Rich Balsley of the New Jersey Mycological Society. Microscopic characters were determined from hand-sectioned mounts stained with Cotton Blue, heated over an alcohol lamp, then rinsed and visualized in de-ionized water. KOH was not used because alkaline solutions dissolve the spore ornaments (Smith et al. 2006). Two-dimensional measurements are given as length by width. For details of molecular procedures and phylogenetic analysis, see Smith et al. (2006).

Species description

Genea balsleyi **M.E. Sm. sp. nov.** FIG. 1–2

MycoBank # MB 510416; GenBank # DQ218302

Peridium nigrum, pilis destitutum, verrucis rotundatis vel subangulatis 75-150 µm altis x 200-300 µm latis. Asci 180-240 x 2-31 (-33) µm, parietibus tenuibus. Sporae hyalinae, subglobosae vel late ellipsoideae, 24-28 (-30) x (20-) 21-25 µm sine ornamento aggregato verrucarum rotundarum, conicarum vel irregularium (2-) 2.5-4.5 (-5) µm altarum, apicibus truncatis vel rotundis. Holotypus Trappe 30528 (OSC130517)

Ascomata hypogeous, subglobose to irregular with lobes and furrows, 7–10 mm high X 8–16 mm broad as dried, hollow, with an apical orfice opening to a single, rounded to irregular chamber. **Peridium** black, lacking obvious surface hairs, with low, rounded to subangular warts 75–150 µm tall x 200–300 µm wide. **Epithecium** lining the ascomatal chamber similar to the peridium, dark grey in fresh specimens but becoming black upon drying. **Mycelial tuft** attached at the base of ascomata, brownish and lighter in color than the peridium

Peridium with two distinct layers. *Outer layer* 150–200 (250) µm thick, of inflated, isodiametric to irregular cells 10–30 x 10–30 (50) µm, with walls varying in thickness 0.5–1.5 (2.5) µm, outer cell layers tending to be larger, with thickened walls (±2µm) and darker grey than the innner cells. Outer layer of peridium abruptly differentiated from the *Inner layer*, 80–100 µm thick, composed of hyaline, compressed, isodiametric to elongated, ovoid or irregular cells 3–10 x 10–15 µm with walls ±0.5 µm thick.

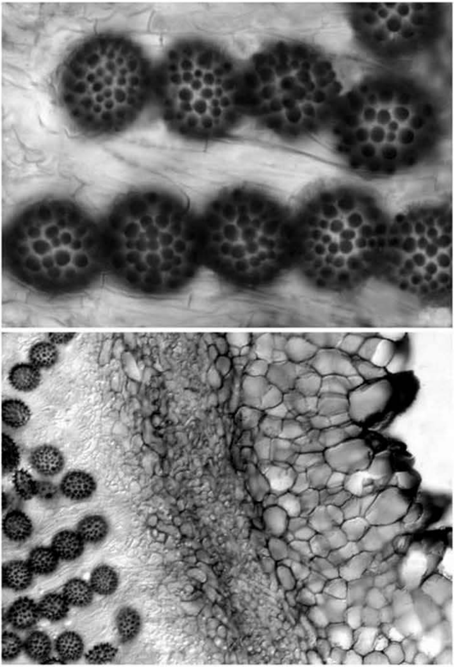
Subhymenium of isodiametric cells, mostly 3–5 x 5–7 (10) µm, with walls, 0.5–1.0 µm thick, less compact than the inner peridial layer.

Asci hyaline, thin-walled, 180–240 x 24–31 (33) µm, mostly 8-spored but in some areas 1-spored.

Paraphyses hyaline, septate, thin-walled, highly variable in width, 3–8 µm wide at the septa, interwoven with one another and surrounded in some areas by rounded to irregular, thin-walled cells 3–5 x 2–5 µm, apparently not connected to the paraphyses themselves, tips exceeding the asci and forming a tissue of small isodiametric cells similar to the subhymenium, abruptly grading to the epithecium.

Epithecium 150–200 (250) µm thick, similar to the peridium.

Spores hyaline, globose to subglobose 24–28 (-30) x (20-) 21–25 µm excluding ornamentation, mean Q (L:W) = 1.21, Q range = 1.0–1.33, (n=20 spores), spore



Figs. 1–2 Holotype collection of *Genea balsleyi* (Trappe30528). **Fig. 1.** Spores of *G. balsleyi*, scale bar = 10 µm. **Fig. 2.** Peridial section and spores of *G. balsleyi*, scale bar = 30 µm. Note the spore ornamentation of conical to irregular knobs or warts, with truncate to angular tops.

walls 1–2 (2.5) µm thick. **Spore ornamentation** of crowded, conical to irregular knobs or warts, with truncate to angular tops, mostly (2) 2.5–4.5 (5) x (1.5) 2–4 (5) µm, sometimes two or more conical warts joined at the base to form composite warts with multiple tips.

Etymology in honor of Mr. Rich Balsley, avid amateur mycologist and the collector of all known specimens of *G. balsleyi.*

Distribution, habitat, and season — *Genea balsleyi* is known from three collections in Northern New Jersey. All of the collections were associated with *Quercus rubra* (red oak), the presumed ectomycorrhizal host.

Collections examined — **Holotype: USA, New Jersey:** Passaic Co., Patterson, Rich Balsley. Trappe30528. 28 September 2004. (OSC130517). **Paratypes: United States, New Jersey:** Hunterdon Co., Lebanon, R. Balsley. Trappe28214. 24 September 2003 (OSC111704) (GenBank DQ218302). Trappe30679. August 2001. (OSC130518)

Discussion

Genea balsleyi can be distinguished from other eastern North American *Genea* species by a combination of characters including a black peridium lacking surface hairs and spores 28–24 x 25–21 µm, ornamented with angular warts up to 4.5 µm high. Three of the eastern North American species, *Genea echinospora*, *G. macrosiphon*, and *G. thaxteri*, are easily differentiated from *G. balsleyi* by the brown coloration of their peridia (Gilkey 1939). Whereas the two black-colored species resemble *G. balsleyi* macroscopically, both differ in microscopic characters. *Genea anthracina*, thus far known only from Minnesota, has smaller spores than *G. balsleyi*, with hemispherical ornaments up to 4 µm high (Stewart & Heblack 1979). *Genea brachytheca* has scattered dark, septate hairs on the peridium and exceptionally crowded spore ornaments that are shorter than those of *G. balsleyi*. *Genea hispidula*, a European species reported from the Northeastern U.S., has a dense tomentum on the surface of the peridium and spores up to 35 µm long (Montecchi & Sarasini 2000, Gilkey 1939).

Of the *Genea* species from Western North America, *Genea balsleyi* most closely resembles the black-colored species, *G. gardneri* Gilkey, *G. harknessii* Gilkey, and *G. bihymeniata* M.E. Sm. & Trappe. However, *G. gardneri* has larger spores with broader spore ornaments, *G. harknessii* has irregularly shaped spore ornaments with pointed, forked, or anvil-shaped tips, and *G. bihymeniata* has slightly shorter spores and notably rounded spore ornaments (Smith et al. 2006, Gilkey 1939). Previous phylogenetic analysis of 28s rDNA showed that none of these species were closely related to *Genea balsleyi*; it was instead more closely allied to an immature specimen of an undescribed *Genea* species from California (*Genea* sp. src680, Genbank accessions DQ206849, DQ206967) (Smith et al. 2006).

Subsequent analysis indicates that 28s sequences from both *G. balsleyi* and *Genea* sp. (src680) appear similar to those obtained from a European specimen of *Genea verrucosa* Vittad. (collection TL6764 in Herbarium Botanical Museum and Library, University of Copenhagen, GenBank accession AJ969624 – Tedersoo et al., 2006). *Genea balsleyi* is morphologically similar to *G. verrucosa* judging from published descriptions (Moreno-Arroyo et al 2005, Montecchi & Sarasini 2000, Lange 1956), but *G. verrucosa* has shorter, pointed spore ornaments (1–3 µm high) and more ellipsoid spores. Examination of Swedish specimens of *G. verrucosa* at the University of Michigan Herbarium (MICH – L.E.Kers 6038, L.E.Kers 6045) corroborated the morphological differences between *G. verrucosa* and *G. balsleyi*.

Acknowledgements

I thank R. Balsley for providing photographs, basic descriptions and specimens of *Genea balsleyi*. Many thanks are due to P. Rogers and the University of Michigan Herbarium for facilitating access to *Genea* specimens at MICH. K. Hansen provided access to the 28s DNA sequence of *Genea verrucosa* before it was publicly available. J.M. Trappe provided invaluable taxonomic expertise as well as the Latin description. D.M. Rizzo provided access to light and dissecting microscopes and offered editorial advice. This research was also supported by grants to M. E. Smith by the Mycological Society of America (A.H. and H.V. Smith Research Fund & the Forest Ecology Award), San Francisco Mycological Society, Sonoma County Mycological Society (SOMA), and the North American Truffling Society (NATS).

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The world's second record of *Hyalodictyum colchicum* reported from Turkey

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Abstract— *Hyalodictyum colchicum*, a rare coelomycete, is reported and illustrated from Turkey on *Quercus pubescens*. This is only the second locality reported for this fungus.

Key words— anamorphic fungi, morphology

Introduction

The flora of Turkey is very diverse and a lot of studies on higher plants have been carried out. However, research on microfungi on plants is poor in Turkey. First data on micromycetes, including coelomycetes, were recorded by Bremer et al. (1947, 1952) and Petrak (1953). Data concerning coelomycetes were subsequently published as information on diseases of cultivated plants (Karel 1958) and results of a fungal diversity study (Göbelez 1967). Investigation of coelomycetes of Turkey has increased during the last decade (Altan & Tamer 1996, Hüseyinov & Selçuk 1999, Braun et al. 2000, Hüseyinov 2000, Hüseyin & Selçuk 2001, Hüseyinov et al. 2002, Selçuk et al. 2003, Mel'nik et al. 2004, Kırbağ 2004, Hüseyin et al. 2005).

Material and methods

The plant material for this paper was collected from the Küre Mountain National Park in Kastamonu province (Black Sea Region) in September 2005.

Specimens of the fungus were taken to the laboratory and microscopically examined under the Leica compound microscope. Sections were hand cut using a razor blade. The fungus was identified using the relevant literature (Woronichin 1916, Jaczewski 1917, Vassiljevsky & Karakulin 1950, Sutton 1980, Mel'nik 1997).

Host plant was identified using the "Flora of Turkey and East Aegean Islands" (Davis 1982). The author abbreviations of fungi are according to Kirk & Ansell

(2004). All examined specimens are deposited in the Ahi Evran University, Arts and Sciences Faculty, Department of Biology, in Kırşehir province of Turkey.

Results

The description and illustration of *Hyalodictyum colchicum* given below are based on the Turkish collections of the material.

Hyalodictyum colchicum Woron. Bull. Mus. Caucase, 10: 30-32, 1916.

Spots visible on both sides of leaves, generally circular or irregularly rounded, 0.3–1.5 cm diam., sometimes elongated, 1.5–3.5 x 0.8–2 cm, brown on the upper surface, fuscous-chestnut on the lower, spots margin yellow (Fig 1A). **Conidiomata** acervular, epiphyllous, pale brown to nectareous, textura angularis, epidermal to subepidermal, rounded, 95–125 µm diam., dehiscence irregular (Fig.1B). **Conidiophores** filiform, hyaline, septate, 6.5–17.5 x 2.5–3.5 µm. **Conidiogenous cells** holoblastic, determinate, integrated, cylindrical, hyaline, 2,9-3,8 x 2,5-2,9 µm (Fig. 2A). **Conidia** acrogenous, hyaline or slightly greenish, muriform, with 3–7 transverse and 1–3 longitudinal septa (? distoseptate), slightly constricted, elliptical, oblong, ovate, pyriform, reniform to irregular, both ends obtuse, 22.5–30 x 15–17.5 µm (Fig. 2B).

Specimen examined—TURKEY, Kastamonu Prov., Küre Mountain National Park, Azdavay district, on living leaves of *Quercus pubescens* Willd. (*Fagaceae*), 41°41'22"N, 33°10'33" E, 865 m, 1-XI-2005, Co. HUSEYIN E and ERDOGDU M (ME 1761) .

Discussion

The genus *Hyalodictyum* was described by Woronichin (1916: 30-32) as a monotypic genus with the type species *H. colchicum* Woron. The fungus was collected on leaves of *Quercus hartwissiana* and *Q. iberica* from Georgia (Abhasia). Jaczewski (1917: 784) noted the fungus on living leaves of *Q. iberica* only and gave a very short description that repeatedin general the original one. Later Vassiljevsky & Karakulin (1950: 450) gave an interpretation of the genus and species and discussed the basal conidiogenous layer formation between leaf cells. However, Jaczewski and Vassiljevsky & Karakulin did not examine the specimens of *H. colchicum*. They just described the fungus according to the description of Woronichin. Sutton (1980: 172) presented the traditional short description of *Hyalodictyum* with *H. colchicum*, but added the presumed characteristics of conidiogenous cells on the basis of Woronichin's drawings (1916). The type collections of *H. colchicum* are supposed to be lost. Mel'nik (1997) searched for some specimens of the fungus and finally investigated some duplicate type material from the LEP (the Referance collection of the All-Russian Institute of Plant Protection, Russia) without succeeding in finding

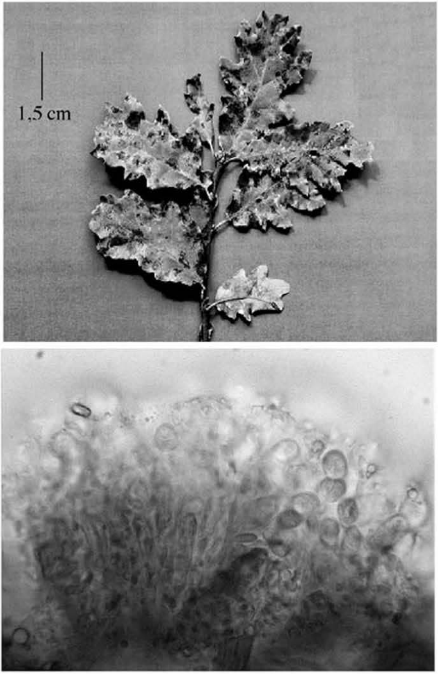

Fig 1. *Hyalodictyum colchicum*:
A.-leaf spots; B.- vertical section of a conidioma. x 200.

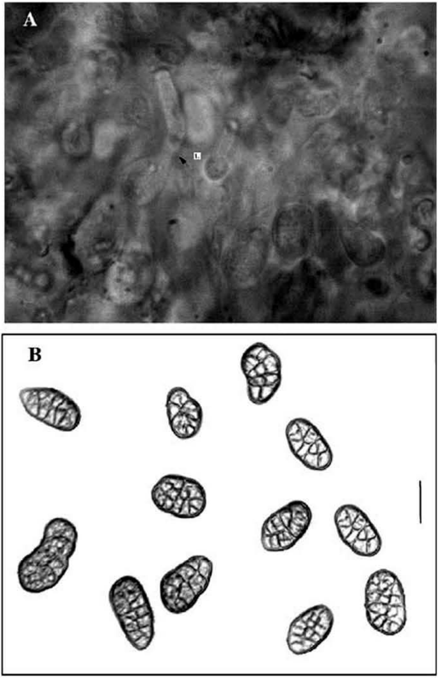

Fig. 2. *Hyalodictyum colchicum*:
A.-Conidiophores and conidiogenous cells. x 1000; B.- natural conidia. Scale bar=20 µm.

fruit bodies of the fungus. He gave a consolidated description of *H. colchicum* based on all previous publications.

The description of *H. colchicum* provided based on the recently collected material from Turkey is more detailed. Many characters agree with existing descriptions of *H. colchicum* (Woronichin 1916, Jaczewski 1917, Vassiljevsky & Karakulin 1950, Sutton 1980, Mel'nik 1997). Nevertheless, some characters are different. Conidiomata measure 95–125 μm diam., falling in the mid-range of the dimensions according to Woronichin (1916), about 60–150 μm. Conidia are hyaline or slightly greenish in the Turkish specimen (not only hyaline as in original diagnosis), 22.5–30 x 15–17.5 μm. According to Woronichin (1916), the conidia are narrower 22–30 x 10–15 μm.

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The genus *Ganoderma* (*Basidiomycota*) in Iran

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Abstract — The genus *Ganoderma* was investigated in Iran. Based on micro- and macromorphology and host relationships, descriptions are made and a key to the identification of the Iranian species provided. Seven species of *Ganoderma* were found in Iran, viz. the three non-laccate species *G. applanatum*, *G. adspersum*, and *G. colossus* and the four laccate species *G. lucidum*, *G. resinaceum*,*G. tsugae* and *G. manoutchehrii*.

Key words — basidiocarp, morphology, taxonomy, basidiospore, *Elfvingia*

Introduction

The genus *Ganoderma* P. Karst. has been known for over 100 years and was introduced by Karsten (1881) based on *Polyporus lucidus*. On the basis of the unique feature of the double-walled basidiospore, Patouillard (1889) described in or transferred into *Ganoderma* a number of species and published a monograph accepting 48 species. He distinguished also the species with globose or subglobose spores as section *Amauroderma*.

Many species belonging to the genus *Ganoderma* were reported by Patouillard (1889), Boudier & Fischer (1894), Boudier (1895), Murrill (1902, 1908) and other taxonomists. Boudier & Fischer (1894) and Boudier (1895) described *G. valesiacum* Boud. from conifers in Europe. Murrill (1902, 1908) published a synopsis of the species occurring in North America. He described seven new temperate species including *G. tsugae*, *G. sessile* Murrill, *G. zonatum*

Murrill, *G. sulcatum* Murrill, *G. oregonense* Murrill, *G. sequoiae* Murrill and *G. nevadense* Murrill, along with 10 others from tropical areas. The identification of *Ganoderma* was by then mainly based on host specificity, geographical distribution, and macromorphological features of the fruitbody, including the color of the context and the shape of the margin of the pileus and whether the fruit body was stipitate or sessile. Murrill (1902, 1908) considered primary taxonomic characters to be host specificity, geographical distribution, and macromorphology of the fruiting body. Atkinson (1908), Ames (1913), Haddow (1931), Overholts (1953), Steyaert (1972, 1975, 1977, 1980), Bazzalo & Wright (1982), and Corner (1983) conducted the identification of *Ganoderma* species by morphological features from a geographically restricted set of specimens. Haddow (1931) and Steyaert (1980) emphasized the basidiospore and hyphal characteristics as key features for the taxonomy of this group. Steyaert (1961a,b, 1962, 1967a, b, 1972, 1980) also investigated the world taxa while evaluating the value of both macro- and micromorphological features and described several new taxa most of which he later reduced to synonymy.

According to Ryvarden (1991), the genus is in a state of taxonomic chaos. Different authors use diverse criteria for the taxonomy of these fungi. This lack of unifying criteria contributed to the difficulty of harmonizing the taxonomy of this group. Recent workers have used characters other than morphology to determine relationships within the genus. These have included, in the first instance cultural and mating characters (Adaskaveg & Gilbertson 1986), isozyme studies (Hseu 1990, Gottlieb & Wright 1999), and more recently ribosomal DNA sequence and cladistic methods (Moncalvo et al. 1995) to infer natural relationships. With the development of cladistic methods to reconstruct phylogeny, the possible resolution of some of these problems appears close to hand.

The family *Ganodermataceae* was erected for polypores having a double-walled basidiospore (Donk 1964). Two kinds of basidiocarps producing this type of basidiospore have been distinguished: those with a shiny (laccate), yellowish or reddish-brown to black pilear surface, and those with a dull (non-laccate), grey-brown to black pilear surface (Moncalvo 2000). The genus *Elfvingia* P. Karst. was created to accommodate non-laccate *Ganoderma* taxa with *Boletus applanatus* as the type species (Karsten 1889). Modern authors such as Corner (1983) and Ryvarden (1991) treat *Elfvingia* as a subgenus of *Ganoderma*.

Seven species of *Ganoderma* have been previously recorded from Iran (Steyaert 1972; Saber & Minassian 2000; Moradali et al. 2004; Arefipour et al. 2002, 2004). They are re-described here in more details based on macro- and micromorphological features (Table 1). Their distributions throughout Iran are shown in Figure 1.

Figure 1- Biogeographical vegetation domain of *Ganoderma* species for Iran: *G. lucidum* (✱); *G. resinaceum* (+); *G. tsugae* (★); *G. applanatum* (▲); *G. adspersum* (◆); *G. colossus* (❋); *G. manoutchehrii* (●).

Materials and methods

In this study we examined herbarium specimens from Herbarium of the Ministry of Jihad-e Keshavarzi (IRAN) and newly collected materials from Northen Iran.

Basidiospores were observed by light microscopy, using 3% KOH, Melzer's reagent and Lactophenol. Spore length and width were determined by ocular micrometer for 20 spores from the fruitbody. Sections of the cutis and tube layer were obtained with a freezing microtome and their elements were observed by using 3% KOH, Melzer's reagent and Lactophenol. Pigments covering the elements of cutis were washed by Acetone solvent. Amyloid or non-amyloid reaction was observed in Melzer's reagent (Kirk et al. 2001, where the recipe can be found). Drawings were made with a drawing tube on a Zeiss microscope.

Table 1 - The *Ganoderma* species reported from Iran

Name	Geographical origin	Host/substrate	Reference
G. lucidum	Shast-Klateh	-	Arefipour et al. 2004
	Astara	*Parrotia persica* *Fagus orientalis* *Alnus* sp.	Saber et al. 2000
	Golestan	*Fagus* sp.	Arefipour et al. 2002
	Tonekabon	wood	Moradali et al. 2004
G. resinaceum	Lahijane	*Quercus* sp. *Parrotia persica*	Saber et al. 2000
	Bandar-e-Anzali	*Robinia pseudoacacia*	Saber et al. 2000
	Rasht	*Populus* sp.	
	Tonekabon	wood	Moradali et al. 2004
G. tsugae	Gilan	Conifer	Saber et al. 2000
G. applanatum	Golestan	*Fagus* sp.	Arefipour et al. 2002
	Shast-Klateh Drazno	- -	Arefipour et al. 2004
	Ahvaz Chalous Golestan	- - -	Saber et al. 2000
	Tonekabon	Wood	Moradali et al. 2004
	Dohezar	Wood	
G. adspersum	Astara	-	Saber et al. 2000
	Dohezar	*Ulmus* sp.	Saber et al. 2002
	Dohezar	Wood	Moradali et al. 2004
G. colossus	Kish Island Ahvaz	*Ficus benghalensis* *Ziziphus spina-christi*	Saber et al. 2000
G. manoutchehrii	Ramsar	*Acacia* sp.	Steyaert 1972

Key to *Ganoderma* species of Iran

1a. Cutis a hymenoderm; context pale, white to pale brown or brown **2**
1b. Cutis a characoderm; context dark brown **5**

2a. (1a) Basidiocarp laccate and context white to pale or dark brown; without chlamydospores **3**
2b. Basidiocarp non-laccate, context yellowish to buff; chlamydospores 8.0-12.5 x 13-19.5 µm .... ***G. colossus***

3a. (2a) Context dark cinnamon brown; basidiospores 6.7-11.5 x 5.7-7.6 µm .... ***G. resinaceum***
3b. Context white to pale brown or yellowish; basidiospores longer than 9 µm **4**

4a. (3b) Context white to brownish; carpophore brownish orange to black; on coniferous trees; basidiospores 9-11 x 6-8 µm .... *G. tsugae*

4b. Context pale brown to yellowish; carpophore reddish brown to black; on angiosperms; basidiospores 10.5-13.4 x 6.7-9.6 µm .... *G. lucidum*

5a. (1b) Basidiocarp non-laccate, with or without hyaline hyphae in cutis 6

5b. Basidiocarp laccate with hyaline hyphae in cutis .... *G. manoutchehrii*

6a. (5a) Cutis with hyaline hyphae; basidiospores 8.6-10.5 x 5.7-7.6 µm .... *G. adspersum*

6b. Cutis without hyaline hyphae; basidiospores 7.6-11.5 x 5.7-6.7 µm .... *G. applanatum*

Taxonomy

Ganoderma applanatum (Pers.) Pat.Hyménomyc. Eur. (Paris): 143, 1887 **Figs. 2-3**

≡ *Boletus applanatus* Pers., Obs. Mycol. 2: 2, 1800 ('1799').
≡ *Polyporus applanatus* (Pers.) Wallr., Fl. Cryp. Germ. 2: 591, 1833.
≡ *Elfvingia applanata* (Pers.) P. Karst., Bidr. Känn. Finl. Nat. Folk 48: 334, 1889.
= *Polyporus megaloma* Lév., Annls Sci. Nat. (Bot.) III 5: 128, 1846.
= *Polyporus leucophaeus* Mont., Syll. Crypt. p. 157, 1856.

Key characters — Basidiocarp perennial, woody, typically sessile, up to 35 x 26 x 9 cm, fan-shaped to slightly convex, usually solitary but also connected with each others; margin rounded early and becoming narrowed at maturity; surface a hard crust, brown to grey brown, dull grey, irregular, often furrowed, nodulose and zonate, often dusted with brown spores, crust thick, of characodermis type with irregular hyphal elements; context up to 6.0 cm thick, brown to dark brown, veined with white mycelia, tough, corky; pore 4-5 per mm, pore surface at first white, becoming grey-brown at maturity and quickly bruising brown when injured, fading to pale yellowish-buff when dried, most specimens with several tube layers (up to 6 layers) separated by thin layers of brown tissue.

Basidiospores ovoid to broadly ellipsoid, with a truncate apex, thick and double-walled, brown, spinulose, 5.7-6.7 x 7.6-10.5-11.5 µm. Hyphal system trimitic with hyaline, thin- walled, septate, clamped generative hyphae, 1-2 µm in diam., skeletal hyphae golden brown, thick-walled, aseptate, very long, 4-6 µm in diam. and binding hyphae profusely branched, thinner and lighter than the skeletals, aseptate, limited growth, 1-4 µm in diam.

Habitat — This species grows solitary or in small groups almost always on fallen logs of both hardwood and conifers, but also on living trees as a weak parasite, penetrating through injured tissue and causing a white rot.

Material examined- On fallen logs of hardwood, Kotra, Tonekabon, Mazandaran, April 21, 2003 (IRAN 1538 F); on fallen logs of hardwood, Dohezar forest, Tonekabon, April 21, 2003 (IRAN 1527 F); on fallen logs of hardwood, Mazoben, Kotra, Tonekabon, July 21, 2003 (IRAN 1528 F); on fallen logs, Namak-Abroud forest, Chalous, Mazandaran, July 30, 2003 (IRAN 2100 F).

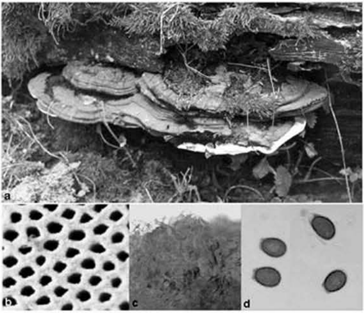

Figure 2- Macro- and micromorphological characteristics of *Ganoderma applanatum*.
a, basidiocarp; b, pore surface; c, cutis elements; d, basidiospores

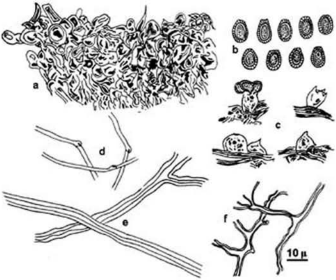

Figure 3- Basidiocarp characteristics of *Ganoderma applanatum*.
a, cutis elements; b, basidiospores; c, basidia;
d, generative hyphae; e, skeletal hyphae; f, binding hyphae

Ganoderma adspersum (Schulzer) Donk, Proc. Ned. Akad. Wet., C 72: 273, 1969.
Figs. 4-5

≡ *Polyporus adspersus* Schulzer, Flora 61: 11, 1878.
= *Polyporus linhartii* Kalchbr., in Linhart, Fung. Hong. no. 252, 1884.
≡ *Ganoderma linhartii* (Kalchbr.) Z. Igmándy, Acta Phytopath. Acad. Sci. Hung. 3: 237, 1968.
= *Ganoderma europaeum* Steyaert, Bull. Jard. Bot. Brux. 31: 70, 1961.

Key characters — Basidiocarp perennial, woody, sessile, dimidiate, up to 17 x 16 x 6 cm; pileus brown to dark brown; very hard when dry, zoned with concentric sulcate rings, somewhat cracking when dry, surface a hard crust, cutis 0.9-1.5 mm thick, of characodermis type with irregular hyphal elements also with hyaline hyphae that branch off in the cutis; context relatively thin, up to 4.0 cm thick, dark brown, corky; pore 4-5 per mm, pore surface whitish grey to light brown, fading to pale yellowish-buff when dried; tube layer with lighter color than context, clearly differentiated from the context, without distinct separating context zones between each tube layer and tubes, whitish, up to 1.5 cm thick.

Basidiospores ovoid, with a rounded or truncate apex, thick and double-walled, brown, spinulose, 5.7-6.7-7.6 x 8.6-9.6-10.5 µm. Hyphal system trimitic with hyaline, thin- walled, septate, clamped generative hyphae, 1-3 µm in diam., skeletal hyphae golden brown, thick-walled, aseptate, very long, 4-8 µm in diam. and binding hyphae profusely branched, thinner and lighter than the skeletal hyphae aseptate, limited growth, 2-5 µm in diam.

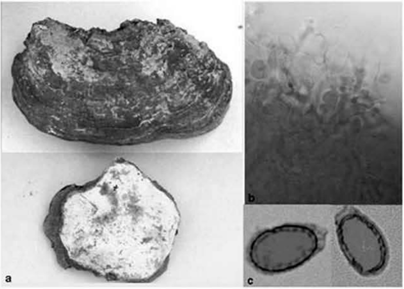

Figure 4- Macro- and micromorphological characteristics of *Ganoderma adspersum*. a, basidiocarp; b, cutis elements; c, basidiospores

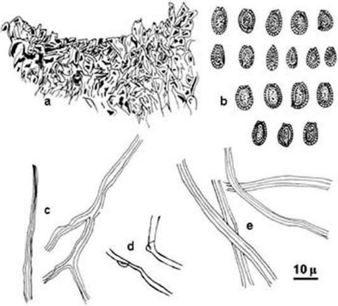

Figure 5 - Basidiocarp characteristics of *Ganoderma adspersum*.
a, cutis elements; b, basidiospores; c, binding hyphae; d, generative hyphae; e, skeletal hyphae

The basidiocarps of *G. applanatum* and *G. adspersum* are sometimes similar to each other. However, the differences between them is clearly seen in their spore dimensions and micromorphology of the cutis, the basidiospores of *G. applanatum* being the smaller. Also there are hyaline hyphae that branch off in the cutis of *G. adspersum*. According to Steyaert's study on the Iranian specimens of *G. adspersum*, it is quoted that they have smaller spores and thinner context than in European specimens (Saber 1973). The context in these specimens is brown and they have white hyphae whereas European specimens have a red context and no white hyphae (Saber 1973). According to Steyaert (Saber 1973), the existence of white hyphae is caused by a facultative parasite, that this species is subject to in the climatic conditions of northern Iran. This difference can arise from their geographical distribution, habitat and behaviour of organisms in each geographical region.

