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LORELEI L. NORVELL
editor@mycotaxon.com
Pacific Northwest Mycology Service
6720 NW Skyline Boulevard
Portland, Oregon 97229-1309 USA

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# An index to Fries's Epicrisis Systematis Mycologici, 1838
# 1: Agaricini

S.R. Pennycook

*PennycookS@LandcareResearch.co.nz*
*Manaaki Whenua Landcare Research*
*Private Bag 92 170, Auckland, New Zealand*

**Abstract**—All the generic, specific, and varietal taxa included under 'Ord. I. Agaricini' in Fries's Epicrisis Systematis Mycologici are indexed and annotated with basionyms and other nomenclatural synonyms published before 1838. All names are provided with accurate authorities and publication dates. The index covers 20 genera: *Agaricus, Bolbitius, Cantharellus, Coprinus, Cortinarius, Gomphidius, Hygrophorus, Lactarius, Lentinus, Lenzites, Marasmius, Montagnites, Nyctalis, Panus, Paxillus, Russula, Schizophyllum, Stylobates, Trogia,* and *Xerotus*.

**Key words**—nomenclature, hymenomycetes, gilled basidiomycetes

## Introduction

Epicrisis Systematis Mycologici (Fries 1838) is a major publication in which Elias Fries presented his first comprehensive revision and overview of hymenomycetous fungi subsequent to the early volumes of his sanctioning works (Fries 1821, 1822, 1832). Epicrisis adds greatly to the taxa recognised in the sanctioning works, by including: (i) taxa omitted from the sanctioning works; (ii) taxa relegated to synonymy in the sanctioning works but subsequently recognised as distinct; (iii) new taxa described by Fries and other authors in the intervening years; and (iv) taxa newly described in Epicrisis. Among these newly described taxa are three new genera (*Bolbitius, Grandinia, Panus*) and five new infrageneric "tribes"* (*Agaricus* "trib." *Entoloma, Panaeolus, Pluteus, Psathyrella*; *Cortinarius* "trib." *Hydrocybe*).

An Index Dispositionis Hymenomycetum (Fries 1838, pp. 595–608) lays out the classificatory scheme on which Epicrisis is organised; it indexes and provides

* Tribe (tribus) is defined by ICBN (Vienna) Article 4.1 (McNeill et al. 2006) as a suprageneric rank, lying between family and genus. Use of this name at any other rank is contrary to Article 33.10, with the sole exception [Article 33.12] of Fries's use of tribus in his sanctioning works as an infrageneric rank below series. In Epicrisis, Fries (1838) did not explicitly name an infrageneric rank below series; therefore the taxa that he placed at this rank are validly published as names of unspecified rank [Article 35.3]. However, because the rank in Epicrisis equates with the rank tribus in the sanctioning works, for convenience I have indicated it in this index as "tribe" or "trib." (omitting the quotation marks when referring to tribus names published in Fries 1821).

key diagnostic characters for all suprageneric, generic, and infrageneric taxa. Many taxa that the sanctioning works recognised under *Agaricus* are treated in Epicrisis as new combinations under segregate genera (*Bolbitius*, *Cantharellus*, *Coprinus*, *Cortinarius*, *Gomphidius*, *Hygrophorus*, *Lactarius*, *Lentinus*, *Lenzites*, *Marasmius*, *Nyctalis*, *Panus*, *Paxillus*, *Russula*, *Stylobates*, *Trogia*), and five "tribes" are transferred from *Agaricus* to *Cortinarius* (*Dermocybe*, *Inoloma*, *Myxacium*, *Phlegmacium*, *Telamonia*).

The full scope of the taxonomic and nomenclatural contribution of Epicrisis is often overlooked in the literature, with many of its new species and new combinations incorrectly attributed to the much later Hymenomycetes Europaei (Fries 1874), the so-called 2nd Edition of Epicrisis (see below). A possible reason may be the contrasting accessibility of the contents of the two publications. Where Hymenomycetes Europaei has 49 pages of exhaustively comprehensive epithet indexes, Epicrisis has only a 1½-page Index Alphabeticus Generum (Fries 1838, pp. 609–610). For taxa that are included in both publications, the entry in Epicrisis can be simply found via Hymenomycetes Europaei cross-references to 'Ed. I'. However, it is misleading to describe Hymenomycetes Europaei (Fries's subtitle notwithstanding) as a 2nd Edition of Epicrisis. The scope of the two publications is very different. For example, Epicrisis treats five genera (*Agyrium*, *Crinula*, *Geoglossum*, *Midotis*, *Mitrula*) that were later recognised as out of place among the hymenomycetes, and not included in Hymenomycetes Europaei. Much more significantly, Epicrisis includes numerous taxa described from Asia, Africa, and the Americas, whereas Hymenomycetes Europaei excludes taxa not reported from Europe. Consequently, the descriptions of the many extra-European taxa in Epicrisis remain unindexed and difficult to find.

The purpose of this publication is to provide an annotated index to all the generic, specific, and varietal taxa accepted in Epicrisis. Names listed in synonymy in Epicrisis have not been indexed, but many of them are included in the annotations. No suprageneric and infrageneric taxa are indexed, except for "tribes" within *Agaricus* and *Cortinarius*. Part 1 of the index (published here) deals with 'Ord. I. Agaricini' (Fries 1838, pp. 2–408) including 20 genera: *Agaricus*, *Bolbitius*, *Cantharellus*, *Coprinus*, *Cortinarius*, *Gomphidius*, *Hygrophorus*, *Lactarius*, *Lentinus*, *Lenzites*, *Marasmius*, *Montagnites*, *Nyctalis*, *Panus*, *Paxillus*, *Russula*, *Schizophyllum*, *Stylobates*, *Trogia*, and *Xerotus*. Part 2 of the index (Pennycook 2007) deals with 'Ord. II. *Polyporei*', 'Ord. III. *Hydnei*', 'Ord. IV. *Auricularini*', 'Ord. V. *Clavariei*', and 'Ord. VI. *Tremellinae*' (Fries 1838, pp. 408–594).

## Methods

### Index entries and annotations

Main entries are listed alphabetically by epithet. To facilitate use of the index, species entries are formatted as '*epithet*, *Genus* [Author date]' (e.g. ***heterophylla***, *Russula* [(Fr.) Fr. 1838]), and variety entries as '*epithet, Genus species* var. [Author date]' (e.g. *galochroa, Russula heterophylla* var. [(Fr.) Fr. 1838]). For all taxa in *Agaricus* and *Cortinarius*, the "tribe" has been inserted in parentheses immediately after the generic name; in Fries's text, the "tribe" name appears only as a heading, and is not included in the names of individual taxa. For all other genera, any index entry that includes an infrageneric name in parentheses is a direct transcription of an Epicrisis entry; for example, the taxon that Fries presented as: 18. L. (Scleroma) descendens is indexed as: *descendens, Lentinus (Scleroma)* [Fr. 1837]. All index entries are referred to the relevant page(s) in Epicrisis, cross-referenced to Hymenomycetes Europaei (abbreviated as 'Hym. Eur.'), and annotated with basionyms and other nomenclatural synonyms published before 1838. Nomenclatural novelties first published in Epicrisis are presented in **bold type**, and their status is indicated as 'sp. nov.', 'nom. nov.', etc.

All names are provided with full authorities and dates (checked against the original sources, whenever possible), and sanctioned names are identified by inclusion of the standard tag ':Fr.' (but only for combinations at the sanctioned rank). When the publishing author ascribed a taxon to another author, the names of both authors are cited with a linking 'ex', except in the rare instances where there is explicit evidence that the ascription includes both the name and the description of the taxon (e.g. *Agaricus fritillariformis* Lasch 1838); otherwise, the lack of such unambiguous evidence makes strict application of ICBN (Vienna) Article 46 (McNeill et al. 2006) difficult, if not impossible.

Homonyms and invalid names are identified and annotated. Mistranscribed epithets and other typographic and grammatical errors appearing in Epicrisis have been corrected, annotated, and cross-referenced. For errors that occur in nomenclatural novelties the annotation is appended to the author citation; otherwise the annotation is appended to the corrected epithet. Similar errors in basionyms and synonyms are not cross-referenced but have been corrected, mostly without comment. Fries's more extreme orthographic variants, mistranscriptions, and errors—e.g., *Agaricus cancrinus* as '*canerinus*', *A. conopileus* as '*conopilus*', *A. melanospermus* as '*melaspermus*', *A. rhodocylix* as '*rhodocalyx*', *Agaricus tessellatus* as '*tessulatus*', *A. versicolor* as '*vebsicolor*', *A. violaceofulvens* as '*violaceofulvus*', *Boletus aereus* as '*aeneus*', *Clavaria amethystea* as '*amethystina*', *Clavaria vermicularis* as '*vermiculata*', *Coprinus extinctorius* as '*exstinctorius*', *Hericium stalactiticum* as '*stalactitium*', *Hexagonia wightii* as '*wrightii*', *Hygrophorus irrigatus* as '*irriguus*', *Lactarius crampylus* as '*campylus*', *Lentinus alopecia* as '*alopecinus*', *Lentinus stupens* as '*stuppeus*', *Marasmius caulicinalis* as '*cauticinalis*', *Odontia barba-jobi* as '*barba-jovis*', *Polyporus tessellatus* as '*tessulatus*', *Polyporus verrucosus* as '*verruculosus*', *Stereum frustulatum* as '*frustulosum*'—have all been treated as errors to be corrected; for some of them, an alternative treatment would be to interpret them as nomina nova.

The epithets of *Lenzites* species have all been corrected from feminine to masculine, following ICBN Article 62.4; however, I question the advisability of such an arbitrary negation of Fries's original gender assignment plus the unvarying usage of 170 years of mycological tradition.

## Typographic interpretations

Taxa Fries prefixed with an asterisk (*) are interpreted as varieties of the preceding accepted (numbered) species; for example, the taxon Fries presented as: * A. AMSEGETES (following: 416. A. VITILIS) is interpreted as: *Agaricus vitilis* var. *amsegetes*, and indexed as: ***amsegetes*, Agaricus (*Mycena*) *vitilis* var.** [Fr. 1838]. (The asterisked entries in Epicrisis have the epithet either in small capitals or in lower case italics; no speculative distinction has been made between these two typographies.) Interpretation of the asterisk as denoting a variety results in numerous names (e.g., *Agaricus cerussatus* var. *difformis*, *A. hypnorum* var. *bryorum*, *A. udus* var. *elongatus*) which correspond exactly with the names of taxa that Fries treated explicitly as varieties (prefixed by Greek letters) in the sanctioning works (Fries 1821, 1822). It also conforms with the instructions of ICBN (Vienna) Article 35.4 (McNeill et al. 2006); the asterisked names (of unspecified rank) are the sole category of formal infraspecific taxa in Epicrisis. There is no evidence that Fries was anticipating the later convention of employing an asterisk to denote the rank of subspecies.

Other taxa Fries prefixed with a dagger (†) are interpreted as supernumerary species; the dagger annotation has been retained in the index. It is not apparent why Fries excluded these species from the numbered sequences. A small number of additional species that are both unmarked and unnumbered in Epicrisis are indicated in the index by a dagger enclosed in square brackets. For taxa Fries prefixed with a question mark (?), this annotation has been retained in the index.

## Pagination Errors

The pagination of Epicrisis contains one major ambiguity; the page numbers '79' and '80' are repeated on two consecutive leaves. In this index, the pages of the second leaf are designated as '79[bis]' and '80[bis]'. There are another three trivial errors in page numbering: p. 215 printed as '521'; p. 222 as '122'; and p. 554 as '553'. The entries for names that appear on these pages are annotated accordingly.

## Dates and Publications

Although the title page of Epicrisis carries the date '1836–1838', the evidence suggests the work was not issued in parts but published complete in late 1838 (Stafleu & Cowan 1976); the date has been accepted as '1838' throughout the index. Names attributed to Paulet have been assigned a tentative date of '?1793', the probable publication date of his Traité des Champignons (Stafleu & Cowan 1983). Persoon's Observationes Mycologicae, Pars Secunda has been dated as '1800' rather than the title page date of '1799' (Stafleu & Cowan 1983), and Nees von Esenbeck's Das System der Pilze und Schwämme has been dated as '1816–17' to reflect the uncertainty shrouding its original publication (Stafleu & Cowan 1981). I have been unable to establish publication dates for *Agaricus ocreatus* sensu Dunal [see: ***dunalii, Montagnites***] and *Clavaria kunzei* sensu Krombh. [see: ***krombholzii, Clavaria***].

Fries referred a number of West African taxa to figures in, variously, '*Fung. Guin.*', '*Fr. Fung. Guin.*', '*Fr. Afz. Guin.*', and '*Fr. Afz. Fung. Guin.*' These are citations of the figures prepared for Fries's manuscript, Adami Afzelii Fungi Guineenses. Only the first 8 pages of this manuscript were published (Fries 1837), describing just one monotypic genus, *Stylobates*, and four species of *Lentinus*. The remainder of the text and all of the figures have never been published. The '*Fung. Guin.*' names (except for those published in Fries 1837) are indexed as having been first published in Epicrisis, and annotated with Fries's reference to the unpublished manuscript.

**Acknowledgements**

I thank Don Pfister (Harvard University, Cambridge, MA) and Paul Kirk (CABI Bioscience, Egham) for answering questions about literature and nomenclature; David Hawksworth (MycoNova, Madrid), for supplying information on relevant Articles of the Vienna Code; and Joost Stalpers (CBS, Utrecht) and Scott Redhead (Systematic Mycology and Botany, Agriculture and Agri-Food Canada, Ottawa) for reviewing the manuscript and for their many insightful criticisms and suggestions.

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Fries EM. 1874. Hymenomycetes Europaei: sive Epicriseos Systematis Mycologici, Editio Altera. Uppsala. 756 p.

McNeill J, Barrie FF, Burdet HM, Demoulin V, Hawksworth DL, Marhold K, Nicolson DH, Prado J, Silva PC, Skog JE, Wiersema J, Turland NJ. 2006. International Code of Botanical Nomenclature (Vienna Code). Adopted by the Seventeenth International Botanical Congress, Vienna, Austria, July 2005. Regnum Vegetabile 146. 568 p.

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Stafleu FA, Cowan RS. 1981. Taxonomic Literature, Vol. III: Lh–O. Utrecht. 980 p.

Stafleu FA, Cowan RS. 1983. Taxonomic Literature, Vol. IV: P–Sak. Utrecht. 1214 p.

## Index to Epicrisis Systematis Mycologici. 1: *Agaricini*

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| ***camphoratus, Cortinarius (Inoloma)*** [**(Fr.:Fr.) Fr. 1838**, comb. nov.] | **280** | [362] |
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| = *Agaricus camphoratus* Bull. 1792-93, non Fr.:Fr. 1821 | | |
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| *canescens, Agaricus (Mycena)* [Weinm. 1836] | 114 | [146] |
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| = *Agaricus anomalus* ε *caninus* Fr.:Fr. 1821 | | |
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[The etymology and original orthography of Bulliard's (and Sowerby's) epithet is '*caulicinalis*'. This orthography was retained by Fries (1821) when he sanctioned Bulliard's name at varietal rank (p. 138) and made reference to Sowerby's taxon (p. 167); and also retained for both taxa in Index Alphabeticus (Fries 1832, pp. 11–12). In Epicrisis (p. 87) Fries continued to retain the original orthography for Bulliard's taxon, but introduced the orthography '*cauticinalis*' (without explanation) for Sowerby's taxon. In Hym. Eur. (pp. 117, 476, 711) Fries used the variant orthography for both Bulliard's and Sowerby's taxa; which suggests that the variant was a persistent (and proliferating!) lapsus calami, rather than an attempt to differentiate the epithets of the two taxa.]

[Fries's (1838, 1874) reference to '*With.*' is erroneus; Withering did not list *A. caulicinalis* in any of his publications. Fries's citation (1838, p. 383) of '*Sow. t. 164*' [i.e. *Agaricus pilosus*] is a lapsus calami, later corrected to '*Sow. t. 163*' (Fries 1874, p. 476). Elsewhere (Fries 1838, p. 386) he cited '*Sowerb. t 164*' correctly as a synonym of *Marasmius hudsonii* (cf. Fries 1821, p. 139).]

| Taxon | Page | [Hym. Eur. page] |
|---|---|---|
| *clavipes, Agaricus (Clitocybe)* [Pers.:Fr. 1801] | 56 | [79] |
| ***clavularis, Agaricus (Mycena) dilatatus* var.** | | |
| [(Batsch) Fr. 1838, comb. nov.] | **117** | [151] |
| = *Agaricus clavularis* Batsch 1786 | | |
| *clavus, Agaricus (Collybia)* [L.:Fr. 1753] | 94 | [123] |
| non *Agaricus clavus* Batsch 1789 | | |
| *clavus, Agaricus (Hebeloma)* [Batsch 1789] | 179 | [239 sub *Agaricus clavipes*] |
| nom. illegit., non *Agaricus clavus* L.:Fr. 1753 | | |
| ***cliduchus, Cortinarius (Phlegmacium)*** | | |
| [Fr. 1838, sp. nov.] | **260** | [340] |
| *Clitocybe, Agaricus* trib. [Fr.:Fr. 1821] | 55, 597 | [3, 78] |
| *Clitopilus, Agaricus* trib. [Fr.:Fr. 1821] | 148, 598 | [5, 197] |
| ***clusii, Russula emetica* var.** [Fr. 1838, nom. nov.] | **358** | [449] |
| = *Agaricus emeticus* Vittad. 1835, nom. illegit., non Schaeff.:Fr. 1774 | | |
| ***clusilis, Agaricus (Collybia)*** [Fr. 1838, nom. nov.] | **98** | [129] |
| = *Agaricus umbilicatus* Bull. 1789, nom. illegit., non Scop. 1772, nec Schaeff. 1774 | | |
| *clypeatus, Agaricus (Entoloma)* [L. 1753] | 146 | [194] |
| *clypeolarius, Agaricus (Lepiota)* [Bull.:Fr. 1789] | 15 | [32] |
| ***cnista, Agaricus (Tricholoma)*** [Fr. 1838, sp. nov.] | **50** | [73] |
| *coccineus, Hygrophorus* [(Schaeff.:Fr.) Fr. 1836] | 330 | [417] |
| = *Agaricus coccineus* Schaeff.:Fr. 1774 | | |
| *coccola, Agaricus (Amanita)* [Scop. 1772] | 3 | [18] |
| *cochleatus, Lentinus* [(Pers.:Fr.) Fr. 1825] | 394 | [484] |
| = *Agaricus cochleatus* Pers.:Fr. 1793 | | |
| ***cocles, Agaricus (Nolanea)*** [Fr. 1838, sp. nov.] | **158** | [211] |
| coelestinus [sic], Agaricus – See *caelestinus, Agaricus* | | |
| coerulea [sic], Russula – See *caerulea, Russula* | | |
| coerulescens [sic], Cortinarius – See *caerulescens, Cortinarius* | | |
| *coffeatus, Agaricus (Clitocybe)* [Fr.:Fr. 1821] | 65 | [89] |
| ***cognatus, Agaricus (Tricholoma) arcuatus* var.** | | |
| [Fr. 1838, var. nov.] | **46** | [70] |
| *cohaerens, Agaricus (Mycena)* [Pers.:Fr. 1801] | 105 | [137] |
| *collariatus, Agaricus (Mycena)* [Fr. 1818] | 114 | [146] |
| ***collinitus, Cortinarius (Myxacium)*** | | |
| [(Sowerby:Fr.) Fr. 1838, comb. nov.] | **274** | [354] |
| = *Agaricus collinitus* Sowerby:Fr. 1796–97 | | |
| *collinus, Agaricus (Collybia)* [Scop.:Fr. 1772] | 90 | [119] |
| *Collybia, Agaricus* trib. [Fr.:Fr. 1821] | 81, 597 | [3, 109] |
| *colossus, Agaricus (Tricholoma)* [Fr. 1836] | 38 | [50] |
| *colubrinus, Agaricus (Lepiota)* [Krombh. 1831] | 16 | [34] |
| nom. illegit., non *Agaricus colubrinus* Bull. 1781–82 | | |
| *columbetta, Agaricus (Tricholoma)* [Fr.:Fr. 1821] | 32 | [55] |
| ***colus, Cortinarius (Hydrocybe)*** [(Paulet) Fr. 1838, comb. nov.] | **308** | [391] |
| = *Hypophyllum colus* Paulet ?1793 | | |
| ***colymbadinus, Cortinarius (Dermocybe)*** [Fr. 1838, sp. nov.] | **289** | [372] |

## D

| Taxon | Page | [Hym. Eur. page] |
|---|---|---|
| ***diabolicus, Cortinarius (Dermocybe)*** [(Fr.) Fr. 1838, comb. nov.] | **285** | [367] |
| = *Agaricus anomalus* δ *diabolicus* Fr.:Fr. 1821 | | |
| = *Agaricus diabolicus* (Fr.) Secr. 1833, nom. inval. | | |
| *diatretus, Agaricus (Clitocybe)* [Fr.:Fr. 1818] | 78 | [104] |
| ***dibaphus, Cortinarius (Phlegmacium)*** [Fr. 1838, sp. nov.] | **266** | [346] |
| = *Agaricus luteopes* Secr. 1833, nom. inval. | | |
| *dichrous, Agaricus (Entoloma)* [Pers.:Fr. 1801] | 146 | [194] |
| *dictyorhizus, Agaricus (Pleurotus)* [DC.:Fr. 1806] | 136 | [178] |
| *difformis, Agaricus (Clitocybe)* [Pers.:Fr. 1801] | 79 | [106] |
| *difformis, Agaricus (Clitocybe) cerussatus* var. [(Schumach.:Fr.) Fr. 1821] | 61 | [86] |
| = *Agaricus difformis* Schumach. 1803 | | |
| ***diffractus, Agaricus (Hebeloma)*** [Fr. 1838, sp. nov.] | **182** | [242] |
| ***digitalis, Coprinus*** [(Batsch) Fr. 1838, comb. nov.] | **249** | [327] |
| = *Agaricus digitalis* Batsch 1783 | | |
| *dilatatus, Agaricus (Mycena)* [Fr. 1815] | 117 | [151] |
| ***dilectus, Coprinus*** [Fr. 1838, sp. nov.] | **250** | [328] |
| ***dilutus, Cortinarius (Hydrocybe)*** [(Pers.) Fr. 1838, comb. nov.] | **305** | [389] |
| = *Agaricus [Cortinaria] dilutus* Pers. 1801, p. 300, non *Agaricus [Lepiota] dilutus* Pers. 1801, p. 261 | | |
| = *Agaricus armeniacus* γ *A. dilutus* (Pers.:Fr.) Fr. 1821 | | |
| ***discoideus, Hygrophorus*** [(Pers.:Fr.) Fr. 1838, comb. nov.] | **323** | [408] |
| = *Agaricus discoideus* Pers.:Fr. 1801 | | |
| *discretus, Agaricus (Mycena)* [Fr.:Fr. 1828] | 104 | [–] |
| *dispar*, † *Agaricus* ? [sub *Marasmius*] [Batsch 1789] | 378 | [471 '† *Marasmius dispar*' (nom. illegit., non Fr. 1838)] |
| ***dispar, Marasmius*** [Fr. 1838, nom. nov.] | **382** | [–] |
| = *Agaricus dispar* Mont. 1834, nom. illegit., non Batsch 1789 | | |
| ***dispersus, Agaricus (Hypholoma)*** [Fr. 1838, nom. nov.] | **222** ['122'] | [292] |
| = *Agaricus marginatus* Pers. 1796, nom. illegit., non Batsch 1789 | | |
| = *Agaricus fascicularis* γ *A. marginatus* Pers.:Fr. 1801 | | |
| *disseminatus, Agaricus (Psathyrella)* [Pers.:Fr. 1800] | 240 | [316] |
| ***dissiliens, Agaricus (Mycena)*** [Fr. 1838, nom. nov.] | **108** | [141] |
| = *Agaricus pseudoclypeatus* Bolton 1792 | | |
| ***distortus, Agaricus (Collybia)*** [Fr. 1838, sp. nov.] | **84** | [113] |
| *ditopus, Agaricus (Clitocybe)* [Fr.:Fr. 1815] | 77 | [104] |
| *djamor, Lentinus* [(Rumph. ex Fr.:Fr.) Fr. 1836] | 395 | [–] |
| = *Agaricus djamor* Rumph. ex Fr.:Fr. 1821 | | |
| ***dolabratus, Cortinarius (Hydrocybe)*** [Fr. 1838, sp. nov.] | **311** | [394] |
| *domesticus, Coprinus* [(Bolton:Fr.) Gray 1821] | 251 | [330 'non Bolton'] |
| = *Agaricus domesticus* Bolton:Fr. 1788 | | |
| ***dorsalis, Panus*** [(Bosc:Fr.) Fr. 1838, comb. nov.] | **399** | [–] |
| = *Agaricus dorsalis* Bosc:Fr. 1811 | | |
| *dryinus, Agaricus (Pleurotus)* [Pers.:Fr. 1800] | 129 | [167] |
| *dryophilus, Agaricus (Collybia)* [Bull.:Fr. 1790] | 92 | [122] |

## F

| Taxon | Page | [Hym. Eur. page] |
|---|---|---|
| ***fulvellus, Agaricus (Psalliota) spodophyllus* var.** | | |
| [**Fr. 1838**, var. nov.] | **214** | [279 as *Agaricus pratensis* * *fulveolus* (sic)] |
| = *Agaricus fulvodenticulatus* Lasch 1829 | | |
| ***fulvellus, Agaricus (Tricholoma) nictitans* var.** | | |
| [**Fr. 1838**, var. nov.] | **28** | [50] |
| = *Agaricus fulvus* Bull.:Fr. 1792 | | |
| ***fulvescens, Cortinarius (Hydrocybe)*** [**Fr. 1838**, sp. nov.] | **311** | [395] |
| = *Agaricus ochrofulvescens* Secr. 1833, nom. inval. | | |
| *fumosus, Agaricus (Clitocybe)* [Pers.:Fr. 1801] | 56 | [91] |
| furcata [sic], Lenzites – See *furcatus, Lenzites* | | |
| *furcata, Russula* [(Lam.:Fr.) Pers. 1796] | 352 | [441] |
| = *Amanita furcata* Lam.:Fr. 1783 | | |
| = *Agaricus furcatus* (Lam.:Fr.) Hoffm. 1789 | | |
| ***furcatus, Lenzites*** | | |
| [(**Link ex Fr.:Fr.** )**Fr. 1838**, comb. nov., '*furcata*'] | **404** | [–] |
| = *Daedalea furcata* Link ex Fr.:Fr. 1830 | | |
| *furfuraceus, Agaricus (Naucoria)* [Pers.:Fr. 1801] | 200 | [272] |
| ***furfurosus, Lentinus (Scleroma)*** [**Fr. 1838**, nom. nov.] | **391** | [–] |
| = *Agaricus omphalomorphus* Bertero & Mont. 1837 | | |
| *furvus, Agaricus (Tricholoma)* [Fr. 1818] | 33 | [57] |
| = *Agaricus phaiocephalus* β *furvus* (Fr.:Fr.) Fr. 1821 | | |
| ***fuscescens, Coprinus*** [**(Schaeff.) Fr. 1838**, comb. nov.] | **244** | [322] |
| = *Agaricus fuscescens* Schaeff. 1774 | | |
| ***fuscoalbus, Hygrophorus*** [(**Lasch:Fr.**) **Fr. 1838**, comb. nov.] | **324** | [410] |
| = *Agaricus fuscoalbus* Lasch:Fr. 1829 | | |
| ***fuscopallens, Cortinarius (Telamonia) triformis* var.** | | |
| [**Fr. 1838**, var. nov.] | **299** | [383] |
| ***fuscopurpureus, Marasmius*** [(**Pers.:Fr.**) **Fr. 1838**, comb. nov.] | **377** | [469] |
| = *Agaricus fuscopurpureus* Pers.:Fr. 1798 | | |
| ***fusiformis, Agaricus (Tricholoma) saponaceus* var.** | | |
| [(**Schumach.**) **Fr. 1838**, comb. nov.] | **36** | [59 sub *Agaricus saponaceus*] |
| = *Agaricus fusiformis* Schumach. 1803 | | |
| *fusipes, Agaricus (Collybia)* [Bull.:Fr. 1782–83] | 83 | [111] |
| *fusus, Agaricus (Flammula)* [Batsch 1789] | 186 | [247] |

## G

| Taxon | Page | [Hym. Eur. page] |
|---|---|---|
| *galbanus, Agaricus (Tricholoma)* [Lasch:Fr. 1829] | 41 | [168 sub *Agaricus decorus*] |
| *Galera, Agaricus* trib. [Fr.:Fr. 1821] | 203, 599 | [6, 266] |
| *galericulatus, Agaricus (Mycena)* [Scop.:Fr. 1772] | 106 | [138] |
| = *Mycena galericulata* (Scop.:Fr.) Gray 1821 | | |
| *gallinaceus, Agaricus (Clitocybe)* [Scop. 1772] | 63 | [88] |
| ***galochroa, Russula heterophylla* var.** | | |
| [(**Fr.**) **Fr. 1838**, comb. nov.] | **353** | [447] |
| = *Agaricus galochroa* Fr. 1815 | | |

## H

## J



## K

[Fries apparently mistook the orthography of Bulliard's epithet when he sanctioned this taxon as *Agaricus leucopus* and attributed it to Bulliard (Fries 1821, pp. 236, 511). The error was later acknowledged (Fries 1832, p. 27) but the orthography was never corrected. In all his publications (Fries 1818, 1821, 1832, 1838, 1874), Fries consistently treated *A. leucopodius* Bull. and *A. leucopus* Pers. (originally described as a distinct taxon) as synonyms, under the name '*Agaricus leucopus*'. It is therefore difficult to argue that the correct name for the sanctioned taxon should be *Agaricus leucopodius* Bull.:Fr., with Fries's '*leucopus*' orthography treated as a correctable lapsus calami.]

| Taxon | Page | [Hym. Eur. page] |
|---|---|---|
| *libertatis, Agaricus (Psilocybe)* [Batsch 1783] | 229 | [300] |
| ***licinipes, Cortinarius (Telamonia)*** [Fr. 1838, sp. nov.] | 293 | [376] |
| ***ligatus, Hygrophorus*** [(Fr.:Fr.) Fr. 1838, comb. nov.] | 320 | [405] |
| = *Agaricus ligatus* Fr.:Fr. 1821 | | |
| *lignatilis, Agaricus (Pleurotus)* [Pers.:Fr. 1801] | 132 | [169] |
| ***lilacinus, Lactarius*** [(Lasch:Fr.) Fr. 1838, comb. nov.] | 348 | [435] |
| = *Agaricus lilacinus* Lasch:Fr. 1828 | | |
| ***limacinus, Hygrophorus*** [(Scop.:Fr.) Fr. 1838, comb. nov.] | 324 | [409] |
| = *Agaricus limacinus* Scop.:Fr. 1772 | | |
| ***limbatus, Agaricus (Naucoria)*** [Fr. 1838, nom. nov.] | 201 | [264] |
| = *Agaricus fimbriatus* Bull. 1792–93, nom. illegit., non Bolton:Fr. 1788 | | |
| ***limonius, Cortinarius (Telamonia)*** [(Fr.:Fr.) Fr. 1838, comb. nov.] | 296 | [379] |
| = *Agaricus limonius* Fr.:Fr. 1818 | | |
| *limosus, Agaricus (Nolanea)* [Fr.:Fr. 1828] | 156 | [206] |
| ***limpidus, Agaricus (Pleurotus)*** [Fr. 1838, nom. nov.] | 135 | [177] |
| = *Agaricus lacteus* Scop. 1772, non Pers.:Fr. 1801 | | |
| *limulatus, Agaricus (Flammula)* [Fr. 1818] | 190 | [252] |
| ***lindgrenii, Cortinarius (Telamonia)*** [Fr. 1838, sp. nov.] | 300 | [383] |
| *lineatus, Agaricus (Mycena)* [Bull.:Fr. 1791] | 103 | [134] |
| *linkii, Agaricus (Leptonia)* [Fr.:Fr. 1818] | 151 | [201] |
| ***linnaei, Russula*** [(Fr.) Fr. 1838, comb. nov.] | 356 | [444] |
| = *Agaricus linnaei* Fr. 1815 | | |
| ***liquidus, Cortinarius (Myxacium)*** [Fr. 1838, sp. nov.] | 276 | [357] |
| = *Agaricus dicroninus* Secr. 1833, nom. inval. | | |
| *liquiritiae, Agaricus (Flammula)* [Pers. 1801] | 190 | [251] |
| ***liratus, Cortinarius (Phlegmacium)*** [Fr. 1838, sp. nov.] | 272 | [353] |
| ***lithophilus, † Panus*** [Fr. 1838, sp. nov.] | 400 | [–] |
| ***lituus, Agaricus (Omphalia)*** [Fr. 1838, sp. nov.] | 121 | [156] |
| = *Agaricus icmadophilus* Secr. 1833, nom. inval. | | |
| ***lividoalbus, Hygrophorus*** [Fr. 1838, sp. nov.] | 324 | [412] |
| = *Agaricus eburneus* sensu Hornem. 1827, non Bull.:Fr. 1782-83 | | |
| *lividus, Agaricus (Entoloma)* [Bull. 1788] | 143 | [189] |
| ***livor, Cortinarius (Hydrocybe)*** [Fr. 1838, sp. nov.] | 306 | [390] |
| ***lixivius, Agaricus (Tricholoma)*** [Fr. 1838, nom. nov.] | 54 | [77] |
| = *Agaricus compressus* With.:Fr. 1792 | | |
| *lobatus, Cantharellus* [(Pers.:Fr.) Fr. 1821] | 369 | [461] |
| = *Merulius lobatus* Pers.:Fr. 1801 | | |
| *longicaudus, Agaricus (Hebeloma)* [Pers.:Fr. 1801] | 181 | [241] |
| *longipes, Agaricus (Collybia)* [Bull. 1785] | 81 | [110] |
| ***loricatus, Agaricus (Tricholoma)*** [Fr. 1838, sp. nov.] | 37 | [60] |
| ***loripes, Agaricus (Collybia)*** [Fr. 1838, sp. nov.] | 83 | [111] |
| *loveianus, Agaricus (Volvaria)* [Berk. 1836] | 139 | [182] |
| *lubricus, Agaricus (Flammula)* [Pers.:Fr. 1801] | 185 | [246] |
| *lucifer, Agaricus (Pholiota)* [Lasch 1828] | 167 | [222] |

## O

## P

## Q



## R

| Taxon | Page | [Hym. Eur. page] |
|---|---|---|
| *rhodocylix* ['*rhodocalyx*'], *Agaricus (Eccilia)* [Lasch:Fr. 1829] | 160 | [213] |
| ***rhodomelas*, *Agaricus (Volvaria) volvaceus* var.** **[(Lasch) Fr. 1838, comb. nov.]** | **138** | [183 as *Agaricus rhodomelas*] |
| = *Agaricus rhodomelas* Lasch:Fr. 1829 | | |
| *rhodopolius*, *Agaricus (Entoloma)* [Fr.:Fr. 1818] | 147 | [195] |
| ***rhytipus*, *Russula*** **[Secr. ex Fr. 1838, sp. nov.]** | **357** | [445 '*rhytipes*'] |
| = *Agaricus rhytipus* Secr. 1833, nom. inval. | | |
| ***riculatus*, *Cortinarius (Dermocybe)*** **[Fr. 1838, sp. nov.]** | **284** | [366] |
| ***riederi*, *Cortinarius (Phlegmacium)*** **[(Weinm. ex Fr.:Fr.) Fr. 1838, comb. nov.]** | **259** | [339] |
| = *Agaricus riederi* Weinm. ex Fr.:Fr. 1828 | | |
| ***rigens*, *Agaricus (Pluteus) cervinus* var.** **[(Pers.) Fr. 1838, comb. nov.]** | 140 | [186] |
| = *Agaricus pluteus* β *A. rigens* Pers. 1801 | | |
| [The species name, *Agaricus cervinus* Schaeff. 1774, is unavailable, non Hoffm.:Fr. 1789] | | |
| ***rigens*, *Cortinarius (Hydrocybe)*** **[(Pers.) Fr. 1838, comb. nov.]** | **311** | [395] |
| = *Agaricus rigens* Pers. 1801 | | |
| ***rigidus*, *Cortinarius (Telamonia)*** **[(Scop.) Fr. 1838, comb. nov.]** | **302** | [386] |
| = *Agaricus rigidus* Scop. 1772 | | |
| *rimosus*, *Agaricus (Hebeloma)* [Bull.:Fr. 1789] | 174 | [232] |
| *ringens*, *Lentinus* [(Fr.:Fr.) Fr. 1836] | 396 | [490 as *Panus ringens*] |
| = *Agaricus ringens* Fr.:Fr. 1828 | | |
| *rivulosus*, *Agaricus (Clitocybe)* [Pers.:Fr. 1801] | 61 | [86] |
| *robustus*, *Agaricus (Armillaria)* [Alb. & Schwein.:Fr. 1805] | 21 | [41] |
| ***romanus*, *Xerotus*** [Fr. 1838, nom. nov.] | 401 | [491] |
| = *Merulius torulosus* Pers. 1825 | | |
| *roridus*, *Agaricus (Mycena)* [Fr.:Fr. 1815] | 117 | [150] |
| ***rosacea*, *Russula*** [(Pers.) Fr. 1838, comb. nov.] | 351 | [442] |
| = *Russula rosea* Pers. 1796 | | |
| = *Agaricus Russula rosaceus* Pers. 1801 | | |
| *rosellus*, *Agaricus (Mycena)* [Fr.:Fr. 1821] | 101 | [132] |
| *roseoalbus*, *Agaricus (Pluteus)* [Hornem.:Fr. 1819] | 142 | [188] |
| ***roseus*, *Agaricus (Lepiota) clypeolarius* var.** **[(Scop.) Fr. 1838, comb. nov.]** | 15 | [–] |
| = *Agaricus roseus* Scop.:Fr. 1772 | | |
| ***roseus*, *Gomphidius glutinosus* var.** **[(Fr.:Fr.) Fr. 1838, comb. nov.]** | **319** | [400] |
| = *Agaricus glutinosus* β *roseus* Fr.:Fr. 1821 | | |
| ***rotula*, *Marasmius*** **[(Scop.:Fr.) Fr. 1838, comb. nov.]** | **385** | [477] |
| = *Agaricus rotula* Scop.:Fr. 1772 | | |
| *rubellus*, *Agaricus (Entoloma)* [Scop. 1772] | 145 | [192] |
| *rubescens*, *Agaricus (Amanita)* [(Pers.:Fr.) Fr. 1821] | 7 | [23] |
| = *Amanita rubescens* Pers.:Fr. 1797 | | |
| *rubiginosus*, *Agaricus (Galera)* [Pers. 1801] | 206 | [269] |
| = *Agaricus hypnorum* ε *A. rubiginosus* (Pers.:Fr.) Fr. 1821 | | |

## S

| Taxon | Page | [Hym. Eur. page] |
|---|---|---|
| ***sublateritius, Agaricus (Hypholoma)*** **[Fr. 1838, nom. nov.]** | **221** | [290] |
| = *Agaricus lateritius* Schaeff.:Fr. 1774 | | |
| *subliquescens, Agaricus (Psathyra)* [Schumach.:Fr. 1803] | 232 | [305] |
| *subluteus, Agaricus (Pholiota)* [Vahl:Fr. 1797] | 168 | [224] |
| ***subnotatus, Cortinarius (Dermocybe)*** **[Fr. 1838, nom. nov.]** | **290** | [372] |
| = *Agaricus notatus* Pers. 1801 | | |
| ***subpalmatus, Agaricus (Pleurotus)*** **[Fr. 1838, sp. nov.]** | **131** | [168] |
| = *Agaricus palmatus* sensu Sowerby 1796–97, non Bull.:Fr. 1785 | | |
| *subpulverulentus, Agaricus (Tricholoma)* [Pers. 1828] | 52 | [76] |
| ***subpurpurascens, Cortinarius (Phlegmacium) purpurascens*** **var. [(Batsch) Fr. 1838, comb. nov.]** | **265** | [346] |
| = *Agaricus subpurpurascens* Batsch 1786 | | |
| ***subradiatus, Hygrophorus*** **[(Schumach.) Fr. 1838, comb. nov.]** | **328** | [416] |
| = *Agaricus subradiatus* Schumach. 1803 | | |
| substiptica [sic], Russula integra – See *substyptica, Russula integra* | | |
| ***substyptica, Russula integra*** **var. [(Pers.) Fr. 1838, comb. nov., '*substiptica*']** | **360** | [451 '*substiptica*'] |
| = *Agaricus alutaceus* β *substypticus* Pers. 1801 | | |
| = *Agaricus substypticus* (Pers.) Secr. 1833, nom. inval. | | |
| *subtilis, Agaricus (Psathyrella)* [Fr.:Fr. 1821] | 240 | [316] |
| ***subtortus, Cortinarius (Phlegmacium)*** **[(Pers.:Fr.) Fr. 1838, comb. nov.]** | **273** | [342] |
| = *Agaricus subtortus* Pers.:Fr. 1801 | | |
| *subzonatus, Agaricus (Hebeloma)* [Weinm. 1836] | 182 | [242] |
| ***succineus, Agaricus (Collybia)*** **[Fr. 1838, nom. nov.]** | **91** | [120] |
| = *Agaricus melleus* Schaeff. 1774, non Vahl:Fr. 1790 | | |
| ***sudorus, Agaricus (Mycena)*** **[Fr. 1838, sp. nov.]** | **106** | [138] |
| ***sudus, Agaricus (Tricholoma)*** **[Fr. 1838, sp. nov.]** | **38** | [61] |
| *suffrutescens* ['*suffutescens*'], *Lentinus* [(Brot.:Fr.) Fr. 1825] | 393 | [484] |
| = *Agaricus suffrutescens* Brot.:Fr. 1805 | | |
| suffutescens [sic], Lentinus – See *suffrutescens, Lentinus* | | |
| ***suillus, Cortinarius (Inoloma)*** **[Fr. 1838, sp. nov.]** | **281** | [362] |
| sulfureus [sic], Agaricus – See *sulphureus, Agaricus* | | |
| *sulphureus* ['*sulfureus*'], *Agaricus (Tricholoma)* [Bull.:Fr. 1783–84] | 40 | [63] |
| *supinus, Agaricus (Mycena)* [Fr.:Fr. 1821] | 113 | [147] |
| ***suratus, † Cortinarius (Myxacium)*** **[Fr. 1838, sp. nov.]** | **275** | [356] |
| = *Agaricus spilomeus* Secr. 1833, nom. inval. et illegit., non Fr.:Fr. 1818 | | |
| *sylvaticus* ['*silvaticus*'], *Agaricus (Psalliota)* [Schaeff. 1774] | 214 | [280 '*silvaticus*'] |
| *sylvicola* ['*silvicola*'], *Agaricus (Psalliota) campestris* var. [Vittad. 1835] | 213 | [280 '*silvicola*'] |
| ***synodicus, Marasmius*** **[(Kunze:Fr.) Fr. 1838, comb. nov.]** | **381** | [–] |
| = *Agaricus synodicus* Kunze:Fr. 1830 | | |

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| ***torvus*, Cortinarius (*Telamonia*)** | | |
| **[(Fr.:Fr.) Fr. 1838, comb. nov.]** | 293 | [376] |
| = *Agaricus torvus* Fr.:Fr. 1818 | | |
| trabea [sic], Lenzites – See *trabeus, Lenzites* | | |
| ***trabeus*, Lenzites** [**(Pers.:Fr.) Fr. 1838, comb. nov., '*trabea*'**] | 406 | [494 '*trabea*'] |
| = *Agaricus trabeus* Pers.:Fr. 1801 | | |
| = *Daedalea trabea* (Pers.:Fr.) Fr. 1821 | | |
| *trachelinus, Agaricus (Mycena)* [Fr.:Fr. 1818] | 118 | [152] |
| ***traganus*, Cortinarius (*Inoloma*)** | | |
| **[(Fr.:Fr.) Fr. 1838, comb. nov.]** | 281 | [362] |
| = *Agaricus traganus* Fr.:Fr. 1818 | | |
| *translucens*, ? *Agaricus (Crepidotus)* [DC.:Fr. 1815] | 211 | [213] |
| *tremulus, Agaricus (Pleurotus)* [Schaeff.:Fr. 1774] | 135 | [177] |
| ***trepidus*, Agaricus (*Psathyrella*)** [**Fr. 1838, sp. nov.**] | 238 | [314] |
| *Tricholoma, Agaricus* trib. [Fr.:Fr. 1821] | 25, 596 | [2, 47] |
| *tricholoma, Agaricus (Flammula)* [Alb. & Schwein.:Fr. 1805] | 184 | [236] |
| *tricolor, Agaricus (Omphalia)* [Alb. & Schwein.:Fr. 1805] | 124 | [159] |
| ***tricolor*, Lenzites** [**(Bull.) Fr. 1838, comb. nov.**] | 406 | [494] |
| = *Agaricus tricolor* Bull. 1792 | | |
| ***triformis*, Cortinarius (*Telamonia*)** [**Fr. 1838, sp. nov.**] | 299 | [382] |
| = *Agaricus caesareus* sensu Schaeff. 1771, t.247, non Scop.:Fr. 1772 | | |
| ***trigonophyllus*, Agaricus (*Naucoria*) *furfuraceus* var.** | | |
| **[(Lasch) Fr. 1838, comb. nov.]** | 200 | [273] |
| = *Agaricus trigonophyllus* Lasch:Fr. 1828 | | |
| *trinii, Agaricus (Hebeloma)* [Weinm. 1836] | 175 | [233] |
| *tristis, Agaricus (Tricholoma)* [Scop. 1772] | 34 | [58] |
| ***triumphans*, Cortinarius (*Phlegmacium*)** [**Fr. 1838, sp. nov.**] | 256 | [336] |
| ***trivialis*, Lactarius** [**(Fr.:Fr.) Fr. 1838, comb. nov.**] | 337 | [426] |
| = *Agaricus trivialis* Fr.:Fr. 1815 | | |
| ***trochilus*, Agaricus (*Collybia*)** [**Lasch ex Fr. 1838, sp. nov.**] | 87 | [116] |
| *Trogia* [Fr. 1836] | 402, 602 | [10, 491] |
| ***trogii*, Agaricus (*Clitocybe*)** [**Fr. 1838, sp. nov.**] | 59 | [85] |
| = *Agaricus suaveolens* sensu Trog 1832, non Schumach.:Fr. 1803 | | |
| trullaeformis [sic], Agaricus – See *trulliformis, Agaricus* | | |
| *trulliformis* ['*trullaeformis*'], *Agaricus (Clitocybe)* [Fr.:Fr. 1821] | 68 | [94 '*trullaeformis*'] |
| *truncatus, Agaricus (Hebeloma)* [Schaeff. 1774] | 181 | [242] |
| ***truncorum*, Coprinus** [**(Scop.) Fr. 1838, comb. nov.**] | 248 | [326] |
| = *Agaricus truncorum* Scop. 1772 | | |
| ***tuba*, Agaricus (*Clitocybe*)** [**Fr. 1838, nom. nov.**] | 72 | [99] |
| = *Hypophyllum tubaeforme* Paulet ?1793 | | |
| *tubaeformis, Cantharellus* [(Bull.:Fr.) Fr. 1821] | 366 | [457] |
| = *Helvella tubaeformis* Bull.:Fr. 1790 | | |
| *tuber-regium, Lentinus* [(Rumph. ex Fr.:Fr.) Fr. 1832] | 392 | [–] |
| = *Agaricus tuber-regium* Rumph. ex Fr.:Fr. 1821 | | |
| *tuberculosus, Agaricus (Pholiota)* [Schaeff.:Fr. 1774] | 167 | [223] |

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## X



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MYCOTAXON

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# An index to Fries's Epicrisis Systematis Mycologici, 1838
# 2: Polyporei, Hydnei, Auricularini, Clavariei, Tremellinae

S.R. Pennycook

*PennycookS@LandcareResearch.co.nz*
*Manaaki Whenua Landcare Research*
*Private Bag 92 170, Auckland, New Zealand*

**Abstract**—All the generic, specific, and varietal taxa (except those under 'Ord. I. Agaricini') in Fries's Epicrisis Systematis Mycologici are indexed and annotated with basionyms and other nomenclatural synonyms published before 1838. All names are provided with accurate authorities and publication dates. The index covers 44 genera: *Agyrium, Auricularia, Boletus, Calocera, Clavaria, Cora, Corticium, Craterellus, Crinula, Cyclomyces, Cyphella, Dacrymyces, Daedalea, Exidia, Favolus, Fistulina, Geoglossum, Grandinia, Guepinia, Hericium, Hexagonia, Hydnum, Hymenula, Hypochnus, Irpex, Kneiffia, Laschia, Merulius, Midotis, Mitrula, Naematelia, Odontia, Phlebia, Pistillaria, Polyporus, Porotheleum, Radulum, Sistotrema, Sparassis, Stereum, Thelephora, Trametes, Tremella,* and *Typhula.*

**Key words**—nomenclature, hymenomycetes, *Aphyllophorales*

## Introduction

Epicrisis Systematis Mycologici (Fries 1838) is a major publication in which Elias Fries presented his first comprehensive revision and overview of hymenomycetous fungi subsequent to the early volumes of his sanctioning works (Fries 1821, 1822, 1832). However, access to the contents of Epicrisis and its numerous nomenclatural novelties has been hampered by the lack of an index (Pennycook 2007).

This publication completes an annotated index to all the generic, specific, and varietal taxa accepted in Epicrisis. The first part of the index (Pennycook 2007) dealt with 'Ord. I. Agaricini' (Fries 1838, pp. 2–408). This second part deals with 'Ord. II. Polyporei' (Fries 1838, pp. 408–504), including 10 genera: *Boletus, Cyclomyces, Daedalea, Favolus, Hexagonia* ('*Hexagona*'), *Laschia, Merulius, Polyporus, Porotheleum* ('*Porothelium*'), *Trametes*; 'Ord. III. Hydnei' (Fries 1838, pp. 504–530) including 10 genera: *Fistulina, Grandinia, Hericium, Hydnum, Irpex, Kneiffia, Odontia, Phlebia, Radulum, Sistotrema*; 'Ord. IV. Auricularini'

(Fries 1838, pp. 530–570) including 10 genera: *Auricularia*, *Cora*, *Corticium*, *Craterellus*, *Cyphella*, *Guepinia*, *Hypochnus*, *Midotis*, *Stereum*, *Thelephora*; 'Ord. V. Clavariei' (Fries 1838, pp. 570–587) including 8 genera: *Calocera*, *Clavaria*, *Crinula*, *Geoglossum*, *Mitrula*, *Pistillaria*, *Sparassis*, *Typhula*; and 'Ord. VI. Tremellinae' (Fries 1838, pp. 587–594) including 6 genera: *Agyrium*, *Dacrymyces*, *Exidia*, *Hymenula*, *Naematelia*, *Tremella*.

For details of the organisation of the index, see Pennycook (2007).

## Acknowledgements

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Pennycook SR. 2007 ('2006'). An index to Fries's Epicrisis Systematis Mycologici, 1838. 1: Agaricini. Mycotaxon 98: 1–73.

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# 2: Polyporei, Hydnei, Auricularini, Clavariei, Tremellinae

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| *alveolarius, Polyporus* [(Bosc:Fr.) Fr. 1821] | 431 | [–] |
| = *Boletus alveolarius* Bosc:Fr. 1811 | | |
| = *Favolus alveolarius* (Bosc:Fr.) Fr. 1825 | | |
| ***amarus, Boletus pachypus* var.** [(Pers.) Fr. 1838, comb. nov.] | 417 | [–] |
| = *Boletus amarus* Pers. 1801 | | |
| *amboinensis, Polyporus* [(Lam.:Fr.) Fr. 1821] | 442 | [–] |
| = *Agaricus amboinensis* Lam.:Fr. 1783 | | |
| *amethystea* ['*amethystina*'], *Clavaria* [Bull.:Fr. 1791] | 571 | [667 '*amethystina*'] |
| amethystina [sic], Clavaria – See *amethystea, Clavaria* | | |
| ***amorphum, Corticium*** [(Pers.:Fr.) Fr. 1838, comb. nov.] | 559 | [648] |
| = *Peziza amorpha* Pers.:Fr. 1801 | | |
| = *Thelephora amorpha* (Pers.:Fr.) Fr. 1828 | | |
| *amorphus, Polyporus* [Fr.:Fr. 1818] | 457 | [550] |
| ***amphibolium, Stereum*** [(Fr.:Fr.) Fr. 1838, comb. nov.] | 554 ['553'] | [645 as "*Th. amphibola*" (sic)] |
| = *Thelephora amphibolia* Fr.:Fr. 1815 | | |
| *aneirinus, Polyporus* [Sommerf.:Fr. 1826] | 487 | [575] |
| *angustata, Daedalea* [(Sowerby:Fr.) Pers. 1801] | 494 | [587 as *Daedalea confragosa* * *angustata*] |
| = *Boletus angustatus* Sowerby:Fr. 1798–99 | | |
| *annosus, Polyporus* [Fr.:Fr. 1821] | 471 | [564] |
| *anomala, Clavaria* [Fr.:Fr. 1818] | 576 | [673] |
| ***anthocephala, Thelephora*** [(Bull.:Fr.) Fr. 1838, comb. nov.] | 535 | [634] |
| = *Clavaria anthocephala* Bull.:Fr. 1790 | | |
| = *Thelephora palmata* β *T. anthocephala* (Bull.:Fr.) Fr. 1821 | | |
| *anthochroa, Thelephora* [Pers.:Fr. 1801] | 544 | [661 as *Corticium anthochroum*] |
| ***apiaria, Hexagonia*** [(Pers.) Fr. 1838, comb. nov.] | 497 | [–] |
| = *Polyporus apiarius* Pers. 1827 | | |
| *apiculata, Clavaria* [Fr.:Fr. 1818] | 575 | [673] |
| *appendiculatus, Boletus* [Schaeff. 1774] | 416 | [505] |
| *applanatus, Polyporus* [(Pers.) Wallr. 1833] | 465 | [557] |
| = *Boletus applanatus* Pers. 1800 | | |
| ***arcticus, Polyporus*** [Fr. 1838, sp. nov.] | 479 | [–] |
| *arcularius, Polyporus* [(Batsch:Fr.) Fr. 1821] | 430 | [526] |
| = *Boletus arcularius* Batsch:Fr. 1783 | | |
| *ardenia, Clavaria* [Sowerby:Fr. 1798–99] | 579 | [677 as *Clavaria fistulosa* * *ardenia*] |
| *arenarius, Polyporus* [Klotzsch 1833] | 487 | [–] |
| ***areolatum, Stereum*** [(Chaillet ex Fr.:Fr.) Fr. 1838, comb. nov.] | 552 | [642] |
| = *Thelephora areolata* Chaillet ex Fr.:Fr. 1828 | | |
| *argillacea, Clavaria* [Pers.:Fr. 1797] | 577 | [675] |
| *argutum, Hydnum* [Fr.:Fr. 1821] | 519 | [616] |
| *arida, Thelephora* [Fr.:Fr. 1828] | 543 | [659 as *Corticium aridum*] |
| *arundinis, Hymenula* [(Fr.:Fr.) Fr. 1828] | 594 | [701] |
| = *Hymenella arundinis* Fr.:Fr. 1822 | | |
| ***asprellus, Boletus*** [Fr. 1838, sp. nov.] | 423 | [514] |

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|---|---|---|
| ***benzoina*, *Trametes*** [(Wahlenb.:Fr.) **Fr. 1838, comb. nov.**] | **489** | [554 as *Polyporus resinosus* * *benzoinus*] |
| = *Boletus benzoinus* Wahlenb.:Fr. 1826 | | |
| = *Polyporus benzoinus* (Wahlenb.:Fr.) Fr. 1828 | | |
| *betulinus*, *Polyporus* [(Bull.:Fr.) Fr. 1815] | 461 | [555] |
| = *Boletus betulinus* Bull.:Fr. 1787–88 | | |
| ***beyrichii*, Corticium** [(Fr.:Fr.) **Fr. 1838, comb. nov.**] | **558** | [–] |
| = *Thelephora beyrichii* Fr.:Fr. 1830 | | |
| ***beyrichii*, *Trametes*** [(Fr.:Fr.) **Fr. 1838, comb. nov.**] | **491** | [–] |
| = *Polyporus beyrichii* Fr.:Fr. 1830 | | |
| *bicolor*, *Hydnum* [Alb. & Schwein.:Fr. 1805] | 518 | [615] |
| ***bicolor*, Stereum** [(Pers.:Fr.) **Fr. 1838, comb. nov.**] | **549** | [640] |
| = *Thelephora bicolor* Pers.:Fr. 1801 | | |
| ***biennis*, Polyporus** [(Bull.:Fr.) **Fr. 1838, comb. nov.**] | **433** | [529] |
| = *Boletus biennis* Bull.:Fr. 1790 | | |
| *biennis*, *Thelephora* [Fr.:Fr. 1821] | 540 | [636] |
| *biformis*, *Polyporus* [Klotzsch 1833] | 475 | [–] |
| *biparasitica*, *Tremella* [Fr.:Fr. 1822] | 590 | [–] |
| *bivalvis*, *Polyporus* [Pers. 1827] | 480 | [–] |
| *Boletus* [Fr.:Fr. 1821] | 408, 603 | [10, 495] |
| ***boltonii*, Corticium** [**Fr. 1838, sp. nov.**] | **558** | [647] |
| *bombycina*, *Thelephora* [Sommerf.:Fr. 1826] | 544 | [659 sub *Corticium serum*] |
| *bombycinus*, *Polyporus* [Fr.:Fr. 1828] | 483 | [575] |
| *borealis*, *Polyporus* [Fr.:Fr. 1821] | 459 | [552] |
| ***boryanum*, Stereum** [(Fr.:Fr.) **Fr. 1838, comb. nov.**] | **547** | [–] |
| = *Thelephora boryana* Fr.:Fr. 1830 | | |
| botrytes [sic], Clavaria – See *botrytis*, *Clavaria* | | |
| botrytes [sic], Radulum – See *botrytis*, *Radulum* | | |
| *botrytis* ['*botrytes*'], *Clavaria* [Pers.:Fr. 1797] | 571 | [667 '*botrytes*'] |
| *botrytis* ['*botrytes*'], *Radulum* [Fr.:Fr. 1828] | 526 | [624 '*botrytes*'] |
| ***boucheanus*, Polyporus** [(Klotzsch) **Fr. 1838, comb. nov.**] | **438** | [533] |
| = *Favolus boucheanus* Klotzsch 1833 | | |
| *boveanum*, *Hydnum* [Mont. 1835] | 513 | [–] |
| *bovinus*, *Boletus* [L.:Fr. 1753] | 411 | [499] |
| *brasiliensis*, *Favolus* [(Fr.:Fr.) Fr. 1828] | 498 | [–] |
| = *Daedalea brasiliensis* Fr.:Fr. 1821 | | |
| brassicaefolius [sic], Merulius – See *brassicifolius*, *Merulius* | | |
| *brassicifolius* ['*brassicaefolius*'], *Merulius* [Schwein.:Fr. 1822] | 502 | [–] |
| *brumalis*, *Polyporus* [(Pers.:Fr.) Fr. 1818] | 430 | [526] |
| = *Boletus brumalis* Pers.:Fr. 1794 | | |
| *bufonia*, ? *Thelephora* [Pers.:Fr. 1801] | 545 | [645 as "*Th. bufonia*"] |
| *bulbosa*, † *Clavaria* [Schumach. 1803] | 577 | [674] |
| bulliardi [sic], Trametes – See *bulliardii*, *Trametes* | | |
| ***bulliardii*, Trametes** [**Fr. 1838, nom. nov.**, '*bulliardi*'] | **491** | [584 '*bulliardi*'] |
| = *Boletus suaveolens* Bull.:Fr. 1787–88, non L.:Fr. 1753 | | |
| = *Daedalea suaveolens* (Bull.:Fr.) Pers. 1801 | | |

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| *bullosus, Polyporus* [Fr. ex Weinm. 1826] | 486 | [579] |
| *byssiseda, Clavaria* [Pers.:Fr. 1796] | 576 | [673] |
| *byssoides, Thelephora* [Pers.:Fr. 1801] | 541 | [659 as *Corticium byssoideum*] |

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|---|---|---|
| ***caeruleum, Corticium*** | | |
| **[(Lam.:Fr.) Fr. 1838, comb. nov., '*coeruleum*']** | **562** | [651] |
| = *Byssus caerulea* Lam.:Fr. 1779 | | |
| *caeruleum* ['*coeruleum*'], *Hydnum suaveolens* var. | | |
| [(Hornem.:Fr.) Fr. 1821] | 507 | [602] |
| = *Hydnum caeruleum* Hornem.:Fr. 1808 | | |
| *caesia, Thelephora* [(Pers.:Fr.) Pers. 1801] | 541 | [638] |
| = *Corticium caesium* Pers.:Fr. 1796 | | |
| *caesium, Agyrium* [Fr.:Fr. 1822] | 593 | [–] |
| *caesius, Dacrymyces* [Sommerf.:Fr. 1826] | 592 | [699] |
| *caesius, Polyporus* [(Schrad.:Fr.) Fr.1821] | 454 | [547] |
| = *Boletus caesius* Schrad.:Fr. 1794 | | |
| ***calceum, Corticium* [(Pers.:Fr.) Fr. 1838, comb. nov.]** | **562** | [652] |
| = *Thelephora calcea* Pers.:Fr. 1801 | | |
| *caliciiformis, Crinula* [Fr.:Fr. 1821] | 584 | [–] |
| *callosus, Polyporus* [Fr.:Fr. 1821] | 485 | [577] |
| *Calocera* [(Fr.:Fr.) Fr. 1825] | 580, 607 | [15, 679] |
| = *Clavaria* subgen. *Calocera* Fr.:Fr. 1821 | | |
| *calopus, Boletus* [Pers.:Fr. 1801] | 416 | [506] |
| *canadensis, Favolus* [Klotzsch:Fr. 1832] | 499 | [–] |
| *canaliculata, Clavaria* [Fr.:Fr. 1818] | 579 | [678] |
| ***canalium*, [†] *Polyporus* [(Lour.) Fr. 1838, comb. nov.]** | **437** | [–] |
| = *Boletus canalium* Lour. 1790 | | |
| [Fries 1832, p. 56, cited: '[BOLETUS] *canalium Lour.* (Polyp.)', which could be interpreted as creating a comb. nov. in *Polyporus*.] | | |
| ***candicans, Hydnum* [Fr. 1838, sp. nov.]** | **510** | [606] |
| *candida, Clavaria* [Weinm. 1832] | 580 | [679] |
| *candida, Thelephora* [(Schwein.:Fr.) Fr. 1828] | 538 | [–] |
| non *Thelephora candida* Schwein.:Fr. 1822 | | |
| = *Merisma candidum* Schwein.:Fr. 1822 | | |
| *candidum, Hydnum* [J.C.Schmidt:Fr. 1817] | 506 | [601] |
| ***candidum, Stereum* [(Schwein.:Fr.) Fr. 1832, comb. nov.]** | **552** | [–] |
| = *Thelephora candida* Schwein.:Fr. 1822, non (Schwein.:Fr.) Fr. 1828 | | |
| *candidus, Irpex* [(Ehrenb.) Weinm. 1836] | 523 | [622] |
| = *Sistotrema candidum* Ehrenb. 1818 | | |
| ***candidus, Polyporus* [(Roth) Fr. 1838, comb. nov.]** | **449** | [541] |
| nom. illegit., non *Polyporus candidus* Pers. 1825 | | |
| = *Boletus candidus* Roth 1797 | | |
| ***canescens, Irpex* [Fr. 1838, sp. nov.]** | **522** | [621] |
| ***cantharellus, Craterellus* [(Schwein.:Fr.) Fr. 1838, comb. nov.]** | **534** | [–] |
| = *Thelephora cantharella* Schwein.:Fr. 1822 | | |

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| ***capula, Cyphella*** **[(Holmsk.:Fr.) Fr. 1838, comb. nov.]** | **568** | [664] |
| = *Peziza capula* Holmsk.:Fr. 1781 | | |
| *caput-medusae, Hydnum* [(Bull.:Fr.) Pers. 1801] | 512 | [608] |
| = *Clavaria caput-medusae* Bull.:Fr. 1789 | | |
| *carbonarius, Polyporus* [Fr.:Fr. 1821] | 436 | [532] |
| ***carneoalbus, Irpex*** **[Fr. 1838, sp. nov.]** | **521** | [620] |
| *carneum, ? Geoglossum* [Schultz:Fr. 1806] | 583 | [–] |
| *carneus, Irpex* ? [(Fr.:Fr.) Fr. 1828] | 524 | [622] |
| = *Sistotrema carneum* Fr.:Fr. 1818 | | |
| = *Hydnum carneum* (Fr.:Fr.) Fr. 1821 | | |
| *carneus, Polyporus* [Blume & T.Nees:Fr. 1826] | 471 | [563] |
| *carpineus, Polyporus adustus* var. [(Sowerby) Pers. 1825] | 456 | [550] |
| = *Boletus carpineus* Sowerby 1798-99 | | |
| ***cartilagineum, Stereum*** **[(Fr.:Fr.) Fr. 1838, comb. nov.]** | **545** | [–] |
| = *Thelephora cartilaginea* Fr.:Fr. 1828 | | |
| caryophyllaea [sic], Thelephora – See *caryophyllea, Thelephora* | | |
| *caryophyllea* ['*caryophyllaea*'], *Thelephora* [(Schaeff.:Fr.) Pers. 1801] | 536 | [634] |
| = *Helvella caryophyllea* Schaeff. 1774 | | |
| ***casearius, Polyporus*** **[Fr. 1838, sp. nov.]** | **449** | [541] |
| *castaneus, Boletus* [Bull.:Fr. 1787–88] | 426 | [517] |
| *castaneus, Polyporus* [Fr.:Fr. 1821] | 471 | [564] |
| ***cati, Auricularia*** **[Willd. ex Fr. 1838, nom. nov.]** | **555** | [–] |
| = *Thelephora auricula-cati* Fr.:Fr. 1830 | | |
| *cavipes, Boletus* [Klotzsch ex Fr. 1835] | 413 | [520] |
| ***centrifugum, Stereum*** **[(Weinm.) Fr. 1838, comb. nov.]** | **554** ['553'] | [658 as *Corticium centrifugum*] |
| = *Thelephora centrifuga* Weinm. 1836 | | |
| *cervinus, Polyporus* [(Schwein.:Fr.) Steud. 1824] | 474 | [–] |
| = *Boletus cervinus* Schwein.:Fr. 1822 | | |
| ***chailletii, Stereum*** **[(Pers.:Fr.) Fr. 1838, comb. nov.]** | **551** | [642] |
| = *Thelephora chailletii* Pers.:Fr. 1822 | | |
| chalybaea [sic], Thelephora – See *chalybea, Thelephora* | | |
| *chalybea* ['*chalybaea*'], *Thelephora* [(Pers.) Pers. 1801] | 543 | [660 as *Corticium* '*chalybaeum*'] |
| = *Corticium chalybeum* Pers. 1800, '*chalybaeum*' | | |
| ***chartaceum, Stereum*** **[(G.Mey.:Fr.) Fr. 1838, comb. nov.]** | **546** | [–] |
| = *Thelephora chartacea* G.Mey.:Fr. 1818 | | |
| *chioneus, Polyporus* [Fr.:Fr. 1815] | 453 | [546] |
| *chrysenteron* ['*chrysentheron*'], *Boletus* [Bull. 1791] | 415 | [502] |
| chrysentheron [sic], Boletus – See *chrysenteron, Boletus* | | |
| ***ciliatum, Corticium*** **[(Fr.:Fr.) Fr. 1838, comb. nov.]** | **558** | [653] |
| = *Thelephora ciliata* Fr.:Fr. 1828 | | |
| *ciliatus, Polyporus* [Fr.:Fr. 1815] | 431 | [527] |
| *cinerascens, Polyporus* [(Schwein.) Steud. 1824] | 481 | [–] |
| = *Boletus cinerascens* Schwein. 1822 | | |
| *cinerea, Clavaria* [(Bull.:Fr.) Bull. 1791] | 572 | [668] |
| = *Clavaria coralloides* var. *cinerea* Bull.:Fr. 1788 | | |

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| ***lacteum*, *Corticium*** **[(Fr.:Fr.) Fr. 1838, comb. nov.]** | 560 | [649] |
| = *Thelephora lactea* Fr.:Fr. 1821 | | |
| *lacteus*, *Irpex* [(Fr.:Fr.) Fr. 1828] | 522 | [621] |
| = *Sistotrema lacteum* Fr.:Fr. 1818 | | |
| = *Hydnum lacteum* (Fr.:Fr.) Fr. 1821 | | |
| *lacteus*, *Polyporus* [Fr.:Fr. 1821] | 453 | [546] |
| ***laeta*, *Cyphella*** **[Fr. 1838, sp. nov.]** | 568 | [664] |
| *laetum*, *Radulum* [Fr.:Fr. 1828] | 525 | [624] |
| *laeve*, *Corticium* [Pers.:Fr. 1794] | 560 | [649] |
| ***laevigatum*, *Corticium*** **[(Fr.:Fr.) Fr. 1838, comb. nov.]** | 565 | [656] |
| = *Thelephora laevigata* Fr.:Fr. 1828 | | |
| *laevigatum*, *Hydnum* [Sw.:Fr. 1810] | 506 | [599] |
| *laevis*, *Boletus* [Fr. 1835] | 425 | [516] |
| *laminosa*, *Sparassis* [Fr. 1836] | 570 | [666] |
| ***lanata*, *Trametes*** **[Fr. 1838, sp. nov.]** | 490 | [–] |
| = '*Fung. Guin. f.* 15' [ined.] | | |
| *laneus*, [†] *Polyporus* [Pers. 1825] | 488 | [–] |
| ***languidus*, *Polyporus*** **[Fr. 1838, sp. nov.]** | 442 | [–] |
| = '*Fung. Guin. l. c.*' [ined.] | | |
| *Laschia* [Fr.:Fr. 1830] | 499, 605 | [591] |
| *latissima*, *Daedalea* [(Fr.:Fr.) Fr. 1821] | 495 | [589] |
| = *Polyporus latissimus* Fr.:Fr. 1815 | | |
| *lauri*, *Calocera* [(Brot.:Fr.) Fr. 1832] | 581 | [680] |
| = *Clavaria lauri* Brot.:Fr. 1805 | | |
| *laxa*, *Thelephora* [Fr.:Fr. 1828] | 543 | [659 as *Corticium laxum*] |
| ***laxum*, *Corticium evolvens* var.** **[(Pers.) Fr. 1838, comb. nov.]** | 557 | [648 sub *Corticium amorphum*] |
| = *Thelephora laxa* Pers. 1822, non Fr.:Fr. 1828 | | |
| *leoninum*, *Hydnum* [Fr.:Fr. 1821] | 513 | [610] |
| *leoninus*, *Polyporus* [Klotzsch 1833] | 459 | [–] |
| *lepideus*, *Polyporus* [Fr.:Fr. 1818] | 430 | [526] |
| *leprodes*, *Polyporus* [Rostk. 1828] | 439 | [535 as *Polyporus varius* * *leprodes*] |
| ***leprosum*, *Stereum*** **[(Fr.:Fr.) Fr. 1838, comb. nov.]** | 551 | [–] |
| = *Thelephora leprosa* Fr.:Fr. 1828 | | |
| *leprosus*, *Polyporus* [Fr.:Fr. 1828] | 464 | [–] |
| *leptocephalus*, *Polyporus* [(Jacq.:Fr.) Fr. 1821] | 432 | [528] |
| = *Boletus leptocephalus* Jacq.:Fr. 1778 | | |
| *leucomelas*, *Polyporus* [(Pers.:Fr.) Pers. 1825] | 429 | [524] |
| = *Boletus leucomelas* Pers.:Fr. 1801 | | |
| = *Polyporus subsquamosus* γ *P. leucomelas* (Pers.:Fr.) Fr. 1821 | | |
| *levissimus*, *Polyporus* [Fr.:Fr. 1828] | 470 | [–] |
| *lignosus*, ? *Polyporus* [Klotzsch 1833] | 471 | [–] |
| *ligula*, *Clavaria* [Schaeff.:Fr. 1774] | 578 | [676] |
| ***lilacinum*, *Stereum purpureum* var.** **[(Batsch) Fr. 1838, comb. nov.]** | 548 | [639] |
| = *Helvella lilacinum* Batsch 1786 | | |

## M

N

| Taxon | Page | [Hym. Eur. page] |
|---|---|---|
| nigra pannosa [sic], Thelephora – See *nigropannosa*, *Thelephora* | | |
| ***nigrescens*, Corticium** [(Schrad.) Fr. 1838, comb. nov.] | 565 | [656] |
| = *Thelephora nigrescens* Schrad. 1794 | | |
| *nigricans*, *Agyrium* [Fr.:Fr. 1822] | 593 | [–] |
| *nigricans*, *Polyporus* [Fr.:Fr. 1821] | 466 | [558] |
| *nigripes*, *Polyporus* [Fr.:Fr. 1830] | 435 | [–] |
| *nigrita*, *Clavaria* [Pers.:Fr. 1797] | 578 | [676] |
| *nigrocinctus*, *Hypochnus* [Ehrenb.:Fr. 1820] | 569 | [–] |
| ***nigropannosa*, † Thelephora** [**Secr. ex Fr. 1838**, sp. nov., '*nigra pannosa*'] | 545 | [–] |
| = *Thelephora nigra pannosa* Secr. 1833, nom. inval. | | |
| *nigrum*, *Hydnum* [Fr.:Fr. 1815] | 509 | [605] |
| *nitens*, *Polyporus* [Fr.:Fr. 1830] | 463 | [–] |
| *nitidus*, *Polyporus* [(Pers.:Fr.) Fr. 1818] | 483 | [574] |
| = *Poria nitida* Pers.:Fr. 1800 | | |
| = *Boletus nitidus* (Pers.:Fr.) Pers. 1801 | | |
| *niveum*, *Hydnum* [(Pers.:Fr.) Pers. 1801] | 518 | [616] |
| = *Odontia nivea* Pers.:Fr. 1794 | | |
| *niveus*, *Merulius* [Fr.:Fr. 1828] | 501 | [592] |
| ***nodulosus*, Polyporus** [**Fr. 1838**, sp. nov.] | 474 | [566] |
| ***nubilus*, Polyporus** [**Fr. 1838**, sp. nov.] | 471 | [–] |
| = '*Fung. Guin. f.* 1' [ined.] | | |
| *nucleata*, *Naematelia* [(Schwein.:Fr.) Fr. 1822] | 592 | [696] |
| = *Tremella nucleata* Schwein.:Fr. 1822 | | |
| ***nudum*, Corticium** [(Fr.:Fr.) **Fr. 1838**, comb. nov.] | 564 | [655] |
| = *Thelephora nuda* Fr.:Fr. 1821 | | |
| ***nummularius*, Polyporus elegans* var.** [**(Bull.) Fr. 1838**, comb. nov.] | 441 | [536] |
| = *Boletus nummularius* Bull.:Fr. 1782–83 | | |
| = *Polyporus varius* β *nummularius* (Bull.) Fr. 1821 | | |
| = *Polyporus nummularius* (Bull.:Fr.) Pers. 1825 | | |

## O

| Taxon | Page | [Hym. Eur. page] |
|---|---|---|
| *obducens*, *Polyporus* [Pers. 1825] | 485 | [577] |
| *obliquus*, *Irpex* [(Schrad.:Fr.) Fr. 1828] | 523 | [622] |
| = *Hydnum obliquum* Schrad.:Fr. 1794 | | |
| = *Sistotrema obliquum* (Schrad.:Fr.) Alb. & Schwein. 1805 | | |
| *obliquus*, *Polyporus* [(Ach. ex Pers.:Fr.) Fr. 1821] | 482 | [570] |
| = *Boletus obliquus* Ach. ex Pers.:Fr. 1801 | | |
| *obsoletus*, *Polyporus* [Fr.:Fr. 1830] | 442 | [–] |
| ***obsonium*, Boletus** [**(Paulet) Fr. 1838**, comb. nov.] | 421 | [509] |
| = *Tubiporus obsonium* Paulet ?1793 | | |
| *obtusum*, [†] *Hydnum* [Schrad.:Fr. 1794] | 525 | [623 sub *Radulum quercinum*] |
| ***occarium*, Sistotrema** [**(Batsch:Fr.) Fr. 1838**, comb. nov.] | 520 | [619] |
| = *Hydnum occarium* Batsch:Fr. 1783 | | |

## T

## W



## X



## Z

MYCOTAXON

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# *Astrosphaeriella linguiformis*, a new species on bamboo

Chi Yu Chen & Jenn Wen Huang*

*chiyu86@dragon.nchu.edu.tw *jwhuang@dragon.nchu.edu.tw*
*Department of Plant Pathology, National Chung Hsing University*
*250 Kuo Kuang Rd, Taichung 402, Taiwan*

**Abstract**—*Astrosphaeriella linguiformis* is described from culms of bamboos in Taiwan. The characteristic tongue-like appendage at one end of ascospores distinguishes this species from other members of *Astrosphaeriella*.