Habitat — This species grows on fallen logs of hardwoods causing a white rot. It has been collected in northern Iran on *Gleditschia caspica, Prunus spinosa, Citrus aurantium, Diospyros kaki, Mespilus germanica,* but also on living trees of *Quercus* spp., *Acer* spp. and *Fagus orientalis* (Saber et al. 2000).

Material examined- On fallen log of hardwood tree, Dohezar forest, Tonekabon, Mazandaran, April 22, 2003 (IRAN 1539 F); on dry wood, Gorgan and shamoshak forest, Golestan province, Nov. 2003 (IRAN 311 F).

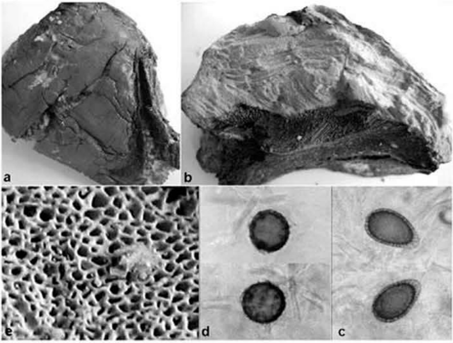

Figure 6 – macro – and micromorphological characteristics of *Ganoderma colossus*.
a, basidiocarp; b, context and tube layer; c, basidiospores; d, chlamydospores; e, pore surface

Ganoderma colossus (Fr.) C.F. Baker, Fung. Malay. no 425, 1918. Fig. 6

≡ *Polyporus colossus* Fr., Nova Acta Soc. Sci. Upsal. III 1: 56, 1851.

≡ *Dendrophagus colossus* (Fr.) Murrill, Bull. Torrey Bot. Club 32: 473, 1905.

≡ *Tomophagus colossus* (Fr.) Murrill, Torreya 5: 197, 1905.

= *Ganoderma obockense* Pat., Bull. Soc. mycol. Fr. 3: 119, 1887.

= *Polyporus hollandii* Massee, Bull. Misc. Inf. Kew 1901: 163, 1901.

Key characters — Basidiocarp dimidiate, bulky, up to 35 cm in radius and 9 cm thick; pileus tender, soft and upper surface dull to somewhat shiny, yellowish to buff; cutis very thin, dark dull yellow, scaling off easily, of hymeniodermis type with club-shaped elements, about 40 µm long and 7-8 µm thick at the apex; context usually two third of the thickness of the basidioma, chamois; pore surface white at first and dark buff at maturity and when dried; tube layer up to 3.0 cm thick, buff.

Basidiospores ovoid, chamois, double-walled, echinulate with 1 µm long spines along the spore side and up to 4 µm long at the apex, 8-9.7-12.5 x 13-16.3-19.5 µm.

Chlamydosporesglobose,coveredwithshort,stumpyspinesorridges,chamois, 16-18-21 µm, located irregularly in context; hyphal system dimitic with hyaline, thin-walled, septate, clamped generative hyphae, strongly branched in the context, 2-4 µm in diam. and skeletal hyphae pale yellow, thick-walled, aseptate, 3-5 µm in diam.

Habitat — This species was collected on *Ficus benghalensis* and on an unknown tree in Kish Island, and on *Ziziphus spina-christi* in Ahvaz, Khuzestan province, both areas situated in southern Iran (Saber & Minassian 2000).

Material examined- On *Ziziphus spina-christi*, Ahvaz, Khuzestan, Nov. 1999 (IRAN 10927 F); on *Ficus benghalensis*, Kish Island, Oct. 1997 (IRAN 10560 F).

Ganoderma lucidum (Curtis) P. Karst., Revue mycol., Toulouse 3(9): 17, 1881

Fig. 7-9

= *Boletus lucidus* Curtis, Fl. Lond. 2: pl. 216, 1781.
= *Polyporus lucidus* (Curtis) Fr., Syst. Mycol. 1: 353, 1821.
= *Placodes lucidus* (Curtis) Quél., Enchir. Fung. p. 170, 1886.

Key characters — Basidiocarp sessile, dimidiate or stipitate either centrally, excentrically or laterally, and then usually reniform, with different sizes, up to 20 x 14 x 1.5 cm; upper surface radially and concentrically plicate, usually irregular, sometimes warty, laccate, shiny, pale red, reddish brown to blackish brown; margin usually thick, sometimes acute, white in actively growing specimens, and turning yellowish, orange, and reddish brown from the extreme outline inward; stem lateral, vertical, cylindrical, usually long, slender, up to 3 cm thick and 27 cm long, reddish black to almost black, laccate, brilliant, and often but not always with a stem; cutis thin, shiny, a hymenoderm with club-shaped elements originating from the ends of skeletal hyphae, arranged in a palisade-like hymenium, up to 10.5 x 62 µm, amyloid in Melzer's reagent or non-amyloid, these elements are covered by a thick layer of a lacquer pigments that dissolve in a hot solution of 5% KOH and acetone; context creamy white to ochraceous brown, corky, about 1.0 cm thick; tube layer about 1.0 cm thick; tube layer darker than context, about 7.0 mm thick; pore surface white at first and turning greyish when mature and dried; pores more or less rounded, somewhat irregular, 4-6 per mm.

Basidiospores ovoid, double-walled, with a rounded or truncate apex, brown, echinulate comparatively few, long and thick, 6.7-8.6-9.6 x 10.5-12.4-13.4 µm. Hyphal system trimitic with hyaline, thin-walled, septate, clamped generative hyphae, 1-3 µm in diam., skeletal hyphae golden brown, thick-walled, aseptate, very long, 3-7 µm in diam. and binding hyphae profusely branched, thinner and lighter than the skeletals, aseptate, limited growth, 2-4 µm in diam.

Habitat — At the base of trunks and on roots of hardwoods, rarely on conifers. Specimens of this species were collected on *Buxus hyrcana, Acacia dealbata, Pterocarya fraxinifolia, Quercus* sp., *Albizia* sp., *Casuarina* sp., *Platanus* sp. (Saber 1973 Saber & Minassian 2000 Saber & Esmailii-Taheri 2004).

Figure 7- Basidiocarp characteristics of *Ganoderma lucidum*

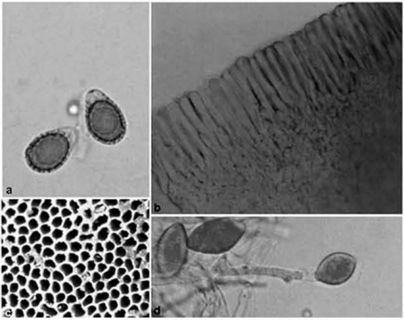

Figure 8- Micromorphological characteristics of *Ganoderma lucidum*.
a, basidiospores; b, cutis elements; c, pore surface; d, chlamydospores

Material examined- On fallen hardwood trunk, Dohezar forest, Tonekabon, Mazandaran, July, 2003 (IRAN 1540 F); on fallen hardwood trunk, Dohezar forest, Tonekabon, Mazandaran, April, 2003 (IRAN 1541 F); on fallen hardwood trunk, Mazoben, Kotra, Tonekabon, Mazandaran, July, 2003 (IRAN 2099 F); on *Carpinus betulus*, Gavsar, Tonekabon, Mazandaran, August 19, 1971 (IRAN 6722 F); on wood, Tonekabon, Mazandaran, summer, 1970 (IRAN 6721 F).

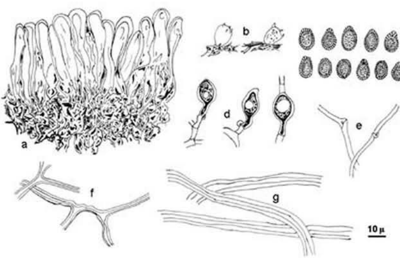

Figure 9 - Basidiocarp characteristics of *Ganoderma lucidum*.
a, cutis elements; b, basidia; c, basidiospores; d, chlamydospores;
e, generative hyphae; f, binding hyphae; g, skeletal hyphae

Ganoderma resinaceum Boud. in Patouillard, Bull. Soc. mycol. Fr. 5: 72, 1889

Figs. 10-11

= *Ganoderma chaffangeonii* Pat., Bull. Soc. mycol. Fr. 5: 74, 1889.
= *Ganoderma sessile* Murrill, Bull. Torrey Bot. Club 29: 604, 1902.
= *Polyporus polychromus* Copel., Ann. Mycol. 2: 507, 1904.
  ≡ *Ganoderma polychromum* (Copel.) Murrill, N. Am. Fl. 9: 119, 1908.
= *Ganoderma praelongum* Murrill, N. Am. Fl. 9: 121, 1908.
= *Ganoderma argillaceum* Murrill, N. Am. Fl. 9: 122, 1908.
= *Ganoderma subperforatum* G.F. Atk., Bot. Gaz. 46: 337, 1908.
= *Ganoderma platense* Speg., Bol. Acad. Nac. Cienc. Córdoba 28: 363, 1926.

Key characters — Basidiocarp dimidiate to reniform, substipitate to long stipitate, usually laterally, sometimes centrally stipitate; pileus very variable in size, up to 26 x 13 x 5 cm, often very irregular in shape; upper surface applanate, concave or more or less infundibuliform, smooth, irregularly rugose, concentrically sulcate and radially rugose or strongly tuberculose, shiny laccate, reddish brown or light reddish brown in maturity, central zone yellowish brown and very light in young specimens, may have a thick white margin when these are not mature, gradually turning yellow, red, brown and finally black from the margin toward the base; stem very short to long, lateral or central, slender to thick, black, laccate, brilliant; cutis thin, 100 µm, shiny black, a hymenoderm with club-shaped elements originating from the ends of the skeletal hyphae, arranged in a palisade-like hymenium, up to 22 x 57 µm, amyloid in Melzer's reagent; context corky, cinnamon brown in the upper parts

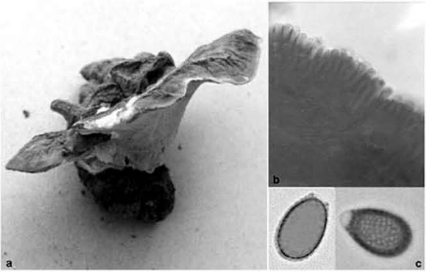

Figure 10- Macro- and micromorphological characteristics of *Ganoderma resinaceum*.
a, basidiocarp; b, cutis elements; c, basidiospores

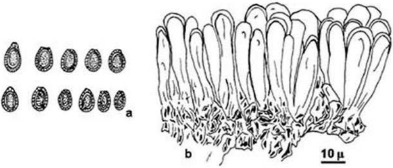

Figure 11 - Basidiocarp characteristics of *Ganoderma resinaceum*.
a, basidiospores; b, cutis elements

but with zone closed to tube layer cacao brown; tube layer slightly lighter than context, about 4-15 mm thick; pore surface white at first turning greyish when mature and dried; pores rounded, somewhat irregular, 4-6 per mm.

Basidiospores ellipsoid, double-walled, with a rounded or truncate apex, chamois, with short, thin, closely packed spines, thus appearing smooth when observed at 400 x, 5.7-6.7-7.6 x 6.7-11.5 µm. Hyphal system trimitic with hyaline, thin-walled, septate, clamped generative hyphae, 1-5 µm in diam., skeletal hyphae golden brown, thick-walled, aseptate, very long, mostly unbranched or with one or two distal branches besides some lateral swellings, 3-7 µm diam. and binding hyphae branched, thinner and lighter than the skeletal hyphae, aseptate, limited growth, much branched, 2-4 µm in diam.

Habitat — On trunks and fallen logs of hardwoods and conifers. *Quercus* sp., *Robinia pseudoacacia* and *Populus* sp. are its hosts in Iran (Saber & Minassian 2000).

Material examined- On fallen trunk, Gisum Park, Gilan, Iran, June 21, 1991 (IRAN 10685 F).

Ganoderma tsugae Murrill, Bull. Torrey Bot. Club 29: 601, 1902 **Fig. 12**

= *Polyporus tsugae* (Murrill) Overh., Ann. Mo. Bot. Gard. 2: 714, 1915.

Key characters — Basidiocarp reniform or flabelliform, stipitate or narrowed to an almost sessile base, corky; pileus variable in size, up to 20 x 30 x 5 cm, brownish orange to blackish, shiny laccate, paler on the margin, sometimes with a brown coating of spores, azonate or somewhat zonate or sulcate on the margin; stem when present usually lateral, sometimes central with color as in the pileus or more shining, 3-5 cm; cutis thin, shiny red, a hymenoderm; context tough and watery when fresh, white or nearly so throughout but usually slightly brownish next to the tube, 0.5-2.5 cm thick; pore surface white to brown, tube layer 0.5-1 cm thick; pores 4-6 per mm.

Basidiospores ovoid, double-walled, with a truncate apex, light brown, apparently echinulate, 6-8 x 9-11 µm. Hyphal system trimitic with hyaline, thin-walled, septate, clamped generative hyphae, 1-3 µm in diam., skeletal hyphae pale brown, thick-walled, aseptate, 4-6 µm in diam. and binding hyphae branched, thinner and lighter than the skeletals, aseptate, 2-4 µm in diam.

Habitat — On logs and living trees of conifers.

Material examined- On conifer, Gisom-Rezvanshahr, Gilan province, July 1997 (IRAN 10843 F); on wood, 10 Km Fuman to Masuleh, Gilan province, May 1996 (IRAN 10782 F).

Ganoderma manoutchehrii Steyaert, Persoonia 7(1): 71, 1972

This species was described by Steyaert (1972) based upon a single specimen on *Acacia* sp., collected from Ramsar (Northern Iran). The holotype was not available for us to check. We also visited type locality of above species several times to find topotype but no specimen was found.

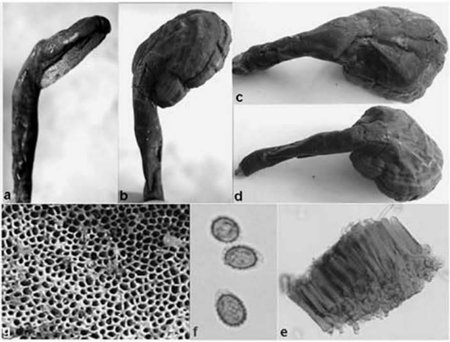

Figure 12- macro- and micromorphological characteristics of *Ganoderma tsugae*.
a-d, basidiocarp; e, cutis elements; f, basidiospores; g, pore surface

Discussion

Identifications of *Ganoderma* species were traditionally based on a combination of micro- and macromorphological studies and host relationship. More recently, cultural and mating type studies, together with molecular taxonomy added new insight into the taxonomy of this difficult group, resolving partly the taxonomical chaos of *Ganoderma*. Distributions of the *Ganoderma* species species especially through Middle East and Asia in combination with their host relationship are still poorly known.

In the present work we investigated collections of *Ganoderma* species from Iran and introduced them based on micro- and macromorphology and host relationships and also provide a key for their identification. Seven *Ganoderma* species are reported from Iran, two of which belong to subgenus *Elfvingia* (P. Karst.) Imazeki (non-laccate species, *G. applanatum*, *G. adspersum*, and four species belong to subgenus *Ganoderma* (laccate species, *G. lucidum*, *G. resinaceum*, *G. tsugae*, *G. manoutchehrii*) and one species, *G. colossus*, that does not belong to above mentioned subgenera (This species was once placed in its own genus, *Tomophagus* Murrill. Although most authors consider *Tomophagus* as a synonym of *Ganoderma*, recent data from molecular studies would support the recognition of the genus).

Most authors consider *Elfvingia* to be a subgenus of *Ganoderma* including non-laccate species, the laccate species being referred to as subgenus *Ganoderma*. The species belonging to subgenus *Ganoderma* have a hymeniodermis or characodermis type cutis; many of them are stipitate or variably sessile to stipitate (see *G. resinaceum* for instance). Members of subgenus *Elfvingia* have a cutis and are mostly sessile. *Ganoderma applanatum* is the type species of *Elfvingia* and along with *G. adspersum*, form the core species in the *G. applanatum-adspersum* complex. *Ganoderma applanatum* possibly has a northern distribution (Ryvarden & Gilbertson 1993). *Ganoderma applanatum* and *G. adspersum* spread in temperate and humid areas of Iran that includes the southern margin of the Caspian Sea. In northern Iran with its temperate and humid climate the growth of some *Ganoderma* species is favored. In this area there are dense and temperate forests of *Alnus subcordata, Pterocarya fraxinifolia, Celtis caucasica, Quercus sessiliflora, Q. castaneifolia, Carpinus betulus, Fagus orientalis, Gleditschia caspica, Betula pendula,* and *Populus caspica.*

Ganoderma colossus was collected from southern subtropical areas of Iran growing on deciduous trees. This species has in contrast to other non-laccate species a hymenoderm.

G. manoutchehrii was described on the basis of a collection originating from Iran (Steyaert 1972). This species has not been collected during this study, although we specifically search for in the type locality.

Host specificity has been used to circumscribe *Ganoderma* taxa. In the northern temperate regions *G. valesiacum*, *G. carnosum* Pat., *G. tsugae* and *G. oregonense* have been distinguished from *G. lucidum* based on their host relationships, and all appear to be restricted to conifers. *Ganoderma tsugae* was originally described from North America on Conifer, and have been reported from East Asia (China and Japan) on *Picea*, *Pinus*, *Tsuga*, and *Abies*, more rarely on *Acer* and *Betula*.

Among the studied specimens IRAN 6722 F, IRAN 6721 F are Eurasian specimens of *G. lucidum*. They differ from Asian specimens in the amyloid reaction of cutis elements in Melzer's reagent. However, amyloid reaction of the cutis is not usually a stable character and may vary considerably with age and development, and consequently, has to be used with caution in the taxonomy of this genus (according to personal communications with Dr. Ryvarden). They differ also both in the size and ornamentation of their basidiospores. The Eurasian specimens have smaller basidiospores than Asian specimens (4.8-5.7-6.7 x 6.7-7.6-9.6 μm) and the spines are more delicate, plentiful and smaller than in other specimens. It is important that in the first observation such spores be very like *G. resinaceum* ones. With regard to such differences we can agree that such specimens belong to *G. lucidum* complex reported from Iran and that molecular studies can help us to more precise identification.

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Orbilia vermiformis sp. nov. and its anamorph

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Abstract—During our study of orbiliaceous fungi and their anamorphs, a specimen of *Orbilia* was collected and its anamorph culture was obtained. The morphological characteristics plus phylogenetic analyses based on nuclear rDNA sequences indicate that both the anamorph and teleomorph represent new novel distinct species. Both teleomorph and anamorph are described and illustrated. The teleomorph *Orbilia vermiformis* is similar to *O. crystallina*, but differing by its apothecia without solid, glassy processes at the margin, larger asci and ascospores, and the anamorph *Dactylella vermiformis* is characterized by branched conidiophores and 0-1-septate clavate conidia.

Key words—teleomorph-anamorph connection

Introduction

Xerointolerant species of the genus *Orbilia* Fr. are characterized by small, waxy, light-colored, semi-translucent apothecia, tiny asci and usually swollen paraphysis apices. This group of fungi is generally reported to occur on semi-moist decayed wood or bark and produces various anamorphs (Pfister 1997). The connection between *Orbiliaceae* and their anamorphs has been well established and many anamorph species have been reported recently (Mo et al. 2005a, b, Liu et al. 2005a, b, Yang & Liu 2005, Yu et al. 2006). However, anamorphs have been mainly isolated from species with subulate (Mo et al. 2005a, Webster et al. 1998, Pfister 1994, Pfister & Liftik 1995, Rubner 1996), subcylindrical (Liu et al. 2005a), globose and kidney-shaped (Pfister 1997) ascospores but not from species with helicoid ascospores. During our survey on the orbiliaceous fungi in China, an *Orbilia* species with helicoid ascospores was collected and its anamorph was obtained. The anamorph was placed within the genus *Dactylella* according to the system of Scholler et al. (1999). After detailed examination and phylogenetic analysis based on DNA sequences from the internal transcribed spacer region (ITS) of the ribosomal RNA gene, we believe both teleomorph and anamorph were not described previously.

Materials and methods

The fresh holotype specimen of *Orbilia vermiformis* was collected from XiaoHeiJiang Forest Park, Pu'er County, Yunnan Province, China, in September, 2005, by Min Qiao. The anamorph was isolated and observed as the way described by Yu et al. (2006). The measurement of each character is derived from 50 repeats. To induce the formation of nematode-trapping organs, about 100 nematodes (*Panagrellus redivivus* Goodey) into a 1 × 1 square centimeter slot at the margins of the colony where the agar was removed.

The total DNA of the fungus was isolated from fresh mycelium as described by Turner et al. (1997). A region of rDNA, containing the ITS regions 4, 5 and the 5.8S rRNA, was amplified by PCR using the primers described by White et al. (1990). The parameters for PCR amplifications were as follows: 1 min at 94°C, followed by 30 cycles of 94°C for 1 min, 50°C for 1 min, 74°C for 90 s, and a final extension period of 7 min at 74°C. The PCR products were purified with a commercial Kit (TaKaRa Biotechnology Co., Ltd.), and sequenced (Kindermann et al. 1998).

DNA sequences were aligned using the ClustalX 1.83 and the BioEdit programs. Parsimony analysis was run using PAUP* 4.0b10 (Swofford 2002), with the following settings: gaps treated as missing, all characters weighted equally, used heuristic searches with TBR (tree-bisection-reconnection) as the branch-swapping algorithm and bootstrap values generated using 1000 replicates.

Taxonomic description

Teleomorph:

Orbilia vermiformis Baral, Z.F. Yu & K.Q. Zhang **sp. nov.** FIGURE 1

MycoBank # MB510463

Apothecia 1.2-2.0 mm in diam., solitaria vel gregaria, margine glabra vel minute crenulata, superficialia, sessilia, alba vel pallide lutea. Excipulum ectale textura angulare, cellulis 10-35 μm diam, marginem versus sine processibus solidis. Asci 39.3-62.0 × 3.8-5.0 μm, 8-spori, cylindraceo-clavati, apice truncati, basi angustati plerumque furcati, apice truncati vel rotundati. Ascosporae hyalinae, filiformes-subulatae, valde helicoideae, non-septatae, imbricate 2-4-seriatae, 8.8-11.5 × 1.0-1.5 μm, ad apicem cum vacuola refringente lacrimiforme, 1.3-1.8 × 0.8-1.0 μm. Paraphyses filiformes, apice non inflatae, usque 2.8-3.0 μm diam., hyalinae.

Etymology: *vermiformis*, referring to the worm-shaped ascospores.

Holotype: YMFT 1.01842, isolated from exposed rotten root of broad-leaved tree, XiaoHeiJiang Forest Park, Pu'er County, alt. 2100 m, Yunnan Province, PR China, Min Qiao, 3 Sep. 2005, a culture preserved in liquid nitrogen, permanent slide culture (YMF 1.01842), Isotype: H.B. 8313.

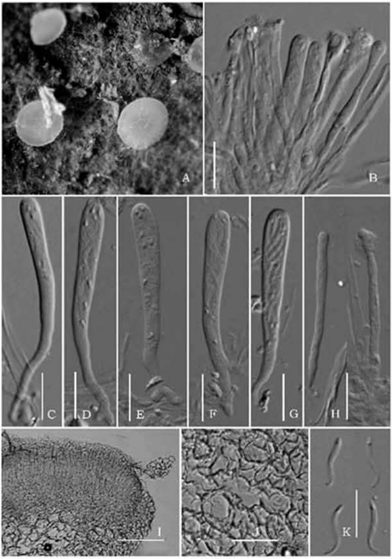

Fig 1. ***Orbilia vermiformis.*** Holotype A. Fresh apothecia. B. Cluster of asci and paraphyses. C-G. Dead asci with living spores. H. Dead paraphyses. I. Median section of an apothecium. J. Cells of ectal excipulum. K. Living ascospores. Scale bars: B-H, J-K = 10 µm, I = 50 µm.

Apothecia scattered to gregarious, sessile, superficial on rotten wood. Disc 1.2-2.0 mm in diam., white or pale yellow throughout, waxy, not translucent when fresh, margin even or minutely crenulate. Ectal excipulum 250 µm thick in centre, composed of angular to prismatic cells from base to margin, hyaline, thin-walled, 25-45 × 10-35 µm, marginal cortical cells 13-17 × 8-13 µm, without glassy processes. Medullary excipulum 20 µm thick, textura intricata-

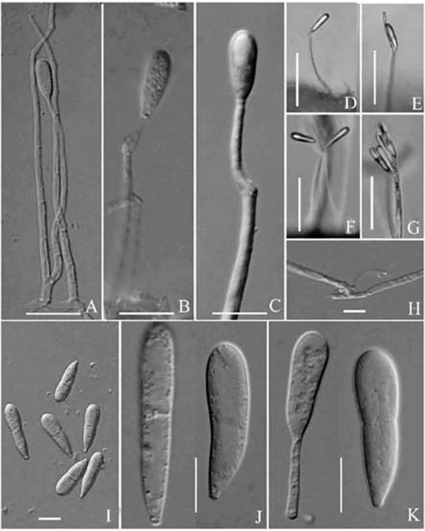

Fig. 2. ***Dactylella vermiformis***. Holotype. A-G. Living conidiophores with conidia. H. Joint of two conidiophore bases. I-K. Living conidia.

Scale bars: A-C, J-K = 10 µm, D-G = 50 µm, H-I = 10 µm.

angularis. Asci cylindric-clavate,rounded or strongly truncate with a distinct indentation (depending on direction of view) at the thin-walled apex, tapered and often forked at the base, 8-spored, 39.3-62.0 × 3.8-5.0 µm (living state), 45 × 3.3-3.7 µm (in KOH). Ascospores hyaline, non-septate, filiform, helicoid or sigmoid, 8.8-11.5 × 1.0-1.5 µm (living state) and 10-10.7 x 0.9-1.1 µm (in KOH), broadest above and slightly tapered to the rounded upper end, gradually tapered to a fine point at the base, lower spores in ascus inversely oriented, bearing a refractive tear-shaped spore body (SB) at the apex (broader end), 1.3-

1.8 × 0.8-1.0 μm, attachment of SBs to the apical wall of the ascospores partly visible. Paraphyses filiform, apex not or only very slightly enlarged to 2.8-3.0 μm, usually covered at the apex by a thin rough exudate, containing globose SCBs (cytoplasmic bodies).

Anamorph:

Dactylella vermiformis Z.F. Yu, Ying Zhang & K.Q. Zhang **sp. nov.** FIGURE 2
MycoBank # MB510462

Coloniae in agaro CMA , post 10 dies 25°C 40 mm diam. Mycelium sparsum, hyphis septatis, 3-4 μm latis. Conidiophora erecta, simplices vel ramose, 70-150 μm longa, 3 μm lata ad basim, 1.8-2 μm lata ad apicem. Conidia hyalina, clavata, 20-36.8 × 5.8-8.1 μm, 0-1 septata.

Etymology: species epithet refers to the teleomorph species.

Holotype: YMF 1.01842, permanent slide, XiaoHeiJiang Park, Pu'er County, Yunnan, P. R. China, alt. 2100 m, Min Qiao, Sep. 2005.

Colonies white, growing slowly on PDA, reaching 44 mm at 21°C after 10 days, 63 mm at 25°C, 61 mm at 28°C, no growth at 35°C, producing black pigment in the back of colonies. Colonies white, aerial mycelium sparse on CMA, 2.5-4 μm wide, reaching 30 mm at 22°C, 40 mm at 25°C, 45 mm at 28°C after 10 days, no growth at 35°C. Vegetative hyphae hyaline, branched and septate, 3-4 μm wide. Primary conidiophores septate, erect, simple or branched, 3 μm wide at the base and 1.8-2 μm wide above, 70-150 μm in length, single conidiophores with a single apical spore, most conidiophores growing in flexing knee with a spore at the flexing place, and another spore at the apex. Conidiophores often form loose bundles because of the joining of conidiophore bases. Conidia colorless, clavate, rounded at the distal end, constricted into bottleneck shape at the proximal end, straight, sometimes slightly curved, with (0-)1 septum (median or nearer to distal end), occasionally constricted at septum, 20.0-36.8 (25.3) × 5.8-8.1 (6.7) μm (living state). No trapping structures on WA were observed when nematodes were added.

Phylogenetic analysis

Maximum parsimony analysis of the ITS sequences (FIG. 3) yielded single tree based on 260 parsimony informative characters (constant characters are 221 and uninformative characters are 89). The MP tree had 1044 steps in length with a consistency index (CI) of 0.614 and a retention index (RI) of 0.6147. In our analysis, *Hyalorbilia brevistipitata* (a member of the family *Orbiliaceae*) was used as an outgroup. The ITS phylogenetic tree indicated that taxa forming adhesive knobs, forming constricting rings and forming networks clustered into different clades respectively, but four species of *Dactylella* located within different clade. *D. vermiformis* showed close affinities to species producing constricting rings and species producing adhesive knobs. Unfortunately, in our

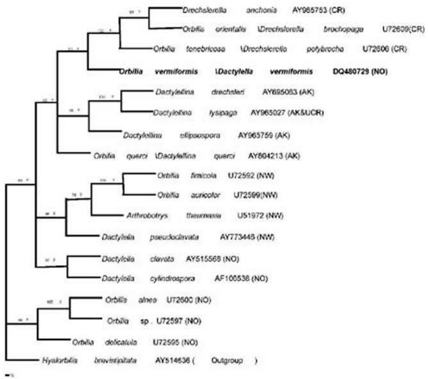

Fig. 3 Most parsimonious phylogenetic tree generated from a heuristic search based on the alignment of the ITS region sequences of some nematode-trapping fungi. Numbers above lines represent bootstrap values from 1000 replicates on all parsimony-informative characters, with only bootstrap values >50% shown. Except for the sequence of *O. vermiformis*, other sequences were obtained from the GenBank (accession numbers shown following each taxon name). The abbreviation in the parenthesis for each taxon refers to nematode-trapping device (or no device): AK, adhesive knobs; CR, constricting rings; NW, networks; UCR, non-constricting ring; NO, no-trapping advice.

molecular analyses no ITS sequence of species morphologically similar to *D. vermiformis* is available from GenBank, except *Dactylella pseudoclavata,* and these two species are phylogenetically distant.