**Key words**—loculoascomycetes, taxonomy, bambusicolous fungi

## Introduction

*Astrosphaeriella* Syd. & P. Syd. was reintroduced by Hawksworth (1981) to accommodate four loculoascomycetous species with characteristic hemispherical to conical ascomata and occurring on monocotyledonous hosts. The generic concept was afterwards extended to include five additional species (Hawksworth & Boise 1985). Hyde & Fröhlich (1998) adopted the extended concept and, accordingly, reviewed this genus, in which they accepted 31 species. Additional species were provided by Chen & Hsieh (2004), Hyde et al. (2000), Rogers & Barr (2003), San Martín & Lavín (1999), Tanaka & Harada (2005), and Wang et al. (2004). Presently 45 taxa are accepted in *Astrosphaeriella*. In a continuous survey of fungal diversity in Taiwan, a fungus colonizing culms of bamboos was found belonging to the genus *Astrosphaeriella*. By virtue of its conical, carbonaceous ascomata surrounded by star-like host fragments, this species most closely resembles the generic type. As the tongue-like appendage at the basal end of ascospores is unlike that of any *Astrosphaeriella* species, a new species, *Astrosphaeriella linguiformis*, is proposed for this fungus. Specimens examined are deposited at National Museum of Natural Science (TNM) and National Chung Hsing University (NCHUPP). Single ascospore isolations were made to obtain pure cultures, but no asexual spores were produced. The ex-type culture is deposited at BCRC (Bioresource Collection and Research Center).

*corresponding author

## Taxonomy

***Astrosphaeriella linguiformis*** Chi Y. Chen & J.W. Huang, **sp. nov.**

MYCOBANK 510154 **(Fig. 1)**

*Mycelium subepidermalium, stromate efficientium. Ascomata dispersa, erumpentia, superficialia ubi maturitate, conica, 400–700 µm lata, 300–500 alta, apice rotundo, non papillato, basibus cortice hospitis cinctis. Paries ascomatis 25–35 µm crassus, carbonaceus. Asci cylindrici, 130–160 × 14–18 µm, brevipedicellati, 8-spori. Pseudoparaphyses 1.5–2.5 latae, ramosae. Ascosporae irregulariter biseriatae in asco, ellipsoideae vel fusiformes, 24–34 × 6–8 µm, glabrae, pallide brunneae, septo primo submedio, vagina tenui obtectae, cum vagina postica protracta et linguiformi.*

**Etymology:** From Latin "lingua" means "tongue" and "formis" means "formed", in reference to the tongue-shaped appendage.

**Holotype:** TAIWAN. PINTUNG HSIEN: Henchun, Kenting, on unknown bamboo, 24 Dec. 2002, C.Y. Chen, *TNM F19957*; culture ex-type *BCRC 33879*.

Mycelium subepidermal, extensively connecting adjacent ascomata, forming stromatic tissue, which is particularly prominent around ascomata. Ascomata scattered, immersed at first, at maturity erumpent through the host tissue with ruptured host remnants surrounding the ascomata and appearing star-like in surface view, conical, 400–700 µm wide, 300–500µm high, apex non-papillate, flattened at base. Peridium at sides carbonaceous, 25–35 µm thick, composed of melanized, opaque cells except at the inner cell layers of lateral rim where the cells are hyaline and elongated in palisade-like rows; peridium at base much reduced, composed of cells interwoven with host tissue. Asci cylindrical, 130–160 × 14–18 µm, short-stalked, 8-spored. Pseudoparaphyses embedded in gelatinous matrix, frequently branched and anastomosing, 1.5–2.5 µm wide. Ascospores irregularly biseriate in ascus, ellipsoid to fusiform, 24–34 × 6–8 µm, smooth, pale brown, with a conspicuously constricted, submedian septum, surrounded by a sheath which expands around the lower cell and is drawn out at the posterior end to form a tongue-like appendage, up to 20 µm long.

**Other specimens examined:** TAIWAN. HUALIEN HSIEN: Hsiulin county, Tienshiang, on *Phyllostachys* sp., 28 Dec. 2001, C.Y. Chen, *NCHUPP c0427*. KAOHSHIUNG HSIEN: Taoyuan county, Meishan, on *Phyllostachys* sp., 25 Aug. 2001, C.Y. Chen, *NCHUPP c0304*; Taoyuan county, Tengchih, on *Phyllostachys* sp., 18 Dec. 2003, C.Y. Chen, *TNM F19958*.

## Discussion

Under the current accepted circumscription of *Astrosphaeriella* (Hawksworth & Boise 1985), three groups of species can be recognized in this genus (Chen & Hsieh 2004): typical *Astrosphaeriella* species (containing species most closely related to the generic type), *Trematosphaeria*-like species, and *Massarina*-like species. The similarity of *Astrosphaeriella* to *Trematosphaeria* Fuckel and

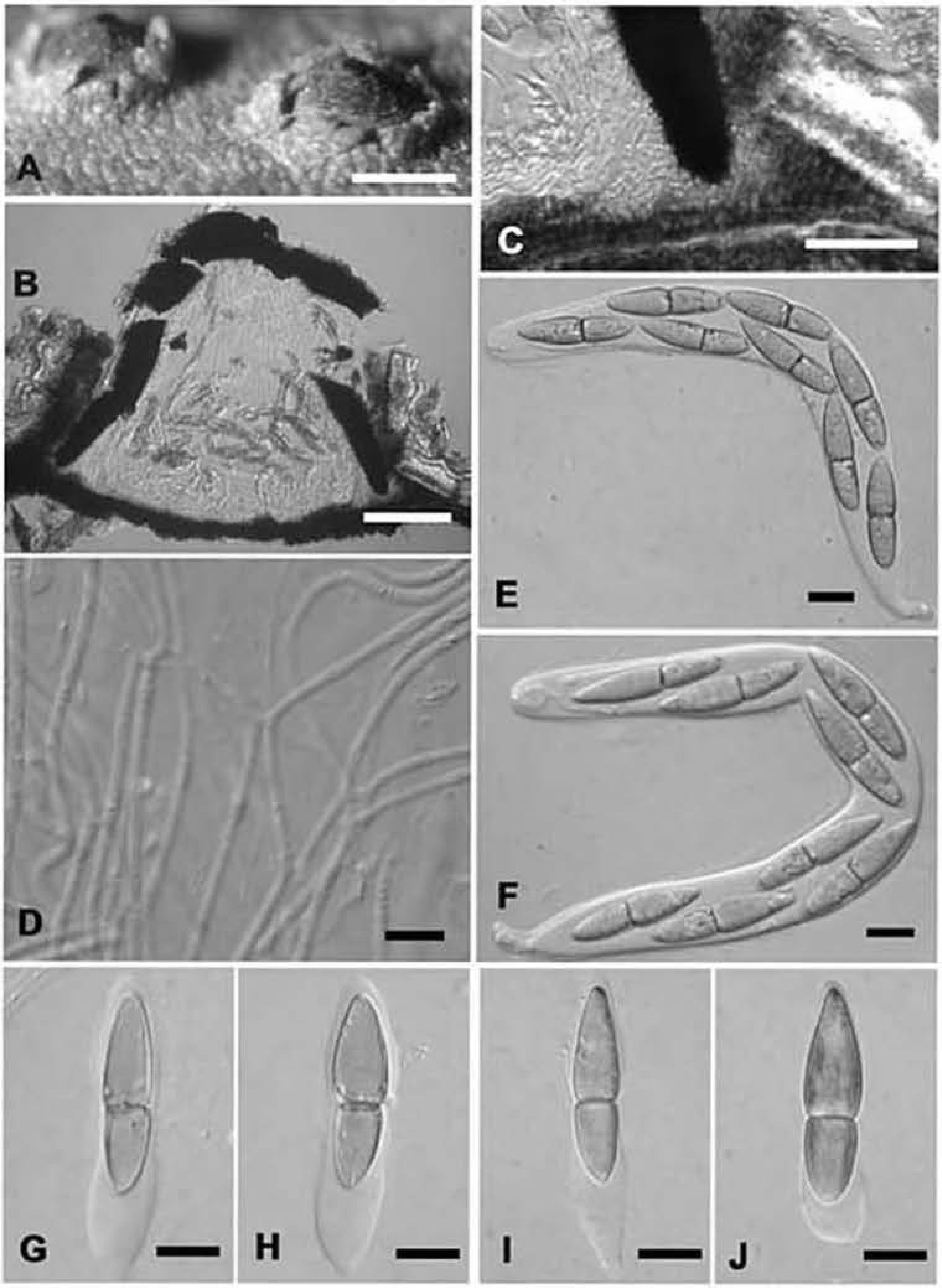


Figure 1. *Astrosphaeriella linguiformis* (from holotype). A. Ascomata on host surface. Note the ruptured host remnants. B. Section of ascoma. C. Close-up view of B, showing the lateral rim of ascoma. D. Pseudoparaphyses. E–F. Asci. G–J. Ascospores. Scale bars, A = 300 µm; B = 100 µm; C = 40 µm; D–J = 10 µm.

*Massarina* Sacc. has also been reported by Boise (1985) and Aptroot (1998) respectively. This suggests that there are ambiguities in the circumscriptions among these related genera. However *Astrosphaeriella linguiformis* apparently does not belong to *Trematosphaeria* or *Massarina,* as possessing the superficially appearing ascomata flanked by star-like host remnants, the most significant feature that characterizes the generic type, *A. stellata* (Pat.) Sacc. Accordingly this fungus undoubtedly belongs to the group of "typical *Astrosphaeriella* species" in the sense of Chen & Hsieh (2004). This fact warrants it being a good species in this genus even though the genus is eventually proved heterogeneous and certain species are to be removed from the genus. As the ascospores possessing a significantly submedian septum and a tongue-like appendage are unique in the genus, the recognition of a new species is warranted.

In the collections TNM F19958 (Fig. 2) and NCHUPP c0304, nearly all ascospores examined are hyaline, and prior to the formation of appendage these hyaline ascospores usually give the appearance of having a median septum. However, the occasional existence of brown ascospores with the characteristic tongue-like appendage reveals that the identity of these two collections is *A. linguiformis*. These hyaline ascospores are apparently immature, and the two specimens should be considered in young stage. It is likely that the ascospores are subjected to a prolonged maturing process, which may account for the fact that hyaline ascospores are dominant in some collections. It is worth noting that the tongue-like appendage is derived from part of the lower cell of ascospores based upon the observation of different stages of immature ascospores.

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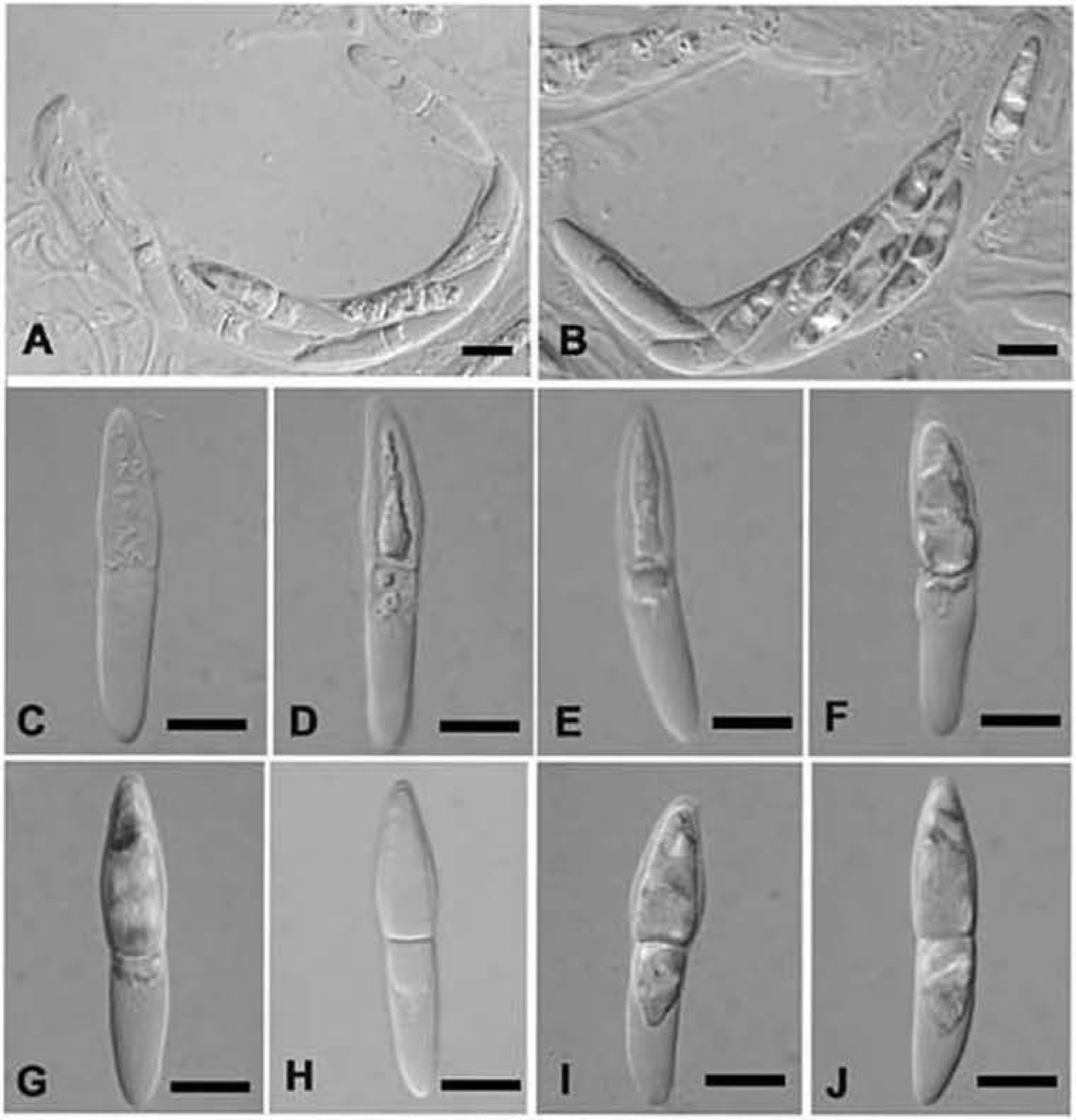


Figure 2. Immature stage of *Astrosphaeriella linguiformis* (from TNM F19958). A–B. Asci. C–J. Ascospores, showing different stages of maturity. Note the development of appendage. Scale bars A–J = 10 µm.


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# *Septoria malagutii* sp. nov., cause of annular leaf spot of potato

Erica T. Cline[1] & Amy Y. Rossman[1]

ecline@u.washington.edu amy@nt.ars-grin.gov
*Systematic Botany & Mycology Laboratory*
*USDA-ARS, 10300 Baltimore Ave., Beltsville, Maryland, USA*

**Abstract**—The fungus causing annular leaf spot of potato, reported only from South America, poses a risk as a potentially invasive species due to its ability to flourish in the cooler temperatures typical of potato-producing regions in Europe and North America. Initially described as "*Septoria lycopersici* var. *malagutii*", the variety is not validly published as required by the International Code of Botanical Nomenclature because no type specimen was specifically designated. Specimens of *S. lycopersici* var. *lycopersici* and *S. lycopersici* "var. *malagutii*" were examined and their rRNA ITS regions and (TEF)-1α genes were sequenced. The 'var. *malagutii*' conidia were significantly longer and narrower with the conidiogenous cells significantly shorter and narrower than the "var. *lycopersici*" cells. Although the sequences were similar — ITS at 99.6% and TEF-1α at 99.2% — the "var. *lycopersici*" ITS was more similar to several other *Septoria* species than to its "var. *malagutii*" counterpart, suggesting that the latter should recognized as a new species: *Septoria malagutii*.

**Key words**—plant pathogen, plant quarantine, systematics, translation elongation factor, internal transcribed spacer

## Introduction

Annular leaf spot ('mancha anular foliar') is a fungal disease affecting wild and cultivated varieties of potatoes, including *Solanum andigenum* Juz. & Bukasov, *S. tuberosum* L., and other tuber-forming *Solanum* spp. in the "species series" *tuberosa* (*Solanaceae*; Jimenez & French 1972). The disease has been documented to occur in the Andes mountains of South America at elevations above 3000 m in Peru (Torres et al. 1970), above 1700 m in Venezuela (Piglionica et al. 1978), above 3000 m in Ecuador (Carrera & Orellana 1972), and may also occur in Bolivia (Smith et al. 1992). It is reportedly restricted to higher elevations of South America due to its growth requirement for cool temperatures (Piglionica et al. 1978).

The European Plant Protection Organization (EPPO) has listed "*Septoria lycopersici* var. *malagutii*" as an A1 quarantine pest to restrict it from spreading to cool and humid regions outside of South America, where it could be a potentially dangerous potato pathogen (Smith et al. 1992). The Andes of South America are widely accepted as the site of origin and the center of diversity for native potatoes (Ochoa 1991). Despite its possible invasive potential, "*S. lycopersici* var. *malagutii*" has received little taxonomic attention since initial publication of the species description (Piglionica et al. 1978).

The fungus causing annular leaf spot of potato was described by Jimenez & French (1972) as "Strain A" of *Septoria lycopersici* Speg., a common, cosmopolitan pathogen on leaves of tomato, *Lycopersicon esculentum* Mill., sometimes included in the genus *Solanum* (Spooner et al. 1993). Citing its distinctive host range and preference for cooler temperatures as well as the brown discoloration of the agar, Piglionica et al. (1978) described this fungus as a new variety, "*Septoria lycopersici* var. *malagutii*". In the initial description of "*S. lycopersici* var. *malagutii*", conidia from agar cultures were described as "4-6 septate and 60-95 x 1.7 µm". Other characters were described as identical to the type variety. Unfortunately, the authors did not specifically designate a holotype specimen as required by the International Code of Botanical Nomenclature (Greuter et al. 2000, Art. 37.1, Note 1); rather they mention co-types at three different institutions. As a result, this must be regarded as an invalid name. We will refer to it from this point on as *Septoria malagutii* and the typical variety, *S. lycopersici* var. *lycopersici*, as simply *S. lycopersici*.

*Septoria lycopersici* has not been known to occur on potatoes nor has *S. malagutii* been reported to occur on tomatoes in nature. In inoculation studies, *S. malagutii* was able to infect leaves of cultivated tomatoes, but produced smaller lesions than *S. lycopersici* (Piglionica et al. 1978). When inoculated on potato, *S. lycopersici* was able to infect leaves, but produced only sterile lesions (Jimenez & French 1972). Both taxa were able to infect *Datura stramonium* L. but were unable to infect *Physalis peruviana* L. (Jimenez & French 1972). In culture, *Septoria malagutii* had maximal growth at 21° C and was unable to grow at temperatures at or above 28° C. In contrast, *S. lycopersici* had maximal growth at 24° C and growth persisted at temperatures up to 28° C (Piglionica et al. 1978).

No teleomorph has been reported for *Septoria lycopersici* or *S. malagutii*. In a recent phylogenetic analysis of ITS and LSU nuclear ribosomal DNA, all 17 *Septoria* species were associated with the monophyletic teleomorphic genus *Mycosphaerella* Johanson (*Dothideales*) (Verkley et al. 2004a, b). However, the anamorphic genus *Septoria* was not monophyletic within *Mycosphaerella*. There was no support for separation of *Septoria* from *Phloeospora*, but the type of *Septoria*, *S. cytisi* Desm., was not included in the study (Verkley et al. 2004b). Several species of *Septoria* on hosts in varying plant genera or families had identical D2 (LSU) sequences and similar ITS sequences (Verkley et al. 2004b).

Verkley et al. (2004b) concluded that, in the absence of clear morphological differences, host specificity alone may not provide a reliable basis for differentiating species.

Our objectives were to 1) evaluate the taxonomic status of "*Septoria lycopersici* var. *malagutii*", 2) validate and redescribe *Septoria malagutii* as a new species, 3) explore the degree of relatedness of *S. lycopersici* (var. *lycopersici*) and *S. malagutii* by comparing their morphology in culture and sequence homology of ITS rRNA and the TEF-1α gene, and 4) evaluate the potential connection of *Septoria lycopersici* and *S. malagutii* to the teleomorphic genus *Mycosphaerella*. Such knowledge will facilitate identification and management of this pathogen and significant quarantine organism.

## Materials and methods

Cultures were obtained from the Centraal Bureau voor Schimmelcultures (CBS). *Septoria lycopersici var. lycopersici* CBS 353.49 (ATCC 9685) was isolated and identified by S.P. Doolittle in 1945 from *Lycopersicon esculentum* (location unknown); *S. lycopersici var. lycopersici* CBS 354.49 (IMI 100277) was isolated and identified by B.H. MacNeill from *L. esculentum* in Ontario, Canada, and deposited June 1949 by M. Bakker; *S. malagutii* (as "*S. lycopersici* var. *malagutii*,") CBS 106.80 (PD 75/912) was collected by L.J. Turkensteen in 1975 from Peru, Dep. Junin, Huasahuasi, at an altitude of 3000 m, on leaves of *Solanum* sp. in the series *tuberosa*, and identified and deposited by G.H. Boerema, Jan. 1980.

Cultural morphology and growth rates were assessed and DNA was extracted from isolates growing on potato dextrose agar (PDA, Difco Labs, Detroit, Michigan, U.S.A.). Attempts to induce sporulation were performed under supplemental fluorescent light on synthetic nutrient agar (SNA, Gerlach & Nirenberg 1962) with and without filter paper and on water agar (WA) with sterile alfalfa twigs incubated for up to 60 days. Terminology in describing cultures follows Nobles (1948). Color names were chosen with reference to standard mycology color charts (Raynor 1970).

Specimen #2029 was provided by the Plantenziektenkundige Dienst Wageningen, labeled "*Septoria lycopersici* Speg. var. *malagutii* Ciccarone et Boerema," host *Solanum tuberosum*, location Llicllatambo, Peru, alt. 3700 m, collected by H. Torres, Oct. 1979, received from Turkensteen, determined by W.M. Loerakker. Specimens of *Septoria lycopersici* var. *lycopersici* were obtained from the U.S. National Fungus Collections: BPI 381364 *S. lycopersici*, host *Lycopersicon esculentum*, from Unionville, CT USA, Aug. 26 1902, collected and determined by G.P. Clinton; BPI 381365, *S. lycopersici*, host *L. esculentum*, from Westville CT, USA, Aug. 28, 1902, collected and determined by G.P. Clinton; BPI 381366, *S. lycopersici*, host *L. esculentum*, from New Haven, CT, USA, Aug. 17, 1902, collected and determined by G.P. Clinton; BPI 381367, *S. lycopersici*, host *L. esculentum*, from New Haven, CT, USA, Oct. 4 1928, collected by A.D. McDonnell, determined by A.A. Dunlop; BPI 381509, *S. lycopersici*, host *L. esculentum*, from Cranja Agricola, Roldanillo (Valle), Colombia, May 26, 1939, collected by C. Garces O., determined by A.J. Watson; BPI 522039 (#1786, 1109 Herb. of John Sheldon), *S. lycopersici*, host *L. esculentum*, from Willow Grove, WV, USA, July 18 1905, collected by A.L. Post; BPI 522032, *S. lycopersici*, host *L. esculentum*, London, Canada, Sept. 1898, collected by J. Dearness; BPI 381513, *S. lycopersici*, host *L. esculentum*, from Sanare, Venezuela, alt. 4700 ft., July 27 1949, collected by W.F. Jeffers, determined by P.L. Lentz.

Specimens and cultures were mounted in 5% KOH with or without addition of phloxine dye and examined using a Zeiss Stemi SVII Apo dissecting microscope and a Zeiss Axiophot DIC microscope with a Nikon DXM 1200F digital camera. Images were processed using the Nikon ACT-1 software package (Version 2.63, ©2000 Nikon Inc.). Measurements were taken using the *Taxonomica* program designed by M. Sogonov to run on a Microsoft ACCESS 1997 platform. Analysis of dimensions of conidia and conidiogenous cells was performed using the Microsoft Excel statistical package.

Genomic DNA was extracted from actively growing PDA cultures using the Ultraclean Plant DNA Isolation kit standard protocol (MoBio Inc., Carlsbad, California, U.S.A.). The internal transcribed spacer (ITS) of the ribosomal RNA was amplified via polymerase chain reaction (PCR) using the primer pair ITS-1F/ITS4 (White et al. 1990). Two overlapping portions of the translation elongation factor (TEF)-1α gene were amplified with the primer pairs 526F/1567R and 983F/2218R using a touchdown protocol with 45 cycles as described by Rehner & Buckley (2005). Sequencing reactions were performed using the BigDye® (Applied Biosystems, Foster City, California, U.S.A.), using the primers ITS-1F and ITS-4 for ITS (White et al. 1990), and 983F, EF-cf, EF-df, 1577f, 2218R, 1953R, EF-gr, and 1567R for TEF-1α (Rehner & Buckley, 2005) run on an ABI 3100 sequencer. Sequences were assembled using the Sequencher software program (Gene Codes Inc., Ann Arbor MI, U.S.A.), aligned and analyzed using the MEGA software package version 3.1 (Kumar et al., 2004), and adjusted manually as needed. Sequences have been submitted to GenBank under the accession numbers DQ 841154-DQ841159.

## Results

Conidiogenous cells of *Septoria malagutii* (Fig. 1) were significantly shorter than those of *S. lycopersici* (Fig. 2), 7.4 ± 0.2 µm compared to 9.1 ± 0.3 µm (mean ± standard error of the mean, $T_{(2,118)} = 4.66$, $P = 8 \times 10^{-6}$). Conidiogenous cells of *S. malagutii* were also significantly narrower, 3.6 ± 0.1 µm compared to 4.1 ± 0.1 µm for *S. lycopersici* ($T_{(2,118)} = 2.9$, $P = 0.005$). Conidiogenous cells of *S. malagutii* and *S. lycopersici* were just over twice as long as they were wide. The ratio of length to width was not significantly different, 2.3 ± 0.1 for both species ($T_{(2,118)} = 0.5$, $P = 0.7$).

Conidia of *Septoria malagutii* (Figs 3, 4) were longer than those of *S. lycopersici* (Figs 5, 6), 90.6 ± 3.4 µm compared to 73.2 ± 2.4 µm (mean ± standard error of the mean). The difference was significant with $\alpha = 0.05$ based on a two sample Student's T-test assuming equal variance ($T_{(2,103)} = 4.23$, $P = 0.00005$). Conidia of *S. malagutii* were significantly narrower, 1.9 ± 0.03 µm compared to 2.2 ± 0.05 µm for *S. lycopersici* ($T_{(2,103)} = 3.89$, $P = 0.0002$). Conidial length to width ratios were significantly greater for *S. malagutii*, 47.8 ± 1.9 compared to 33.4 ± 1.2 for *S. lycopersici* ($T_{(2,103)} = 6.35$, $P = 6.0 \times 10^{-9}$). Conidia of *S. malagutii* had 4.3 ± 0.2 septae while conidia of *S. lycopersici* had 4.7 ± 0.3 septae, not significantly different ($T_{(2,98)} = 1.2$, $P = 0.23$).

Although colonies of *Septoria malagutii* and *S. lycopersici* appear similar on the surface (Figs 7, 8), when viewed in reverse, these colonies vary. The *S. malagutii* culture was brown-vinaceous in reverse, with one sector producing a livid red pigment (Figs 7, 9), while the *S. lycopersici* cultures (Figs 8, 10) were salmon-colored in reverse.

The ITS and TEF-1α sequences for two cultures of *Septoria lycopersici* (CBS 353.49 and CBS 354.49) (Figs 7, 9) were identical. Sequences of *S. malagutii* differed from *S. lycopersici* at two nucleotides within the ITS region, consisting of ITS-1, 5.8S rRNA, and ITS-2, totalling 549 bp (one transition, one transversion, 0.4% difference). The PCR amplification of the TEF-1α sequence using the 526F/1567R primer pair for *S. malagutii* (CBS 106.80) was unsuccessful, therefore only 895 bp from the 983F/2218R primer pair could be compared to *S. lycopersici*. Over this region of the EF-1α gene, *S. malagutii* differed from *S. lycopersici* at seven nucleotides (four transitions, three transversions, 0.8% difference).

## Discussion

Verkley et al. (2004b) have suggested that host specificity alone may not reliably differentiate among species in the genus *Septoria*. Here we reinforce the distinction of the two species based on differences in host range by presenting morphological and molecular evidence to justify treatment of *S. malagutii* as a species distinct from *S. lycopersici*.

Measurements of morphological characters from specimens of *S. malagutii* and *S. lycopersici* displayed considerable overlap. Nevertheless, there were significant differences in conidial length and width and conidiogenous cell length and width that allow for separation of these two species. The ratio of length to width may prove particularly useful in distinguishing the longer and narrower conidia of *S. malagutii* from those of *S. lycopersici*. Qualitative morphological characters also help to differentiate the two taxa. The conidia of *S. malagutii* are frequently curved or sigmoid and pointed at both ends (Figs. 3, 4), while those of *S. lycopersici* are truncate to obtuse at the base (Figs. 5, 6; Sutton & Waterston 1966).

In this study, infertile pycnidia of *Septoria malagutii* were produced in culture on SNA with filter paper with supplemental fluorescent light, while no pycnidia were produced on SNA with alfalfa twigs. Jimenez & French (1972) reported that sporulation of *S. malagutii* could be induced on V8-agar or corn meal agar at 20° C with supplemental fluorescent light. Carerra & Orellana (1978) found that pycnidia of *S. malagutii* on all media tested were infertile; fertile conidiomata were only produced on Lima bean agar.

Based on ITS sequence homology, *S. malagutii* is closely related to other species currently accepted in the genus *Septoria*. The genus *Septoria* was demonstrated by Verkley et al. (2004b) to be polyphyletic, therefore the generic concept may be subject to future revision. Unfortunately, the ITS sequence of the type species *S. cytisi* is not available for comparison to that of *S. malagutii*. In phylogenetic analysis (data not shown), the ITS sequences of *S. lycopersici* and *S. malagutii* were placed within the monophyletic clade representing the teleomorphic genus *Mycosphaerella* (Verkley et al. 2004b).

Among published DNA sequences available from Genbank, the most similar ITS sequence to *S. malagutii* was that of *S. lycopersici*. In contrast, the ITS sequence of *Septoria lycopersici* was more similar to that of *Septoria epambrosiae* D.F. Farr, *Septoria glycines* Hemmi, and *Septoria scabiosicola* Desm. (one transversion) and *Septoria lamiicola* Sacc. (one single nucleotide insertion) than it was to the ITS of *S. malagutii*. For both *S. lycopersici* and *S. malagutii*, the most similar teleomorphic ITS sequence in BLAST searches was *Mycosphaerella rubi* Roark (anamorph *Septoria rubi* Berk. & M.A. Curtis non Westend., nom. illeg.), with two transversions from *S. lycopersici* to *M. rubi* and four transversions from *S. malagutii* to *M. rubi*.

Among Genbank DNA sequences, the TEF-1α sequence most similar to *S. malagutii* in BLAST searches (Altschul et al. 1997) was *Aureobasidium pullulans*, with 89% similarity (797/890 bp). There are no *Mycosphaerella* spp. or *Septoria* spp. sequences of the relevant region of TEF-1α available for comparison. The TEF-1α sequence most similar to *S. lycopersici* was *Cercospora piaropi* (AF146148) (teleomorph unknown). Only the first 449 bp of the TEF-1α gene was available for comparison, for which the similarity was 323/399 (80%). There were no other *Septoria* sequences of TEF-1α available for comparison.

While ITS and LSU rDNA sequences are available for a large number of *Septoria* and *Mycosphaerella* spp. (Crous et al. 2000, 2001; Verkley et al. 2004a, b), none of these include any of the *Septoria* species known to occur on *Lycopersicon esculentum* or *Solanum* species. Additional *Septoria* species on *Solanum* spp. include *Septoria alamoi* Toro, *S. dulcamarae* Desm., *S. melongenae* Lobik, *S. pseudoquinae* Pat., *S. solanicola* Ellis & Everh., *S. solanicola* Grove non Ellis & Everh., nom. illeg., *S. solanina* Speg., *S. solani-nigri* Scalia, and *S. solanophila* Speg. Of these, only *S. pseudoquinae* has been reported on *Solanum tuberosum* or other tuber-forming *Solanum* species. *Septoria malagutii* is distinguished from the other species of *Septoria* on *Solanum* spp. by its longer

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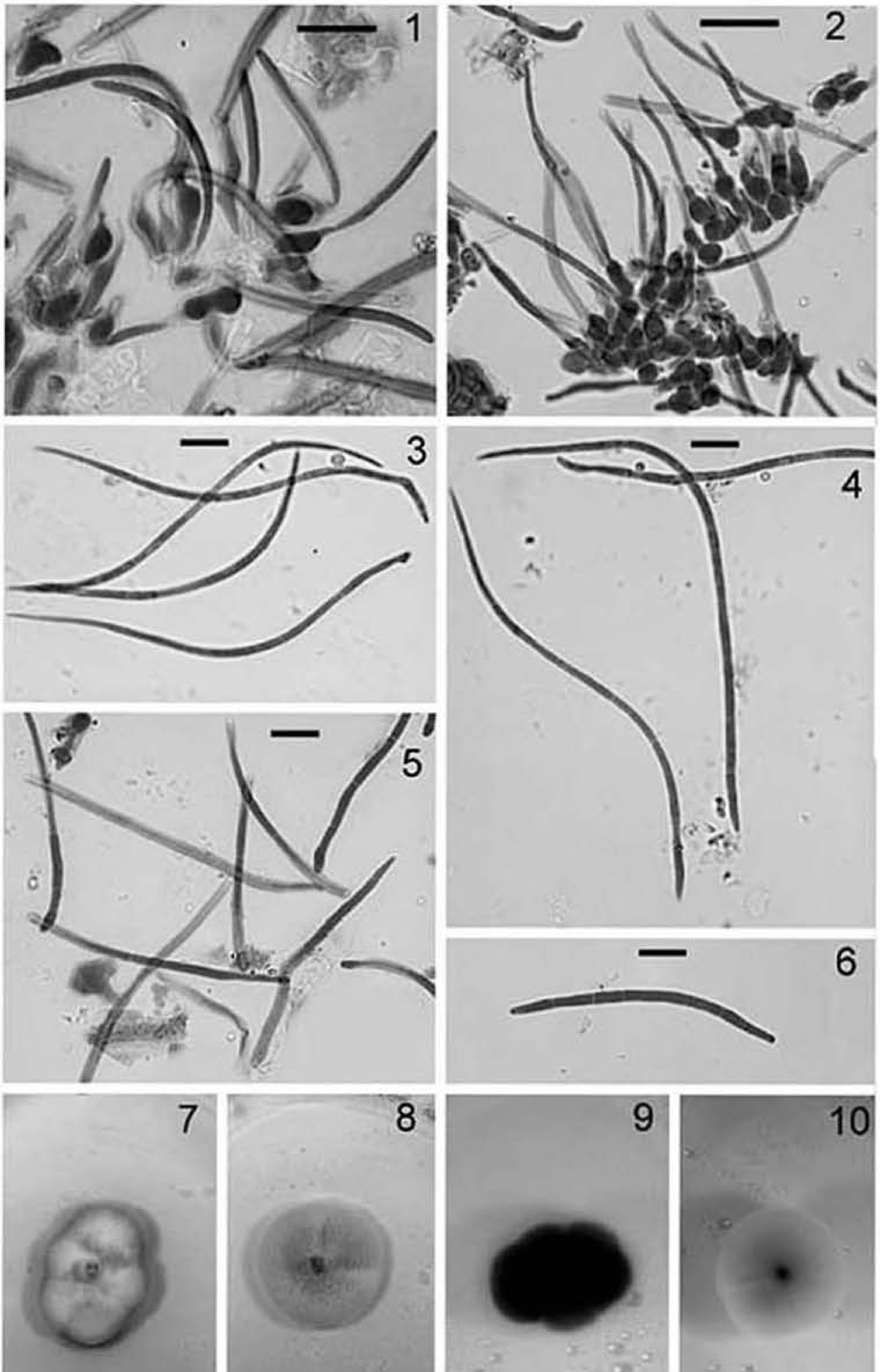
**Figs 1-10.** 1, 3, 4, 7, 9 *Septoria malagutii*; 2, 5, 6, 8, 10 *Septoria lycopersici*. 1-2, conidiogenous cells (100x lens); 3-6, conidia (63x lens); 7-8, cultures, top view; 9-10, cultures, reverse. 1, 3, 4, – *S. malagutii*, specimen #2029; 2, 5 – *S. lycopersici*, BPI381513; 6 – *S. lycopersici*, BPI 522039; 7, 9 – *S. malagutii*, CBS 106.80; 8, 10 – *S. lycopersici*, CBS 354.49. Bar 10 μm.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conidia. Species of *Septoria* on *Lycopersicon esculentum* include *S. lycopersici* var. *lycopersici*, *S. lycopersici* var. *europaea* Briosi & Cavara, *S. lycopersici* var. *microspora* Dominik, *S. dulcamarae*, and *S. tomates* Speg.

## Taxonomy

***Septoria malagutii*** Ciccar. & Boerema ex E.T. Cline, **sp. nov.**

MycoBank MB 510075

[*Septoria lycopersici* var. *malagutii* Ciccar. & Boerema in Piglionica et al. 1978. La septoriosi della patata. Phytopathologia Mediterranea 17 (2): 87-88.] nom. inval.; type not explicitly designated (Art. 37.1, Art. 37.N1).

*Maculae distinctae, amphigenae, circulares, 1-4 mm diam. raro 2 × 4 mm, in epiphyllo sepiaceae, laeves vel. circinatae, margine elevatulo cinctas, in hypophyllo plus pallidae, laeves. Conidiomatae pycnidiae epiphyllae, plerumque in medio macularum solitariae vel paucae, prominulae, < 100 µm diam., (aperta non vidi). Pycnidiae in agaris immaturae, 45-70 µm diam., brunneae vel. atrae, 3-5 µm, parietibus tenuibus, 3-5 µm, textura angularis faciens. Conidiophora absentia. Cellulae conidiogenae ampulliformes vel lageniformes, raro doliformes, discretae, determinatae, hyalinae, 7.4 ± 0.2 (4-11) µm × 3.57 ± 0.12 (2-8) µm. Conidia holoblastica, hyalina, filiformia, parum vel fortiter curvata, interdum recta aut sigmoidea, fortiter acuta ad utrinque apices, interdum parum rotundata ad basim, conidia affixa apice rotundato, 90.6 ± 3.4 (53 - 132) µm × 1.91 ± 0.03 (1.4 - 2.2) µm, (2-) 4-6 (-7) septata, non constricta.* Coloniae (ex CBS 106.80) in agaro "potato-dextrose," post 15 dies 31 mm diam., mycelio aereo dealbato velatae et in agaro cinereo-purpureo vel pallenti, floccosae, reverso brunneo-vinaceo, raro livido-rubro. Temperatura crescentia optima 21° C, maxima <28° C.

*Holotypus: Specimen 2029, Herbarium Plantenziektenkundige Dienst Wageningen.*

Etymology: in honor of Dr. G. Malaguti, a distinguished phytopathologist from Venezuela.

**Leaf lesions** amphigenous, circular, 1-4 mm diam or rarely elongate, 2 × 4 mm, delimited at one side by vein, solitary, occasionally confluent, scattered, epiphyllous spots sepia, sometimes grayish sepia toward center, smooth with faint concentric ridges, margin well-defined, slightly raised, hypophyllous spots slightly paler, smooth. **Conidiomata** pycnidial, epigenous, solitary, scattered, one to three per lesion, immersed, visible as a slightly raised bump, less than 100 µm diam, ostiole not seen, immature pycnidia developing in culture, 45-70 µm diam, brown to black, thin-walled, 3-5 µm wide, of textura angularis in cross section. Conidiophores absent. **Conidiogenous cells** ampulliform to lageniform, rarely doliiform, discrete, determinate, hyaline, 7.4 ± 0.2 (4-11) µm long × 3.57 ± 0.12 (2-8) µm wide, formed from inner surface of conidiomatal wall. **Conidia** holoblastic, hyaline, filiform, slightly to strongly curved, occasionally straight or sigmoid, sharply pointed at both ends, sometimes slightly rounded at base, apex rounded when conidia still attached, 90.6 ± 3.4 (53-132) µm long × 1.91 ± 0.03 (1.4-2.2) µm wide, (2–) 4-6 (–7) septate not constricted at septa. **Cultural characteristics** based on strain CBS 106.80 on

PDA after 15 days at 23° C, with supplemental fluorescent light, colony 31 mm diam, aerial mycelium white, underlying color purplish-grey to pale purplish grey, surface floccose, slightly raised, margin even to bayed, fawn to salmon, reverse faintly ringed, brown-vinaceous, one sector livid red.

**Specimens examined**—#2029, labeled "*Septoria lycopersici* Speg. var. *malagutii* Ciccarone et Boerema." PERU: Dist. Yarowilca near Chavinillo, Llicllatambo, alt. 3700 m., on *Solanum tuberosum*, coll. by H. Torres, Oct. 1979, received from Turkensteen, determined by W.M. Loerakker, holotype. Herbarium Plantenziektenkundige Dienst Wageningen.

**Culture examined**—CBS 106.80 (PD 75/912) PERU: Dep. Junin, Huasahuasi, alt. 3000 m, on leaves of *Solanum* sp. in series *tuberosa*, coll. L.J. Turkensteen, 1975, identified & deposited by G.H. Boerema, Jan. 1980.

**Habitat**—on living leaves of *Solanum tuberosum* and other tuber-forming *Solanum* spp. in series *tuberosa* in the Andes mountains of South America at elevations above 3000 m in Peru and Venezuela. Distinguished from *Septoria lycopersici* var. *lycopersici* by its shorter, narrower conidiogenous cells, longer, narrower, frequently curved or sigmoid conidia, growth preference for lower temperatures, production of a vinaceous pigment in culture and inability to form fertile pycnidia on living leaves of *Lycopersicon esculentum*.

**Notes**—According to Piglionica et al. (1978), isotypes (in Italian, described as "co-typi") were deposited at il Centro de Investigaciones Agronomicas, Maracay, Venezuela; l'Instituto di Patologia Vegetale, Universita di Bari, Italy, and the Plantenziektenkundige Dienst, Wageningen, The Netherlands. No specimen number or other supporting detail was given. This does not constitute an adequate designation of the type specimen (Greuter et al. 2000, Art. 37.1, Note 1), therefore "*Septoria lycopersici* var. *malagutii*" must be regarded as an invalid name. Material from the original collection was not available from the three herbaria listed by Piglionica et al. (1978). We have designated as holotype specimen #2029 from the Herbarium Plantenziektenkundige Dienst Wageningen labelled "*Septoria lycopersici* var. *malagutii*", collected Oct. 1979, one year after Ciccarone & Boerema published the invalid description of "*Septoria lycopersici* var. *malagutii*."

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# Description and phylogenetic placement of *Beauveria malawiensis* sp. nov. (*Clavicipitaceae, Hypocreales*)

Stephen A. Rehner[1], Marilena Aquino de Muro[2] & Joseph F. Bischoff[1,3]

*rehners@ba.ars.usda.gov*
*[1]Insect Biocontrol Laboratory, USDA-ARS*
*Beltsville, Maryland 20705 U.S.A.*

*[2]CABI Bioscience*
*Bakeham Lane, Egham, TW20 9TY, U.K.*

*[3]National Center for Biotechnology Information, National Institutes of Health*
*Bethesda, Maryland 20894 U.S.A.*

**Abstract**—A new entomopathogenic species, *Beauveria malawiensis*, is described. *Beauveria malawiensis* was isolated from a cadaver of *Phoracantha semipunctata* (*Coleoptera: Cerambycidae*) collected in Zomba, Malawi. Morphologically, *B. malawiensis* is distinguished by its pink colony color, the terminal and intercalary clusters of inflated conidiophores that each gives rise to multiple rachiform conidiogenous cells, and holoblastic cylindrical conidia. Phylogenetic analysis of nuclear ribosomal internal transcribed spacer and translation elongation factor-1 alpha sequences place *B. malawiensis* apart from other species in the genus that also produce cylindrical conidia, supporting its proposed species status.

**Key words**—*Cordyceps*, fungal entomopathogen, new species, taxonomy

## Introduction

*Beauveria* Vuill. is a genus of ecologically prominent fungal entomopathogens. Due to widespread interest in this genus for biological control of pest insects, numerous isolates of *Beauveria* have been deposited in fungal culture collections throughout the world. Evaluation of these germplasm resources, however, has been hindered by difficulties in applying existing morphological species concepts and the lack of a contemporary taxonomic revision for the genus (MacLeod 1954, de Hoog 1972).

Recent phylogenetic analyses of *Beauveria* inferred from nuclear ribosomal internal transcribed spacers (ITS) and elongation factor-1alpha (EF-1$\alpha$) resolved six major clades (A-F), each of which includes one or more recognized species (Rehner & Buckley 2005). Subsequently, our laboratory has screened over 800 *Beauveria* isolates by analyses of nucleotide variation in the 5' intron-rich region of EF-1α (Rehner unpublished). Using this diagnostic phylotyping approach, all strains were assigned to the aforementioned Clades A-F. These results affirm the use of nucleotide data for rapid provisional species identification in *Beauveria*. Additionally, because the majority of Asian, European and South American isolates screened were assigned to these previously recognized clades, it is likely that the principal lines of diversity in *Beauveria* that commonly occur in these regions have already been discerned.

Table 1. Cultures of taxa included in ITS and EF-1α phylogenetic analyses and their corresponding GenBank accession numbers.

| Taxa | Culture Number[1] | ITS Genbank # | EF1-α Genbank # |
|---|---|---|---|
| *Beauveria bassiana* | ARSEF 751 | AY532045 | AY531954 |
| *Beauveria bassiana* | ARSEF 1040 | AY531972 | AY531881 |
| *Beauveria bassiana* | ARSEF 300 | AY532015 | AY531924 |
| *Beauveria bassiana* | ARSEF 1811 | AY531992 | AY531901 |
| *Beauveria bassiana* | ARSEF 1478 | AY531981 | AY531890 |
| *Beauveria bassiana* | ARSEF 1848 | AY531995 | AY531904 |
| *Beauveria brongniartii* | ARSEF 4362 | AY532025 | AY531934 |
| *Beauveria brongniartii** | JE 276 | DQ376245 | DQ376244 |
| *Beauveria* sp. | ARSEF 3220 | AY532020 | AY531928 |
| *Beauveria* sp. | ARSEF 4933 | AY532029 | AY531938 |
| *Beauveria caledonica* | ARSEF 2567 | AY532006 | AY531915 |
| *Beauveria amorpha* | ARSEF 2251 | AY532003 | AY531912 |
| *Beauveria vermiconia* | ARSEF 2922 | AY532012 | AY531920 |
| *Beauveria* sp. | ARSEF 1685 | AY531990 | AY531899 |
| *Cordyceps* cf. *staphylinidicola* | ARSEF 7044 | AY532040 | AY531949 |
| *Beauveria* sp. | ARSEF 1969 | AY531998 | AY531907 |
| *Beauveria* sp. | ARSEF 2641 | AY532008 | AY531917 |
| *Cordyceps* cf. *scarabaeicola* | EFCC 2533 | AY532058 | AY531967 |
| *Beauveria malawiensis** sp. nov. | IMI 228343 | DQ376247* | DQ376246* |

*Sequences determined in this study. Other sequences were obtained from GenBank.

[1]Accession codes of isolates sequenced: ARSEF (ARS Entomopathogenic Fungus Collection, Ithaca, NY, U.S.A.); EFCC (Entomopathogenic Fungus Culture Collection, Kangwon National University, Korea); IMI (CABI Bioscience UK Centre, Egham, England); JE (Jürgen Enkerli, Swiss Federal Research Station for Agroecology and Agriculture, Zurich, Switzerland).

Past investigations of *Beauveria* have largely omitted material from Africa, and isolates from this continent are poorly represented in most culture collections. We recently examined a *Beauveria* isolate from Malawi, IMI 228343, infecting the *Eucalyptus* borer *Phoracantha semipunctata*. This isolate possesses unusual cultural and morphological characteristics and we have determined through phylogenetic analysis that it is uniquely derived within *Beauveria*. Based on these results we conclude that IMI 228343 represents a new species, which is described herein.

## Materials and methods

Fungal Material: The isolate of *Beauveria malawiensis* (IMI 228343) was collected May 4, 1978 by R.G. Pawsey in Zomba, Malawi from the Eucalyptus borer, *Phoracantha semipunctata*. Routine growth of IMI 228343 was on quarter-strength Sabouraud's dextrose + yeast agar (SDY: 1% w/v peptone, 4% w/v dextrose, 0.2% yeast, 1.5% w/v agar; Goettel & Inglis 1997). The culture was maintained at approximately 23 °C under irregular light/dark fluorescent illumination in the laboratory. All cultural and morphological features described here were obtained from an ex-type culture of IMI 228343.

Cultural Studies: IMI 228343 was grown on quarter-strength SDY (SDY/4), Difco™ potato dextrose agar (PDA) (J.T. Baker Chemical Co., Phillipsburg, New Jersey, U.S.A.) and Difco™ corn meal agar (CMA). Culture plates were maintained at 23 °C in a diurnal light/dark cycle and the growth rate and morphology of the colonies was observed over a three-week period. Terminology for colony color is from Kornerup & Wanscher (1978). Hyphae, conidiophores, conidiogenous cells and conidia were observed by light microscopy. Measurements of conidiogenous cells and conidia were determined at two and three days following transfer to fresh agar plates and are based on the ranges of at least 20 independent measurements.

DNA extraction, PCR, Sequencing and Analysis: Liquid culture and DNA extraction were performed according to Rehner & Buckley (2005). ITS and EF-1$\alpha$ of IMI 228343 and *B. brongniartii* JE 276 were amplified by PCR and sequenced as described by Rehner and Buckley (2005). Culture voucher and Genbank accession numbers for these and additional taxa included in the phylogenetic analysis are provided in Table 1.

Editing and alignment of ITS and EF-1$\alpha$ sequences were performed as described by Rehner & Buckley (2005) and were combined within a single Nexus file. Bayesian inference and Maximum Parsimony bootstrapping were conducted on an alignment including all sequences listed in Table 1. Initial analyses of the data sets were conducted to determine whether the data could be combined (not shown). Clades with 70% or greater bootstrap (BP) and 95% or greater posterior probability (PP) support were considered significantly supported by the data (Mason-Gamer & Kellog 1996, Reeb et al. 2004). No conflict was detected under these criteria and the two data sets were combined. The combined ITS and EF-1$\alpha$ sequences were analyzed as separate partitions by Bayesian inference with the program MrBayes 3.0b4 (Huelsenbeck 2000, Huelsenbeck et al. 2001). Bayesian analysis was run with four chains (three cold, one heated) and the current tree was saved to a file every 100 generations for a total of 2,000,000 generations.

The analysis was repeated four times. For each analysis, the initial 5000 trees ("burn-in") were discarded and the remaining 15,000 trees (post "burn-in") were combined into a single tree file and a 50% majority-rule consensus tree of the remaining trees was obtained with PAUP* v.4.0b10 (Swofford 2002). Posterior probabilities for branches receiving ≥95% support are reported above the respective branches on the single best tree from the Bayesian analysis (Fig. 7). As a second measure of branch support, ten replicates and a thousand pseudoreplicates of non-parametric bootstrapping were performed under Maximum Parsimony with PAUP* using the heuristic search strategy and the branch-swapping algorithm set to tree-bisection-reconnection. The bootstrap values for branches supported in ≥70% of pseudoreplicates are listed below branches in Fig. 7. Sequences of *Cordyceps* cf. *scarabaeicola* EFCC 2533 were used to root the analyses. Rehner & Buckley (2005) showed that this isolate is either a basal member or sister to the *Beauveria* lineage.

## Taxonomic description

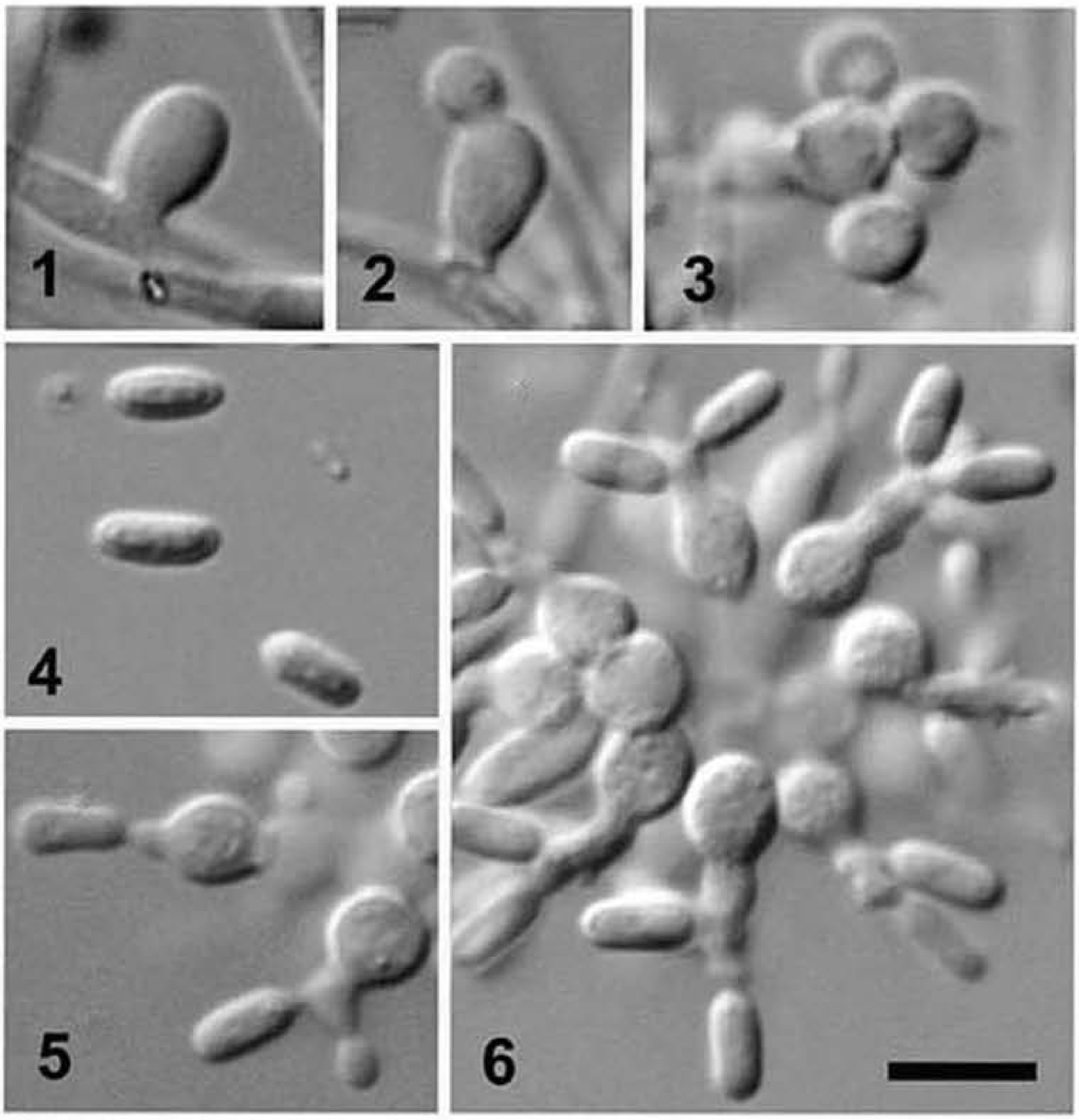
***Beauveria malawiensis*** S.A. Rehner & Aquino de Muro, **sp. nov.**

MYCOBANK #: MB 510468 (Figs. 1-6)

Etymology: *malawiensis*, for the country of origin, Malawi.

*Colonia in agaro cultivata 32.5 mm diametro post 10 dies 23 °C flocci modo, initio alba et postea pallido-rosacea, dorso albo, postea pallido-rosaceo quoque. Hyphae saeptis praeditae, hyalinae, laeves, 1.6-2.4 µm latae. Conidiophorae hyalinae, globosae, 4.3-8.0 µm latae, simplices. Conidogenae cellulae hyalinae, base inflatae, globosae 3.7-8.0 x 1.3-1.9 µm. Conidia holoblastica, hyalina, simplicia, cylindrica, unicellularia, 3.7-1.9 x 1.3-4.5 µm, laevia. Typus, Zombae, Malawi, 1978, legit R.G. Pawsey, IMI 228343.*

Colonies on SDY/4 white, becoming light pink (7A2; Kornerup & Wanscher 1978) in older portions of the colony, aerial mycelium dense and cottony, colony attaining a diameter of 32.5 mm after 10 days at 23°C, heavy accumulation of conidia over older portions of colony which also become light pink (7A2; Kornerup & Wanscher 1978) en masse, the reverse light pink (7A2; Kornerup & Wanscher 1978) and faintly zonate, the margin white. On PDA, the colony white to pale pink (7A2; Kornerup & Wanscher 1978) and slightly zonate, the aerial mycelium dense and appressed to the agar surface, attaining a diameter of 34 mm after 10 days at 23 °C, powdery accumulation of conidia over older portions of colony light pink en masse, reverse subtly zonate and alternating between white and light pink, the margin white. On CMA, the colony not pigmented, mycelium growing as a thin submerged layer that is nearly transparent, surface with scattered areas of conidia production, attaining a diameter of 32 mm after 10 days at 23 °C, reverse white. Odor indistinct. Mycelium of septate, branched, hyaline, smooth, 1.6–2.4 µm wide hyphae. Conidiophores (Fig. 1–3) originate laterally and less commonly terminally from hyphae, becoming globose 4.3–8.0 µm wide, giving rise to multiple conidiogenous cells. Conidiogenous cells with globose to obpyriform base, 4.2–6.6 µm wide, with a holoblastic geniculate apex.




Figs. 1–6. Microscopical features of *B. malawiensis* from the ex-type BPI 871188. 1. Conidiophore initial arising laterally from hypha. 2. Conidiogenous cell originating from conidiophore. 3. Conidiogenous cells produced from a single conidiophore in a two-day-old culture. 4. Conidia. 5. Conidia originating from conidiogenous cells. 6. Conidiogenous cells with attached conidia projecting outward from a cluster of conidiophores in a three-day-old culture. Bar = 5 µm.