Discussion

Morphologically, *D. vermiformis* is similar to *Dactylella arrhenopa* (Drechsler) K.Q. Zhang et al., *Dactylella polyctona* (Drechsler) K.Q. Zhang et al. and *Dactylella pseudoclavata* Z.Q. Miao & X.Z. Liu in producing clavate conidia with one septum (Zhang et al. 1995, Miao et al. 2003). However, conidia of *D. vermiformis* were larger with broader distal end than that of *D. arrhenopa* and *D. polyctona*. Compared to *Dactylella pseudoclavata*, *D. vermiformis* has shorter conidia without nematode-trapping devices whereas *D. pseudoclavata* produces three-dimensional trapping networks (Table 1).

Table 1. Morphological comparison of *D. vermiformis* and similar species.

Dactylella species	Size of conidia (μm)	Trapping device	Number of conidial septa
D. pseudoclavata	30 – 45 × 8 – 11	three-dimensional networks	0-1
D. vermiformis	20.0 – 36 ×5.8 – 8.1	not observed	0-1
D. polyctona	12.7 – 21 ×2.3 – 2.8	not observed	1
D. arrhenopa	17 – 25 × 2.6 – 3.7	not observed	1

Orbilia vermiformis, the teleomorph of *Dactylella vermiformis*, is also distinctly different from other described species in the genus *Orbilia*. *O. vermiformis* is characterized by filiform, helicoid ascospores. Although similar ascospores exist in *Orbilia crystallina* (Quél.) Baral, those of *O. vermiformis* are broader and longer than that of *O. crystallina*. Other characteristics such as marginal cortical cells of *O. crystallina* being elongated and terminated by glassy and solid processes were not found in *O. vermiformis*, while the asci and paraphyses of *O. vermiformis* are distinctly larger than those of *O. crystallina*. In our present specimen, the apothecia of *O. vermiformis* were not translucent which is rather unusual, especially in xerointolerant species of *Orbilia*. However, in an American collection referable to *O. vermiformis* (see below) the apothecia were medium translucent.

A collection from Central America (Martinique, Le St. Esprit, Le Bois La Charles, bark of broad-leaved tree, C. Lechat, H.B. 8031) fits quite well with the type of *O. vermiformis*, except the narrower marginal cortical cells (9-15 × 5-7 μm). Also the presumed anamorph which was found on the natural substrate, resembles that of the type of *D. vermiformis* but the 1-septate conidia were found to be smaller (14.5-20.5 × 4.2-6.5 μm, in KOH). For the time being the specimen is considered to belong in the scope of *O. vermiformis*.

It was strange that *D. vermiformis* did not produce any nematode-trapping devices but was grouped with constricting ring forming species with 93% bootstrap support in phylogenetic tree. The possible reasons could be that the fungus lost its ability to form trapping devices or the fungus could capture other microscopic animals such as rotifers and rhizopods. The predatory ability of this fungus needs to be further investigated.

Acknowledgements

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Studies on *Lactarius*: Two new records from Costa Rica and additional information from Mexico

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Abstract— *Lactarius luteolus* and *L. verae-crucis* are recorded from Costa Rica for the first time. New collections from Veracruz and Guerrero expand their known distribution ranges. Studies on fresh basidiomes of *L. luteolus* recorded throughout 2002-2005 from a monitored plot in a protected mesophytic forest in Veracruz, Mexico, revealed additional data on its morphology, phenology, and ecological association with *Carpinus caroliniana*. Descriptions, coupled with illustrations of macro- and micromorphological features and discussions of both taxa, are presented based on Costa Rican and Mexican specimens.

Key words—ectomycorrhizal fungi, neotropics, *Russulaceae*, taxonomy

Introduction

Knowledge about the distribution of *Lactarius* in The American Continent is gradually being improved with data from the Neotropics (Singer et al. 1983, Montoya et al. 1990, Mueller & Halling 1995, Montoya 2000). The distribution of ectotrophic trees with temperate affinities such as *Pinaceae*, *Fagaceae* and *Betulaceae* in Mexican forests (Rzedowski 1978, Styles 1993) explains the high diversity of ectomycorrhizal macrofungi such as *Lactarius*. In Costa Rica, both *Alnus* (Halling 2001) and *Quercus* (Singer et al. 1983, Halling 2001, Halling & Mueller 2002, Montoya et al. 2003, Montoya & Bandala 2005) represent important associated phanerogams which allow for the near continuous distribution of some *Lactarius* taxa from North America into Central America.

Lactarius luteolus has been documented from several regions of the U.S.A. and Canada, in deciduous and mixed woods (Peck 1896, Burlingham 1908,

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Murrill 1938, Hesler & Smith 1979, Smith & Smith 1985, Phillips 1991, Bessette et al. 1997). In Mexico the species has been recorded in the West Coast, in a mesophytic forest (Montoya & Bandala 2005). In this paper we provide data to document that it also occurs in Eastern Mexico, in association with *Carpinus*, and in Costa Rica with *Quercus oleoides* Schltdl. & Cham.

The lowlands of Mexico house *Lactarius* species known from tropical regions, such as *Lactarius verae-crucis*, which is one of the under-collected species of the genus. It was first described from a tropical rain forest in southern Veracruz (Mexico) (Singer 1973) and then from the Dominican Republic (Singer 1975). In Mexico the species is also known from Chiapas and Jalisco (Montoya et al. 1996) and Guerrero (this paper). Here we document that *L. verae-crucis* occurs also in northern Costa Rica, in subtropical humid forest and in pre-montane forest from Guanacaste and Alajuela.

Materials and methods

Macromorphological characters were observed on fresh basidiomes collected in Mexico and Costa Rica. Colour codes in descriptions refer to Kornerup & Wanscher (1967), Smithe (1975) (in italics) and Munsell (1994) (in bold). One of the species treated here, *Lactarius luteolus*, was studied in a monitored plot within the cloud forest adjacent to the Instituto de Ecología A.C. at Xalapa, Veracruz (Santuario del Bosque de Niebla) which was visited weekly during 2002-2005. Measurements and colours of the micromorphological structures were recorded in 3% KOH, except for the basidiospores, which were studied in Melzer´s reagent. The methods used to estimate spore ranges and SEM analyses are those used by Montoya & Bandala (2003). In the basidiospore descriptions, 0 corresponds to the range of means of basidiospore length and width, and **Q** to the range of the mean of Q (length/width ratio) of **n** collections. Line drawings were made with the aid of a drawing tube. The acronyms for the Herbaria follow Holmgren et al. (1990).

Results

Lactarius luteolus Peck, Bull. Torr. Bot. Club 23: 412, 1896. **Figures 1-3**

= *L. foetidus* Peck, Bull. N.Y. St. Mus. 54: 949, 1902.
= *L. praeserifluus* Murrill, Mycologia 30: 361, 1938.
= *L. echinatus* Thiers, Mycologia 49: 716, 1957.

Pileus 15–75 mm diam, plano-convex, plane to slightly depressed centrally, at times with a short eccentric lobe, without umbo, azonate, yellowish, yellowish with a pale orange tint to grayish-orange (5A4, 3B4-5); primordia yellowish-white to pale yellow-ochre with pale orange tinges (4-5A2–4; **7.5YR 8/6, 10YR 8/6**); subtomentose to tomentose or velutinous, dry, compact and rigid; margin

Fig. 1. *Lactarius luteolus* basidiomes
(a. Montoya 4400, b. Montoya 4014). Bar = 1 cm.

rugose, edge entire, undulate, decurved when young, smooth to faintly rugose. ***Lamellae*** narrow, 1–3 mm wide, crowded or close if lamellulae are excluded, adnate to faintly sinuate, with lamellulae of at least five sizes, yellowish-white to yellowish (4A2–4, 3A2; **2.5Y 8/3**), stained brown, margin entire. ***Stipe*** 8–55 x 4–22 mm, cylindrical, equal or at times attenuated towards the base, central or frequently excentric, at times fasciculate, rigid, tomentose, compact, dry, at times rugose, concolorous to darker than pileus surface, yellowish-white to pale orange or grayish orange (4A2, 5A3, 5B5-C5; **7.5YR 7/6–8/4, 8/6**), primordia yellowish-white to pinkish-orange (4A2, 5A2; **7.5YR 8/4**); reddish-brown after bruising. ***Latex*** watery-white to white, stained brown after some minutes of exposure and stains white paper brown, abundant, taste mild, at first very fluid, latter sticky and more dense, negative to KOH. ***Context*** cream to beige, staining brown when exposed, compact. ***Odor*** of fish. ***Taste*** mild.

Basidiospores 6.5–8.5 (–9) x 5.6–6.5 (–7) µm, 0 = 7.3–7.9 x 6–6.2 µm, **Q** = 1.2–1.3, broadly ellipsoid, verrucose, ornamentation 0.5–1 µm high, composed of isolated warts, suprahilar plage at times with a faint or coarse amyloid dot. ***Basidia*** 50-67 x 7-8 µm, clavate, sinuous, tetrasporic, with granular refringent contents. ***Pleurocystidia*** septate, terminal segments 14-45 x 4–8 µm, subcylindric, capitate, other segments 20–28 x 5–8 µm, hyaline, at times with dense yellow-brown contents, thin walled. ***Cheilocystidia*** 16–76 x 3–10 µm, subcylindric, clavate, capitate, apex up to 13–17 µm diam, thin walled or at times 1.2–1.5 µm thick, septate. ***Pseudocystidia*** 3–8 µm diam, attenuated towards the apex, contorted, originated from the trama. ***Pileipellis*** composed of a trichodermis above a pseudoparenchymatous layer; suprapellis with subcylindric, septate elements; terminal cells 9-76 x 3.4–8 µm, thin or thick-walled, frequently capitate; subpellis composed of sphaerocytes 10–40 µm diam, wall up to 1 µm thick. ***Context*** hyphae 3–12 µm diam, laticifers 5–20 µm diam, abundant, sphaerocytes 15–31 µm diam. ***Hymenophoral trama*** hyphae 3–11 µm diam, laticifers 6–14 µm diam, abundant, sphaerocytes 10–20 µm diam; subhymenial layer composed of subcylindrical septate cells, 6–20 x 5–10 µm.

Habitat: Gregarious in small troops. In Costa Rica in tropical humid forest in transition to pre-montane, at 800-900 m alt., reaching the tropical dry forest in ecotone with humid forest at 300 m alt., both sites with *Quercus oleoides*. In Mexico in cloud forest, growing near *Carpinus caroliniana* Walter and *Quercus* spp., at 1300 m alt.

Material examined: COSTA RICA. Guanacaste. Area de Conservación Guanacaste, Parque Nacional Rincón de la Vieja, Sector Las Pailas, Sendero a Las Cataratas, 20 July 1996, *C. Cano 338* (INB 0001543824); Parque Nacional Santa Rosa, Bosque San Emilio, 15 June 2003, *M. Mata 1281* (INB 0003721250). MEXICO. Veracruz, Mpio. Xalapa, Instituto de Ecología, Santuario del Bosque de Niebla, 4 July 2003, *Montoya 4014*;

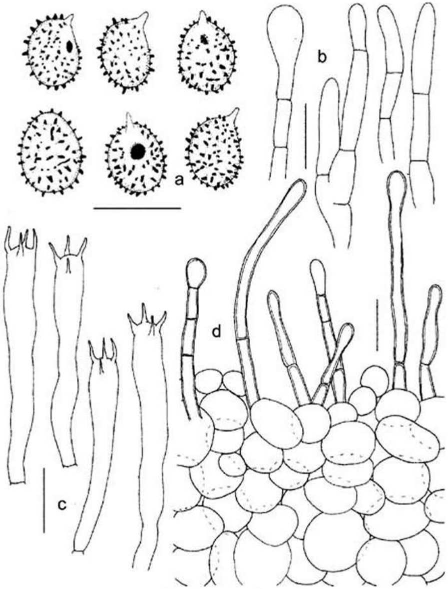


Fig. 2. *Lactarius luteolus* (Mata 1281).
A. Basidiospores, b. Pleurocystidia, c. Basidia, d. Pileipellis.
Bars: a = 10 µm, b-d = 20 µm.

8 July 2003, *Montoya 4031*; 14 July 2003, *Montoya, 4040*; 16 July 2003, *Montoya 4047*; 26 September 2003, *Montoya 4058*; 13 November 2003, *Montoya 4067*; 3 August 2005, *Bandala 3993*; 25 August 2005, *Montoya 4400*; 19 October 2005 *Montoya 4411* (all at XAL).

Other material examined: U.S.A. Massachussetts, East Milton, August, *H. Webster* s/n (NYS *Lactarius luteolus* **holotype**).

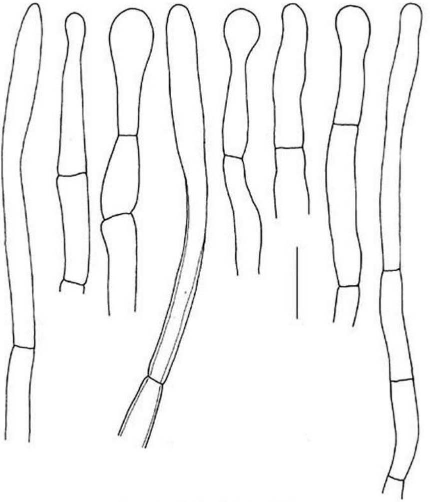


Fig. 3. *Lactarius luteolus* (Mata 1281).
Cheilocystidia. Bar = 20 µm.

Notes: The material upon which Singer (1990) based his report of *Lactarius echinatus* (a synonym of *L. luteolus*) from NE Mexico belongs to another taxon (Montoya & Bandala 2005). After the study of a specimen collected by Ruth McVaugh (985) in Jalisco, housed at MICH, Montoya & Bandala (2005) formally recorded *L. luteolus* from Mexico. The macro- and micromorphological features described above are based on new fresh collections gathered in Mexico and Costa Rica, which complement the micromorphological information recovered from the specimen of R. McVaugh 985 [for SEM study see Montoya & Bandala (2005)]. The ecological information recorded during weekly visits to a plot dominated by *Carpinus caroliniana* in Veracruz showed that the species presented a summer-autumn phenology in the area and that it did not fructify yearly. No basidiomes were found in 2002 or 2004. While *Lactarius luteolus* was found under *Carpinus caroliniana* in Veracruz, it was found associated with *Quercus oleoides* in Costa Rica. and with *Quercus* spp. in U.S.A. (Murrill 1938).

Basidiome colour for *L. luteolus* observed during different stages of development in the examined collections from both countries ranges from yellowish to pale yellow with pale orange to pale yellowish-ochre tinges. The studied samples are more or less similar in colour to those shown by Phillips (1991). Illustrations of *L. luteolus* in different contributions (Marchand 1980, Courtecuisse & Duhem 1994, Basso 1999, web page of "Micolist" Pérez-De-Gregorio i Capella *http://www.grn.es/ amjc/activi/ llinars.htm*, Bessette et al. 1997), in general depict whitish basidiomes or whitish with brownish stains but not basidiomes with yellowish colours. We interpret the colour shown by Mexican and Costa Rican specimens as coinciding with the concept of buff colour used in the protologue (Peck 1896), the pale yellow or buff colour described by Peck (1902) (as *L. foetidus*), the pale yellowish by Murrill (1938) (under *L. praeserifluus*) and the buff or yellow buff shades mentioned by Peck (1902a). The comment by Peck (1896) that *Lactarius luteolus* is related to *L. volemus* and *L. hygrophoroides* but with a paler buff colour, as well as the common name "yellowish *Lactarius*" applied by Peck (1902a) can inform us also on *L. luteolus* colour variation. The basidiospore shape and verrucose ornamentation pattern, the structure of pileipellis and hymenial elements of the studied specimens are similar to the holotype.

Lactarius capitatus K. Das et al. described from Himalaya is a close allied taxon which is distinguished from *L. luteolus* by the reddish-orange pileus, orange-yellow lamellae and context, latex turning to pinkish, dark reddish-brown or finally brown, and subglobose basidiospore shape (Q = 1-1.1) (Das et al. 2004).

Lactarius verae-crucis Singer, Beih. Sydowia 7: 104 (1973) **Figures 4-6**

Pileus 25–80 mm diam., centrally depressed, plane, often uplifted to infundibuliform, subtomentose, rugose, bright yellow-orange colour (*16 chrome orange, 17 Spectrum Orange*) to bright yellow-orange or egg yellow, margin faintly sulcate, edge entire. ***Lamellae***, distant to subdistant, subdecurrent, narrow, up to 4 mm wide, with anastomosing veins between the lamellae, thick, white-cream (*153 Trogon Yellow, 92 Pale Horn*) to yellowish with orange tinges, subdecurrent, edge even, lamellulae present. ***Stipe*** 30–55 x 5–9 mm, subcylindric, subvelvety, yellow-orange (*16 Chrome Orange, 17 Spectrum Orange*), concolorous with pileus or paler, subcylindric, slightly attenuated towards the base. ***Latex*** white, staining the lamellae pinkish-brown when drying. KOH stains the pileus and stipe faintly yellow-green. ***Context*** whitish. ***Odor*** of fish when dried. ***Taste*** mild. ***Spore print*** white-cream.

Basidiospores (6.4–) 8–8.8 (–10.4) x 5.6–7.5 (–8) µm; 0 = 7–8.8 x 6.1–7.2 µm; Q = 1.13–1.23; subglobose to broadly ellipsoid, subreticulate or with an incomplete reticulum, ornamentation up to 0.5 µm high; under SEM seen to have irregular verrucae, at times nodulose, isolated or with a pronounced base and then joined. ***Basidia*** 64–120 x 6.4–10.4 µm, tetrasporic, cylindrical, attenuated towards the base, where it appears sinuous or contorted, thin walled, born from subhymenium or deeper. ***Pleurocystidia*** 40–120 x 4–6 µm, subcylindrical, subfusiform, sinuous to contorted, at times (mostly when young) projected above the hymenial level, septate, thin-walled, wall at times faintly thick; terminal segment 28–41.6 x 3–7.2 µm. ***Pseudocystidia*** 2.4–4 µm diam, subcylindric. ***Cheilocystidia*** (25.6–) 32–100 x 3.2–5.6 µm, subcylindrical, subfusiform, contorted, or bifurcate, septate, at times (mostly when young) faintly thick-walled, 0.8 µm thick, abundant, projected; terminal segment 26–49 x 3.2–5 µm, rounded, equal or attenuated at apex. ***Pileipellis*** a trichodermis above a pseudoparenchymatous layer; suprapellis consisting of erect, filamentous, subcylindric, subclaviform, subfusiform, sinuous, simple or branched elements, thin or slightly thick-walled, wall up to 0.8 (–1.6) µm thick, born from subisodiametric or irregular cells or some from hyphal elements originating from the subpellis or even from the context; terminal cells 13–56 x (2.4–) 4–4.8 (–5.6) µm, other elements 20–35 x 3–5 µm; subpellis composed of subisodiametric cells, 8–35 µm diam., thin or thick-walled, 0.8–1.6 µm thick or with thick, yellowish-green patches (up to 2 µm thick), irregularly disposed. ***Context*** hypae 4–12 µm diam, laticifers 5–12 µm diam, sphaerocytes 8–36 µm diam. ***Hymenophoral trama*** composed of hyphae 3.2–9.2 µm diam, laticifers 4–10.7 µm diam and abundant sphaerocytes 8–25 µm diam.

Habitat: Solitary, terricolous. In Costa Rica, in a subtropical humid forest at 600-700 m alt. and in pre-montane humid forest at 1250-1300 m alt. Both sites with Sapotaceae and very scarce and scattered *Quercus*. In Mexico, in tropical rain forest at 180 m alt. and tropical semi-evergreen forest at 130 m alt.

Material examined: COSTA RICA. Guanacaste, Area de Conservación Arenal, Zona Protectora Miravalles, Sector Finca Río Naranjo, 23 May 1999, *I. López 401* (INB 0001545919). Alajuela, Area de Conservación Arenal, Bijagua, Albergue Heliconias, Sendero Heliconias, 22 May 1999, *I. López 383* (INB 0001545909). MÉXICO, Guerrero, Mpio. Tierra Colorada, Xolapa, 4 July 1981, *Capello 47* (FCME).

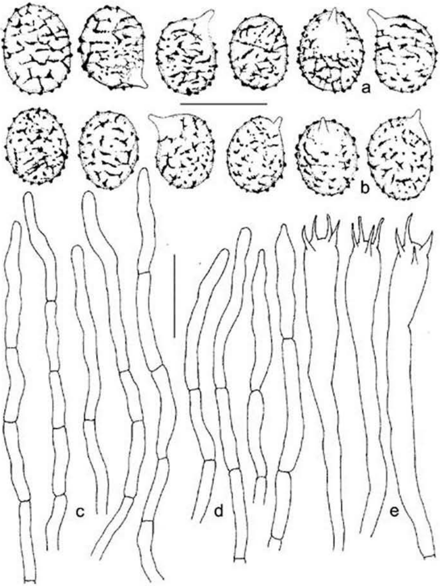


Fig. 4. *Lactarius verae-crucis* (López 397).
A-b. Basidiospores, c. Pleurocystidia, d. Cheilocystidia, e. Basidia.
Bars: a-b = 10 µm, c-e = 20 µm.

Other material examined: MEXICO, Estación Biológica de Los Tuxtlas, 19 July 1969, *Singer M-8025* (ENCB *Lactarius verae-crucis* **isotype**). BURUNDI, Nyamirambo, near Rumoge, March 1994, *Verbeken 94.463* (BR, *Lactarius luteopus*, **holotype**).

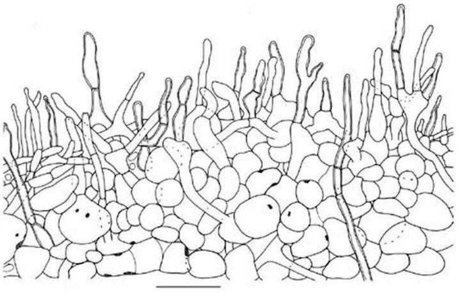
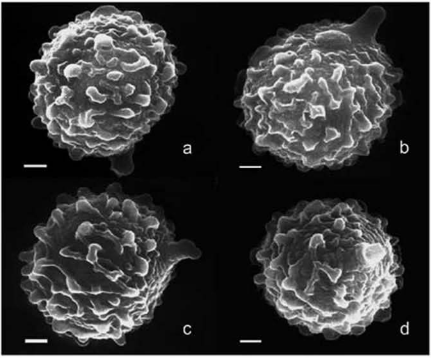


Fig. 5. *Lactarius verae-crucis* (López 397).
Pileipellis. Bar = 20 µm.

Notes: This species has been sporadically collected since its description (Singer 1973, 1975, Singer et al. 1983). The records from Mexico and Costa Rica confirm that it is associated with tropical flora but its interactions with specific trees have not yet been studied.

Lactarius luteopus Verbeken is a tropical African species which presents a set of morphological features comparable to *L. verae-crucis*, *i.e.* basidiome colour, dry surfaces, distant lamellae, spore print colour, basidiospore ornamentation pattern, septate pleurocystidia, two-layered pileipellis and sphaerocytes in both hypodermium and lamellae trama. Even the basidiospore ornamentation in both taxa, as observed in the examined material, shares a similar pattern. *Lactarius luteopus*, however, differs in having more elongate basidiospores (Q = 1.26-1.41) and lacking both cheilocystidia and hyphal elements that project from the subpellis or context. The similarity between *L. verae-crucis* and *L. luteopus*, the latter a member of subgenus *Lactiflui* (Burl.) Hesler & A.H. Sm., sensu Verbeken (2001), suggests considering *L. verae-crucis* also in this group. As *Lactarius verae-crucis* represents the type species of sect. *Polysphaerophori*, we should treat this section, at least with *L. verae-crucis*, as part of subgenus *Lactiflui*.



Figs. 6. *Lactarius verae-crucis* basidiospores under SEM.
A-b. López 397, c-d. Capello 47. Bar = 10 µm.

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Myxomycetes from Sonora, Mexico. 3: National Forest Reserve and Wildlife Refuge, Ajos-Bavispe

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Abstract – Twenty-four species of myxomycetes from the national forest reserve and wildlife refuge, Ajos-Bavispe, located in Sonora, México, were studied. Nineteen taxa are new records for the Sonoran myxobiota; these are *Arcyria cinerea*, *Ceratiomyxa fruticulosa*, *Comatricha elegans*, *C. tenerrima*, *Craterium obovatum*, *Diderma spumarioides*, *Echinostelium apitectum*, *Lamproderma scintillans*, *Licea minima*, *L. variabilis*, *Perichaena depressa*, *Physarum album*, *P. bivalve*, *P. flavicomum*, *P. javanicum*, *P. leucophaeum*, *P. leucopus*, *P. tenerum* and *Willkomlangea reticulata*. There are now 66 taxa known, including the new records. The studied species are discussed and photomicrographs of their macro- and microscopic characters are given for some of them.

Key words - Myxomycota, chorology, taxonomy, SEM

Introduction

This is the third contribution to the knowledge of the myxomycetes of Sonora, México, which was initiated by Pérez-Silva et al. (2001) and Moreno et al. (2004, 2006). These authors cited 47 taxa for Sonora, with 23 of them from the National Forest Reserve and Wildlife Refuge Ajos-Bavispe (NFAB). Nineteen new records of myxomycetes for Sonora are included in the present study, all of them from the NFAB. Sixty-six taxa are now known for Sonora, including the new records, with 42 recorded from NFAB.

The survey was conducted at NFAB. Seven types of vegetation were sampled seasonally. These were pine-oak gallery forest, pine-oak forest on other sites, oak forest, oak open forest, microphyllous desert scrub, mezquital and subtropical scrub. The specimens were collected in the field and cultivated in moist chambers. Collections are kept in the mushroom collection of the "Centro de Estudios Superiores del Estado Sonora" (CESUES) and the herbarium of the University of Alcalá, Spain (AH).

All sporocarps were mounted in Hoyer's medium. SEM photographs were taken after applying the critical point drying technique as described in Moreno et al. (2002). The locality for each species in provided according to Table 1; names of collectors are abbreviated: A. Bautista (AB), S. Gómez (SG), M. Lizárraga (ML), A. Sánchez (AS) and M. Rivera (MR); date and herbarium. First records for the Sonoran myxobiota are indicated by an asterisk.

Table 1. Sampling localities in National Forest Reserve and Wildlife Refuge Ajos-Bavispe.

Localities	N	W	Altitude	Vegetation
Municipality of Cananea				
1. El Campamento	30°58'22"	109°57'38"	1997 m	POGF
Municipality of Bacoachi				
2. El Manzano	30°56'04"	109°57'58"	2218 m	POF
Municipality of Fronteras				
3. El Frijolito	30°56'35"	109°57'21"	2286 m	POF
4. La Valdeza	30°38'06"	109°47'22"	1546 m	OOF
Municipality of Cumpas				
5. Km 8 Moctezuma-Antena	29°58'53"	109°39'52"	818 m	MDS
6. El Encinal	30°00'02"	109°33'29"	1653 m	OF
7. La Selva	29°57'41"	109°36'55"	881 m	SS
8. El Mezquital	29°57'26"	109°38'23"	882 m	M

Vegetation types: Pine-Oak Gallery Forest (POGF); Pine-Oak Forest (POF); Oak Forest (OF); Oak Open Forest (OOF); Microphyllous Desert Scrub (MDS); Mezquital (M); and Subtropical Scrub (SS).

List of Species

******Arcyria cinerea*** (Bull.) Pers., Syn. Meth. Fung.: 184 (1801)

SPECIMENS STUDIED: Locality 1, leg. ML & AB, 24.VIII.2005, on rotten wood of *Quercus* sp., *CESUES 7246*. Locality 7, leg. ML & AB, 27.VIII.2005, on rotten wood of *Prosopis* sp., *CESUES 7258*.

Observations: Although this taxon is widely distributed in Mexico (Illana et al. 2000, Rodríguez-Palma et al. 2002, Lado et al. 2003, Lizárraga et al. 2003a,b), this is the first record for Sonora.

******Ceratiomyxa fruticulosa*** (O.F. Müll.) T. Macbr., N. Amer. Slime-Moulds: 18 (1899)

SPECIMENS STUDIED: Locality 7, leg. ML & AB, 27.VIII.2005, on rotten wood of *Prosopis* sp., *CESUES 7257*.

Observations: Widely distributed in México (Illana et al. 2000, Lado et al. 2003, Lizárraga et al. 2003a).

******Comatricha elegans*** (Racib.) G. Lister, Guide Brit. Mycetozoa, ed. 3: 31 (1909)

SPECIMENS STUDIED: Locality 2, leg. ML, SG, AB, AS & MR, 22.II.2005, on decayed wood of *Pinus engelmanii*, *CESUES 7231*. Cultivated in moist chamber (22.IV.2005), fruiting on 10.V.2005.

Observations: Because of its small sporocarps, fibrous stalk that is as long as the diameter of the sporotheca, weakly anastomosed capillitium which at the base forms a small net and verrucose spores 7-9 µm diam., the Sonoran collection was determined as *Comatricha elegans* var. *pallens* G. Lister. Only two sporocarps were obtained in moist chambers, and these were mounted in Hoyer's medium. It has been infrequently reported for México: Jalisco, Veracruz (Illana et al. 2000) and Chihuahua (Lizárraga et al. 2005b).

******Comatricha tenerrima*** (M.A. Curtis) G. Lister, Guide Brit. Mycetozoa, ed. 4: 39 (1919) **Figs. 1-2**

SPECIMENS STUDIED: Locality 5, leg. ML & AB, 24.VIII.2005, on dead wood of *Prosopis* sp., *CESUES 7249*.

Observations: Characterized by its 7-8 µm diam. spores which are pale brown and weakly ornamented with warts by transmitted light. Spore ornamentation is observed as baculate under SEM, and these have a coralloid apex forming a typical stelliform ornamentation, and the capillitium is wavy. Recorded for several Mexican states (Illana et al. 2000, Lado et al. 2003, Lizárraga et al. 2005b).

******Craterium obovatum*** Peck, Bull. Buffalo Soc. Nat. Sci. 1: 64 (1873) **Figs. 3-4**

SPECIMENS STUDIED: Locality 4, leg. ML & AB, 24.VIII.2005, on litter leaves of *Quercus* sp., *CESUES 7248* in *AH 31786*, *CESUES 7248a, 7248b, 7248c*.

Observations: This foliicolous species is recognized by its stalked, crowded sporocarps, and globose sporothecae which are cylindrical to more or less pyriform. Spores 13-15 µm diam., globose to subglobose, dark by transmitted light, conspicuously spinose warted ornamentation and black spore-mass; under SEM, the spines are as baculate and more or less irregularly coralloid. This species is little known in the Mexican myxobiota: Baja California and Veracruz (Illana et al. 2000).

******Diderma spumarioides*** (Fr.) Fr., Syst. Mycol 3: 104 (1829) **Figs. 5-6**

SPECIMENS STUDIED: LOCALITY 4, leg. ML & AB, 24.VIII.2005, on dead leaves of *Quercus* sp., *CESUES 7247*.

Observations: This species belongs to *Diderma spumarioides*, *D. crustaceum* and *D. donkii* complex, the members of which are very difficult to separate due to the dissimilarity of descriptions of these taxa by various authors (Lister 1911, 1925; Martin & Alexopoulos 1969, Nannenga-Bremekamp 1974, Neubert et al. 1995) and by the existence of intermediate collections between these species. The differences given in the monograph of the genus by Buyck (1982) are complicated and are difficult to apply to the Sonoran collection. The studied collection is characterized by its globose sporocarps; peridium double and strongly attached, dehiscence apical and irregular; columella globose, whitish; capillitium hyaline, more or less wavy with some pale nodules; spores of 10-12 µm diam., with crowded verrucae. Although spores are larger than size indicated by Buyck (1982): (8.8-)9.04-9.73(-10.1) µm, we decided to use the denomination of Fries. Spore ornamentation is observed as baculate under SEM, and these have conforming short crests. The species was previously reported in México for Estado de México, Jalisco (Illana et al., 2000) and Quintana Roo (Lado et al. 2003).

Didymium clavus (Alb. & Schwein.) Rabenh., Deutschl. Krypt.-Fl. 1: 280 (1844)

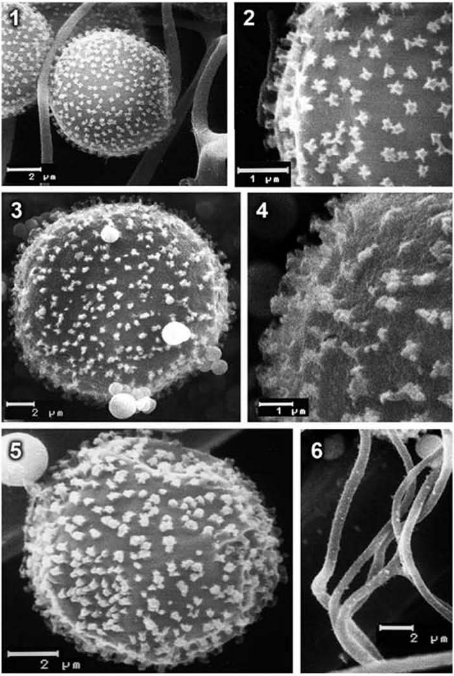
SPECIMENS STUDIED: LOCALITY 4, leg. ML & AB, 25.VIII.2005, on fallen leaves of *Quercus* sp., *CESUES 7250*.

Observations: This taxon is recorded for Baja California, Chiapas, Yucatán (Illana et al. 2000), Veracruz (Lado et al. 2003), Chihuahua (Lizárraga et al. 2005a) and Sonora (Moreno et al. 2006).

******Echinostelium apitectum*** K.D. Whitney, Mycologia 72(5): 954 (1980)

SPECIMENS STUDIED: LOCALITY 5, leg. ML, SG, AB, AS & MR, 24.II.2005, on dead wood of *Prosopis glandulosa*, *CESUES 7234*. Cultivated in moist chamber (22.IV.2005), fruiting on 26.IV.2005.

Observations: A permanent slide was prepared of several sporocarps: Stalk 120-150 µm long, hollow, filled with granular materials, broad at the base, attenuating at apex which supports the sporotheca of 11 µm diam.; spores of 6-8 µm diam.,



Figs. 1-2 ***Comatricha tenerrima*** **CESUES 7249:** 1. Spore. 2. Detail of spore-ornamentation. **Figs. 3-4** ***Craterium obovatum*** AH **31786:** 3. Spore. 4. Detail of spore ornamentation. **Figs. 5-6** ***Diderma spumarioides*** CESUES **7247:** 5. Spore. 6. Detail of capillitium.

hyaline. Previously observed in moist chamber, on substrata originating from Baja California Sur (Lizárraga et al. 2004), Tlaxcala (Rodríguez-Palma et al. 2002) and Chihuahua (Lizárraga et al. 2005b).

Fuligo cinerea (Schwein.) Morgan, J. Cincinnati Soc. Nat. Hist. 19: 33 (1896)
= *F. stercoriformis* (Zopf) Racib., Hedwigia 26: 111 (1887)

SPECIMENS STUDIED: Locality 5, leg. ML & AB, 26.VIII.2005, on caw dung, *CESUES 7253*.

Observations: This new coprophilous record corroborated the antique denomination and the establishment of *Fuligo stercoriformis* (Zopf) Racib. as synonymous. In México, it is recorded for Baja California, Nuevo León, Sonora (Illana et al. 2000) and Chihuahua (Lizárraga et al. 2003a).

Fuligo septica (L.) F.H. Wigg., Prim. Fl. Holsat: 112 (1780)

SPECIMENS STUDIED: Locality 8, leg. ML & AB, 27.VIII.2005, on ant's land, *CESUES 7252*.

Observations: This taxon is well-recorded in México (Illana et al. 2000, Pérez-Silva et al. 2001, Lizárraga et al. 2003b, 2005a).

****Lamproderma scintillans*** (Berk. & Broome) Morgan, J. Cincinnati Soc. Nat. Hist. 16: 131 (1894) **Figs. 7-8**

SPECIMENS STUDIED: Locality 1, leg. ML & AB, 23.VIII.2005, on dead leaves, *CESUES 7236*. *Ibidem*, 24.VIII.2005, *CESUES 7244*.

Observations: Determined without difficulty by its foliicolous habit, small size; peridium iridescent; capillitium dark and radiating from the columella with the bases hyaline. Spores of 7-9 µm diam., verrucose; a conspicuous baculate ornamentation under SEM, which is regularly distributed. It was previously known from several Mexican states (Illana et al. 2000, Lado et al. 2003, Lizárraga et al. 2003a) and a new record for Sonora.

Licea kleistobolus G.W. Martin, Mycologia 34(6): 702 (1942)

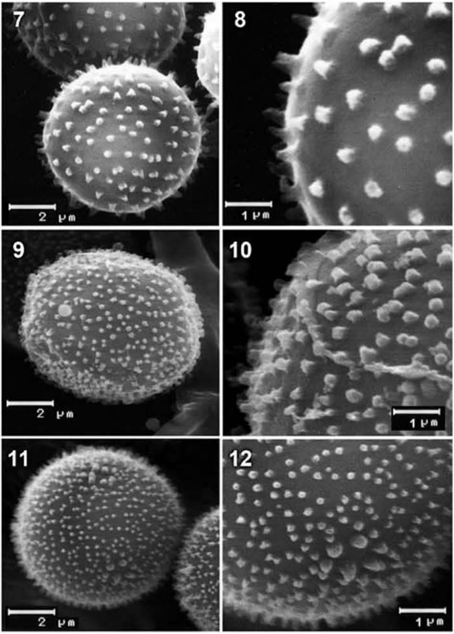
SPECIMENS STUDIED: Locality 1, leg. ML & AB, 24.VIII.2005, on rotten wood of *Quercus* sp., *CESUES 7245*.

Observations: This species is recorded for Baja California (Lizárraga et al. 2004), Distrito Federal (Braun & Keller 1986), Tlaxcala (Rodríguez-Palma et al. 2002), Chihuahua (Lizárraga et al. 2003a) and Sonora (Moreno et al. 2006).

****Licea minima*** Fr., Syst. Mycol. 3: 199 (1829)

SPECIMENS STUDIED: Locality 3, leg. ML & AB, 23.VIII.2005, on dead wood of *Pinus* sp., *CESUES 7238*.

Observations: Characterized by its polygonal sporocarps, ferrugineous spore-mass, deep red peridium with granular materials, the peridial plates edged



Figs. 7-8 ***Lamproderma scintillans*** **CESUES 7236:** 7. Spore. 8. Detail of spore ornamentation. **Figs. 9-10** ***Physarum javanicum*** **AH 31787:** 9. Spore. 10. Detail of spore ornamentation. **Figs. 11-12** ***Physarum tenerum*** AH **31788:** 11. Spore. 12. Detail of spore ornamentation.

with protuberances or papillae; spores 9-11 μm diam., with conspicuous ornamentation but some areas appearing smooth. Recorded for Jalisco (Villarreal 1990), Tlaxcala (Braun & Keller 1976, Rodríguez-Palma et al. 2002) and Chihuahua (Lizárraga et al. 2003a).

*****Licea variabilis*** Schrad., Nov. Gen. Pl.: 18 (1797)

> **SPECIMENS STUDIED:** Locality 2, leg. ML, SG, AB, AS & MR, 22.II.2005, on dead wood of *Pinus engelmanii*, *CESUES 7230.*

Observations: Recognized by its short and irregular plasmodiocarps; membranous peridium with an irregular dehiscence; spores of 11-13 μm diam., greenish spore-mass and spores with olivaceous hues by transmitted light, strongly spinuloses. Previously cited in Mexico for Baja California (Illana et al. 2000) and Chihuahua (Lizárraga et al. 2003a).

Mucilago crustacea F.H. Wigg., Prim. Fl. Holsat.: 112 (1780)

> **SPECIMENS STUDIED:** Locality 2, leg. ML & AB, 23.VIII.2005, on cones of *Pinus ayacahuite*, *CESUES 7239.*

Observation: This taxon is commonly recorded in Mexico (Illana et al. 2000, Moreno et al. 2006).

*****Perichaena depressa*** Lib., Pl. Crypt. Arduenna: 378 (1837)

> **SPECIMENS STUDIED:** Locality 6, leg. ML, SG, AB, AS & MR, 24.II.2005, on dead wood of *Quercus* sp., *CESUES 7233.* Cultivated in moist chamber (28.II.2005), fruiting on 20.III.2005.

Observations: Recognized by its yellowish capillitium, verrucose surface, with numerous constrictions; spores 10-12 μm diam., yellowish by transmitted light. This species has been frequently cited for the Mexican myxobiota (Illana et al. 2000, Rodríguez-Palma et al. 2002, Lado et al. 2003, Lizárraga et al. 2003a,b). This is the first record for Sonora.

*****Physarum album*** (Bull.) Chevall., Fl. Gén. Env. Paris 1: 336 (1826)
= *P. nutans* Pers., Ann. Bot. (Usteri) 15: 6 (1795)

> **SPECIMENS STUDIED:** Locality 2, leg. ML & AB, 23.VIII.2005, on strobilous of *Pinus ayacahuite*, *CESUES 7240.* Locality 8, leg. ML & AB, 27.VIII.2005, on dead wood of *Prosopis* sp., *CESUES 7256.*

Observations: Although this taxon has been commonly cited for México (Illana et al. 2000, Lado et al. 2003, Lizárraga et al. 2003a), this is the first record for Sonora.

*****Physarum bivalve*** Pers., Ann. Bot. (Usteri) 15: 5 (1795)

> **SPECIMENS STUDIED:** Locality 1, leg. ML & AB, 23.VIII.2005, on dead leaves of *Quercus* sp., *CESUES 7237. Ibidem*, 24.VIII.2005, on rotten wood of *Quercus* sp., next to *Licea kleistobolus*, *CESUES 7243.*

Observations: This cosmopolitan species has been infrequently recorded from Mexico: Jalisco, Baja California (Illana et al. 2000) and Chihuahua (Lizárraga et al. 2003a).

****Physarum flavicomum*** Berk., London J. Bot. 4: 66 (1845)

SPECIMENS STUDIED: LOCALITY 1, leg. ML & AB, 24.VIII.2005, on cone of *Pinus ayacahuite*, *CESUES 7241*.

Observations: This species is closely related to *Physarum galbeum* Wingate, but because of its persistent capillitium, yellowish brown stalk and spores with violet hues by transmitted light, we determined the Sonoran specimens as *P. flavicomum*. It is recorded in Mexico for Puebla (Illana et al. 2000) and Quintana Roo (Lado et al. 2003).

****Physarum javanicum*** Racib, Hedwigia 37: 53 (1898) **Figs. 9-10**

SPECIMENS STUDIED: LOCALITY 8, leg. ML & AB, 27.VIII.2005, on living wood of *Prosopis* sp., *CESUES 7254*, *CESUES 7255* in *AH 31787*.

Observations: Recognized by its whitish sporocarps; compressed sporotheca that is umbilicate at the apex; solid, rigid capillitium with whitish, elongated nodules; spores 9-11 µm diam., globose, minutely roughened, with a baculate ornamentation under SEM. This species was previously known in Mexico only from Jalisco (Illana et al. 2000).

****Physarum leucophaeum*** Fr., Symb. Gasteromyc.: 24 (1818)

SPECIMENS STUDIED: LOCALITY 7, leg. ML, SG, AB, AS & MR, 24.II.2005, on dead wood of *Ambrosia ambrosioides*, *CESUES 7235*. It was cultivated in moist chamber (22.IV.2005), fruiting in 28.IV.2005.

Observations: Characterized by its lenticular to subglobose, whitish sporothecae; stalk dark at base; peridium with irregular dehiscence. It is not common in moist chamber culture. This species has been infrequently recorded for México (Illana et al. 2000, Lizárraga et al. 2003a,b).

****Physarum leucopus*** Link, Ges. Naturf. Freunde Berlin Mag. 3: 27 (1809)

SPECIMENS STUDIED: LOCALITY 6, leg. ML & AB, 25.VIII.2005, on dead leaves of *Quercus* sp., *CESUES 7251*.

Observations: Characterized by its whitish sporocarps; solid, columnar stalk covered with lime; spores 8-10 µm diam., verrucose, some areas with more crowded warts. This species is known in the Mexican myxobiota for Baja California Sur, Jalisco, Tlaxcala and Veracruz (Illana et al. 2000).

****Physarum tenerum*** Rex,
Proc. Acad. Nat. Sci. Philadelphia 42: 192 (1890) **Figs. 11-12**

SPECIMENS STUDIED: LOCALITY 1, leg. ML & AB, 24.VIII.2005, on dead wood of *Quercus* sp., *CESUES 7242* in *AH 31788*, *CESUES 7242a*.

Observations: Recognized by its large, columnar, calcareous, rigid, pale yellow, with lime-crystals inside stalk; sporotheca globose, generally pendulous, very fragile and easily separated from stalk. Peridium single, whitish, with conspicuous scattered calcic granules. Columella absent. Capillitium ornamented with small and yellowish nodules. Spores 8-10 µm diam., with violet hues by transmitted light, ornamented with small warts, which are observed as baculate under SEM.

The studied collections possessed a stalk, sporotheca, and capillitium with spherical, yellowish granules, these morphologic and macroscopic characters are related to *P. tenerum*. Reported from Chiapas (Emoto 1933; unpublished records of Matuda), Quintana Roo (Lado et al. 2003) and Yucatán (Stephenson et al. 2003).

* ***Willkomlangea reticulata*** (Alb. & Schwein.) Kuntze, Revis. Gen. Pl. 2: 875 (1891)

SPECIMENS STUDIED: Locality 1, leg. ML, SG, AB, AS & MR, 24.II.2005, on dead wood of *Quercus gambelii*, *CESUES 7232*. It was cultivated in moist chamber (22.IV.2005), fruiting in 3.V.2005.

Observations: Characterized by its plasmodiocarpic sporocarps, superficially ornamented with reddish zones, and badhamioid capillitium. There are few records of this species for México: Jalisco, Nuevo León (Illana et al. 2000), Quintana Roo (Lado et al. 2003) and Chihuahua (Lizárraga et al. 2005b).

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New species and new records of *Graphis* from India with partially carbonized exciples and transseptate ascopores

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Abstract—A key is presented to 57 species of *Graphis* recorded from India. *Graphis alboglaucescens, G. eburnea, G. filiformis, G. meghalayaensis, G. salacinilongiramea, G. subvittata* and *G. valparaiensis* are described as new to science. *Graphis* cf. *bakeri, G. furcata, G. immersella, G. malacodes, G. olivacea, G. rigidula, G. sapii, G. stenotera, G. urandrae,* are recorded for the first time from India. One species remains unnamed.

Keywords—lichenized fungi, *Ascomycetes*, taxonomy, *Graphidaceae*

Introduction

The family *Graphidaceae* with 918 species world wide (Kirk et al. 2001) is one of the largest group of crustose lichens which are widely distributed, mainly in tropical regions. Several lichenologists have contributed to the knowledge of the family *Graphidaceae*, through publications recording species from Ceylon (Leighton 1869), the Philippines, and Siam (Vainio 1921a, b), Brazil (Redinger 1935), Mexico (Wirth & Hale 1963), Japan and adjacent areas (Nakanishi 1966, Nakanishi & Harada 1999, Nakanishi et al. 2002, 2003), Dominica (Wirth & Hale 1978), Thailand (Nakanishi et al. 2001), India (Awasthi 2000), Guiana (Sipman 1994) and from Australia (Archer 1999, 2001a, b, c, 2004).

The family *Graphidaceae* is also one of the largest and widely distributed groups of lichens in India and is well represented mainly by the artificial genera *Graphina* (60 species), *Graphis* (74 species), *Phaeographina* (25 species), and *Phaeographis* (32 species) (Awasthi 1991, 2000) but is still inadequately studied and the taxa reported so far are mostly in need of revision. Also, with Staiger's (2002) revision, genera are now recognized differently. The Indian *Graphidaceae* have been recorded in many scattered publications (Awasthi & Singh 1975, Awasthi & Singh 1977, Patwardhan & Kulkarni 1976, 1979, Kulkarni 1977, Nagarkar & Patwardhan 1982, Singh 1984, Singh & Sinha 1994 and Makhija et al. 1992a, b) but there has never been a comprehensive treatment of the family in India.

We are currently undertaking a detailed survey of *Graphidaceae*. A revision of the genus *Graphis* Adans. sensu Müller Arg. (1880, 1882) from India, revealed the occurrence of 145 species which are now placed in different genera sensu Staiger (2002) (Adawadkar & Makhija 2004, 2005, Makhija & Adawadkar 2003, 2005a, b, Makhija et al. 2005a, b).

In our previous papers we have recorded ten new species of the lichen genus *Graphis* from the Andaman and Nicobar Islands of India (Makhija et. al. 2005a, Makhija & Adawadkar 2005b) and published an account of ten species, with transseptate ascospores and completely carbonized exciples, from India (Adawadkar & Makhija 2006).

In the present paper we have recognized fifty seven species of *Graphis* with transseptate ascospores and partially carbonized exciples from India. Of these, 16 species are recorded for the first time from India including 7 species new to science. A key to the species of *Graphis* with transseptate ascospores and partially carbonized exciples from India is given. One species has not been formally described and remains unnamed.

Materials and methods

Sections of the thalli and the ascomata were mounted in water, 10% KOH (K), Lugol's solution (I), and lactophenol cotton-blue (LPCB). All measurements were made in water. The iodine reaction of the hymenium was studied in Lugol's iodine solution after pretreatment with K. The secondary products of the specimens were identified by thin-layer chromatography using methods standardized for lichen products (Culberson & Kristinsson 1970 Culberson 1972 White & James 1985) using solvent systems benzene-dioxane-acetic acid (180:45:5), hexane-diethylether-formic acid (130:100:20) and toluene-ethyl acetate-formic acid (139:83:8 ml). All specimens were observed under UV light (365 nm).

We have had available to us the morphological and chemical data, based on the re-examination of type or authentic material of several taxa in the *Graphidaceae* together with photographs of type specimens from the late Dr. Mason Hale, which was provided to us by him for our studies during his several visits to our laboratory at ARI.

Key to the Indian *Graphis* species with transseptate ascospores and partially carbonized exciples

Exciple laterally carbonized, carbonization borders hymenium .... Group I
Exciple carbonized only at the tips, carbonization does not border hymenium . . GroupII

Group I

1a. Exciples not striate 2
1b. Exciples striate 27

2a. Ascospores exceeding 100 µm in length 3
2b. Ascospores not exceeding 100 µm in length 4

3a. Thallus saxicolous, corticate, gray; ascomata up to 9 mm long, emergent, simple to branched, margin thick; ascospores 11–27-transseptate, 44–133 x 9–16 µm in size; norstictic and salazinic acids present; from Meghalaya and Nagaland .... ***G. longispora*** D.D. Awasthi & S.R. Singh
3b. Thallus corticolous, grayish, rough, corticate; ascomata 2–5 mm long, black, semi-emergent; exciple indistinct at the base; ascospores 15–20-transseptate, 70–110 x 10–14 µm in size; from Kerala, Tamil Nadu .... ***G. hossei*** **Vain.**
4a. Thallus foliicolous.
Thallus foliicolous, corticate; ascomata 0.5–1.3 long, unbranched, flexuose; exciple not present at the base, carbonized; ascospores 7–11-transseptate, 28–56 x 5–8 µm in size; from Palni hills .... ***G. pavoniana*** Fée
[Syn. *G. foliicola* var. *major* D.D. Awasthi & Kr. P. Singh (Awasthi 1991)]
4b. Thallus corticolous 5
5a. Thallus servediate.
Thallus corticate, whitish, soredia granular; ascomata 5–10 mm long, concolorous, flexuose, dendroidly branched; disc pruinose; exciple indistinct at base; outer surface not smooth, indistinctly incised; ascospores 6–8-transseptate, 27–32 x 7–10 µm; stictic and constictic acids present; from Meghalaya .... ***G. sorediosa*** Nagarkar & Patw.
5b. Thallus lacking soredia and isidia 6
6a. Lichen substances present 7
6b. Lichen substances absent 23
7a. Protocetraric acid present
Thallus greenish, warty, corticate; ascomata 0.2–3 mm long, immersed, simple to branched, ends acute to subacute; exciple present below; ascospores 7–9-transseptate, 21–34 x 4–5 µm in size; constictic, protocetraric, and stictic acids present; from Andaman Islands .... ***G. distincta*** Makhija & Adaw.
7b. Protocetraric acid absent 8
8a. Only salazinic acid present.
Thallus gray, warty; ascomata up to 5 mm long, black, ends obtuse, semiemergent; exciple present at the base; ascospores 9–12-transseptate, 42–46 x 4–5 µm in size; salazinic acid present; from Andaman Islands, Himachal Pradesh and Kerala .... *G.* cf. ***bakeri***
8b. Salazinic acid may or may not present with other acids 9

9a. Only norstictic acid present 10
9b. Norstictic and/or other other acids present 11

10a. Thallus brownish to greenish gray, smooth, corticate; ascomata 0.5–6 mm long, concolorous, immersed, ends obtuse; disc broad, pruinose; exciple may or may not present at the base; ascospores 8–16-transseptate, 40–46 x 8–12 µm; norstictic acid present; from Maharashtra .... ***G. pyrrhocheiloides*** Zahlbr.
10b. Thallus whitish brown, yellowish, smooth, corticated; ascomata up to 10 mm long, thin, black, simple to branched; ends acute; exciple present below; ascospores 7–9-transseptate, 21–25 x 6–8 µm in size; norstictic acid present; from Karnataka .... ***G. filiformis***

11a. Ascomata concolorous with the thallus 12
11b. Ascomata black 13

12a. Thallus silvery white, glossy; ascomata 5–7mm long, concolorous with thallus, simple to branched, ends acute to subacute, immersed to slightly raised; exciple present below; ascospores 6–7-transseptate, 21–25 x 4–5 µm; constictic, salazinic and stictic acids present; from Andaman Islands .... ***G. argentea*** Makhija & Adaw.
12b. Thallus whitish, corticate; ascomata 3–8 mm long, whitish, emergent, unbranched, flexuose; exciple present below, carbonized only at the tip but sometimes laterally carbonized; ascospores 12–15-transseptate, 60–75 x 5–10 µm; norstictic and salazinic acids; from Arunachal Pradesh, Kerala, Meghalaya, Orissa .... ***G. garoana*** Nagarkar & Patw.

13a. Ascospores not exceeding 50 µm in length 14
13b. Ascospores exceeding 50 µm in length 21

14a. Ascomata long exceeding 5 µm in length 15
14b. Ascomata short, not exceeding 5 µm in length 17

15a. Norstictic acid present.
Thallus whitish, smooth, corticate; ascomata 1–8 mm long, black, simple to branched; exciple present below; ascospores 8–11-transseptate, 25–50 x 7–10 µm in size; norstictic, and stictic acids present; from Karnataka, Kerala, Maharashtra and Tami Nadu .... ***G. guimarana***
15b. Norstictic acid absent. 16

16a. Thallus whitish, stramineous, ferinaceous, ecorticate; ascomata 1–5 (-7) mm long, black, immersed, simple, radiately to irregularly branched; exciple thin at the base; ascospores 7–9-transseptate, 21–34 x 4–5 µm in size; constictic, salazinic, and stictic acids present; from Andaman Islands .... ***G. insularis*** Makhija & Adaw.
16b. Thallus whitish gray, corticate; ascomata 1–8 mm long, black, simple to furcate; disc pruinose; exciple present below; ascospores 5–8-transseptate, 20–38 x 5–8 µm; constictic, stictic acids present; from Maharashtra .... ***G. modesta*** Zahlbr.

17a. Norstictic acid absent.
Thallus yellowish, rugose; ascomata 1–4 mm long, black, ends acute to obtuse; simple to branched, immersed; exciples thin at the base;

ascospores 5–7-transseptate, 16–25 x 4–5 μm in size; constictic and stictic acids present; from Andaman Islands .... ***G. inmersella***

17b. Norstictic acid present **18**

18a. Salazinic acid present.
Thallus olivaceous, greenish glaucous, corticate; ascomata 1–3 mm long, black, flexuose, semi emergent, radiately branched; exciple absent below; ascospores 5–8-transseptate, 14–24 x 4–7 μm in size; salazinic, stictic, and norstictic acids present; from Assam .... ***G. subasahinae*** Ngarakar & Patw.

18b. Salazinic acid absent **19**

19a. Ascomata simple.
Thallus greenish glaucous to olivaceous buff, smooth to minutely warty, corticate; ascomata 1–4 mm long, black, ends obtuse, simple, straight, curved; exciple present below; ascospores 9–11-transseptate, (20-) 30–40 x 6–8 μm in size; constictic, norstictic and stictic acids present; from Karanataka, Kerala, Maharashtra and Tamil Nadu
.... ***G. ajarekarii*** Patw. & C.R. Kulk.

19b. Ascomata branched **20**

20a. Ascomata simple to rarely branched.
Thallus buff to greenish brown, rough, smooth to plicate, corticate; ascomata 1–2.5 mm long, black, simple, semiemergent; exciple present below; ascospores 3–10-transseptate, 17–42 x 5–9 μm; constictic, norstictic acids; from Maharashtra .... ***G. librata*** C. Knight

20b. Thallus glaucose white to whitish gray, smooth to furfuraceous, corticate; ascomata 2–4 mm long, black, immersed, simple to radiately branched; exciple present at base; ascospores 6–9-transseptate, 30–40 x 4–6 μm; constictic, norstictic and stictic acids present; from Lakshadweep Island
.... ***G. caesiella*** Vain.

21a. Ascomata short, up to 5 mm long.
Thallus pale grayish, corticate; ascomata 1–5 mm long, blackish, immersed to semi-emergent, simple to irregularly branched, ends subacute; exciple present below; ascospores 13–17-transseptate, 63–84 x 4–8 μm; constictic and stictic acids present; from Andaman Islands
.... ***G. sitapurensis*** Makhija & Adaw.

21b. Ascomta long, more than 5 mm long **22**

22a. Thallus glaucous to grayish, corticate; ascomata 5–16 mm long,black, immersed to semi-emergent, radiately dichotomously branched; exciple present below; ascospores 8–16-transseptate, 45–87 x 9–10 μm; stictic acid; from Manipur, Nagaland, Nillgiri hills .... ***G. longiramea*** Müll. Arg.

22b. Thallus glaucous to grayish, corticated; ascomata 5–12 mm long, black, emergent, radiately dichotomously branched; exciple present below; ascospores 10–18-transseptate, 40–89 x 9–10 μm; stictic, salazinic (major), hypostictic and hyposalazinic acids; from Karnataka
.... ***G. salacinilongiramea***

23a. Ascospores exceeding 50 µm in length.
Thallus buff to offwhite, smooth, corticate; ascomata 3–5 mm long, black, simple to branched, immersed to semi-emergent, acute ends; exciple not striate, rarely 1–2 striate, present at the base; ascospores 7–15-transseptate, 25–56 x 8–12 µm; from Tamil Nadu .... ***G. rigidula***

23b. Ascospores not exceeding 50 µm in length **24**

24a. Ascomata exceeding 10 mm in length.
Thallus glaucous green, membrancaeous; ascomata 1–15 mm long, black, simple to sparsely branched, ends acute to round; exciple present below; ascospores 10–14-transseptate, 38–46 x 4–6 µm; from Nicobar Islands. .... ***G. leptocarpoides*** Makhija & Adaw.

24b. Ascomata not exceeding 10 mm in length **25**

25a. Ascomata simple.
Thallus greenish gray, smooth; ascomata simple, unbranched, 0.5–3 mm long, black, semi-emergent, ends subacute; exciple present at the base; ascospores 8–11-transseptate, 21–48 x 4–6 µm in size; from Kerala .... ***G. persicina*** Meyen & Flot.

25b. Ascomata branched **26**

26a. Thallus whitish gray, smooth; ascomata 1–7 mm long, black, simple or dendroidly and irregularly branched, acute ends; exciple present below; ascospores 5–7-transseptate, 21–25 x 4–5 µm in size; from Andaman Islands .... ***G. furcata***

26b. Thallus grayish green, rough, verrucose, corticate; ascomata branched 3–5 mm long, emergent simple to branched, ends round; exciple present at the base; ascospores 3–6-transseptate, 21–34 x 4–5 µm; from Andaman Isalnds and Sikkim .... ***G. urandrae*** Vain.