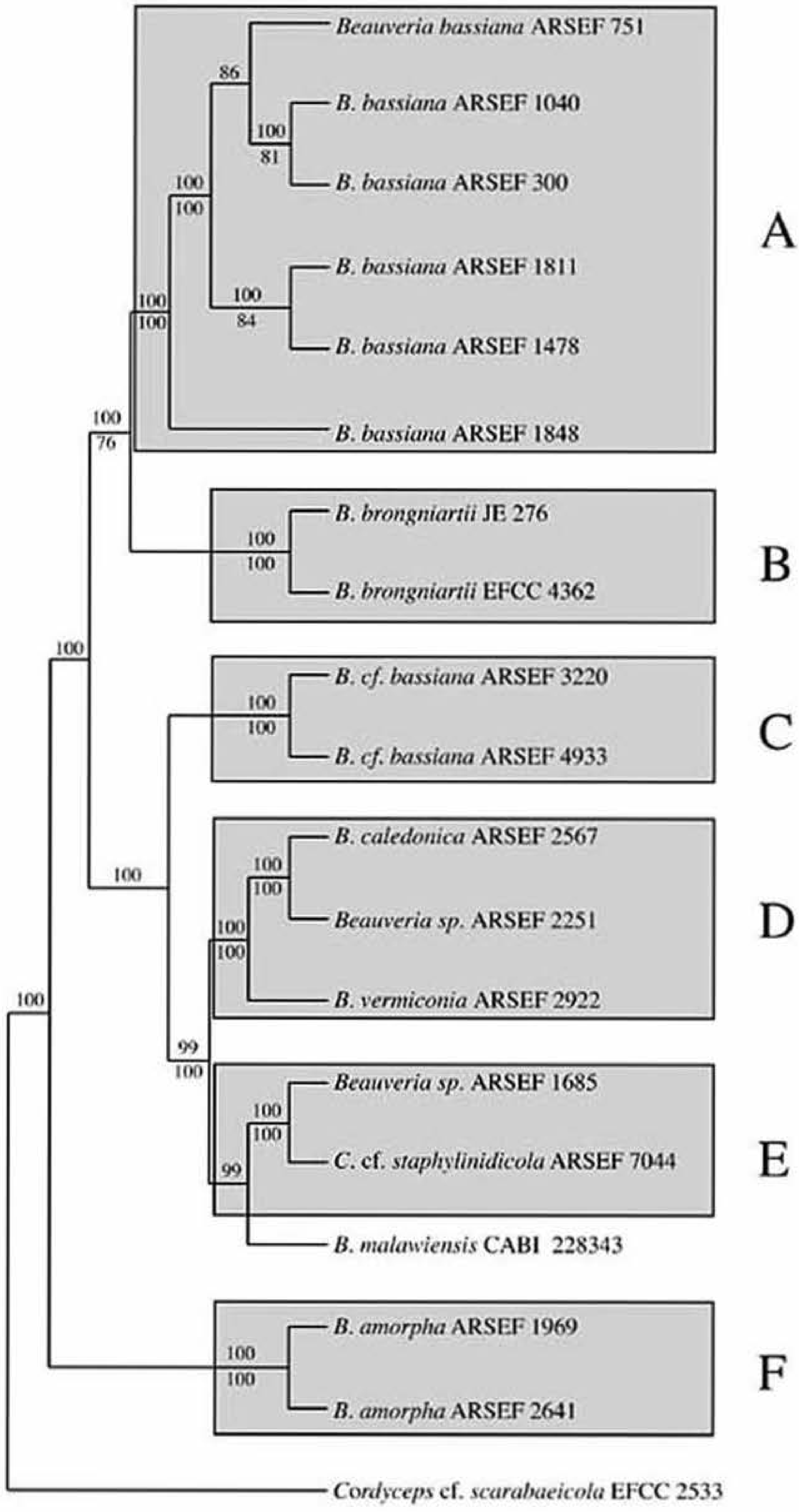
Conidia (Fig.4) holoblastic, hyaline, simple, eguttulate or with 1–2 guttules, cylindrical, smooth, aseptate 3.7–4.5 x 1.3–1.9 µm, en masse pale pink. No chlamydospores were observed on any medium after 21 days. Teleomorph not observed. Holotype: *Beauveria malawiensis*, isolated from *Phoracantha semipunctata* (*Coleoptera: Cerambycidae*), Zomba, Malawi, holotype, IMI 228343, a dried agar culture. A dried ex-type agar culture has been deposited as BPI 871188.

In agar culture *Beauveria malawiensis* is distinguished by the progressive light pink pigmentation of the hyphae and conidia in mass when grown on SDY and PDA media. Most species of *Beauveria* are white to buff on solid media although yellow and pink colony pigmentation may develop in some cultures of *B. bassiana* (Bals.-Criv.) Vuill. and *B. brongniartii* (Sacc.) Petch (de Hoog 1972). The conidia of *B. amorpha* (Höhn.) Samson & H.C. Evans are yellow in mass (Samson & Evans 1982). Although the pink pigmentation of *B. malawiensis* did not diffuse into the agar media during the course of our observations, this isolate did produce a deep red water-soluble pigment when grown in SDY broth. Other species of *Beauveria* (e.g., *B. bassiana*, *B. brongniartii*, *B.* cf. *bassiana* "clade C") also produce extracellular red pigments in either or both agar and liquid SDY, although this ability is often inconsistent among isolates and even among subcultures of individual isolates (Basyouni et al. 1968, Rehner unpub.). In *B. bassiana*, this red soluble pigment has been identified as dibenziquinone (3, 3', 6, 6'-tetrahydroxy-5, 5'-dimethyl-2, 2'-bi-benziquinone), which is also known as oosporein (MacLeod 1954, Basyouni et al. 1966, Eyal et al. 1994, Strasser et al. 2000, Vey et al. 2001). It is not known if the soluble red pigment produced by *B. malawiensis* is also oosporein nor is it known whether the pigment accumulating in the walls of mycelia and conidia of *B. malawiensis* is the same as that produced in liquid culture. The taxonomic and functional significance of these and other metabolites produced by *Beauveria* species are part of ongoing investigations (MAdeM, unpublished).

Microscopically, *B. malawiensis* is characterized by cylindrical conidia, globose conidiophores and globose conidiogenous cells. Two other species of *Beauveria* also produce cylindrical conidia: the South American species *B. amorpha* (Samson & Evans 1982) and the European species *B. caledonica* Bissett & Widden (Bissett & Widden 1988). The size of *B. malawiensis* conidia, 3.7–4.5 x 1.3–1.9 µm, is intermediate but overlap the conidia of *B. amorpha*, which are 5–6 x 1.5–1.7 µm, and slightly larger than conidia of *B. caledonica*, which are 2.6–4.2 x 1.6–2.3 µm. The conidia of *B. malawiensis* tend to be straight in profile as opposed to the slight curvature described for conidia of *B. amorpha* and *B. caledonica*.

*Beauveria malawiensis* also differs from *B. amorpha* and *B. caledonica* by its distinctive globose conidiophores, which are 4.3–8.0 µm wide and give rise to multiple, sessile, globose conidiogenous cells. Although conidiophores of *B. amorpha* were not mentioned in the emended description of this species by Samson & Evans (1982), they are illustrated in their Fig. 7F–G and the shape is depicted as short cylindrical to subglobose. In *B. caledonica* the conidiophores

Fig. 7. Best tree from Bayesian likelihood analysis (-lnL 6159.96) with Bayesian posterior probabilities and bootstrap values labeled above and below branches, respectively. Labeling of clades A–F as described in Rehner & Buckley (2005). This analysis illustrates the phylogenetic placement of *B. malawiensis* as the sister to Clade E.


Beauveria bassiana ARSEF 751
B. bassiana ARSEF 1040
B. bassiana ARSEF 300
B. bassiana ARSEF 1811
B. bassiana ARSEF 1478
B. bassiana ARSEF 1848
A
B. brongniartii JE 276
B. brongniartii EFCC 4362
B
B. cf. bassiana ARSEF 3220
B. cf. bassiana ARSEF 4933
C
B. caledonica ARSEF 2567
Beauveria sp. ARSEF 2251
B. vermiconia ARSEF 2922
D
Beauveria sp. ARSEF 1685
C. cf. staphylinidicola ARSEF 7044
E
B. malawiensis CABI 228343
B. amorpha ARSEF 1969
B. amorpha ARSEF 2641
F
Cordyceps cf. scarabaeicola EFCC 2533
86
100
81
100
100
100
84
100
100
100
76
100
100
100
100
100
100
100
100
100
100
99
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100

are subclavate to short-cylindrical, 2.4–4.8 µm wide and up to 8 µm long. In both *B. amorpha* and *B. caledonica*, conidiogenous cells are also borne laterally from hyphae, whereas sessile conidiogenous cells were rarely observed in *B. malawiensis*. The conidiogenous cells of both *B. amorpha* and *B. caledonica* are smaller and differ in shape from *B. malawiensis*, which are globose and 4.2–6.6 µm wide. The conidiogenous cells of *B. amorpha* are globose to subglobose and 2–4 µm wide; for *B. caledonica* the conidiogenous cells are ellipsoidal and 2.6–4.2 µm wide.

In the Bayesian analysis of ITS and EF-1α sequences (Fig. 7), *B. malawiensis* is positioned as the sister to clade E, a lineage identified by Rehner & Buckley (2005). Clade E consists of a *Cordyceps* isolate, ARSEF 7044, which was accessioned under the name *C. staphylinidicola* Kobayasi & Shimazu, and an unidentified isolate of *Beauveria* (ARSEF 1685). Both isolates have ellipsoidal conidia, 3.0–4.4 x 2.5–3.3 µm, and originate from northeast Asia. *Beauveria malawiensis* is phylogenetically distinct from other *Beauveria* species that produce cylindrical conidia, i.e., *Beauveria amorpha* (Clade F), and *B. caledonica* (Clade D) (Fig. 7). Thus, the phylogenetic data support the recognition of *B. malawiensis* as a distinct species.

The discovery of *B. malawiensis*, which was deposited in the IMI culture collection over twenty years ago, illustrates the potential for encountering novel fungi within existing germplasm resources. Furthermore, it is interesting to note that isolates from Africa are poorly represented in most culture collections. The discovery of this new species suggests the biodiversity of African *Beauveria* warrants further investigation.

## Acknowledgements

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# *Coprinus doverii* sp. nov., a unique new species of subsection *Setulosi* from central and southern Europe

László Nagy*

*cortinarius2000@yahoo.co.uk
Department of Microbiology, University of Szeged
P.O.Box 533.H-6701, Szeged, Hungary*

**Abstract** – A new species of *Coprinus*, *Coprinus doverii*, is described based on material collected in Hungary and Italy. This new species is a very peculiar member of subsection *Setulosi* because of the mitriform spores with two large nodules at each side. The taxonomic position of the new species and possible relationships with other members of the genus *Coprinus* sensu lato are discussed.

**Key words**—*Agaricales*, *Coprinaceae*, taxonomy

## Introduction

Species of the genus *Coprinus* are rather well investigated in northern and western Europe due to the extensive work of Kees Uljé. In eastern and southern Europe, however, no extensive revisions were carried out. Other genera of *Agaricales* often show a good number of species that are geographically restricted to mediterranean or continental regions of Europe. There is, indeed, considerable unknown diversity, especially in species of subsection *Setulosi*, of the genus *Coprinus* sensu lato (Nagy 2005, unpubl.). In this paper we present a peculiar new species found twice in Hungary and once in Italy.

## Materials and methods

The macroscopical description was made on fresh material growing on dung samples that were incubated in a moist chamber. Drawings of microscopic details were made based on microphotographs of dried material rehydrated in 10% $NH_4OH$; spore measurements are based at least on 20 samples from each collection. A notation like (20,2,1) after the word „spores" refers to the number of spores measured, the number of fruitbodies and the number of collections from which the spores were taken, respectively. $Q_1$ means the quotient of length divided by the breadth in face view, while $Q_2$ means the breadth in lateral view being the denominator. Herbarium acronyms follow Holmgren & al. (1998). In this paper we follow a traditional concept of the genus *Coprinus* and not the one proposed by Redhead & al. (2001), because we feel it is premature to adopt at the moment and because unpublished phylogenetic results of the author fail to support that subdivision of coprinoid homobasidiomycetes in the family *Psathyrellaceae*. Collections have been deposited in the personal herbarium of the author, Francesco Doveri, L and BP.

## Taxonomic description

***Coprinus doverii*** L. Nagy sp. nov.

MYCOBANK # MB510304 — FIGURE 1.

*Pileus primo late ellipsoideus vel obtuse conicus, usque ad 1.5 x 2 mm, deinde hemisphaericus vel campanulatus, demum applanatus, usque ad 5 (7) mm diam., in primordiis olivaceo-fuscus, deinde concolor at ad marginem pallidior, demum ochraceus, oleagino suffusus, radialiter striatus, deinde fissuratus, brevipilosus. Lamellae stipitem non attinentes, densae, valde ventricosae, usque ad 0.3 mm altae, ex albo nigricantes. Stipes 0.2-0.6 x 10-25 mm, procerus, omnino pilosus, immutabiliter albidus. Sporae (20,2,1) 7-8.3 x 5-5.7 x 3.8-4.1 µm, in adverso visu mitriformes ad subhexangulae, rotunde quadrinodosae, superne angustiores, aliquando ad apicem rotundatae, a latere cylindratae ad subamygdaliformes, fuscobadiae, valde excentrico, 1.7-2 µm lato, poro germinativo praeditae. Basidia tetraspora, bimorpha, 17-25 x 6-7 µm. Cheilocystidia valde dispersa, plus minusve globosa, 10-14 µm diam. Pleurocystidia absentia. Pileocystidia 35-65 x 6-13 µm, lageniformia, rare incrustata, ad acutum apicem contracto, vel perraro cylindrato collo praedita. Caulocystidia pileocystidiis similia, in forma magis mutabilia, ad basim latioria, usque ad 16 µm diam. Sclerocystidia absentia. Velum in pileo oculis non subiectum, ex 11-25 µm latis, globosis, saepe refringentibus crystallis conspersis partibus compositum. Pileipellis in hymenidermae modum. Fibulae praesentes.*

*Holotype:* HUNGARY, NEAR KECSKEMÉT: Nyír, on deer dung in xerothermous *Convallario-Quercetum roboris* association (both found in the field and incubated in moist chambers), approx 50 fruitbodies, 10.9.2006., leg.: L. Nagy & Zs. Gorliczai, herb.: BP.

*Etymology:* named after Francesco Doveri, who collected this fungus in Italy and made several important conrtibutions on various coprophilous fungi.

## Description

**Pileus** up to 1.5 x 2 mm when still closed, mainly broadly elliptical to obtusely conical, becoming hemispherical to campanulate, flattened when fully mature, up to 5 (7) mm diam., dark olive-brown in primordial stages, with brown olive-brown centre and pale ochraceous margin later, uniformly dark ochraceous with faint olive tint when old; surface strongly translucently striate when young, becoming radially sulcate, shortly pilose. **Veil** macroscopically not observable, see below under microscopical features. **Lamellae** free, crowded, strongly ventricose, up to 0,3 mm broad, at first white, then blackish. **Stipe** 0.2-0.6 x 10-25 mm, slender, whitish also when old, pilose all over.

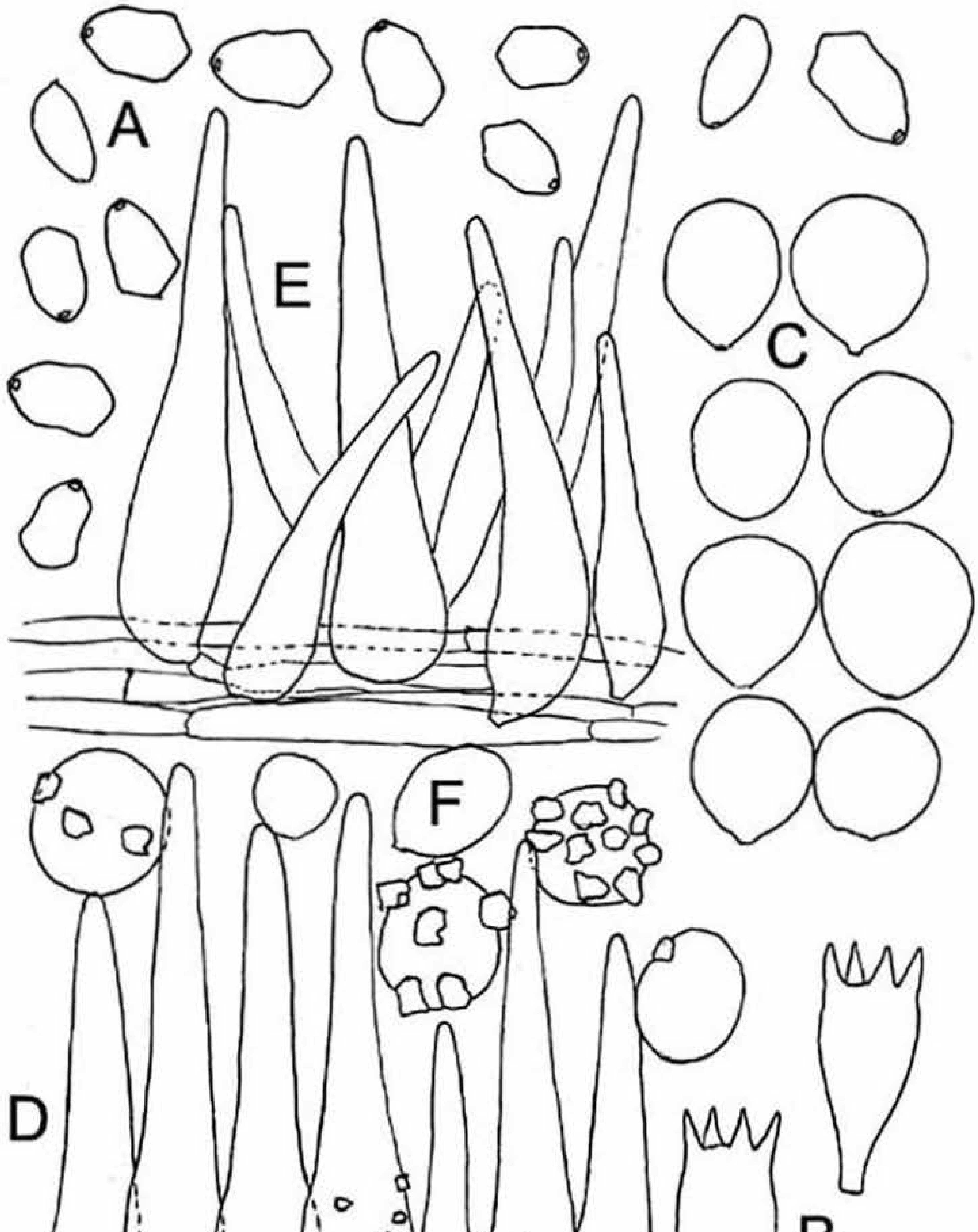


**Figure 1.** ***Coprinus doverii*** (Holotype) A: Spores, B: Basidia, C: Cheilocystidia, D: Pileocystidia, E: Caulocystidia, F: Velar spherocysts. (Magnification 2500x for spores, 2000x for other features)

**Basidiospores** (65,4,3) 6.2–8.3 x 4.5–5.8 x 3.8–4.1 µm, on average 7.68 x 5.32 µm, $Q_1$ = 1.36–1.54, $Q_2$ = 1.8–2.1; in frontal view mitriform to subhexagonal with four, more or less rounded nodules with an apical half being narrower, sometimes with rounded apex, in lateral view cylindrical to subamygdaliform, medium dark red-brown, with strongly eccentric, 1.7–2 µm wide germ pore; **Basidia** 4-spored, dimorphic, 17–25 x 6–7 µm; **Cheilocystidia** very sparse, globose to balloon-shaped, 10–14 µm diam.; **Pleurocystidia** absent; **Pileocystidia** short, lageniform with tapering, exceptionally cylindrical neck and narrow, more or less acute tip, rarely somewhat encrusted, 35–65 x 6–13 µm; **Caulocystidia** similar to pileocystidia, more variable in shape, mainly broader in the basal part, up to 16 µm; **Sclerocystidia** absent, but some pileocystidia with slightly thickened walls are observable; **Veil** on pileus made up of 11–25 µm wide, globose elements, often covered with coarse, strongly refringent crystals; **Pileipellis** a hymeniderm; Clamp – connections present.

**Habitat and distribution:** Two of the collections found were growing on deer dung, in the third case, it was impossible to identify the animal from which the dung originated. Two collections were obtained by incubating the dung sample in moist chambers. The hungarian collections were made in xerothermous *Convallario – Quercetum roboris* association and in a swamp – forest (*Fraxino pannonicae – Alnetum*). To date this species is only known from Hungary and Italy.

COLLECTIONS EXAMINED: HUNGARY, NEAR KECSKEMÉT: Nyír, 10.9.2006., leg.: L. Nagy & Zs. Gorliczai, herb.: BP (*Holotypus*): TŐSERDŐ, 30 km E of Kecskemét, 20.10.2005., L. Nagy & Zs. Gorliczai, herb.: L.N.; ITALY: LIVORNO, F. Doveri, 16.04.2004., herb. Doveri 016.04 and L.

## Discussion

This species is easily recognizable by the nodulose spores, coprophilous habitat and the presence of pileo- and caulocystidia. With the exception of *C. angulatus* Peck, a carbonicolus species, other taxa with nodulose spores can be found only in other sections, like *C. calosporus* Bas & Uljé in subsection *Lanatuli* and *C. iocularis* Uljé in subsection *Nivei*. The spores of *C. iocularis* are extremely similar to that of *C. doverii*, their separation is, however, straightforward, because *C. iocularis* has no pileo- and caulocystidia, but abundant granulose veil, central germ pore, habitat on lawns, and utriform cheilocystidia.

Within subsection *Setulosi* our species seems to possess an isolated position. In Uljé's (1991, 2005) practical key our species would key out near *C. angulatus* and *C. marculentus Britzelm.* The former has similar spores, but they are larger, has a carbonicolus habitat, much larger fruitbodies, and pleurocystidia. *C. marculentus* can grow on dung, but it is generally larger, has hexagonal spores, which are, in addition larger and the neck of its pileocystidia is cylindrical with enlarged apex. Based on size of the spores, size and shape of the pileocystidia, and globose cheilocystidia, one could assume a relationship with the *brevisetulosus* group (*C. pellucidus* P. Karst., *C. brevisetulosus* Arnolds) but these species lack any veil, have central germ pore, and the spores have a typical pale colour.

In all our collections, the pileocystidia showed both tapering and cyrindrical neck. It is very difficult to assess the taxonomic importance of this otherwise intraspecifically constant character. Uljé (1991, 2005), although informally, used it to divide *Setulosi* species with elliptical spores into two larger groups. However, there are obviously very closely related species pairs combining both types of pileocystidia neck. Such an example is *C. callinus* M.Lange. & A. H. Sm. and *C. sclerocystidiosus* M.Lange. & A. H. Sm., the former having pileocystidia with tapering neck, somewhat less abundant sclerocystidia and insignificantly smaller spores. Of these differences, only the shape of the neck of pileocystidia seems to be a constant character. Our species is the first example having both types of pileocystidia neck within one species and even within a single fruitbody.

### Acknowledgements

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# Two new species of *Kirschsteiniothelia* from Taiwan

Chi Yu Chen, Chih Li Wang & Jenn Wen Huang*

*chiyu86@dragon.nchu.edu.tw chihli@fthes-tari.gov.tw*
**jwhuang@dragon.nchu.edu.tw*

*Department of Plant Pathology, National Chung Hsing University*
*250 Kuo Kuang Rd, Taichung 402, Taiwan*

**Abstract**—The generic concept of *Kirschsteiniothelia* is clarified based on the characteristics of the type species, *K. aethiops*. Two new species, *K. reticulata* and *K. smilacis*, are described and illustrated from Taiwan. They are more closely related to the type species than other species in *Kirschsteiniothelia* by having conical ascomata, obclavate asci, and ascospores with a mucilaginous sheath.

**Key words**—loculoascomycete, taxonomy

## Introduction

The genus name *Kirschsteiniothelia* was introduced by Hawksworth (1985) for a group of species previously included in the genus *Microthelia* Körber and similar to *Microthelia incrustans* (Ellis & Everh.) Corlett & S. Hughes. *Kirschsteiniothelia* is based on the type species *K. aethiops* (Berk. & M.A. Curtis) D. Hawks. of which Hawksworth (1985) considered *M. incrustans* to be a synonym. Because the basionym *Sphaeria aethiops* Berk. & M.A. Curtis 1876 predates the basionym *Amphiosphaeria incrustans* Ellis & Everh. 1890, he recognized this species as *K. aethiops*. Further species were subsequently added to this genus by Barr (1993), Hyde (1997), Shearer (1993), and Wang et al. (2004), largely conforming to the genus definition provided by Hawksworth (1985). At present 17 species are included in *Kirschsteiniothelia*.

Chen & Hsieh (2004a) reexamined the type specimen of *Sphaeria aethiops*, and concluded that *S. aethiops* and *M. incrustans* are actually two different species. In *S. aethiops* the ascomata are conical, the asci are generally obclavate, and the ascospores have a mucilaginous sheath, whereas in *M. incrustans* the ascomata are subglobose, the asci are subcylindrical, and the ascospores lack a sheath. As a result, the species concept of *K. aethiops* should be altered to coincide with the

*corresponding author

features of its basionym. The circumscription of the genus *Kirschsteiniothelia* based on the restricted concept of *K. aethiops* is narrower than currently recognized. Many species in *Kirschsteiniothelia* were described using the broad generic concept. Many of these species are closer to *Microthelia incrustans* than to the generic type *K. aethiops*. Judging from the significant differences between *K. aethiops* and *M. incrustans*, species similar to *M. incrustans* should be assigned to a genus other than *Kirschsteiniothelia*.

In a continuing survey of ascomycetes in Taiwan, two fungi were found sharing the following major characteristics with *K. aethiops*: conical ascomata, obclavate asci, 1-septate brown ascospores with surface ornamentation and surrounding sheath. They are best accommodated in *Kirschsteiniothelia*, and the ascospore morphology distinguishes both fungi from *K. aethiops*. Two new species, *K. reticulata* and *K. smilacis*, are accordingly proposed. Combined with *K. aethiops*, these species constitute a well-defined group within *Kirschsteiniothelia*, distinguishable from other species of this genus. *Kirschsteiniothelia* species with conical ascomata, i.e. *K. aethiops* and the two newly established species, *K. reticulata* and *K. smilacis*, may be confused with species in the genus *Astrosphaeriella* Syd. & P. Syd. (Chen & Hsieh 2004b Hyde & Fröhlich 1998). However, the ascomata in these three *Kirschsteiniothelia* species have neither covering clypeus nor star-like host remnants around the base as in *Astrosphaeriella*. The asci are obclavate with ellipsoid ascospores in *Kirschsteiniothelia*, while the asci are cylindrical to clavate with elongate fusiform ascospores in *Astrosphaeriella*. Two new species are described and illustrated in this study. Specimens examined are deposited at TNM (National Museum of Natural Science) and NCHUPP (National Chung Hsing University).

## Taxonomy

***Kirschsteiniothelia reticulata*** Chi Y. Chen, C.L. Wang & J.W. Huang, **sp. nov.**
MycoBank 510242 **Fig. 1**

*Ascomata dispersa, primo immersa, demum per rimam laceratam protrusa, conica, 320–450 µm lata, 180–220 µm alta, ad apicem rotundata. Hyphae in matrice intercellulosae et intracellulosae, 3–5 µm latae, per cellulam parietem hospitis profunde constrictae. Paries ad later 20–40 µm crassus, ad basim lateralem ex cellulis parappelis constans, basi reducta. Asci obclavati, 90–110 × 23–27 µm, breviter pedicellati usque ad 15 µm longi. Pseudoparaphyses 1.5–2 µm crassae. Ascosporae ellipsoideae, 17–23 × 7–10 µm, atrobrunneae, unisepattae, ornamento reticulato in facie, vaginis mucilaginosis obtectae.*

**Etymology:** In reference to the reticulate ornamentation on ascospores

**Holotype:** TAIWAN. NANTOU HSIEN: Piluchi, on unknown twigs, Aug. 1999, C.L.Wang, *TNM F19959*.

Ascomata scattered, immersed at first, then erumpent through torn fissure of host, conical, 320–450 µm wide, 180–220 µm high, apex rounded; hyphae

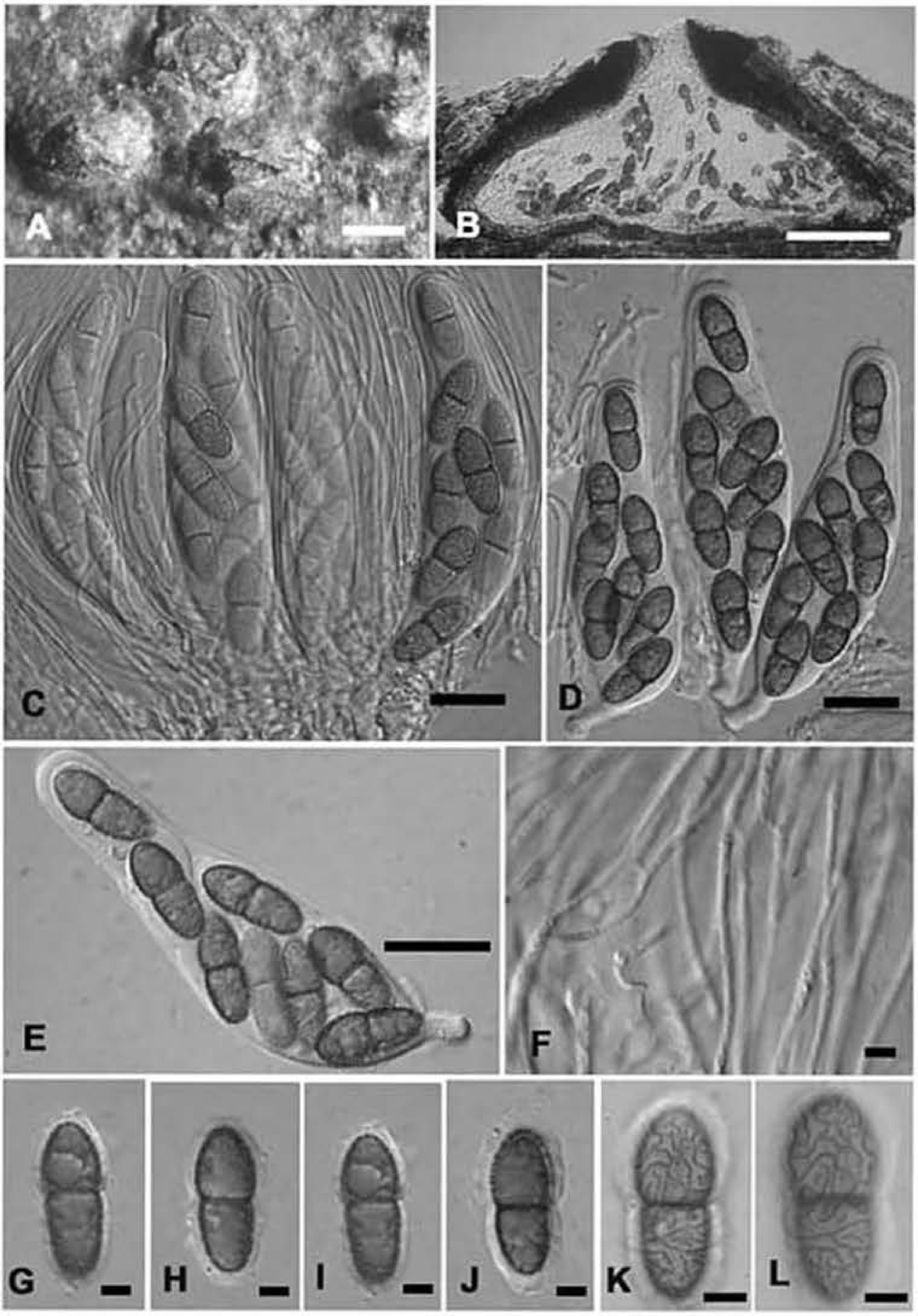


Figure 1. *Kirschsteiniothelia reticulata* (from holotype). A. Ascomata on host surface. B. Section of ascoma. C–E. Asci. F. Pseudoparaphyses. G–L. Ascospores.

Scale bars, A = 200 µm; B = 100 µm; C–E = 20 µm; F–L = 5 µm.

intercellular and intracellular in host, broad, 3–5 µm wide, deeply constricted where crossing host cell wall. Peridium 20–40 µm thick at sides, composed of cells forming a textura angularis, thickened around ostiolar canal and at lateral rim where cells usually arranged in palisade-like rows, at base reduced, usually merged with underlying host tissue. Asci obclavate, 90–110 × 23–27 µm, with a short stalk up to 15 µm long. Pseudoparaphyses frequently branched and anastomosing, 1.5–2 µm wide. Ascospores ellipsoid, 17–23 × 7–10 µm, dark brown, 1-septate, septum constricted, median or occasionally slightly deviating from middle, with reticulate ornamentation on surface, covered with mucilaginous sheath.

Notes: This species is characterized by ascospores ornamented with a reticulum of small ridges. It is an unique character previously not found in *Kirschsteiniothelia*. In *Kirschsteiniothelia*-related genera, this character only occurs in *Roussoella scabrispora* (Höhn.) Aptroot. However, judging from the illustration provided by Aptroot (1994), *R. scabrispora* is different in the shape of ascospores, which have no sheath and constriction.

***Kirschsteiniothelia smilacis*** Chi Y. Chen, C.L. Wang & J.W. Huang, **sp. nov.**

MycoBank 510241 Fig. 2

*Ascomata dispersa, similiter superficialia, extere e epidermide tenui obsita, conica, 450–600 µm lata, 200–300 µm alta, ad apicem rotundata. Hyphae in matrice intercellulosae, 2.5–4 µm latae, per cellulam parietem hospitis tenuiter filiformes. Paries 35–50 µm crassus, ex cellulis opacis, denigrates compositus, ad basem debiliter evolutus. Asci obclavati, 75–100 × 16–21 µm, breviter pedicellati usque ad 10 µm longi. Pseudoparaphyses 1–2 µm crassae. Ascosporae ellipsoideae, 20–24 × 6–8 µm, pallide brunneae, uniseptatae, ad septum leniter constrictae, inconspicue verrucosae, strato mucilagino indutae.*

**Etymology:** From the host genus *Smilax* (*Smilaceae*).

**Holotype:** TAIWAN. NANTOU HSIEN: Tsuifeng, on stem of *Smilax* sp., 15 Oct. 2002, C.Y. Chen, *TNM F19960*.

Ascomata scattered, superficial in appearance, externally covered with a thin layer of host epidermis, conical, 450–600 µm wide, 200–300 µm high, apex rounded; hyphae intracellular in host, broad, 2.5–4 µm wide, becoming thread-like crossing host cell wall. Peridium 35–50 µm thick, composed of opaque melanized cells, poorly developed at base where cells usually integrate with host tissue. Asci obclavate, 75–100 × 16–21 µm, short-stalked, stalk up to 10 µm long. Pseudoparaphyses 1–2 µm wide, frequently anastomosing and branched. Ascospores ellipsoid, 20–24 × 6–8 µm, pale brown, 1-septate, slightly constricted at septum, wall finely and inconspicuously verrucose, covered with mucilaginous sheath.

**Other specimen examined:** TAIWAN. NANTOU HSIEN: Meifeng, on stem of *Smilax* sp., 2 Nov. 2005, C.Y. Chen, *NCHUPP c1105*.

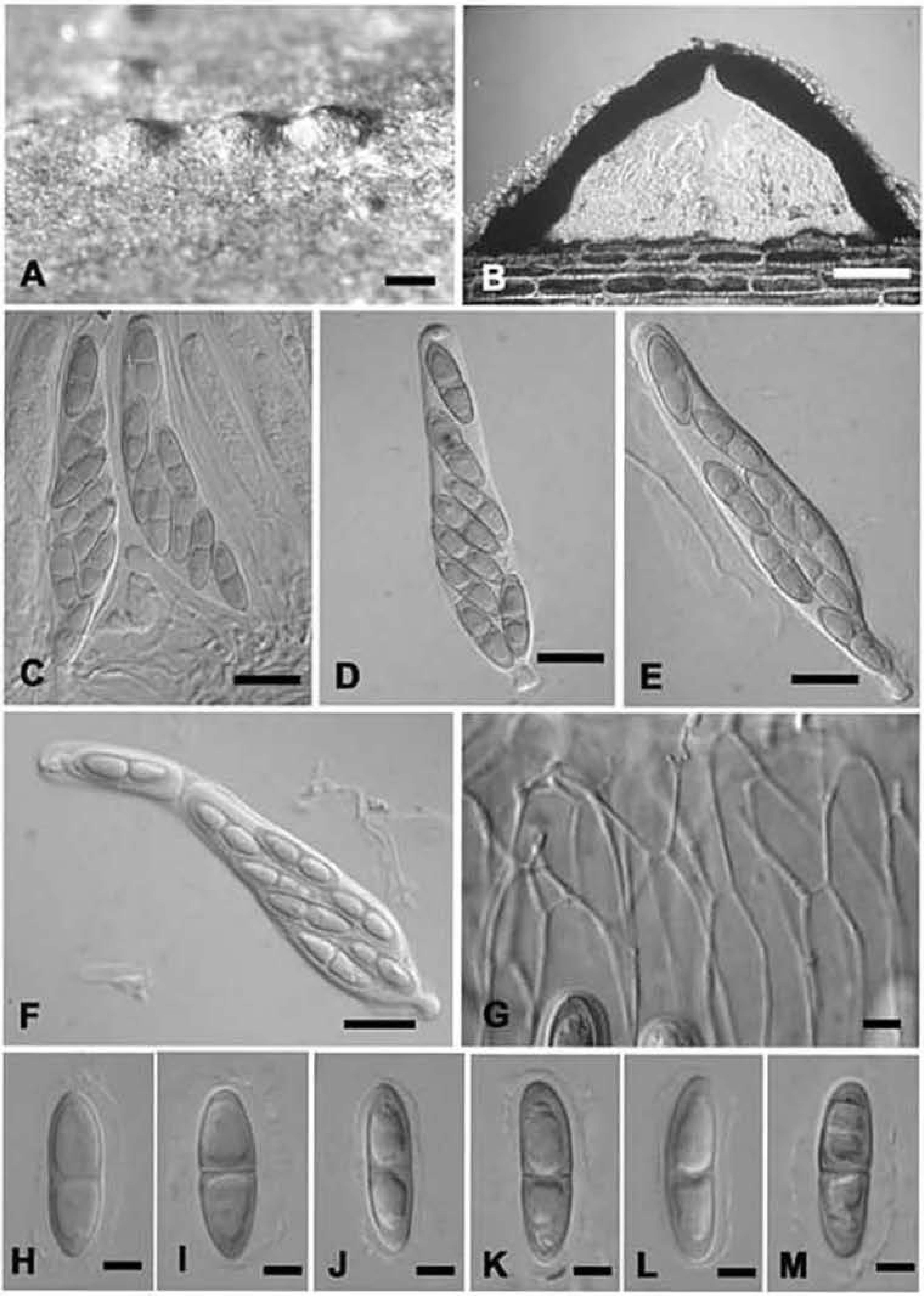


Figure 2. *Kirschsteiniothelia smilacis* (from holotype). A. Ascomata on host surface. B. Section of ascoma. C–F. Asci. G. Pseudoparaphyses. H–M. Ascospores.
Scale bars, A = 300 µm; B = 100 µm; C–F = 20 µm; G–M = 5 µm.

Notes: *Kirschsteiniothelia smilacis* occurs on the plant genus *Smilax*, not the bamboos or palms that are common hosts for *Astrosphaeriella* species (Chen & Hsieh 2004b Hyde & Fröhlich 1998).

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# Aphyllophoraceous wood-inhabiting fungi on *Arbutus unedo* in Italy

Sergio Pérez Gorjón[1], Annarosa Bernicchia[2] & Tatiana Baptista Gibertoni[3]

[1]*spgorjon@usal.es* [2]*abernicc@agrsci.unibo.it* [3]*tbgibertoni@hotmail.com*

[1]*Departamento de Botánica & Centro Hispano-Luso de Investigaciones Agrarias*
*Universidad de Salamanca*
*Ldo. Méndez Nieto s/n, 37007 Salamanca, Spain*

[2]*Dipartimento di Scienze e Tecnologie Agroambientali,*
*Patologia Vegetale Università degli Studi di Bologna*
*Via Fanin 42, Bologna 40127 Italy*

[3]*Departamento de Micologia, Centro de Ciências Biológicas*
*Universidade Federal de Pernambuc*
*Av. Nelson Chaves s/n, 50670-420, Recife, Pernambuco, Brasil*

**Abstract**—Fifty-two species representing 32 aphyllophoraceous genera growing on *Arbutus unedo* in Italy are reported. *Phlebia longicystidiata* is reported as new from Italy while *Antrodia sandaliae* has previously been described as a new species associated with *A. unedo*. The complete checklist of fungi is available on http://www.mycotaxon.com/resources/weblist.html.

**Key words**—lignicolous fungi, diversity, Mediterranean, *Ericaceae*

## Introduction

Italy, except for the north and mountainous areas, has a typically Mediterranean climate characterized by cold, rainy winters and dry summers that supports a particular vegetation type, called a sclerophyll forest, composed of trees and shrubs with hard leaves that are very resistant to changes in temperature and humidity. One of the most representative sclerophyllous plants is *Arbutus unedo* L. (*Ericaceae*), a 5-10 m tall evergreen shrub or tree with a variable trunk diameter that may be found growing on rocky slopes and (generally) acid soils. It often forms maquis, isolated or mixed with other plants, occasionally forming dense woods. *Arbutus unedo* is of great importance for the dynamics of vegetation because it grows rapidly after fires. The mild temperature and high environmental dampness are very important features that allow the development of large number of fungi. *Arbutus* woods, however, have not

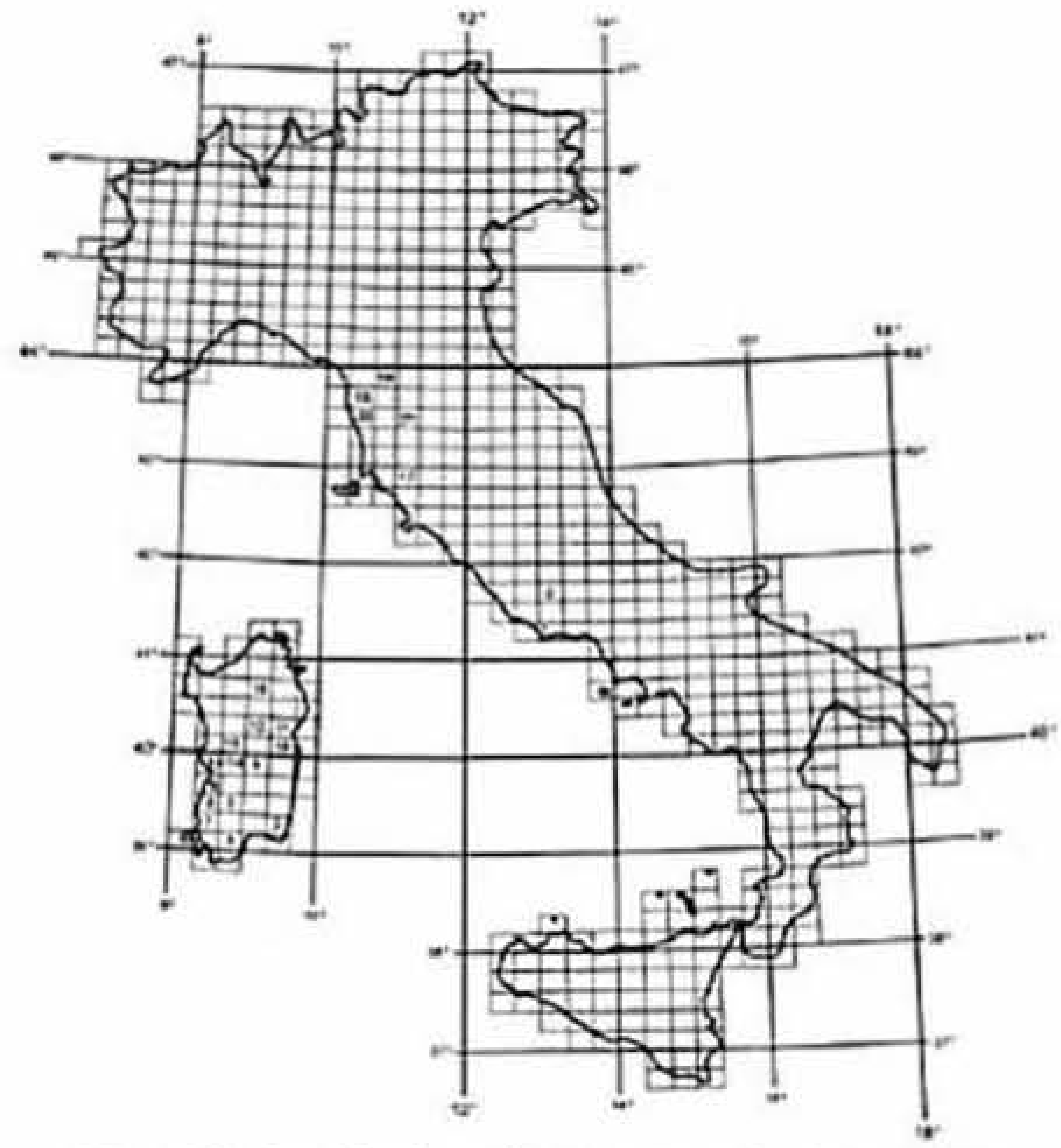

Map of approximate distribution of *Arbutus unedo* in the Mediterranean area

been well investigated from the mycological point of view and only scattered information can be found in literature. The distribution *Arbutus unedo* is limited to temperate zones, mainly in the Mediterranean region that includes Turkey and northern Africa (Figure 1). In Italy, *A. unedo* occurs naturally at the 500 m.a.s.l. elevation, although it may also be found until 1200 meters in some southern areas. The species is distributed throughout the islands and along the coastal zone, except for the North Adriatic area.

## Materials and methods

During the last 25 years, fungi have been collected in the sites listed below. Samples were taken to the laboratory for microscopical examination and identifications followed Eriksson & Ryvarden (1973, 1975, 1976), Eriksson et al. (1978, 1981, 1984), Burdsall (1985), Hjortstam et al. (1988), Ryvarden & Gilbertson (1993, 1994), Bernicchia (2005), and Miettinen et al. (2006). All specimens are kept in Herbarium HUBO. The list is partially referred to Onofri (2005) and the nomenclature to Donk (1984), Parmasto (1997), Hjortstam (1998), Kirk et al. (2001), and CBS (2006).

**Collection localities** (see also Figure 2): Collections were taken from the following sites—(1) Lazio, Latina, National Park of Circeo; (2) Lazio, Roma, San Martino al Cimino; (3) Sardegna, Cagliari, Campu Omu; (4) Sardegna, Cagliari, Capoterra; (5) Sardegna, Cagliari, Collinas; (6) Sardegna, Cagliari, Gentilis; (7) Sardegna, Cagliari, Is Antiogus; (8) Sardegna, Cagliari, Sibiri; (9) Sardegna, Nuoro, Montarbu Forest; (10) Sardegna, Nuoro, Piana di Urzulei; (11) Sardegna, Nuoro, Pinery Arzana; (12) Sardegna, Nuoro, Supramonte di Orgosolo; (13) Sardegna, Oristano, Arci Mountain, (14) Sardegna, Oristano, Arci Mountain, Pau; (15) Sardegna, Oristano, Sossu Mountain; (16) Sardegna,



Map of Italy with the collecting sites. Scale 1:50000

Sassari, Badde Longa; (17) Toscana, Grosseto, Amiata Mountain; (18) Toscana, Livorno, Colognole; (19) Toscana, Livorno, Il Giardino Forest; (20) Toscana, Livorno, Bibbona Forest; (21) Toscana, Siena, Santa Agnese *Cupressus* Forest.

## Results

In this survey, 52 species of aphyllophoraceous wood-inhabiting fungi representing 32 different genera were identified as occurring on *Arbutus unedo*. Species are listed in alphabetic order; each site number (given in brackets) is followed by collection date, habitat, and herbarium number. Additional notes on distribution or abundance are given for some species. *Phlebia longicystidiata* is reported as a new record from Italy. Particularly rare or infrequent species are *Aleurodiscus cerussatus, Antrodia sandaliae, Intextomyces contiguus, Junghuhnia semisupiniformis, Mycoaciella bispora, Oligoporus simanii, Peniophora pilatiana, Phellinus rosmarini* and *Scytinostromella heterogenea*.

## Conclusions

From an ecological point of view, the *Arbutus* maquis fulfil a series of suitable conditions for the development of lignicolous fungi and support high fungal diversity. Although many of the aphyllophoraceous wood-inhabiting fungi listed above may also be found growing on conifers and other deciduous trees, at least one recently described species, *Antrodia sandaliae*, is expected to be found exclusively on *Arbutus unedo*, which makes this substrate worthwhile for mycological surveys.

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We would like to thank Prof. Giuseppe Venturella and Dr. Ireneia Melo for critically reviewing the manuscript. The first author is supported by a research grant co-financed by the *European Social Fund* and the *Junta de Castilla y León* (Spain).

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# *Lysurus pakistanicus*, a new species of *Phallales* from Pakistan

S. H. Iqbal[1], T. Kasuya[2], A. N. Khalid[1] & A. R. Niazi[1]

nasir@botany.pu.edu.pk
[1]Department of Botany, University of the Punjab, Lahore 54590, Pakistan
s0310849@ipe.tsukuba.ac.jp
[2]Laboratory of Plant Parasitic Mycology, Institute of Agriculture and Forestry, University of Tsukuba, Tsukuba, Ibaraki 305-8572, Japan

**Abstract**—A new species of a phalloid mushroom, *Lysurus pakistanicus*, is described from Lahore, Pakistan, based on its morphological characteristics.

**Key words**—gasteromycetes, lawn

## Introduction

The phalloid genus, *Lysurus* Fr. is morphologically characterized by long-stipitate receptacles bearing vertical arms that may or may not be united transverse arms and with or without glebiferous processes emerging from the junctions (Dring 1980). This genus was monographed by Dring (1980) with only five species. Although *L. cruciatus* (Lepr. & Mont.) Henn. and *L. periphragmoides* (Klotszch) Dring were hitherto recorded for Pakistan (Ahmad 1939, 1952; Ahmad et al. 1997), this genus has not yet been comprehensively studied. During the floristic investigations of macromycetes of Pakistan (Iqbal & Khalid 1996; Khalid & Iqbal 1995, 1996, 2004), an undescribed *Lysurus* was collected on lawn of the campus of University of the Punjab, Lahore. In this article, we describe this fungus as a new species based on results of morphological observations.

## Materials and Methods

The material examined in this study is deposited in the Mycological Herbaria of the Department of Botany, University of the Punjab, Lahore, Pakistan (SHI) and the National Science Museum, Tokyo, Japan (TNS). Macroscopic characters were described by observations on fresh materials. For light microscopic observations, free-hand sections of gleba and peridium were mounted in water and 1% (w/v) cotton-blue lactophenol on glass slides. Forty randomly selected basidiospores were measured under a light microscope at 1000x magnification.

## Taxonomy

***Lysurus pakistanicus*** S. H. Iqbal, Kasuya, Khalid & Niazi, **sp. nov.**
MycoBank MB 510257 **Figs. 1-3**

*Ovo subgloboso vel ovoido, 18-25 x 20-30 mm diametro, epigaeo, albo vel cremeo-flavido. Gleba gelatinosa, obscura olivaceo-brunnea. Receptaculo formanti pseudostipite 50 mm alto, 15 mm lato in apice, 6 mm lato basi, cylindrico, infra angustato, pallido-flavo, flexo levilter, spongioso, fragili, cum reticulio clathrato globoso vel hemisphaerico 10-30 x 10- 25 mm diametro, formanti brachia anastomosanti 6-10 ex loculo tubulato singulari, salmonio primum, aurantiaco-persicino in maturatione, denique expansis admodum. Basidiosporis ellipsoidis, 1.75-2.15 µm x 3.85-5.25 µm, paginis laevis, hyalinis. Odore foetida levilter.*

**Holotypus:** *Pakistan, Lahore, University of the Punjab, Quaid-e-Azam Campus, June 30, 2006, M. Rafi leg., Rafi #630 (SHI).*

**Etymology:** The Latin *pakistanicus*, derived from Pakistan.

**Basidioma** solitary, fully expanded at maturity. **Egg** stage 18-25 x 20-30 mm in diameter subglobose to ovoid, epigeal, white to cream or yellowish, arising from a white mycelial strand that is 20 mm long, 2 mm thick. **Peridium** whitish, surface papery, inner fleshy, easily breakable, with hyaline, gelatinous endoperidium. **Gleba** gelatinous, dark olivaceous brown, at first fills the entire interior of the arms and extends outwards in the meshes. **Receptacle** a pseudostipe, 50 x 15 mm diam. near apex and 6 mm diam. near base, cylindrical, tapering below, pale yellow, slightly bending, spongy, hollow, covered with thin papery layer; wall of receptacle composed of up to 2-layered, numerous polygonal chambers. Apical receptacle as a irregular, globose to hemispherical, 10-30 x 10-25 mm in diameter clathrate network of anastomosing arms, with about 6-10, irregular to elongated meshes, salmon rosy at first, becoming orange pink at maturity. **Arms** triangular in section, each consisting of single, wide tube, transversely keeled outer and inner, fully opened at ultimate maturity. **Smell** weak, foetid.

**Basidiospores** 1.75–2.15 x 3.85-5.25 µm, elliptical, smooth, thick-walled, hyaline. **Basidia** not observed.

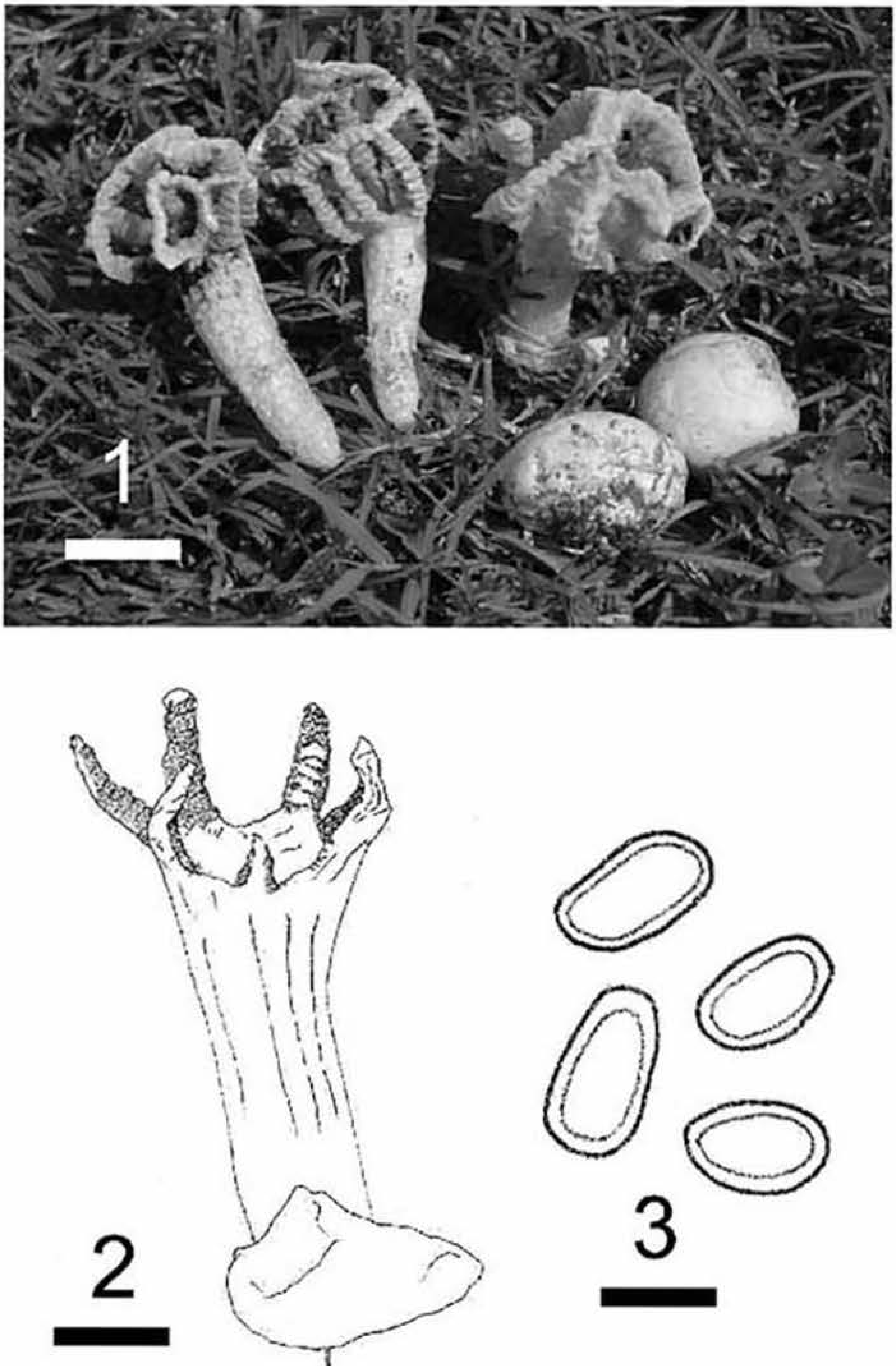
**Habitat:** Terrestial in grass lawns.

**Distribution:** Known only from Pakistan (Lahore).

**Materials examined:** Pakistan, Lahore, University of the Punjab, Quaid-e-Azam Campus, June 30, 2006, M. Rafi, Rafi #630 (SHI, holotype), TNS-F-12540 (isotype); July 6, 2006, M. Rafi, Rafi #631 (SHI); August 2, 2006, M. Rafi, Rafi #632 (SHI).

## Discussion

Two species of *Lysurus* have a receptacle that surmounts a clathrate network: *L. periphragmoides*, from pantropical to warm-temperate areas of the world




**Figs. 1-3.** *Lysurus pakistanicus.* **1:** Immature (on the right) and young (on the left) basidiomata. **2:** Mature basidioma. **3:** Basidiospores.
*Bars* **1-2:** 10 mm, **3:** 3 µm (from Rafi #630, SHI, holotypus).

(Conrad 1913, Long & Stouffer 1948, Dring 1980, Dominguez de Toledo 1995), and *L. corallocephalus* Welw. & Curr., known only from tropical Africa (Dring 1964, 1980). While the receptacle of *L. pakistanicus* is morphologically very similar to *L. periphragmoides*, both can easily be separated based on clathrate head, shape and size of the pseudostipe, and basidiospore length. In the former, the hollow, narrowly obconical pseudostipe bears an irregularly oblong to hemispherical clathrate network of mesh, while in the latter the head of the receptacle is subglobose or ovoid. The meshes formed by the anastomosis of the arms are irregular to cylindrical, up to 10 in number in *L. pakistanicus* but reaching 100 in *L. periphragmoides*. The meshes in *L. periphragmoides* are isodiametric and pentagonal to hexagonal. The size of the netted clathrate head is 10 mm longer in *L. periphragmoides*. *L. periphragmoides* is further distinguished by having a geranium pink pseudostipe that is twice as long as that possessed by *L. pakistanicus*. Basidiospores of *L. periphragmoides* are similar, 1.5-2 x 4-4.5 µm (Dring 1980).

*Lysurus corallocephalus*, with its white to yellowish receptacle surmounting a clathrate network, also morphologically resembles *L. pakistanicus*. However, *L. corallocephalus* is well distinguishable in possessing a network bearing erect, simple or branched, coralloid appendages at intersection of arms, and gleba located on the outer arm surfaces.

*Lysurus cruciatus*, with a worldwide distribution (Bottomley 1948, Dring 1980), can also be considered close to *L. pakistanicus* for their pseudostipe. Both species produce a narrowly obconical pseudostipe, but that of *L. cruciatus* is 2 times longer than *L. pakistanicus*. Both can also be separated on the basis of the mature receptacle. In *L. cruciatus* the pseudostipe is surmounted by 4–7 vertical columns that are usually free at their tips and tending to curve away from the axis (Dring 1980). In case of *L. pakistanicus*, clathrate netted head is composed of meshes that have been formed by the anastomosis of arms. The arms of *L. cruciatus* are smooth on the adaxial surface but strongly grooved down the entire adaxial surface (Dring 1980). Basidiospores in *L. cruciatus* are elliptical to cylindrical, 1.5-2 x 4-4.5 µm long (Dring 1980).

The present fungus is characterized by basidiomata that are 68–75 mm tall with pale yellow, narrowly obconical pseudostipes that are surmounted by irregularly globose to hemispherical clathrate networks of anastomosing arms. The meshes formed by the arms are irregular to oblong, cylindrical, up to 10 in number, and salmon rosy to orange pink. Also diagnostic are the open arms at ultimate maturity. Finally, after complete morphological observations of Pakistani specimens and literature review of *Lysurus*, we concluded that the above characteristics justify the introduction of a new species, *L. pakistanicus*.

## Key to the species of *Lysurus*

1. Receptacle surmounts a clathrate network .................................... 2

1'. Receptacle surmounts simple erect arms .................................... 4

2. Network devoid of coralloid appendages. Gleba located on inner surface and side of the arms .................................................... 3

2'. Network bearing erect simple or branched, coralloid appendages at intersection of arms. Gleba located on outer surface of the arms ............ *L. corallocephalus*

3. Network irregularly oblong to hemispherical, consists of up to 10 meshes. A pseudostipe of receptacle is pale yellow. Basidiospores 1.75-2.15 x 3.85-5.25 µm ............................................ *L. pakistanicus*

3'. Network subglobose to ovoid, consists of up to 100 meshes. Pseudostipe is geranium pink. Baisdiospores 1.5-2 x 4-4.5 µm .................. *L. periphragmoides*

4. Pseudostipe 4-6-angled, arms often attached a sterile pointed apex ..... *L. mokusin*

4'. Pseudostipe cylindrical to obconical, arms often becoming free at the apex ...... 5

5. Arms with a well marked, narrow, sterile base. Basidiospores elliptical, 1.5 x 4-5 µm ................................................... *L. gardneri*

5'. Arms without sterile base. Basidiospores elliptical to cylindrical, 1.5-2 x 4-4.5 µm. .. ................................................... *L. cruciatus*

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# Two new species of *Mycosphaerella* on milk tree, *Sapium glandulosum*, from Brazil

DARTANHA J. SOARES, DOUGLAS F. PARREIRA & ROBERT W. BARRETO

*dartjs@yahoo.com.br*

*Departamento de Fitopatologia, Universidade Federal de Viçosa*
*Viçosa, Minas Gerais, 36570-00, Brazil*

**Abstract**—Two new species of *Mycosphaerella* (*Ascomycota, Mycosphaerellaceae*) are described on *Sapium glandulosum* from Brazil. Both *Mycosphaerella sapiicola* and *M. sapii* differ in ascospore shape and size from the other species of *Mycosphaerella* described on *Sapium* (*M. sodiroana*). An anamorph belonging to *Septoria* was also found associated with *M. sapii*. The type of *M. sodiroana* was reexamined and is illustrated here for the first time.

**Key words**—*Alchornea sodiroi*, fungal diversity, mycobiota, *Sapium aucuparium*, tropical fungi

## Introduction

*Sapium glandulosum* (L.) Morong (milk tree) belongs to the *Euphorbiaceae* and is native to and widespread in Central and South America (Kruijt 1996). It has potential as an ornamental tree (Lorenzi 2002) but it is best known for being poisonous to mammals (Lampe & McCann 1985). Although widely distributed, little is known about its mycobiota. A literature survey yielded eight fungal records on this host and its synonyms: *Cercospora sapiicola* Speg., *Cytosporina sapii* Speg., *Uromyces cisneroanus* Speg., *Uromyces globosus* Dietel & Holw., *Zygosporium* sp. (Farr et al. 2006), and *Helminthosporium guaraniticum* Speg., *Microthyriella rimulosa* (Speg.) Theiss., *Sphaeropsis sapii* (Speg.) Sacc. (Viégas 1961). None of these records were from Brazil (Mendes et al. 1998, Silva & Minter 1995) except for *U. cisneroanus* which was recorded on *Sapium* sp. (cf. *aucuparium*) in the states of São Paulo and Rio de Janeiro (Lindquist 1982, Hennen et al. 2005).

Knowledge of the Brazilian mycodiversity in general, and particularly of the state of Minas Gerais (MG), is still scarce. Surveys of fungi associated with native plants, with particular reference to Viçosa-MG and neighboring areas have been on-going since 2003, resulting in some newly-discovered fungal taxa and fungus-host associations (Pereira & Barreto 2006, Pereira et al. 2006, Soares et al. 2006a, Soares et al. 2006b, Soares & Barreto 2005, Vieira et al. 2005).

In July 2004, during a survey in the natural reserve 'Parque Estadual da Serra do Brigadeiro' in the state of Minas Gerais (Brazil), plants identified as *S. glandulosum* were found showing two distinct types of foliar spots. In a preliminary examination, both spots had fruit bodies of *Mycosphaerella* (*Ascomycota, Mycosphaerellaceae*) consistently associated with them. After a more detailed examination, it was found that distinct species were associated with each kind of leaf spot, one of which was also producing a *Septoria* anamorph.

Although about twenty-eight species and one variety of *Mycosphaerella* have been recorded in the family *Euphorbiaceae* (Sivanesan & Shivas 2002, Farr et al. 2006), only one species has been described previously on '*Sapium*', viz. *Mycosphaerella sodiroana* Petr., on '*Sapium sodiroi*' from Ecuador (Petrak 1950). However, as the epithet '*sodiroi*' is not listed under the genus *Sapium* in either the Missouri Botanical Garden (W3Tropicos 2006) or in the International Plant Names Index (IPNI 2006), it is probable that the plant Petrak designated as '*S. sodiroi*' was *Alchornea sodiroi* Pax & K. Hoffm. (*Euphorbiaceae*), an Ecuadorian endemic (S. Pennycook pers. comm. 2006). However the status of '*Sapium sodiroi*', cannot be resolved here, and this would require a molecular study since only leaves are present in Petrak's type. Therefore, until future evidence is forthcoming we must accept that *M. sodiroana* is on a *Sapium* host and that this is still the only recognized *Mycosphaerella* species on that host genus. The fungi from the Serra do Brigadeiro were found to be distinct from *M. sodiroana* and are described below.