27a. Thallus isidiate.
Thallus pale olivaceous buff to citrine green, minutely warty, corticate; ascomata black, 2–7 mm long, simple to dendroidly branched, ends obtuse; exciple with 3–6 striae on each side; ascospores 15–20-transseptate, 60–90(-110) x 8–12 µm; from Tamil Nadu .... ***G. patwardhanii*** C.R. Kulk.

27b. Thallus non isidiate **28**

28a. Ascospores exceeding 100 µm in length **29**

28b. Ascospores not exceeding 100 µm in length **30**

29a. Ascomata 1–5 (-6) mm long, emergent, simple, rarely furcate, straight to flexuose; exciple 6–8 striate on each side; ascospores vermiform, 25–28-transseptate, 44–120 (-150) x 7–10 µm; norstictic acid present; from Manipur .... ***G. celata*** Stirt.

29b. Ascomata semi-emergent, black, straight to curved, mostly simple, rarely branched, 0.1–7 mm long; exciple with 2–13 striae on each side, partially to completely carbonized; ascospores 4–8/ ascus, oblong, 12–24-transseptate, with one end acute, 25–109 x 4–8 µm; no lichen substances present; from Maharashtra ...... ***G. polystriata*** Makhija & A. Dube

30a. Lichen substances present 31
30b. Lichen substances absent 33

31a. Ascospores not exceeding 30 µm in length.
Thallus greenish, rough; ascomata small, 0.5–1.5 mm long, immersed, simple to branched, ends acute to obtuse; exciple present at the base; ascospores 5–7-transseptate, 17–25 x 4–5 µm in size; norstictic acid present; from Keral .... ***G. schiffneri***
31b. Ascospores exceeding 30 µm in length 32

32a. Thallus undulate, glaucous white, corticate; ascomata 0.5–3 mm long, simple, curved, sparsely branched, flexuose; exciple thin at the base; ascospores 8–12-transseptate, (33-) 40–56 x 7–12 µm; norstictic acid present; from Assam, Meghalaya and Nagaland .... ***G. inamoena*** Zahlbr.
32b. Thallus greenish; ascomata 2–5 mm long, mostly simple, flexuose; exciple indistinctly present at the base; 9–11-transseptate, ascospores 50–60 x 10–12 µm; norstictic acid present .... ***G. elegans*** (Borrer ex Sm.) Ach.

33a. Thallus glaucous green, slightly warty, evanescent; ascomata black, up to 7 mm long, simple to branched, semi-emergent; exciple indistinctly present at the base; ascospores 4–6-transseptate, 16–21 x 4–5 µm; from Andaman Islands .... ***G. tenella*** Ach.
33b. Ascomata 1–5 mm long, black, emergent, simple to rarely branched; exciple present at the base, multistriate; ascospores 7–9-transseptate, 21–35 x 4–8 µm in size; from Maharashtra .... ***G. duplicata*** Ach.

Group II : Exciple carbonized only at the tip

1a. Exciple striate 2
1b. Exciple without striae 15

2a. Thallus isidiate.
Thallus greenish gray, rugulose; ascomata concolorous to brownish, 2–8 mm long, simple to dichotomously branched, flexuose; exciple indistinctly present at the base, 4–5 straie on each side; ascospores 5–9-transseptate, 21–34 x 4–8 µm in size; stictic and consticite acids present; from Karnataka .... ***G. isidiza*** Adaw. & Makhija
2b. Thallus non isidiate 3

3a. Lichen substances present 4
3b. Lichen substances absent 9

4a. Ascospores exceeding 50 µm long.
Thallus olivaceous, verruculose; ascomata 0.5–6 mm long, concolorous with the thallus, simple, rarely branched, semi-emergent, acute to obtuse ends; exciple present below, multistriate, more than 10 striate on each side; ascospores 24–30-transseptate, 84–93 x 5–7 µm in size; norstictic and stictic acids present; from Meghalaya .... ***G. meghalayaensis***
4b. Ascospores not exceeding 50 µm long 5

5a. Only stictic acid present.
Thallus grayish green, verruculose, corticate; ascomata black, 0.5–4 mm long, curved, branched, emergent; exciple present below, with 3–4 striae on each side; ascospores 7–9-transseptate, 21–39 x 4–7 µm in size; stictic acid present; from Maharashtra .... ***G. vittata*** Müll. Arg.

5b. Stictic and other acids present 6

6a. Norstictic acid absent.
Thallus off white; ascomata black, 0.5–6 mm long, mostly unbranched, ends pointed emergent; exciples 5–6 striae on each side; ascospores 5–9-transseptate, 21–38 x 4–6 µm in size; constictic and stictic acids present; from Karnataka Kerala and Tamil Nadu .... ***G. stenotera***

6b. Norstictic acid present 7

7a. Ascomata concolorous with the thallus.
Ascomata 0.5–6 mm long, flush with the thallus, concolorous, more or less effuse; exciple not striate to mostly 2–4 striae on each side, indistinctly present at the base; ascospores 7–11-transseptate, 21–49 x 4–6 µm; constictic, and norstictic acids present; from Maharashtra
.... ***G. nerurensis*** Makhija et al.

7b. Ascomata black 8

8a. Thallus cream or whitish, rough; ascomata 0.2–2 mm long, emergent, simple, unbranched, ends round; disc narrow, indistinct; exciple present below, 3–4 striate on each side; ascospores 8–11-transseptate, 25–29 (-33) x 4–5 µm; constictic, stictic and norstictic acids present; from Karnataka
.... ***G. subvittata***

8b. Thallus grayish green; ascomata black, 0.3–9 mm long, immersed to semi-immersed; simple to branched, flexuose; disc blackish brown to black; exciple present at the base, 2–3 striate on each side; ascospores 4–8-transseptate, 16–25 x 5–6 µm; norstictic and stictic acids present; from Tamil Nadu .... ***Graphis*** sp. A

9a. Ascomata concolorous with the thallus.
Thallus gray, offwhite within, smooth; ascomata 0.3–7 mm long, simple to branched, concolorous, ends acute; exciple present at the base, 2–3 striate on each side; ascospores 4–8-transseptate, 21–25 x 4–8 µm; from Andaman Islands .... ***G. chloroalba*** Makhija & Adaw.

9b. Ascomata black 10

10a. Ascomata short, not exceeding 2 mm long.
Ascomata up to 2 mm long, simple to furcate; exciple not deeply striate, absent at the base, 2–3 crenations at apical region; ascospores 11–13-transseptate, 40–54 x 9–11 µm in size; from Manipur and Palni hills
.... ***G. rockii*** Redinger
[erroneously referred to *G. striatula* (Ach.) Spreng. (Awasthi 1991)]

10b. Ascomata long, exceeding 2 mm long 11

11a. Ascomata more than 10 mm long.
Thallus yellow to olivaceous buff; ascomata 8–20 (-30) mm long, black, semi-emergent, radiately branched; exciple present at the base, 5–6 striate on each

side; ascospores 7–9-transseptate, 24–44 x 6–8 µm in size; from Sikkim. .... ***G. sikkimensis*** Nagarkar & Patw.

11b. Ascomata less than 10 mm long **12**

12a. Ascospores exceeding 50 µm in length.
Thallus olivaceous buff, gray, verruculose; ascomata 2–5 mm long, black, simple to radiately profusely branched, immersed to semi-emergent, scattered in well defined groups; exciple present at the base, 3–6 striate on each side, apically carbonized; ascospores 10–13-transseptate, 42–80 x 4–8 µm in size; from Tamil Nadu .... ***G. olivacea***

12b. Ascospores not exceeding 50 µm in length. **13**

13a. Ascomata simple.
Thallus glaucous green to pale yellow, smooth to ferrinose; ascomata 1–3 mm long, black, semiemergent, simple, sparsely branched; strongly pruinose labia; exciple absent below, rarely not straite, mostly striate, 2–3 striate on each side; ascospores 11–13-transseptate, 40–50 x 8–10 µm; from Manipur. .... ***G. supertecta*** Müll. Arg.

13b. Ascomata branched **14**

14a. Thallus gray-white; ascomata 1.5–5 (-6) mm long, black, immersed to semi-emergent, branched; exciple 2–3 striate on each side; ascospores 7–9-transseptate, 32–45 x 5–8 µm in size; from Andaman Islands, Assam, E. Himalaya and Sikkim. .... ***G. chlorotica*** A. Massal.

14b. Thallus grayish-yellow; ascomata 1–4 mm long, black, emergent, simple to radiately dichotomously branched, ends acute to round; exciple 2–3 internal striae, present at the base; ascospores 10–14-transseptate, 26–38 x 4–8 µm, from Manipur, Eastern & Western Himalaya ...... ***G. proserpens*** Vain.

15a. Lichen substances present **16**

15b. Lichen substances absent. **20**

16a. Ascospores exceeding 50 µm in length.
Thallus greenish gray, smooth; ascomata up to 4 mm long, concolorous with the thallus, simple, unbranched, immersed to semiemergent; exciple present below; ascospores 15–23-transseptate, 76–100 x 8–12 µm; stictic and connorstictic acids; from Karnataka .... ***G. valparaiensis***

16b. Ascospores not exceeding 50 µm in length **17**

17a. Ascomata concolorous with the thallus or whitish. **18**

17b. Ascomata black or brownish **19**

18a. Thallus whitish green, corticate; ascomata 0.5–2 mm long, concolorous, immersed, simple to branched, ends acute; exciple present below; ascospores 8–11-transseptate, 16–25 x 4–5 µm in size; norstictic acid present; from Karnataka. .... ***G. alboglaucescens***

18b. Thallus brown, evanescent, effuse, corticate; ascomata up to 8 mm long, superficially white, prominent, simple, unbranched, rarely furcate, ends acute; exciple present below; ascospores 4–5-transseptate, 19–23 x 5–8 µm in size; constictic, stictic acids present; from Ceylon. .... ***G. nematoides*** Leight.

19a. Thallus greenish gray; ascomata 1–5 mm long, black, immersed to slightly emergent, straight to flexuose, irregularly branched; exciple not present at the base; ascospores 7–9-transseptate, 25–40 x 5–7 µm ; stictic acid present; from Kerala, Tamil Nadu. .... ***G. arecae*** Vain.

19b. Thallus offwhite; ascomta 0.5–2 mm long, brownish, unbranched; exciple present below; ascospores 9–12-transseptate, 33–42 x 4–6 µm in size; norstictic acid present; from Karnataka. .... ***G. eburnea***

20a. Ascospores not exceeding 30 µm in length.
Thallus greenish; ascomata up to 5 mm long, black, surrounded by whitish area, simple, rarely branched, acute ends, irregularly curved; exciple present at the base, plane at the apical region; ascospores 5–9-transseptate, 5–9-transseptate, 21–28 x 4–5 µm in size; from Tamil Nadu .... ***G. sapii***

20b. Ascospores exceeding 30 µm in length 21

21a. Ascomata irregularly branched
Thallus ashy gray, thick; ascomata 0.5–4 mm long, concolorous with the thallus, simple to branched, thin, irregularly curved, ends acute; exciple present at the base; ascospores 8–10-transseptate, 25–38 x 6–8 µm; from Assam. .... ***G. malacodes***

21b. Ascomata dendroidly/dichotomously branched 22

22a. Thallus whitish grey; ascomata up to 5 mm long, concolorous, immersed to semi-emergent, simple, flexuose, dendroidly branched; exciple K+ orange-red, present at the base; ascospores 7–9-transseptate, 30–40 x 6–8 µm; from Assam, Kerala & Orissa. .... ***G. intermediella*** Stirt.

22b. Thallus glaucous gray, rough; ascomata 1–6 mm long, concolorous, simple to dichotomoulsy branched; exciple K-, present below; ascospores 9–11-transseptate, 38–46 x 8–10 µm in size; from Andaman Islands, Kerala and Tamil Nadu .... ***G. glaucescens*** Fée

Taxonomic descriptions

Graphis alboglaucescens Adaw. & Makhija, **sp. nov.** **Figure 1**

MycoBank # MB510478

Similis G. glaucescenti sed acidum norsticticum continens et thallus albidus differ.

Etymology: from the Latin *albidus*, whitish and from the species name *glaucescens*.

Holotype–India, Karnataka, Nandi hills, 26.9.1981, *P.K. Sethy & M.B. Nagarkar, 81.578*; holotype:AMH.

Thallus whitish green, smooth, distinctly cracked, delimited by a thin black hypothallus. **Ascomata** lirelline, 0.5–2 mm long and 0.1–0.2 mm broad, simple to branched, irregularly curved, concolorous with the thallus , immersed, thin, scattered, narrow, acute ends. **Disc** black, narrow, covered by white pruina. **Thalline margin** concolorous with the thallus, seperated from the exciple by a fine crack. **Exciple** yellowish, complete, present at the base, convergent, covered by a thalline margin up to the top, without striations, apically carbonized.

Epithecium pale yellow, thin. **Hymenium** hyaline, not inspersed, 86–90 µm high and 140–145 µm broad, I-, KI-. **Hypothecium** hyaline, 6–8 µm thick. **Paraphyses** simple, long, thin, filiform. **Asci** 8 sporate. **Ascospores** 8–11-transseptate, ellipsoidal, 16–25 x 4–5 µm, I+ blue.

Chemistry — Norstictic acid present.

Remarks — *Graphis alboglaucescens* is closely related to *Graphis glaucescens* (syn. *G. bulcana* Vain.) with respect to external morphology. According to Lücking (pers. comm.2006), *G. glaucescens* has an entire striate excipulum, the thallus is ecorticate, glaucous gray and lacks lichen substances. The species is somewhat comparable to *G. kakaduensis* A.W. Archer from Australia and the pantropical *G. caesiella* in having small transversely septate ascospores and norstictic acid; however, the exciples are laterally carbonized in *G. kakaduensis,* and *G. caesiella*. *G. alboglaucescens* can easily be distinguished from *G. stipitata* A.W. Archer by the additional presence of lichexanthone and the laterally carbonized excipulum in that species. *G. immersella* can also be distinguished from the present species in having stictic acid and a laterally carbonized excipulum. *G.alboglaucescens* can be distinguished from the closely related new species *G. eburnea* (in the present paper) by its small ascopores. *G. eburnea* has larger ascospores of 33–42 x 4–6 µm.

The species was collected on a roadside tree in the dry deciduous forests of Karnataka.

Graphis* cf. *bakeri Vain. Ann. Acad. Sci. Fenn. Ser. A., 15(6): 253, 1921. **Figure 2**

Thallus yellowish to whitish gray, smooth, cracked, unevenly thickened, delimited by thin black hypothallus. **Ascomata** lirelline, 0.5–5 mm long, dichotomously to irregularly branched, black, scattered, slightly raised, acute to obtuse ends. **Disc** narrow, blackish brown, pruinose. **Exciple** complete, indistinct at the base to sometimes absent at the base, convergent, covered by a thalline exciple to the top, not striate, laterally carbonized. **Epithecium** indistinct. **Hymenium** hyaline, not inspersed, 90–120 µm high and 121–150 µm broad, I-, KI-. **Hypothecium** thin, hyaline to pale yellowish orange. **Paraphyses** simple, long, thick, unbranched. **Asci** 8 sporate. **Ascospores** 9–12-transseptate, ellipsoidal, 42–46 x 3–4 µm, I+ blue.

Chemistry — Salazinic acid present.

SPECIMENS EXAMINED–INDIA. ANDAMAN ISLANDS: South Andaman, Nilambur forest, Baratang, Forest guest house, P.G. Patwardhan & M.B. Nagarkar *85.367*; HIMACHAL PRADESH: Kalatop, above Dharmashala, P.G. Patwardhan *70.726*, Khajjiar, above Chamba, P.G. Patwardhan *70.739*; KERALA: Shabrimalai hills, Patnamthatta, U.V. Makhija & P.G. Patwardhn *83.490, 83.497, 83.517* (AMH).

Remarks — The present species seems to be most similar to *G. bakeri* except the slightly smaller ascospores in *G. bakeri*.

Graphis eburnea Adaw. & Makhija, **sp. nov.** **Figure 3**
MycoBank # MB 510479

Similis G. desquamescenti sed excipulo apicibus striatus et hymenium non inspersus.

Etymology: from the Latin *eburnea*, white with yellow tinge; a reference to the off-white thallus.

Holotype–India, Karnataka, Anamod Ghat, 21.10.1970, *P.G. Patwardhan & P.D. Badhe, 70.70*; holotype:AMH.

Thallus offwhite, smooth, thin, delimited by thin black hypothallus. **Ascomata** lirelline, 0.5–2 mm long and 0.1–0.25 mm broad, simple, brownish black, scattered, slightly raised above the thallus, narrow, acute ends. **Disc** narrow to slightly broad, blackish brown. **Exciple** complete, present below, convergent, covered by a thalline exciple to the top, not striate, apically carbonized. **Epithecium** thin, pale brown, K-. **Hymenium** hyaline, not inspersed, 80–84 µm high and 138–147 µm broad, I-, KI-. **Hypothecium** hyaline, 6–8 µm thick. **Paraphyses** simple, long, thick, globose at the tip, unbranched. **Asci** 8 sporate. **Ascospores** 9–12-transseptate, ellipsoidal, 33–42 x 4–6 µm, I+ blue.

Chemistry — Norstictic acid present.

Remarks — *Graphis eburnea* resembles *G. desquamescens* Fée. Both species have an off-white thallus and contain norstictic acid, but the exciple is completely carbonized in *G. desquamescens* and the hymemium is inspersed. *G. vinosa* Müll. Arg., also resembles the new species but is distinguished by the laterally carbonized exciple and slightly larger ascospores, 40–50 µm long. The species can also be compared with *G. vittata* in overall morphology but it is differentiated from the present species in having stictic acid only.

Graphis filiformis Adaw. & Makhija, **sp. nov.** **Figure 4**
MycoBank # MB 510480

Similis G. intricatae sed lirellis longioribus et ascosporis minoribus differt.

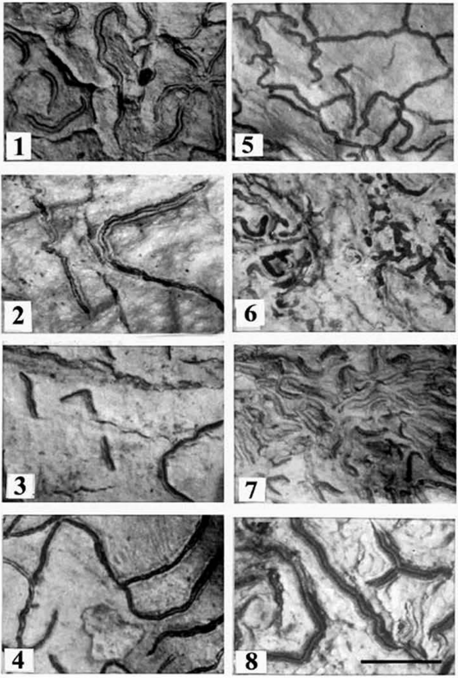
Etymology: from the Latin *filiformis*, thread like; a reference to thin, slender, thread like lirellae.

Holotype–India, Karnataka, Jog Falls, 1.11.1971, *D.N. Mhaskar, 71.54*; holotype:AMH.

Thallus whitish brown, smooth, delimited by thin black hypothallus. **Ascomata** distinct, black, few in number, irregularly curved, thin, slender, thread like, more than 10 mm long, simple to branched, ends acute. **Disc** narrow to moderately broad, black. **Exciple** not striate, present at the base, convergent, laterally carbonized. **Epithecium** indistinct, sometimes pale brownish. **Hymenium** hyaline, not inspersed, 80-90 µm high and 100–130 µm broad, I-, KI-. **Asci** 8 sporate. **Ascospores** 7–9-transseptate, 21–25 x 6–8 µm, I+ blue.

Chemistry — Norstictic, connorstictic acids present.

Remarks — *Graphis intricata* Fée somewhat resembles the new species *G. filiformis* in internal morphology, however, *G. intricata* has a basally carbonized



Figures—1-8. Habit 1. *Graphis alboglaucescens*, **2.** *G.* cf. *bakeri*, **3.** *G. eburnea* , **4.** *G. filiformis*, **5.** *G. furcata*, **6.** *G. immersella*, **7.** *G. malacodes*, **8..** *G. meghalayaensis*. Bar = 2mm excipulum. *G. pyrrhocheiloides* is another species close to *G. filiformis* in respect of morphology and chemistry, however, *G. pyrrhocheiloides* has larger ascopores of 40–46 x 8–12 µm in size.

The species was collected in moist deciduous forests along waterfalls.

Graphis furcata Fée Essai Cryptog. Ecorc. Officin., 40, 1824. Figure 5

Thallus whitish gray, pale yellowish, rough to smooth, unevenly thickened, warty, cracked, delimited by thin black hypothallus. **Ascomata** lirelline, 1–7 mm long and *ca.* 0.1–0.25 mm broad, scattered, simple, dendroidly or irregularly branched, black, irregular, acute to round ends. **Disc** narrow, blackish brown to black. **Exciple** present at the base, convergent apically, covered by a thalline margin up to the top, not striate, laterally carbonized. **Epithecium** pale brown, thin. **Hymenium** hyaline, not inspersed, 63–84 µm high and 105–126 µm broad, I-, KI-. **Hypothecium** hyaline, 4–6 µm thick. **Paraphyses** simple, long, thin, filiform, septate. **Asci** cylindrical, 8 sporate. **Ascospores** 5-7-transseptate, ellipsoidal, 21–25 x 4–5 µm, I+ blue.

Chemistry — no lichen substance present.

SPECIMENS EXAMINED–INDIA. ANDAMAN ISLANDS: Middle Andaman, Betapur Range, Dhaninala, M.B. Nagarkar & P.G. Patwardhan *85.2529*. ASSAM: Balaparai, P.G. Patwardhan & M.B. Nagarkar *77.1236* P.G. Patwardhan & M.B. Nagarkar, *85.2027* (AMH).

Remarks — *Graphis furcata* apparently resembles *G. tenella* from which it differs in having narrower, wavy ascomata with entire exciple. The type material of *G. tenella* at Helsinki has striate labia (Wirth & Hale 1978). The species is known from the tropical regions of the world and now being reported for the first time from India. The species is found to be associated with member of *Arthoniaceae*.

Graphis immersella. Müll. Arg. Bull. Herb. Boiss. 3: 319, 1895. Figure 6

Thallus yellowish rugose, unevenly thickened, delimited by thin black hypothallus. **Ascomata** lirelline, 1–4 mm long, 0.1–0.3 mm broad, simple to branched, black, scattered, immersed, with acute to obtuse ends. **Disc** moderately broad, 0.1–0.2 mm broad, blackish brown. **Exciple** complete, present below, convergent, covered by a thalline exciple to the top, narrow at the base and expanded at the apical region, entire, laterally carbonized,. **Epithecium** thin, hyaline, K-. **Hymenium** hyaline, not inspersed, 37–50 µm high and 105–168 µm broad, I-, KI-. **Hypothecium** thin, hyaline. **Paraphyses** simple, long, thick, unbranched. **Asci** 8 sporate. **Ascospores** 5–7-transseptate, ellipsoidal, 16–25 x 3–4 µm, I+ blue.

Chemistry — Stictic and constictic acids present.

SPECIMEN EXAMINED–INDIA. ANDAMAN ISLANDS: North Andaman, Mayabander Range, Interview Island, P.K. Sethy & P.G.Patwardhan *85.2871* (AMH).

Remarks — The species was earlier known from Australia and is now being reported for the first time from India.

Graphis malacodes Nyl. Bull. Soc. Linn. Norm. ser. 2, 2 : 116, 1868. Figure 7

Thallus ashy gray, thick, uneven, cracked, delimited by thin black hypothallus. **Ascomata** lirelline, 0.5–4 mm long and 0.1 mm broad, simple to branched, thin, irregularly curved, concolorous with the thallus, immersed to slightly raised by the thalline margin, separated from the thallus by a crack, thin, crowded, narrow, acute ends. **Disc** narrow, slit like, black, covered by white pruina. **Exciple** complete, present below, convergent, covered by a thalline exciple to the top, not striate, apically carbonized. **Epithecium** thin, hyaline, K-. **Hymenium** hyaline, not inspersed, 97–105 µm high and 185–189 µm broad, I-, KI-. **Hypothecium** orange brown, 16–21 µm thick. **Paraphyses** simple, long, thick, globose at the tip, unbranched. **Asci** 8 sporate. **Ascospores** 8–10-transseptate, ellipsoidal, 25–38 x 6–8 µm, I+ blue.

Chemistry — no lichen substances present.

SPECIMEN EXAMINED–INDIA. ASSAM: Maniknagar, P.G. Patwardhan *77.1198*, P.G. Patwardhan & M.B. Nagarkar, *77.1194* (AMH).

Remarks — The species is being reported for the first time from India.

Graphis meghalayaensis Adaw. & Makhija, sp. nov. Figure 8

MycoBank # MB 510481

Similis G. nigroglaucae sed ascospsoris majoribus differt.

Etymology: from the Latin *ensis*, a place of origin, and Meghalaya, the type locality.

Holotype–India, Meghalaya, Wiloe, 30.10.1977, *P.G. Patwardhan & M.B. Nagarkar, 77.1115*; holotype:AMH.

Thallus olivaceous, rough, thin, warty. **Ascomata** lirelline, 0.5–6 mm long, mostly simple to rarely branched, concolorous with the thallus, scattered, semi-emergent, acute to obtuse ends. **Disc** narrow, black, epruinose. **Exciple** complete, present below, convergent, spreading at the apical region, covered by a thalline exciple till top, multistriate, striae not separated from each other, apically carbonized. **Epithecium** thin, hyaline, K-. **Hymenium** hyaline, not inspersed, 60–75 µm high and 80–90 µm broad, I-, KI-. **Hypothecium** thin, pale orange. **Paraphyses** simple, long, thick, unbranched. **Asci** 8 sporate. **Ascospores** 24–30-transseptate, long, ellipsoidal, 84–93 x 5–7 µm, I+ blue.

Chemistry — Norstictic, and stictic acids present.

Remarks — The new species *Graphis meghalayaensis* resembles *G. nigroglauca* Leight. which, however, differs from the present taxon by the smaller ascospores of 30–50 x 6–10 µm in that species.

Graphis olivacea Redinger Ark. Bot. 27(A): 55, 1935. **Figure 9**

Thallus olivaceous buff, gray, rough, thick, minutely cracked, verruculose, epruinose. **Ascomata** lirelline, 2–5 mm long and 0.2–0.5 mm broad, simple to radiately branched, distinctly black, immersed to semiemergent, scattered in well defined groups, narrow, acute ends. **Disc** narrow, covered by white pruina. **Exciple** complete, present at the base, convergent, covered by a thick thalline margin to the top, striate, 3–6 striae on each side, apically carbonized, expanded at the apical region. **Epithecium** hyaline, thin. **Hymenium** hyaline, not inspersed, 90–120 µm high and 130–160 µm broad, I-, KI-. **Hypothecium** indistinct. **Paraphyses** simple, long, thin, filiform, septate. **Asci** cylindrical, 8 sporate. **Ascospores** 10–13-transseptate, ellipsoidal, 42–80 x 4–8 µm, I+ blue.

Chemistry — no lichen substances present.

SPECIMENS EXAMINED–INDIA. TAMIL NADU: Kollaimalai, P.G. Patwardhan *85.1721*, *85.1732* (AMH).

Graphis rigidula Müll. Arg. Bull. Soc. Roy. Bot. Belgique 30: 78, 1891. **Figure 10**

Thallus buff to off white, smooth, thin, finely cracked. **Ascomata** lirelline, 3–5 mm long and 0.1–0.2 mm broad, simple to irregularly branched, scattered, black, immersed to slightly raised above the thallus, thin, acute ends. **Disc** light brown, narrow to slightly broad, covered by white pruina. **Exciple** not striate to sometimes rarely striate, 1–2 striae on each side, present at the base, convergent, covered by a thalline margin to the top, laterally carbonized. **Epithecium** hyaline, thin. **Hymenium** hyaline, not inspersed, 70–105 µm high and 112–175 µm broad, I-, KI-. **Hypothecium** yellowish to pale orange, 10–15 µm thick. **Paraphyses** simple, long, thin, filiform. **Asci** cylindrical, 6–8 sporate. **Ascospores** 7–15-transseptate, ellipsoidal, 25–56 x 8–12 µm, I+ blue.

Chemistry — no lichen substances present.

SPECIMEN EXAMINED–INDIA. TAMIL NADU: Kodaikanal, P.G. Patwardhan & M.B. Nagarkar *73.1847* (AMH).

Remarks — *Graphis rigidula* is morphologically similar to *G. longula* Kremp., but *G. longula* has sunken ascomata, is laterally carbonized and has larger ascospores (40-)70–90 x 9–13 µm. This is a new record for India. The species was previously known from Costa Rica, and Dominica

Graphis salacinilongiramea Adaw. & Makhija, **sp. nov.** **Figure 11**

MycoBank # MB 510482

Similis G. longirameae sed acida salazinicum, sticticum, hyposticticum, et hypoconsticticum continens differt.

Etymology: from the species name *longiramea* and salazinic acid contents.

Holotype–India, Karnataka, Sringeri, 6 km from Sringeri-Balehonur Road, 17.12.1974, *C.R. Kulkarni & A.V. Prabhu, 74.3180*; holotype: AMH.

Thallus glaucous green, grayish to pale brown, smooth, thick, tightly attached to substratum, delimited by black hypothallus. **Ascomata** lirelline, 5–12 mm long and 0.1–0.3 mm broad, simple to radiatly dichotomously branched, stellate, immersed to semiemergent, scattered all over the thallus, black, acute to obtuse ends. **Disc** narrow black, epruinose. **Exciple** not striate, present at the base, and converging at the apical portion, covered by a thick thalline margin up to the top, laterally carbonized. **Epithecium** hyaline, thin. **Hymenium** hyaline, 110–150 µm high and 180–220 µm broad, I-, KI-. **Hypothecium** hyaline, 10–12 µm thick. **Paraphyses** simple, long, thin, filiform, septate, thickened at the tips. **Asci** cylindrical, 8 sporate. **Ascospores** fusiform-oblong, 8–16-transseptate, 45–87 x 9–10 µm, I+ blue.

Chemistry — Salazinic (major), Stictic acid (major), hypoconstictic and hyposalazinic acids present.

SPECIMENS EXAMINED–INDIA. KARNATAKA: South Canara, Balehonur to Sringeri Road, C.R. Kulkarni *74.3188*, *74.3204*; P.G. Patwardhan & M.B. Nagarkar *74.3205*, *74.3235 74.3607*; Talcauvary, Coorg, M.B. Nagarkar & A.V. Prabhu *74.3353* (AMH).