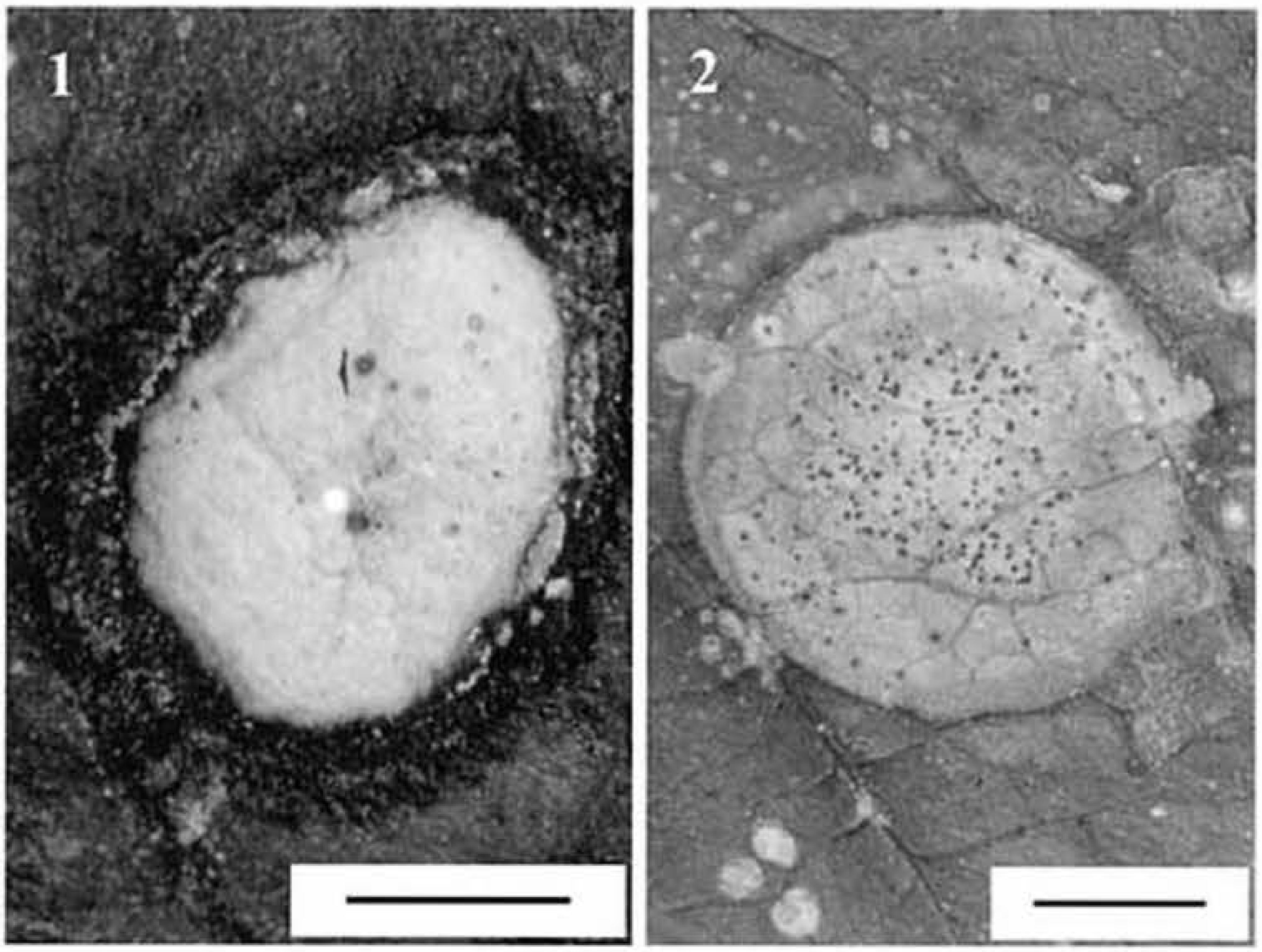
## Material and methods

Infected leaves of *Sapium glandulosum* were collected from this tree host in a stretch of Atlantic rainforest in the Serra do Brigadeiro. The samples were dried in a plant press and later examined under a dissecting microscope. Semi-permanent slides containing hand-free or cryomicrotome sections of the fungal structures were mounted using lactophenol or lacto-fuchsin and sealed with nail varnish. Observations, measurements and line drawings were prepared with an Olympus BX 50 light microscope fitted with a drawing tube. Representative specimens of the fungi were deposited in the herbarium at the Universidade Federal de Viçosa (Herbarium VIC).

## Taxonomic description

***Mycosphaerella sapii*** D.J. Soares, Parreira & R.W. Barreto, **sp. nov.**
MYCOBANK MB510072 **(FIGS 1, 5 and 6)**

*Differt a M. sodiroana macullae amphigenae, albidae, cum margine nigrae incrassatae elevatae. Ascomata singularia, 70–250 µm diam., asci 56–74 × 10–13.5 µm. Ascosporae 14–19 × 3–4 µm. Conidiomata pycnidial, 60–150 µm diam. Cellulae conidiogenae,*




Figs. 1-2. Symptoms of *Mycosphaerella sapii* (1) and *Mycosphaerella sapiicola* (2) ex type. For details see text. Scale bars = 5 mm.

*phialidicae, ampulliformis vel subcylindricae, hyalinae, 6.5–13.5 × 1.5–3.5 µm. Conidia cylindricae, hyalinae, pluriseptata, 34–65 × 1.5–2 µm.*

Anamorph: ***Septoria*** sp.

Etymology: named in reference to host genus.

Holotype: Brazil, state of Minas Gerais, Araponga, Serra do Brigadeiro, 20°35'26" S 42°24'07" W, on *Sapium glandulosum*, July 2004, D.J. Soares (VIC-29380).

Leaf spots amphigenous, circular to subcircular or elliptic, 2.5–8 mm wide, separate, whitish, surrounded by a thick and raised black border. *Pseudothecia* epigenous, single, scattered, globose to subglobose, 70–250 µm diam., brown, subepidermal becoming erumpent, walls of 3–5 layers of brown *textura angularis* cells. *Asci* fasciculate, bitunicate, aparaphysate, eight-spored, obclavate to cylindrical, widest above the middle, sessile to short pedicellate, straight to slightly curved, 56–74 × 10–13.5 µm. *Ascospores* biseriate to inordinate, overlapping, fusiform, with subacute ends, 14–19 × 3–4 µm, thick-walled, hyaline, 1-septate, guttulate. *Conidiomata* pycnidial, globose, subepidermal, becoming erumpent, 60-150 µm diam., apical ostiole 5–7 µm diam., thin-walled, 3–3.5 µm, with light brown *textura angularis* cells. *Conidiophores* reduced to *conidiogenous cells*, phialidic, ampulliform to subcylindrical, 6.5–

13.5 × 1.5–3.5 µm, hyaline. *Conidia* cylindrical, straight to sinuous, 34–65 × 1.5–2 µm, multiseptate, mostly 4–7 septate, hyaline.

**Comments** — This species is easily distinguished from *M. sodiroana* by ascospore size (Table 1). Only few foliar lesions containing material belonging to this taxon were found, and under the dissecting microscope it was impossible to distinguish pseudothecia from pycnidia, but it was observed that pseudothecia were more commonly found in the center of the lesions whereas the pycnidia were more abundant near the edges. According to Sutton (1980), the type species of *Septoria* (*S. cytisi* Desm.) has holoblastic sympodial conidiogenesis, but holoblastic development and no sign of sympodial or percurrent proliferation, as well as phialides were also recorded. Therefore, Sutton considered *Septoria* as heterogeneous.

Recent molecular studies demonstrate that roughly at least three lineages are present in the genus *Septoria* and that it is not monophyletic within *Mycosphaerella* (Verkley et al. 2004). Distinct conidiogenesis, percurrent and sympodial proliferation, even in a single conidiogenous cell, can occur; although the conidiogenous cells of the anamorph of *M. sapii* are described as phialidic, it is possible that we are misinterpreting "cryptically proliferating cells, which under the light microscope easily can be mistaken for phialides" as reported for *S. chrysanthemella* (Verkley 1998). Moreover a recent study (Priest 2006) accepted four distinct conidiogenous cell events for the genus *Septoria*: holoblastic simple, holoblastic sympodial, enteroblastic non-progressive and enteroblastic percurrent. At the present no new arrangement, for *Septoria* species with conidiogenesis cells distinct from that of *Septoria cytisi*, has been proposed, so the placement of the anamorph of *M. sapii* in the genus *Septoria* was based on *Septoria* sensu Sutton (1980) that also includes taxa with apparently non-proliferating, phialidic conidiogenous cells.

***Mycosphaerella sapiicola*** D.J. Soares, Parreira & R.W. Barreto, **sp. nov.**
MYCOBANK MB510073 (FIGS 2-3)

*Differt a M. sodiroana macullae amphigenae, brunneae. Ascomata singularia, 65–110 µm diam. Asci 28–30.5 × 6.5–7.5 µm. Ascosporae, non constrictae, latissime at septum, 10–15.5 × 2–2.5 µm, biseriatae vel inordinate.*

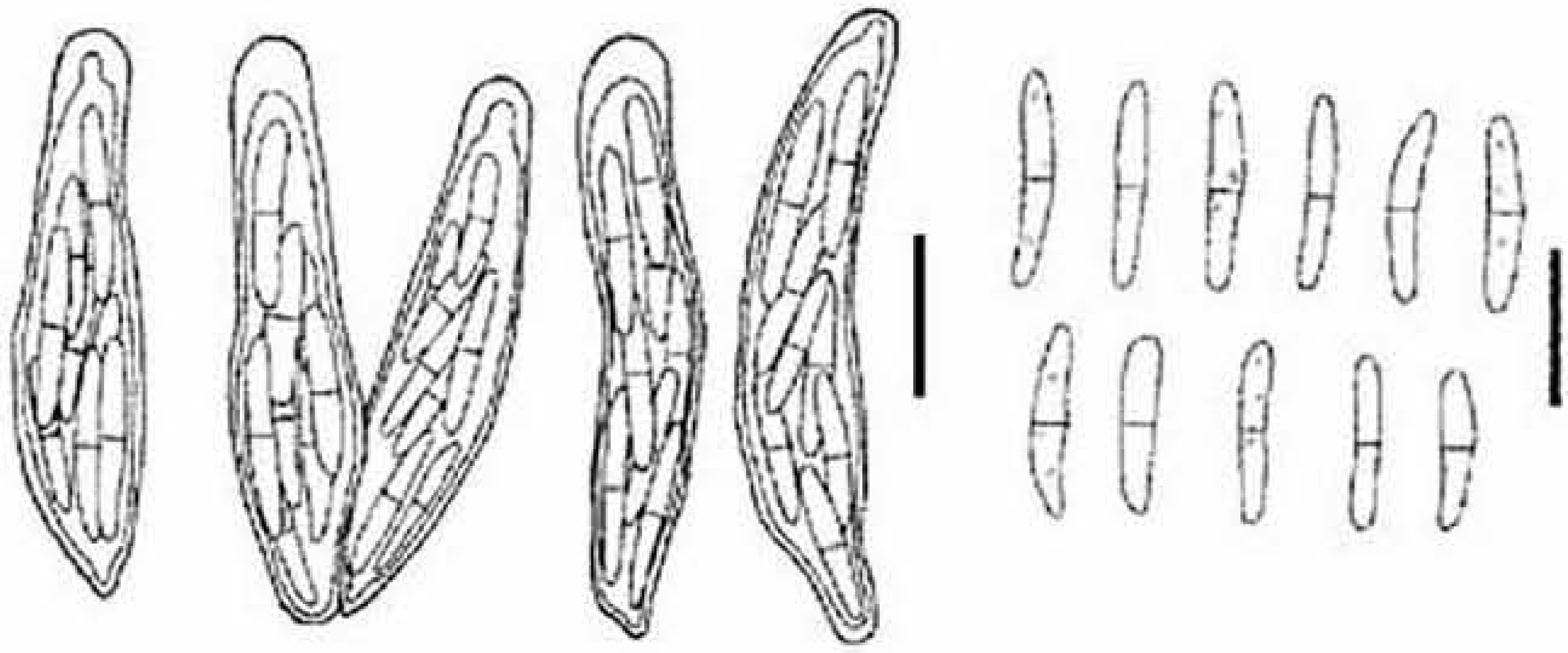
Etymology: named in reference to host genus.

Holotype: Brazil, state of Minas Gerais, Araponga, Serra do Brigadeiro, 20°35'26" S 42°24'07" W, on *Sapium glandulosum*, July 2004, D.J. Soares (VIC-29380).

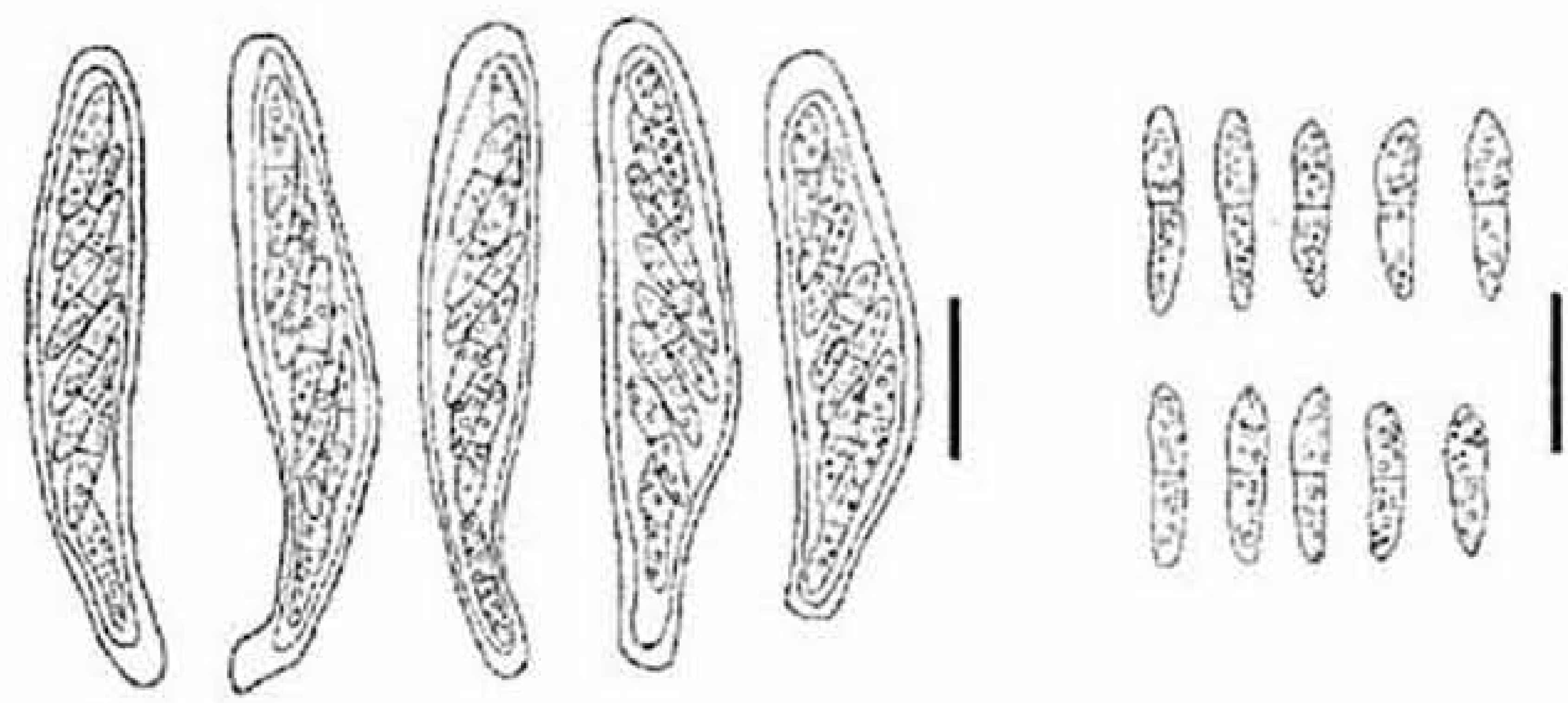
*Leaf spots* amphigenous, circular to subcircular, 3.5–19 mm wide, separate, grey to pale brown with a thin, dark brown border. *Pseudothecia* epigenous,

Figs. 3-5. Line drawing of *Mycosphaerella* spp. on *Sapium* spp. ex type. 3- Asci and ascospores of *Mycosphaerella sapiicola*; 4- Asci and ascospores of *Mycosphaerella sodiroana*; 5- Asci and ascospores of *Mycosphaerella sapii*. Scale bars = 10 µm.

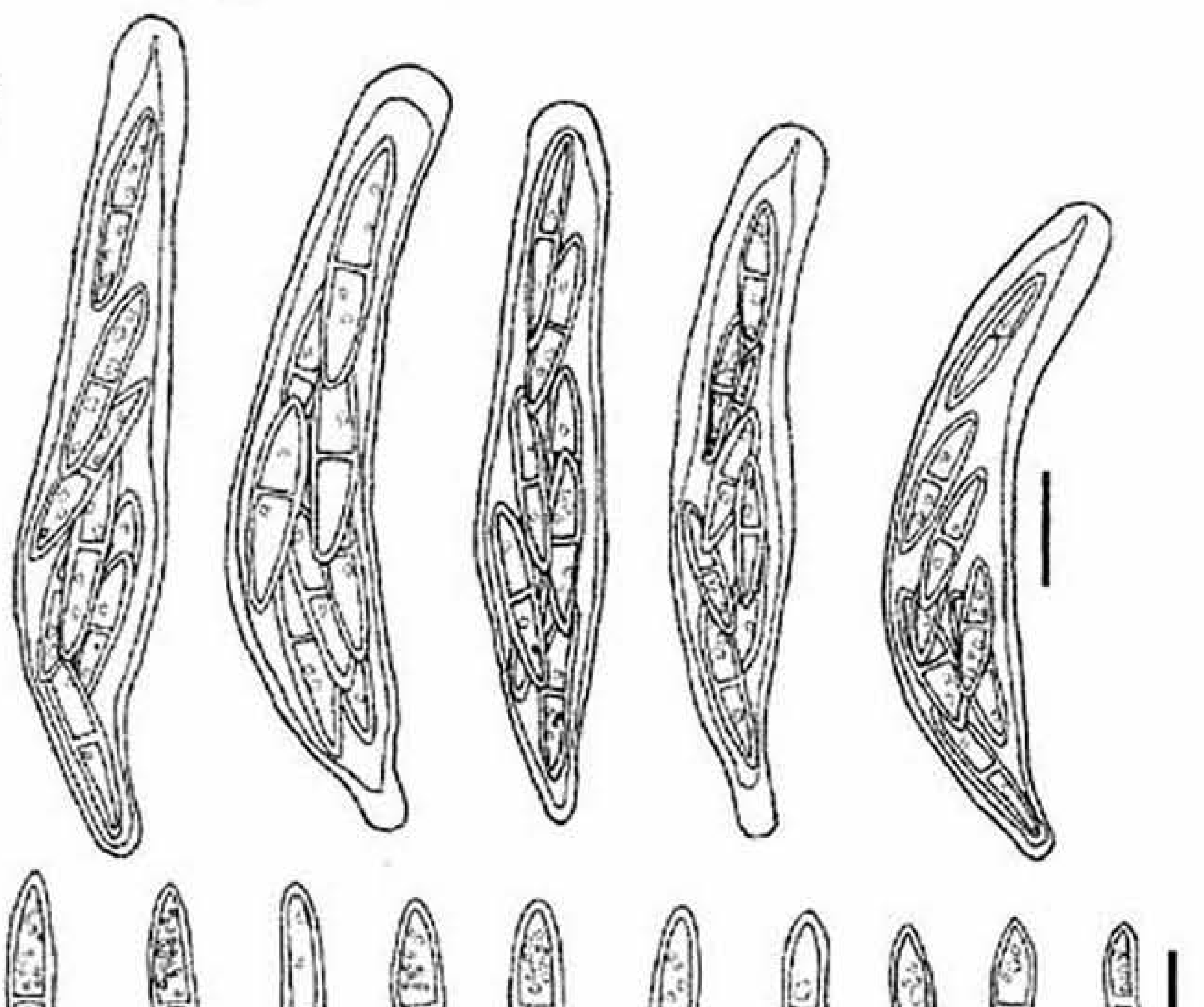
**3**



**4**



**5**



6

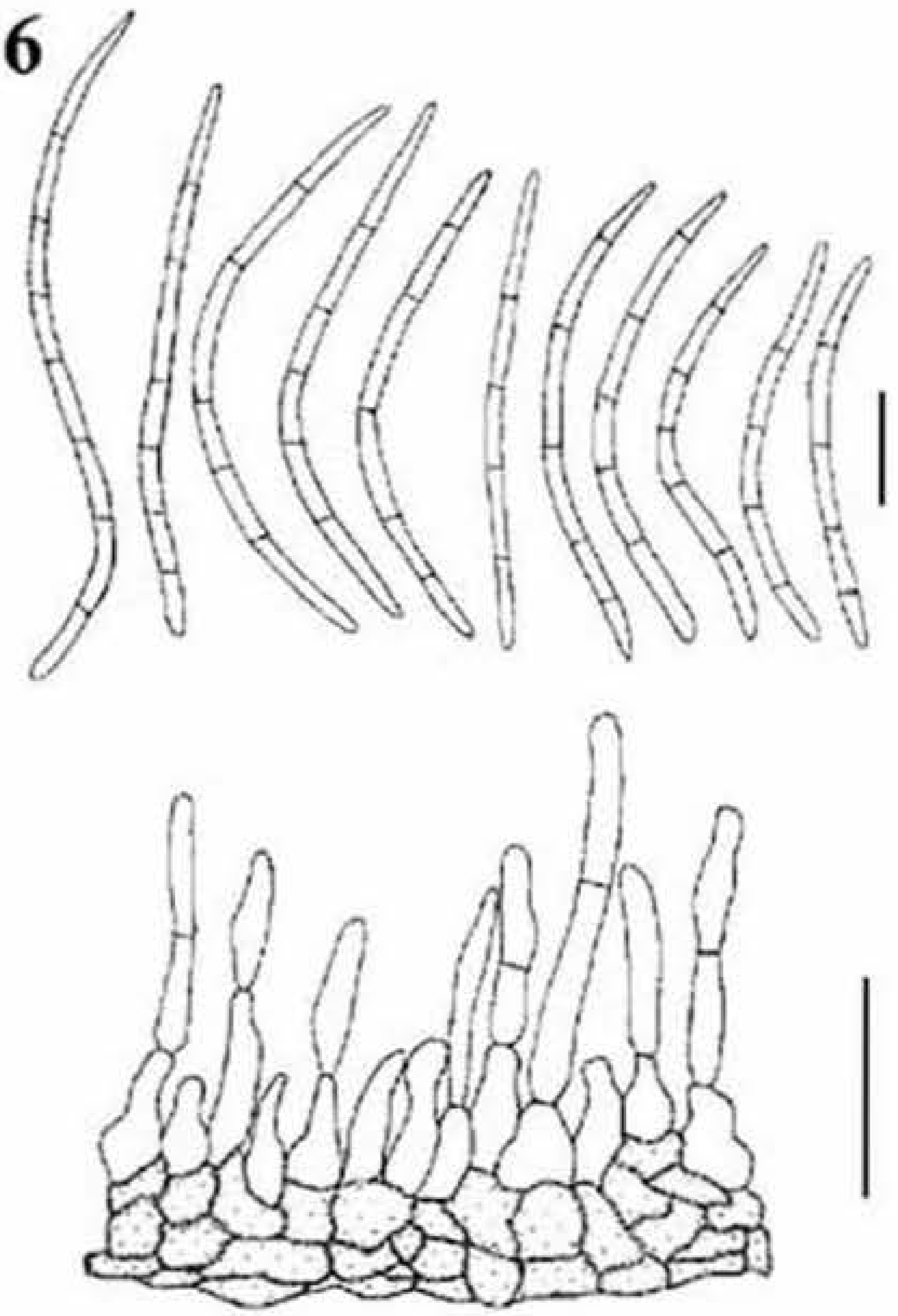


Fig. 6. Line drawing of the anamorph of *Mycosphaerella sapii* on *Sapium glandulosum*. Scale bars = 10 µm.

single, scattered at the periphery of lesions, aggregated in the center, globose to subglobose, 65–110 µm diam. dark brown, subepidermal becoming erumpent, walls of *textura angularis* 6–9.5 µm thick. *Asci* fasciculate, bitunicate, aparaphysate, eight-spored, obclavate to cylindrical, sessile to short pedicellate, straight to slightly curved, 28–30.5 × 6.5–7.5 µm. *Ascospores* biseriate to inordinate and overlapping, cylindrical to fusiform, with rounded ends, 10–15.5 × 2–2.5 µm, 1-septate, thin-walled, smooth, hyaline, with or without guttules.

**Comments** — We have examined Petrak's type of *M. sodiroana* (Herbarium S, Reliquiae Petrakianae 659, on '*Sapium sodiroi*', Ekuador: Prov. Tungurahua, Hacienda San Antonio bei Baños, 20.12.1937) and concluded that the specimen from *S. glandulosum*, although biometrically similar (Table 1), is a distinct taxon. On Petrak's description an excellent account of the fungus is given but no illustration was provided by the author. While *M. sodiroana* does not develop clear lesions and has ascospores that are densely and minutely guttulate, slightly constricted at the septum, widest in the upper cell, mainly clavate to fusiform which are uniserially arranged (Fig. 4), *M. sapiicola* is associated with circular lesions, has ascospores with or without guttules, that are not constricted

Table 1. Morphological characters of *Mycosphaerella* spp. on *Sapium* spp.

| Features | | *M. sodiroana* | *M. sapii* | *M. sapiicola* |
|---|---|---|---|---|
| Ascoma | | 60–100 µm diam | 70–250 µm diam | 65–110 µm diam |
| Asci | shape | clavate to cylindrical-clavate | obclavate to cylindrical | obclavate to cylindrical |
| | size | 30–40 × 5–7 µm | 56–74 × 10–13.5 µm | 28–30.5 × 6.5–7.5 µm |
| Ascospores | shape | clavate to fusiform | fusiform | cylindrical to fusiform |
| | size | 8–12 × 2–3.5 µm | 14–19 × 3–4 µm | 10–15.5 × 2–2.5 µm |
| | guttules | guttulate | guttulate | guttulate / eguttulate |
| | arrangement | uniseriate | biseriate to inordinate | biseriate to inordinate |
| Anamorph | | unknown | *Septoria* sp. | unknown |
| Habit | | on fallen leaves of '*S. sodiroi*' | on living leaves of *S. glandulosum* | on living leaves of *S. glandulosum* |

at the septum, widest in the middle, cylindrical to fusiform and biseriate to inordinately arranged within the asci. *M. sapiicola* is easily distinguished from *M. sapii* by the size of asci and ascospores (Table 1). In addition, *M. sapiicola* has thin-walled ascospores, with rounded ends and with or without guttules, *M. sapii* has thick-walled ascospores, with subacute ends and is minutely and densely guttulate, similar to *M. sodiroana*.

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# Contributions to the macrofungi of Kastamonu province, Turkey

Dursun Yağiz[1], Ahmet Afyon[1], Muhsin Konuk[2], & Stephan Helfer[3]

*dyagiz@selcuk.edu.tr aafyon@selcuk.edu.tr*
*mkonuk@aku.edu.tr s.helfer@rbge.org.uk*

[1]*Selcuk University, Education Faculty, 42099, Meram, Konya-TURKEY*
[2]*Afyon Kocatepe University, Faculty of Art and Science, Afyonkarahisar-TURKEY*
[3]*Royal Botanic Garden Edinburgh, 20A Inverleith Row, Edinburgh EH3 5LR, U.K.*

**Abstract**—This study was based on specimens of macrofungi collected from Kastamonu province between 1998 and 2000. Field and laboratory identification revealed 197 taxa belonging to 34 families (4 families of *Ascomycotina* and 30 families of *Basidiomycotina*). 13 new taxa were added to the Turkish mycota as new records. The full checklist is available at http://rbg-web2.rbge.org.uk/mycotaxon/140.pdf

**Key words**—macromycota, flora, A4-A5 floristic squares, fungi

## Introduction

This research was carried out in Kastamonu province (Figure 1), which is situated in the western Black Sea Region of Turkey. The western Black Sea Region is situated from west of Kızılırmak river delta to the east of Adapazarı and Bilecik provinces. Kastamonu is placed in squares A4-A5 according to the floristic system of Davis (1965-1985). Three rainfall regimes (Akman 1990) are prevalent in the study area: A) near the Black Sea coast the second type of oceanic rain fall regime, B) around Kastamonu central-Taşköprü the semi continental rain fall regime, and C) in Daday-Araç-Ilgaz a transition rain fall regime.

The canopy vegetation of the study area is composed mainly of conifers (*Pinus nigra, P. sylvestris, Abies nordmanniana*) and broadleaved trees (*Populus alba, Salix alba, Quercus pubescens, Q. petraea, Q. macranthera, Q. hartwissiana, Fagus orientalis*). Previous mycological investigations were carried out by Öder (1982), Afyon (2001 a, b), and Afyon & Konuk (2001a, b). No further studies are known from the area but Afyon et al. (2004, 2005), Yağız et al. (2005) and

Sesli & Denchev (2005) produced checklists of adjacent regions.

Although parts of the area have been intensively managed for timber production, forest cover is almost intact (WWF 2006) and a small part of Ilgazdağı Mountain National Park is situated within the research area. Many of its habitats are ideal for mycological studies. The work presented here is the most up-to-date and extensive list of macrofungi of Kastamonu province. Ilgazdağı mountain is mainly situated in Çankırı province. Some foot hills extend into to Kastamonu. Since it is a huge mountain a separate study should be planned for it in its entire area. According to the report of the Kastamonu local environmental and Forestry authority, it has various types of topography, climate and soil (Kastamonu 2004). The members of the *Russulaceae* growing under oak, pine, and beech trees form ectomycorrhizae with them according to Öder (1988). The members of *Boletaceae* under pine and beech trees form ectotroph mycorrhizae with their roots.

## Materials and methods

Specimens were collected from the research area during field trips between 1998 and 2000. The macroscopic and ecological characters of the specimens were recorded in situ and their microscopic features determined in the laboratory. The diagnoses of the taxa were carried out as described in previous studies (Afyon et al. 2005; Yağız et al. 2006). Taxa and their authors are given according to an amended list of authors of fungus names CABI Bioscience electronic

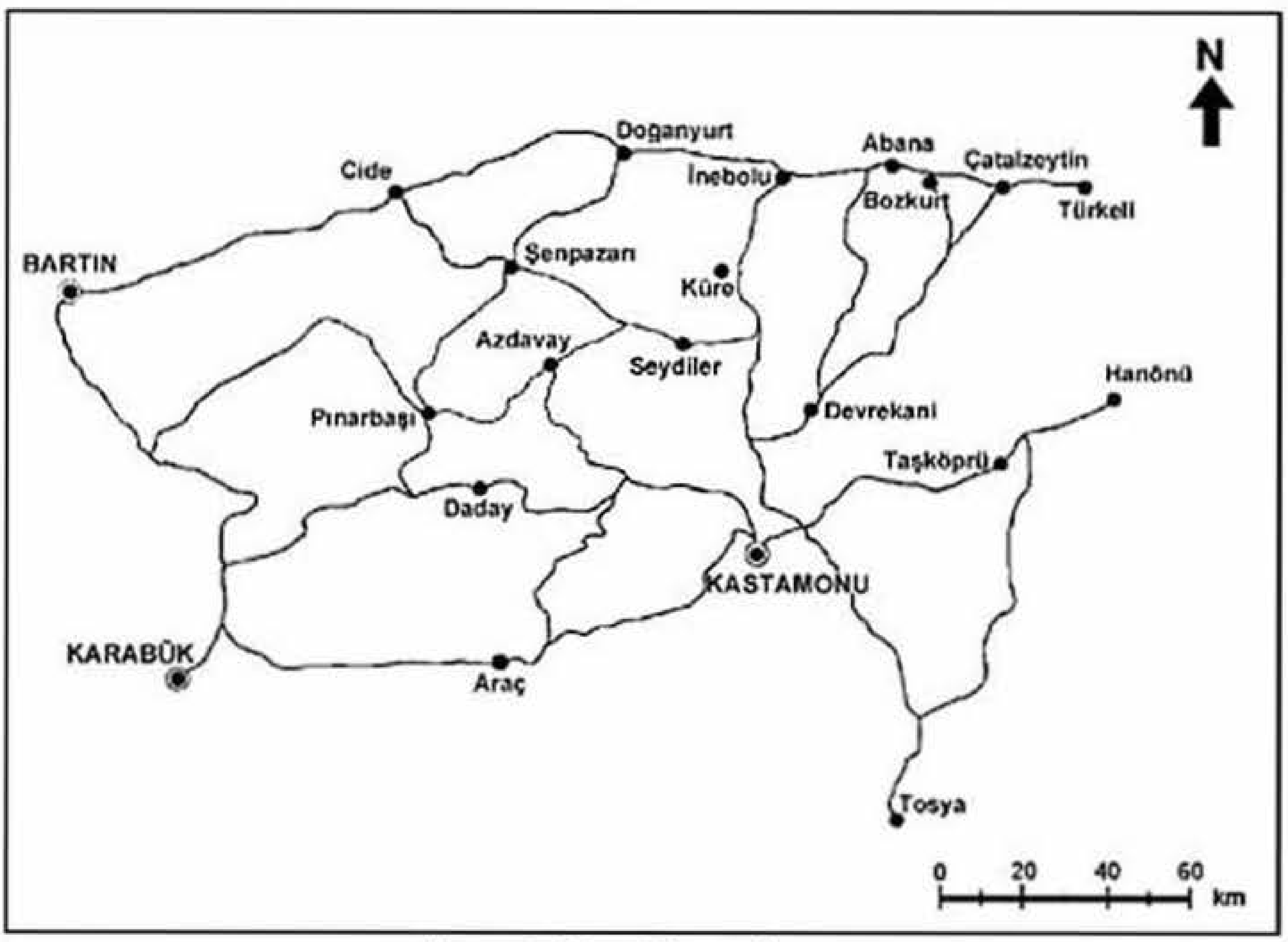


Figure 1: Map of the study area.

version (http://www.indexfungorum.org/Names/Names.asp). The specimens are kept at Selcuk University, Education Faculty Herbarium (KNYA).

## Results

In our study, 197 species were recovered belonging to 34 families. The distribution of the species and their families are: *Discinaceae* 1, *Helvellaceae* 3, *Morchellaceae* 3, *Pezizaceae* 1, *Agaricaceae* 12, *Bankeraceae* 3, *Bolbitiaceae* 13, *Boletaceae* 10, *Cantharellaceae* 1, *Clavariaceae* 1, *Clavulinaceae* 1, *Cortinariaceae* 20, *Dacrymycetaceae* 1, *Entolomateceae* 1, *Ganodermataceae* 2, *Geastraceae* 2, *Gomphaceae* 1, *Gomphidiaceae* 3, *Hydnangiaceae* 2, *Hygophoropsidaceae* 1, *Hymenochaetaceae* 1, *Lycoperdaceae* 9, *Marasmiaceae* 7, *Nidulariaceae* 1, *Phallaceae* 1, *Plutaceae* 10, *Polyporaceae* 5, *Psathyrellaceae* 3, *Rhizopogonaceae* 2, *Russulaceae* 26, *Sclerodermataceae* 1, *Strophariaceae* 3, *Suillaceae* 4, *Tricholomataceae* 41, and *Tulostomataceae* 1. Their collection dates, localities, habitats, collector's names and herbarium numbers are given in the list published on the internet at http://rbg-web2.rbge.org.uk/mycotaxon/140.pdf.

## Discussion

197 species of macrofungi were collected from Kastamonu province, Turkey. Eight of them belonged to *Ascomycotina* and 189 to *Basidiomycotina*. Öder (1982) reported 15 macromycota from the study area. Afyon & Konuk (2001 a) reported 26 species of edible macrofungi known by local people from the entire western Black Sea Region of Turkey. 20 of these grow in Kastamonu. An additional 36 species of poisonous macrofungi were reported by Afyon & Konuk (2001 b) for the entire western Black Sea Region and 18 of them occurred in Kastamonu province. Moreover, Afyon (2001 a) reported four new Turkish records belonging to *Entolomataceae* two of which had been recorded from Kastamonu province. A further two species of *Hygrophoraceae* were reported by Afyon (2001 b) as part of five new records from the western Black Sea Region. The present report vastly increases and complements the results from these studies. Reports from neighbouring regions of the study area were: Afyon et al. (2000) 62 taxa from Bartın; Afyon & Konuk (2002) 77 taxa from Zonguldak; Afyon et al. (2004) 170 taxa from Sinop; Yağız et al. (2005) 121 taxa from Karabük; Afyon et al. (2005) 80 wood-decaying taxa from the western Black Sea Region; Yağız et al. (2006) 277 taxa from Bolu and Düzce provinces. When comparing taxa given from neighbouring areas, the present study gives a very high number of recorded data. Furthermore, Kastamonu province seems to be the richest area for its macrofungi diversity. This could be because of its climatic diversity and vegetation types in its different parts as described above.

13 taxa were added to the Turkish mycoflora as new records from the study area. These are: *Cystolepiota adulterina, Hebeloma pusillum, Boletus*

*subappendiculatus*, *Cortinarius isabellinus*, *C. renidentoides*, *C. spilomeus*, *C. talus*, *Inocybe mixtilis*, *I. petiginosa*, *Armillaria borealis*, *Tricholoma arvernense*, *T. basirubens*, and *T. cingulatum*.

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# Notes on some Japanese smut fungi. III. *Ustilago moehringiae*

Cvetomir M. Denchev[1*], Makoto Kakishima[2],
Hyeon-Dong Shin[3] & Seung-Kyu Lee[4]

*cmdenchev@yahoo.co.uk*
[1]*Institute of Life Science and Natural Resources*
*Korea University, Seoul 136-701, Korea*

*kaki@sakura.cc.tsukuba.ac.jp*
[2]*Graduate School of Life and Environmental Sciences*
*University of Tsukuba, Tsukuba, Ibaraki 305-8572, Japan*

*hdshin@korea.ac.kr*
[3]*Division of Environmental Science and Ecological Engineering*
*Korea University, Seoul 136-701, Korea*

*leesk77@foa.go.kr*
[4]*Laboratory of Forest and Shade Tree Pathology*
*Korea Forest Research Institute, Seoul 130-712, Korea*

**Abstract**—A new combination in *Haradaea* is proposed for *Ustilago moehringiae* on *Moehringia trinervia* var. *platysperma*. The fungus is described and illustrated based on revision of the authentic specimens.

**Key words**—*Caryophyllaceae*, Japan, *Microbotryum*, taxonomy

## Introduction

Recently, it has been demonstrated that the genus *Microbotryum* should be reduced only to the group of the anthericolous species (incl. *M. majus*) on *Caryophyllaceae* (Almaraz et al. 2002, Denchev et al. 2006, Kemler et al. 2006). For accommodation of the seed-destroying species of *Ustilago* on *Caryophyllaceae*, a new genus, *Haradaea*, was described (Denchev et al. 2006) uniting seven species: *H. alsineae* (G.P. Clinton & Zundel) Denchev & H.D. Shin, *H. arenariae-bryophyllae* (Vánky) Denchev & H.D. Shin, *H. duriaeana* (Tul. & C. Tul.) Denchev & H.D. Shin, *H. holostei* (de Bary) Denchev & H.D. Shin, *H. jehudana* (Zundel emend. Denchev) Denchev & H.D. Shin, *H. moenchiae-manticae* (Lindtner) Denchev & H.D. Shin, and *H. nivalis* (Liro)

*Author for correspondence

Denchev & H.D. Shin. In the article establishing *Haradaea* (Denchev et al. 2006), the results of Amaraz et al. (2006), based on ITS rDNA, were taken into consideration and cited. After the publication of *Haradaea*, however, it was learned that the sequences that they reported as being from *Ustilago duriaeana* were, in fact, those of *Cryptococcus* spp. due to contamination (Ch. Roux, pers. comm.). Nevertheless, the results from the investigated sequences of the other specimens in this article, as well as those in Kemler et al. (2006), confirm the proposal that *Microbotryum* should be restricted to the group of anthericolous species on *Caryophyllaceae*. On the basis of our current knowledge the seed-destroying species on *Caryophyllaceae* should not be treated as species of either *Ustilago* or *Microbotryum*, as they have been traditionally and in many recent literature sources (cfr Vanky 1994, 1998), but as members of either *Haradaea* or *Bauhinus*. Definitive assignments, though, must await further molecular and/or ultrastructural investigations.

In connection with the revision of Japanese smut fungi, we studied the type of *Ustilago moehringiae*, a seed-destroying species on *Moehringia trinervia* var. *platysperma* (*Caryophyllaceae*). Because the correct place of this smut fungus is neither in *Ustilago* nor in *Microbotryum*, a new combination in *Haradaea* is proposed herein.

## Materials and methods

Herbarium material from the collections of Hokkaido University, Sapporo (SAPA) and the Department of Botany, National Science Museum, Tsukuba (TNS) was examined under light (LM) and scanning electron (SEM) microscopy. For LM observations, the spores were mounted in lactophenol solution on glass slides by gently heating to the boiling point and then cooling. The measurements of spores are given in the form: min-max (mean ± 1 standard deviation). In the description, a symbol '$n/_x=$' is used to indicate the total numbers of measured collections and spores, respectively. For SEM, the spores were attached to specimen holders by double-sided adhesive tape and coated with platinum with a Hitachi E-1010 Ion Sputter. The surface structure of spores was observed and photographed with a Hitachi S-3500N Scanning Electron Microscope.

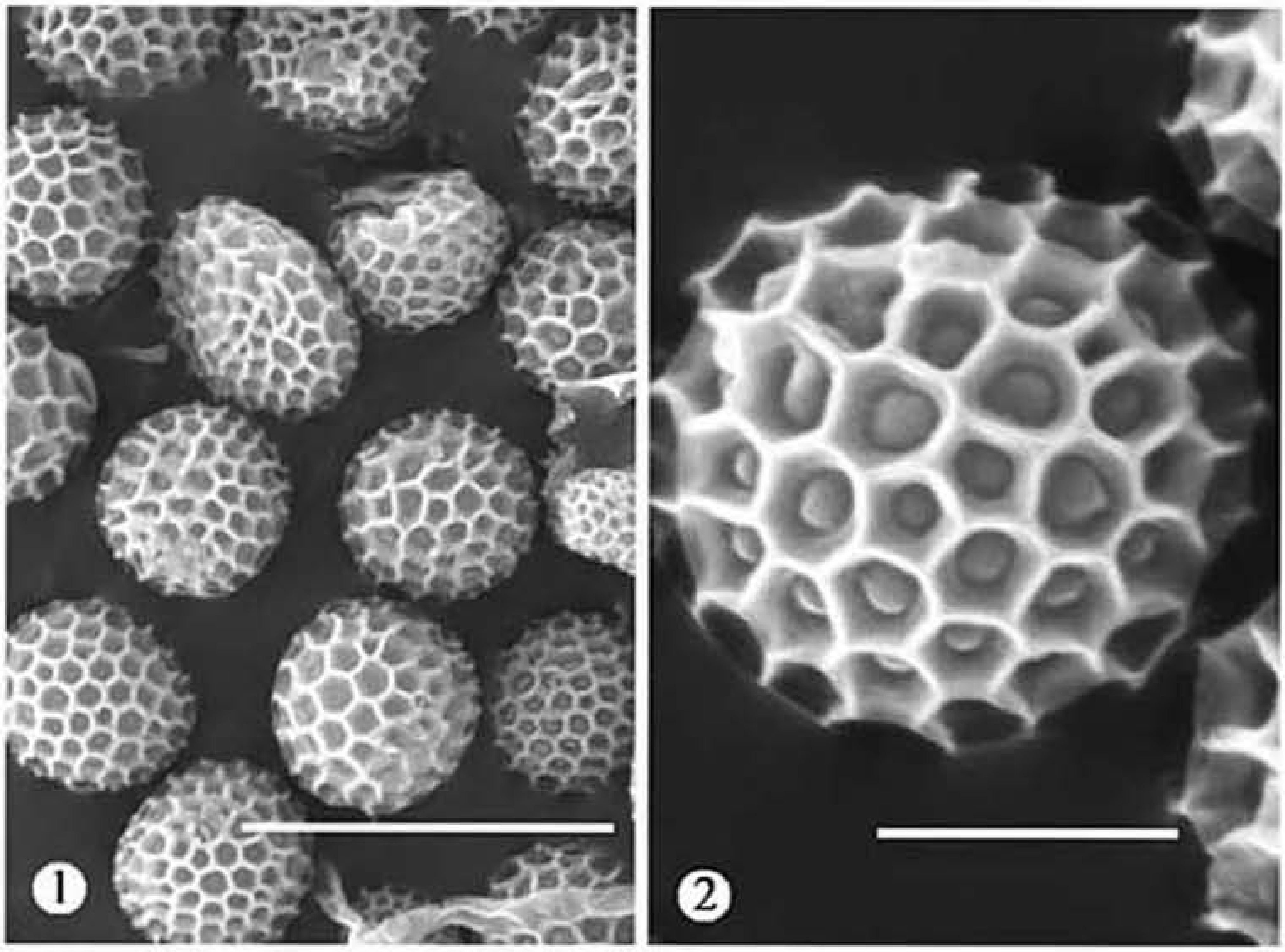
## New combination proposed

***Haradaea moehringiae*** (Togashi & Y. Maki) Denchev, **comb. nov.**

MYCOBANK # MB510498 Figs. 1-2

Basionym: *Ustilago moehringiae* Togashi & Y. Maki, Ann. Phytopathol. Soc. Japan 10: 139, 1940.

= *Microbotryum moehringiae* (Togashi & Y. Maki) Vánky, Mycotaxon, 67: 46, 1998.




Figs. 1-2. *Haradaea moehringiae* on *Moehringia trinervia* var. *platysperma* (SAPA) – spores in SEM. Scale bars: 1 = 20 µm, 2 = 5 µm.

**Sori** in the ovaries, destroying the seeds and filling the capsules with a spore mass. **Spore mass** powdery, purplish brown. **Spores** mainly globose or subglobose, rarely broadly ellipsoidal or ovoid, 11.5-15 × 11-14.5 µm (13.0±0.7 × 12.5±0.7) µm ($n/_2$=90), length/width ratio 1.04, light to middle purplish brown; spore wall reticulate, muri livid purple, the bottom of the meshes light yellowish brown, (5-) 6-7 (-8) meshes per spore diameter, meshes irregularly hexagonal or pentagonal, (1.5-) 2-2.5 (-4) µm long, (17-) 19-22 (-23) muri in the spore circumference at median view, muri 1-2 (-2.4) µm high; in SEM the meshes usually with a well developed, hemispherical or elongated protuberance on the bottom.

SPECIMENS EXAMINED — JAPAN: **Kyushu, Fukuoka Pref.**, YOSHIKAWA-MURA, in the seeds of *Moehringia trinervia* var. *platysperma* (Maxim.) Makino (*M. platysperma* Maxim.), 7 May 1938, Y. Maki (TNS-F 243 892, holotype; SAPA – isotype).

Known distribution: only from the type collection.

**Comments**—*Haradaea moehringiae* was originally described as possessing purplish black spore mass (see also Vánky 1998: 46) and verruculose-reticulate spores. The colour of the spore mass seems to be purplish brown and definitely not dark enough to be considered as purplish black. The wall ornamentation is reticulate, as it has been corrected by Vánky (1998). The well developed protuberance on the bottom of the meshes is noteworthy (Fig. 2). Spores were very rarely up to 16 µm and they were not taken into consideration.

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# Preliminary check list of *Albuginales* and *Peronosporales* (*Chromista*) reported from the Iberian Peninsula and Balearic Islands

Gema García-Blázquez[1], Ovidiu Constantinescu[2], M. Teresa Tellería[1] & María P. Martín[1]

[1]gemagarcia@rjb.csic.es
Real Jardín Botánico, C.S.I.C.
Plaza de Murillo 2, E-28014 Madrid, Spain

[2]ovidiu.constantinescu@evolmuseum.uu.se
Botany Section, Museum of Evolution, Uppsala University
Norbyvägen 16, SE-752 36 Uppsala, Sweden

**Abstract**—The scrutiny of ca. 188 publications issued between 1867 and 2005 revealed that ca. 1500 fungus/host combinations of white rusts and downy mildews (*Albuginales* and *Peronosporales*) have been reported from Iberian Peninsula and Balearic Islands. The fungi belong to 13 genera and 101 species, and are parasitic on 266 plants belonging to 146 genera and 32 families. The hosts represent about 3.3 % of the total number of plants known from this territory. It is concluded that the probable number of fungi belonging to these two orders should be sensibly higher in this area, and that more collecting is necessary. The complete list can be accessed at: http://www.mycotaxon.com/resources/weblists.html

**Key words**—Andorra, Portugal, Spain, occurrence, *Peronosporomycetes*

## Introduction

The records of *Albuginales* (white rusts) and *Peronosporales* (downy mildews) reported from the Iberian Peninsula and Balearic Island are scattered over nearly 200 publications issued between 1867 and 2005. The first record seems to be that of *Albugo candida* by Colmeiro (1867). Major contributions and/or preliminary lists for Portugal (Traverso & Spessa 1910; Câmara et al. 1936; Câmara & Oliveira 1944; Lucas & Dias 1976; Lucas et al. 1982) and Spain (González Fragoso 1916; Lázaro e Ibiza 1920) were also published, and the first list regarding the whole peninsula is due to González Fragoso (1924). A rather recent review, though incomplete and restricted to the genus *Peronospora*, is that by Gustavsson (1991).

The aim of this check-list is to provide a preliminary view of the presence and diversity of these fungi in the Iberian Peninsula including the Balearic Islands.

## Materials and methods

Some 188 publications have been scrutinized. These include short or longer floristic reports, lists, but even papers dealing primarily with plant pathology aspects. A few references were not included because the information on the fungus and/or host was too vague.

The taxonomy and nomenclature of the fungi and the hosts are those considered correct by us at the moment when this list was edited. In many cases they differ from the names used in the original publications. Taking into account the preliminary character of this list, no cross-indexing for old-new names is provided.

For the taxonomy of various genera of fungi the following main sources have been used: *Albuginales* (Biga 1955; Choi & Priest 1995; Thines & Spring 2005), *Hyaloperonospora* (Constantinescu & Fatehi 2002; Göker et al. 2004), *Paraperonospora* (Constantinescu 1989), *Perofascia* (Constantinescu & Fatehi 2002), *Peronospora* (Gäumann 1923; Constantinescu 1991), *Plasmopara* (Kochman & Majewski 1970; Voglmayr et al. 2006), *Plasmoverna* (Constantinescu et al. 2005), and *Pseudoperonospora* (Waterhouse & Brothers 1981).

The taxonomy and nomenclature of the host plants follow Flora Iberica (Castroviejo et al. 1986-2003) and Flora Europaea (Tutin et al. 1964-1993). No authority names for fungal and host taxa are included. They can be found either in the sources mentioned above, or in the following on-line sites: Index fungorum (www.indexfungorum.org), CBS Utrecht (www.cbs.knaw.nl/databases/index.htm), Flora Europaea (http://rbg-web2.rbge.org.uk/FE/fe.html), and The International Plant Names Index (http://www.ipni.org).

Acronyms used: AND (Andorra), ESP (Spain), POR (Portugal). Name of provinces are those from Pando ( 1991).

## Results

About 1500 individual, fungus/host combination records were available. The number and diversity of these fungi is summarized in Table 1.

Because the identity of both fungi and hosts was not checked against the specimens, some errors are unavoidable. Moreover, in the absence of deposited specimens, some records are and will remain doubtful.

Being based on literature records, and not on the examination of specimens, this list should be regarded only as a rough estimation of the *Albuginales* and *Peronosporales* occurring in the Iberian Peninsula. Future monographic studies will certainly alter the present situation.

It is estimated that ca. 8000 taxa of phanerogams are present in the flora of Iberian Peninsula and Balearic Islands. The number of hosts on which members

Table 1. Numbers of *Peronosporomycetes* and their hosts reported from from Iberian Peninsula and Balearic Islands.

| FUNGI | | NUMBER OF HOSTS[1] | | |
|---|---|---|---|---|
| Genus | Number of species | Families | Genera | Infra generic taxa[2] |
| *Albugo* | 5 | 4 | 29 | 41 |
| *Basidiophora* | 1 | 1 | 1 | 1 |
| *Bremia* | 1 | 1 | 15 | 20 |
| *Hyaloperonospora* | 7 | 1 | 19 | 25 |
| *Paraperonospora* | 1 | 1 | 1 | 1 |
| *Perofascia* | 1 | 1 | 2 | 4 |
| *Peronospora* | 69 | 24 | 66 | 152 |
| *Plasmopara* | 7 | 5 | 10 | 14 |
| *Plasmoverna* | 1 | 1 | 3 | 3 |
| *Pseudoperonospora* | 4 | 3 | 4 | 5 |
| *Pustula* | 1 | 1 | 7 | 10 |
| *Sclerospora* | 1 | 1 | 1 | 1 |
| *Wilsoniana* | 2 | 1 | 2 | 2 |
| TOTAL | 101 | 32 | 146 | 266 |

[1] In several cases the same host may be parasitized by more than one fungus.

[2] Inclusive 11 subspecies and 9 hosts identified only to genus level.

of *Peronosporomycetidae* were recorded is ca. 266 (3.3 %). This percentage is low, particularly when compared with the situation from Romania, a smaller territory but with rather similar mixture of climatic conditions, in which more than 21% of the ca. 3000 plants are host of these fungi (Constantinescu & Negrean 1983). Undoubtedly, more collecting and taxonomic studies are necessary in order to get a more realistic picture of the presence of these fungi in the Iberian Peninsula and the Balearic Islands.

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# *Oidium perseae-americanae* sp. nov. on avocado

J. R. Liberato [1] & R. W. Barreto [2]

*jose.liberato@dpi.qld.gov.au*

[1] *Department of Primary Industries & Fisheries, Plant Pathology Herbarium 80 Meiers Rd, Indooroopilly, Qld 4068, Australia*

[2] *Universidade Federal de Viçosa, Departamento de Fitopatologia Viçosa, MG, 36571-000, Brazil*

**Abstract** — *Oidium perseae-americanae* is described causing powdery mildew on avocado (*Persea americana*) in New Caledonia and Brazil.

**Key words** — *Erysiphaceae, Pseudoidium*, new species

## Introduction

Avocado (*Persea americana, Lauraceae*) is an evergreen fruit tree, up to 20 m tall, native to Central America and widely cultivated in the tropics and subtropics. There have been occasional records of powdery mildews on avocado in the world literature (Ruehle 1958, Weber 1973, Menge & Ploetz 2003, Ohr et al. 2003), but strangely such reports refer to the etiological agent only as *Oidium* sp. Amano (1986) listed the geographical distribution of *Oidium* sp. on avocado as South and Central America, Africa, USA and Israel, but this author did not provide any references or details for these records. The names *Oidium perseae* Noack (Junqueira et al. 2002) and *Oidium persicae* (Wellman 1972, Mendes et al. 1998) appear in the literature for the fungus causing powdery mildew on avocado. However, the original publications for these two names could not be traced in the main lists of published fungal names as well as in Braun (1987) and Noack (1898). It appears that these names are nomina nuda. An evidence for such a status for the name *O. perseae* is that Viégas (1961), who was known to be very meticulous regarding the citation of authors of fungal names, listed the name *O. perseae* without an author, in his list of South American fungi.

Specimens of the fungus on avocado collected in New Caledonia and Brazil were examined and recognized as belonging to an undescribed species belonging to the subgenus *Pseudoidium*. This new species is described below. Morphology of the fungus was examined on microscopic mounts in lactic acid.

Biometric data were obtained only from the examination of turgid structures and only mature conidia (those unattached to conidiophores) were measured.

## Taxonomic description

***Oidium perseae-americanae*** Liberato & R.W. Barreto **nov. sp.** **Figs. 1-5**

MycoBank #: MB 510486

*Maculae in foliis vivis Mycelium externum, hypophyllum, albidum. Hyphae steriles ramosae, septatae, hyalinae, flexuosae, 2.5–6.5 µm crassae. Appressoria lobata. Conidiophora ex hyphis sterilibus oriunda, erecta, cylindracea, hyalina, levia, non-ramosa, 0–2-septata, 45–75 × 6.5–10 µm, cellulis basalibus 27.5–50 µm longis, cellulis subsequentibus brevioribus 0–2. Conidia solitaria, hyalina, non septata, ovoidea, doliiformes vel cylindracea, 27.5–40 × 10–20 µm, longitudo/latitudo 1.5–3.2, tubis germinativis plerumque brevibus, non ramosis, appressoriis lobatis. Status teleomorphosis absens.*

**Etymology:** from the host *Persea americana*

**Habitat:** in foliis *Persea americana* Mill.

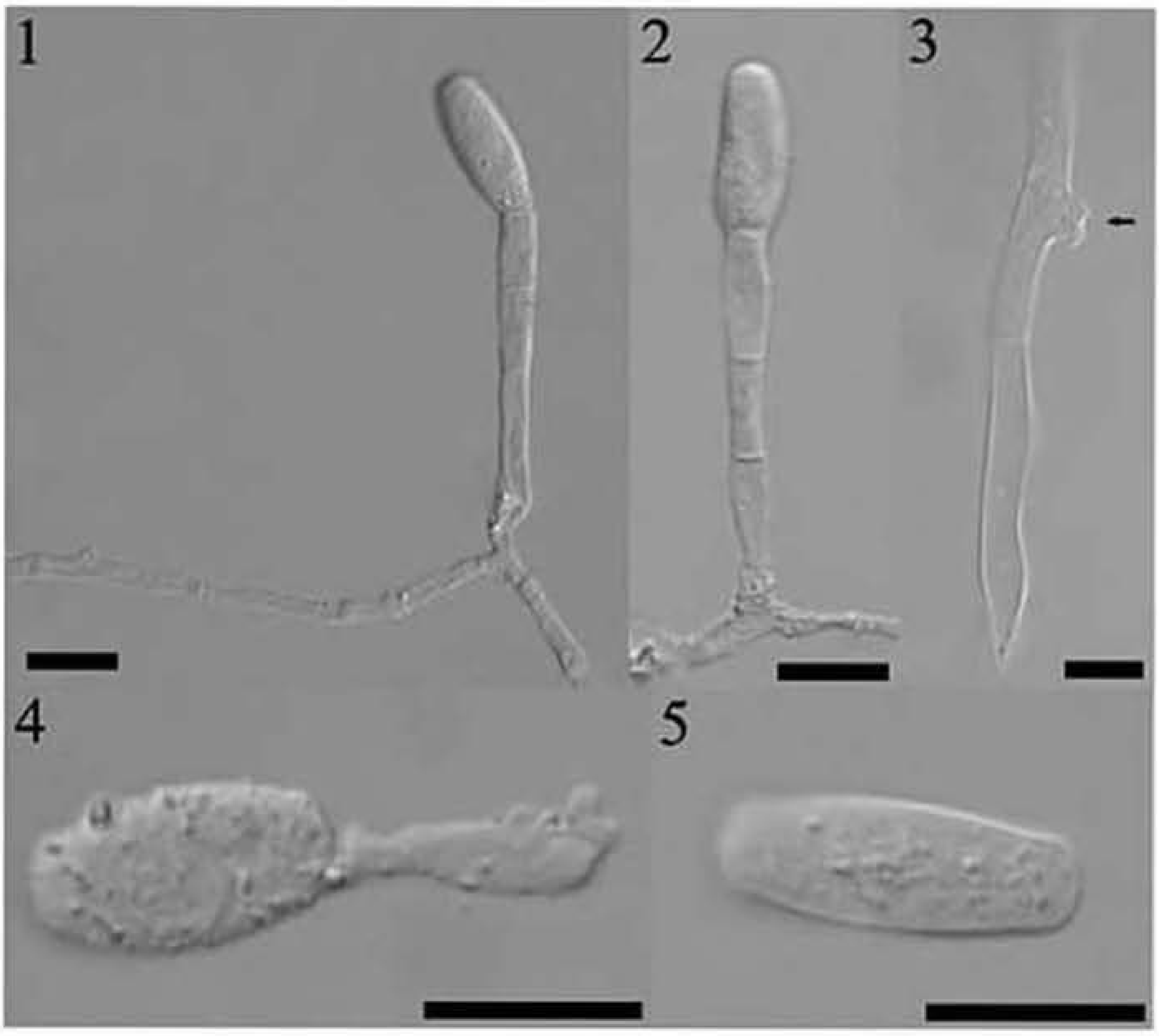
**Specimens examined** – **New Caledonia**, La Foa, Sud, on *Persea americana*, 29 Oct 2003, J.C Wright (**Holotype:** BRIP 45247); **Brazil**, Campinas, São Paulo, on *P. americana*, 2 June 1944, A.R. Teixeira (**Paratype:** IACM 4629); São Paulo, São Paulo, on *P. americana*, 23 June 1944, R.R. Yalowosky (IACM 4589).

On living leaves. *Mycelium* hypophyllous. Superficial *hyphae* branched, septate, hyaline, flexuous, 2.5–6.5 µm wide, mycelial appressoria lobed. *Conidiophores* produced from the external mycelium, cylindrical, hyaline, smooth, unbranched, 0–2-septate, 45–75 × 6.5–10 µm, foot-cells 27.5–50 µm long, followed by 0–2 shorter cells. Conidia formed singly, ovoid, doliiform or cylindrical, 27.5–40 × 10–20 µm, l/w ratio 1.5–3.2, aseptate, hyaline, smooth. One germ tube per conidium, up to 1 × the length of the conidium, ending in a lobed appressorium. Teleomorph: not found.

## Discussion

Three additional specimens (IACM 142, 3985 and 4587), labelled as *Oidium* sp. on avocado, were also examined but were in poor condition, so it was not possible to identify them. *Oidium perseae-americanae* is the first species of powdery mildew described on avocado.

Six powdery mildew species have been recorded on plants of the family *Lauraceae*, namely *Erysiphe benzoin* (F.L. Tai) U. Braun & S. Takam. (≡ *Microsphaera benzoin* F.L. Tai), *Erysiphe blasti* (F.L. Tai) U. Braun & S. Takam. (≡ *M. blasti* F.L. Tai), *Erysiphe cinnamomicola* U. Braun & S. Takam. (≡ *M. cinnamomi* (L.S. Olive) U. Braun), *Erysiphe dabashanensis* (R.Y. Zheng & G.Q. Chen) U. Braun & S. Takam. (≡ *Uncinula dabashanensis* R.Y. Zheng & G.Q. Chen), *Erysiphe irregularis* (R.Y. Zheng & G.Q. Chen) U. Braun & S. Takam. (≡ *U. irregularis* R.Y. Zheng & G.Q. Chen) and *Oidium lauracearum* Graniti & U. Braun (Braun 1987, Graniti & Braun 1998, Zhen & Chen 1978). The anamorphs




Figs 1-5. *Oidium persea-americanae* (bar = 20 µm). Figs 1-2. Conidiophore and conidium (IACM 4583 and IACM 4629). Fig 3. Lobed hyphal appressorium (arrowed) (BRIP 47247). Fig 4. Germinated conidia (IACM 4629). Fig 5. Conidium (BRIP 47247).

of these five *Erysiphe* species have not been described. *E. cinnamomicola*, *E. dabashanensis* and *E. irregularis* are only known from the type collections. The first was observed on *Cinnamomum camphora* (L.) J. Presl and the latter two on *Litsea populifolia* (Hemsl.) Gamble. *E. benzoin* occurs on *Lindera glauca* Blume and *E. blasti* on *Lindera* spp., *Litsea* sp. and *Parabenzoin praecox* Nakai (Braun 1987). *O. lauracearum*, described on *Laurus nobilis* L., differs from *O. perseae-americanae* by having mycelial appressoria that are nipple-shaped, hyphae that vary from smooth to verruculose, longer conidiophores (50–120 µm long), conidiophore cells that may be as long as the foot-cell, and longer conidia (25–50 × 12–20 µm) smooth to rough-walled (Graniti & Braun 1998). Powdery mildews are mostly considered to be host specific. The subfamily *Erysiphoideae*, whose anamorphs belong to the genus *Oidium*, has two polyphagous compound species, namely *Golovinomyces cichoracearum* (DC.) V.P. Gelyuta and *Podosphaera fusca* (Fr.) U. Braun & Shishkoff s. lat. Unlike *Oidium perseae-americanae*, both species produce conidia in chains.

Therefore, we regard *O. perseae-americanae* to be a new species of *Erysiphaceae*, although seemingly widespread, as suggested by the disjunct records. There are no records of powdery mildews as relevant diseases of avocado. This may explain the fact that this fungal species remained neglected until now, although associated to an important crop species.

## Acknowledgements

The authors wish to acknowledge the herbaria IACM for specimen loans and thank Dr Maria Havrylenko (Universidad Nacional del Comahue, Argentina) and Dr Uwe Braun (Martin-Luther-Universität, Germany) who kindly reviewed the manuscript. R.W. Barreto acknowledges the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for financial support.

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# *Urocystis chifengensis* sp. nov. (*Urocystaceae*) from China

Lin Guo[1] & Tiezhi Liu[2]

*guol@sun.im.ac.cn*
*[1]Key Laboratory of Systematic Mycology and Lichenology*
*Institute of Microbiology, Chinese Academy of Sciences*
*Beijing 100080, China*

*tiezhiliu@yahoo.com.cn*
*[2]Department of Life Science, Chifeng College*
*Inner Mongolia, Chifeng 024001, China*

**Abstract**—A new species, *Urocystis chifengensis* on *Lepidium apetalum*, is described. The specimen was discovered in Chifeng of Inner Mongolia Autonomous Region, China. A key to the species of *Urocystis* on *Brassicaceae* is given.

**Key words**—*Ustilaginomycetes*, smut fungus, taxonomy

An *Urocystis* species on *Lepidium apetalum* was collected from Chifeng of Inner Mongolia Autonomous Region by the junior author. It is parasitic on the stems, not forming galls. The host plant belongs to the family *Brassicaceae*. So far, four species of the genus *Urocystis* on *Brassicaceae* have been reported, all causing root galls (Vánky 1991, Guo 2003a): 1) *Urocystis coralloides* Rostr. (Rostrup 1881); 2) *U. brassicae* Mundk. (Mundkur 1938); 3) *U. sophiae* Griffiths (Griffiths 1907) and 4) *U. yunnanensis* L. Guo (Guo 2003a). The newly collected species is quite different from the above four species by having sori in the stems, not forming root galls, and having few ustilospores (1–3) in the spore balls. The new species differs from *U. coralloides* on *Lepidium* by having larger spore balls (37–66.5 x 32.5–53 µm) and only few sterile cells surrounding the ustilospores, or sterile cells are lacking. It is described as:

***Urocystis chifengensis*** L. Guo & T. Z. Liu, **sp. nov.** Figs. 1-4
MycoBank MB510329

*Sori in caulibus, usque ad 10 mm longi, primum membrana cinereo-argentea cooperti, deinde expositi. Massa sporarum nigra, pulverulenta. Glomeruli sporarum subglobosi, ellipsoidei, ovoidei vel irregulares, 37–66.5 x 32.5–53 µm, e ustilosporis 1–3 constructi, cellulis sterilibus nonnullis vel nullis circumdati. Ustilosporae subglobosae, ellipsoideae,* *ovoideae vel leviter irregulares, 32–49 x 29.5–46.5 μm, atrobrunneae; pariete (1–)2–3.5 μm crasso, superficie levi sub LM, minute et dense verruculoso sub SEM. Cellulae steriles subglobosae, ellipsoideae vel elongatae, 11–30 x 7.5–22 μm, brunneae vel hyalinae; pariete ca. 0.5–1 μm crasso, levi.*

Sori on stems, up to 10 cm long, at first covered by a grayish-silvery membrane, later becoming exposed. Spore mass black, powdery. Spore balls subglobose, ellipsoidal, ovoid or irregular, 37–66.5 x 32.5–53 μm, composed of 1–3 ustilospores, surrounded by a few sterile cells or lacking. Ustilospores subglobose, ellipsoidal, ovoid or slightly irregular, 32–49 x 29.5–46.5 μm, dark brown; wall (1–)2–3.5 μm, surface smooth as seen by LM (light microscopy), minutely and densely verruculose as seen by SEM (scanning electron microscopy). Sterile cells subglobose, ellipsoidal or elongated, 11–30 x 7.5–22 μm, brown or hyaline; wall ca. 0.5–1 μm thick, smooth.

On *Lepidium apetalum* Willd. (*Brassicaceae*), Inner Mongolia: Chifeng, Hongshan District, Dasanjia, 21 VI 2003, T.Z. Liu 262, HMAS 143932 (holotype), HUV 21381 (isotype).

## Key to the species of *Urocystis* on *Brassicaceae*

1. Sori on stems, not forming galls .................................. *U. chifengensis*
1. Sori on roots as galls ................................................. 2

    2. Ustilospores per spore ball often more than 8 ................. *U. yunnanensis*
    2. Ustilospores per spore ball always less than 9 ................ 3

3. Ustilospores per spore ball 1–6(–8) ................................ *U. brassicae*
3. Ustilospores per spore ball 1–5 ....................................... 4

    4. Sterile cells thin-walled (1–2 μm) ................................ *U. sophiae*
    4. Sterile cells thick-walled (1.5–4 μm) ............................ *U. coralloides*

In China, so far 48 *Urocystis* species have been reported of which 3 occur on *Brassicaceae* (Wang 1963, Tai 1979, Guo 1991, 1992, 1993, 1997, 1998, 1999, 2001, 2002a, b, 2003a, b, 2005, 2006, Guo & Xi 1989, Guo & Zhang 2004, 2005, Vánky 2004, Vánky & Guo 1986, Yang et al. 2007).