Remarks — *Graphis salacinilongiramea* is very similar to *Graphis longiramea* in all respects, however, it contains salazincic acid, hypostictic and hyposalazinic acid in addition to stictic acid and therefore described as a separate species. The new species is also comparable with *G. arecae* regarding its morphology and chemistry but that species differs in having smaller ascospores of 25–40 x 5–7 µm.

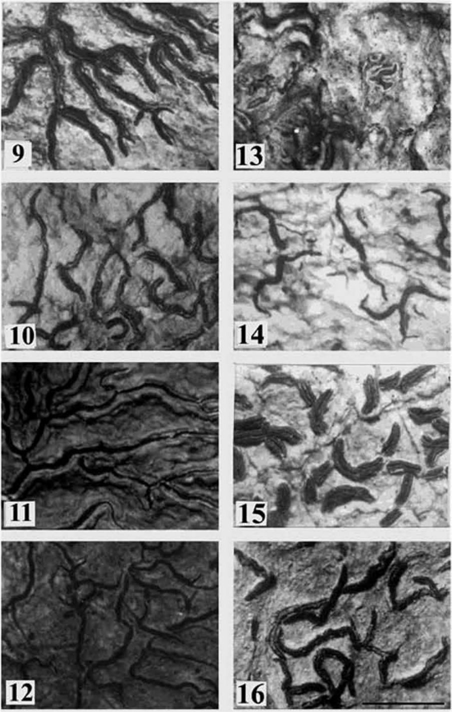
Graphis sapii Zahlbr. Symbol. Sinic., Pars 3: 39-40, 1930. Figure 12

Thallus greenish gray, thick, uneven, distinctly cracked, delimited by thin black hypothallus. **Ascomata** lirelline, 0.5–5 mm long and 0.1–0.2 mm broad, mostly simple to rarely branched, thin, irregularly curved, black, immersed, thin, scattered, narrow, separated by distinct fine cracks, acute ends. **Disc** brown, narrow, epruinose. **Exciple** orange yellow, plane at the apical region, complete or indistinctly present at the base, convergent, covered by a thalline margin up to the top, not striate, apically carbonized. **Epithecium** hyaline, thin. **Hymenium** hyaline, not inspersed, 75–84 µm high and 92–105 µm broad, I-, KI-. **Hypothecium** hyaline, 6–7 µm thick. **Paraphyses** simple, long, thin, filiform. **Asci** cylindrical, 8 sporate. **Ascospores** 5–9-transseptate, ellipsoidal, 21–28 x 4–5 µm, I+ blue.

Chemistry — no lichen substances present.

SPECIMENS EXAMINED–INDIA. TAMIL NADU: Upper Kodayar, on the way to Kakachi, elev. approx. 1400 m., P.G. Patwardhan *84.133* (AMH).

Remarks — The most closely related species are *Graphis glaucescens* and *G. chlorotica* from Amboina, also having the exciple carbonized only at the tip and the thallus without lichen substances. They differ from the present species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especially in having larger ascospores. In *G. glaucescens* ascospores are of 38–45 x 8–10 µm and in *G. chlorotica* 33–45 x 5–8 µm. The specimen was collected on the road side tree in undisturbed forest at higher elevation. The species is earlier known from China and now being reported for the first time from India.

Graphis schiffneri Zahlbr. Ann. Cryptog. Exot. 1: 127, 1928. Figure 13

Thallus greenish, rough, uneven, thick, epruinose, delimited by thin black hypothallus. **Ascomata** lirelline, 0.5–1.5 mm long and 0.1–0.2 mm broad, simple to branched, immersed, curved, flexuose, scatterd all over the thallus, ends acute to obtuse. **Disc** narrow, black, covered by white pruina. **Exciple** complete, present at the base, without striae or sometimes 2 striae seen on each side, convergent, laterally carbonized. **Epithecium** hyaline, thin. **Hymenium** hyaline, not inspersed, 90–110 µm high and 100–120 µm broad, K-. KI-. **Hypothecium** orange broad, 4–6 µm thick. **Paraphyses** simple, long, thin, filiform, sepate, thickened at the apices. **Asci** cylindrical, 8 sporate. **Ascospores** ellipsoidal, 5–7-transseptate, 17–25 x 3–4 µm, I+ blue.

Chemistry — norstictic acid present.

SPECIMEN EXAMINED–INDIA. KERALA: Paranthal, near Changaneshi-Trivandrum road, C.R. Kulkarni *76.884* (AMH).

Remarks — he most closely *G. exalbata* Nyl. differs from the present species only in having saxicolous thallus. The species is known from North West Himalaya of India.

Graphis stenotera Vain. Ann. Acad. Sci. Fenn., Ser. A. 15(6): 243, 1921. Figure 14

Thallus off white, yellowish to stramineous, thin, rough, uneven, sometimes evanescent, delimited by thin black hypothallus. **Ascomata** lirelline, 0.5–6 mm long and 0.1–0.2 mm broad, mostly simple to occasionally branched, thin, irregularly curved, black, narrow, semi-emergent, acute ends. **Disc** black, narrow, epruinose. **Exciple** complete, present at the base, convergent, covered by a thalline margin up to the top, striate, 5–6 striae on each side, apically carbonized, carbonization extending laterally on the outer straie and does not border hymenium, inner part reddish orange. **Epithecium** indistinct. **Hymenium** hyaline, not inspersed, 54–63 µm high and 84–96 µm broad, I-, KI-. **Hypothecium** hyaline, 6–8 µm thick. **Paraphyses** simple, long, thin, filiform, septate. **Asci** cylindrical, 8 sporate, **Ascospores** 5–9-transseptate, ellipsoidal, 21–38 x 4–6 µm, I+ blue.

Chemistry — stictic acid (major) and constictic acid (trace) present.

Figures—9-16. **Habit 9.** *G. olivacea*, **10.** *G. rigidula*, **11.** *G. salacinilongiramea*, **12.** *G. sapii*, **13.** *G. schiffneri*,**14.** *G. stenotera*, **15.** *G subvittata*, **16.** *G. urandrae*. Bar = 2mm

SPECIMENS EXAMINED–INDIA. KARNATAKA: Kemmengundi, U.V. Makhija & S.P. Kekre *82.467*; Silent Valley, M.B. Nagarkar *81.776*, P.G. Patwardhan M.B. Nagarkar *82.19*. **KERALA:** Wyanad, M.B. Nagarkar *76.61*; Anamalai hills, Valparai forest, M.B. Nagarkar *76.405*; Upper Kodayar, P.G. Patwardhan *83.344*. **TAMIL NADU:** Nandi hills, M.B. Nagarkar P.K. Sethy *81.480* (AMH).

Remarks — *Graphis stenotera* is distinguished by its off white to stramineous thallus; black, mostly simple to occasionally branched long lirellae; striate and laterally carbonized exciples and presence of stictic and constictic acids in the thallus.

The species was previously reported from Philippines and now reported for the first time from India.

Graphis subvittata Adaw. & Makhija, **sp. nov.** **Figure 15**

MycoBank # MB 510483

Similis G. vittatae sed acida sticticum, consticticum continens differt.

Etymology: from the Latin *sub*, somewhat, almost and the epithet *vittata*, a reference to the similarity with *Graphis*.

Holotype– India, Karnataka, Nandi hills, 26.9.1981, *M.B. Nagarkar & P.K. Sethy, 81.508*; holotype: AMH.

Thallus cream whitish, rough, cracked, uneven, delimited by black hypothallus. **Ascomata** lirelline, 0.2–2 mm long, emergent, simple, black, distinctly raised above, scattered, round ends. **Disc** narrow, not visible. **Exciple** complete, present at the base, convergent, covered by a thalline margin till the top, stirate, 3–4 striae on each side, apically to laterally carbonized. **Epithecium** indistinct. **Hymenium** hyaline, not inspersed, 92–105 µm high and 126–147 µm broad, I-, KI-. **Hypothecium** hyaline to light orange yellow. **Paraphyses** simple, long, thin, filiform, septate. **Asci** cylindrical, 8 sporate. **Ascospores** 8–11-transseptate, ellipsoidal, 25–29 (-33) x 4–5 µm, I+ blue.

Chemistry — stictic (major), constictic and norstictic (major) acids present.

Remarks — *Graphis subvittata* is characterized by conspicuous, black, emergent lirellae; 3–4 striate, apically carbonized exciple and constictic, norstictic and stictic acids. This new species is distinguished from *G. vittata* especially by the presence of norstictic acid in the thallus. *Graphis subvittata* can also be compared with *G. nigroglauca* having striate, apically carbonized exciple, chemistry norstictic and stictic acid, however, differs from the present species in having large ascospores of the size (-28) 39–57 x 5–7 µm, and the absence of constictic acid.

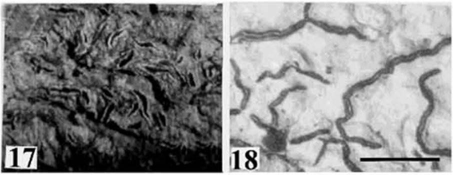
Graphis urandrae Vain. Ann. Acad. Sci. Fenn. Ser. A. 15(6): 255, 1921. **Figure 16**

Thallus grayish green, rough, unevenly thickened to distinctly verrucose, distinctly cracked. **Ascomata** lirelline, 3–5 mm long, 0.1–0.2 mm broad, black, simple to branched, emergent, round ends. **Disc** black, narrow. **Exciple** complete, present at the base, convergent, covered by a thalline margin to the top, entire, laterally carbonized. **Epithecium** distinct pale brown, thin. **Hymenium** hyaline to brownish tinged, not inspersed, 130–140 µm high and 168–315 µm broad, I-, KI-. **Hypothecium** hyaline, thin. **Paraphyses** simple, long, thin. **Asci** 8 sporate. **Ascospores** 3–6-transseptate, ellipsoidal, 21–34 x 4–5 µm, I + blue.

Chemistry — no lichen substances.

SPECIMENS EXAMINED–INDIA. ANDAMAN ISLANDS: North Andaman, Diglipur Range, Sitapur M.B. Nagarkar & P.G. Patwardhan *86.196*; P.K. Sethy & M.B. Nagarkar *86.197, 86.232*; SIKKIM: Gangatok, near Tangshi View Point, P.G. Patwardhan & M.B. Nagarkar *77.1953, 77.1963* (AMH).

Remarks — *Graphis urandrae,* a very distinct species, is here reported for the first time from India. The species was collected in association with *Physcia* and other graphids in the tropical rain forests of the Andaman Islands. The species was previously known from the Philippines.



Figures—17-18. Habit. 17. *G. valparaiensis*, **18.** *G.* sp. A. Bar = 2mm

Graphis valparaiensis Adaw. & Makhija, **sp. nov.** **Figure 17**

MycoBank # MB 510484

Similis G. olivaceae sed excipulo non striato et acidum sticticum continens differt.

Etymology: From the Latin *ensis*, a place of origin, and Valparai the type locality.

Holotype–India, Tamil Nadu: Anamalai hills, on the way to Valparai, 200 ft., 3.1.1982, *P.G. Patwardhan & M.B. Nagarkar, 82.262;* holotype: AMH.

Thallus greenish-gray, distinctly cracked, thick, delimited by thin, black hypothallus. **Ascomata** lirelline, 0.5–4 mm long and 0.1–0.2 mm broad, mostly simple to occasionally branched, concolorous with the thallus, scattered, immersed, narrow, acute ends. **Disc** narrow, black, epruinose. **Exciple** yellowish, complete, present below, convergent, covered by a thalline exciple till top, entire, apically carbonized. **Epithecium** thin, hyaline. **Hymenium** hyaline, not inspersed, 126–189 µm high and 168–210 µm broad, I-, KI-. **Hypothecium** pale brown, 8–12 µm high. **Paraphyses** simple, long, unbranched. **Asci** 8 sporate, 110–125 x 10–14 µm. **Ascospores** hyaline, 15–23-transseptate, ellipsoidal, 76–100 x 8–12 µm, I+ blue.

Chemistry — stictic, con-norstictic acids present.

Remarks — *Graphis valparaiensis* is distinguished by its apically carbonized exciple, large ascospores of 76–100 x 8–12 µm and presence of stictic and connorstictic acids in its thallus. *G. valparaiensis* is somewhat close to *G. olivacea* and *G. meghalayaensis*, a new species described here with large ascospores of the size (-45) 60–90 (-125) x 8–10 µm and 84–93 x 3–4 µm, however *G. olivacea* has a striate, apically carbonized exciple and *G. meghalayaensis* has a striate exciple and norstictic acid.

Graphis sp. A — Figure 18

Thallus grayish, pale green to gray, yellow within or offwhite, smooth, cracked, delimited by black hypothallus. **Ascomata** lirelline, 0.3–9 mm long and 0.2 mm broad, black, simple, curved, scattered, immersed to slightly emergent, separated from the thallus with a narrow fissure, irregular, flexuose, acute ends. **Disc** narrow barely visible, blackish brown to black. **Exciple** complete, present at the base, convergent, covered by a thalline margin up to the top, striate, 2–3 striae on each side, apially carbonized, studded with crystals between striae. **Epithecium** pale, thin. **Hymenium** hyaline, not inspersed, 84–109 µm high and 117–134 µm broad, I-, KI-. **Hypothecium** yellow, 6–8 µm high. **Paraphyses** simple, long, thin. **Asci** 6–8 sporate. **Ascospores** 4–8-transseptate, ellipsoidal, 16–25 x 5–6 µm, I+ blue.

Chemistry — norstictic and stictic acids present.

SPECIMEN EXAMINED–INDIA. TAMIL NADU: Kodaikanal, near Daisy Bank, P.G. Patwardhan & C.R. Kulkarni *75.337* (AMH).

Remarks — The present species somewhat resembles *Graphis longula* and *G. persulcata* Stirt. in having striate exciple. *G. longula*, however, has much longer ascospores of 70-90 µm and has no lichen substances and *G. persulcata* has laterally carbonized exciple. On account of the insufficient material this species has not been described fomally and has been kept unnamed for the time being.

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The genus *Campanella* in Western Australia

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Abstract—Two species of *Campanella* are noted. The genus was previously unrecorded in Western Australia. *Campanella gregaria* sp. nov. predominantly occurs on rotting wood and bark of *Banksia* and *Eucalyptus* in south Western Australia. *C. gregaria* can be recognized by having often numerous, dull dark brown to grey, tiny, shell-shaped to cup-shaped, gelatinized basidiomes with an extensively anastomosed, almost poroid hymenophore. It is affiliated with species in *Campanella* subsection *Floridanae*, perhaps closest to the northern East Asian species *Campanella boninensis*. A second species of *Campanella* from Western Australia is noted but not formally described pending further collections.

Key words—*Agaricales*, *Marasmiaceae*, taxonomy

Introduction

Campanella Henn. is a saprotrophic genus of white-spored fungi with small, shell-like basidiomes produced on rotting stumps, logs and other dead wood. The majority of species of *Campanella* occur in tropical, subtropical and southern temperate regions (Segedin 1993). An exception is *C. boninensis* (S. Ito & S. Imai) Parmasto from temperate regions of East Asia such as Japan and Russia. Currently 56 names are listed for the genus (Index of Fungi, Farr et al. 2005). Four named species of *Campanella* have been reported in Australia (May & Wood 1997) and four other species in New Zealand (Segedin 1993).

The genus *Campanella* is well defined by a set of distinctive morphological features (Singer 1986). The basidiomes are often semi-transparent, strongly gelatinized, and have anastomosing ridges that interlink the lamellae. The hymenophore is poroid or favoloid in some of the more strongly anastomosed species. Microscopically the genus is characterized by inamyloid spores, abundant clamp connections, and a rameales pileipellis. *Favolaschia* resembles poroid species of *Campanella* but has amyloid spores.

A close relationship between *Campanella* and *Tetrapyrgos* is indicated by morphology and by some molecular studies but the degree of distinction between these genera remains unresolved. At least some species of *Campanella* have the triangular or pastie-shaped spores typical of *Tetrapyrgos*. Singer (1986) did not accept *Tetrapyrgos* (*Pterospora*) and placed its species in *Marasmiellus* and *Campanella*. Phylogenetic analyses of the rDNA nuclear large subunit gene by Moncalvo et al. (2002) indicate that *Campanella* is a sister group to *Tetrapyrgos* within a tetrapyrgoid clade of fungi with gelatinized pilei, clamp connections, rameales type of pileipellis structure, and inamyloid spores. The tetrapyrgoid clade is in turn entrenched within a clade of saprotrophic fungi traditionally assigned to the *Marasmiaceae* including some *Marasmius*, *Crinipellis* and *Chaetocalathus* species (Moncalvo et al. 2002). Analyses of rDNA sequences by Thorn et al. (2005) show two un-named species of *Campanella* nested within a *Tetrapyrgos* clade. A multi-locus cladogram by Matheny et al. (2006) has a terminal clade in the *Marasmiaceae* comprised of an un-named species of *Campanella* and *Tetrapyrgos subdendrophora*. A *Tetrapyrgos* clade derived from rDNA sequences by Wilson & Desjardin (2005) does not contain the only species of *Campanella* in their study - *Campanella eberhardtii* (Pat.) Singer.

Within *Campanella* Singer (1975) nominated two sections based on presence or absence of metuloids. *Campanella* included species with small broadly ellipsoid to subglobose spores and dark pigmentation. Those species may extend the generic boundary of *Campanella* towards *Resupinatus*, a genus with similar basidiomes (Pegler 1986). Previously *Resupinatus* was considered only to include species without an interveined hymenophore (Singer 1986), but poroid species are now accepted in *Resupinatus* (Thorn et al. 2005). Recognition of the two genera is supported by molecular analyses: *Resupinatus* species occur in a separate clade to the tetrapyrgoid clade containing *Campanella* species in the analysis of Moncalvo et al. (2002), and the genera are also well separated in Thorn et al. (2005).

This present paper describes a new species of *Campanella* subsection *Floridanae* characterized by its dark brown to grey, non-vinaceous, non-staining, gelatinized basidiomes, strongly anastomosed hymenophore, and predominantly subglobose spores.

Description of the species

Campanella gregaria Bougher, sp. nov. Figure 1

MycoBank # MB 510526

Pileus ad 8 (–12) mm diam, primo cupulatus dein umbonato-applanatus flabelliformis, dimidatus vel conchatus vel orbiculatus, primo pallide maturitate sordide dein pallide luteus vel cremeus, gelatinosus. Caro gelatinescens. Hymenophorum cremeum dein concolorum, lamelliis ad 15 ad punctum excentricum radiantibus, anastomosantibus. Stipes nullus. Odor nullus. Sapor mitis. Sporae 4.9 – 6.1 (6.3) x 4.2 – 5 (5.3) µm, dominante subglobosae, *laeves, hyalinae inamyloideae. Cystidia 20–40 x 2–5 μm, filiformia, irregularia, raro sublanceolata, laevia. Septa hypharum fibulata. Gregaria, lignicola, in sylvis, Australia Occidentalis, 30.6.2004.*

Holotypus: Ken Hurst Park, Perth, 32° 4' 44.72" S 115° 52' 51.43" E, Western Australia, 13 June 2004, N.L. Bougher & N. Carrington E8006 - Holotypus: PERTH.

Etymology: from the Latin adjective *gregarius* = growing in companies but not united together. In reference to this fungus often having multitudes of basidiomes in crowded groups.

Basidiomes 2–8 (–12) mm diam., some basidiomes fused laterally, at first cupulate with strongly inrolled, thick margin surrounding a narrow circular aperture that widens with age. Mature basidiomes flabelliform, dimidate to conchate (basidiomes on vertical side of wood), or orbicular (basidiomes under horizontal side of wood), with wavy, undulating, sometimes sulcate, thin margin; **surface** dry but jelly-like with age, smooth or with minute pruinosity visible under lens in young specimens, translucent showing tessellated–mottled pattern of the hymenophore, color variable depending on degree of gelatinisation but usually dull greyish-brown (7E5), paler when young, sometimes becoming very pale or yellowish cream (4A3) when older or particularly when gelatinized, vinaceous or bluish tinges absent at all stages, dark grey to black when dried; **stipe** absent, basidiomes broadly attached laterally, excentrically, or central dorsally; **hymenophore** cream at first then concolorous with pileus, with up to 15 lamellae radiating out from an excentric point (flabelliform, dimidate to conchate basdiomes) or central point (orbicular basidiomes), radial pattern less dominant or conspicuous in mature basidiomes than young basidiomes and very obscure in mature orbicular basidiomes, anastomosing cross walls between lamellae forming crowded poroid pattern of polygonal and irregular locules, some anastomoses forming partial intrusions into the locules, isolated lamellulae rare or absent, lamellae and anastomoses are of same height (up to 1 mm tall) and thickness; **context** firm, fleshy, jelly-like at first then increasingly flabby, gelatinous with age, finally collapsed; **mycelium** not visible on substrate surface between basidiomes; **odor** not distinctive; **taste** mild; **spore print** white.

Basidiospores 4.9 – 6.1 (6.3) x 4.2 – 5 (5.3) μm (n = 30), mean 5.58 x 4.77 μm, L/B ratio 1.07–1.24, mean 1.17, hyaline in 3% KOH or water, inamyloid, predominantly subglobose, some broadly ellipsoid or subovoid, smooth, thin-walled; **basidia** 22–30 x 5–7 μm, cylindro-clavate to clavate, hyaline, thin-walled, sterigmata to 4–7 μm in length, 4-spored, clamped at base, subtended by narrow hypha 1.5 μm broad, arranged in tightly packed hymenium which collapses and/or gelatinises post-maturity; **basidioles** narrow, cylindric; **lamellae trama** loosely entangled hyphae 1.5–2 μm broad, hyaline, smooth-walled, all septa clamped, becoming gelatinized; **subhymenium** hyphae similar to trama; **cystidioid elements** 20–40 x 2–5 µm, mostly filiform, sometimes irregular, rarely sublanceolate, rarely with hyphal-like extension, hyaline, smooth-walled and without encrusted tips, usually single accompanying a basidium, not associated with every basidium, not usually emerging beyond hymenium; **pileipellis** a dense tangled rameales layer directly emanating from the loosely entangled hyphae of the pileus trama, composed of coralloid elements up to 2 (2.5) µm broad, with short, blunt-tipped branches, often branching at right angles and tapering towards the tips, elements with intracellular brown pigment (seen in KOH or water), in young specimens hyphal tips emerge from the pileipellis as minute horn-like structures, in older specimens the walls of many tapered hyphal tips dissolve into a gelatinous material without crystalline material present; **pileus trama** of hyaline, thin-walled, smooth, hyphae (1.5–2 µm broad), very loosely entangled in a hyaline gelatinised matrix, most hyphal walls remain intact; **clamp connections** present, large, including some medallion clamps, some associated with abruptly swollen septa.

Habit and Habitat—In crowded clusters spread over dead wood in natural forests and woodlands dominated by *Eucalyptus* and *Banksia*, on fallen logs of *Banksia* species, usually growing on the inner side of loose rotting bark, and on burnt and unburnt logs and stumps of Jarrah (*Eucalyptus marginata*) and *Allocasuarina* species. Variable in number, usually from 10 to in excess of 100 basidiomes. May to July.

Specimens examined—**AUSTRALIA. Western Australia: Ken Hurst Park**, Perth, 32° 4' 44.72" S 115°52' 51.43" E, on fallen rotting banksia wood in banksia woodland, 13 June 2004, coll. *N. Bougher & N. Carrington E8006* - **holotype** here designated (PERTH). **Kings Park**, Perth, in bushland near southern end of Hale Oval – Ivey Watson Playground, 31° 57' 18.86" S 115°50' 13.09" E, on fallen rotting banksia wood in banksia woodland, 9 June 2004, coll. *N. Bougher & J. Weaver E8004* (PERTH). **Bold Park**, Perth, 31° 57' 28.9" S 115°46' 17.4" E, on bark of fallen rotting banksia wood in banksia and jarrah (*Eucalyptus marginata*) woodland, 29 June 2004, coll. *N. Bougher & R. Hart E8034* (PERTH). **Dwellingup**, ALCOA World Alumina Australia bauxite mining lease, Wuka Rd, 32° 35' 28.8" S 116°4' 29.3" E, on surface of a jarrah (*Eucalyptus marginata*) stump in natural jarrah forest, 27 June 2001, coll. *N. Bougher E6816* (PERTH). **Dwellingup**, ALCOA World Alumina Australia bauxite mining lease, Nettleton Rd, 32° 35' 26.9" S 116°4' 23.1" E, on old rotting jarrah (*Eucalyptus marginata*) wood lying on the ground in natural jarrah forest, 28 June 2001, coll. *M. Glen E6887* (PERTH). **Boddington**, Worsley Alumina Pty Ltd bauxite mining lease, Nettleton Rd, 32° 58' 38.5" S 116°27' 9.7" E, in dense clusters of about 20 basidiomes on wood in natural jarrah forest of *Eucalyptus marginata*, 16 July 2001, coll. *M. Glen E6991* (PERTH). **Dwellingup**, ALCOA World Alumina Australia bauxite minesite, Nettleton Rd, 32° 35' 26.9" S 116°4' 23.1" E, on the ground in 4-year-old rehabilitated forest of *Eucalyptus marginata*, *Acacia* sp., 11 June 2002, coll. *D. Willyams E7144* (PERTH). **Serpentine**, Lowlands, about 1km north of Lowlands Rd and gate to private property, 32° 19' 11.4" S 115°55' 30.9" E, on bark of fallen rotting *Banksia attenuata* wood in banksia and jarrah (*Eucalyptus marginata*) woodland, 20 May 2006, coll. *K. Griffiths, N. Goldsborough, M. Langley & P. Robertson E8314* (PERTH).

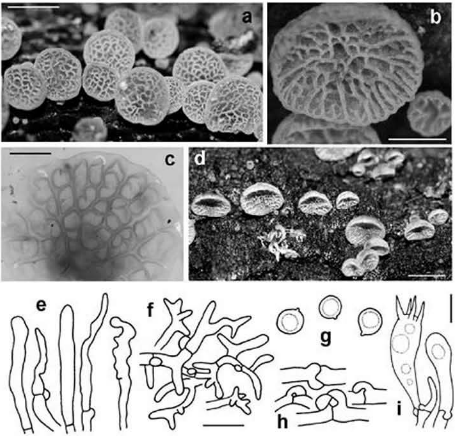

Fig. 1. *Campanella gregaria*: a. Young basidiomes (Holotype) b. Mature basidiomes (E8314) c. Young hymenophore revived in 3% KOH after drying (E8004). Note the incomplete anastomoses projecting into the locules. d. Mature basidiomes (Holotype) e. Cystidia and cystidia-like elements in the hymenium f. Coralloid elements in the pileipellis g. Basidiospores h. Trama hyphae with large clamp connections i. A developing basidium and a mature basidium
Scale bars: a, d = 5 mm, b = 2 mm, c = 1 mm, e-i = 10 µm (bar in f applies to e-h).

Comments—*Campanella gregaria* can be recognized by its dull dark brown to grey, tiny shell-shaped to cup-shaped, gelatinized basidiomes often numerous on rotting wood. Young basidiomes that are dorsally attached due to their position on the under side of logs appear cup-shaped. They have a thick, inrolled margin that encircles a narrow aperture. As the basidiome expands, the aperture widens and the margin unrolls to reveal the poroid hymenophore. Basidiomes have up to 15 radiating lamellae. The lamellae are interlinked by secondary anastomosing cross-walls of similar height that form a crowded poroid pattern of polygonal and irregular locules. Radial lamellae are mostly evident in young specimens and in excentrically attached mature specimens (Figure 1b). In dorsally attached, circular-shaped basidiomes the lamellae can become obscured amid a predominantly non-radial, poroid hymenophore (Figure 1a). The extent of anastomosing is not affected by size of the basidiome. Old basidiomes become paler and can transform into a soft gelatinous amorphous mass often engulfing several adjacent basidiomes. Air-dried specimens of *C. gregaria* are dark grey or black. Dried specimens rapidly revive and swell up to their original size and shape and pale yellow-brown colour in KOH or water (Figure 1c).

Taxonomic relationships of *Campanella gregaria*—The spores of *C. gregaria* are predominantly subglobose to almost globose with an average length/breadth ratio of 1.1 to 1.2. *C. gregaria* therefore is affiliated with section *Campanella* Singer as defined (Singer 1986) by absence of metuloids, and belongs in subsection *Floridanae* Singer, defined by short, ellipsoid to subglobose spores to 6.5 um long, or, if longer, arising from bisporic basidia (Singer 1986).

Four named species of *Campanella* have been reported in Australia (May & Wood 1997), all outside Western Australia. None represent the subsection *Floridanae*. (1) *C. gigantospora* Singer has large spores (11-15.5 x 9.5-12 µm) and diverticulate cystidia (Singer 1986). (2) *C. junghuhnii* (Mont.) Singer has light-coloured pilei and larger (7.4-10.6 x 4.8-6.7 µm), ellipsoid spores (Parmasto 1981). (3) *C. olivaceonigra* (E. Horak) T.W. May & A.E. Wood reported from New Zealand and Australia (May 1989) has angular, tetrahedral spores (8-10 x 5-6 µm, Horak 1983), and previously has been assigned to the genera *Pterospora* and *Tetrapyrgos* before more recent placement in *Campanella* (May & Wood 1995). (4) *C. pustulata* (Berk. & Broome) Pegler has large (10-14 x 6-7.5 µm) amygdaliform spores (Pegler 1986). All Australian reports of *C. pustulata* are based on a record named *Laschia pustulata* Berk. & Broome by Cooke (1892) which is considered by many authors to be a misidentification (May & Wood 1997). The identities of *Campanella* sp. reported in South Australia by Burns & Conran (1997), and the Australian fungi depicted as *Campanella* species by Heino Lepp at www.anbg.gov.au/fungi/images are unconfirmed.