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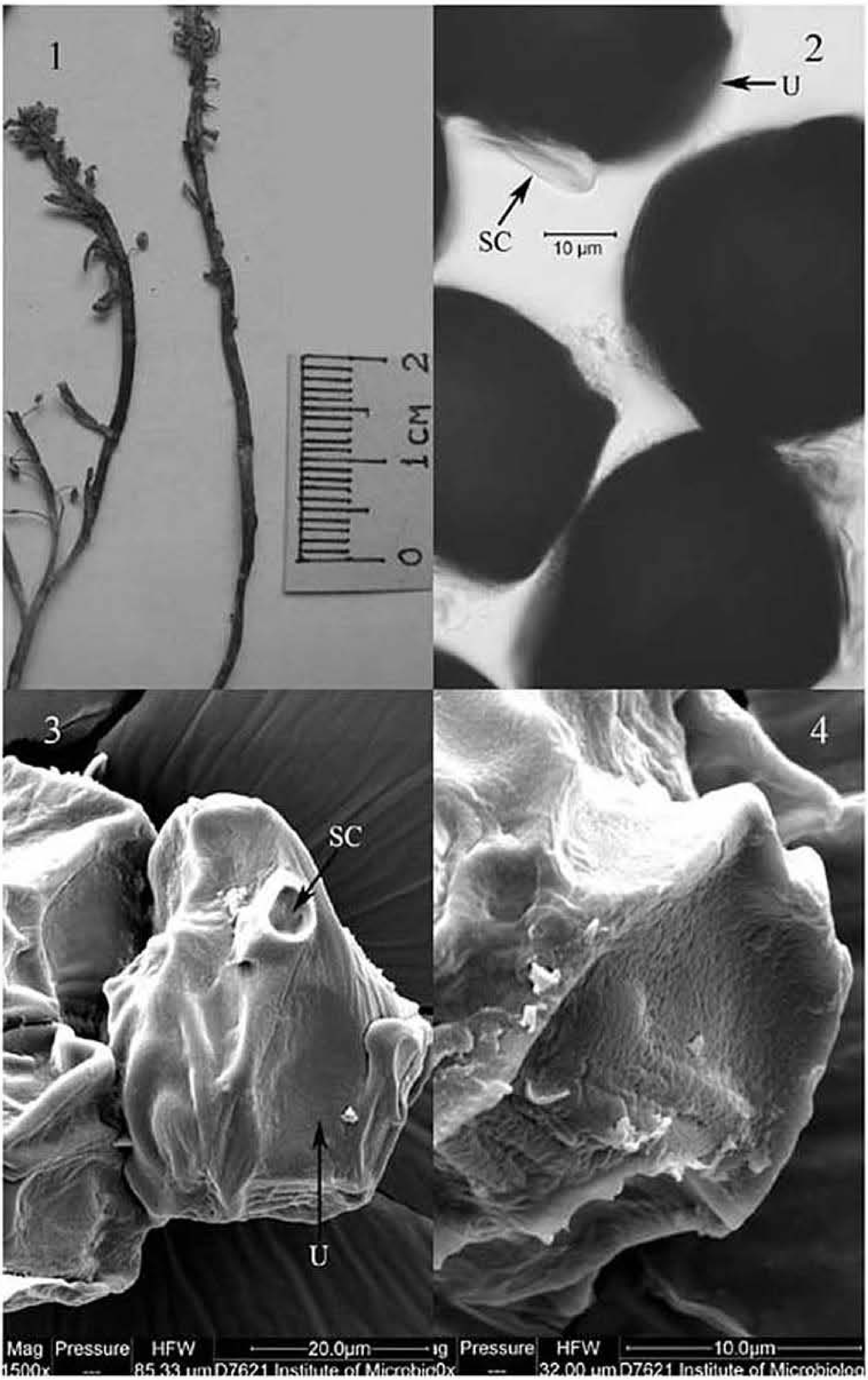
Figs. 1-4. *Urocystis chifengensis* on *Lepidium apetalum* (HMAS 143932, holotype); Fig. 1. Sori; Fig. 2. Spore balls, ustilospores (u, arrowhead) and sterile cells (sc, arrowhead) as seen by LM; Figs. 3-4. Spore balls, ustilospores (u, arrowhead) and sterile cells (sc, arrowhead) as seen by SEM.


1
2
U
SC
10 µm
0 1CM 2
3
SC
U
4
Mag Pressure HFW 20.0µm
1500x 85.33 µm D7621 Institute of Microbio
Pressure HFW 10.0µm
32.00 µm D7621 Institute of Microbiolog

and to Mrs. Xie Jiayi for assistance with SEM photographs. This study was supported by the Ministry of Science and Technology of the People's Republic of China (No. 2005DKA21401).

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# Lepiotaceous fungi in California, U.S.A. – 1. *Leucoagaricus amanitoides* sp. nov.

Else C. Vellinga[1*] & R. Michael Davis[2]

*vellinga@nature.berkeley.edu or ecvellinga@comcast.net
[1]Department of Plant and Microbial Biology, University of California at Berkeley, Berkeley, CA 94720-3102, U.S.A.
[2]Department of Plant Pathology, University of California at Davis, Davis, CA 95616, U.S.A.

**Abstract** — A new, white *Leucoagaricus* species is described from central California. *Leucoagaricus amanitoides* is characterized by a volvate, short and bulbous stipe, long narrowly clavate cystidia and ellipsoid spores without a germ pore.

**Key words** — biodiversity, *Agaricales*, Central Valley

## Introduction

The *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae* is represented by many species in California (Vellinga 2004a, b), with a considerable number still undescribed. A striking white species, resembling a short-stiped *Amanita* species, was discovered in Davis (Yolo Co.), and is here described as new in the genus *Leucoagaricus* Singer.

The genera *Leucoagaricus* Singer, *Leucocoprinus* Pat. and *Sericeomyces* Heinem. form one monophyletic clade within the family *Agaricaceae* (Vellinga 2004a). The molecular data on which this conclusion is based, support, though weakly, a monophyletic *Leucocoprinus*, embedded within *Leucoagaricus*, rendering that genus paraphyletic. *Sericeomyces* is polyphyletic. Preliminary data on protein coding gene sequences confirm that *Leucoagaricus* and *Leucocoprinus* form one, monophyletic, clade (non published results, ECV).

The type species of *Leucoagaricus*, *L. macrorhizus* Locq. ex E. Horak, (synonym *L. barssii* (Zeller) Vellinga), does not have close relatives and is morphologically different from all other species analysed, so its position within the genus and the clade is not yet final (Vellinga 2004a).

Morphologically, *Leucoagaricus* is characterized by the following combination of characters: metachromatic spores, absence of clamp-connections, absence of pseudoparaphyses around the basidia, and a pileus which is not or hardly plicate in the outer zone (Singer 1986; Vellinga 2001). *Leucocoprinus* shares the metachromatic spores and the absence of clamp-connections, but does have pseudoparaphyses around the trimorphic basidia, and a plicate pileus.

Despite these morphological differences between *Leucoagaricus* and *Leucocoprinus*, several species have been placed in both genera, e.g. *L. americanus* (Peck) Vellinga and the other reddening species like *L. badhamii* (Berk. & Broome) Singer (compare Reid 1990 and Vellinga 2001).

If the *Leucoagaricus/Leucocoprinus* clade were recognized as one genus, this would be an enormous genus and many new combinations would have to be made, since *Leucocoprinus* is the older name (Patouillard 1888; see e.g. Vellinga 2004a). This step may be premature, since it is likely that the clade can be split into smaller monophyletic and morphologically uniform groups which can be recognized at the genus level. The inclusion of further species from the large number in the tropics that are presently undescribed, combined with data from a wider range of genes, will surely clarify the division of the clade into distinct genera. Pending this research, a conservative approach is adopted here. The new species with characters in concordance with the old concept of *Leucoagaricus* will be accommodated in that genus.

The *Leucoagaricus* species described here was found under redwood (*Sequoia sempervirens*) and Valley oaks (*Quercus lobata*), pushing up through heavy clay, in the arboretum of the University of California at Davis. This arboretum is a half-natural area alongside a creek, where various California native trees and a number of exotics are planted among original Valley oaks. As the Davis campus lies in an area which is mycologically virtually unexplored, the vast Central Valley of California, the species could be a California native or an exotic brought in with plant material from elsewhere. The species fruits regularly in December/January.

## Materials and methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (2001). The notation [84, 5, 4] indicates that measurements were made on 84 spores in five samples in four collections. The following abbreviations are used: avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient.

## Taxonomic description

***Leucoagaricus amanitoides*** R.M. Davis & Vellinga **sp. nov.** Figures **1-3**

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*Leucoagaricus amanitoides basidiocarpis albis, stipite volvato bulboso brevi, cheilocystidiis longis anguste clavatis, sporis inamyloideis sine poris, fibularum absentia designatus.*

***Holotypus***: 'U.S.A., California, Yolo Co., Davis, University of California Davis Arboretum, 7 January 2006, R.M. Davis (coll. E.C. Vellinga 3456) (UC)'.

Fig. 1: *Leucoagaricus amanitoides*, basidiocarp from holotype (photo by R.M. Davis)

*Etymology:* amanitoides is derived from the Greek 'αμανιτοειδης' = 'looking like an *Amanita*', because of the striking resemblance to some members of that genus.

**Basidiocarp** when young with a small hemispherical pileus sitting on top of a turbinate stipe.

**Pileus** 35 mm when young, expanding to 85 mm, when young hemispherical with flat top, later expanding to plano-convex, wavy applanate with low wide umbo or with applanate centre, white in all stages, but when old with brown patches, dry, slightly radially squamose-fibrillose with short fibrils, when young with thick involute margin, later straightening out, but still exceeding lamellae. **Lamellae,** L = about 105, l = 0 or 1, free, rather crowded, not or slightly ventricose, segmentiform, up to 9 mm wide, in some specimens lamellulae anastomosing with lamellae, slightly cream to cream coloured when seen from aside, with distinctly white cystidiose, irregular or even scalloped edge. **Stipe** 32-90 x 11-20 mm, with amorphous bulbous base with turbinate or rounded bottom, up to 35 mm wide in young specimens, 30 mm in mature specimens, white-cream, smooth and shiny with up to 3 bands of guirlandes of white velar material on the stipe, with some white velar remnants at top of bulb, solid, or narrowly hollow. **Annulus** small and triangular in cross-section, white. Velum universale soft and white. **Context** in pileus very thick, white and dull, not changing colour; in stipe white, slightly glassy in outer part. **Smell** (of cut specimen) sweet and pleasantly fungoid, but slightly astringent at back of throat. **Taste** indistinctly fungoid.

**Basidiospores** [84, 5, 4] in side view 6.1-8.3 (8.8) x 4.1-5.4 µm, avl x avw = 6.7-7.5 x 4.6-5.0 µm, Q = 1.27-1.79, avQ = 1.43-1.51, most ellipsoid, some oblong, some slightly amygdaloid in side-view, in frontal view ellipsoid or slightly oblong, not-coloured, thick-walled, without germ pore, with oil drop, congophilous but variable, either only the young ones, or all, dextrinoid, and vaguely metachromatic in Cresyl blue. **Basidia** 30-39 x 8.5-10 µm, 4 spored, without basal clamp connection. **Lamella edge** sterile. **Cheilocystidia** 29-75 x (6-)8-15 µm, narrowly clavate, often slightly capitate, rarely moniliform or narrowly lageniform, not-coloured, and slightly thick-walled. **Pleurocystidia** not observed. **Pileus covering** a loosely arranged cutis of cylindrical, colourless hyphae, 3-7 µm in diameter, with terminal elements slightly inflated and up to 12 µm wide. **Lamella trama** regular. **Stipe covering** a cutis of loosely arranged slightly inflated to cylindrical colourless hyphae, around 5-10 µm wide. **Clamp connections** absent.

**Habitat and distribution** - Solitary to gregarious, under planted *Sequoia sempervirens*, other conifers and *Quercus lobata* on heavy clay, December-beginning of January, only known from the type locality, an arboretum, in Davis, California (U.S.A.).

**Collections examined** — U.S.A., California: Yolo Co., Davis, University of California at Davis Arboretum, 3.I.2003, R.M. Davis 03001 (herb. R.M. Davis) (Genbank nrITS EF080870; nrLSU EF080872); *ibidem*, 17.XII.2004, E.C. Vellinga 3331 (UC) (Genbank nrITS EF080869; nrLSU EF080873); *ibidem*, 19 Dec. 2004, R.M. Davis (herb. R.M. Davis) (Genbank nrITS EF080871); *ibidem*, 7.I.2006, R.M. Davis (coll. E.C. Vellinga 3456; Holotype UC).

**Comments** — In the field the species resembles most closely an *Amanita* species, but the spores are dextrinoid and not amyloid, and the hymenophoral trama is regular, not divergent.

The closest relatives to this new species are, according to phylogenetic analyses of nrITS and nrLSU sequences (see examined collections for GenBank accession numbers), species cultivated by attine ants in cultivar clade 1 in the

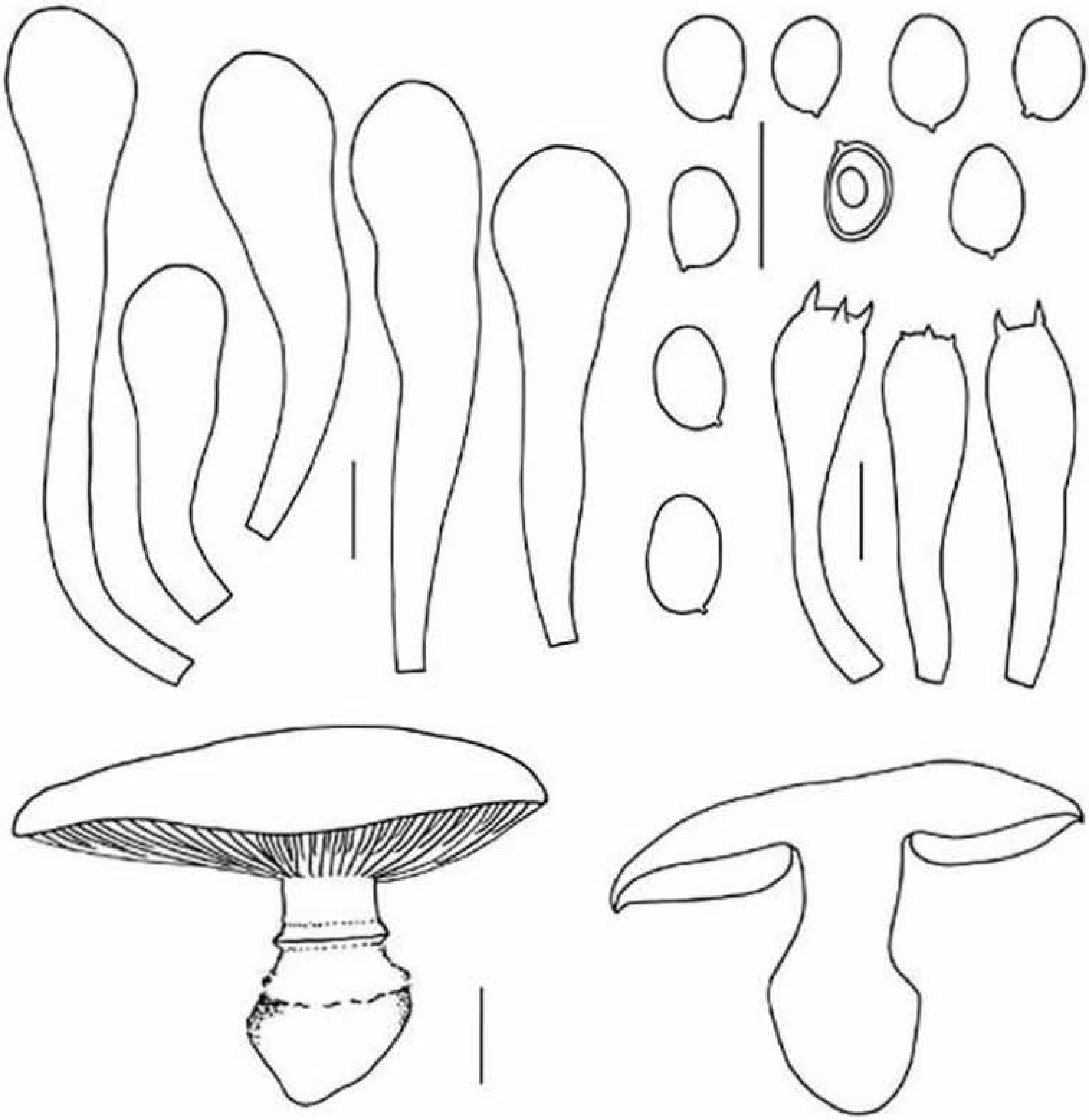

**Fig. 2:** *Leucoagaricus amanitoides*, basidiocarp (ecv3331), spores (ecv3456), basidia (rmd03001) and cheilocystidia (ecv3456). Scale bar is 1 cm for basidiocarp and 10 µm for microscopic features.

analyses by Mueller et al. (1998). *Leucoagaricus amanitoides* has a combination of striking characters: it is completely white, has a volva, and a bulbous stipe base, and microscopically, the spores lack a germ pore, cheilocystidia are narrowly clavate and long, and pleurocystidia are lacking. We compared our species with others from the literature which either share the presence of a volva, are white and fleshy, or in other respects resemble *Amanita* species. A short discussion of those species follows.

The two white European volvate species, *Leucoagaricus subvolvatus* (Malençon & Bertault) Bon and *Leucoagaricus volvatus* Bon & A. Caball. belong to sect. *Rubrotincti* Singer. The former has been included in molecular

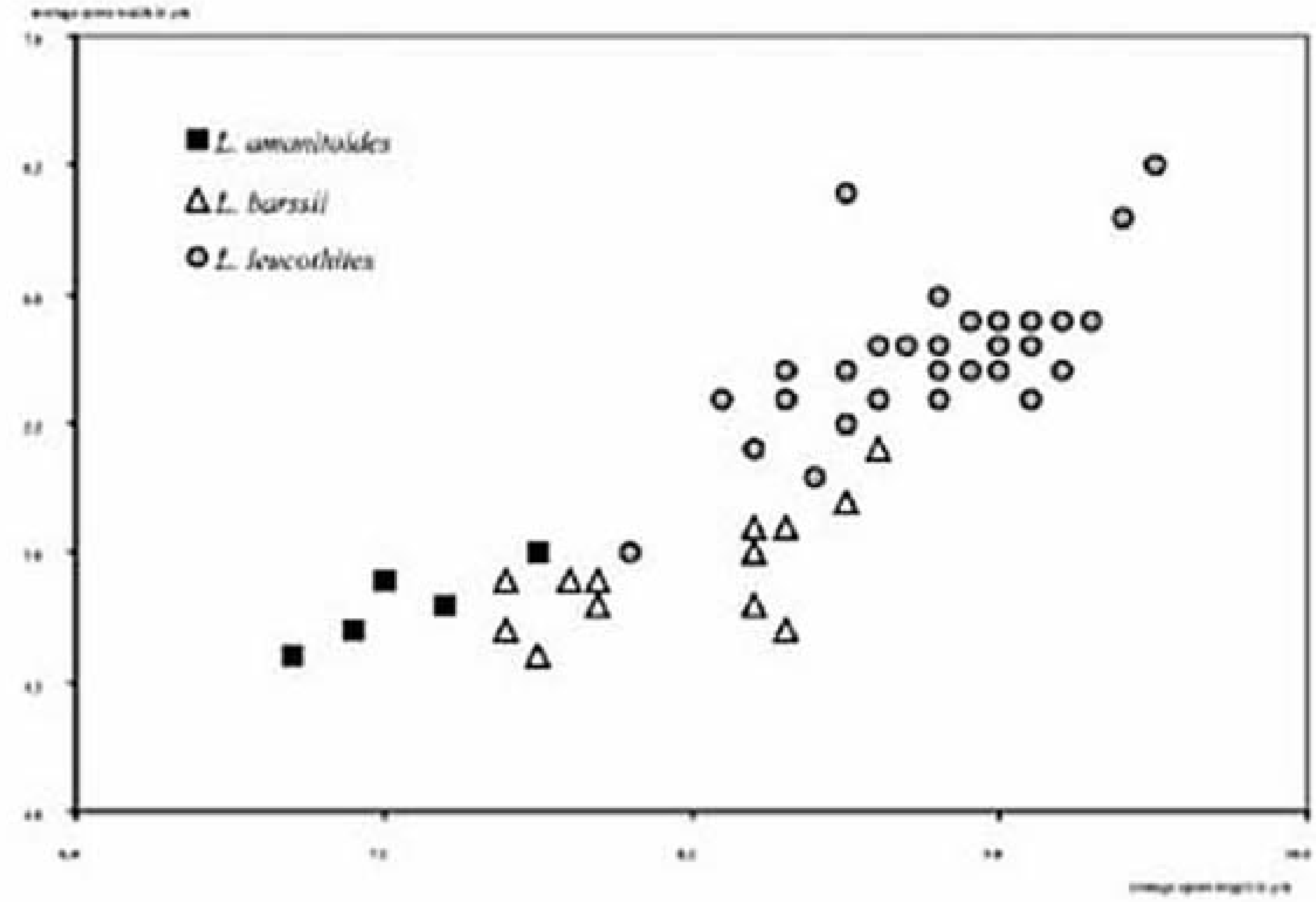


Fig. 3: Scatter diagram of average spore sizes for *Leucoagaricus amanitoides*, *L. barssii* and *L. leucothites*. The measurements for *L. barssii* are based on 14 collections from Europe, western North America (including the type collection) and Australia; those for *L. leucothites* are based on 33 collections from Europe, North America and Australia. Average spore length on the X-axis, average spore width on the Y-axis.

phylogenetic studies (Vellinga 2004a) and is close to *Leucoagaricus crystallifer* Vellinga and *L. menieri* (Sacc.) Singer, and other white species with crystals on top of the cheilocystidia. *Leucoagaricus volvatus* has some olivaceous tinges in the pileus, but also has crystals on the cystidia and a slightly gelatinized pileus covering.

Two other volvate species are *Leucoagaricus bivelatus* B.P. Akers & Ovrebo from Panama and *Lepiota volvatula* Pegler from the Caribbean island of Martinique. The former has slender basidiocarps with a sheathing volva, and a bluish black pileus; the spores are ellipsoid, lacking a germ pore, and the cheilocystidia are relatively short and narrowly clavate (Akers & Ovrebo 2005). The latter is a small species (pileus 2.5-3 cm), with a thin and fragile, brownish pileus, which is sulcate-plicate; the spores are 5.5-7.2 x 3.5-4.5 µm (Pegler 1983).

Fleshy white or whitish species that show some resemblance to the new species are *Leucoagaricus leucothites* (Vittad.) Wasser and *L. barssii*. *Leucoagaricus leucothites* is a common species of open man-made habitats, such as lawns and fields. There is no volva at the base of the stipe, the spores have a germ pore and the pileus covering is a trichoderm. The spores are bigger than those of *L. amanitoides* (Fig. 3). *Leucoagaricus leucothites* is widespread and has been recorded from Europe, Asia, North America, Africa and Australia (see Vellinga 2004b and references therein).

*Leucoagaricus barssii* also occurs in man-made habitats, but has a radially fibrillose, white to greyish pileus covering, and a tapering stipe. The ellipsoid spores lack a germ pore, and pleurocystidia are present close to the lamella edge (Vellinga 2000, 2001). The spore sizes overlap with those of *L. amanitoides* (Fig. 3). This species is widespread and known from Europe, North America and Australia (e.g. Vellinga 2000, 2001, and personal observations).

*Leucoagaricus gaillardii* Bon & Boiffard resembles *L. amanitoides* in its sturdiness; it is a species with a pinkish pileus, a distinctly bulbous stipe, which can be volvate. The spores measure 7-9(-10) x 5-6(-7) µm. The cheilocystidia are narrowly lageniform to cylindrical and wavy, and not narrowly clavate as in *L. amanitoides*, but they are of the same length (Bon & Boiffard 1975). *Leucoagaricus gaillardii* grows in sandy habitats in south-western Europe. Its phylogenetic position is not quite clear; it has been originally described in section *Rubrotincti* (Bon & Boiffard 1975), but on account of the reddening of the pileus centre when touched, and the green reaction in ammonia it was placed in sect. *Piloselli* (Kühner) Singer (Priou et al. 1995). One of us (ECV) has examined one collection from France, and its nrITS1 sequence groups with those of species in section *Rubrotincti* (data not shown).

Several other species resemble *Amanita* species, but differ from *L. amanitoides* in the colours of the basidiocarps; these are discussed here briefly in alphabetical order.

*Lepiota amanitiformis* Murrill was described from conservatories of the New York Botanical Garden. Its pileus surface is dry, and reddish brown, the stipe very short and thick, usually tapering upward from an abrupt, globose bulb at the base, white or tinged with reddish-brown ( Murrill, 1914).

*Lepiota amanitoides* Beeli, with dingy white pileus with yellowish stains, and a bulbous stipe base, turned out to be an *Amanita* species (Bas 1969).

*Lepiota subamanitiformis* S. Imai from Hokkaido (Japan) has a red-brown pileus, and the margin of the annulus is given as 'incarnate' (Imai 1938).

*Lepiota subamanitiformis* Dennis is characterized by a pale brown pileus with darker umbo, and was described from Trinidad (Dennis 1952).

## Acknowledgements

Jan Frits Veldkamp was so kind as to correct the Latin description. John Lennie edited the text and ECV's work was in part funded by NSF grant DEB 0618293. Comments by Dr Brian A. Perry and Prof. Zhu-liang Yang greatly improved the text.

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MYCOTAXON

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# Lepiotaceous fungi in California, U.S.A. – 2. *Lepiota rhodophylla* sp. nov.

Else C. Vellinga

*ecvellinga@comcast.net* or *vellinga@nature.berkeley.edu*
*Department of Plant and Microbial Biology, University of California at Berkeley, Berkeley, CA 94720, U.S.A.*

**Abstract** — A new *Lepiota* species with spurred spores and a pileus covering made up of repent hyphae is described from a *Cupressus macrocarpa* stand in central coastal California. Thick pinkish lamellae and sturdy pink-lilac brown basidiocarps are striking macroscopical characters of this species.

**Key words** — biodiversity, native forest, *Agaricaceae*, steno-spored species

## Introduction

Stands of *Cupressus macrocarpa* and of *Sequoia sempervirens* in coastal California are rich in lepiotaceous species (white-spored members of the family *Agaricaceae*) (e.g. Vellinga 2004; Sundberg 1971, 1989; Largent 2000), though many have not been recognized as separate species in the past (e.g. the species of *Leucoagaricus* sect. *Rubrotincti*). A high number of these species may grow together in a small area, such as a single Monterey cypress stand in the San Francisco Watershed (Vellinga 2004), where 25 species were encountered in the 2002/2003 mushroom season. Reasons for this phenomenon may be found in the absence of competition from ectomycorrhizal fungi, temporal differences in growth optimum for the species involved, and specialization to different micro-habitats by individual species (see also Vellinga 2004).

During fieldwork in this area in the mushroom seasons of 2000 and 2002/2003 a striking *Lepiota* species with pink lamellae was found. It is here described as new.

## Materials and methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (2001). Colour annotations in the macroscopical descriptions are from Munsell soil color charts (1975). The notation [80, 5, 5] indicates that measurements were made on 80 spores in five samples in five collections. Spores were measured in Congo Red in ammonia. The length of the spores is measured from bottom of spur to top of spores; the width of the spores is measured in the middle of the spore, excluding the spur. In other words, the spur is included in the length of the spores, but excluded from the measurements of the width. The following abbreviations are used: avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient.

## Taxonomic description

***Lepiota rhodophylla*** Vellinga sp. nov. Figures 1-2

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Lepiotae boudieri *Bres. affinis; basidiocarpa valida; pileus pallide roseobrunneus, vel purpuraceobrunneus; lamellae crassae, roseolae.*

***Holotypus:*** 'U.S.A., California, San Mateo County, San Francisco Watershed, Monterey cypress grove, 28 January 2003, E.C. Vellinga 3026 (UC)'.

***Etymology:*** The epithet 'rhodophylla' is derived from the Greek 'ροδοφυλλος', pink leaf, because of the striking pink lamellae.

**Pileus** 27-68 mm, irregularly convex with deflexed to involute margin when young, wavy applanate plano-convex later, with low umbo to plano-concave in older specimens, completely felted-tomentose, either completely closed or in small patches, not distinctly discreetly squamose, sometimes radially fibrillose at margin, variable in colour, pale pinkish brownish (like 5 YR 7/4-8/4) all over, or rather dark brown (7.5 YR 4-3/4, 5 YR 5/4 to 6/4 around centre), and paler at margin to pinkish-greyish or beige (like 5YR8-7/2-3), in some places showing white context, but orange where damaged; margin when young thick, pale pinkish, and cottony, exceeding lamellae. **Lamellae,** L = 55-70, l = 0-3, moderately crowded, free, often almost emarginate, rather thick, segmentiform to ventricose up to 6 mm wide, pink, pale brownish, pinkish beige or pale pinkish (10 YR 8/4, 7.5 YR 7/4, 5 YR 6/4, 5 YR 7/4, 5 YR 8/3-4, sometimes with touches of 5 YR 6/4), with white irregular cystidiose edge or with concolourous even edge. **Stipe** 38-65 x 7-15 mm, sturdy, cylindrical or, rarely, compressed, sometimes slightly narrower at base, pale pink and distinctly lilac pink or pale lilac pink at apex, with colour as on pileus lower down, longitudinally innately striate-fibrillose in upper 1/3, in lower 2/3 when young with distinct bands or girdles and tufts of material as on pileus, later less clearly so, and more woolly, when young with annulus-like structure, with white rhizomorphs at base, hollow. **Context** whitish in pileus and pinkish just above the lamellae, orange around maggot holes; pinkish or lilac in stipe apex to cream at bottom, with white pith, brown discoloured at utmost base. **Smell**

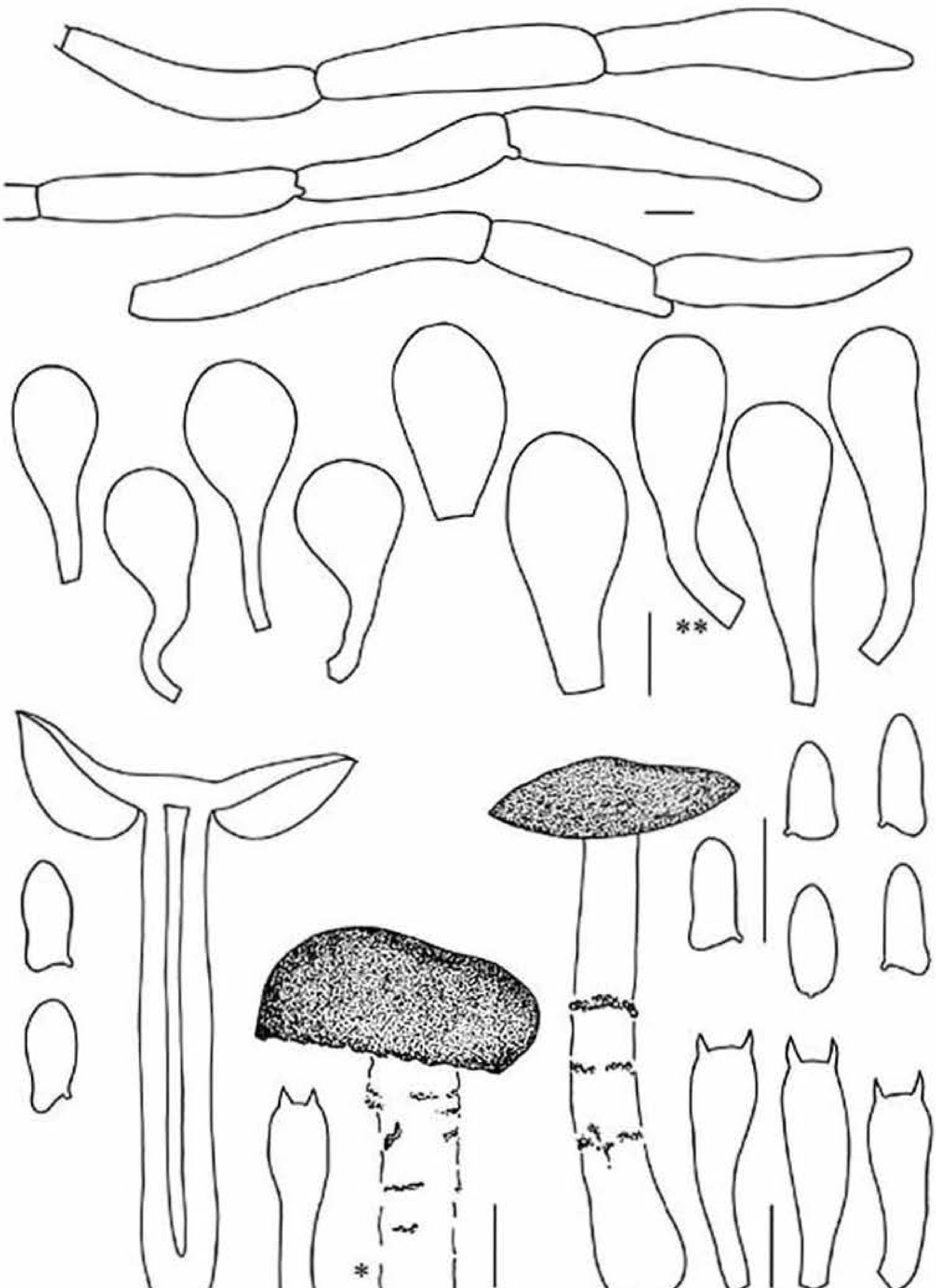


**Fig. 1:** *Lepiota rhodophylla*. Basidiocarps, spores, basidia, cheilocystidia and pileus covering elements. All from ecv3026, except * from ecv2972 and ** from ecv2610.

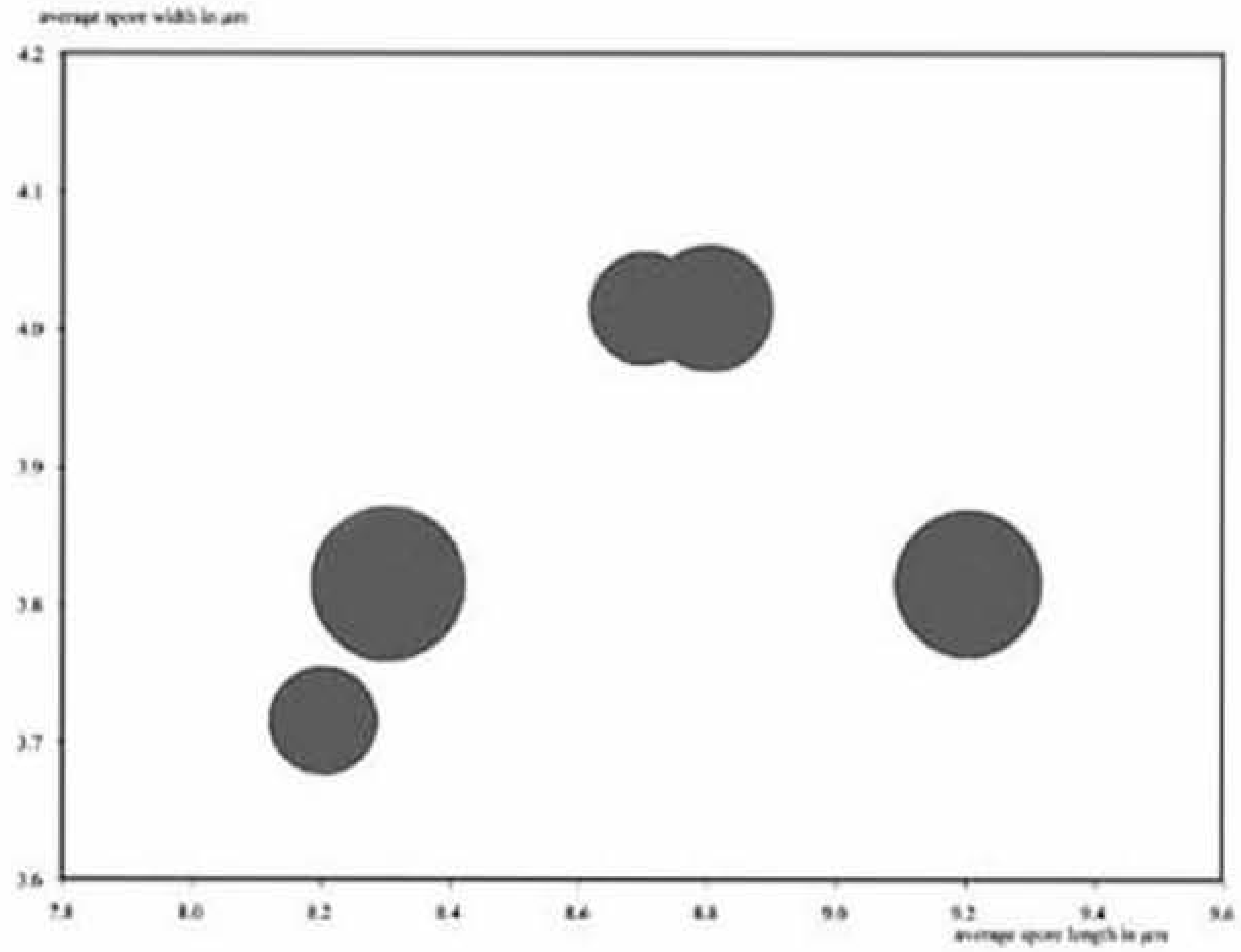


**Fig. 2:** *Lepiota rhodophylla:* average spore sizes per collection; the size of the bubble is an indication of the maximum size of the cheilocystidia, varying from 23 to 41 µm.

variable, from vaguely rubber-like, i.e. like the smell of *L. cristata* (Bolton :Fr.) P. Kumm. to very strongly so, but without the sweet component. **Taste** and **spore print** colour unknown. KOH on pileus surface yellow.

**Basidiospores** [80, 5, 5] 7.6-10.0 x 3.3-4.2 µm, avl x avw = 8.2-9.2 x 3.7-4.0 µm, Q = 2.0-2.7, avQ = 2.2-2.45, in side-view subcylindrical, with (but not always) broad straight or outgrown spur, in frontal view subcylindrical, slightly thick-walled, with one guttule, dextrinoid, congophilous, not metachromatic in Cresyl blue. **Basidia** 23-35 x 6.5-8.5 µm, 4-spored, with basal clamp connection. **Lamella edge** sterile. **Cheilocystidia** 16-41 x 7.0-16 µm, clavate, broadly clavate or narrowly clavate, varying in size between collections, e.g. 20-30 µm long in collection ecv2992, and 23-40 µm long in collection ecv2610. **Pleurocystidia** absent. **Pileus covering** a cutis with adnate hyphae, made up of up to 5-6 pigmented elements, with terminal cells, 56-120 x 8-16 µm, tapering towards apex; clamp connections present at all septa; pigment intracellular light purple brown, sometimes granular, soluble in ammonia. **Stipe covering** a cutis of cylindrical, straight hyphae, 3-7 µm in diameter; in lower 2/3 of stipe patches made up of repent hyphae, as on pileus. **Clamp connections** present at all septa.

**Habitat and distribution** – Gregarious in small groups, only known from one locality in central coastal California, terrestrial in an almost 100 yr old *Cupressus* *macrocarpa* plantation on an east-facing slope, close to a small seasonal creek. December-end of February.

**Collections examined** — U.S.A., CALIFORNIA: San Mateo Co., SAN FRANCISCO WATERSHED, 8.XII.2000, E.C. Vellinga 2610 (Genbank nrITS AY176480); *ibidem*, 23.XII.2002, E.C. Vellinga 2972; *ibidem*, 7.I.2003, E.C. Vellinga 2992; *ibidem*, 28.I.2003, E.C. Vellinga 3026 (Holotype; Genbank nrITS EF080864); *ibidem*, 25.II.2003, E.C. Vellinga 3049 (all in UC).

**Comments** — At first sight, *Lepiota rhodophylla* can be taken for an *Agaricus* species, because of the strikingly pink lamellae. However, the absence of brown spores, and the presence of white spurred spores and clamp connections make identification as a *Lepiota* species easy. The present author knows no *Lepiota* species with which it can be confused. The combination of its robustness and the pink lamellae is unique. *Lepiota andegavensis* also has sturdy basidiocarps, but the pileus is dark brown, and the stipe and lamellae are strikingly white (Mornand 1983, Chalange 1995).

There is intraspecific variation in the colour of the basidiocarps, and in the length of the spores and cheilocystidia. There does not seem to be any correlation between spore length and cystidium length (fig. 2). The two collections represented by the nrITS sequences in Fig. 3 exhibit differences in colour, ecv2610 being dark, and ecv3026 pale pink.

*Lepiota rhodophylla* groups together with *L. boudieri* Bres. in a maximum likelihood analysis of nrITS data in a wide sampling of *Lepiota* species (Clade I in fig. 3). *Lepiota rhodophylla*, *L. boudieri* and the others in this clade are characterized by spurred spores, and repent, clamped hyphae on the pileus covering (see also Vellinga 2003). The sister group to this clade has also spurred spores, but the pileus covering is made up of erect elements, with septa lacking clamp connections (Clade II in fig. 3).

One species, *Lepiota andegavensis* Mornand (1983), is an enigma in morphological and molecular-phylogenetic aspects. Bon (1993) described its pileus covering as a cutis, resembling that of *L. rhodophylla* and *L. boudieri*, but Vellinga (2001) who studied his collection concluded it was closer to that of *L. castanea* Quél., i.e. with septate but clampless elements. Parsimony analyses of the nrITS sequences group *L. andegavensis* with *L. boudieri* and *L. rhodophylla*, but in the Maximum Likelihood analyses it is basal to all spurred spored (stenospored) species.

The sister group to all stenospored species is morphologically characterized by ellipsoid spores and long cells in the pileus covering (Vellinga 2003). This group, comprising *L. subincarnata* J.E. Lange and *L. brunneoincarnata* Chodat & C. Martin, is infamous due to the occurrence of α- and β-amanitines in the basidiocarps, though these substances have also been reported in the stenospored *L. castanea* (Gérault & Girre 1975).

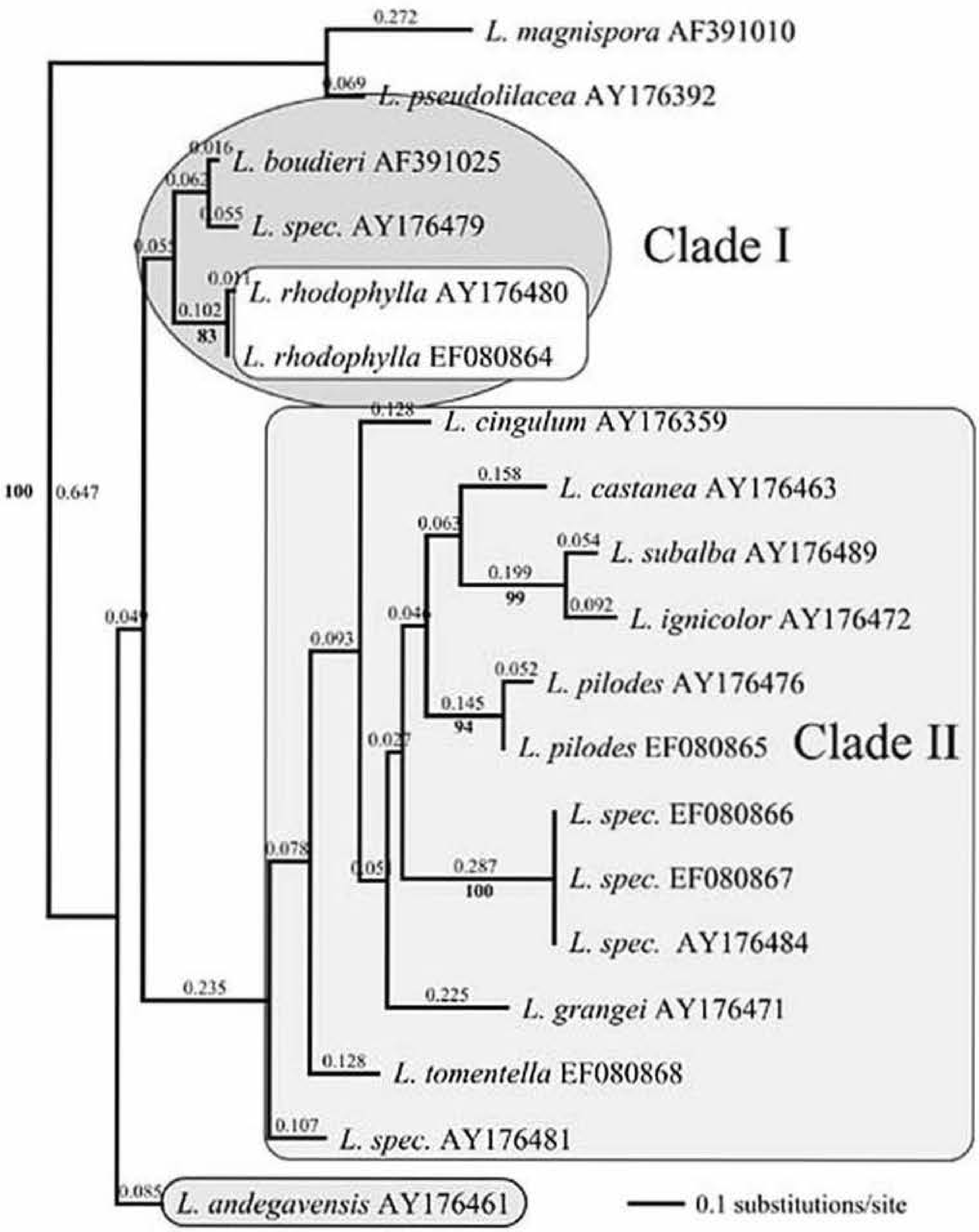


**Fig. 3:** Phylogenetic relationships of *Lepiota* species with spurred spores and a pileus covering made up of long elements, based on a Maximum Likelihood analysis of nrITS sequences under the HKY85 model. Bootstrap values in bold are based on 100 replicates. Genbank accession numbers are given for each collection. The topology of a tree based on Maximum Parsimony analysis is identical, except for the position of *L. andegavensis* which belongs to Clade I in the MP analysis. *Lepiota magnispora* Murrill and *L. pseudolilacea* Huijsman, with a trichodermal pileus covering with both long elements, and short, clavate elements at the base of these long elements, are used as outgroup.

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MYCOTAXON

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# Lepiotaceous fungi in California, U.S.A. – 3. Pink and lilac species in *Leucoagaricus* sect. *Piloselli*

ELSE C. VELLINGA

*vellinga@nature.berkeley.edu* or *ecvellinga@comcast.net*
*Department of Plant & Microbial Biology, University of California at Berkeley, Berkeley, CA 94720-3102, U.S.A.*

**Abstract** – Type collections of two beautiful pink and lilac agarics, viz. *Lepiota roseolivida* and *L. decorata*, are studied, and descriptions based on many fresh collections from California are given. *Leucoagaricus marriagei* is considered a synonym of *L. roseolivida*, based on morphology and ITS sequences, and *Leucoagaricus idae-fragum* is placed in synonymy with *L. decorata*. Based on morphology and molecular data, these species belong to the *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae*. Morphologically, they are placed in *Leucoagaricus* sect. *Piloselli*. However, nomenclatural changes are not made at this moment, as there are uncertainties over generic circumscriptions within the clade.

**Key words** – biodiversity

## Introduction

California is rich in species in the *Leucoagaricus/Leucocoprinus* clade of the *Agaricaceae* (Vellinga 2004a, b), many of which are new to science. Murrill on his 1911 trip to the west coast of North America (Murrill 1912) collected and later described several new species, of which *Lepiota roseolivida* from Muir Woods, north of San Francisco, is the most beautiful. *Lepiota decorata* (Zeller 1922, 1929) is also a striking species, originally described as *L. pulcherrima*, from central western Oregon, which is also found in California.

Descriptions of the microscopical details of the type collections, and full descriptions based on recent collections are given here.

Based on the morphological characters of these species, both belong to *Leucoagaricus* sect. *Piloselli* (Kühner) Singer, a group of species whose basidiocarps turn red, when they are scratched, and parts turn green in ammonia vapours (see also Vellinga 2004b for phylogenetic placement based on nrITS and nrLSU sequences). The taxonomy of the *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae* is still in flux (Vellinga 2004b), with the main question whether it is one genus, *Leucocoprinus* Pat., or whether it can be split up into several smaller morphologically well-defined genera. Awaiting further research on tropical species, and the outcome of multigene phylogenetic analyses, *Lepiota roseolivida* and *L. decorata* are provisionally retained in the genus *Lepiota*, despite the fact that both species clearly do not belong there.

## Methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (2001). Colour annotations in the macroscopical descriptions are from Kornerup & Wanscher (1974) and Munsell soil color charts (1975). The notation [105, 7, 7] indicates that measurements were made on 105 spores in seven samples in seven collections. The following abbreviations are used: L for lamellae, l for lamellulae, avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient. The abbreviation *L.* is used for '*Lepiota*' and *La.* for '*Leucoagaricus*' The modern descriptions are based on North American collections, though the European material which has been used as comparison, is listed for completeness.

## Taxonomic descriptions

**1. *Lepiota roseolivida*** Murrill — Figures 1-2

*Lepiota roseolivida* Murrill, Mycologia 4: 234. 1912.
*Lepiota marriagei* D.A. Reid, Nova Hedwigia 11, Suppl.: 20. 1966 (Fung. rar. ic. Col. 1);
*Leucoagaricus marriagei* (D.A. Reid) Bon, Doc. mycol. 6 (24): 44. 1976.
*Leucoagaricus marriagei* var. *ammovirescens* Bon, Doc. mycol. 22 (88): 31. 1993.

**Description of type collection** (W.A. Murrill 1138 (NY)) (Fig. 1)

Murrill (1912): "Pileus convex to expanded, thin, umbonate, gregarious, 2.5-4 cm. broad; surface dry, minutely and densely fibrillose-scaly, rose-lilac, livid in the center, becoming slightly darker on drying; lamellae white, unchanging, free, crowded, narrow; spores ellipsoid smooth, hyaline, 8-9 x 4-5 µ; stipe slender, tapering upward, subglabrous, white or pallid, changing to lilac on drying, hollow, 7-10 cm. long, 2-5 mm. thick; annulus superior, movable, ample, membranous, lilac-tinted, becoming lilac on drying."

### Type study

**Basidiospores** [20,1,1] in side view 7.1-9.6 x 3.9-4.9 µm, on average 8.0 x 4.5 µm, Q = 1.6-2.0, av Q = 1.77, oblong, many asymmetrical and amygdaliform, in frontal view oblong, thick-walled, colourless, dextrinoid, congophilous and metachromatic in Cresyl Blue. **Basidia** 19-23 x 7-8 µm, 4-spored. Lamella edge sterile; **cheilocystidia** 25-48 x 7-12 µm, narrowly utriform, narrowly clavate, narrowly ellipsoid-fusiform, to cylindrical with narrow pedicel, colourless, slightly thick-walled. **Pleurocystidia** absent. **Pileus covering** a cutis made up of repent hyphae, with terminal elements 60-190 x 8-12 µm, tapering towards apex; up to three to five elements in a row with intracellular brownish pigment; pileus covering exuding greenish pigment in 10 % ammonia. **Clamp connections** absent.

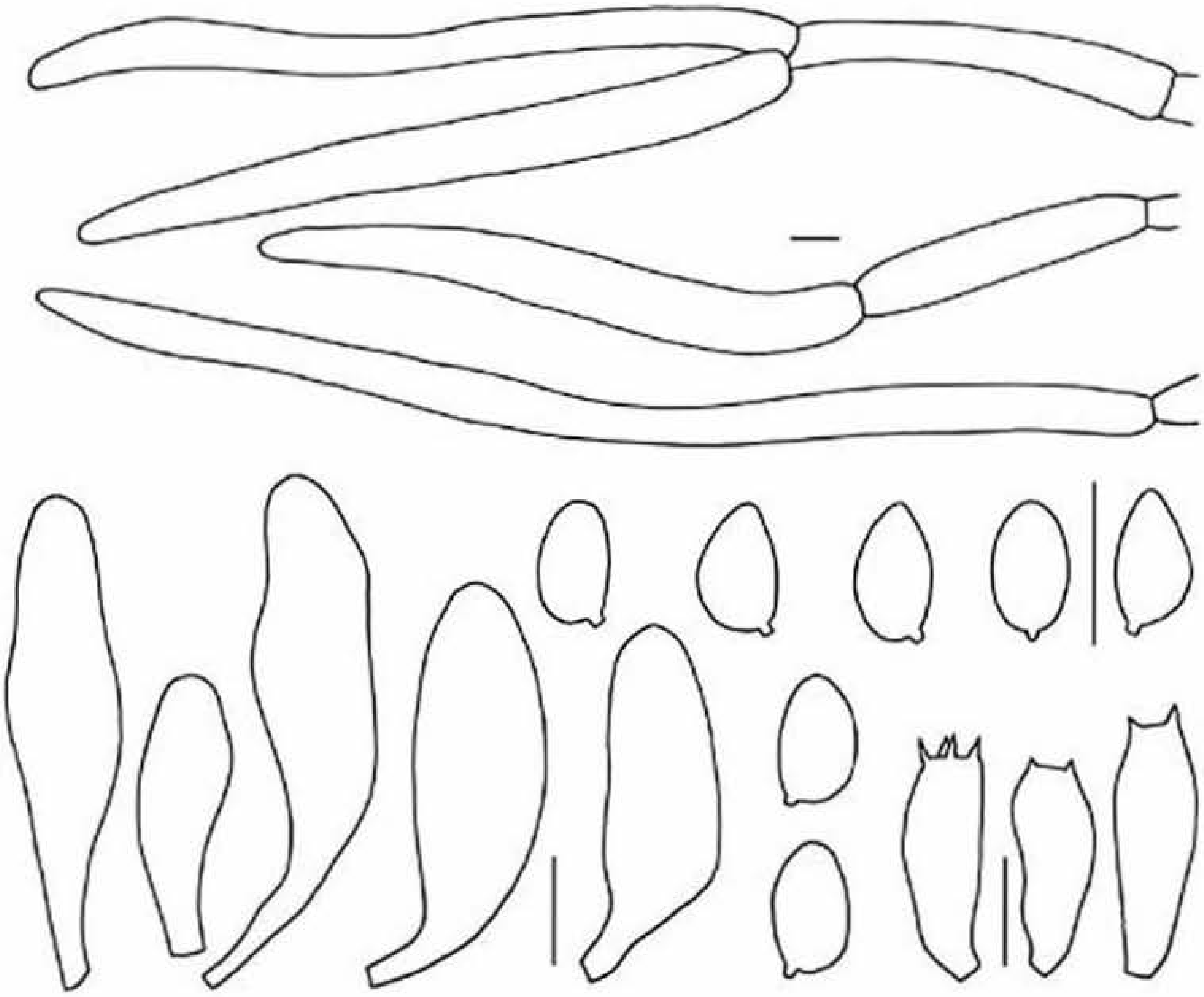

Fig. 1: *Lepiota roseolivida* – Spores, basidia, cheilocystidia and elements of pileus covering (all from holotype). Scale bar 10 µm.

## Description of modern material (Fig. 2)

**Pileus** 5-30 mm, widely conical, convex to plano-convex or wavy plano-convex with rounded to inconspicuous and low umbo, with age plano-concave to concave without umbo, when young with margin exceeding and overhanging lamellae, but with age equal, at centre (umbo) velvety-tomentose to slightly tufted-tomentose and around centre with radially arranged appressed short fibrils in narrow to cobwebby squamules, not or hardly showing underlying context, at margin often in v-shaped patches on white background, at centre beautiful lilac-purple (10E4), dark violet-pink (12DE5), pink-lilac (11-12CDE4) or dark purple (a bit more purple than 10R5/4), and often paler around centre (e.g. 10D4, 10D5), but sometimes dark violet (10DE5/4), with age with yellowish tinges from context. **Lamellae**, L = 40-45, l = 0-3, moderately to rather crowded, free, often distinctly so and up to 2 mm from stipe, ventricose or slightly ventricose, up to 3 mm wide, pale cream to distinctly cream or yellowish tinged especially so in older specimens, sometimes with pinkish tinges, with white cystidiose edge. **Stipe** 18-90 x 0.75-4 mm, sometimes bulbous, in most cases becoming wider downwards, up to 8 mm at base, often slightly compressed in lower half, white in upper half, yellowish in lower half and in basal part with hints of lilac and purple, smooth, or slightly cystidiose above annulus, and sometimes slightly fibrillose in lower part, hollow. **Annulus** in general quite flimsy and not persistent, consisting of a small white cuff, irregularly ragged at lower edge, and a small flaring white part, with rim of pink-purplish material as on pileus, in half of the collections completely coloured on the outside, lilac like pileus, and white on the inside. **Context** white, thin and dull in pileus, white to whitish and shiny in stipe. **Smell** very weak and indistinct, fungoid, or sweet and like rubber (as *Lepiota cristata* (Bolton : Fr.) P. Kumm.). **Taste** not recorded. **Spore print** white.

**Basidiospores** [105, 7, 7] in side-view 6.7-9.8 x 3.8-5.7 µm, on average 7.4-8.3 x 4.2-4.9 µm, Q = 1.4-2.3, average Q = 1.55-1.95, oblong to subcylindrical, many amygdaliform often with distinct though small apical papilla, in frontal

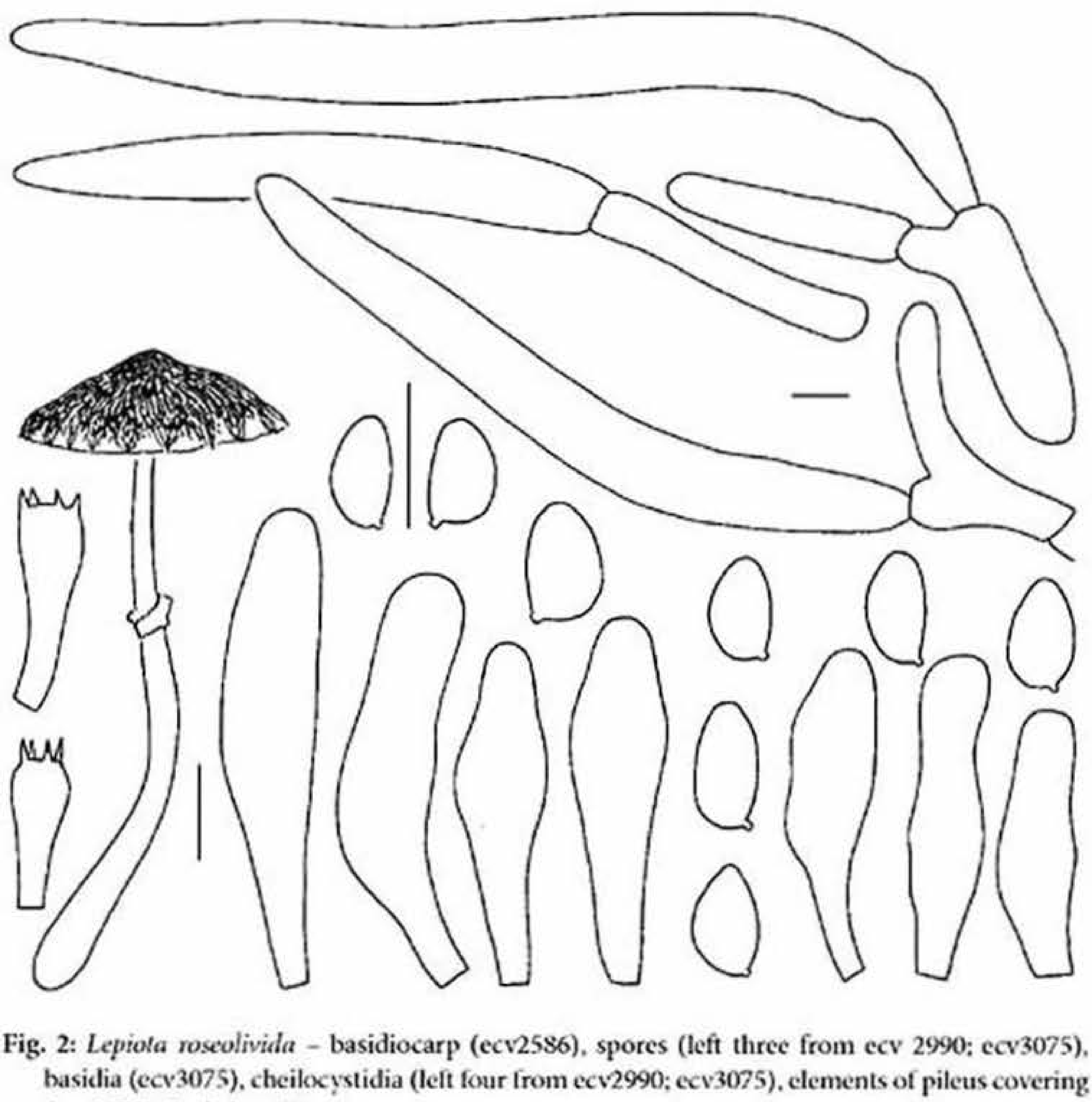

Fig. 2: *Lepiota roseolivida* – basidiocarp (ecv2586), spores (left three from ecv 2990; ecv3075), basidia (ecv3075), cheilocystidia (left four from ecv2990; ecv3075), elements of pileus covering (ecv3075). Scale bar 10 µm.

view oblong, with or without apical small papilla, thick-walled, colourless, dextrinoid, congophilous, and metachromatic in Cresyl blue. **Basidia** 15-26 x 6-9 µm, 4-spored, rarely 2-spored. Lamella edge sterile; **cheilocystidia** 21-62 x 5.5-13 µm, variable in shape, from narrowly utriform to wavy cylindrical or narrowly clavate, slightly thick-walled, colourless. **Pleurocystidia** absent. **Pileus covering** a loose cutis made up of repent hyphae, with terminal elements 60-190 x 8-12 µm, cylindrical or tapering towards apex; pigment intracellular and pinkish-lilac, more brown in older and dried material; cells further away from the apices with encrusting brownish pigments. **Stipe** covering a cutis of narrow, 2-3 µm wide hyphae with pale coloured walls; occasional hyphae with pigmented walls; below annulus with scattered hyphae as in pileus covering. **Clamp connections** absent.

**Habitat and distribution** – Solitary or in small groups, terrestrial and saprotrophic, in various forests, e.g. redwood forests and Monterey cypress groves, but also along a path in a more ruderal setting, widespread, and not uncommon, end of October-beginning of January.

COLLECTIONS EXAMINED – **U.S.A., Washington, King Co.**, Seattle, Seward Park, S.A. Trudell 95-293-01 (herb. Trudell) (Genbank nrITS EF121815); **California, Humboldt Co.**, Patrick's Point State Park, near Mussel Rock, 23.X.2003, E.C. Vellinga 3075; **Mendocino Co.**, Jackson State Demonstration Forest, 'mushroom corner', 22.XI.2003, D.E. Desjardin (coll. E.C. Vellinga 3129); 0.5 mile south of junction of Highways 1 and 128, 17.XI.2006, E.C. Vellinga 3493; **Marin Co.**, Muir Woods, 22.XI.1911, W.A. Murrill 1138 (**Holotype**, NY); Point Reyes, along Limantour Road, 4.XI.2005, E.C. Vellinga 3348; Point Reyes, Bayview Trail, 22.XI.2006, D. DeShazer 531; Mount Tamalpais, Bolinas-Fairfax Road, 15.XI.2005, E.C. Vellinga 3368; **Contra Costa Co.**, Tilden Regional Park, along Upper Packrat Trail above Jewel Lake, 13.XI.1999, E.C. Vellinga 2378; *ibidem*, 4.XI.2000, E.C. Vellinga 2486 (Genbank nrLSU AY176395); *ibidem*, 23.XI.2001, E.C. Vellinga 2738; **San Mateo Co.**, San Francisco watershed, 8.XII.2000, E.C. Vellinga 2586; *ibidem*, 7.I.2003, E.C. Vellinga 2990 (Genbank nrITS EF121816); *ibidem*, 5.XII.2003, E.C. Vellinga 3141; San Mateo Co. Memorial Park, along Pomponio trail, northeast facing slope, 31.X. 2000, E.C. Vellinga 2475 (Genbank nrITS AY176394).

**THE NETHERLANDS, prov. Noord-Holland**, Heiloo, Heilooërbosch, 2.X.1996, F.A. v.d. Bergh (L); **prov. Limburg**, Elsloo-Geulle, Bunderbos, 9.IX.1996, E.C. Vellinga 2005 (L) (Genbank nrITS AF482866).

All collections in UC unless otherwise stated.

Comments – *Lepiota roseolivida* is a slender, elegant, fragile and unusually and subtly coloured little mushroom, which cannot be confused with any other species. Basidiocarp sizes vary, and basidiocarps with 5 mm wide mature pilei have been found in some habitats. The observations on the type collection are in agreement with those by Smith (1966).

*Leucoagaricus marriagei* is considered a synonym here. The macroscopic and microscopic characters of the two species are virtually identical, though

Reid (1966) described the spores as rather narrow (3.2-4 µm wide), which is not confirmed by measurements on Dutch material identified as *La. marriagei* (Vellinga 2001), where the spores were found to be 4.0-5.0 µm wide; Migliozzi & Perrone (1991) described Italian collections with 3.7-4.1 µm wide spores.

European literature shows that there is some confusion about the differences between *La. marriagei* and *La. ionidicolor* Bellù & Lanzoni (e.g. Bon 1976), *La. tener* (P.D. Orton) Bon and *L. brunneocingulatus* (P.D. Orton) Bon. *Leucoagaricus ionidicolor* has more greyish bluish lilac tinges, is more robust with a relatively wider pileus, and the pileus covering consists of erect long tapering elements. *Leucoagaricus tener* is a brown fragile species, copiously provided with clear golden droplets when fresh, and *La. brunneocingulatus* is also brown-capped, lacking such drops.

Sequences of the nrITS (Vellinga 2004b and new sequences) show up to nine base differences among the three American collections sampled (Genbank accession numbers are provided with the collection data), and the sequence of the one sampled European collection falls within this variation. The four collections studied form a monophyletic group. All collections exhibit the same positive reaction in ammonia, but shape of spores and cheilocystidia shows some variation (Fig. 2).

*Lepiota roseolivida* has a weak reaction in ammonia; the pileus covering cells for instance exude a brownish pigment when placed in ammonia. The recognition of a separate variety, based on this character, seems superfluous, hence the placement of *La. marriagei* var. *ammovirescens* (Bon 1993) in the synonymy of *L. roseolivida*.

*Lepiota roseolivida* is known from western North America and Europe. It has not yet been recorded from other parts of North America, though its occurrence there is expected. It has been found regularly in coastal forests in the western parts of the U.S.A., but due to its small size, and the fact that it grows in small groups or solitarily, it can easily be overlooked. It is rare in Europe, but reported there occasionally (e.g. Henrici 2001 (United Kingdom), Migliozzi & Perrone 1991 (Italy)).

**2. *Lepiota decorata* Zeller** — Figures 3-5

*Lepiota pulcherrima* Zeller, Mycologia 14: 186. 1922, non *Lepiota pulcherrima* P.W. Graff, 1914; *Lepiota decorata* Zeller, Mycologia 21: 103. 1929.

*Leucoagaricus idae-fragum* Guinb., Boisselet & G. Dupuy, Bull. trimest. Soc. mycol. Fr. 114 (3): 14. 1998.

**Description of type collection** (J.W. Severy & S.M. Zeller 2123 (NY)) (Fig. 3)

Zeller (1922): "Pileus 6-12 cm. broad, subhemispheric at first, then convex to quite plane, moderately fleshy, young buttons quite solid, acajon-red to Vandyke red at the center, venetian or alizarine-pink on the margin, often fading to a silvery livid-pink in age; cuticle on margins of older specimens split; surface appearing velvety because of the innate-pubescence towards the center, nearly glabrous or silky on the margin or squamulose when closely covered by another pileus, becoming slightly appressed-scaly in age due to growth. Margin sterile. Flesh white, rather thin except disk. Gills free, white, close, broad, rounded behind, edges even. Stem 5-10 cm. long, 8-12 mm. thick, equal or tapering upward, slightly bulbose, peronate by a thin membrane colored like this pileus about one half to two thirds of the way up to the rather large, flaring, rather fleshy persistent annulus, white within, white to pinkish above the annulus. Spores smooth, white, oblong, 3-4.5 x 5-8 μ, usually uniguttulate. Pleasant flavor. Odor mildly farinescens."

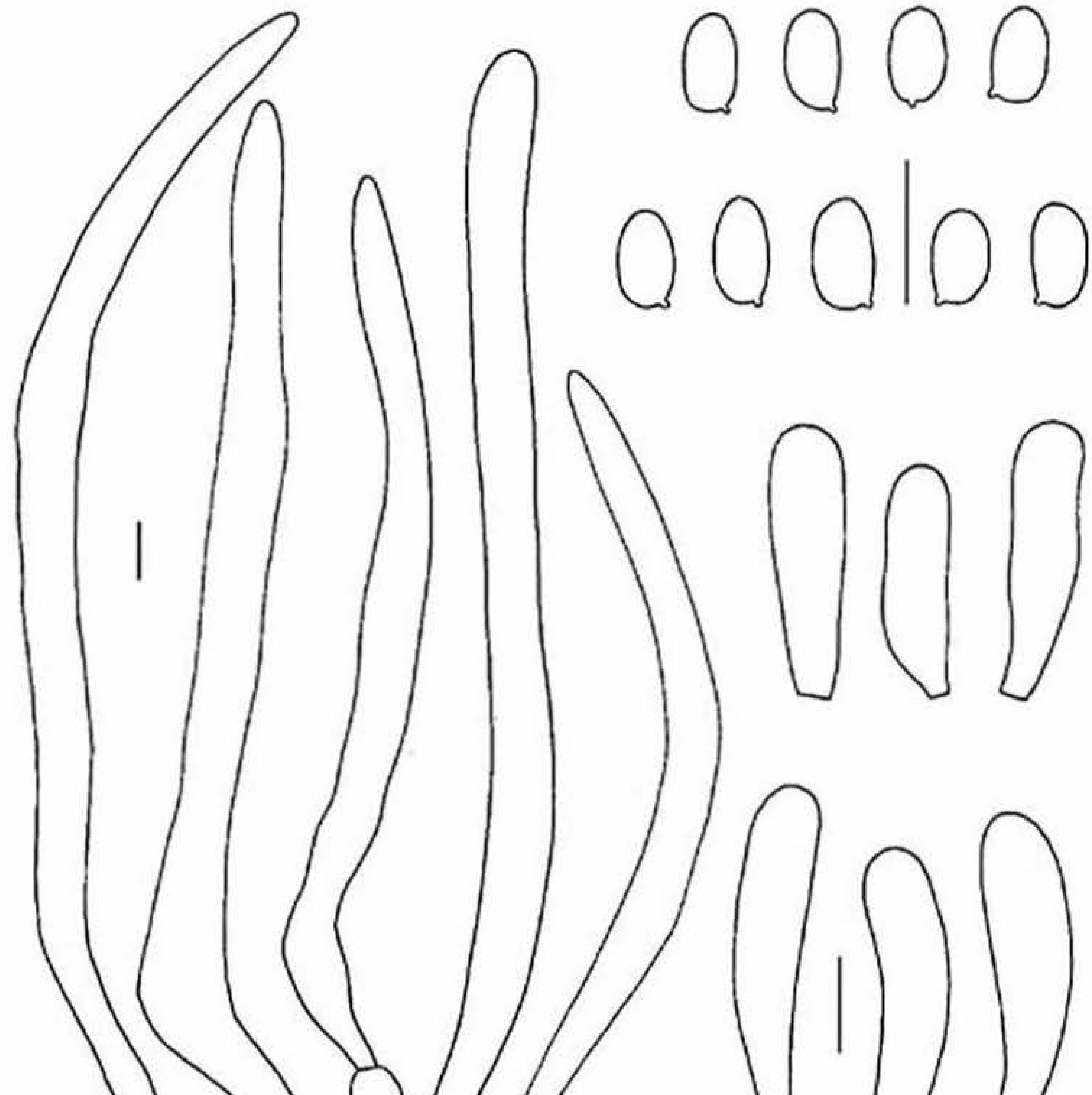

Fig. 3: *Lepiota decorata* – spores, basidia, cheilocystidia, elements of pileus covering (all from holotype). Scale bar 10 μm.

## Type study

**Basidiospores** [21,1,1] in side view 5.9-7.8 x. 3.6-4.4 μm, on average 6.6 x 4.0 μm, Q = 1.45-1.9 average Q = 1.66, ellipsoid to oblong, with rounded apex, rarely amygdaliform, with central guttule, thick-walled and without germ pore, congophilous, dextrinoid and metachromatic in Cresyl blue. **Basidia** 4-spored, difficult to revive. Lamella edge sterile; **cheilocystidia** 20-38 x 5.5-8.5 µm, narrowly clavate, cylindrical, thin-walled, colourless. **Pleurocystidia** not observed. **Pileus covering** made up of upright elements 100-240 x 7-13 µm, tapering towards apex, often widest above base, with brownish intracellular pigment, exuding pigment in ammonia. **Clamp connections** absent.

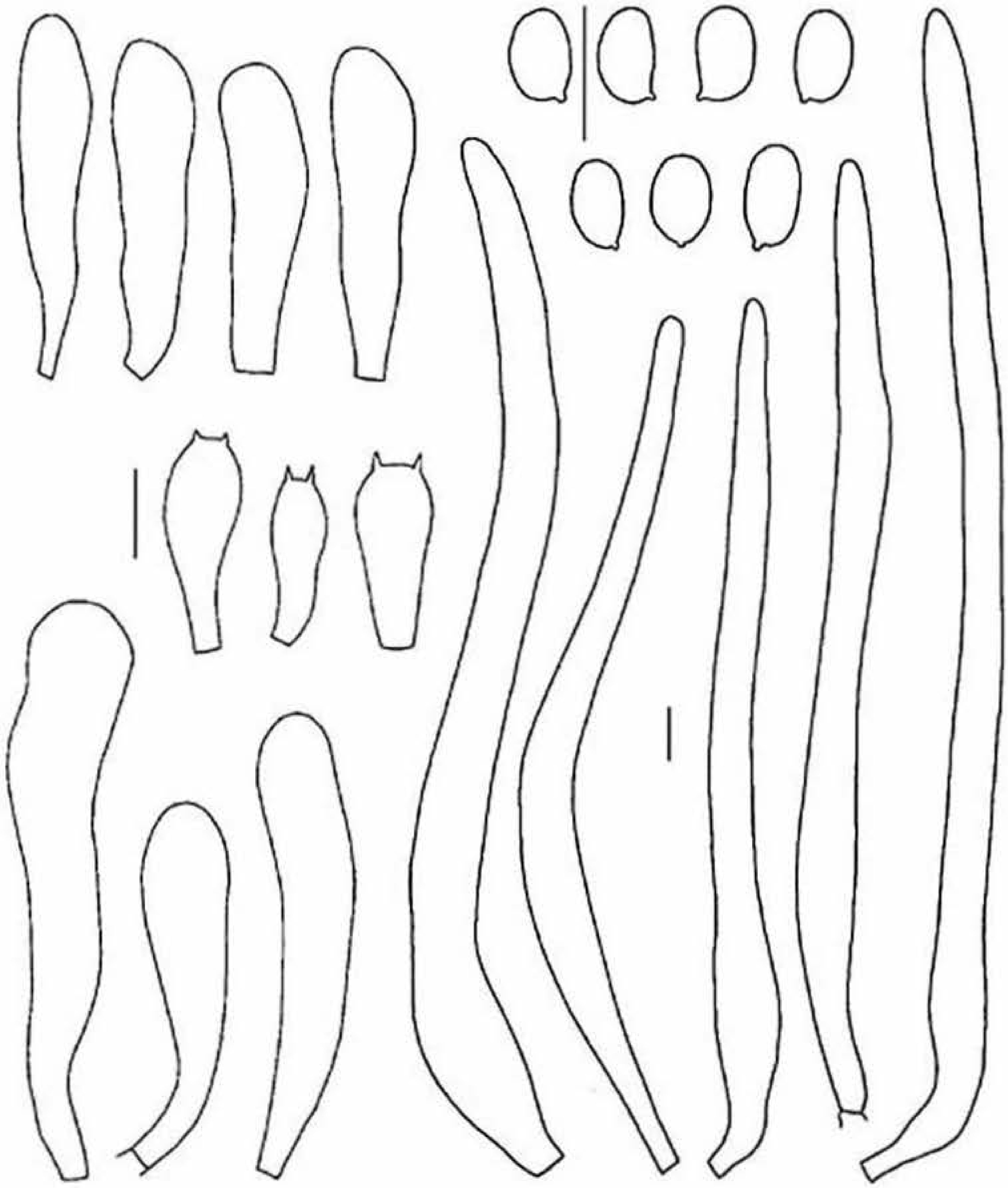

**Fig. 4:** *Lepiota decorata* – spores (ecv2810), basidia (ecv2810), cheilocystidia (upper ones from ecv2810; lower three from ecv3453), elements of pileus covering (left two from ecv2810; right from scale bar from ecv3190). Scale bar 10 µm.

**Description of modern material (figs. 4-5)**

**Pileus** 38-80 mm, campanulate with umbo, hemispherical-convex with inflexed margin when young, to wavy plano-convex with low umbo with age, beautiful rose-vinaceous purple, pink purplish, or pink-purple, darkest at centre, and slightly paler at margin (at centre 10D5, 10E5, around centre 10A3, 11C6-11C5, or in the range of 12AB3-4), velvety-tomentose at centre and closed, around centre in some places breaking open into small fibrillose adnate tufts on whitish background, or velvety to fine squamulose in outer part of pileus, in one specimen slightly radially fibrillose near margin; margin exceeding lamellae, entire or slightly fringed with age, white at first, brownish with age and pressure. **Lamellae**, L = 90-100, l = 0-3, crowded, free, but not remote from stipe, slightly or not ventricose, up to 7 mm wide, white to pale cream with white, irregularly eroded cystidiose edge. **Stipe** 75-90 x 7-11 mm, cylindrical, but in some specimens gradually widening towards base, at utmost base up to 14 mm wide, at apex white to whitish, when young only with some pink tinges at base, but with age below annulus with pinkish sheen or with a wash of lilac-rose (11A3-2), strongest near base, caused by long coloured adnate fibrils, and pubescent (lens!) in basal part, hollow, protruding into pileus; with copious white mycelium or mycelial mat at base. **Annulus** easily torn apart, consisting of an ascending or descending pale pink cuff with an up to 4 mm wide flaring part, with pink underside, concolorous with pileus or slightly paler, and dark pink rim, and white to pale pink inner upperside. **Context** relatively thick in pileus (c. 5 mm thick), white and dull, white to creamy shiny in stipe, not discolouring when cut. **Smell** astringent lepiotoid, strong and fungoid or indistinct. **Taste** and **spore print** colour not recorded.

**Basidiospores** [55,4,4] in side view 5.4-7.6 x 3.2-4.9 µm, avl x avw = 5.8-6.8 x 3.7-4.0 µm, Q = 1.37-1.88, avQ = 1.47-1.71, ellipsoid to oblong, with abaxial side in most spores straight, in most spores with rounded apex, rarely slightly amygdaliform, in frontal view ellipsoid-oblong, with one guttule, thick-walled, without a germ pore, dextrinoid, congophilous, and metachromatic in Cresyl blue. **Basidia** 18-36 x 6.5-8.5 µm, 4-spored, rarely 2-spored. Lamella edge sterile; **cheilocystidia** 23-65 x 7-13 µm, narrowly clavate, cylindrical, slightly utriform, colourless. **Pleurocystidia** absent. **Pileus covering** in young specimens more or less a cutis with long tapering terminal elements; these terminal elements more erect and giving a trichodermal aspect to covering in mature specimens; terminal elements 120-250 x 9-18 µm, cylindrical or slightly widened above base, with rounded apex, with pinkish or brownish intracellular pigment, and incrusting pigment in lower hyphae. **Stipe covering** of lower part of stipe a tomentum of narrow, 2-3 µm wide, interwoven hyphae with yellow refracting walls. **Clamp connections** absent.

Fig. 5: *Lepiota decorata* – basidiocarp (ecv3453; colour version available at http://plantbio.berkeley.edu/~bruns/people/ev.html). Photo by John Lennie.

**Habitat and distribution** – Solitary or in small groups, terrestrial in forests, ranging from old-growth forest with *Pseudotsuga menziesii*, a mixed *Acer macrophylla*, *Thuja plicata*, *Alnus rubra* wood to a *Eucalyptus* plantation with grassy undergrowth, rare, known from a handful of places in Oregon (Portland, Corvallis) and California (Contra Costa Co.); Sundberg (1967) and Burlingham (1945) mentioned three other coastal Californian localities, all with *Cupressus macrocarpa*; fruiting relatively late in the mushroom season; the type collection was made on November 1, but modern collections are all from the end of December; the species fruits into January at the Californian site.

COLLECTIONS EXAMINED – **U.S.A., Oregon, Benton Co.**, Corvallis, 1 Nov. 1920, J.W. Severy & S.M. Zeller 2123 (NY); **Multnomah Co.,** Portland, 6720 NW Skyline Blvd, L.L. Norvell 2051224 (Pacific Northwest Mycology Service Herbarium); **California, Contra Costa Co.**, Tilden Regional Park, E.C. Vellinga 2810 (GenBank nrITS AY243645); *ibidem*, 25 Dec. 2003, E.C. Vellinga 3190; *ibidem*, 24 Dec. 2005, E.C. Vellinga 3453 (all in UC).

**Comments** – This is one of the most beautiful fungi in California, easily recognized by its size and deep pink overall colours. Its colours change quickly after collecting, and the specimens exhibit a more pink colour in the field than after transport.

It fruits consistently late in the season, and has been found in Oregon and in California at the same time of the year. It is rare, and only encountered in a couple of localities.

*Leucoagaricus idae-fragum* has been described from several localities on the Atlantic coast of France (Guinberteau et al. 1998). The only difference with *L. decorata* is the often, but not always, persistent white velum on the pileus, and the slightly bigger spores, but all other characters are in concordance with *L. decorata* as described here. *Leucoagaricus idae-fragum* is considered a synonym of *L. decorata*. A very detailed description of *La. idae-fragum* was given by Guinberteau et al. (1998).

*Lepiota decorata* is a sister species to *Leucoagaricus ionidicolor* in the phylogenetic analyses of the nrITS sequences (Vellinga 2004b). *Leucoagaricus ionidicolor* shares the same type of pileus covering structure with *L. decorata*, but is a smaller, violaceous coloured species, occurring in Europe. *Leucocoprinus caeruleoviolaceus* D.A. Reid is a synonym of *La. ionidicolor*. It is a rare species, fruiting under relatively dry circumstances throughout Europe (e.g. Antonín & Vágner 1997, Vasas 2000, Vellinga 2001, Vila et al. 1997).

*Lepiota decorata* exhibits a disjunct distribution; it is so far known from the western parts of North America, and the western parts of France. Records of this species from other parts of North America could be expected.

## Acknowledgements

The care of the curator of fungi in the New York Botanical Garden is appreciated. Steven Trudell and Lorelei Norvell sent me their specimens on loan. John Lennie suggested valuable linguistic improvements of the text. P. Brandon Matheny and Ana Esperanza Franco Molano gave me valuable feedback on an earlier version. Partial funding by NSF grant DEB 0618293 is gratefully acknowledged.

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# MYCOTAXON

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# Lepiotaceous fungi in California, U.S.A. – 4. Type studies of *Lepiota fumosifolia* and *L. petasiformis*

ELSE C. VELLINGA

*vellinga@nature.berkeley.edu* or *ecvellinga@comcast.net*
*Department of Plant and Microbial Biology, University of California at Berkeley, Berkeley, CA 94720-3102, U.S.A.*

**Abstract** – The type collections of *Lepiota fumosifolia* and *L. petasiformis* were studied. *Lepiota fumosifolia* has cheilocystidia and abundant pleurocystidia with yellow contents and exudates; spores are smooth, clamp connections present and velar cells globose. This is an older name for *Cystolepiota cystidiosa*, *C. luteicystidiata* and *L. lycoperdoides*. *Lepiota petasiformis* is characterized by rough spores, absence of cystidia and clamp connections, and elongate velar cells. *Cystolepiota pulverulenta* is morphologically identical, and synonymized with it. Three new combinations are made in the genus *Cystolepiota*, viz. *C. fumosifolia*, *C. oregonensis*, and *C. petasiformis*. A key is provided for all *Cystolepiota* species recorded from western North America.

**Key words** – *Agaricaceae*, biodiversity

## Introduction

In an ongoing effort to inventory, describe and catalogue the lepiotaceous fungi (white spored agaricoid members of the family *Agaricaceae*) in California, the type collections of *Lepiota fumosifolia* and *L. petasiformis*, two species with a granular-mealy pileus covering, described from Washington by Murrill (1912), were studied. Both species turn out to belong to *Cystolepiota*, new combinations are made, and their position is discussed. The occurrence of these species in California is confirmed. To facilitate their recognition, a key is provided for the identification of *Cystolepiota* species in western North America.

## Methods

Standard methods for microsopic observations were used; material was revived in Congo red in ammonia; Melzer's reagent and Cresyl blue were used to study reactions of the spore walls. Terminology follows Vellinga (2001). The following notations and abbreviations are used: [15,1,1] indicates that measurements were made on 15 spores in one sample from one collection; avl stands for average length, avw for average width, Q for quotient of length and width and avQ for average quotient.

## Taxonomic descriptions

***Cystolepiota fumosifolia*** (Murrill) Vellinga, comb. nov. Figures 1-2

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Basionym: *Lepiota fumosifolia* Murrill, Mycologia 4: 233. 1912.

*Lepiota cystidiosa* A.H. Sm., Papers Mich. Acad. Sci., Arts Letters 27: 58. ('1941') 1942; *Cystolepiota cystidiosa* (A.H. Sm.) Bon, Doc. mycol. 11 (43): 26. 1981.

*Lepiota luteicystidiata* D.A. Reid, Nova Hedwigia 13, Suppl. (Fung. rar. Ic. col. 2): 9. 1967; *Cystolepiota luteicystidiata* (D.A. Reid) Bon, Doc. mycol. 6 (24): 43. 1976.

*Lepiota lycoperdoides* Kreisel, Wiss. Z. Ernst Moritz Arndt-Univ. Greifswald 16: 238. 1967; *Cystolepiota luteicystidiata* var. *lycoperdoides* (Kreisel) Bon, Doc. mycol. 11 (43): 26. 1981.

Murrill (1912 ): "Pileus convex, not umbonate, gregarious, 3 cm. broad; surface dry, white with isabelline, granular scales, the center isabelline; lamellae free, broad, rather crowded, white, becoming fumosous on drying; spores oblong-fusiform, smooth, hyaline, 12 x 7 μ; stipe equal or tapering upward, cylindric, smooth, white, furfuraceous, pale-avellaneous below, 6 cm. long, 6 mm. thick; veil soon breaking into fragments which cling to the margin and stipe.

"Type collected on the ground in woods near Seattle, Washington, October 20-November 1, 1911, W.A. Murrill 229."

### Type study

**Basidiospores** [20,1,1] in side view 4.9-5.7 x 2.6-3.1 μm, avl x avw = 5.2 x 2.9 μm, Q = 1.6-2.0, avQ = 1.8, oblong with flattened adaxial side, in frontal view oblong or obovoid, often in tetrads, non-dextrinoid, non-amyloid, metachromatic in Cresyl blue, smooth. **Basidia** 4-spored. **Lamella edge** sterile, set with cheilocystidia. Individual cheilocystidia hard to recover; cheilocystidia narrowly clavate with separate capitulum, with yellow contents and yellow exudates. **Pleurocystidia** numerous, about 25 μm apart from each other, easily recognizable because of the yellow exudate which turns red in Congo red, most numerous close to lamella edge, similar in shape to cheilocystidia, but individual cystidia not recovered. **Pileus covering** made up of loosely arranged globose and ellipsoid cells, 25-60 x 25-40 μm, with brown walls. **Clamp connections** present.

COLLECTIONS EXAMINED (the above description is based on the type only) –U.S.A., WASHINGTON, NEAR SEATTLE, X.20-XI.1, 1911, W.A. Murrill 229 (holotype, NY).

CALIFORNIA, Humboldt Co., HUMBOLDT REDWOODS STATE PARK, SOUTH OF WEOTT, 12.XI.2004, E.C. Vellinga 3278 (UC; Genbank nrITS EF121817).

Comments – *Lepiota fumosifolia* is transferred to the genus *Cystolepiota* on account of its pileus covering made up of loosely arranged globose cells, and the small, non-dextrinoid spores.

Most striking in this species is the abundance of cystidia, on the edge and the sides of the lamellae. The pleurocystidia stand out as dark red dots in Congo red. The yellow exudate and contents are visible when viewed in ammonia. As

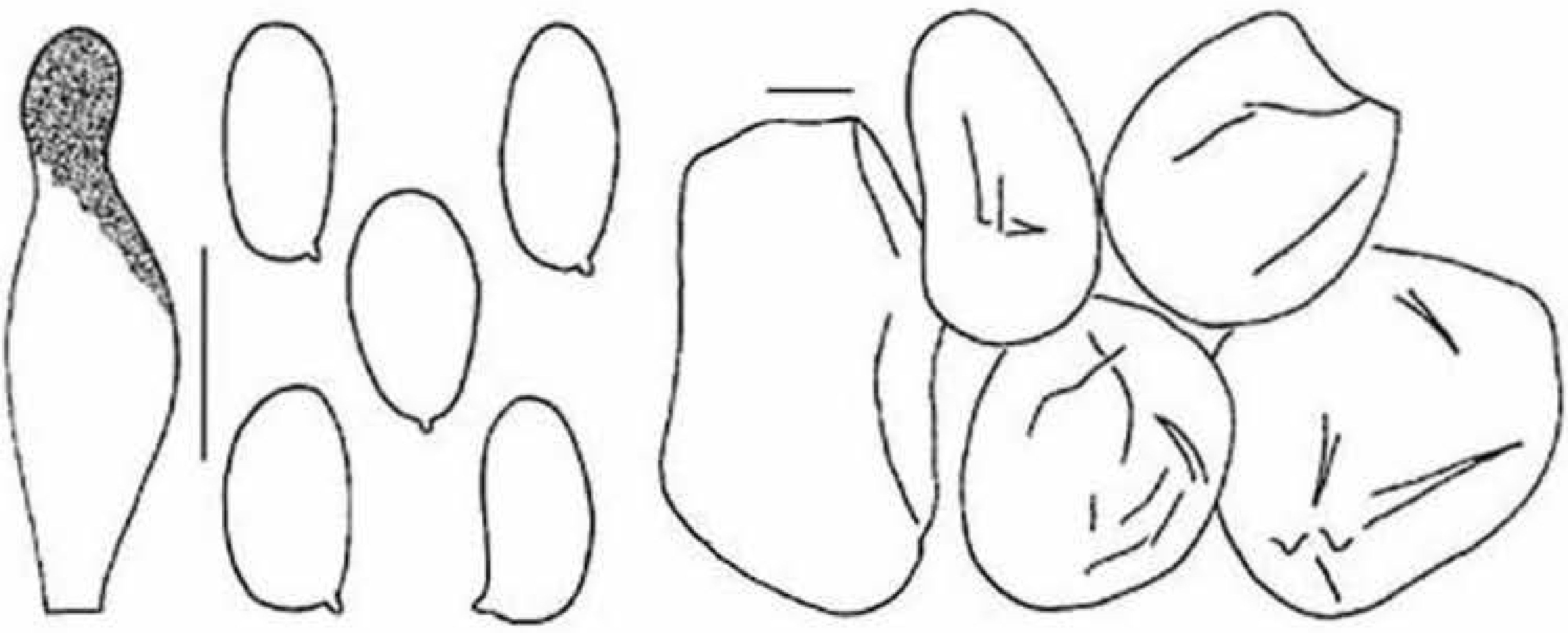

Fig. 1: *Cystolepiota fumosifolia* – spores, cheilocystidium, pileus covering elements. Scale bar is 5 µm (spores) or 10 µm (cystidium, pileus covering elements). All from holotype.

Smith (1966) also pointed out, the spores are not 12 x 7 µm and fusoid, as stated by Murrill (1912), but much smaller and oblong.

*Cystolepiota cystidiosa*, described from Michigan (Smith 1942) is identical, in macroscopical and microscopical characters and is placed in the synonymy of *L. fumosifolia*.

A discussion and comparison of the type collections of *C. cystidiosa*, *L. lycoperdoides* and *C. luteicystidiata* was given by Vellinga & Huijser (1998).

Murrill (1912) indicated the macroscopical differences between *C. fumosifolia* and *C. petasiformis*. The pileus of *C. fumosifolia* is convex, whereas in *C. petasiformis* it is often conical because of the copious velum cells. The lamellae of *C. fumosifolia* turn a smoky colour on drying, a feature also described by Vellinga & Huijser (1998) for European material of this species (as *C. cystidiosa*), whereas the lamellae of dried specimens of *C. petasiformis* are cream coloured.

Microscopically, the differences are more conspicuous: abundant cheilocystidia and pleurocystidia in *C. fumosifolia*, none in *C. petasiformis*; globose velar cells on the pileus in *C. fumosifolia*, and elongate, irregularly-shaped cells in *C. petasiformis*; and smooth spores in *C. fumosifolia*, versus rough, finely warted spores in *C. petasiformis*.

*Cystolepiota fumosifolia* appears to be rare in the Pacific states of North America. The present author has seen the species once, in the redwood forests of northern California (see collections examined).

*Lepiota oregonensis* can be confused with *C. fumosifolia*. It is a smaller species, with rusty-brown discoloration, without pleurocystidia. The cheilocystidia and spores are of the same size and shape as those in *C. fumosifolia*. *Lepiota oregonensis* comes very close to the European species *C. hetieri* (Boud.) Singer, the only difference being the presence of pleurocystidia (at least close to the lamella edge) in *C. hetieri*, and the absence of pleurocystidia in *L. oregonensis*. Smith (in Smith & Sundberg 1979) noted that clamp connections are also absent; however, study of the type specimen revealed that they are present, as in all *Cystolepiota* species with globose velar cells (pers. obs.). The new combination ***Cystolepiota oregonensis* (H.V. Sm.) Vellinga** (MYCOBANK MB 510371; basionym *Lepiota oregonensis* H.V. Sm. in Mycotaxon 8: 449. 1979) is here proposed.

This species has not been found in California yet, but is known from several places in western Oregon and Washington.

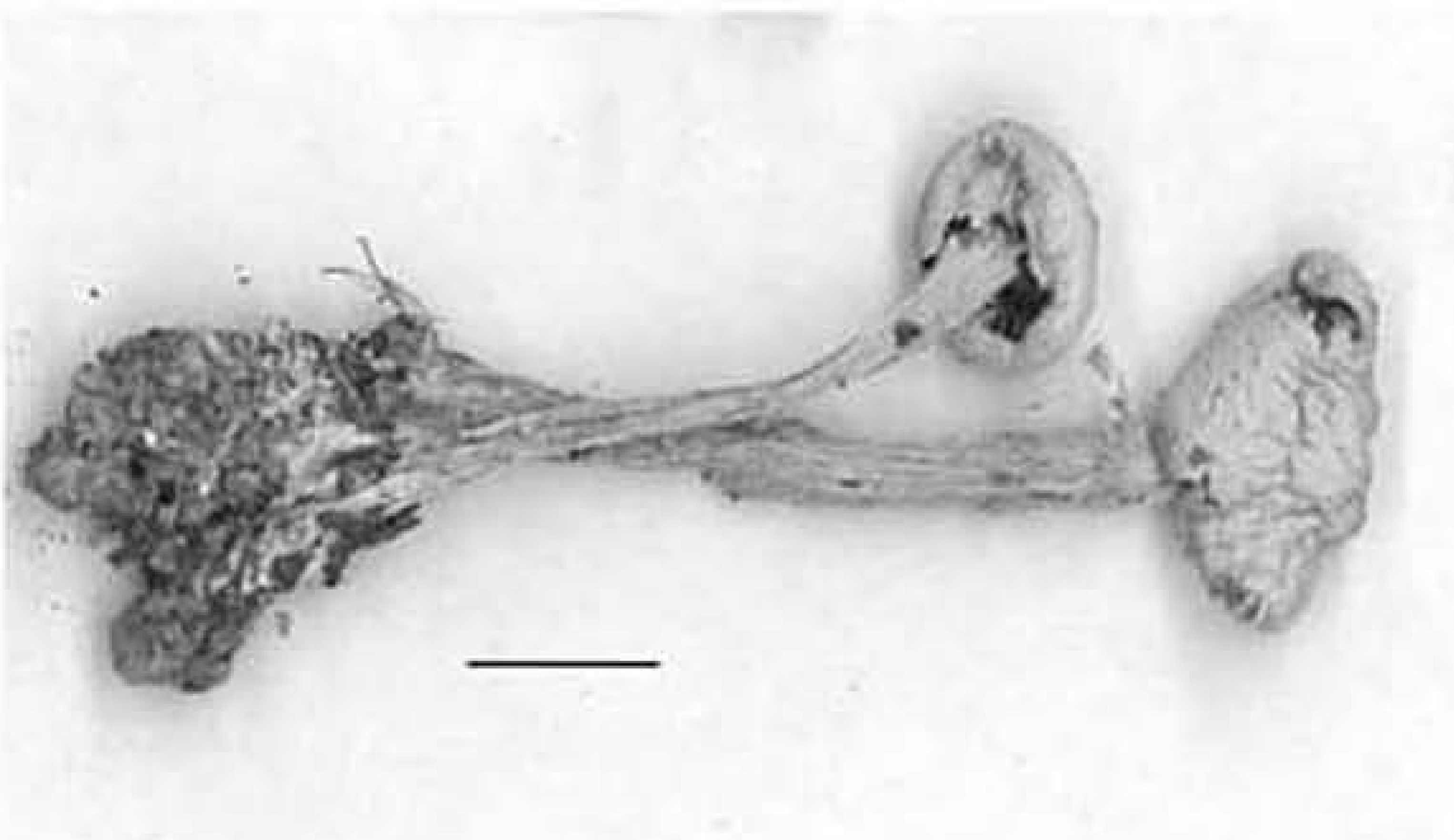

Fig. 2: *Cystolepiota fumosifolia* – dried specimens of collection ecv3278. Compare with the scan of the type collection conserved at NY, at the web site http://207.156.243.8/emuwebnybg/pages/common/imagedisplay.php?irn=103199 (accessed on 13 November 2006).

***Cystolepiota petasiformis*** (Murrill) Vellinga, **comb.nov.** Figure 3

MYCOBANK MB 510372

Basionym: *Lepiota petasiformis* Murrill, Mycologia 4: 232. 1912.

*Lepiota pulverulenta* Huijsman, Persoonia 1: 328. 1960; *Leucoagaricus pulverulentus* (Huijsman) Bon, Doc. mycol. 8 (30-31): 70. 1978; *Leucoagaricus pulverulentus* (Huijsman) M.M. Moser, Röhrlinge-Blätterpilze, 4. Aufl.: 246. 1978; *Cystolepiota pulverulenta* (Huijsman) Vellinga, Persoonia 14: 407. 1992; *Pulverolepiota pulverulenta* (Huijsman) Bon, Doc. mycol. 22 (88): 30. 1993.

*Leucoagaricus pulverulentus* f. *minimus* Bon, Migl. & Brunori, Doc. mycol. 19 (75): 54. 1989; *Pulverolepiota pulverulenta* f. *minima* (Bon, Migl. & Brunori) Bon, Doc. mycol. 22 (88): 30. 1993; *Cystolepiota pulverulenta* f. *minima* (Bon, Migl. & Brunori) La Chiusa, Riv. Micol. 41: 152. 1998.

Murrill (1912): "Pileus thin, hat-shaped, with prominent conic umbo, scattered or gregarious, 1.5-2.5 cm. broad; surface dry, rosy-isabelline, or about the color of the back of the hand, covered with an abundance of fine powder; lamellae free, subdistant, rather broad, white; spores ellipsoid, smooth, hyaline, minute, 3.5 x 2 µ; stipe slender, tapering upward, clothed with powder like the pileus, reaching 5 cm. long and 2-3 mm. thick; veil fugacious, not forming an annulus.

"Type collected in humus in woods near Seattle, Washington, October 20-November 1, 1911, W.A. Murrill 629. Also collected in the same region, Zeller 119. It suggests some forms of *L. cretacea*."

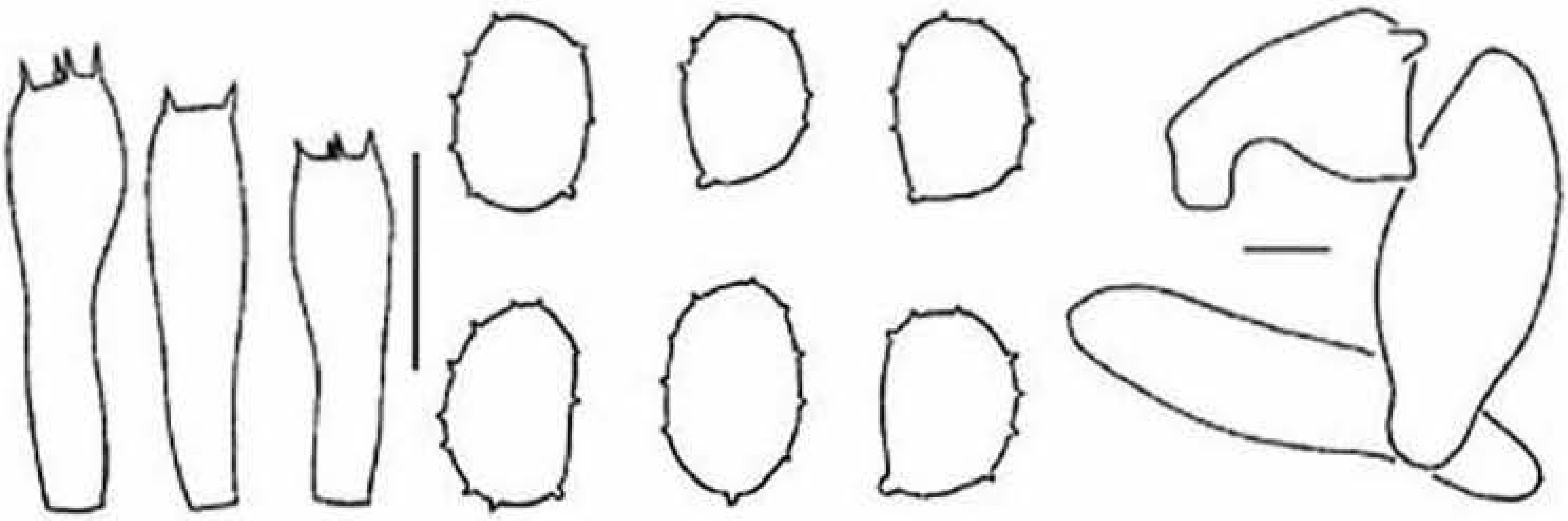

**Fig. 3:** *Cystolepiota petasiformis* – spores, basidium, pileus covering elements. Scale bar is 5 µm (spores) or 10 µm (basidia, pileus covering elements). All from holotype.

### *Type study*

**Basidiospores** [20,1,1] in side view 3.9-5.4 x 2.6-3.2 µm, avl x avw = 4.7 x 2.8 µm, Q = 1.6-1.85, avQ = 1.66, oblong with flattened adaxial side, in frontal view oblong, congophilous, not dextrinoid, and metachromatic in Cresyl Blue, with small warts or spines. **Basidia** 14-21 x 5-6 µm, 4-spored, without clamp connection at base. **Lamella edge** fertile; **cheilocystidia** absent. **Pleurocystidia** absent. **Pileus covering** made up of loosely arranged irregular, oblong and some subglobose cells, around 22-70 x 8-22 µm, with pale brown walls, hard to recover. **Clamp connections** absent.

COLLECTIONS EXAMINED (the above description is based on the type only) – **U.S.A., Washington, near Seattle**, X.20-XI.1, 1911, W.A. Murrill 629 (holotype, NY); **Clallam Co.**, Joyce, 11.X.1935, A.H. Smith 3104 (MICH); Olympic National Park, Wall Creek, 29.IX.1941, D.E. Stuntz (coll. A.H. Smith 17388) (MICH).

**Oregon**, Mt. Hood, 24.IX.1922, C.H. Kauffman (MICH).

California, **San Mateo Co.**, San Francisco Watershed, 8.XII.2000, E.C. Vellinga 2572 (UC; genbank nrITS AF391035); *ibidem*, 23.XII.2002, E.C. Vellinga 2968 (UC); *ibidem*, 28.I.2003, E.C.Vellinga 3017 (UC); *ibidem*, 25.II.2003, E.C. Vellinga 3048 (UC); **Humboldt Co.**, Humboldt Redwoods State Park, south of Weott, 8.XI.2004 (UC); **Marin Co.**, Point Reyes, Bear Valley Trail, 26.XI.2004, E.C. Vellinga 3322 (UC); Mt Tamalpais, Bolinas-Fairfax Road, 15.XI.2005, E.C. Vellinga 3373 (UC).

Comments – *Cystolepiota petasiformis* is easily recognized because of the copious velum on the basidiocarps often forming a conical top on the pileus, the slightly rough spores, and the absence of cystidia and clamp connections. The roughness of the spores in this species has not been noted before, though with a good 100x objective it is easily discernible.

Spores from the Kauffman collection from Mt Hood in Oregon, are a bit longer than those of the type: [11,1,1] 5.1-6.0 x 2.7-3.1 µm, avl x avw = 5.5 x 3.0 µm, Q = 1.7-2.0, avQ = 1.87, but other characters are in agreement with those for *C. petasiformis*.

*Lepiota petasiformis* is transferred to *Cystolepiota* here. Singer (1975, 1986) listed *L. petasiformis* (as *L. petasitiformis*) as "obviously" belonging to *Cystolepiota*, but he did not propose a new name for them, neither did he cite the basionym. Though there are some morphological differences (e.g. *Cystolepiota* species have clamp connections and smooth spores), in other respects it fits well into the genus. In analyses based on molecular characters (Vellinga 2003, 2004) monophyly of *Cystolepiota* including *C. petasiformis*, is acceptable, but further research on this group and its relationships with *Lepiota* sect. *Echinatae* and the genus *Melanophyllum* are needed.

*Cystolepiota pulverulenta* is tentatively placed in the synonymy of *C. petasiformis*, to which it is morphologically very similar. It should be noted that Huijsman (1960) did not notice the roughness of the spores of *L. pulverulenta*. The present author does not know how to distinguish the two morphologically, but the nrITS sequences of two collections, representative of the taxa in western North America and in Europe, contain eight differences. These collections are sister taxa forming a monophyletic group in the sample studied (Vellinga 2003). It is not known whether the type collection from Washington has the same nrITS sequence as the Californian collection.

Vellinga (1992, 2003) discussed the generic placement of this species or species complex. The species has been accommodated in *Lepiota* (Huijsman 1960), *Leucoagaricus* (Bon 1978), *Cystolepiota* (Vellinga 1992) and its own genus *Pulverolepiota* (Bon 1993).

*Cystolepiota petasiformis* is rare in California, but has been found scattered throughout the western part of the state, in Monterey cypress, and coastal Redwood forests (see under 'Collections examined'). Sieger (2003) included it in his key but noted that he has never seen the species in Washington.

### Key to the *Cystolepiota* species in western North America

1. Stipe and pileus with lilac and violaceous tinges; smell strong, of coal gas (indole), like the smell of *Tricholoma sulphureum* (Bull. : Fr.) P. Kumm. and *T. inamoenum* (Fr. : Fr.) Gillet . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *C. bucknallii*[1]

1. Stipe and pileus pinkish, white, or whitish and often discolouring with age, without lilac or violaceous tinges, and not smelling of coal gas, but of *Lepiota cristata* (Bolton : Fr.) P. Kumm.

[1] *Cystolepiota bucknallii* (Berk. & Broome) Singer & Clémençon is rare in the Pacific Northwest (Sieger 2003), and has not yet been found in California.

2. Pileus covering copious, made up of elongate inflated irregular cells; basidiospores rough; clamp connections absent ............................ *C. petasiformis*
2. Pileus covering made up of globose cells; basidiospores smooth; clamp connections present
   3. Basidiocarps slender; pileus small (about 1 cm, rarely up to 2 cm) and white; stipe vinaceous, especially at base; cheilocystidia absent ............. *C. seminuda*[2]
   3. Basidiocarps slender to quite robust, with pink pileus, or starting out white and discolouring isabelline to rust-brown; cheilocystidia present
      4. Pileus covered with small pink granulose warts, which do not change colour ....................................................... *C. moelleri*[3]
      4. Pileus covered in white or whitish floccose granular velum, changing colour with age to isabelline or rusty brown
         5. Basidiocarp with age with isabelline colours; pleurocystidia abundant over entire surface of lamellae; pleurocystidia and cheilocystidia with yellow contents and exudates .................................. *C. fumosifolia*
         5. Basidiocarp with rusty brown colours with age; pleurocystidia absent; some yellow contents or exudates can be present in cheilocystidia .. *C. oregonensis*


## Acknowledgements

Curators of the herbaria NY and MICH are acknowledged for the loan of type material and other collections. The Mycological Society of America's A.H. and H.V. Smith Award enabled me to visit the herbarium of the University of Michigan at Ann Arbor, and see the specimens in situ. The San Francisco Public Utilities Commission granted permission to inventory the cypress groves of the San Francisco watershed area (west of Crystal Spring Reservoir). Christian Lange and Ana Esperanza Franco Molano gave much appreciated comments on an earlier version. Partial funding by NSF grant DEB 0618293 is gratefully acknowledged.


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[2] *Cystolepiota seminuda* (Lasch) Bon is the most common *Cystolepiota* species in the area, and can be found in various forest types.

[3] *Cystolepiota moelleri* Knudsen is known from the state of Washington (Birkebak, pers. comm.).

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MYCOTAXON

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# A new species of *Phaeoramularia* on *Papaveraceae*

Feng-Yan Zhai[1] Ying-Lan Guo[2] Yu Li[1*]

[1]fengyan780103@163.com [1*]yuli966@126.com
*Jilin Agricultural University*
*Changchun 130118, China*

[2] guoyl@sun.im.ac.cn
*Institute of Microbiology, Chinese Academy of Science*
*Beijing 100080, China*

**Abstract**—A new species, *Phaeoramularia papaveris* on *Papaver nudicaule* (*Papaveraceae*) is reported. It is described and compared with other similar hyphomycetes occurring on *Papaveraceae*: *Cercospora papaveris*, *C. papavericola*, *Passalora bocconiae*, and *Ramularia chelidonii*. The holotype and isotype specimens are deposited in HMAS and HMJAU.

**Key words**—imperfect fungi, taxonomy

## Introduction

In our recent study, we found a leafspot fungus on *Papaver* from Inner Mongolia, China that distinctly differed from other similar leafspot fungi known to occur on *Papaveraceae*. We identified as a previously undescribed species of *Phaeoramularia*, a genus that previously has not been known to occur on *Papaveraceae*. The new species is described below.

## Taxonomy

***Phaeoramularia papaveris*** F.Y. Zhai, Y.L. Guo & Yu Li, **sp. nov.** Fig. 1
MB510350

*Maculae amphigenae, orbiculares vel ellipsoideae, 1.0–6.0 mm diam., aliquando confluentes, centro griseo-brunneae vel brunneae, margine atro-brunneae, extus flave halonatae. Caespituli amphigeni. Mycelium immersum. Stromata substomata, parva vel bene evoluta, subglobosa, pallide brunnea, 18.5–45.0 µm diam. Conidiophora emergena per stomata, laxe vel dense fasciculata, pallide olivacea, olivaceo-brunnea vel pallide brunnea ubi fascicula, laevia, non ramosa, erecta vel leviter curvata, 0–5-geniculata, ad apicem conico-truncata, 0–4-septata, 15.5–60.0×2.0–5.0 µm. Cicatrices conspicue incrassatae, 1.0 µm. latae. Conidia obclavato-cylindrica vel cylindrica, subhyalina vel pallide olivacea,*

*Corresponding author

*catenata, laevia, recta vel interdum leviter curvata, ad apicem conico-truncata ad basin obconico-truncata, 0–4-septata, 10.0–44.0×1.5–5.0 µm.*

Leaf spots amphigenous, circular or elliptical, at the edge of the leaf semi-circular, 1.0–6.0 mm in diam., sometimes confluent, center grayish brown to brown, margin dark brown, sometimes with a yellow halo on the upper surface, paler on the lower surface. Fruiting amphigenous. Mycelium immersed. Stromata substomatal, small to well-developed, subglobose, pale brown, 18.5–45.0 µm in diam. Conidiophores emerging through stomata, loosely to densely fasciculate, pale olivaceous, olivaceous brown to pale brown when in cluster, paler and narrower towards the apex, smooth, not branched, straight to slightly curved, 0–5-geniculate, conically truncate at the apex, 0–4-septate, 15.5–60.0×2.0–5.0 µm. Conidial scars conspicuously thickened, 1.0 µm wide. Conidia obclavate-cylindrical to cylindrical, subhyaline to pale olivaceous, catenate and in branched chains, smooth, straight to slightly curved, conically truncate at the apex, obconically truncate at the base, 0–4-septate, occasionally constricted at septa, 10.0–44.0×1.5–5.0 µm.

On leaves of *Papaver nudicaule* L. (*Papaveraceae*), Arshan, Inner Mongolia, China, 9 VIII 1991, coll. Y. L. Guo, no. 1524 (HMAS 143915 , holotype; HMJAU 30002, isotype).

**Comments:** Both *Cercospora papaveris* Nakata (Takimoto 1918) and *C. papavericola* Chupp (Chupp 1954), which also occur on *Papaver* species, differ from the newly described *Phaeoramularia papveris* in having darker conidiophores (the former dark brown, the latter pale to medium olivaceous brown). Additionally, *C. papaveris* possesses wider (5.0–9.0 µm) conidiophores and longer and wider (50.0–115.0×5.0–9.0 µm) obclavate dark yellowish-brown conidia, while *C. papavericola* is distinguished by longer conidiophores (75.0–350.0 µm) and hyaline, acicular conidia.

*Passalora bocconiae* (Chupp) U. Braun & Crous (Braun et al. 2002; ≡ *Cercospora bocconiae* Chupp ) on *Bocconia frutescens* L. (*Papaveraceae*) is distinguished from our newly described *Phaeoramularia papaveris* in that *P. bocconiae* exhibits epiphyllous fruiting; slight stromata; fascicles that are densely compact to almost coremoid; conidiophores that are clavate, rarely geniculate, and longer (40.0–125.0 µm); and obclavato-cylindric, longer conidia (20.0–70.0 µm).

*Phaeoramularia papaveris* is also very similar to *Ramularia chelidonii* (Jacz.) Karak. (Vassiljevsky & Karakulin 1937) on *Chelidonium japonicum* Thunb. (*Papaveraceae*), but *R. chelidonii* has hyaline conidiophores and conidia, with the conidia being ellipsoid (-ovoid), subcylindric, and wider (4.0–6.5 (–8.0) µm).

*Phaeoramularia papaveris* is the first species of *Phaeoramularia* reported on a plant of *Papaveraceae*.

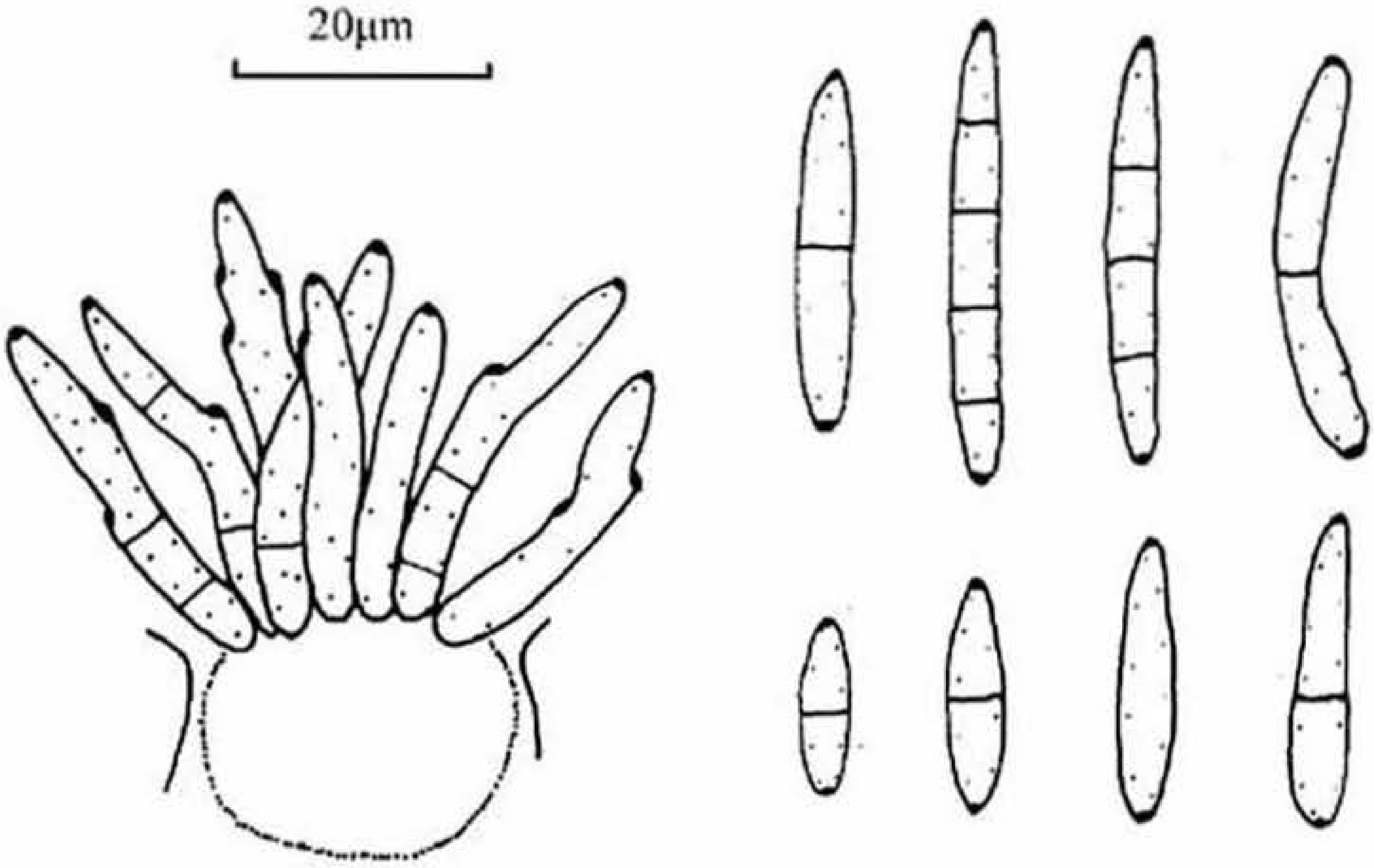


Fig. 1 *Phaeoramularia papaveris* (HMAS 143915).
1. Conidiophores; 2. Conidia

## Acknowledgements

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MYCOTAXON

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# *Phoma adonidicola* sp. nov. on *Adonis palaestina*

YAN LI QI WANG[1] RU-HONG MEI

*wangqi@cau.edu.cn*
*Department of Plant Pathology, China Agricultural University*
*Beijing 100094, China*

GUO-ZHONG LU[1]

*luguozhongg@hotmail.com*
*Institute of Bio-Resources and Environment, Dalian Nationalities University*
*Dalian 116600, China*

**Abstract**—*Phoma adonidicola*, described in this paper, is a virulent parasite on *Adonis palaestina*. It is characterized by its rapidly growing colony, abundant sclerotia and large chlamydospores on diagnostic media, and its thin pycnidial wall.

**Key words**—pycnidium, conidium, culture

During investigation of plant diseases on the introduced adonis (*Adonis palaestina)* in Tongliao, Inner Mongolia, China in 2004, a stem spot disease was found to be widespread and causing serious damage. After a comprehensive investigation the fungus was found to be an undescribed species.

***Phoma adonidicola*** Yan Li, Q. Wang & G. Z. Lu, **sp. nov.** **Figs.1-6**
MYCOBANK #: MB510335

*Maculis ellipsoideus vel irregularis, primo pallide brunneae, demum atro-brunneae. Pycnidia solitaria vel gregaria, immersa vel semi-immersa, demum erumpentibus, glabra, globosa vel subglobosa, 115–180μm diam, brunneae. Paries cellularum textura angularis composito, 2–3 cellulae crassae, ostiolata. Cellulae conidiogenae enteroblasticae, phialidicae, ampulliformes, hyalinae. Conidia hyalina, ellipsoideae ad oblongae, aseptatae, 5–7.5×2.0–2.5μm, 2 guttula polaris.*

*Coloniae in agaro avenae celerito, post 7 dies 20–22°C ad 7.6 cm diam, olivaceo-viridae ad olivaceo-nigrae. Pycnidia globosa ad subglobosa, ostiolata, papillata, 100–150μm diam. solitaria ad gregaria, glabra, paries cellularum texura angularis, 2–3 cellulae crassae.*

[1]*Corresponding authors*

*Conidia ellipsoideae ad oblongae, aseptata, 2-guttulae polaris, hyalinae, 5.0-6.25 × 2.5-3.0µm. Chlamydospora unicellula, intercalara, solitaria vel cateniformae, subglobosa vel ellipsoideae, olivaceae, intra olivaceae cinereae guttulae, maximum partem 12.5-20µm diam. Sclerotia abunda in agaro, globosa ad irregulares, superficiles, atrobrunnea vel nigra, 50-100µm diam.*

**Etymology:** *adonidicola*, in reference to the host plant genus.

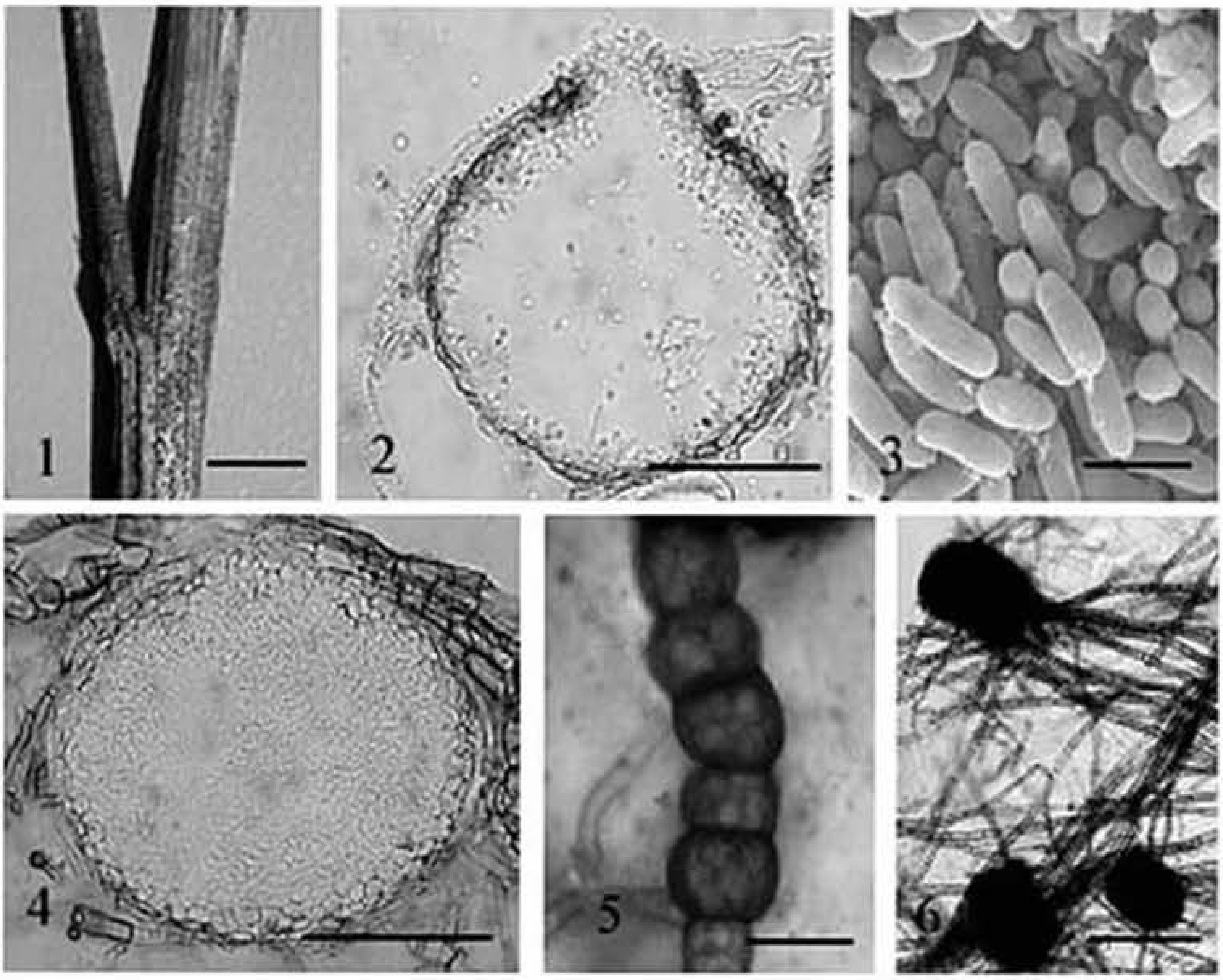
**Symptom:** The disease mostly occurred on stems and petioles of the plants, and subsequently developed on roots and leaves. The pathogen could infect the petioles of the young seedlings and soon spread to the stems. Under humid conditions the stems and petioles of the infected plants were covered with many lesions. The lesions firstly were light yellow-brown with a yellow halo and elliptical or irregular in shape, and later turned blackish brown. The lesions coalesced, resulting in early death of the plant. Many black conidiomata were produced on the lesions (Fig. 1).

**Morphology:** In vivo the conidiomata are pycnidial (Fig. 2), globose or subglobose, immersed or semi-immersed, sometimes becoming erumpent, solitary or in clusters, glabrous, 115-180 µm diam, yellow brown or brown, with walls of thin-walled, pale to medium brown texura angularis, 2-3 cells thick, and a single ostiole. Conidiophores absent. Conidiogenous cells enteroblastic, phialidic, integrated or discrete, ampulliform, hyaline, smooth. Conidia hyaline, ellipsoidal to oblong, aseptate, thin-walled, usually with two polar guttules, 5-7.5 × 2.0-2.5 µm (Fig. 3).

Colony on OA at 20-22°C growing rapidly, attaining around 70 mm diam after 7 days, regular, olivaceous greenish to olivaceous black, often with darker concentric zones; aerial mycelium sparse, white, floccose, reverse similar, slightly more grey. NaOH spot test in the margin demonstrates an oxidation reaction: a blue green discoloration of the agar, changing to brown red. On PDA felted white aerial mycelium, colony grayish green, attaining 65-70 mm diam, the reverse brownish red.

In vitro pycnidia (Fig. 4) globose to subglobose with one ostiole, slightly papillate, 100-150 µm diam., solitary or confluent, glabrous, thin-walled with 2-3 layers of textura angularis. Conidia ellipsoidal to cylindrical, aseptate, with 2 polar guttules, hyaline, 5.0-6.25 × 2.5-3.0 µm. Chlamydospores (Fig. 5) unicellular, intercalary, solitary or in chains, subglobose to ellipsoidal, olivaceous with olivaceous grey guttules, mostly 12.5-20 µm diam. Sclerotia abundant on agar, globose to irregular, superficial, dark brown to black, 50-100 µm (Fig. 6).

**Holotype:** on *Adonis palaestina* Boiss., Tongliao, Inner Mongolia, China, 20 September, 2004, Yan Li (IBE 002001). **Isotype:** dried cultures (IBE 002002, 002003). The type specimens and cultures are preserved in Mycological Herbarium of Dalian Nationalities University.



Figs. 1-6 *Phoma adonidicola*. 1. Pycnidia on stem. 2. Vertical section of pycnidium on stem. 3. Conidia in a pycnidium on stem (SEM ). 4. Vertical section of pycnidium on OA. 5. Chlamydospores on OA. 6. Sclerotia on OA.

Bars: 1=5 mm; 2=50 μm; 3=5 μm; 4=50 μm; 5=10 μm; 6=50 μm.

**Note:** The present fungus belongs to section *Phoma* of the genus *Phoma* according to Sutton (1980) and Boerema et al. (2004). However it differs from *P. eupyrena* Sacc. and *P. pereupyrena* Gruyter et al. It is characterized by its fast growing colony on OA and larger conidia by comparison with *P. eupyrena*, its pycnidial wall is composed of only 2-3 layers of cells, while that of *P. pereupyrena* consistent of 5-8 layers of cells. Its chlamydospores are much larger than those of the other two species. *P. eupyrena* and *P. pereupyrena* were not illustrated with sclerotia on various media. The authors also conducted the comparison between the studied species and *P. medicaginis* Malbr. & Roum. and *P. exigua* Desm., the latter two species are characterized by some 1-2 septate conidia.

**Acknowledgements**

We are grateful to Dr. Paul Cannon of CABI Bioscience and Dr. Hyeon-Dong Shin of Korea University for reviewing versions of this manuscript.

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MYCOTAXON

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# A new species of *Phyllachora* on *Peltastes peltatus* (*Apocynaceae*) from Minas Gerais, Brazil

Olinto L. Pereira & Robert W. Barreto

oliparini@ufv.br
*Departamento de Fitopatologia, Universidade Federal de Viçosa*
*Viçosa, Minas Gerais, 36570-000, Brazil*

**Abstract**—A tar-spot fungus, found associated with *Peltastes peltatus* (*Apocynaceae*), was identified as a previously unknown *Phyllachora*. This new fungal species is named *Phyllachora peltaticola* and is described and illustrated herein. It represents the first fungus to be described in association with a plant in the genus *Peltastes*.

**Key words**—*Ascomycota*, biodiversity, *Phyllachoraceae*, taxonomy, tropical fungi.

## Introduction

Fungi belonging to *Phyllachora* Nitschke ex Fuckel are characterized by the development of perithecia beneath a subcuticular or epidermal clypeus in the host tissue and cause tar spots on plants belonging the *Magnoliopsidae* (Cannon 1991, 1996, 1997; Cannon & Evans 1999) and *Liliopsidae* (Parbery 1967, Cannon 1997). In this genus are included 500 spp., according to Kirk et al. (2001), with a predominantly tropical distribution. It is wholly comprised of biotrophic species and there is evidence of close coevolution between these fungi and their host plants (Cannon 1994). There are few examples of members of *Phyllachora* known to be capable of causing significant crop losses, eg: *Phyllachora lespedezae* (Schwein.) Sacc. on *Lespedeza* (Lopez-Rosa & Sherwood 1966, Cannon 1991) and *Phyllachora maydis* Maubl. on *Zea mays* L. (Parbery 1967).

The families *Arecaceae, Asteraceae, Cyperaceae, Fabaceae, Moraceae, Myrtaceae, Melastomataceae* and *Poaceae* are known to serve as hosts to many species of *Phyllachoraceae* (Cannon 1997). Although the *Apocynaceae* s. l. is a large family having a pantropical distribution, the number of *Phyllachora* known to have members of this family as hosts is limited. For Brazil, Mendes et al. (1998) listed only two species in association with *Apocynaceae*: *Phyllachora maculicola* Syd. & P. Syd. on *Aspidosperma* sp. and *Phyllachora aspidospermatis-tomentosi* R.B. Medeiros & Dianese on *Aspidosperma tomentosum* Mart. Viégas

(1961) reported nine species of *Phyllachora* on the *Apocynaceae* for South America and the Caribbean. A possible explanation for the somewhat limited number of species known to parasitize members of the *Apocynaceae* may be the limited exploration of neotropical mycological diversity.

The Reserva Florestal Mata do Paraíso (RFMP) is a protected area representing the semideciduous tropical montane forest (a sub-type of the Atlantic tropical rainforest) that belongs to the Universidade Federal de Viçosa (municipality of Viçosa, state of Minas Gerais, Brazil). During a floristic survey (September 2002), samples of the liana *Peltastes peltatus* (Vell.) Woodson (*Echiteae, Apocynaceae*) were collected. It was later observed that some leaves of this specimen showed tar spot symptoms associated with an undescribed species of *Phyllachora*. This work describes and illustrates the new species as part of an ongoing program of surveying and describing the mycodiversity in the state of Minas Gerais.

## Material and Methods

Selected leaves showing tar-spot symptoms were taken from the botanical sample originally collected, photographed, and dried in a plant press. Sections of fresh material of infected leaves were prepared with a freezing microtome (Leitz, Kryomat). The sections were mounted in lactophenol and the fungal structures were later examined, measured and illustrated with a light microscope fitted with a camera lucida (Olympus, BX 50).

## Taxonomic Description

***Phyllachora peltaticola*** O.L. Pereira & R.W. Barreto, **sp. nov.** FIGS 1-5

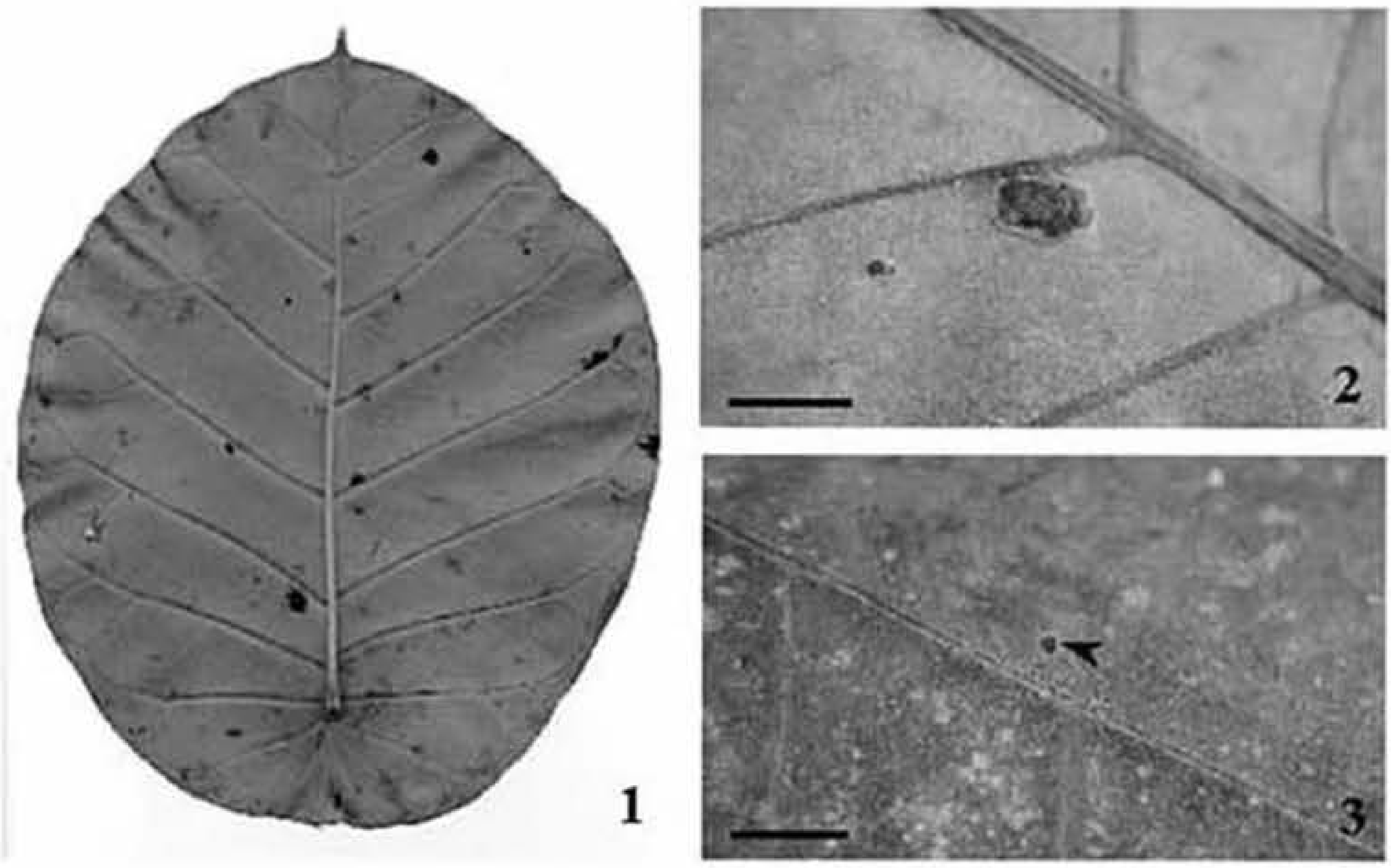
MycoBank 500207

*Epigena stromata nigra et nitida 1.0-1.5 mm diam., circularis, hypogyna stromata nigra et nitida 2.0–9.0 mm diam. irregularis. Ascomata clypeata, 198.0–257.0 µm lata, 232.0–247.0 µm alta, immersa, subepidermalia. Asci cylindrici, octospori, unitunicati, 100.0–123.0 × 10.0–11.0 µm. Paraphyses hyalinae. Ascosporae fusiforme-ellipsoideae hyalinae, 23.0–37.0 × 6.0–7.0 µm, unicellulares. Anamorphosis non observata.*

Etymology: inhabiting *Peltastes peltatus* (*Apocynaceae*).