Four species of *Campanella* have been reported from New Zealand (Segedin 1993) in addition to *C. olivaceonigra*. *Gloiocephala rubescens* (Segedin) Desjardin & E. Horak (formerly *C. rubescens* Segedin) and *C. tristis* (G. Stev.) Segedin have staining basidiomes and ellipsoid spores. *C. fimbriata* Segedin has stipitate basidiomes and broadly ellipsoid to ovate spores. *C. vinosolivida* Segedin is the only known New Zealand representative of *Campanella* that may be considered close to members of subsection *Floridanae*. Segedin (1993) indicates possible affinities of *C. vinosolivida* with species of subsection *Floridanae* such as *C. boninensis* and *C. purpureobrunnea* Petch, but it differs from them by having diverticulate cystidia, ellipsoid spores, and more complex pileipellis elements. It differs from *C. gregaria* by having large brightly-coloured basidiomes with margin not inrolled, elliptic-oblong spores, and strongly diverticulate cheilocystidia. The hymenophore of *C. vinosolivida* is rather crowded (see Fig. 4, Segedin 1991). However *C. gregaria* does not share with *C. vinosolivida* lamellulae that remain isolated from the poroid hymenophore. Also the radial lamellae are less dominant at maturity in *C. gregaria* than in *C. vinosolivida*, particularly in circular-shaped basidiomes.

Species of *Campanella* in the Subsection *Floridanae* (Singer 1975) to consider in relation to *C. gregaria* include *C. podocarpi* Singer, *C. floridana* Singer, *C. alnetorum* Singer, *C. caerulescens* (Berk. & M.A. Curtis) Singer, and *C. boninensis*. *C. podocarpi* has scarcely anastomosed lamellae, bisporic basidia and occurs on conifers in South America (Singer 1975). *C. floridana* has narrow anastomoses, no cystidia, and occurs on *Magnolia* in Florida (Singer 1975). *C. alnetorum* from Argentina has distant and forked lamellae, grayish fuscous circular basidiomes 12-13 mm broad, subglobose spores 4.5 –5 x 4-4.5 µm, narrowly cylindric basidioles, no thin- or thick-walled cystidia, and a broad non- or weakly-gelatinised epicutis layer (Singer 1975). *C. caerulescens* is a neotropical species with white or yellowish basidiomes that become bluish purple with age (Singer 1975). *C. boninensis* from East Asia has (data from Parmasto 1981): (1) small dull brown vinaceous almost sepia, astipitate basidiomes; (2) alveolate hymenium with concurring radiating lamellae; (3) narrow, loosely arranged clamped hyphae embedded in gelatinous matter; (4) epicutis of nodulose end cells with short side branches; (5) cheilocystidia rare or very rare; (6) small, broadly ellipsoid to subglobose spores (4.8- 6.4 x 3.8 -5 µm). *C. gregaria* may represent a southern hemisphere taxon with non-vinaceous basidiomes that is more closely related to *C. boninensis* than to any other known *Campanella* species.

C. gregaria also may be compared with *C. purpureobrunnea* from Sri Lanka as that species has small, abundant blackish brown to purplish brown basidiomes which uniformly blacken on drying (Pegler 1986). *C. purpureobrunnea* was incorrectly placed in the metuloid-bearing Section *Diplocystides* by Singer (1986). According to Pegler (1986) it lacks cystidia. *C. purpureobrunnea* differs from *C. gregaria* by having darker, purplish basidiomes and smaller, narrower spores (4-5.5 x 3.5-4.5 µm) (Parmasto 1981, Pegler 1986).

A second species of *Campanella* in Western Australia—This species, currently represented only by a single collection, also belongs in subsection *Floridanae*, possibly closest to the purplish species such as *C. purpureobrunnea*. It has similar spores (4.5- 5.6 x 4.0 –5.1 µm) to *C. gregaria* but differs from that species by: (i) purplish date colour of the lamellae and the pilei and markedly crenate/lobed margin; (ii) more frequent occurrence of coralloid, knobbly cystidia, including some branched cystidia. Determination of its identity awaits further collections.

It is likely that species of *Campanella* in addition to this one and *C. gregaria* occur in Western Australia, as this region spans a broad range of vegetation types and climatic regions (e.g. temperate, tropical).

Specimen examined—**AUSTRALIA. Western Australia: Manjimup**, Pine Creek Road, on old log of *Allocasuarina* sp. in natural forest of karri (*Eucalyptus diversicolor*), 13 June 1985, coll. *N. Bougher E3689* (PERTH).

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Hygrophorus penarioides, a new species identified using morphology and ITS sequence data

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Abstract—*Hygrophorus penarius* sensu lato is a whitish, dry or only slightly viscid, rather robust mushroom forming ectomycorrhizae with *Fagus sylvatica* or *Quercus* spp. There are slight morphological differences between the *Fagus* and the *Quercus* forms. The taxonomy has been complicated. Both forms have been interpreted as *Hygrophorus penarius*. Based on ITS sequence data it is here shown that they ought to be looked upon as two distinct species. As no reliable name in the literature could be used that fits the species associated with *Quercus* it is here described as a new species, *Hygrophorus penarioides*.

Key Words—*Basidiomycotina*, *Agaricales*, phylogeny

Introduction

Fries described *Hygrophorus penarius* 1836 and then stated that the species was found in beech forests of southern Sweden. In Epicrisis Systematis Mycologici 1838, the habitat was indicated as "silvis mixtis, praecipue fagetis". These statements correspond well with a mushroom rather frequently fruiting in Swedish *Fagus* forests, e.g. in Femsjö, Fries's home parish. Another form is associated with *Quercus* and has a very limited distribution in Sweden. It is restricted to calcareous soils, and most likely Fries never saw it. The morphological variation within *H. penarius* was observed by Becker (1954), who divided it into two species and described *Hygrophorus barbatulus*. Unfortunately, Becker applied the new name to the species growing with *Fagus* and retained *H. penarius* for the larger form under *Quercus*, ignoring that the description by Fries unambiguously indicated the *Fagus* form. Consequently, *H. barbatulus* G. Becker is a synonym of *H. penarius* Fr., leaving the *Quercus* form without a name.

Bon keyed out the two forms as rather well distinguished species (Bon 1977) or varieties (Bon 1992) but retained *H. penarius* for the taxon under *Quercus* and called the taxon under *Fagus H. barbatulus* or *H. penarius* var. *barbatulus*

(G. Becker) Bon. However, other authors such as Arnolds (1986) and Krieglsteiner (2001) did not separate them.

A molecular study using ITS sequence data was therefore undertaken to investigate the taxonomical status of the two forms in Europe. The ITS region was selected since an earlier study in *Hygrophorus* showed the region to be suitable for disentangling morphologically similar species and the study also indicated the species within *Hygrophorus* to be strictly host specific (Larsson & Jacobsson 2004).

Materials and methods

Data on sequenced specimens are provided in Table 1. We generated three sequences of both the *Fagus* and the *Quercus* forms using collections originating from different localities. In additon, a sequence of *H. sordidus* Peck was included to exclude the possibility that the North American species could occur in Europe and represent the *Quercus* form. We selected three morphologically related species as outgroup, *H. nemoreus* (Pers.) Fr. and *H russula* (Schaeff.) Kauffman associated with *Quercus*, and *H. poetarum* R. Heim associated with *Fagus*.

Collections have been deposited at the herbarium of the Department of Plant- and Environmental Sciences, Göteborg University (GB). Additional specimens of the new species *H. penarioides* are listed under the species description. Additional specimens morphologically examined of *H. penarius* are listed below.

Hygrophorus penarius: **Sweden: Sm.**, Femsjö, Lidhult-Femsjö, 7 Sep. 1957, T. Nathost-Windahl and M. Moser (NW6446); Voxtorp, Rusarebo, 19 Sep 1972, J. Eriksson. **Hl:** Veddige, Björkholm, 7 Sep 1958, F. Karlvall (FK8264); Älvsåker, Mariedal, 11 Sep. 1966, F. Karlvall (FK11905); Fjärås, Fagared, 11 Oct. 1980, S. Jacobsson (SJ80290). **Boh:** Romelanda, Grandalen, 7 Oct. 1978, S. Jacobsson (SJ78249); Bokenäs, 2 Sep. 1988, L. & A.- Stridvall (LAS88/141-B); Sotenäs, Tossene, 6 Oct. 2004, L. & A. Stridvall (LAS 04/145). **Vg:** Tostared, 5 Sep. 1973 J. Eriksson; Partille, Bokedalen, 27 Sep 1997, S. Jacobsson (SJ97027).

Sequences were obtained from fresh material and herbarium specimens (Tab. 1). Total DNA was isolated using DNeasy plant mini kit (QIAGEN, Valencia), following manufacturers recommendations. PCR reactions were carried out using Ready-To-Go™ PCR beads (Amersham Biosciences, Uppsala). Primers used to amplify the complete ITS region were ITS1F and ITS4B (Gardes & Bruns 1993). Amplified products were purified using Qiaquick spin columns (Qiagen, Hilden). Primers used for sequencing were ITS1, ITS3, ITS4 (White et al. 1990). Fifty to 75 ng of PCR products were used in each sequencing reaction using DTCS Quick Start Kit (Beckman Coulter, Fullerton). Sequences were obtained using CEQ 8000 DNA analysis system (Beckman Coulter).

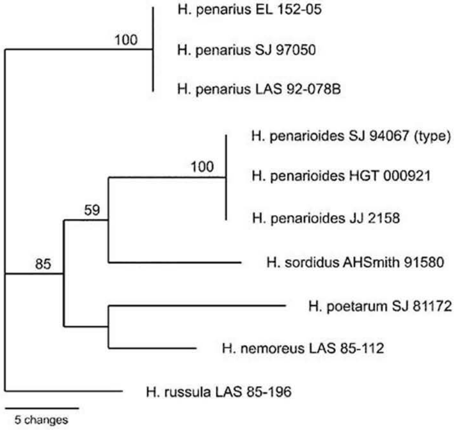

Figure 1. One of the most parsimonious trees from the phylogenetic analysis presented as a phylogram, showing the phylogenetic placement of *Hygrophorus penarioides*. Bootstrap values greater than 50% are indicated above branches.

Sequences were edited and assembled using Sequencher 3.1 (Gene Codes, Ann Arbour) and aligned manually using the data editor in PAUP* (Swofford 2003). Sequences generated in this study have been deposited in GenBank and accession numbers are given in Table 1.

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 treated as missing data. Searches used 1000 random-addition sequence replicates and TBR branch swapping. Relative robustness of clades was assessed by the bootstrap method using 1000 heuristic search replicates with 100 random taxon addition sequence replicates and TBR branch swapping.

Table 1. Data of sequenced collections

Species	Collection id.	Origin	Host	Accession nr.
H. penarius	EL152-05	Swe., Sk.	*Fagus*	EF395367
H. penarius	SJ97027	Swe., Vg.	*Fagus*	EF395368
H. penarius	LAS92-078	Swe., Boh.	*Fagus*	EF395369
H. penarioides	JJ2158	Swe., Vg.	*Quercus*	EF395372
H. penarioides	HGT000921	Swe., Gtl.	*Quercus*	EF295371
H. penarioides	SJ94067,Type	Swe., Öl.	*Quercus*	EF395370
H. nemoreus	LAS85-112	Swe., Vg.	*Quercus*	EF395374
H. poetarum	SJ81172	Swe., Sk.	*Fagus*	EF395375
H. russula	LAS85-196	Swe., Boh.	*Quercus*	EF395376
H. sordidus	AHSmith91580	USA., Wisc.	*Quercus*	EF395373

Results

The aligned dataset had 546 characters. After exclusion of ambiguous areas 375 characters remained for the analyses. Of these 325 were constant, 23 variable and parsimony uninformative, and 27 parsimony informative. Maximum parsimony analyses yielded two equally most parsimonious trees (length = 63, CI = 0.9048, RI = 0.9032). One of the two most parsimonious trees is presented in Figure 1. Bootstrap frequencies above 50% have been indicated on branches.

The bootstrap analysis recovered the three sequences of *H. penarius* with 100% bootstrap support and the three sequences of *H. penarioides* with 100% bootstrap support. The sequence differences between the two clades are 31 substitutions and 18 insertion/deletion events. The sequence of *H. sordidus* clusters with *H. penarioides* with 59% bootstrap support (Fig. 1). The sequence difference between the North American and the European species with similar morphology and associated with *Quercus* is 22 substitutions and 12 insertion/deletion events.

The phylogenetic analyses clearly verify the occurrence of two distinct species in Europe and that the North American species *H. sordidus* is different from the *Quercus* form in Europe. The species associated with *Fagus* is *H. penarius* and the other species associated with *Quercus* is here described as *H. penarioides*.

Species description

Hygrophorus penarioides Jacobsson & E. Larss. **sp. nov.** **Fig. 2**

MYCOBANK # MB510527

Misapplication: *Hygrophorus penarius* Fr. var. *penarius ss* Bon

Pileus 90-150 mm latus, primo cum umbone lato vel convexus et margine valde involuto, primo pure albus, sed dein in disco plus vel minus cremeopaleaceus, glaber, subviscidus vel siccus. Lamellae decurrentes, distantes vel distantissimae, primo albae, sed deinde cum colore cremeopaleaceo vel modice roseo. Stipes 60-100 x 15-35 mm, firmus et confertus, generatim deorsum valde attenuatus, albus, sed deorsum quidem cum colore cremeopaleaceo vel ochraceo, in summa parte tenuiter floccosus. Sapor mitis vel paene mitis. Odor levis et difficilis ad describendum (oleosus vel dulcidulus). Sporae late ellipsoides vel ovatae, (5-)5.5-6.5(-7) x 4-4.5 µm. Q = 1.3-1.6. Basidia graciliter clavata, 50-60 x 6-8 µm, quadrispora. Pileipellis crassa ixocutis ex 3-6 µm latis hyphis. Habitatio: sub Querco/Corylo in terra calcarea. Certe mycorrhizam formans cum Quercu.

Holotypus—Sweden, Öland, Långlöt parish, N Ismantorp, 1 Oct. 1994,. SJ 94067: in herbarium GB *concervatus est.*

Etymology—Similar to *penarius*

Pileus 90-150 mm broad, when young with a broad umbo or convex with a strongly involute margin, pure white at first but with age becoming more or less cream in centre, smooth, subviscid to dry. **Lamellae** decurrent, distant to very distant, white at first but later with a cream or slightly pinkish flush. **Stipe** 60-100 x 15-35 mm, firm and compact, mostly strongly attenuated towards the base, white but at least in lower part with a cream or ochraceous flush, finely floccose in the uppermost part, taste mild or almost so. **Odour** present, but weak and difficult to describe (oily or sweetish). **Basidiospores** broadly ellipsoid to ovoid, (5-)5.5-6.5(-7) x 4-4.5 µm. Q = 1.3-1.6. **Basidia** slenderly clavate, 50-60 x 6-8 µm, 4-spored clamped. **Hyphae** with clamps. **Gill edge** fertile. **Pileipellis** a thick ixocutis of 3-6 µm broad hyphae.

Habitat under *Quercus*/*Corylus* on calcareous ground. Fruiting time (in Scandinavia) Sept. - Oct., forming ectomycorrhiza with *Quercus*.

Additional collections: Sweden: Öl, Långlöt, Ismantorp, SO Vargmossen, 2 Oct. 1998, S. Jacobsson, SJ 98040; Vg., Österplana, 2 Oct. 1982, J. Jeppson 2158 ; Gtl., Lojsta, 21 Sep. 2000, HG. Thoresson .

Discussion

In the present study ITS sequence data confirm the occurrence of the two species *H. penarius* and *H. penarioides* in Europe. *Hygrophorus penarioides* is very similar to *H. penarius* in many aspects, e.g. the colours, the subviscid to dry pileus surface, the distant and decurrent lamellae and the robust habitus. Despite these facts it is not difficult to distinguish the two species. Apart from the different ecology there are clear morphological differences: *H. penarioides* has in average considerably larger basidiomes and the spores are slightly shorter

Figure 2. Fruitbodies of *Hygrophorus penarioides*. Foto Leif Stridvall.

with a Q value of 1.3-1.6 compared to 1.5-1.8 in *H. penarius*. There seems also to be a difference in odour but this is difficult to indicate as it is weak and may be differently perceived. Becker (1954) and Bon (1977) mention some other differences: *H. penarius* is said to be finely scaly towards the edge of the pileus (hence the name *barbatulus*) and to have a fully mild taste whilst *H. penarioides* is said to be smooth and to have a bitter taste. However, these characters do not seem to be constant. Only some of our collections of *H. penarius* are slightly appressed scaly while others look smooth and no bitter taste was perceived in the single collection of *H. penarioides* tested.

The North American species *Hygrophorus sordidus* is also similar to *H. penarioides*. *H. sordidus* also has very large basidiomes and the spores seem to be identical with those of *H. penarioides*. As *H. sordidus* is said to grow in oak/hickory woods (Hesler & Smith 1963) we first suspected it to be identical with the taxon connected with *Quercus* in Europe. Some collections of the species were borrowed from the Herbarum of University of Michigan (MICH). The only observed morphological difference between *H. penarioides* and *H. sordidus* is that the lamellae in *H. sordidus* seem to be closer, however we have not been able to study fresh material of the species. The large sequence divergence between them clearly indicates that they should be looked upon as distinct species.

In addition to Fig. 2 good illustrations of *H. penarioides* are found in the literature, e.g. in Cetto (1978: pl. 659), Marchand (1973: pl. 155) and Michael et al. (1979), all under the name *H. penarius*.

In Sweden *H. penarioides* has been collected or observed at localities on the calcareous islands Öland and Gotland in the Baltic sea, always in *Quercus/Corylus* woods. It has also been collected on Kinnekulle in the province of Västergötland, where the same type of calcareous bed-rock and vegetation occurs. Two collections of *H. penarius* from *Quercus* forests in Norway are preserved in Herbarium O. Very likely these in fact represent *H. penarioides*. To our knowledge it has not been collected in the other Nordic countries. The Swedish and Norwegian localities are apparently northern outposts of a species widespread in central and southern Europe (e.g. southern Germany, France and Italy) and seemingly not rare. Bon (1977) states that it is common in Mediterranean oak woods.

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We thank the curator of the Herbarium MICH for loan of collections and Hans-Jörgen Winqvist for help with the latin diagnosis. Financial support was received from The Swedish Taxonomy Initiative, ArtDatabanken SLU, to EL (Grant dha 146/05). We are also grateful to Drs G. Gulden, Oslo and H. Knudsen, Copenhagen, for presubmittal reviews the manuscript.

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Hygrophorus virescens is transferred to *Hygrocybe*

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Abstract — The combination *Hygrocybe virescens*, long used in the popular literature for the species first described in *Hygrophorus*, is here formally proposed for the first time.

Key words — *Hygrophoraceae*, sect. *Hygrocybe*, nomenclature, valid publication

In their North American treatment of *Hygrophorus*, Hesler & Smith (1963) described *H. virescens* based on a single collection (Smith 56649) from a redwood forest near Trinidad, California, U.S.A. For forty years, the species has been cited only rarely in the literature (Largent 1985, Arora 1986), although there have been several mentions of collections displayed in annual mushroom fairs in both California and Oregon (Norvell pers. comm. 2007). The species had not been reported from outside the U.S.A. until Montoya et al. (2005) reported on discoveries made during monitoring of the macromicobiota of Veracruz, Mexico.

Hesler & Smith (1963), included *H. virescens* in section *Hygrocybe* of subgenus *Hygrophorus*. Both micromorphology (regular hymenophoral trama, slender basidia, pileipellis in a cutis) and macroscopic habit support placement of *Hygrophorus virescens* in *Hygrocybe*, according to current interpretations of the genus by Bon (1976), Pegler (1983), Singer (1986), Boertmann (1995), and Young & Wood (1997). In fact the species has been cited as '*Hygrocybe*' *virescens* both in the literature (Arora 1986, Cantrell & Lodge 2004, Montoya et al. 2005) and on numerous species lists and in mushroom club newsletters. According to the Index Hygrocybearum by Boertmann (2002), however, the transfer of the species to *Hygrocybe* has not been validly published yet.

In our previous publication (Montoya et al. 2005) where we reported our study of the type specimen, we neglected to note the absence of a combining

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author in *Hygrocybe* and so improperly placed the species in this latter genus. In accordance with the rules of International Code of Botanical Nomenclature (McNeill et al. 2006), we propose the following combination:

Hygrocybe virescens (Hesler & A.H. Sm.) Montoya & Bandala **comb. nov.**

MycoBank MB510600

Basionym: *Hygrophorus virescens* Hesler & A.H. Sm., N. Am. Sp. of *Hygrophorus*, p. 192, 1963.

Holotype: U.S.A. CALIFORNIA: Trinidad, 14.XII.1956, A.H. Smith 56649 (MICH).

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We express our thanks to Drs. Lorelei Norvell (Mycotaxon Editor-in-Chief) and Shaun Pennycook (Mycotaxon Nomenclature Editor) for their advice in the preparation of the manuscript. We acknowledge the curator of MICH for the original loan of the type specimen.

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Two new species of *Corynespora* from Guangdong, China

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Abstract—Two new species, *Corynespora tanaceti* on *Tanacetum vulgare* and *Corynespora scolopiae* on *Scolopia chinensis* are described.

Key words—hyphomycetes, dematiaceous

Introduction

A recent investigation of fungi occurring on dead branches or rotten wood from south China revealed two previously undescribed species of *Corynespora* Güssow. The first species was collected from the Arboretum of Huanan in Guangdong. The specimens of dead branches or rotten wood were collected from subtropical localities of Guangdong province of China during 2005.

Taxonomic descriptions

Corynespora tanaceti Guang M. Zhang & X. G. Zhang, **sp. nov.** **FIGURE 1**
MycoBank # MB 510542

Coloniae griseae vel fuscae, effusae. Mycelium partim superficiale et immersum, ex hyphis ramosis, septatis, subhyalinis vel brunneis, levibus, 2-7 µm crassis compositum. Stromata nulla. Conidiophora singula, erecta, nonramosa, recta vel flexuosa, cylindrica, septata, laevia, pallide brunnea vel brunnea, per usque ad 1-3 proliferationes percurrentes successivas cylindricae, 145-206 µm longa, 5-6 µm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, laevia vel verrucosa, pallide brunnea vel olivaceo-brunnea, fere obclavata longe attenuata, recta vel curvata, 7-12-pseudoseptata, 60-104 µm longa, 12-16 µm lata, basi truncata 4-6.5 µm lata, apicem versus ad 2-3 µm attenuata.

Holotype: on dead branches of *Tanacetum vulgare* L., Arboretum of Huanan, Guangdong Province, China. Sept. 12. 2005, X. G. Zhang, HSAUPIV$_0$ 0022 (isotype: HMAS 143711).

Etymology: in reference to the host, *Tanacetum vulgare*.

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Colonies grey to dark blackish brown, effused. Mycelium partly superficial, partly immersed in the substratum, composed of branched, septate, subhyaline to brown, smooth-walled, 2-7 µm thick hyphae. No stromata. Conidiophores arising singly, erect, unbranched, straight or flexuous, cylindrical, septate, smooth-walled, pale brown to brown, with up to 3 successive percurrent cylindrical proliferations, 145-206 × 5-6 µm. Conidia formed singly through a pore at the apex of the conidiophore which then proliferates through the apical pore and forms another conidium at the apex of the proliferation, smooth or verruculose, pale brown to olivaceous brown, usually obclavate tapering to the narrow apex, straight or obviously curved, 7-12-pseudosepta, 60-104 µm long, 12-16 µm thick, 4.0-6.5 µm wide at the truncate base, tapering to 2-3 µm near the apex. Lower cells dark brown, upper cells becoming gradually paler toward the apex.

The new species differs from *C. foveolata* (Hughes 1958) in its wider conidia (12-16 µm). In addition, the conidiophores of the new species have only 1-3 successive proliferations, while those of *C. foveolata* have up to 7.

Corynespora scolopiae Guang M. Zhang & X.G. Zhang, **sp. nov.** FIGURE 2

MycoBank # MB 510543

Coloniae fuscae, effusae. Mycelium immersum vel superficiales, ex hyphis ramosis, septatis, subhyalinis vel pallide brunneis, laevibus, 2-6 µm crassis compositum. Stromata nulla. Conidiophora singula vel fasciculata, erecta, nonramosa, recta vel flexuosa, cylindrica, septata, laevia, pallide brunnea vel brunnea, 3-10-septata, per usque ad 1-2 proliferationes percurrentes successivas cylindricas elongascentia, 125-130 µm longa, 4-6 µm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, recta vel curvata, obclavata, longe attenuata, laevia, pallide brunnea vel brunnea, 8-11-pseudoseptata, 90-173 µm longa, 10-13 µm crassa, apicem versus ad 2-3 µm attenuata.

Holotype: on dead branches of *Scolopia chinensis* (Lour.) Clos., Arboretum of Huanan, Guangdong Province, China. Sept. 12. 2005, X. G. Zhang, HSAUP IV$_6$0084-2 (isotype: HMAS 143712).

Etymology: in reference to the host, *Scolopia chinensis*.

Colonies blackish brown, effused. Mycelium immersed or superficial, composed of branched, septate, subhyaline to pale brown, smooth-walled hyphae, 2-6 µm thick. Stroma absent. Conidiophores arising singly or in groups, erect, unbranched, straight or flexuous, cylindrical, septate, smooth-walled, pale brown to brown, 3-10-septate, with up to 2 successive percurrent cylindrical proliferations, 125-130×4-6 µm. Conidia formed singly at the apex of the conidiophore, which then proliferates through the apical pore and forms another conidium at the apex of the proliferation. Conidia straight or curved, obclavate, tapering to the apex, smooth-walled, pale brown to brown, 8-11-pseudosepta, 90-150 µm long, 10-13 µm thick in the broadest part, tapering to 2-3 µm near the apex. Lower cells slightly darker brown, upper cells becoming gradually paler toward the apex.

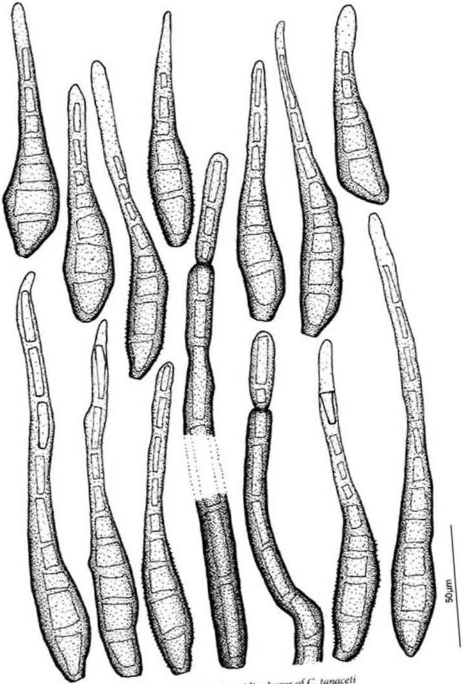

Fig. 1 Conidia and conidiophores of *C. tanaceti*

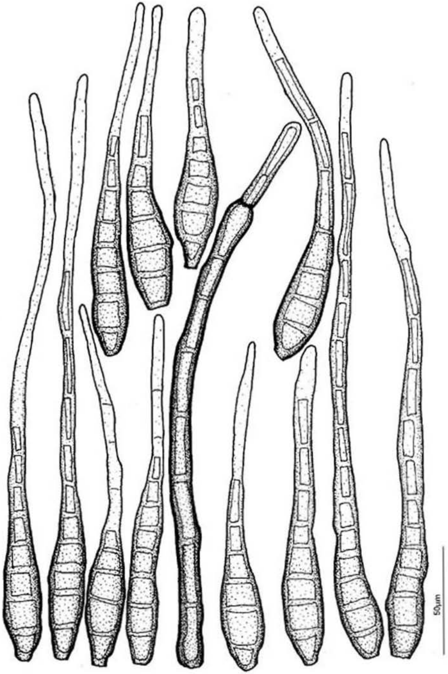

Fig. 2 Conidia and conidiophores of *C. scolopiae*

With respect to conidial morphology, this species resembles *C. tectonae* (Zhang & Shi 2005) and *C. sacchari* (Zhang & Shi 2005). However, the conidia of the new taxon have only 8-11-pseudosepta, while those of *C. tectonae* and *C. sacchari* have 12-18-pseudosepta and 10-14-septa, respectively. In addition, the conidia of the new taxon are smooth-walled, as opposed to those of *C. tectonae* and *C. sacchari*, which are often verrucose.

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Three new species of *Corynespora* from China

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Abstract—This paper provides descriptions and illustrations for three new species of the hyphomycete genus *Corynespora* from dead branches in south of China. *C. gymnocladi, C. myrioneuronis* and *C. euryae* occurred on *Gymnocladus chinensis, Myrioneuron faberi* and *Eurya inaequalis*, respectively. The type specimens are deposited in the Herbarium of the Department of Plant Pathology, Shandong Agricultural University (HSAUP).

Key words—hyphomycetes, dematiaceous

Introduction

This study revealed three previously undescribed species of *Corynespora* Güssow on dead branches in subtropical localities in Sichuan, Guizhou and Yunnan Provinces of China.

Taxonomic Description

Corynespora gymnocladi Jian Ma & X. G. Zhang, **sp. nov.** FIGURE 1
MycoBank # MB 510534

Coloniae fuscae vel atrae, effusae. Mycelium immersum vel superficiales, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus, 2-5 µm crassis compositum. Stromata nulla. Conidiophora singula vel fasciculata, erecta, nonramosa, recta vel flexuosa, cylindrica, septata, laevia, pallide brunnea vel atro-brunnea, per usque ad 2 proliferationes successivas cylindricas elongascentia, 60-145 µm longa, 3.8-5.7 µm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, recta vel leniter curvata, obclavata, laevia, brunnea vel atro-brunnea, cellulis extimis subhyalinis vel pallide brunneis, 2-6 pseudoseptata, 15-40 µm longa, 7-10.5 µm crassa, basi 1.5-3 µm lata.

Holotype: on dead branches of *Gymnocladus chinensis* Baill, subtropical forest of Yaan, Sichuan Province, China. Aug. 12. 2005, J. Ma, HSAUPV_{0MJ} 0369.

Etymology: in reference to the host, *Gymnocladus chinensis*

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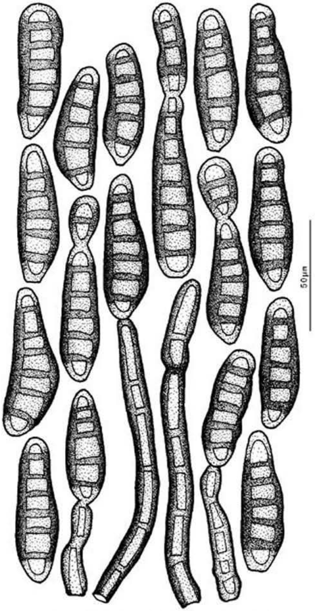

Fig. 1 Conidia and conidiophores of *C. gymnocladi*

Colonies dark blackish brown to black, effused. Mycelium immersed or superficial, composed of branched, septate, pale brown to brown, smooth-walled hyphae, 2-5 µm thick. Stroma absent. Conidiophores arising singly or in groups, erect, unbranched, straight or flexuous, cylindrical, septate, smooth-walled, pale brown to dark brown, with up to 2 successive percurrent cylindrical proliferations, 60-145×3.8-5.7 µm. Conidia formed singly at the apex of the conidiophore, which then proliferates through the apical pore and forms another conidium at the apex of the proliferation. Conidia straight or slightly curved, obclavate, smooth-walled, brown to dark brown except for the cell at each end which is subhyaline or pale brown, 2-6-pseudoseptate, 15-40 µm long, 7-10.5 µm thick in the broadest part, 1.5-3 µm wide at the base.

The conidia of *Corynespora gymnocladi* are similar to those of *C. lanneicola* (Deighton & Ellis 1957), but are smaller. In addition, conidia of this new species have a much less obvious truncate basal scar than the species of *C. lanneicola*.

Corynespora myrioneuronis Jian Ma & X. G. Zhang, **sp. nov.**

MycoBank # MB 510535 **FIGURE 2**

Coloniae fuscae, effusae. Mycelium immersum vel superficiales, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus, 2-4 µm crassis compositum. Stromata nulla. Conidiophora singula vel fasciculata, erecta, nonramosa, recta vel flexuosa, cylindrica, septata, laevia, pallide brunnea vel brunnea, per usque ad 3 proliferationes successivas cylindricas elongascentia, 92-120 µm longa, 3.5-5 µm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, recta vel leniter curvata, obclavata, laevia, pallide brunnea vel brunnea, 3-4-pseudoseptata, 30-46 µm longa, 6.5-8 µm crassa, apicem versus ad 2-3.5 µm attenuata, basi 2-3 µm lata.

Holotype: on dead branches of *Myrioneuron faberi* Hemsl, Arboretum of Guiyang, Guizhou Province, China. Aug. 18. 2005, J. Ma, HSAUPV$_{0MJ}$0451.

Etymology: in reference to the host, *Myrioneuron faberi*

Colonies blackish brown, effused. Mycelium immersed or superficial, composed of branched, septate, pale brown to brown, smooth-walled hyphae, 2-4 µm thick. Stroma absent. Conidiophores arising singly or in groups, erect, unbranched, straight or flexuous, cylindrical, septate, smooth-walled, pale brown to brown, with up to 3 successive percurrent cylindrical proliferations, 92-120×3.5-5 µm. Conidia formed singly at the apex of the conidiophore, which then proliferates through the apical pore and forms another conidium at the apex of the proliferation. Conidia straight or slightly curved, obclavate, smooth-walled, pale brown to brown, 3-4-pseudoseptate, 30-46 µm long, 6.5-8 µm thick in the broadest part, tapering to 2-3.5 µm near the apex, 2-3 µm wide at the base.

The conidia of *Corynespora myrioneuronis* are smaller than those of *C. ligustri* (Guo 1984) and *C. eranthemi* (Yen & Lim 1980), and the mature conidia of *C. myrioneuronis* have fewer pseudosepta (3-4) than those of *C. ligustri* (4-20) and *C. eranthemi* (5-25). In addition, the conidiophores of the new species have only 1-3 successive proliferations, while those of *C. ligustri* and *C. eranthemi* have up to 16 and 8, respectively.

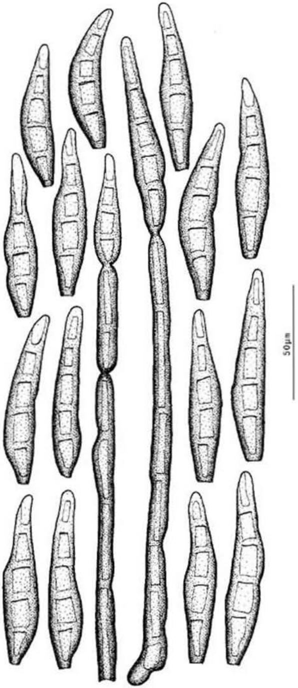

Fig. 2 Conidia and conidiophores of *C. myrioneuronis*

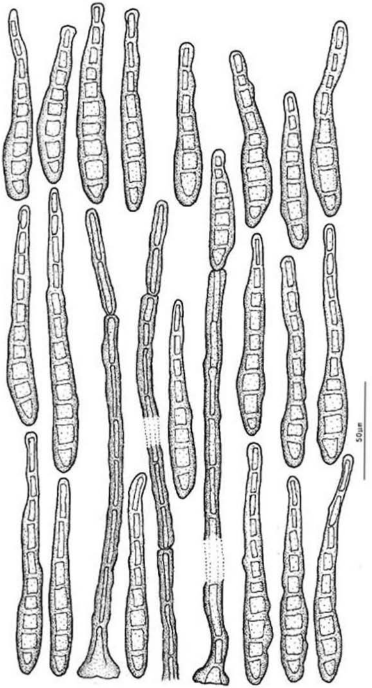

Fig. 3 Conidia and conidiophores of *C. euryae*

Corynespora euryae Jian Ma & X. G. Zhang, **sp. nov.** FIGURE 3
MycoBank # MB 510536

Coloniae fuscae, effusae. Mycelium immersum vel superficiales, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus, 2-6 µm crassis compositum. Stromata nulla. Conidiophora singula vel fasciculata, erecta, nonramosa, recta vel flexuosa, cylindrica, septata, laevia, pallide brunnea vel brunnea, per usque ad 4 proliferationes successivas cylindricas elongascentia, 76-114 µm longa, 3.5-5.5 µm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda. Conidia recta vel leniter curvata, obclavata, laevia, pallide brunnea vel brunnea, 5-9-pseudoseptata, 36-67 µm longa, 6-9 µm crassa, apicem versus ad 2.5-4 µm attenuata, basi 2-3 µm lata.

Holotype: on dead branches of *Eurya inaequalis* P.S. Hsu, tropical forest of Hekou, Yunnan Province, China. Oct. 16. 2004, J. Ma, HSAUPIV0MJ 0144.

Etymology: in reference to the host, *Eurya inaequalis*

Colonies blackish brown, effused. Mycelium immersed or superficial, composed of branched, septate, pale brown to brown, smooth-walled hyphae, 2-6 µm thick. Stroma absent. Conidiophores arising singly or in groups, erect, unbranched, straight or flexuous, cylindrical, septate, smooth-walled, pale brown to brown, with up to 4 successive percurrent cylindrical proliferations, 76-114×3.5-5.5 µm. Conidia formed singly through a pore at the apex of the conidiophore or through the apices of successive percurrent proliferations. Conidia straight or slightly curved, obclavate, smooth-walled, pale brown to brown, 5-9-pseudoseptate, 36-67 µm long, 6-9 µm thick in the broadest part, tapering to 2.5-4 µm near the apex, 2-3 µm wide at the base.
Lower cells brown, upper cells becoming gradually paler toward the apex.

The new species of *Corynespora euryae* differs from *C. combreti* (Ellis 1963) and *C. hansfordii* (Ellis 1960) in the smaller size range of its conidia. In addition, conidia of the new species have a much less obvious truncate scar at the base than those of the other two well-known species.

Acknowledgments

The authors are indebted to W.B. Kendrick and B. Le Cam for serving as pre-submission reviewers and for their valuable comments and suggestions. This study would not have been possible without support from the National Natural Science Foundation of China (no. 30370009, 30499340).

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Taxonomic studies of *Sporidesmium* from Guangxi, China

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Abstract—This paper provides descriptions and illustrations of four new species in the hyphomycete genus *Sporidesmium* from deciduous stems or rotten wood. *S. delavayae*, *S. tarennae*, *S. phoebes* and *S. ochnae* occurred on the hosts *Delavaya toxocarpa*, *Tarenna acutisepala*, *Phoebe rufescens* and *Ochna jabotapita*, respectively. One new record is illustrated from the same area.

Key words—hyphomycetes, dematiaceous

Introduction

A recent investigation of fungi occurring on deciduous stems or rotten wood from the Yulin forest of Guangxi province in south China revealed four previously undescribed species of *Sporidesmium* Link, One other species new to China was found.

Taxonomic Description

Sporidesmium delavayae **Ch. K. Shi & X. G. Zhang, sp. nov.** FIGURE 1
MycoBank # MB 510537

Coloniae griseae vel fuscae, effusae. Mycelium immersum vel superficiales, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus, 2-5 µm crassis, compositum. Conidiophora singula ex apice lateribusque hypharum oriunda, simplicia, recta vel flexuosa, brunnea vel atro-brunnea, cylindrica, 3-5-septata, laevia, per usque ad 2-3 proliferationes successivas elongascentia, 80-130 µm longa, 5-8 µm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, recta vel leviter flexuosa, fusiformia, ad apicem subacuta vel conica, ad basim conico-truncata, laevia, brunnea vel olivaceo-brunnea, sursum pallidiora, 5-7-pseudoseptata, 35-45 µm longa, 12-15 µm crassa, apicem versus ad 3-4 µm attenuata, basi 5-8 µm lata.

Holotype: on dead branches of *Delavaya toxocarpa* Franch., Subtropical forest of Yulin, Guangxi Province, China. Oct. 20. 2003, X. G. Zhang, HSAUP III$_0$zxg0046-2.

Etymology: referring to the host, *Delavaya toxocarpa*.

* *Corresponding author*

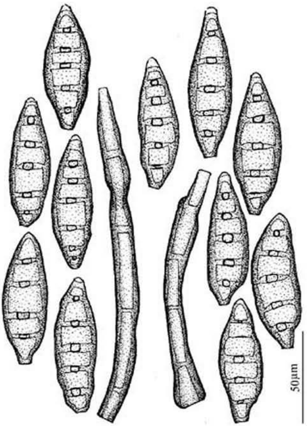

Fig. 1 Conidia and conidiophores of *S. delavayae*

Colonies grey to dark blackish brown, effused. Mycelium immersed or superficial, composed of branched, septate, pale brown to brown, smooth-walled hyphae, 2-5 µm thick. Conidiophores arising singly, terminally and laterally on the hyphae, erect, simple, straight or flexuous, mid to dark brown, cylindrical, 3-5-septate, smooth-walled, with up to 2-3 successive percurrent proliferations; 80-130 µm long, 5-8 µm thick. Conidia formed singly at the apex of the conidiophore, straight or flexuous, fusiform, subacute or conical at the apex, conico-truncate at the base, smooth-walled, brown to olivaceous brown, paler at the tip, 5-7-pseudoseptate, 35-45 µm long, 12-15 µm thick in the widest part, tapering to 3-4 µm near the apex, 5-8 µm wide at the base, pseudosepta averaging 7.5 µm apart.

In conidial morphology, this species resembles *S. leonense* (Ellis 1958). However, the new taxon can be separated from *S. leonense* by its shorter conidia with less numerous pseudosepta. In addition, some conidia of *S. leonense* are rostrate, while those of the new species are not.

Sporidesmium tarennae Ch. K. Shi & X. G. Zhang, **sp. nov.** FIGURE 2

MycoBank # MB 510538

Coloniae griseae vel fuscae, effusae. Mycelium immersum vel superficiales, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus, 3-6 μm crassis, compositum. Conidiophora singula ex apice lateribusque hypharum oriunda, simplicia, recta vel flexuosa, brunnea vel atro-brunnea, cylindrica, 4-6-septata, laevia, per usque ad 3 proliferationes successivas elongascentia, 50-120 μm longa, 4-6 μm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, recta vel curvata, fusiformia, rostrata, ad apicem subacuta vel conica, ad basim conico-truncata, laevia, straminea vel flavo-brunnea, sursum pallidiora, 6-7-pseudoseptata, 45-50 μm longa, 12-15 μm crassa, apicem versus ad 2-3.5 μm attenuata, basi 4-5 μm lata.

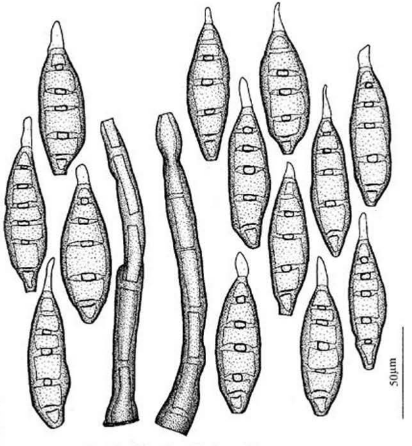

Fig. 2 Conidia and conidiophores of *S. tarennae*

Holotype: on dead branches of *Tarenna acutisepala* W. C. Chen., Subtropical forest of Yulin, Guangxi Province, China. Oct. 20. 2003, X. G. Zhang, HSAUP III$_e$zxg0113.

Etymology: in reference to the host, *Tarenna acutisepala*.

Colonies grey to dark blackish brown, effused. Mycelium immersed or superficial, composed of branched, septate, pale brown to brown, smooth-walled hyphae, 3-6 µm thick. Conidiophores arising singly, terminally and laterally on the hyphae, erect, simple, straight or flexuous, mid to dark brown, cylindrical, 4-6-septate, smooth-walled, with up to 3 successive percurrent proliferations; 50-120 µm long, 4-6 µm thick. Conidia formed singly at the apex of the conidiophore, straight or slightly curved, fusiform, rostrate, subacute or conical at the apex, conico-truncate at the base, smooth-walled, straw coloured to yellowish, paler at the tip, 6-7-pseudosepta, 45-50 µm long, 12-16 µm thick in the widest part, tapering to 2-3.5 µm near the apex, 4-5 µm wide at the base, pseudosepta averaging 10.8 µm apart.

The conidia of this species are similar to those of *S. leonense* (Ellis 1958) and *S. brachypus* (Hughes 1958). However, the conidia in the new taxon are shorter (40-45 µm) than those of *S. leonense* (45-90 µm) and *S. brachypus* (50-90 µm). In addition, the rostrate of the new taxon conidia are also somewhat longer than those of *S. leonense* and obviously shorter than those of *S. brachypus*.

Sporidesmium phoebes Ch. K. Shi & X. G. Zhang, **sp. nov.** FIGURE 3

MycoBank # MB 510539

Coloniae griseae vel fuscae, effusae. Mycelium immersum vel superficiales, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus, 3-6 µm crassis, compositum. Conidiophora singula ex apice lateribusque hypharum oriunda, simplicia, recta vel flexuosa, brunnea vel atro-brunnea, cylindrica, 5-7-septata, laevia, per usque ad 1-2 proliferationes successivas elongascentia, 50-100 µm longa, 5-7 µm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, recta vel curvata, fusiformia, rostrata, ad apicem subacuta vel conica, ad basim truncata, laevia, brunnea vel atro-brunnea, sursum pallidiora, 6-7-pseudoseptata, 50-65 µm longa, 15-18 µm crassa, apicem versus ad 3-4 µm attenuata, basi 2-4 µm lata.

Holotype: on dead branches of *Phoebe rufescens* H. W. Li., Subtropical forest of Yulin, Guangxi Province, China. Oct. 10. 2004, X. G. Zhang, HSAUP IV$_e$zxg0111.

Etymology: in reference to the host, *Phoebe rufescens*.

Colonies grey to dark blackish brown, effused. Mycelium immersed or superficial, composed of branched, septate, pale brown to brown, smooth-walled hyphae, 3-6 µm thick. Conidiophores arising singly, terminally and laterally on the hyphae, erect, simple, straight or flexuous, mid to dark brown, cylindrical, 5-7-septate, smooth-walled, with up to 1-2 successive percurrent proliferations; 50-100 µm long, 5-7 µm thick. Conidia formed singly at the apex of the conidiophore, straight or slightly curved, fusiform, rostrate, subacute or conical at the apex, truncate at the base, smooth-walled, mid to dark brown,

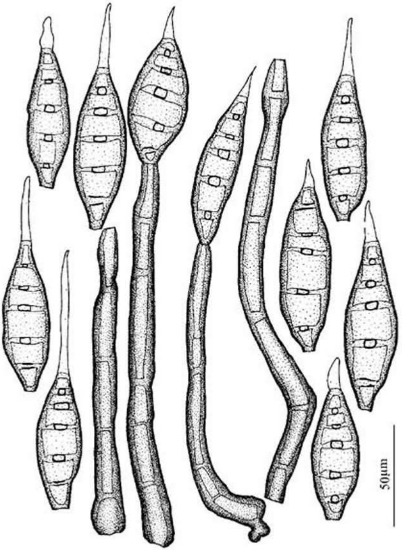

Fig.3 Conidia and conidiophores of *S. phoebes*

paler at the tip, 6-7-pseudoseptate, 50-65 μm long, 15-18 μm thick in the widest part, tapering to 3-4 μm near the apex, 2-4 μm wide at the base, pseudosepta averaging 5.3 μm apart.

The conidia of *Sporidesmium phoebes* are similar to those of *S. brachypus*, but the conidia are shorter than those of *S. brachypus* (50-90 μm), and of wider than those of *S. brachypus* (10-14 μm). In addition, conidia of the new species have lighter truncate scar at the base than in *S. brachypus*.

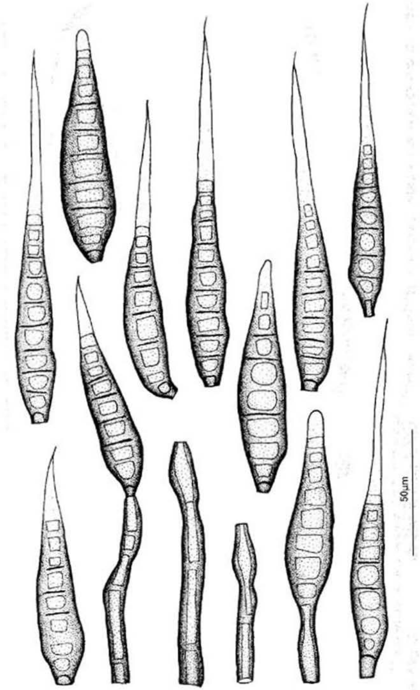

Fig.4 Conidia and conidiophores of *S. ochnae*

Sporidesmium ochnae Ch. K. Shi & X. G. Zhang, **sp. nov.** FIGURE 4

MycoBank # MB 510541

Coloniae tenue effusae, brunneae. Mycelium immersum vel superficiales, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, laevibus, 2-4 µm crassis, compositum. Conidiophora singula ex apice lateribusque hypharum oriunda, simplicia, recta vel flexuosa, brunnea vel atro-brunnea, cylindrica, 2-3-septata, laevia, per usque ad 1-2 proliferationes successivas elongascentia, 45-65 µm longa, 4-5 µm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, recta vel curvata, obclavata, rostrata, ad apicem subacuta vel conica, ad basim truncata, laevia, brunnea vel atro-brunnea, sursum pallidiora, 8-11-pseudoseptata, 80-110 µm longa, 10-12 µm crassa, apicem versus ad 2-3 µm attenuata, basi 4-6 µm lata.

Holotype: on dead branches of *Ochna jabotapita* L., Subtropical forest of Yulin, Guangxi Province, China. Oct. 16. 2003, X. G. Zhang, HSAU III$_0$zxg0499.

Etymology: in reference to the host, *Ochna jabotapita*.

Colonies effused, thin, pale brown. Mycelium immersed or superficial, composed of branched, septate, pale brown to brown, smooth-walled hyphae, 2-4 µm thick. Conidiophores arising singly, terminally and laterally on the hyphae, erect, simple, straight or flexuous, mid to dark brown, cylindrical, 2-3-septate, smooth-walled, with up to 1-2 successive percurrent proliferations; 45-65 µm long, 4-5 µm thick. Conidia formed singly at the apex of the conidiophore, straight or slightly curved, obclavate, rostrate, subacute or conical at the apex, truncate at the base, smooth-walled, mid to dark brown, paler at the tip, 8-11-pseudoseptate, 80-110 µm long, 10-12 µm thick in the widest part, tapering to 2-3 µm near the apex, 4-6 µm wide at the base, pseudosepta averaging 7.2 µm apart.

The conidia of *Sporidesmium ochnae* are similar to those of *S. ellisii* (Ellis 1972), but their size range is larger than that of *S. ellisii* (40-90×7-9 µm). In addition, the mature conidia of *S. ochnae* have more numerous pseudoseptate than those of *S. ellisii*.

New record from China

Sporidesmium brachypus (Ellis & Everh.) S. Hughes, Can. J. Bot. 36: 807, 1958.

On rotten wood of *Canarium tonkinense* Engl., subtropical forest of Yulin, Guangxi Province, China. Oct. 12. 2004, X. G. Zhang, HSAUP IV$_0$zxg0174.

Acknowledgments

The authors are indebted to B. Kendrick and N. R. O' Neill for serving as pre-submission reviewers and for their valuable comments and suggestions. This project was supported by the National Science Foundation of China (No. 30370009, 30499340).

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Hughes SJ. 1958. Revisiones Hyphomycetum aliquot cum appendice de nominibus rejiciendis. Canadian Journal of Botany 36 : 727-836.

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Taxonomic studies of *Sporidesmium* from China

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Abstract—Two new species of *Sporidesmium* from China are described and illustrated: *S. ilicis* and *S. pruni* occurring on the hosts *Ilex dipyrena* and *Prunus pseudocerasus*, respectively. The type specimens are deposited in the Herbarium of the Department of Plant Pathology, Shandong Agricultural University (HSAUP).

Key words—hyphomycetes, dematiaceous

Introduction

The genus *Sporidesmium* was established by Link in 1809. The current generic concept is based on descriptions given by Ellis (1958, 1971) who based his account on Ehrenberg's description of the specimen in Persoon's herbarium at Leiden labeled by Ehrenberg '*Sporidesmium fusiforme* Nees ab Essen. - *Sporidesmium atrum* Link var. teste Link', Ellis (1958) pointed out: 'Link almost certainly saw a part of this specimen; and in the absence of the type or any authentic collection of *S. atrum* it serves to indicate the characters upon which he based his genus *Sporidesmium*', and precisely defined the distinctive features of the genus. *Sporidesmium* is characterized by single phaeophragmospores borne terminally on macronematous, mononematous, simple conidiophores with monoblastic, integrated, terminal, determinate or percurrently extending conidiogenous cells, and curved or occasionally sigmoid, cylindrical, fusiform, obclavate, obpyriform or obturbinate, solitary conidia.

The genus *Sporidesmium* contains about 320 species described from all over the world. Only 37 species have previously been described from China (Wu & Zhuang 2005). Most of these species are reported to survive saprophytically on rotten wood, dead branches, and decaying leaves of various plant species. A recent investigation of fungi occurring on dead branches from tropical or subtropical zones revealed two previously undescribed species of *Sporidesmium*.

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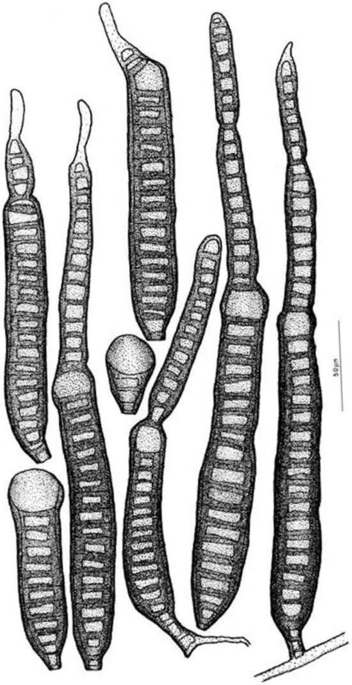

Fig. 1 Conidia and conidiophores of *S. ilicis*

Taxonomic description

Sporidesmium ilicis Jian Ma & X. G. Zhang, **sp. nov.** FIGURE 1

MycoBank # MB 510532

Coloniae effusae, atrae. Mycelium immersum, ex hyphis ramosis, septatis, pallide brunneis, levibus, 1-3 μm crassis compositum. Conidiophora singula vel fasciculata ex apice lateribusque hypharum oriunda, recta vel leviter flexuosa, brunnea vel atro-brunnea, 1-2-septata, 4.5-12.5 μm longa, 4.5-6 μm crassa. Conidia singula in apice conidiophori oriunda, recta vel flexuosa, obclavata, ornati cellula medius tumescente usque ad 13.6 μm crassa et 9.2 μm alta, usque ad 10.5 μm crassi immediate supra cellulam medius tumescentem, aliquando basi vel apice, interdum apice longe attenuata, ad basim conico-truncata, levia, brunnea, 10-38-pseudoseptata, 70-215 μm longa, 13-19.5 μm crassa, apicem versus ad 5-8 μm attenuata, basi 5-6.5 μm lata.

Holotype: on dead branches of *Ilex dipyrena* Wall., tropical forest of Lijiang, Yunnan Province, China. May. 6. 2005, J. Ma, HSAUPV$_{0MJ}$0008(4).

Etymology: in reference to the host, *Ilex dipyrena*

Colonies effused, black. Mycelium immersed in the substratum, composed of branched and anastomosing, septate, pale brown, smooth-walled hyphae, 1-3 μm thick. Conidiophores arising singly or in groups at the ends and along the sides of the hyphae, sometimes from darker, swollen cells, straight or slightly flexuous, mid to dark brown, 1-2-septate, 4.5-12.5 μm long, 4.5-6 μm thick. Conidia formed singly at the apex of the conidiophores, straight or flexuous, obclavate, with a swollen mid cell up to 13.6×9.2 μm in size, up to 10.5 μm thick immediately above the swollen mid cell, occasionally at the base or apex, sometimes tapered towards the rounded apex, conico-truncate at the base, smooth-walled, brown, 10-38-pseudoseptate, 70-215 μm long, 13-19.5 μm thick in the widest part, tapering to 5-8 μm at the apex, 5-6.5 μm wide at the base, pseudosepta averaging 5.7 μm apart.

The conidia of *Sporidesmium ilicis* are similar to those of *S. adscendens* (Ellis 1958). However, the conidia in the new taxon (70-215 μm) are shorter than those of *S. adscendens* (110-375 μm). In addition, the conidia of the new taxon are rounded or rostrate at the apex, and have swollen central cells, as opposed to those of *S. adscendens*, which are rounded at the apex and have no swollen cells.

Sporidesmium pruni Jian Ma & X. G. Zhang, **sp. nov.** FIGURE 2

MycoBank # MB 510533

Coloniae effusae, fuscae vel atrae. Mycelium partim superficiale sed fere immersum, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, levibus, 1-4 μm crassis compositum. Conidiophora singula vel 2-3 fasciculata ex apice lateribusque hypharum oriunda, erecta vel suberecta, recta vel leviter flexuosa, cylindrica, ad apicem conico-truncata, basi inflata, brunnea vel atro-brunnea, 2-5-septata, per usque ad 2 proliferationes successivas elongascentia, 50-85 μm longa, 3-6 μm crassa. Conidia singula, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, recta vel leviter curvata,

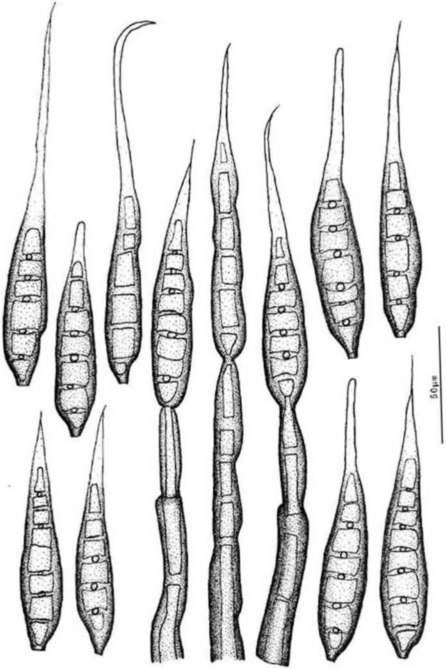

Fig. 2 Conidia and conidiophores of *S. pruni*

fusiformia, rostrata, ad basim conico-truncata, levia, straminea vel olivaceo-brunnea, 5-8-pseudoseptata, 45-87 µm longa, 8.5-10.5 µm crassa, apicem versus ad 2.5-3.5 µm attenuata, basi 2-3.6 µm lata.

Holotype: on dead branches of *Prunus pseudocerasus* Lindl. Arboretum of Mianyang, Sichuan Province, China. Aug. 10. 2005, J. Ma. HSAUPV$_{OMJ}$0539(1).

Etymology: in reference to the host, *Prunus pseudocerasus*

Colonies effused, dark blackish brown to black. Mycelium partly superficial, but mostly immersed in the substratum, composed of branched, septate, pale brown to brown, smooth-walled hyphae, 1-4 µm thick. Conidiophores arising singly or in groups of 2-3 terminally and laterally on the hyphae, erect or suberect, straight or slightly flexuous, cylindrical, conico-truncate at the apex, with a swollen base, brown or dark brown, 2-5-septate, with up to 2 successive proliferations, 50-85 µm long, 3-6 µm thick. Conidia formed singly at the apex of the conidiophore which after the first conidium has fallen sometimes proliferates through the scar and forms another conidium at the apex of the proliferation. Conidia straight or slightly curved, fusiform, rostrate, conico-truncate at the base, smooth-walled, straw coloured to olivaceous brown, 5-8-pseudoseptate, 45-87 µm long, 8.5-10.5 µm thick in the widest part, tapering to 2.5-3.5 µm near the apex, 2-3.6 µm wide at the base, pseudosepta averaging 5.6 µm apart.

The conidia of this species are similar to those of *S. brachypus* (Hughes 1958). However, the conidia of the new taxon are narrower (8.5-10.5 µm) than those of *S. brachypus* (10-14 µm). In addition, the conidiophores of the new species have only 1-2 successive proliferations, while those of *S. brachypus* have up to 4.

Acknowledgments

The authors are indebted to W. B. Kendrick and B. Le Cam for serving as pre-submission reviewers and for their valuable comments and suggestions. This project was supported by the National Natural Science Foundation of China (no.30370009, 30499340).

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Alternaria astragali Wangeline & E.G. Simmons, p. 84
Alternaria dissitiflori Meng. Zhang & T. Y. Zhang, p. 135
Alternaria polygoni Meng. Zhang & T. Y. Zhang, p. 133
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Reviewers, Volume Ninety-nine

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Errata

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Hygrocybe virescens, as cited on pp. 477 (line 1 and line one up from bottom) and 478 & 479 (legends, line 1), is invalid. See the current volume (Mycotaxon 99: 345-346. 2007) for valid publication of the combination.

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p.159, line 13	*for:* Universidade Federal de Pernambuc *read:* Universidade Federal de Pernambuco
p.311, line 2	*for:* see Gilberto *read:* see Coelho
p312, line 21	*delete:* Lepiotaceous fungi in California, U.S.A. 3.

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