Holotype: BRAZIL. Minas Gerais, Viçosa, Reserva Florestal Mata do Paraíso, on leaves of *Peltastes peltatus*, 29. VIII. 2002, Oct., G. E. Valente (VIC 26501).

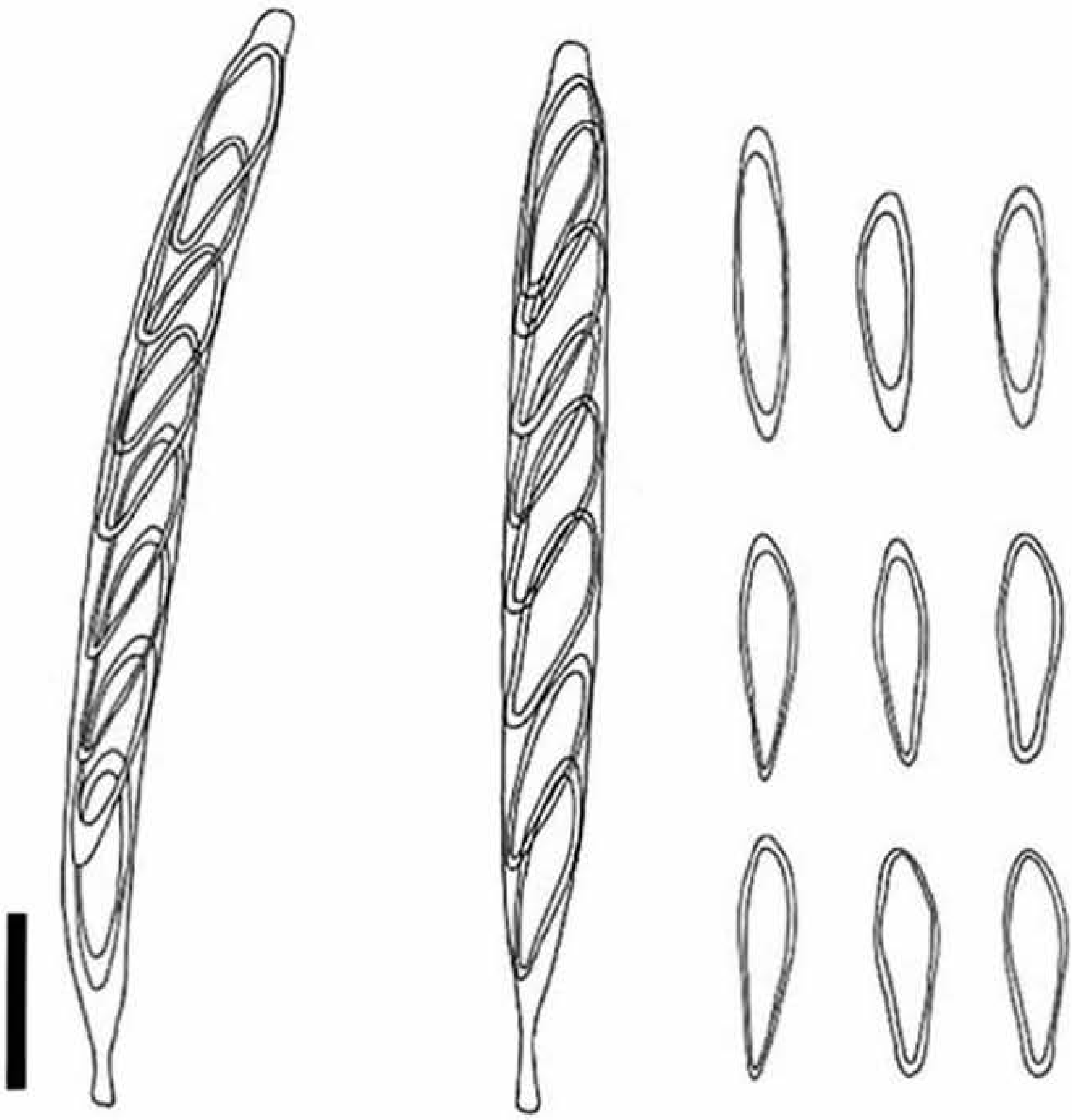
*Colonies* on living leaves, visible on both sides of leaves, small, black, circular with well defined border, 1.0-1.5 mm diam. adaxially; more prominent, black, elliptic to irregular in shape, 2.0-9.0 mm diam. abaxially, multiloculate, ostioles prominence indistinct. *Ascomata* immersed, isolated, subsphaerical, 198.0-257.0 × 232.0-247.0 µm, wall thickness 17.0-25.0 µm, comprising several layers of dark brown pseudoparechimatous cells, clypeus amphigenous, 22.0-37.0 µm



Figures 1-3. *Phyllachora peltaticola* (VIC 26501). 1. Symptoms on infected leaves of *Peltastes peltatus*. 2. Irregular well developed abaxial tar spot. 3. Circular small adaxial tar spot (arrowhead). Bar = 10 mm.

thick. *Dehiscence* ostiolate, circular. *Hamathecium* composed of paraphyses, cylindrical, slightly longer than asci, aseptate, thin walled, hyaline, smooth, unbranched, persistent. *Asci* unitunicate, 8-spored, cylindrical, 100.0-123.0 × 10.0-11.0 µm, thin-walled at maturity, apex undifferentiated. *Ascospores* uniseriate, overlapping, fusiform, rarely ellipsoidal, often acute at one end and rounded at the other, 23.0-37.0 × 6.0-7.0 µm, aseptate, wall thickness variable, hyaline, smooth. Anamorph not observed.

**Remarks** — *Phyllachora peltaticola* is similar to six other species parasitizing members of the *Apocynaceae*: *Phyllachora ajrekarii* Syd. & P. Syd., *Phyllachora dischidiae* Syd. & P. Syd., *Phyllachora gloriana* C. A. Pearce et al., *Phyllachora forsteroniae* (Rehm) Petr., *Phyllachora pressa* Syd. and *Phyllachora tabernaemontanae* F. Stevens in that they all have an amphigenous clypeus. However, *P. peltaticola* is morphologically distinct from these species by having a circular and less prominent clypeus on the adaxial leaf surface (Figure 1). *Phyllachora dischidiae* has a clypeus having a similar morphology on both sides of the leaf whereas *P. ajrekarii* and *P. gloriana* have a clypeus that is more prominent adaxially. *P. peltaticola* is more similar to *P. gloriana* by having ascospores of similar size and shape, and a perithecial wall of similar thickness. *P. peltaticola* is distinguished from *P. gloriana* by prominence and shape of the adaxial clypeus and the absence of a mucilaginous ascospore sheath in the new species, a feature clearly observed on *P. gloriana*. Additionally, *P. peltaticola* and



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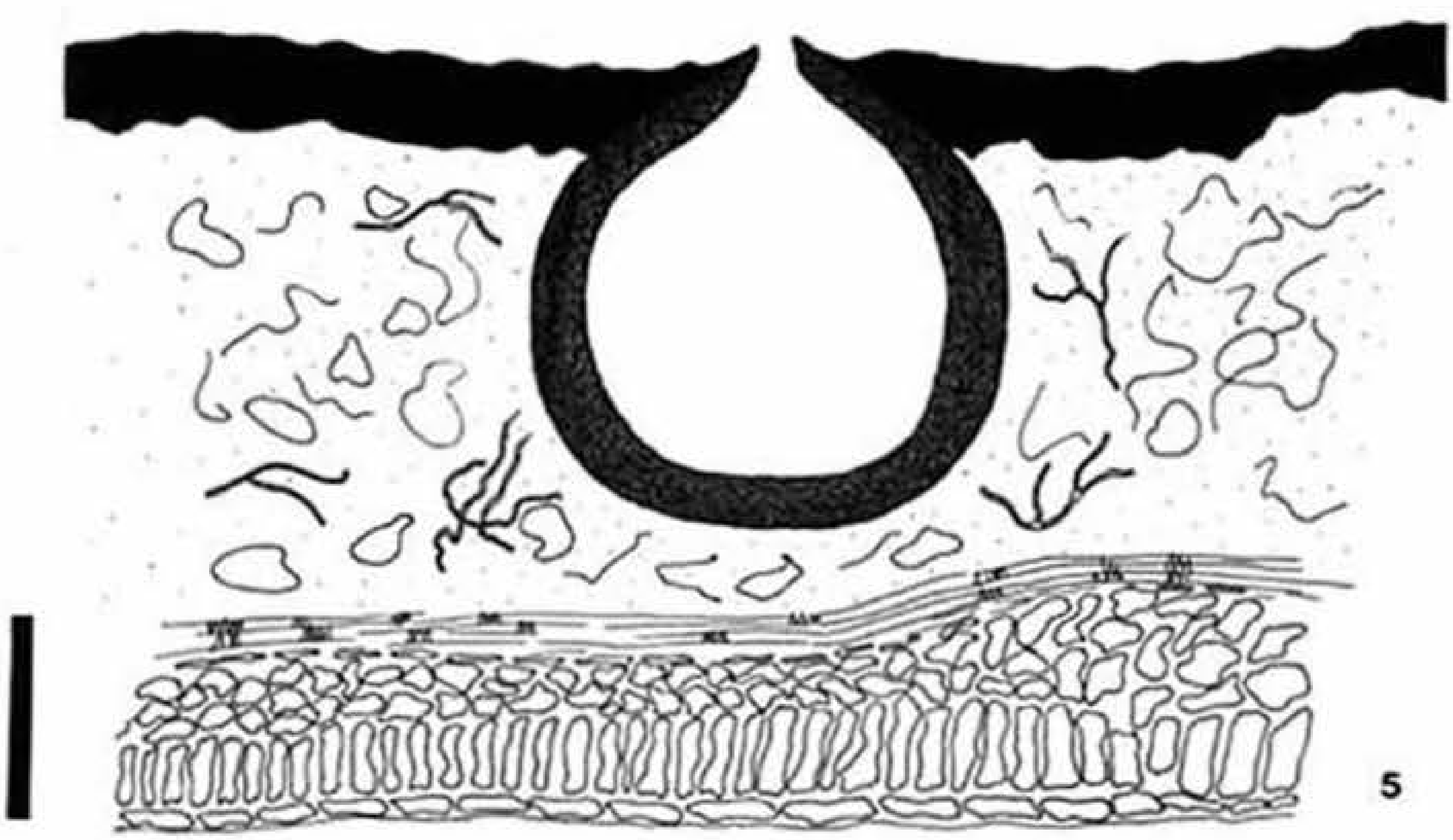

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*P. gloriana* have hosts belonging to different tribes in the family *Apocynaceae* and have a very disjunct geographical distribution. The latter is restricted to *Tylophora benthamii* Tsiang (*Asclepiadeae, Apocynaceae*), a species endemic to tropical and subtropical areas of eastern and northern Australia (Pearce et al. 1999).

The biotrophic nature of most of *Phyllachora* spp., as some other genera belonging to the *Phyllachorales*, means that host specificity has played a major role in the species definition (Cannon 1991, 1997; Silva-Hanlin & Hanlin 1998). A general literature search for records of species of *Phyllachora* and other fungi associated to the genus *Peltastes* yielded no records. *Phyllachora peltaticola* is therefore the first fungal species described on a member of this plant genus. The literature search did not show any species of the genus *Phyllachora* associated to any host genus belonging to the tribe *Echiteae, Apocynaceae* (Endress & Bruyns 2000). Therefore, this is the first record of a *Phyllachora* species in this tribe of the *Apocynaceae*.

## Acknowledgments

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Figures 4-5. *Phyllachora peltaticola* (VIC 26501). 4. Unitunicate eight-spored asci and hyaline aseptate ascospores. 5. Clypeate immersed ascomata. Scale bars: 20 µm and 100 µm respectively.

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# *Chroodiscus himalayanus*, a new species from India

S. Nayaka & D.K. Upreti*

*upretidk@rediffmail.com

*Lichenology Laboratory, National Botanical Research Institute*
*Rana Pratap Marg, Lucknow – 226 001, India*

**Abstract**—*Chroodiscus himalayanus* is described as new to science. The new species has transversely septate, acicular ascospores with a bead-like end cell.

**Key words**—*Thelotremataceae*, chroodiscoid, crustose lichen

## Introduction

India has a rich diversity of thelotremataceous lichens distributed in tropical forests, especially in the Western Ghats region of south India. About 180 species of common thelotremataceous lichens, belonging to the genera *Myriotrema*, *Ocellularia* and *Thelotrema*, are known from the Indian subcontinent (Awasthi 2000). Sethy & Patwardhan (1987) and Singh (1979) described two foliicolous species of *Chroodiscus* from the Andaman and Nicobar Islands. One of our recent collections from Himalayas proved to be an interesting species of corticolous *Chroodiscus*, which is described here as new to science.

## Materials and methods

The specimens were examined morphologically, anatomically and chemically. Thin hand-cut sections of apothecia and thallus were mounted in plain water, cotton blue, 5% KOH and iodine solution and observed under a compound microscope. For chemical spot tests the usual reagents of K, C and PD were used. TLC was performed in solvent system A following Walker & James (1990).

***Chroodiscus himalayanus*** Nayaka & Upreti, sp. nov. Fig. 1-5
Mycobank # MB510460

*Thallus typice corticola, tenuissimus vel evanescens, plerumque circa apothecia plus minusque restrictus, cinereo-viridis vel olivaceo-viridis, haud limitatus, ecorticatus, prothallo nullo, algis ad generam Trentepholiam pertinentibus, in parte basali thalli sitis. Apothecia dispersa, primum in thallo immersa, demum erumpentia, orbicularia, 1.0–2.5* *mm lata, adnata vel basim constricta; disco plano, aurantiaco-brunneis, laevis, nitido, epruinoso, plus minusque aperto, margin albido, 2–5 lobulato. Excipulum proprium hyalinum, ad basim dimidium, grandis crystalliferum; periphysibus parvis, distinctis. Epihymenium hyalinum vel luteolum, I+ caerulescens, deinde vinascens. Hymenium hyalinum, 90–120 µm crassum, oleoso-inspersum, I+ caerulescens, deinde vinascens. Subhymenium et hypothecium hyalinum, oleoso-inspersum, I+ caerulescens, deinde vinascens. Asci 2–3 spori, cylindrici, 85–95(–110)* longi et *8–10 µm lati, parietis, K–, I–, at lumine I+ pallide lutescente vel aurantiascente. Ascosporae hyalinae, non-halonatae, 40–78(–85) longae et 3–5 µm latae, septis transversalibus ad 15–25 (–30), aciculares, extremis cellulis moniliformis, I+ pallide lutescentes usque ad aurantiaco-lutescentes. Paraphyses simplices, tenues, cohaerentes, K–, at I+ caerulescentes, deinde vinascentes.*

Etymology: From the Himalayas, referring to the type locality.

Holotypus: INDIA, Himachal Pradesh, Kullu district, Great Himalayan National Park, Sainj Wildlife Sanctuary, Shakti, 2200 m, on bark, 06-06-2004, R. Srivastava 04-003228 (LWG–holotype).

Thallus corticolous, crustose, thin to evanescent, ecorticated, smooth, rather patchy, usually restricted to around the apothecia, grey-green to olive-green, not delimited; photobiont *Trentepholia*, occurring in the basal part of thallus; prothallus absent.

Ascomata apothecia, scattered, rarely 2–3 confluent, at first ± immersed in the thallus, soon emerging through irregular cracks, roundish, 1.0–2.5 mm in diam., adnate, constricted at the base when mature; disc plane to concave, orange-brown, smooth, shiny, epruinose, usually completely exposed; margin whitish, 2–5 lobate, 0.5–1.0 mm thick, in older apothecia exfoliating, developing radial fissures and dividing into 2–3 lamellae. Proper exciple in section hyaline, densely inspersed with calcium oxalate crystals, dimidiate at base, K–, I–, sometimes in mature apothecia forming with a supportive layer of bark cells; periphyses distinct; epihymenium hyaline to slightly yellowish, K–, I+ blue turning wine red; hymenium hyaline, 90–120 µm high, K–, I+ blue turning wine red, inspersed with oil globules; subhymenium and hypothecium hyaline, inspersed with oil globules, K–, I+ blue turning wine red. Asci 2–3 spored, cylindrical, 85-95(–110) x 8–10 µm, K–, I– or I+ with contents turning yellow to yellowish orange; ascospores hyaline, non-halonate, transversely 15–25(–30) septate, acicular, with basal end cell rounded, 40–78(85) x 3–5 µm, K–, I+ yellow to golden yellow; paraphyses, mostly simple, coherent, K–, I+ blue turning wine red.

*Chemistry:* Thallus K–, C–, KC–, P–. No lichen substances in TLC.

*Distribution and ecology:* At present *C. himalayanus* is known only from its type locality, in the north Himalayas, where it is found growing luxuriantly on tree trunks at an altitude of 2200 m.

*Remarks: C. himalayanus* is characterized by chroodiscoid apothecia with a prominent white, exfoliating margin, transversely septate, acicular ascospores,

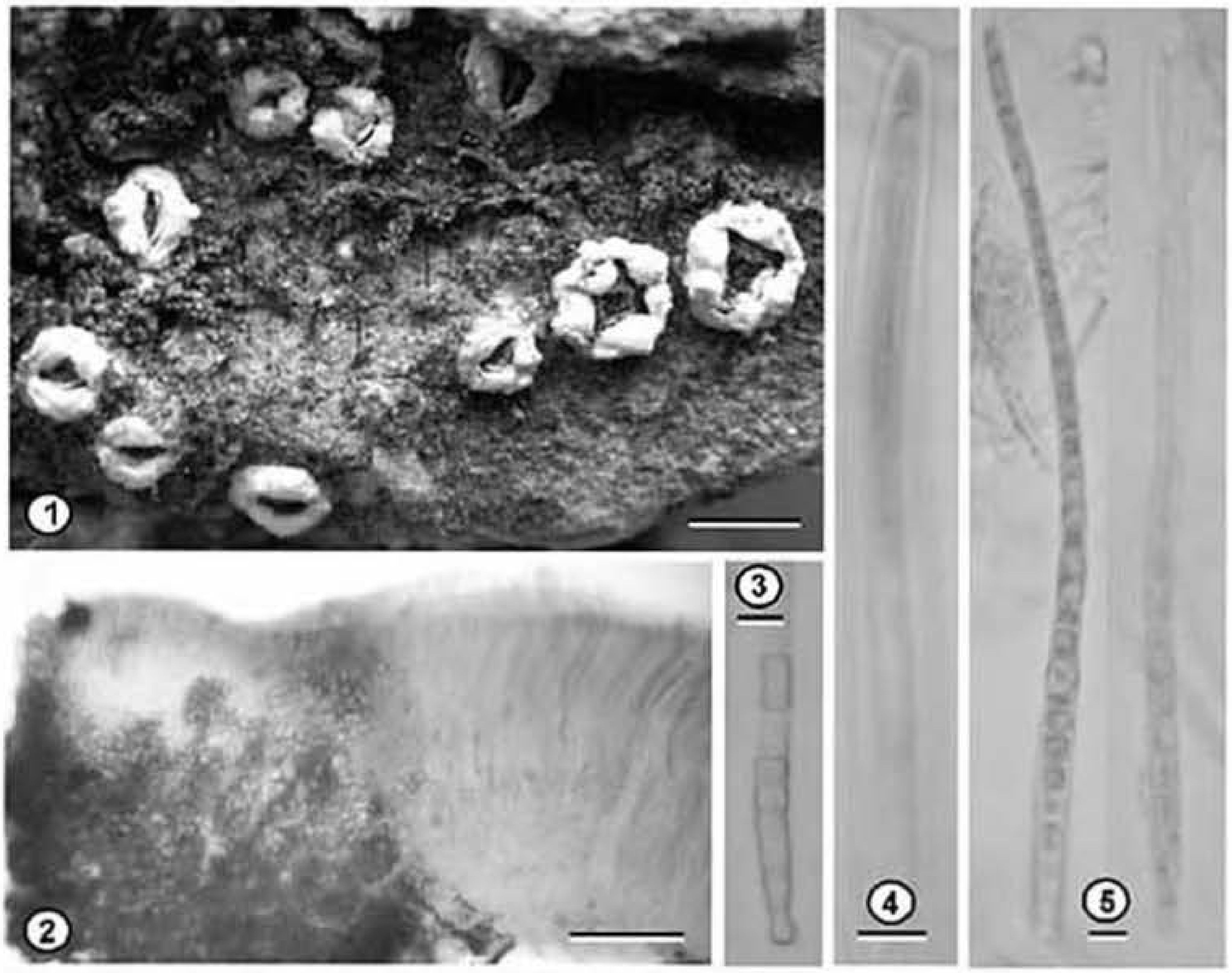


**Figure-1-5.** *Chroodiscus himalayanus* (from holotype): **1.** Habit; **2.** L.S. of apothecia showing calcium oxalate crystals in exciple; **3.** Bead like end cell; **4.** Ascus; **5.** Ascospores (Bars, Fig. 1 = 2 mm, 2 = 0.25 mm, 3&5 = 5 µm, 4 = 10 µm).

the presence of calcium oxalate crystals in the exciple and oil globules in the hymenium. The ascospores are broader at one end and narrow gradually towards the other. The terminal cell at the broader end becomes swollen and bead-like in appearance. The hymenium exhibits a peculiar reaction with iodine by gradually turning from blue to wine red, while the asci and ascospores remain yellow to yellowish orange and yellow to golden respectively. Such a character is unique for the genus though the colour changes in the immature ascus contents or ascospores are observed (Kantvilas & Vězda 2000).

Among the recognized corticolous *Chroodiscus* species, *C. himalayanus* is close to *C. minor* Kantvilas & Vězda, in having transversely septate ascospores, and a similar thallus and apothecial morphology. However, *C. minor* differs by its smaller apothecia (0.5–1.0 mm wide) and transversely up to 7-septate, ellipsoid to fusiform ascospores. The other corticolous *Chroodiscus* taxa have muriform ascospores (Kantvilas & Vězda 2000).

According to the new generic classification of the *Thelotremataceae* (Frisch 2006, Frisch & Kalb 2006) the genus *Chroodiscus* is now restricted to the foliicolous species, being characterised by a non-periphysate proper exciple, truly thin-walled (without any, though faint, lateral thickenings of the septa), small, hyaline, I– ascospores, a low hymenium and rather easily separated paraphyses. Another (monotypic) genus with thin-walled, hyaline, I– ascospores, *Acanthotrema* Frisch (*A. brasilianum* (Hale) Frisch) differs by the presence of periphysoids (with spiny tips) and rigid, rather strongly agglutinated paraphyses with spiny end-cells. This species is corticolous. The third genus with chroodiscoid apothecia, *Chapsa* A. Massal., in the present circumscription appears to be still heterogeneous. It accommodates all corticolous species with thick-walled (though sometimes very indistinct) ascospores (hyaline or brown, I+ or I-), a rather rigid type of the paraphyses often with moniliform or branched tips, and periphysoids (sometimes indistinct). This genus largely complies with *Thelotrema* subgen. *Asteristion* of Matsumoto (2000). However, the new species described here seems not to fit in any of these genera. From *Chroodiscus* and *Acanthotrema* it differs in the large, acicular ascospores, which are of a reduced thick-walled type, and from *Chroodiscus*, additionally by the presence of periphysoids. It differs from *Chapsa* species in having large, acicular ascospores, the large number of crystals in the lateral proper exciple, which is rare in chroodiscoid species of *Thelotremataceae* or in any of the other species with periphysoids and the hymenium turning blue to wine red in iodine. The colour change in hymenial matrix is also rare in species of the *Thelotremataceae*. Some characters of *C. himalayanus* like the large, rather thin-walled acicular ascospores, the large number of crystals in the lateral proper exciple and the hymenium turning blue to wine red in iodine even hint on a possible relationship with the *Stictidaceae* (Sherwood 1977).

The taxonomy of the chroodiscoid *Thelotremataceae* is still not finally settled and further changes in the delimitation of genera (including the description of additional new genera) are to be expected (personal communication, A. Frisch). However, following the old taxonomy and considering the taxonomic difficulties outlined above, *C. himalayanus* is described as a new species here.

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We are thankful to the Director, National Botanical Research Institute, Lucknow for providing necessary laboratory facility to work, to Ministry of Environment and Forests, New Delhi for financial support, to Dr. P.K. Divakar, Mr. Yogesh Joshi for their valuable suggestions, to Mr. Rajesh Bapai for assisting in TLC, to Drs. Gintaras Kantvilas and Andreas Frisch for their useful comments.

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MYCOTAXON

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# NATS truffle and truffle-like fungi 14: *Pachyphloeus austro-oregonensis*, a new species from southern Oregon

Jonathan L. Frank[1], Darlene Southworth[1] & James M. Trappe[2]

*frankjon@sou.edu*

[1]*Department of Biology, Southern Oregon University 1250 Siskiyou Blvd. Ashland, OR 97520-5071, USA*

[2]*Department of Forest Science, Oregon State University Corvallis, OR 97331-5752, USA*

**Abstract** — A new truffle species, *Pachyphloeus austro-oregonensis* (*Pezizaceae, Pezizales*), is described from southern Oregon, USA. This hypogeous species is associated with *Quercus garryana*.

**Key words** — hypogeous fungi, oak woodland, mycorrhizas, mycophagy, DNA

## Introduction

Research on the biodiversity of ectomycorrhizal fungi in Oregon white oak woodlands has included a survey of hypogeous sporocarps at Whetstone Savanna Preserve in southern Oregon (Valentine et al. 2004, Frank 2005, Frank et al. 2006). The site is a remnant woodland of *Quercus garryana* Dougl. ex Hook. interspersed with shrublands of *Ceanothus cuneatus* (Hook.) Nutt. Eighteen species of hypogeous fungi were collected for this survey (Frank 2005, Frank et al. 2006), of which 13 were *Ascomycota* and 5 *Basidiomycota*. Six of the *Ascomycota* were in the family *Pezizaceae*, two of these in the genus *Pachyphloeus: P. citrinus* and *P. austro-oregonensis* sp. nov. Recent molecular analysis suggests that the Genus *Pachyphloeus* forms ectomycorrhizal mutualisms (Tedersoo et al. 2006).

In addition to consulting keys, previously published descriptions of species in the genus *Pachyphloeus* and type collections of all previously described species, molecular methods were used to compare DNA sequences from field collections to those of hypogeous fungi in GenBank, www.ncbi.nlm.nih.gov (Castellano et al. 1989, Gardes & Bruns 1993, Frank 2005, Frank et al. 2006).

Spores from *Pachyphloeus austro-oregonensis* were present in the fecal pellets of two small mammals, *Microtus californicus* and *Peromyscus maniculatus*, trapped at the research site (Frank 2005, Frank et al. 2006). These rodents provide this truffle with a spore dispersal mechanism.

## Materials and methods

Whetstone Savanna Preserve (42°25'N, 122°54'W), owned by The Nature Conservancy, is on an alluvial plain near the Rogue River in southern Oregon. Precipitation is 40-50 cm of rainfall per year. Hypogeous sporocarps were collected by raking the ground with a short-tined garden cultivator beneath and around *Quercus garryana* (Oregon white oak, Garry oak) weekly from April through June, 2003 through 2005, and less frequently in other months. Leaf litter and soil were examined for sequestrate sporocarps. Specimens were described the same day (Weber et al. 1997). Sporocarps were photographed in the field with a Canon EOS digital SLR camera and in the lab under a Leica MZ75 dissecting microscope with a SPOT RT Color camera (Diagnostic Instruments, Inc.) and under a Leica DMLB compound microscope with a SPOT QE insight camera. Microscopic characters were described from razor-blade sections of fresh specimens mounted in water, 5% aqueous KOH, and Melzer's reagent. Collections were deposited in the herbaria of Southern Oregon University (SOC), Oregon State University (OSC) and San Francisco State University (SFSU). Type specimens of all described species in the genus *Pachyphloeus* were examined at the Oregon State University herbarium.

Small mammals were captured in Sherman live traps around Oregon white oak and buck brush where truffles had been collected at Whetstone Savanna Preserve (Frank 2005, Frank et al. 2006). For visual spore identification, slides of fresh fecal pellets were stained with Melzer's reagent and viewed with a compound microscope.

DNA was extracted from sporocarps and fecal pellets in CTAB buffer with chloroform and amplified in polymerase chain reactions (PCR) with fungal specific primers ITS1F and ITS4 (White et al. 1990, Gardes & Bruns 1993). Molecular data were obtained by sequencing of the internal transcribed spacer (ITS) region, including ITS1, the 5.8S ribosomal DNA gene and ITS2. PCR products were cleaned in Montage PCR Centrifugal Filter Devices (Millipore Corporation). PCR products from fecal pellets were cloned with P-Gem-T Vector System II (Promega). Clean PCR products were prepared for sequencing with BigDye Terminator Ready Reaction Mix and sequenced by an ABI 310 Genetic Analyzer (Applied Biosystems). Sequences were edited with Chromas 1.45 (McCarthy 1998) and compared to other fungal DNA sequences in GenBank with BLAST (Altschul et al. 1990). All available DNA sequences from *Pachyphloeus* spp. were aligned and compared visually with ClustalX (Thompson et al. 1997). Sequence data for *P. austro-oregonensis* are available in GenBank (AY830854).

## Taxonomic description

***Pachyphloeus austro-oregonensis*** J. L. Frank & Trappe sp. nov. Figures 1-3
Mycobank# MB510569

*Ascomata subglobosa, ptychothecia, 1-2.5 cm lata. Peridium verrucosum, purpureobrunneum, in glebam invaginatum atque canales loculos paginis externis continuis formantes. Gleba venis labyrinthis hymeniis aureis. Asci 220-360 x 18-28 µm. Paraphyses 8-13 µm latae. Sporae globosae, hyalinae, (10-) 12-16 (-18) µm, ornamenta virgarum aggregatarum includentes. Typus J. L. Frank 775 (SOC).*

Etymology: Latin, *austro-* (southern) and *-oregonensis* (Oregon), "from southern Oregon."

**Ascomata** subglobose to irregular ptychothecia 1–2.5 cm broad. **Peridium** verrucose, purple-brown with a pallid to pink inner layer and invaginated into the gleba as narrow canals that form thin, verrucose, interior chambers continuous with the outer surface. **Gleba** with labyrinthiform veins lined by golden-yellow hymenia; veins, open or with opposing hymenia pressed together, separated by grey-brown sterile tissue. **Ascomatal base** sometimes giving rise to a root-like, white, tapering hyphal mass 10-13 x 2-3 mm. **Odor** mild. **Taste** not recorded.

**Peridium** 500-950 µm thick, with two layers: **outer layer** a textura angularis 200-400 µm thick of inflated, irregular to isodiametric cells 15-40 µm broad, with light brown walls at the peridial surface grading to hyaline toward the interior; **inner layer** 300-550 µm thick, of hyaline cells 4-8 µm broad and of various lengths, contorted and irregularly arranged as a textura intricata. **Trama** 50-200 µm thick, of cells 4-6 µm broad running parallel. **Subhymenium** 20-50 µm thick, a textura intricata with many isodiametric cells 4-10 µm broad. **Asci** in tight palisades lining the glebal canals, cylindrical, 220-360 x 18-28 µm, with a forked base, occasionally bent, with 8 uniseriate to incompletely biseriate spores, amyloid. **Paraphyses** septate, 8-13 µm broad with clavate tips, equal to or extending up to 60 µm beyond the asci. **Ascomatal base** a textura intricata, of cells 8-18 x 2-4 µm and as loose septate hyphae at the exterior surface.

**Spores** globose, hyaline (10-) 12-16 (-18) µm broad including the ornamentation of crowded rods 1-2.5 x 0.5 µm; **spore walls** 1-2 µm thick.

**Habit, Habitat and Season**: hypogeous; associated with *Quercus garryana* in southern Oregon, 400 m elevation, Mediterranean climate with dry summers and less than 50 cm annual precipitation. Sporocarps fruit below leaf litter in top 2-5 cm of mineral soil, May-June. All collections of this new species are from the Whetstone Savanna Preserve, north of Medford, Oregon.

Collections examined: HOLOTYPE— UNITED STATES. OREGON: Jackson Co. North of MEDFORD, Whetstone Savanna Preserve (42°25'N, 122°54'W), J. L. Frank, 4 June 2004, 775 (SOC; isotypes: SFSU, OSC 112205, GenBank AY830854). PARATYPES: UNITED STATES. OREGON: Jackson Co. North of MEDFORD, Whetstone Savanna Preserve J. L. Frank 1 June 2004, 761 (SOC, OSC112204), and 4 June 2004, 774 (SOC).

COMMENTS – The nomenclature of this new species reflects that it was collected in southern Oregon with the support of Southern Oregon University. Additionally, the interior morphology of folded golden hymenia mirrors the landscape of southern Oregon with its golden dry hills. While the sporocarp of *Pachyphloeus austro-oregonensis* is a ptychothecium, its glebal foldings can be so dense as to resemble a stereothecium.

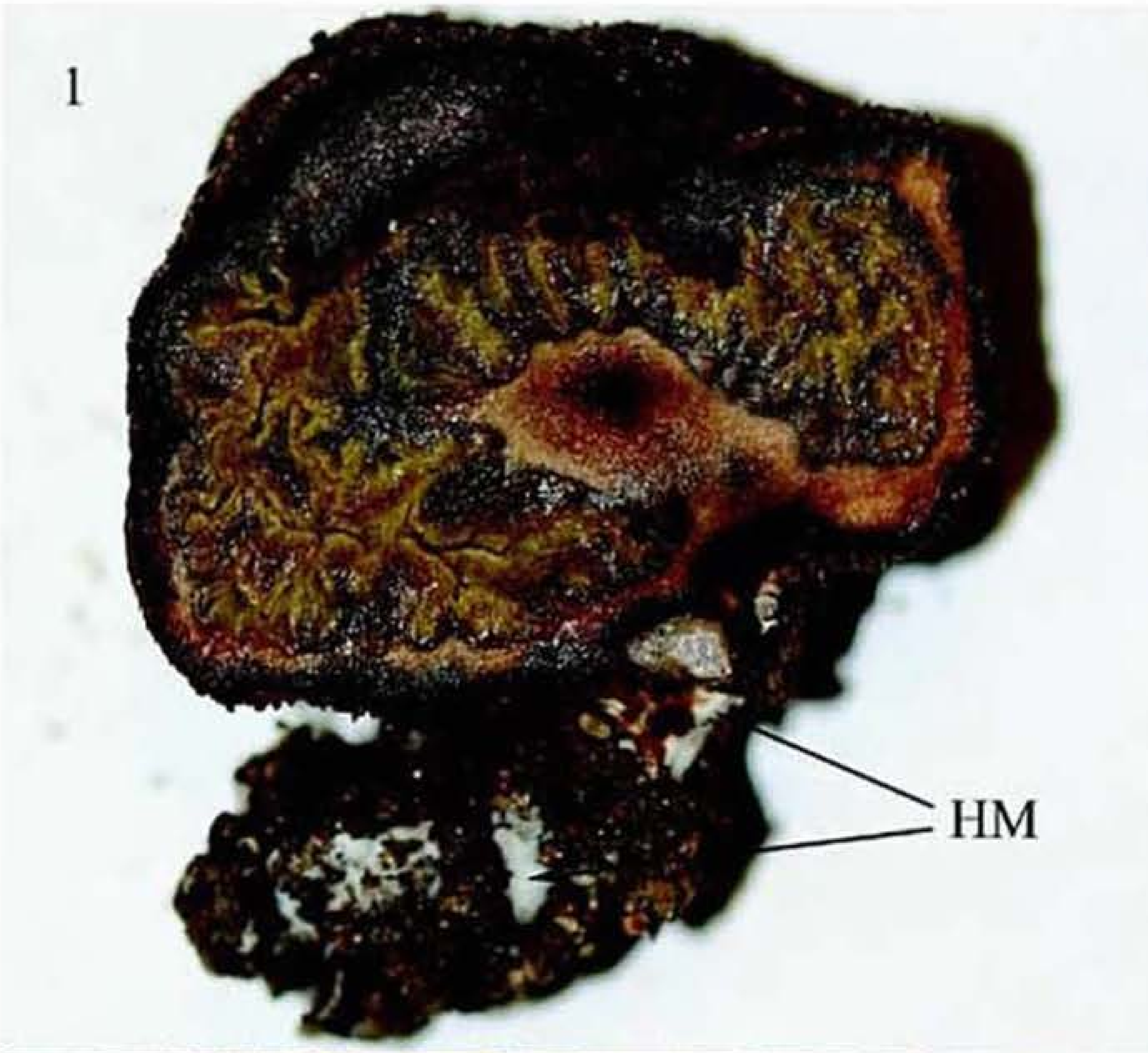



Figure 1. *Pachyphloeus austro-oregonensis* (SOC775) showing basal hyphal mass (HM). Figure 2. *P. austro-oregonensis* (SOC774) showing an invaginated canal (IC), bar = 1mm.

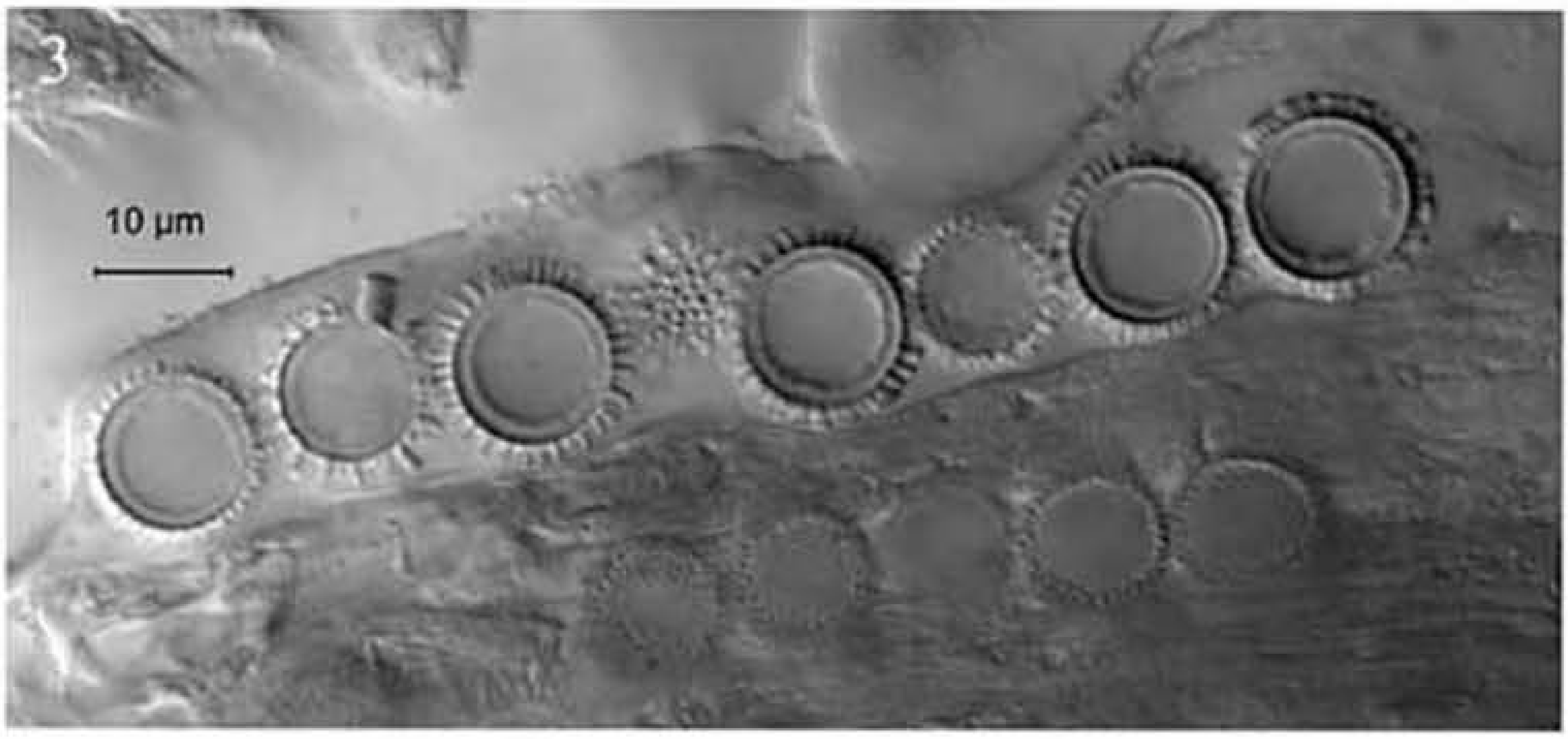


Figure 3. *P. austro-oregonensis* spores in ascus.

*Pachyphloeus austro-oregonensis* differs from *P. lateritius* Fogel & States in having smaller spores with taller ornamentation, and longer, cylindrical asci. *P. melanoxanthus* (Berk.) Tul. & C. Tul and *P. virescens* Gilkey have more broadly ellipsoid asci. *P. citrinus* Berk. & Broome, which fruits under oaks, and *P. thysellii* Colgan & Trappe, which fruits under *Pseudotsuga menziesii,* have elliptical to subglobose asci and solid glebae. *P. virescens* has a dull green external surface, while the exterior surface of *P. austro-oregonensis* is purple-brown and verrucose. *P. conglomeratus* Berk. & Broome has an external surface without distinct warts and also asci that stain in Melzer's. In Melzer's, asci of *P. austro-oregonensis* stain weakly blue-green to vividly blue and immature asci stain orange.

The hyphal mass at the ascomatal base was observed on one fruiting body (SOC775) of the four fruiting bodies collected and examined. In all of the collections, while many asci had fully developed spores with ornamentation, many asci were empty or had a cluster of smaller developing spores lacking ornamentation. Thus the specimens, all collected in June, may not have been fully mature. While no distinct odor was noted, fully mature sporocarps may exude a characteristic aroma. A columella-like structure was visible in one specimen (SOC775), as shown in Fig. 1., but was not visible in the other specimens.

Obtaining clean sequence data from *Pachyphloeus austro-oregonensis* was notably problematic. Despite removing interior regions of clean gleba and extracting DNA under sterile conditions, PCR reactions often yielded multiple bands. After many attempts, a relatively short segment (486 bp) was clear enough to analyze and deposit in GenBank. This segment included the complete sequence for the 5.8S ribosomal DNA gene and partial sequences for ITS regions 1 and 2.

Spores of *P. austro-oregonensis* were observed in fecal pellets of two small mammals, *Microtus californicus* and *Peromyscus maniculatus,* trapped at the Whetstone Savanna site (Frank 2005, Frank et al. 2006). This observation was supported by molecular analysis. One ITS sequence cloned from fungal DNA in the fecal pellet of *Microtus californicus* most closely matched the ITS of *P. austro-oregonensis* with 452 of 486 identities in common.

## Ecology

Hypogeous fungi are common in Mediterranean climates, having evolved under selection pressures for survival in warm, dry climates (Montecchi & Sarasini 2000, Trappe & Claridge 2005). Subterranean fruiting strategies conserve moisture and require alternatives to the aerial spore dispersal mechanism common to epigeous mushrooms. Animals, attracted by volatile aromatics produced by the hypogeous fruiting bodies at maturity, dig them up, consume them, and disperse the spores in their feces (Claridge & Trappe 2005).

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# *Monodictys arctica*, a new hyphomycete from the roots of *Saxifraga oppositifolia* collected in the Canadian High Arctic

Melissa J. Day[1*], Connie Fe C. Gibas[1], Kei E. Fujimura[2], Keith N. Egger[2] & Randolph S. Currah[1]

*mjday@ualberta.ca*

[1] *Department of Biological Sciences, University of Alberta, Edmonton, AB, T6G 2E9, Canada*

[2] *Ecosystem Science and Management Program, University of Northern British Columbia, Prince George, BC, V2N 4Z9, Canada*

**Abstract**—*Monodictys arctica* sp. nov. is described on the basis of nine isolates obtained from the roots of eight separate collections of *Saxifraga oppositifolia* from Ellesmere Island, Nunavut, Canada. Conidia are multicelled, smooth, darkly pigmented, and globose, oblong, ellipsoidal, or pyriform to irregularly shaped or dichotomously branched, consisting of a blastically produced basal cell and a distal proliferation of up to 24 cells arising from meristematic growth. Analyses of SSU and ITS sequences indicate the species is unique but has an affinity to the loculoascomycete taxon *Leptosphaeria dryadophila*.

**Key words** —endophyte, DSE, taxonomy

## Introduction

The surfaces and cortices of fine roots are usually heavily infected with darkly pigmented, septate hyphae, some of which are easily isolated after surface sterilisation and grow readily in culture (Addy et al. 2005). Among the more common and widely distributed species of these "dark septate endophytes" or "DSE" are the helotialean anamorphs *Phialocephala fortinii* C.J.K. Wang & H.E. Wilcox, *Leptodontidium orchidicola* Sigler & Currah, and *Scytalidium vaccinii* Dalpé et al.

A large collection of cultures, composed predominantly of "DSE" fungi, were isolated from the roots of *Cassiope tetragona, Dryas integrifolia, Salix arctica*, and *Saxifraga oppositifolia* collected during the summer of 2000 from Alexandra Fiord, Ellesmere Island, Nunavut, Canada (78° 53'N, 75° 55'W). The plants were collected as part of an experiment to study the effects of passive

*Author for correspondence

warming using open-topped chambers (OTCs) on root-associated fungal communities. Among this collection of fungi were numerous representatives of *P. fortinii*, *L. orchidicola*, and *S. vaccinii* along with isolates of other taxa. Eight of the latter, each from separate collections of *S. oppositifolia*, were distinctive in producing irregular, multicelled, darkly pigmented conidia that were assignable to *Monodictys* (anamorphic *Dothideales*, fide Kirk et al. 2001) but did not match any described species.

Here, we provide a description of *Monodictys arctica* along with a comparison of this new species with similar ones and, using sequence data from the small subunit and internal transcribed spacer regions on the ribosomal DNA, provide an estimation of its phylogenetic position among related taxa in the Loculoascomycetes (sensu Barr & Huhndorf 2001).

## Materials and methods

Specimens of *Saxifraga oppositifolia*, from OTCs and ambient plots, were harvested along with surrounding soil, placed in Ziploc® bags, and stored at 4°C until processed at the University of Northern British Columbia. Soil was loosened from roots by immersing in water for at least 24 hours at 4°C. Roots were gently cleaned with water and then collected in a 0.5 mm sieve (No. 35 USA standard testing sieve, W.S. Tyler, Inc. Mentor, Ohio, USA). Randomly selected root sections were surface-sterilized with 30% $H_2O_2$ following Danielson (1984) and placed on modified Melin Norkrans (MMN) agar (Marx 1969) amended with streptomycin sulphate and chlortetracycline. Plates were incubated at room temperature (20–22°C) and isolates were purified by transfer to fresh media. A 0.5 mm plug from each isolate was placed on an MMN agar slant and stored at 4°C until it was sent to the University of Alberta for identification.

Colony characteristics of the new species were based on growth on oatmeal agar [OA; 20 g oatmeal, 20 g Select agar (Invitrogen, Carlsbad, California, USA), 1 L distilled water] and potato dextrose agar (PDA; Difco Bacto). Conidial morphology was examined using an Olympus BX50 microscope and slide cultures (Kane et al. 1997) mounted in polyvinyl alcohol with acid fuchsin [APVA; 1.66 g polyvinyl alcohol (Sigma Chemicals, Oakville, Ontario, Canada), 10.0 mL lactic acid, 1.0 mL glycerine, 10.0 mL $H_2O$, 0.02 g acid fuchsin] or 1.5 M KOH. Conidial and conidiophore dimensions are based on 140 and 20 measurements respectively and appear in the descriptions as a range. Images of conidia and colonies were prepared using an Olympus DP12 and an Olympus C60 camera, respectively. Freehand line drawings were made based on observations made with the light microscope.

To obtain the targeted rDNA sequences, cultures were grown on PDA overlaid with a Cellophane™ sheet (UCB Films, Bridgwater, Somerset, UK). Approximately 100 mg of mycelium was scraped off the cellophane and placed in a sterilised mortar containing acid-sterilised sand. Liquid nitrogen was added and the frozen mycelium was ground to a powder with a pestle. The powder was dissolved in 1 mL of 2x CTAB [10 mL 1M Tris pH 8.0, 8 mL 0.25M EDTA, 8.7 g NaCl, 20 mL 10% CTAB (10 g CTAB, 100 mL $dH_2O$), 100 mL $dH_2O$] and 2 µL β mercaptoethanol and incubated at 65°C for 2 hours. An equal volume of 24:1 chloroform:isoamyl alcohol was added. The tubes were inverted until an emulsion formed and then centrifuged for 20 min at 14 000 rpm at room temperature.

Table 1. Provenance data for species of *Leptosphaeria* and *Decorospora* used in the parsimony analysis of the ITS DNA region.

| Species | Genbank Number | Host plant |
|---|---|---|
| *Decorospora gaudefroyi* | AF439451 | Not listed |
| *Leptosphaeria biglobosa* | DQ133893 | *Brassica napus* |
| *L. conferta* | AF439459 | *Anacyclus radiatus* |
| *L. doliolum* | U04207 | Not listed |
| *L. dryadophila* | AF439461 | *Dryas octopetala* |
| *L. maculans* | M96384 | *Brassica napus* |
| *L. typharum* | AF439465 | *Typha angustifolia* |
| *Monodictys arctica* | | *Saxifraga oppositifolia* |

The upper DNA-containing layer was collected and purified using a Qiaquick PCR purifying kit (QIAgen Inc., Mississauga, Ontario, Canada). Cleaned extraction products were visualised on a 1% agarose gel stained with ethidium bromide and exposed to UV light.

The target DNA regions, the small subunit rDNA (SSU) and the internal transcribed (ITS) spacer region, consisting of complete ITS 1, 5.8 S, and ITS 2 and partial SSU and LSU DNA, were amplified using primers BMBCR (Lane et al. 1985) and NS8 (White et al. 1990) and BMBCR and ITS 4 (White et al. 1990) respectively. The PCR reaction mixture included 5 µL 10x buffer (500 mM KCl, 100 mM Tris Base pH 8.3), 26 µL distilled water, 3 µL 25 mM $MgCl_2$, 4 µL of dNTP (10 mM of each dNTP), 5 µL of each primer, 1 µL Taq DNA polymerase, and 1 µL of the DNA template. Amplifications were achieved in a GeneAmp PCR System 97000 (PE Applied Biosystems, Foster City, California, USA) with the following program parameters: 94°C for 2 minutes, 30 cycles of 94°C for 1 minute, 55°C for 1 minute, 72°C for 2 minutes, and an extension of 72°C for 7 minutes and 4°C for 10 minutes. Amplification products were subjected to electrophoresis on a 1% agarose gel stained with ethidium bromide and visualised under UV light.

The amplicons were purified using a QIAquick PCR purification kit (QIAgen Inc. Mississauga, Ontario, Canada) and both strands were sequenced using the primers BMBCR, ITS1 (White et al. 1990), ITS2 (White et al. 1990), and ITS4 (for the ITS region) and BMBCR, NS1, NS2, NS3, NS4, NS, NS5, NS6, NS7, and NS8 (White et al. 1990) for the SSU region. The sequencing reactions contained a DNA concentration of 50 nmol $mL^{-1}$, 0.5 µL primer, 2.5 µL sequencing buffer, 1 µL Big Dye v. 3.0 (Applied Biosystems Inc., Foster City, California, USA), and water up to a total of 10 µL. Cycle sequencing reactions were achieved using a GeneAmp PCR System 97000 (PE Applied Biosystems) with the following program parameters: 25 cycles of 94°C for 20 seconds, 50°C for 2 minutes, 60°C for 1 minute. Sequencing reactions were run on an AB 3100 Genetic Analyzer (Applied Biosystems Inc., Foster City, California, USA). Sequences were examined using Sequencher 4.0.5 (Gene Codes Corp., Ann Arbor, Michigan, USA). A BLAST search was performed in GenBank to find related sequences.

The SSU sequences were used to place the isolates within the Ascomycota. The ITS sequences were used to place the isolates within the genus to which they were most similar according to a BLAST search (Table 1). Sequences were manually aligned using Se-Al Carbon version 2.0a11 (http://evolve.zoo.ox.ac.uk). PAUP (version 4.40b) (Swofford 2003) was used for parsimony analyses of sequences. Gaps were treated as missing. Trees were created using the stepwise addition with bisection-reconnection as the branch swapping algorithm. Branch confidence was tested using bootstrap analysis (Felsenstein 1985) with 100 replicates for the ITS tree and 500 replicates for the SSU tree. *Decorospora gaudefroyi* (= *Pleospora gaudefroyi*) and *Saccharomyces cerevisiae* were used as outgroup taxa for the ITS tree and SSU trees, respectively.

## Taxonomy

***Monodictys arctica*** M.J. Day & Currah, sp. nov. Figs. 1-10

MYCOBANK #: MB510336

*In OAT et PDA, coloniae floccosae, margines leves, interdum discolorationem brunneam medii causantes. In PDA, colonia 35 mm post 35 dies, primum alba ad pallide brunnea, deinde brunnea post 4 dies et argenteo-grisea post 7 dies. Conidia sessilia et lateralia in hyphis vegetativis vel ex extremis ramorum orientia, 5–330 µm longitudine, consistent ex cellulis basalibus blastice productis et ex proliferatione distali cellularum, usque ad 24 numero, quae oriunt ex incremento meristematico; imperfecte globosa quando maturant, oblonga, ellipsoidea vel pyriformia vel inaequaliter vel dichotome ramosa, interdum latiora quam longiora, maxime nigrata (melanisata), levia, crassiter tunicata, constricta prope septa, 12–80 × 12–90 µm. Isolata ex radice Saxifragae oppositifoliae ex insula Ellesmere.*

Etymology recognises the collecting locality for the host plant.

Colonies on OAT and PDA floccose with even margins, occasionally causing brown discoloration of medium (Fig. 1). Colony 35 mm after 35 days on PDA, white to light tan at first, becoming brown after four days, and silvery grey

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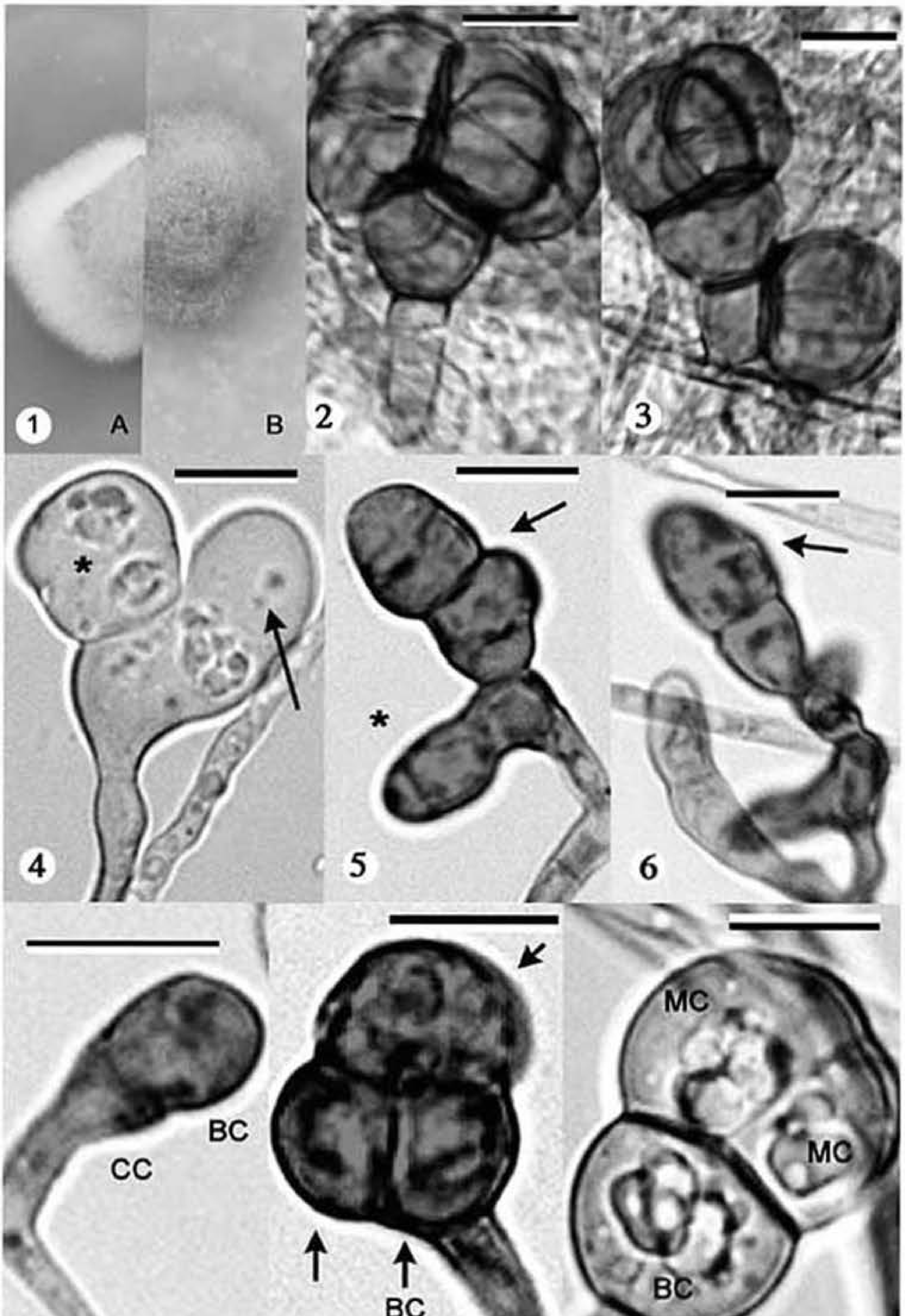
**Figs. 1-9 Cultural and morphological features of *M. arctica*. Figure 1.** Colony morphology at 12 days of *Monodictys arctica* isolates on (PDA) and (OA). Brown discoloration of medium shown on OA. a) UAMH 10719 on PDA. b) UAMH 10720 (ex-type strain) on OA. **Figure 2.** Globose conidium from a 14 d culture of UAMH 10719 stained in APVA showing the prominent basal cell (*) attached to the conidiogenous cell. **Figure 3.** Conidium from a 14 d culture of UAMH 10719 stained in APVA showing branches. Conidial breadth is larger than length. **Figure 4.** Conidium from a 9 d slide culture of UAMH 10720 cleared in 10% KOH showing development of a second conidial branch (arrow) before division of the first branch (*). **Figure 5.** Conidium from a 7 d slide culture of M.J.D.727 (from same root as UAMH 10723) stained with APVA showing development of a second conidial branch (*) after division of the first branch (arrow). **Figure 6.** Conidium from a 7 d slide culture of UAMH 10718 stained in APVA showing a newly formed septum (arrow). **Figure 7.** Conidium from a 3 d slide culture of M.J.D.727 (from same root as UAMH 10723) stained in APVA showing a basal cell (BC) protruding from the conidiogenous cell (CC). **Figure 8.** Branched conidium from a 7 d culture of UAMH 10718 stained in APVA showing the meristematic initials (MI) of two branches produced by basal cell (BC). **Figure 9.** Conidium from a 9 d slide culture of UAMH 10722 cleared in 10% KOH after division of meristematic initial (MC = meristematic cell). BC = basal cell. All bars = 10µm.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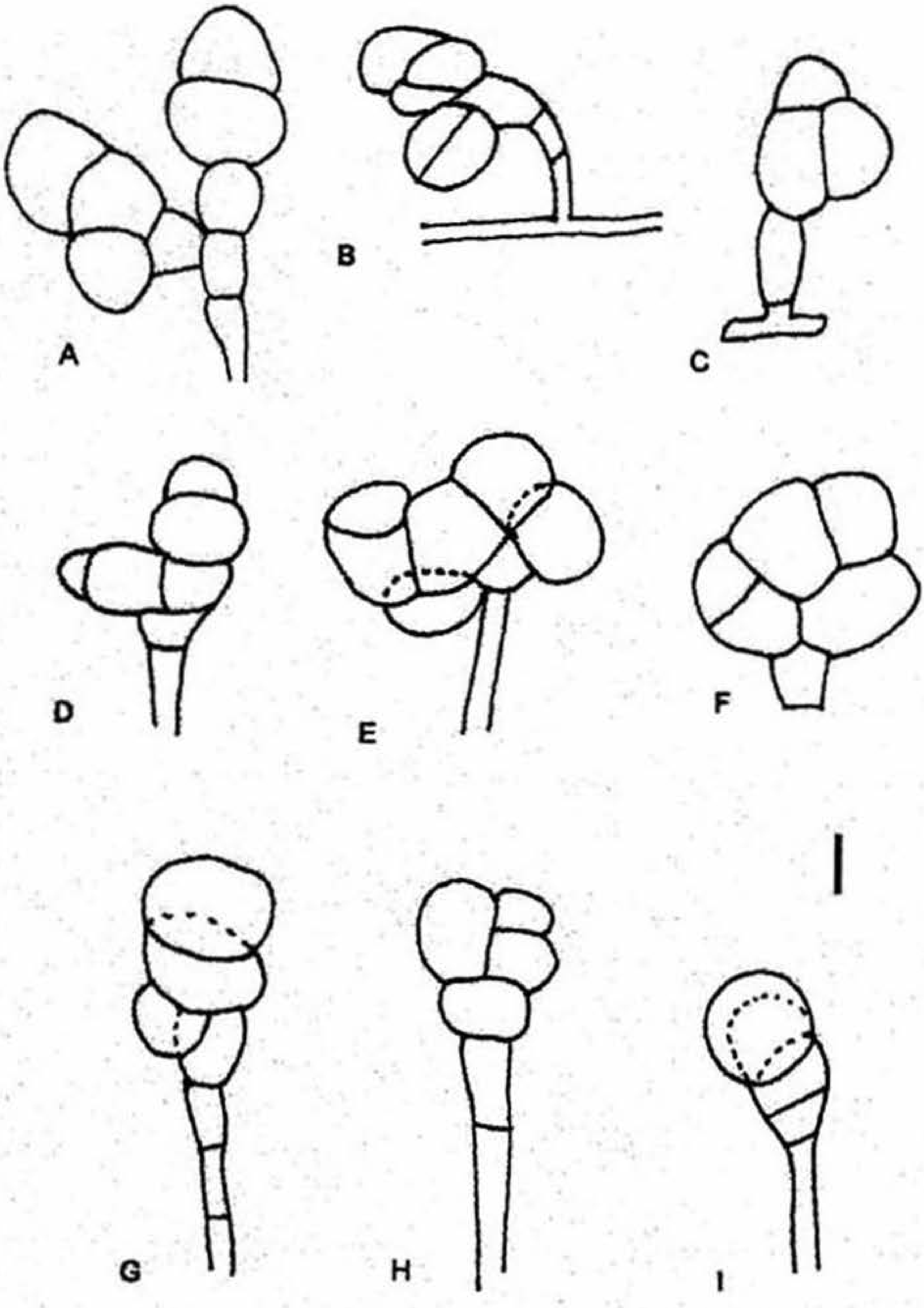


**Fig. 10. Line drawings of conidia of *Monodictys arctica*.** A. Irregularly shaped branched conidium. B. Branched conidium with second branch just developing. C. Conidium showing two meristematic initials. D. Branched conidium with breadth greater than length. E. Conidium broader than long. F. Roughly globose conidium. G. Roughly ellipsoidal conidium. H. Young, roughly globose conidium. I. Young conidium. Bar = 10 µm

after seven days. Conidia sessile and lateral on vegetative hyphae or arising from lateral branches 5–330 µm in length, consisting of a blastically produced basal cell and a distal proliferation of up to 24 cells arising from meristematic growth (Fig. 2); at maturity, roughly globose, oblong, ellipsoidal, or pyriform to irregularly shaped or dichotomously branched (Figs. 3, 4, 5), deeply pigmented and appearing olive to dark brown, smooth, thick walled, with constrictions at septa, 20–80 × 12–50 µm when length greater than breadth and 12–67 × 20–90 µm when breadth greater than length.

HOLOTYPE – CANADA. ELLESMERE ISLAND: Alexandra Fiord, Nunavut (78° 53'N, 75° 55'W), ex roots of *Saxifraga oppositifolia*, 17 Jan 2001, UAMH, a dried culture derived from UAMH 10720 - M.J.D. 121 = K.E.F. 1-S1-OTC3-Saop 3.2)

PARATYPES – dried cultures derived from the following cultures and deposited in the UAMH. All from roots of *Saxifraga oppositifolia* collected at the type locality: 18 Sep 2000, UAMH 10718 - = M.J.D. 73 = K.E.F. 1-S4-OTC3-Saop 4.3; 20 Dec 2000, UAMH 10719 - = M.J.D. 86 = K.E.F. 1-S1-C3-Saop 1.2; 16 Nov 2000, UAMH 10721 - = M.J.D. 192 = K.E.F. 1-S4-OTC2-Saop 4.6; 13 Sep 2000, UAMH 10725 - = M.J.D. 217 = K.E.F. 1-S4-OTC3-Saop 2.2; 25 Sep 2000, UAMH 10722 - = M.J.D. 607 = K.E.F. 1-S4-OTC2-Saop 2.2; 13 Oct 2000, UAMH 10723 - = M.J.D. 729 = K.E.F. 1-S4-OTC2-Saop 1.1B; 13 Oct 2000, UAMH 10724 - = M.J.D. 732 = K.E.F. 1-S4-C1-Saop 4.2.

## Results

For both the SSU and ITS regions, isolates shared greatest sequence similarity with *Leptosphaeria* species according to BLAST searches of GenBank. Subsequent parsimony analysis of the SSU DNA placed *M. arctica* in the *Dothideomycetidae* (Fig. 11). The SSU tree included 31 taxa and 1022 characters, of which 740 were constant, 98 parsimony uninformative, and 184 parsimony informative. Nineteen most-parsimonious trees were produced for the SSU region. The consistency index (CI) was 0.612, the retention index (RI) 0.753, and the homoplasy index (HI) 0.388. Analysis of the ITS regions of *M. arctica* and *Leptosphaeria* species placed our isolates in the same clade as *L. dryadophila* (Fig. 12). The ITS tree included 18 taxa and 600 total characters, 336 of which were constant, 85 parsimony uninformative, and 179 parsimony informative. One most-parsimonious tree was produced for the ITS region. The CI was 0.579, the RI 0.490, and the HI 0.421.

## Discussion

Our isolates are accommodated within *Monodictys* reasonably well on the basis of morphology even though previous authors have noted that the boundaries among similar genera having pigmented, muriform conidia can be difficult to recognise (Rao and de Hoog 1986, Rodríguez et al. 2001). The genus was erected by Hughes (1958) with *M. putredinis* (Wallr.) S. Hughes as the type species, and is characterised by the production of single, dry, darkly pigmented, multicelled

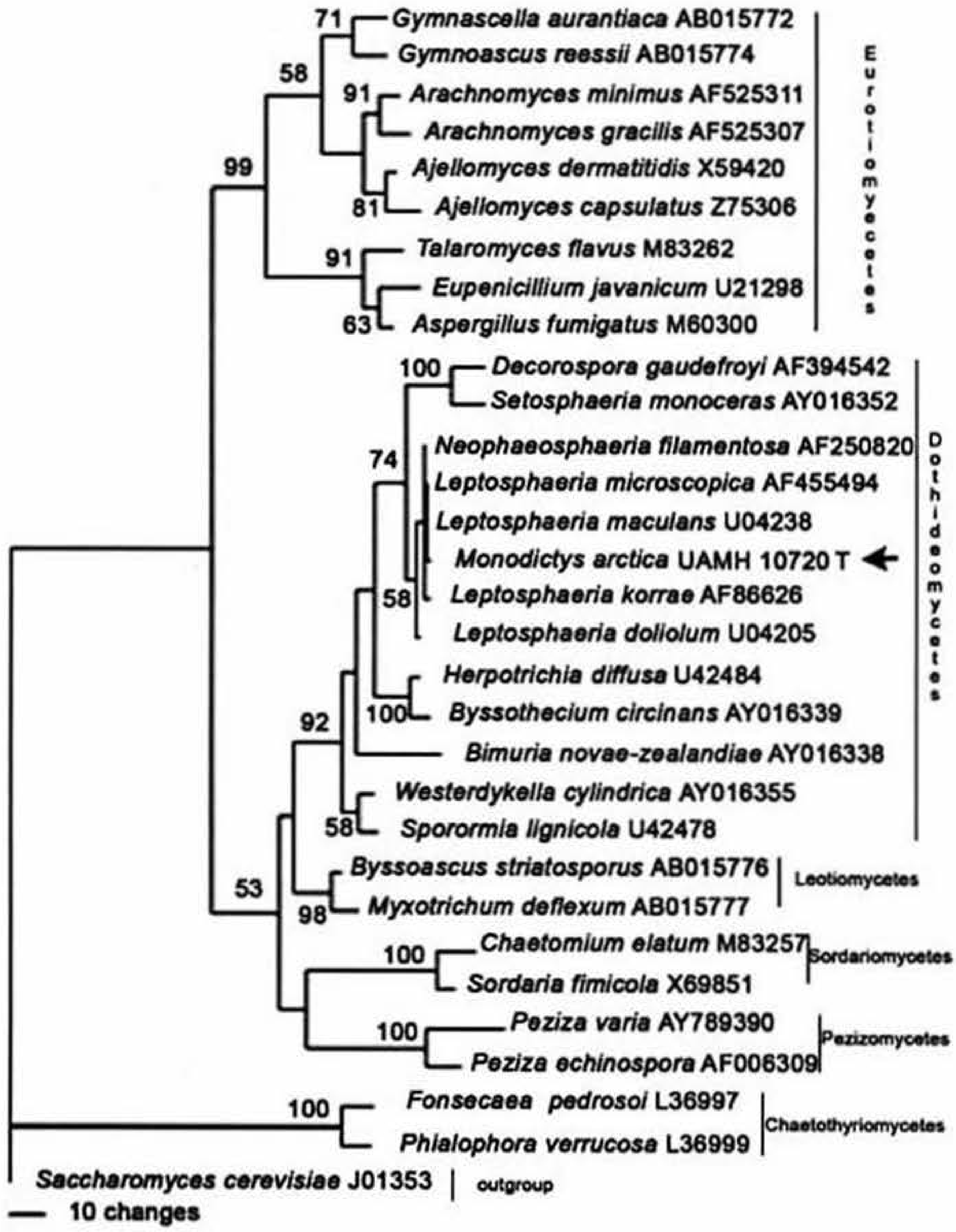


Fig. 11. One of 19 most parsimonious trees based on an analysis of the small subunit rDNA of *Monodictys arctica* and other ascomycetes. The CI = 0.612, RI = 0.752, and HI = 0.38. The outgroup was *Saccharomyces cerevisiae*. Bootstrap support in percentages (for 500 replicates) is shown on branches where support is greater than 50%. T signifies the ex-type strain.

conidia that arise from monoblastic conidiogenous cells. The absence of sporodochia and conidial chains distinguishes members of this genus from developmentally similar taxa (e.g., *Epicoccum*, *Alternaria* respectively) but the resulting group is heterogeneous and the genus needs re-examination and revision (Rao and de Hoog 1986, Rodríguez et al. 2001). *Monodictys arctica* is distinguished from others in the genus by having smooth, mostly irregularly shaped conidia that are occasionally branched. The conidia of *M. antiqua* (Corda) S. Hughes and *M. lepraria* (Berk.) M.B. Ellis are somewhat similar in being lobed (Ellis 1976) but are larger, up to 75 × 25 µm in *M. lepraria* and 100 × 50 µm in *M. antiqua*.

During conidium development in *M. arctica*, the conidiogenous cell swells and produces a transverse septum (Fig. 6) that delineates a basal cell (Wang 1990) (Fig. 7), which in turn produces one or two cells that serve as meristematic initials (Fig. 8). Meristematic initials are subsequently partitioned by septa that form on irregular, i.e., non-orthogonal, planes of division, but resultant cells ("meristematic cells," Fig. 9) enlarge so that the component cells of the mature conidium are similar in size. The basal cell persists in the mature conidium and is recognised by being less heavily pigmented than the more distal meristematic portion. This developmental sequence agrees with previous observations made by Hughes (1953) and Ellis (1971) on *M. paradoxa*. By observing longitudinal sections through the conidium, and the subtending conidiophore in *M. paradoxa* (Corda) S. Hughes, using transmission electron microscopy, Wang (1990) determined that conidiogenesis involved percurrent proliferation of the conidiogenous cell, which resulted in the formation of an inconspicuous annellophore. This process was not detected in *M. arctica* using light microscopy. We also did not see evidence of rhexolytic dehiscence or remnants of the conidiogenous cell forming a hilum (Samuels 1980). Further observations using ultrastructural techniques would be useful in clarifying the mode of conidiogenesis in our new species and similar observations across a range of species of *Monodictys* could be of value in clarifying the conceptual limits of the genus.

Analysis of SSU sequences places *M. arctica* within the *Dothideomycetidae*. Only two other species of *Monodictys*, *M. pelagica* (T. Johnson) E.B.G. Jones and *M. castanea* (Wallr.) S. Hughes, are represented by sequences in GenBank and these show affinities with the *Sordariomycetidae*. However, links between the Loculoascomycetes (sensu Barr and Huhndorf 2001) and *Monodictys* have been reported. For example, Samuels (1980) observed conidia resembling *M. putredinis* developing in cultures derived from ascospores of *Ohleria brasiliensis* (*Melanommataceae*). Unfortunately, there are no sequences for either *M. putredinis* or *O. brasiliensis* in GenBank.

Phylogenetic analysis of the ITS region suggests that *M. arctica* is quite likely the anamorph of a species of *Leptosphaeria*, a loculoascomycete genus known from a broad range of plants and habitats, but otherwise having pycnidial anamorphs (e.g., in *Coniothyrium*, *Diplodina*, *Haplosporella*, *Phaeoseptoria*, *Phoma*, *Scolecosporiella*, *Septoria*, and *Stagonospora*; Dennis 1981, Farr et al. 1989). Pycnidia were not observed in our cultures but conidial development

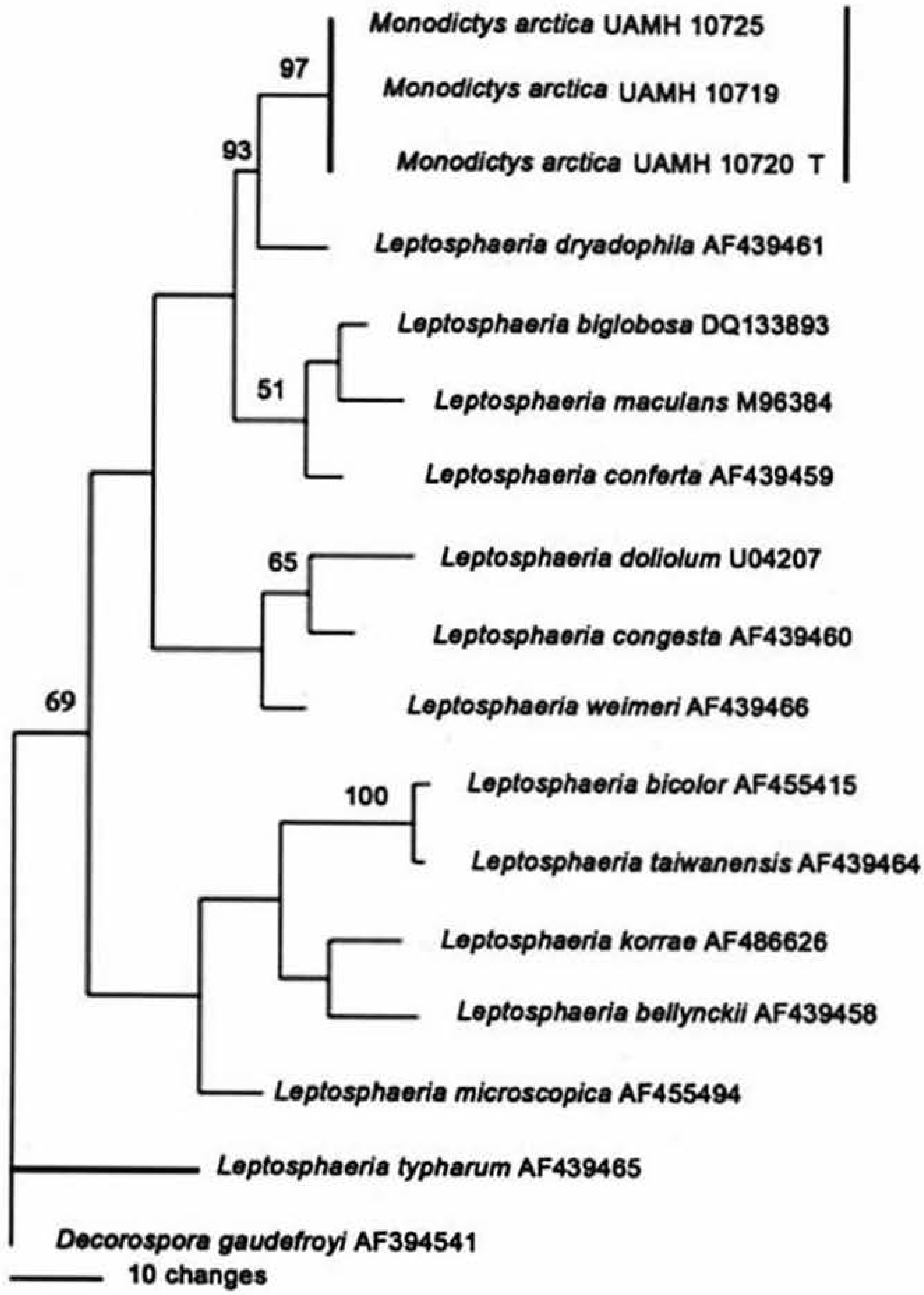


**Fig. 12.** The most parsimonious tree based on an analysis of the internal transcribed spacer region of *Monodictys arctica* and members of *Leptosphaeria*. The CI = 0.579, RI = 0.490, and HI = 0.721. The outgroup was *Decorospora gaudefroyi*. Bootstrap support (100 replicates) is shown on branches where support is greater than 50%. T signifies the ex-type strain.

in *Monodictys* resembles stages in the development of pycnidia by *Phoma* and *Asteromella*. Also, the *Monodictys*-like anamorph of *Tubeufia amazonensis* (*Tubeufiaceae*) often forms pycnidial locules bearing phialides and single-celled conidia (Samuels 1980). Finally, the formation of pseudoparenchymatous balls, reminiscent of large dictyoconidia, have been associated with the appearance of pycnidia and ascomata in *Leptosphaeria* (Samuels 1980).

The closest genetic match to *M. arctica* (94% similar to the ex-type strain, UAMH 10720) is *L. dryadophila* Huhndorf (≡ *Melanomma dryadis* Johanson). The close genetic similarity between these two species and the similar habitat, i.e., on subfrutescent perennial species native to arctic or alpine habitats, suggest these taxa might be sibling species but additional data supporting this supposition are missing. For example, it is unknown if *L. dryadophila*, which produces its ascostromata on the leaves and flowers of *Dryas octopetala* and *D. integrifolia* (Huhndorf 1992, Chlebicki 2002), is systemic and in the roots of these hosts. Furthermore, and as far as we are aware, an anamorph is unknown for *L. dryadophila*. Three other species of *Leptosphaeria*, i.e., *L. brachyasca* Rostr., *L. hyperborea* (Fuckel) Berl. & Voglino, and *L. oreophila* Sacc. (Connors 1967, Farr et al. 1989) have been reported from species of *Saxifraga* but neither cultural nor sequence data are available for these taxa.

Whether *M. arctica* inhabits root cortices in the same relatively harmless manner as other dark septate endophytes such as *Phialocephala fortinii*, *Leptodontidium orchidicola*, and *Scytalidium vaccinii*, all of which were among the isolates examined from the four angiosperm hosts, is unknown. Pattern of occurrence, i.e., in one of four plant species collected from within and outside the OTCs, suggests that host identity had a stronger influence than the experimental treatments. Direct examination of roots of *Saxifraga oppositifolia* infected with *M. arctica* is required to determine the colonisation pattern and whether the fungus is a pathogen or relatively harmless parasite. Furthermore, close inspection of host shoot tissues might indicate the presence of a previously overlooked loculoascomycete teleomorph similar to *Leptosphaeria dryadophila*.

## Acknowledgements

This work was supported by Natural Sciences and Engineering Research Council of Canada Discovery Grants to RSC and KNE. The authors wish to thank Michael Hertwig-Jaksch for the Latin diagnosis and Dr. Greg Henry at the University of British Columbia for logistical assistance and access to the site at Alexandra Fiord. The authors gratefully acknowledge Drs. Carol Shearer (University of Illinois) and Gary Samuels (BPI) for their comments on early versions of this manuscript.

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# Book reviews and notices

Compiled by

DAVID L. HAWKSWORTH[1]

*MycoNova, The Yellow House, Calle Aguila 12, Colonia La Maliciosa Mataelpino, ES-28492 Madrid, Spain*

## General

**MykoLibri: Die Bibliothek der Pilzbücher.** By Christian Volbracht. 2006. MykoLibri, Isestraße 79, D-20149 Hamburg, Germany (e-mail: mykolibri@aol.com). Pp. 528, col. figs and plates 450. ISBN Not indicated. Price: 140 € (normal edition), 220 € (special edition), 540 € (deluxe edition).

This had to take first place in this set of reviews. Christian Volbracht's journey on the road to becoming a mycobibliophile started with a copy of Werner Rauth's *Unsere Pilze* (Carl Winter Universitätsverlag, Heidleberg, 1951) he found on his grandfather's bookshelf. He started to collect, and then in 1974 met the Hamburg collector Joachim Schleimann who put him in contact with the natural history book dealers Wheldon & Wesley in Tring. Contacts with dealers in Amsterdam and Paris followed, and at an auction of some of Schleimann's rarer works in London in 1982, he also encountered the American collector Robert E. Machol, whose personal mycological library was legendary. Christian's collecting gradually developed into selling and exchanging, and evolved into an antiquarian bookselling business launched on the internet in 1996 – and so much more pleasurable than being a foreign correspondent.

What he has accumulated is truly amazing — to judge from this catalogue of his personal library, which treats over 3000 mycological books, manuscripts, and prints that appeared between 1481 and 1959. But this is no ordinary library catalogue. For each work the fullest bibliographical details have been compiled along with numerous notes, and interspersed with superb reproductions (mostly in colour) of 450 selected plates from them – including 90 that are

[1]Books for consideration for coverage in this column should be mailed to the Book Review Editor (address above) in the first instance. Fax (+34) 91 857 3640; e-mail: myconova@terra.es.

full-page. The paper used is Munken Pure, which is both a joy to handle and really does justice to the plates. It includes "all the Great fungal books as well as many considered rare ('rara'), very rare ('rarissima') or nearly impossible to find ('unfindables')" (p. v).

Although the text is in German, an English translation of the introductory sections is available as a tip-in.

Christian's love of mycological books exudes from every page, and this is surely destined to become one of the standard reference sources on mycological works that will be sought after by all mycobibliophiles. The idea of producing such a catalogue was probably inspired by the published catalogues of the personal mycological libraries of Schliemann in Hamburg (Uellner 1976) and Howard A. Kelly in Michigan (Kreiger 1924), but surpasses both those both in content and the splendour of the presentation.

The work comes in three editions: Deluxe (copies 1-25 with more than 20 original coloured plates), Special (copies 26-75 with one original plate), and Normal (copies 76-750). All are individually numbered and signed by the author using "Coprinus ink" prepared using Buillard's recipe of 1792. The price for the normal edition is very reasonable considering its size and quality, and this is a reference work all major mycological libraries should have, and all mycobibliophiles will treasure.

Krieger, L. C. C. (1924) *Catalogue of the Mycological Library of Howard H.Kelly.* Privately printed, Baltimore.

Uellner, W. (1976) *Fungorum Libri Bibliothecae Joachim Schliemann.* J. Cramer, Vaduz.

**Evolutionary Genetics of Fungi.** Edited by Jianping Xu. 2005. Horizon Bioscience, 32 Hewitts Lane, Wymondham, Norfolk NR18 0JA, UK (web address: www.horizonbioscience.com). [Distributed by Taylor & Francis, 2 & 4 Park Square, Milton Park, Abingdon, Oxfordshire OX14 4RN, UK.] Pp. viii + 350. ISBN 1 904933 15 7. Price: £ 99.

My initial reaction on seeing this title was, "surely there cannot be room for yet another book on fungal genetics". On looking at the list of contents and contributors, 19 all from North America or China, I realized that this promised to be more the type of introduction I would want to see being available to graduate students in particular, as it contains authoritative in-depth reviews from across the field.

Especially valuable is the first chapter on Molecular Systematics: Major fungal phylogenetic groups and fungal species concepts, by Jean-Marc Moncalvo, which ranges from the concept of the kingdom, the fossil record, molecular phylogentic systems, discussions on all major groups, and species concepts. Although the overall system is currently changing rapidly, this has references into 2004, including the results from the first major Assembling the

Fungal Tree of Life (AFTOL) paper. The second is something of a miss-fit on the Biodiversity and Biogeography of Higher Fungi in China, and while falling into the common problem of not defining the height of the fungi covered, has the purpose of exposing geneticists to broader issues on a regional scale, bud sadly hardly mentions lichen fungi except in the abstract. The chapter is also made difficult to read through totally inappropriate additions of author citations after scientific names – fortunately something emulated in only one other chapter.

The next five chapters consider biological concepts of vegetative self- and non-self recognition systems, provide a succinct and valuable review of methods of molecular population genetic analysis, and then contributions on population genetics in "Phycomycetes" (a very dated word for a chapter title which I was shocked to see at all in an otherwise forward-looking work), human and animal pathogens, and basidiomycetes. The basidiomycete chapter only considers macromycetes, and also has much on *Cryptococcus neoformans*, and it would have been good so see something of the elegant work on rusts, *Ophiostoma*, and *Phytophthora*.

The closing four chapters are all special and focus on topics meriting modern reviews: on mitochondrial inheritance and evolution, a scholarly account by the editor and Zhuan Yan; the evolution of drug resistance in human pathogenic fungi by Theodore C. White and colleagues; spontaneous mutations in fungi by Clifford Zeyl; and *Cryptococcus neoformans* as a model for studying signal transduction systems by Ping Wang and Deborah S. Fox.

While the book would have benefited from paying more attention to work on plant pathogens and the fascinating work on endomycorrhizal signalling, and more rigorous editing, it merits wide use in courses on fungal biology and evolution. Sadly, the unreasonably high price will place it beyond the pockets of the tertiary students that would most benefit from it, and further means that the important reviews it contains will not be as frequently cited as it merits. Perhaps the publishers could consider releasing a soft-cover edition . . .

**100 Years of Fungal Biodiversity in Southern Africa.** Edited by Pedro W. Crous, Michael J. Wingfield, Bernard Slippers, Isabella H. Rong & Robert A. Samson. 2006. Centraalbureau voor Schimmelcultures, P.O. Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [Studies in Mycology No. 55.] Pp. 305. ISBN 10: 90 70351 62 5, 13: 978 90 70351 62 5. Price: 65 €.

This volume stems from the centenary celebrations of the National Collection of Fungi (PREM) in Pretoria, South Africa in 2005, which now holds almost 60 000 collections. The collection was initiated in 1905, when South Africa was a British colony, after the Boer War (1899-1902) with Pole Evans (1879-1968). But it was Ethel Mary Doidge (1887-1965), first appointed as Evan's assistant that was the force behind its' growth, and whose monumental synthesis of what was known on all fungal groups from the region (Doidge 1950) remains a classic and much used work; it treated 4748 species, and is now available online through CBS (www.cbs.knaw.nl/mycoheritage). Isabella Rong and Alice Baxter document the growth with numerous old photographs, and its role in key work on plant pathogens in details. But just how large is the southern African mycobiota? Ten specialists on different groups combine forces to provide an estimate, coming up with a conservative 200 000, excluding those associated with the enormous insect diversity in the region.

Eighteen original papers follow the introductory duo, mainly focussing on molecular phylogentic studies on plant pathogens, but combining that data with critical morphological investigations. And — as might be expected from the foregoing — many scientific novelties. Appropriately, and in keeping with the model of the CBS centenary volume (*Studies in Mycology* **50**(1-2), 2004[2]), these number 101, including one new family (*Quambalariaceae*), ten new genera, 37 new species, one new form, and 52 new combinations. All these cannot be enumerated here, but can be seen and downloaded as pdf files free of charge from the CBS website. Of most widespread interest are three new segregate genera from *Cryphonectria, Mycosphaerella* and other fungi on *Eucalyptus,* the re-instatement of *Ceratocystiopsis, Calonectria* species and their *Cylindrocladium* anamorphs, a new generic system for *Botryosphaeriaceae*, and new taxa found on endemic plants. All contributions are well illustrated by line drawings and generally superb micrographs, many in colour.

The mix of history and cutting edge systematic mycology, is a fitting tribute to the centenary, and holds promise of more exciting achievements, not least through the close association PREM enjoys with FABI (Forestry and Agricultural Biotechnology Institute, University of Pretoria).

Doidge, E. M. (1950) The South African fungi and lichens to the end of 1945. Bothalia 5: 1-1094.

**La Biodiversità dei Funghi del Parco: Inventario della flora micologica del Parco Naturale Migliarino San Rossore Massaciuccoli.** By Paolo Franchi, Manuela Giovannetti, Luca Gorreri, Mauro Marchetti & Giovanni Monti. 2006. Felici Editore, Via Carducci 64/C, I-56010 Ghezzano (Pisa), Italy (e-mail: felici@felicieditore.it). [I Libri di Leonardo.] Pp. 360, illustrated. ISBN 88 6019 032 0. Price: 30 €.

The fungi of this 23 114 ha regional park to the west of Pisa have been studied for some two centuries, and this work compiles and presents that data using literature and specimens preserved in museums and other institutions. The park includes extensive coastal dunes, and several woodland types. Bearing in

[2] Reviewed in *Mycotaxon* 92: 470-471 (2005).

mind that even though lichen-fungi are omitted and only ten anamorphic fungi are listed, the total of 1485 taxa is particularly impressive. Dung fungi and burnt areas have had particular attention, the former due very much to studies by Franceso Doveri, a leading authority on these[3]. The species entries include full information on collections with dates and the person making the determination, ecological information, and for some rarer species also descriptions. The arrangement follows the current edition of *Ainsworth & Bisby's Dictionary of the Fungi*, and I was pleased to see the system of citing dates of publication after author citations after all accepted names adopted. However, I was unsure why the new generic system for most species formerly referred to *Coprinus* was not adopted or discussed. Two new combinations are made: *Clavulina coralloides* f. *mutans* (syn. *C. mutans*) and f. *subcinerea* (syn. *C. cristata* f. *subcinerea*). Fine colour photographs, some of microscopic characters, make the book a pleasure to look through; some are of frequent species, but many of ones not or rarely figured in field guides (e.g. *Agaricus ossecanus, Coprinus cothurnatus, Peziza subumbrina, Plectania melastoma, Ramaria broomei, Volvariella murinella*). This is a most carefully executed work, and provides a basis on which to build to approach a full inventory of the fungi of this clearly important mycological site.

**Hongos, Líquenes y Briófitos del Parque Nacional de la Caldera de Taburiente.** Edited by Esperanza Beltrán Tejera. 2004. Ministerio de Medio Ambiente, Madrid, Spain. Pp. 504. [Organismo Autónomo de Parque Nacionales, Serie Técnica.] ISBN 84 8014 570 6. Price: Not indicated.

This book is the output from a project started in 1998 to inventory the fungi (including lichens) and bryophytes of this 3500 ha national park, which occupies the volcanic crater on the summit of La Palma, one of the Canary Islands. There is also a wealth of background information on the vegetation, with habitat photographs and phytosociological units, geological maps, and climatic data. For each section a similar format is adopted: a review of earlier reports, lists of sites visited (118 for non-lichenized fungi, and 139 for lichenized and lichenicolous ones), methods of study, information on habits, and then the species accounts. The latter include brief descriptive information, ecological notes, comments on world distribution, and indications of which of any of the Canary Islands the species is also known. Colour photographs are included for several species, and distribution maps of each within the park are collected together in the penultimate section. As the species are, thankfully, presented alphabetically, the sections close with a systematic arrangement of the accepted species. Author citations are omitted from the main lists, something I applaud,

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[3] See the review of Doveri's book in *Mycotaxon* 90: 220-221 (2004).

but they do feature in the systematic arrangements, the reason for which escapes me! The editor is the lead author on the main fungus section, which includes 259 species, mostly slime-moulds and macromycetes, of which 103 are new to La Palma, and 42 new to the Canary Islands as whole. This is clearly hardly more than the tip of the iceberg, but a valuable start and emphasising from the new records that it is an important site for fungal conservation and diversity in the Canary Islands. Consuelo Hernández Padrón is first author on the section on lichens, which is certainly more complete, as it was 264 lichen species, and 26 of lichenicolous fungi: I suspect co-author Javier Etayo Salazar was responsible for the last relatively large figure. There are lists of common names of both plants mentioned and also for the fungi (including lichens), an integrated comprehensive bibliography, and an index listing taxa by binomials and by species epithets. It is hardbound, well laid out, carefully edited, and makes extensive use of colour in charts and diagrams as well as photographs. That this work has been published at such a high standard by the Spanish ministry for the environment is another indication of how highly the ministry regards the biodiversity and conservation of fungi (including lichens).

**Biodiversitá nel Senese: Flora macromicetia nel XX secolo.** By Claudia Perini, Carla Barluzzi, Angela Lagana & Elena Salerna. 2004. Accademia del Fisiocritici Onlus, Piazetta Silvio Gigli 2, I-53100 Siena, Italy (e-mail: fisiocritici@unisi.it). [Memorie No. 11.] Pp. 335. ISBN: Not indicated. Price: 20 €.

This work brings together records of macrofungi, both larger basidiomycetes and larger ascomycetes, made in the Siena area over the past century. It is based on compilations from the literature and specimens preserved in SIENA and other collections and has been made possible through the help of "amateur" and professional mycologists. The total number of taxa reported is 1314, of which 161 have not previously been published. The list is arranged alphabetically, regardless of group, and for each species references to localities and sources are provided, whether literature or preserved collections. Synonyms are not given in the list itself, but ones used in the area are presented in an Appendix; another Appendix gives fuller locality details with map references and latitude/longitude coordinates for 318 sites listed. This carefully prepared compendium will be of considerable help to all wishing to determine macromycetes in the Siena region or ascertain whether species they have collected are already known from the area.

**Checklist of Fungi in Panama: preliminary version.** By Meike Piepenbring. 2006. Estafeta Universitaria, Universdidad Autónoma de Chiriquí, Código Postal 0427, Provincia de Chiriquí, República de Panamá (e-mail: puentebiol@unachi.ac.pa) [order from Meike Piepenbring, Department of Mycology, Instititute 1, Building D, J. W.

Goethe Universität, Siesmayerstraße 71-73, D-60323 Frankfurt/M, Germany (e-mail: piepenbring@em.uni-frankfurt.de).] [Puente Biológico Vol. 1.] Pp. 190, 45 coloured figs. ISSN 1991-2986. Price: 16 €, US$ 20.

This first checklist for the fungi of Panama, a country which the author has been visiting regularly since 1994, is based on a study of some 300 publications including around 3330 records, accepts approximately 1810 taxa in 646 genera. Listing fewer species than are known from one individual site in the UK, it is not be construed as an inventory of the mycobiota of Panama, but a background for future research in the country. I was pleased to see all "fungal" groups covered, including myxomycetes and lichens, though I was sad to see archaic categories such as "Ascolichenes" and "Basidiolichenes" employed rather than being integrated into the *Ascomycota* and *Basidiomycota* sections, respectively. For each species, information on ecology (including host plants), and/or growth form, provinces from which records came, and literature sources, are included. Species first described from the country are highlighted. This has been a painstaking work to compile from so many sources, and provides a landmark publication for all future mycological recording in Panama. It will certainly stimulate me to try and make time to work-up the collections I made there in 1995!

## Basidiomycetes

**Checklist dei Funghi Italiani / Checklist of Italian Fungi. Basidiomycetes. Basidiomycota.** Co-ordinated by Silvani Onofri. 2005. [Organization for the Phyto-Taxonomic Investigation of the Mediterranean Area. Commission on Fungi. Publication No. 1.] Carlo Delfino Editore, Via Caniga 29/B, I-07100 Sassari, Italy (e-mail: info@carlodelfinoeditore.it). Pp. 380. ISBN 88 7138 387 7. Price: 40 €.

This checklist is the first comprehensive listing of the basidiomycetes of Italy for almost a century. It covers 3889 species in 439 genera, and also includes several hundred infraspecific taxa. For each of the included taxa, the name and author citation are provided, along with recently used synonyms. Citation of sanctioning is not consistent – that by Fries is omitted, but that by Persoon is indicated. Notes are provided for 'critical' species, where delimitation is uncertain or problematic against other taxa. The Introduction states that 31 taxa are endemic. A list of these would have been useful; I could only find *Pleurotus nebrodensis* from Sicily indicated as endemic in the text. In addition, 17 exotic taxa are noted, although a few undoubted exotics (such as the *Eucalyptus* associates *Hydnangium carneum* and *Setchelliogaster tenuipes*) are not flagged as such. There is no index but entries are conveniently arranged alphabetically by genus and species. Introductory material in Italian and English explains the scope and production of the work, including the legislative framework for the accumulation of information on fungal names and distribution. Production of the checklist was supported by the Italian Ministry of the Environment. The *Ustilaginomycetes* and *Urediniomycetes* are to be dealt with in future volumes, along with the *Ascomycota*.

For each entry, the largest component is the information on distribution, which is given for the 20 regions of Italy, from Trentino-Alto Adige to Calabria, as well as Sicilia and Sardegna. For each region in which the fungus occurs, one or more sources are indicated. Sources include published or unpublished lists or herbarium material. Unpublished lists are a mix of those compiled by individuals or groups, and the indication of these takes a little getting used to. It helps to know that "AMB" is Associazione Micologica Bresadola, and that some rather cryptic entries such as "AMB (Gr. Mic. B.Cetto di Mestre-VE), 1999" are in fact references to published articles in the Bibliography, which is comprehensive and contains 893 entries.

Some 295 species are indicated as rare or otherwise at risk. For 96 species details are provided of Italian national and regional laws relating to harvesting and marketing of fungi. It is noted that there are currently no specific regulations concerning the protection of rare and threatened taxa, and that the checklist will provide the basis for creation of a Red List to promote the protection of threatened fungi and their habitats.

The work is very much a joint effort. Eleven mycologists are acknowledged on the title page, and data collation was under the direction of a national co-ordinator, five area co-ordinators, and 17 regional data collectors. The several pages of acknowledgements further attest to the way that the publication draws on numerous groups and more than 170 individuals, particularly for the lists of species from various localities that underpin the detailed information on regional distribution provided for each entry. This collaborative approach is commendable in engaging the wider mycological community, professional and amateur, and in effectively collating a massive amount of data: the regional lists are based on integration of 22 500 discrete records.

Standardisation of nomenclature and taxonomy was also achieved by the participation of a number of contributors, each responsible for particular genera or groups of genera. The source for nomenclature (which also provides the generic placement) is indicated for each entry. The most commonly cited sources are the 1994 *Guide des Champignons de France et d'Europe* of Courtecuisse & Duhem, and the 1999 Dutch checklist (*Overzicht van de Paddestoelen in Nederland*) of Arnolds and collaborators. Nomenclature also draws heavily on the on-line *Index Fungorum* database and the *CBS Aphyllophorales Database*. The generic placements adopted are on the whole up-to-date, including such recent changes as the sinking of *Rozites* in *Cortinarius*. Where current revisions are not followed, as in the retention of a wide circumscription for *Collybia*, at least the alternate names, in this case in *Gymnopus* and *Rhodocollybia*, are referred to in synonymy. Similarly, *Neolentinus lepideus* is retained in *Lentinus*, but the correct genus is given as a synonym. There are, however, some exceptions to adoption of current taxonomy, due to use of source checklists that were published prior to significant revisions of particular groups. Examples are *Coprinus*, *Omphalina* and *Phellinus*, where no reference is made to recent combinations for many species in segregate genera such as *Coprinopsis*, *Arrhenia* and *Fomitiporia* respectively. Use of predominantly European sources for names of exotic fungi means that some correct placements are occasionally overlooked, such as that *Hymenogaster albus* belongs in *Descomyces*. Adoption of *Alnicola* (as frequently used in continental Europe) instead of *Naucoria* (as used by Singer in the *Agaricales in Modern Taxonomy*, and in the 2005 *Checklist of British & Irish Fungi*) highlights a long-running discrepancy, which does need to be sorted out, perhaps by conservation of one or other name. Epithets adopted for species are also, on the whole, up-to-date, as with the use of *Volvariella gloiocephala* for *V. speciosa*; although *Bolbitius vitellinus* is used instead of *B. titubans* (which has the earlier basionym). There are also a few slight discrepancies against other checklists in the spelling of epithets, such as use of *Agaricus campester* and *A. xanthoderma* (more familiar as *campestris* and *xanthodermus*). I noted only one typo, *Lyophyllum* "*eucalyptium*" for "*eucalypticum*".

This checklist is a valuable addition to the growing number of comprehensive checklists of various regions of Europe, such as the *Checklist of British and Irish Basidiomycota* by Legon & Henrici[4] and the *Checklist of Polish Larger Basidiomycetes* by Wojewoda[5] [reviewed *Mycotaxon* 94: 379-80], both published in 2005. Given the high degree of overlap in the taxa included in such checklists, there is great potential for standardisation of names. Standardisation would be particularly useful when integrating other data such as on distribution, ecology, conservation status or molecular sequences. Differences in names adopted, such as mentioned above, are often trivial, but even slight differences in spelling can be a nuisance when attempting integration of data. It would be interesting in the first instance to carry out data matching across the growing number of checklists for basidiomycetes of European countries to determine the degree of mismatch in names, and the source of mismatches (whether nomenclatural or taxonomic). A collaborative approach to clarifying and removing discordant names across Europe would be a worthwhile exercise, and would be a good model for such an exercise on a global scale.

There is no indication that the *Checklist of Italian Fungi* is to be made available electronically, but this would be another useful project, especially if the copious distribution information could be shown as maps, and if particular regions could be queried for lists of the fungi present.

[4] Reviewed in *Mycotaxon* 96: 336-342 (2006).
[5] Reviewed in *Mycotaxon* 94: 379-380 (2005).

This work will provide the standard for recording basidiomycete fungi of Italy and will be a great stimulus for expanding distribution information at the regional level. The co-operative approach, using numerous contributors, with the support of a government environment agency, is a model that could well be applied to other regions.

Tom W. May
*Royal Botanic Gardens Melbourne, Private Bag 2000, South Yarra*
*Victoria 3141, Australia*

**Il genere *Cortinarius* in Italia.** By G. Consiglio, D. Antonini & M. Antonini. 2003-2005. 3 vols. Associazione Micologica Bresadola, Via Alessandro Volta 46, I-38100 Trento, Italy. ISBN Not indicated. Price: 50 € per vol.

Three volumes of the impressive publication *Il genere* Cortinarius *in Italia* have now been published by these authors. Although Carls Diego reviewed volume one in an earlier issue of *Mycotaxon*[6], now that the whole work is available, this review considers all three volumes in more detail.

Each volume consists of a neat solid ring binder with several loose four-page inserts. Volume one and two fit together in one binder. Each volume has an introductory chapter on general aspects of the genus *Cortinarius*. The first volume summarises the infrageneric classification of Moser's *Die Gattung* Phlegmacium (GP), and the two contemporary *Cortinarius* mycobiotas, Cortinarius *Flora Photographica* (CFP) by Brandrud et al. and *Atlas des Cortinaires* (AdC) by Bidaud et al. Furthermore, it contains a chapter on secondary metabolites (colour pigments, toxic substances, etc.) found in or possessed by species of *Cortinarius*. Volume two has a chapter on mycorrhizal associations and population structures. Volume three has a chapter explaining the methodology used to assess the distribution of spore sizes. Furthermore, an infrageneric classification is introduced, and subgeneric separators for organising the species are provided. Several of the introductory chapters are equipped with extensive literature references. Each volume has a table with the classification of each species according to both CFP and AdC, and a growing list of *Cortinarius* literature.

The main body of each volume is 50 species portraits which are spacious and comparable to those presented in other Italian mycological publications (e.g. Sarnari's monograph of *Russula*). Each species is presented on four pages and headed by the species name with full author citations, the place of publication, the type specimen and its location. A list of synonyms is presented, and the systematic placement of the species given according to each of the classification schemes in the works mentioned above (CFP, AdC and GP). The full original

[6] Reviewed in *Mycotaxon* 89: 512 (2004).

Latin diagnosis is reproduced followed by a translation in Italian, bibliographic references, and the etymology of the name. The description of the species follows the subheadings, *Capello, Lamelle, Gambo, Carne, Microscopia, Habitat*, and a list of specimens. A taxonomic discussion finishes each presentation. Four illustrations are presented on the facing pages of the spread. On the left page a SEM spore picture is presented as well as a composite illustration with the geographic distribution of the species in Italy (volumes one and two) and six spores representing the extremes according to the methodology introduced in volume three. On the right page, two colour photographs of the species in its natural habitat are presented.

At first glance the publication has the appearance of a cornerstone in cortinariology. Although, the publication contains a lot of valuable information, I find at the same time that it presents several problems.

**Introductory chapters**

The idea of presenting several aspects of the biology of these interesting fungi is good, as taxonomists all too often work in a "classification vacuum", ignorant of ecological information, etc., and *vice versa*. The chapters on chemistry, ecology and spore statistics are very detailed and interesting reviews for the inclined. The essence of these chapters could have been boiled down to allow for other more urgent things to be presented (e.g. methodology, species concepts, morphological characters). An interesting addition to the chapter on the competing classification schemes in *Cortinarius* would have been a more analytical comparison instead of a simple list of infrageneric taxa. Volume three introduces a subgeneric classification and discusses this in light of recent molecular phylogenetic findings. Somewhat pragmatically, the authors settle on a taxonomy with seven subgenera, *Cortinarius, Myxacium, Phlegmacium, Rozites, Dermocybe, Telamonia* and *Leprocybe*, of which only two are potentially monophyletic. The choice of not introducing a completely new infrageneric taxonomy is wise as our present phylogenetic (and morphological) knowledge of the whole genus is still very scarce. The concept is not far from either of those applied in CFP and AdC and the groups are thus not too unfamiliar for most cortinariologists.

The chapter in volume three on the statistical treatment of spore measurements is very interesting. Most taxonomists treat spore length and breadth as independent of each other, and calculate mean value and standard deviation for each separately, which is intuitively wrong. Thus, the authors assume that the length and breadth of spores co-vary, which gives perfect meaning. The presented and applied statistical methodology results in an "ellipse of isoprobability" which encompass 68 % of the actual observed spores, minimum and maximum measurements of length, breadth, and spore quotient (length/breadth). An Excel sheet with the relevant operations is available from the authors. Others have employed a comparable but less rigorous methodology simply by drawing an ellipse on a spore scatter diagram. Despite the inherent lack of repeatability and statistical rigour of this last free-hand method, it might be more explicit in identifying (and excluding) obvious aberrant spores, which would otherwise be included in the calculations.

The huge bibliographic lists are useful as it is often impossible to get an overview of relevant literature for this big genus. Many obscure publications have found their way into the list, which, however, still lack many publications to be exhaustive. I can only complement the effort to try to collect all these references in one publication.

**Species portraits: Text**

In general I find the species presentations pleasant, and with the sheer amount of paper used for each species the layout escapes the appearance of being too crowded. I like the full author citations with publication year. A small inconsistency is that some of them lack the year of publication. As the nomenclature of *Cortinarius* is full of inconsistencies and ambiguities, the full citation is preferable for accuracy. The citation of types is likewise a nice inclusion. Whether the authors actually have studied the types is unclear. To me it seems that the location of types is simply copied from the protologue, so it is, for example, up to the reader to find out where the types of Robert Henry and Marcel Bon are now (they are in Paris and Lille, respectively). Several Henrian types, which are lost, are cited as if they were available for study.

The list of synonyms is often very short, something that partly may reflect the relatively narrow species concept adopted in the major part. But even some "obligate" synonyms have been omitted, e.g. *C. cupreorufus* under *C. orichalceus*. Synonym lists in taxonomic treatments of *Cortinarius* are often flowing over with "*sensu*"-names, which can be relevant but are often very space consuming. This practise is not carried out except in a few instances (e.g. under *C. catharinae*, *C. colymbadinus*, *C. eucaerulescens*). The reason for including/excluding this information in each case remains somewhat obscure.

The indication of the systematic placement of the species in CFP, AdC and GP can be valuable for quick reference purposes, but seems somewhat superfluous as the information is given collectively for all species in tabular form in the introduction. In the portraits, the placement is given with all the infrageneric taxa (and their synonyms) and with full author citations. In several instances this may take up a third of a page -- I find this somewhat redundant and visually disturbing. Several of the presented species have been treated in CFP, AdC and/or GP, and some of the subgeneric placements must thus be at the authors' own expense. For example, *C. caroviolaceus* (portrayed as *C. rapaceus*), a species with morphological and phylogenetic affinities to species in sections *Calochroi* and *Fulvi*, would not be placed in section *Caerulescentes* by Brandrud et al., and *C. vitellinopes*, *C. cephalixus* and *C. subcephalixus* would not be placed in section *Phlegmacium* (rather than *Elastici*). Several species are indicated to be placed in section *Laeticolores* in CFP – a section that CFP does not use.

The citation of the full original diagnosis can be of value for taxonomically inclined readers as these are often difficult to access. I assume that most native Italians are fully capable of understanding the Latin diagnoses, and the usefulness of the word-to-word translation in Italian is unknown to me.

The species descriptions are relatively brief and include general aspects as well as diagnostic characters, and in most cases they characterize the species adequately, and are comparable to those in CFP and AdC. Macrochemical colour reactions are left out except for reactions with alkaline substances in the context and on the pileus. Some cortinariologists will miss the reactions with, for example, Lugol's solution and guaiac.

The taxonomic discussion concluding each species portrait is the most important paragraph for the active user of a publication like this. In many cases the text is clear and informative, and delimitations from similar accepted taxa are clear. But in many instances I find the choice and number of "similar" species insufficient, as in the following examples: the discussion under *C. elegantior* states the delimitation towards *C. quercilicis*, whereas the discussion of the species portrayed as *C. eufulmineus* (which in my opinion is *C. quercilicis* -- also sensu CFP and AdC) carries no reference to *C. quercilicis*. The three portraits, *C. cephalixus* var. *subopimatus*, *C. subcephalixus* and *C. vitellinopes* are similar, and neither of the taxonomic discussions carry references to the two other. In a few discussions the characters mentioned are in clear contradiction with the illustrations and/or descriptions, for exazmple *C. cedretorum* is (like in most other treatments of this taxon) stated to have a more thoroughly blue colouration in the context than *C. elegantissimus* -- a fact contradicted by the chosen illustrations of the two species.

**Species portraits: Illustrations**

First I have to complement the colour photographs. Two representative photos of each species (of which several are rarely illustrated) is an important contribution to the documentation of the genus. Most show a sufficient number of fruit bodies and the important characters, and in most cases the pictures complement each other well. The reproduction of colours is generally very good. All photographs are taken with direct flashlight, which makes the exposures more uniform and thus the pictures easier to compare. It also gives some annoying reflections from moist and/or glutinous surfaces (pilei, stipes, leaves, etc.), and in most cases some hard shadows. As the publication is meant as a *Cortinarius* mycobiota of Italy, I find it a shame that the distribution maps have been left out in volume three. Scanning electron microscopy (SEM) pictures of so many species is again an important contribution to the documentation of the genus. Although the SEM pictures are of variable quality, most of them are good. The spore drawings present six spores. These are not actual spores but represent the extremes as calculated by the method mentioned above. In practice, only one spore has been drawn and subsequently manipulated to fit the extremes. Thus, no variation in the ornamentation and relative proportions is shown. The method is probably just as illustrative as the selection of six representative spores. In volume three, the ornamentation of the six spores has been abandoned. Instead six plain spores illustrating the extremes are shown complemented by two ornamented spores of median size, one seen in lateral view, the other in ventral view showing the suprahilar plague. In all illustrations the suprahilar plaque appears completely smooth, which is unsupported by the SEM pictures. The reproduction of spore-ornamentation in drawings is a precarious matter. The ornamentation is often represented more minute and/or detailed than the light microscope allows (and often more than the SEM pictures indicate). In a few cases clear contradictions between drawings and SEM micrographs is seen, especially when comparing several taxa (e.g. compare the SEM pictures and spore drawings of *C. vitellinopes*, *C. subcephalixus* and *C. cephalixus* var. *subopimatus*).

**Taxonomy**

The infrageneric concept applied corresponds more or less to that used during the last century, and is as such familiar to most users.

The delimitation of *Cortinarius* species is a difficult matter. The extent of phenotypic variation has been little tested (e.g. with mating studies, molecular phylogenetics). Thus, species have been delimited based on a subjective evaluation of morphological characters. CFP and AdC probably represent the two extremes of species concepts, i.e. a broad *versus* a narrow concept. The application of names is also difficult, and as many, especially older, names often are difficult to interpret, it is at many times a matter of taste. The choice of species concepts and names lies between CFP and (closest to) AdC. Generally it seems that the authors simply choose between the names applied in CFP or AdC.

Personally, I disagree with the naming and/or circumscription of some of the taxa within the groups I am familiar with (i.e. *Phlegmacium s. lat.*). From the pictures and the descriptions alone I have several comments, and furthermore I have had the pleasure of studying several of the portrayed collections. Below is a brief discussion of my major points of disagreement.

The upper picture of *C. boudieri* is *C. terpsichores*. The lower picture of *C. catharinae* is *C. platypus*. Both pictures of *C. eufulmineus* (which is most likely a synonym of *C. alcalinophilus*) are *C. quercilicis* (also *sensu* AdC/CFP). The lower picture of *C. frondosophilus* is *C. ochraceopallescens*, and the upper is uncertain (and perhaps *C. haasii*). The species depicted as *C. glaucopus* (which in my opinion is a coniferous forest taxon) is most likely *C. magicus*. The lower picture of *C. molochinus* (a synonym of *C. nymphicolor* in my opinion) is *C. parasuaveolens*, whereas the upper probably is *C. suaveolens*. *C. aurilicis* (which is an independent species) is depicted as a variety (var. *bulbopodius*) of *C. nanciensis* contrasting with the otherwise narrow species concept applied. A putative variety of *C. odoratus* (var. *suavissimus*) is depicted, which in all respects corresponds to the type variety. If *C. olivascentium* is accepted as the right name for the species portrayed as such, *C. xanthochlorus* should have been included as a synonym. The species depicted as *C. rapaceus* (which I perceive as a *nomen dubium* that has been applied to several species) is *C. caroviolaceus*. The species portrayed as *C. subfulgens* (i.e. *C. olearioides*) is most likely *C. claroflavus* (or another species containing phlegmacin pigments). *C. russeoides* is a junior synonym of *C. mussivus* in my opinion. At least the upper picture of *C. velicopia* is *C. barrentium* (a species that may have an older name). The lower picture of *C. violaceipes* is *C. haasii*, whereas the upper is uncertain (perhaps *C. lilacinovelatus* or *C. platypus*). The species portrayed as *C. viridicaeruleus* is *C. subhygrophanus*.

Several taxonomic novelties are presented in the publication. I take the opportunity to comment on some of these within subgenus *Phlegmacium*. *C. turbinatioides* is described as a new species having a more or less brownish cap and pale lamellae and is thus placed in section *Claricolores* (i.e. *Multiformes*). I have had the pleasure of examining the type, and molecular data (unpubl.) give a 100 % ITS sequence match with *C. flavovirens*. And as the illustrations do not plead against conspecificity, I suggest the name *C. turbinatoides* be treated as a junior synonym of *C. flavovirens*. *C. appennini* is described as a new species in section *Glaucopodes*. I find that the species in all respects correspond to the description of Moser's *Phlegmacium avellanocaeruleum*. The authors also state this taxon is the most closely related, and mention some points of dissimilarity, but it is uncertain whether the authors actually accept the existence of two separate taxa. *C. subcephalixus* is described as a new species in the *C. cephalixus*/ *C. olidus* group. The description and discussion, however, leave the delimitation from similar taxa somewhat uncertain as indicated above.

Unfortunately, I don't feel capable of commenting in detail on the taxonomy of other groups (i.e. *Telamonia*, *Leprocybe*, *Dermocybe*, and *Myxacium*).

**Methodology**

I miss clearly stated methodologies. The only explicitly stated method is that of spore measurement in volume three. In the descriptions the number of spores and collections is mentioned. Following is a discussion of some of the most important things I find missing. Which collection does the SEM picture relate to? In cases of taxonomic uncertainty this information is obligatory for future use. And, importantly, how were the spores measured? Were they taken from deposits or lamellae? Were they measured in $H_2O$, KOH, or something else? Were only mature and normally developed spores measured? The table on page 34 of volume three with 100 spore measurements indicates that the authors are able to measure with a precision of one tenth of a micron – what method allowed for this? When this information is lacking, the measurements will be impossible to compare to one's own. Judging from the measurements that are generally more variable and larger than mine, it seems that spores were taken from the lamellae. When working with a group of fungi that allows for measurement of only mature spores (i.e. deposits on the cortina), it is not necessary to work with potentially atypical/immature spores. When the rest of the methods are obscure, the rigid statistical method employed becomes irrelevant in my opinion.

**Conclusions**

The publication is not expensive compared to other mycological publications, and despite my reservations, it presents a lot of data that has never been gathered in one place before. *Cortinarius* is a difficult genus, and the publication is an important contribution to the knowledge of the genus in Italy, where the group has received little attention in recent times. The publication presents some interesting chapters on ecology, etc., and fine portraits of rarely illustrated species (e.g. *C. moenne-loccozii*, *C. subhygrophanus* (as *C. viridicaeruleus*), *C. subalbescens*, *C. natalis*).

TOBIAS G. FRØSLEV
*Department of Microbiology, Institute of Biology*
*Øster Farimagsgade 2D, DK-1353 Copenhagen K, Denmark*

**Los políporos (Basidiomycetes) de los Bosques Andino Patagónicos de Argentina.** By Mario Rajchenberg. 2006. J. Cramer in Gebrüder Borntraeger, D-14129 Berlin, Stuttgart, Germany. [Bibliotheca Mycologica No. 201.] Pp. 300, figs 68. ISBN 3 443 59103 5. Price: 84 €.

How can the polypores contribute to our understanding of fungal biodiversity? Even though historically regarded as among the most known and worked groups in the *Fungi* (due the obvious macroscopic characters), they are amongst the least studied forest organisms from ecological/physiological approaches. Reminding us that new poroid species still have to be described, the picture presented here suggests this is a fertile field for exploration in the future.

Mario Rajchenberg has worked intensively since 1991 on Andean Patagonian forests, compiling published data from other researchers, and combining that with his own, in this book on polypores. These forests grow in a very special area in terms of climate, altitude, and humidity, and so sustain a particular mycobiota. So special is the area, that Rajchenberg's name is linked to the majority of included taxa, amongst them, nine species new to science, and thirteen new combinations. He also found 35 % of the species were endemic to the area, and many others are rare elsewhere.

The book is bilingual (Spanish and English), ensuring it will be understandable to most readers in the world. We can informally split the book into two parts. The first, as in other books devoted to poroid fungi, deals with essential general issues; however, the author adds new data so avoiding redundancy. Keys based on macroscopical and/or microscopical characters and species descriptions appear in the second part. The latter include, in most cases, cultural data, which are not very common in books on polypores, and are meticulously discussed. Species illustrations comprise line drawings, which are excellent and elucidative, actually representing morphological characters. Some printed photographs do not catch the whole beauty of the specimens, so the author does not include any, but has posted these on http://www.ciefap/areas/proteccion/poliporos where they are easily accessed.

Rajchenberg's book is well written, and provides a new brief on the taxonomy of South American polypores. Analyzed data are clearly presented, critically discussed, and decisions competently made. But, nevertheless, does he stimulate the reader in each discussion, and invite his or her participation? Yes, he provides a state-of-the-art view of the taxonomy-phylogeny debate in polypores, in a direct, credible, and stimulating way that connects with readers' minds.

Finally, we enjoyed the book, and, as researchers on South American polypores, have analyzed it here from the point of view of those who are really going to use it; surely we recommend it for mycological studies in the region.

Gilberto Coelho[1] and Rosa Trinidad Guerrero[2]
[1] *Rua Ana Nery 284, CEP 97020030, Bairro Patronato, RS, Brasil*
[2] *Instituto de Biociências, UFRGS, Av. Bento Gonçalves 9500, CEP 91501970 Porto Alegre, Rio Grande do Sul, Brasil.*

**Macrohongos de la Región del Medio Caquetá, Colombia.** By Ana E. Franco-Molano, Aída M. Vasco-Palacios, Carlos A. López-Quintero & Teun Boekhout. 2005. Grupo Taxonomia y Ecologia de Hongos, Universidad de Antioquia, Colombia (e-mail: afranco@quimbaya.udea.edu.co). [Guía de Campo.] Pp. 218. ISBN 958 655 910 6. Price: 30 000 Cp, US $ 15.

This is a field guide, published under the auspices of the Grupo de Taxonomía y Écologia de Hongos Universidad de Antioquia, pocket-book size (19 x 11 cm), and written in Spanish. After the acknowledgements, preface, and guiding suggestions, the book comprises the following chapters: Introduction, Description of species, Glossary, Bibliography, List of herbarium collections used for this book, Index, Synonyms, and finally a fantastic tale on the origin of fungi related by a Colombian Indian.

Scientific and common names, Macromorphology, Spore features, Habitat, Distribution, and popular uses (where they exist), are given for each taxon. The taxa are grouped into orders, and within each of the families treated, showing the most representative taxa in Colombia.

A field illustration is included, together with appropriate symbols to indicate, for example, substrate, habitat, toxicity, and edibility. However, I always doubt the difference between "toxic" and "poisonous". Despite the small size of the illustrations, 7 x 4 cm, their quality is good enough in most cases, but too dark in quite a few.

Ninety-six species are included in this little book. Amongst the most interesting, according to their rarity, are *Hygroaster cleefii,* which is only known in Colombia, and *Cordyceps chlamydosporia* and *Camillea leprieeurii* which are both very rare species. Sadly some illustrations are almost useless due to their poor quality: Fig. 28, *Xerula* sp., *Gymnopilus lepidotus, Gloeocantharellus uitotanus* (just published as new), *Lentinus concavus, Polyporus guianensis, P. leprieurii, P. virgatus, Phellinus calcitratus, Coriolopsis polyzona, Earliella scabrosa, Hexagonia hydnoides, Kretzschamaria clavus, Thamnomyces chordalis, Auricularia fuscosuccinea, A. mesenterica,* and *Tremella mesenterica*.

This represents a good contribution to our knowledge of the Colombian mycobiota, which needs an enormous effort to try to understand the immense mycological treasures to be discovered in such a great territory. This first step is something good to begin with.

FRANCISO D. CALONGE
*Real Jardín Botanico de Madrid, Plaza de Murillo 2*
*Madrid 28024, Spain*

**Common mushrooms of the Talamanca Mountains, Costa Rica.** By Roy E. Halling & Gregory M. Mueller. 2005. The New York Botanical Garden Press, 200th St. & Kazimiroff Blvd,, Bronx, New York 10458-5126 USA (e-mail: nybgpress@nybg.org). Pp. 195. ISBN: 0-89327, ISSN: 007-8931. Price: $19.95.

Since receiving this book for review an embarrassingly long time ago, it has remained next to my computer, open to page 131 to remind me of a particularly pleasant June and July in 2000 among the great tall trees of San Gerardo de Dota seeking (and finding) the usually elusive *Phaeocollybia*. Too many of us who benefited from Halling & Mueller's generosity have yet to publish our discoveries from our neotropical field expeditions through the great Central

American oak forests that hug the ridges of the Costa Rican Talamancas from San José south to the Panama border. Fortunately, the authors did not wait for their guests to complete lab work and manuscripts, publishing this fine field guide of the 'common' mushrooms encountered during ten years worth of treks through Costa Rica. While the volume does not pretend to cover all mushrooms of the area, I was surprised to see how many little known or recently named species are included. (The phaeocollybias are particularly fine!)

The volume is both field guide and taxonomic reference. Its 6 × 9 inch size is small enough to be tucked into a camera pack for easy transport but large enough to present enough information and photos on one page for ready identification in both field and at the scope. An external spine displaying the title permits easy location on a library shelf while an internal spiral binding keeps pages open on the lab bench. A waterproofed outer surface ensures that the orange colors of the cover leccinums will remain bright even after the wettest rainy season.

The introduction that summarizes the biology and geological history of the 'Cordillera de Talamanca' includes maps and graphs. Two lists indicate species representing tropical montane *Quercus*-dominated forest endemics or forming ectomycorrhizas with neotropical *Quercus*. Seven pages set forth protocols for collecting mushrooms for scientific study that will benefit both first-time mushroom collector and seasoned mycologist. A key to the ten included 'fleshy basidiomycete' families (*Cantharellaceae, Russulaceae, Boletaceae, Hygrophoraceae, Amanitaceae, Lepiotaceae, Entolomataceae, Tricholomataceae, Strophariaceae, Cortinariaceae*) precedes the main portion of the book, the species descriptions.

The approximately 100 species are presented alphabetically according to (and within each) family. A key to species precedes each family section of species descriptions. Each 1-2-page species treatment provides at least one excellent technical photo accompanied by a full morphological description and notes on substrates, mycorrhizal hosts, distribution, and general comments — this last generally the first paragraph read by the key user. Microscopic data are provided not only for spores and clamp connections, but also for tramal tissues, cystidia, and pileipellis features. Particularly useful micrographs and SEM scans of basidiospores or cystidia (not usually provided in field guides) may also be included. Excellent habitat photos are scattered throughout the descriptions to remind the reader that these organisms do not grow on a lab bench.

There follow a reference section, a list of specimen vouchers, a glossary (both to aid field collectors not acquainted with technical terms and to refresh the memories of those needing memory jogs for atomate, ixotrichodermium, and pseudoparenchymatous but ashamed to admit it), and index to scientific names. The volume closes with brief backgrounds and photos of the authors in situ that invoke — at least in this reviewer — a heartfelt desire to return to the Costa Rican collecting grounds and such amiable company. Anyone wishing to collect in Central America or who is interested in biogeography of fungi in the 'new world' would be well advised to own this book.

LORELEI L. NORVELL
*Pacific Northwest Mycology Service, 6720 NW Skyline*
*Portland, Oregon 97229, USA*

## Ascomycetes

**Genera of Freshwater Fungi.** By Lei Cai, Kevin D. Hyde & Clement K. M. Tsui. 2006. Fungal Diversity Press, Centre for Research in Fungal Diversity, Department of Ecology & Biodiversity, University of Hong Kong, Pokfulam Road, Hong Kong SAR, PR China (e-mail: kdhyde@hkucc.hku,hk). [Fungal Diversity Research Series No. 18.] Pp. viii + 261, plates 100. ISBN 988 99320 08. Price: US$ 80.

The title of this well-illustrated book is somewhat unfortunate. As stated in the Preface, it "brings together the literature on freshwater ascomycetes and their anamorphs" (p. iii). Consequently, it does not cover basidiomycete, chytrid, ingoldian, lichen-forming, or straminipilous genera, nor any that may be isolated into culture from freshwater but do not normally sporulate within it.

After a brief introduction to methods used to study freshwater ascomycetes, there are two long keys. The first is to ascomycetous genera known from freshwater habitats "in which taxa have been developed to species level" (p. 5); i.e. genera reported but not identified to species are omitted unless commonly encountered. Some 167 genera are keyed out, with the species reported from freshwater added in brackets – a very helpful feature. However, although it is not stated, the key is essentially identical to that already published by Cai et al. (2003) which has one dichotomy more; the couplet dealing with *Cudoniella* in the 2003 key (no. 146) was deleted in the 2006 one. The second key is "to common genera of aero-aquatic and submerged aquatic hyphomycetes", is identical to that published by Goh & Tsui (2003), although that is not acknowledged and nor is this reference included in the Literature list. This keys out 88 genera, amongst which ingoldian taxa are surprisingly not to be found; the explanation may rest in that the word "dematiaceous" in the title of the 2003 key does not appear in the heading of the 2006 one. In this key the names of species reported are not indicated as they are in that to the teleomorphs. Both keys are strictly dichotomous and the separations clear, although in the absence of a glossary, users lacking a thorough mycological training will need a copy of *Ainsworth & Bisby's Dictionary of the Fungi* to hand. In long keys I always find it useful to have the numbers of the previous couplets indicated to facilitate back-tracking, and that would certainly been of value here.

The major part of the book is devoted to descriptions and photographic plates. Each of the 100 genera selected for treatment here has a page of text with a plate opposite it. The page starts with the generic name and its author citation (but not the date or place of publication), has an indication of the systematic placement below the generic name, a description, a statement as to the type species, indicates any anamorph reported and the habitat, has often detailed and informative observations under "Notes", and references to pertinent literature. The photographic plates are composites which include habit shots in most cases as well as details of the asci, interascal filaments, conidiogenesis, and spores. The quality of the originals for the plates must have been exceptional, but the standard of reproduction does not do all of them justice. Where possible it is the type species of the genus that is illustrated, but when that was not available an alternate is shown. Making a decision on what genera to include in this part of the book cannot have been easy, but almost all those selected are perithecioid ascomycetes, their anamorphs, and probably allied dematiaceous fungi with no known teleomorphs. No apothecioid species made it (although these are well-covered in the key) and the moniliaceous conidial fungi fared almost as badly (with only *Dactylaria* and *Helicomyces*).

The literature cited is impressive, and occupies 18 pages, but is not without its slips; for example, Cai et al. (2003) is said to be in *Fungi in Marine Environments* (Hyde 2002) – fortunately the reference to the Fungal Diversity Research Series has the correct volume number (though the last page number is "324" not "326"). The index does not include references to genera covered in the key to anamorphs, although generic and specific names in the teleomorph key are indexed. It was evidently also intended (see p. 31) that the index should have the authorities of species names included there as they are omitted in the text, but they are not to be found.

As the keys have appeared before, the main new benefits of this book are the descriptions, notes, and especially the photographic illustrations of the selected genera. There is no doubt that this book will be of immense value to those wishing to identify freshwater perithecioid ascomycetes and allied dematiaceous fungi, and perhaps this can now be built on by the authors to eventually provide a work covering all the genera reported – and with keys to all the species.

Cai, L. Zhang. K.-Q. & Hyde, K. D. (2003) Freshwater ascomycetes. In: *Freshwater Mycology* (C. K. M. Tseu & K.D. Hyde, eds): 275-324. [Fungal Diversity Research Series No. 10.] Fungal Diversity Press, Hong Kong.

Goh, T. K. & Tsui, C. K. M. (2003) Key to common dematiaceous hyphomycetes from freshwater. In: *Freshwater Mycology* (C. K. M. Tsui & K.D. Hyde, eds): 325-343. [Fungal Diversity Research Series No. 10.] Fungal Diversity Press, Hong Kong.

Hyde, K. D. (ed.) (2002) *Fungi in Marine Environments*. [Fungal Diversity Research Series No. 7.] Fungal Diversity Press, Hong Kong.

***Hypocreales* of the Southeastern United States: an identification guide.** By Gary J.Samuels, Amy Y. Rossman, Priscila Chaverri, Barrie E. Overton & Kadri Põldmaa. 2006. Centraalbureau voor Schimmelcultures, P.O. Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [CBS Biodiversity Series No. 4.] Pp. ix + 145, coloured plates. ISBN 10: 90 70351 59 5, 13: 978 90 70351 59 5. Price: 70 €.

This identification guide was developed for a workshop on hypocrealean fungi in the Great Smoky Mountains in 2004. It includes members of the order occurring in Georgia, North and South Carolina, and Tennessee. Following an introduction to the group and its characters, with practical hints on, for example how to carry out a KOH reaction test on the perithecia, are a series of dichotomous and synoptic keys. The separations all seem clear, but I do worry when dichotomous keys use substrata as the only characters in a couplet. For each genus there is short description and list of key literature, and then each species has a page devoted to it which has the accepted name, any anamorph, information on habitat and distribution, a detailed description including features of the anamorph as well as the teleomorph, and notes about the ecology, identification or taxonomic placement. But I do wish the genera had been treated in alphabetical not a systematic order as this means always having to go to the index or contents page to find a particular genus. Author citations are provided, but without details of the place of publication; I would have like to have seen at least the date added after the authors' names. But what makes this work so special is a superb composite full-colour plate for each species, including habit shots and microscopic details of both anamorph and teleomorph. I was also pleased to see the details of the voucher specimens for the illustrations listed in an Appendix. In total, 102 species dispersed through 20 genera are treated. The most speciose genera covered are *Hypocrea* (31 spp.) and *Hypomyces* (23 spp.) so the work will be of particular value in making identifications in those two genera. In two cases the species remain unnamed (*Arachnocrea* sp., *Cosmospora* sp.), in one the identification it is tentative (*Hypocrea* cf. *pseudostraminea*), and a single new combination is made: *Neonectria ditissima* (syn. *Nectria ditissima*) comb. nov. The book is spiral bound so it lies open flat at any page which is ideal for comparing an "unknown" in the microscope with the illustrations. In addition to producing a fine manual, the beauty of the photographs might also encourage more amateur and professional mycologists to study these super fungi.

**Taxonomy and Pathology of *Togninia* (*Diaporthales*) and its *Phaeoacremonium* anamorphs.** By Lizel Mostert, Johannes Z. Groenewald, Richard C. Summerbell, Walter Gams & Pedro W. Crous. 2006. Centraalbureau voor Schimmelcultures, P.O.

Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [Studies in Mycology No. 54.] Pp. viii + 115. ISBN 10: 90 70351 61 7, 13: 978 90 70351 61 8. Price: 55 €.

When I first was involved with fungi that later became named as *Phaeoacremonium* in the mid-1970s, while we used the name for a human pathogen for a species pathogenic on trees (Hawksworth et al. 1976), the number of species and problems they caused that have subsequently been recognized was not foreseen, not least the importance esca disease of grapevines would assume. Neither was the fact that these fungi are anamorphs of *Togninia* suspected, confirmed only in 2003 by molecular phylogenetic methods. While more and more species have been recognized from humans and woody plants, there has been no overall monograph produced. That is remedied here, in a work combining molecular, cultural, morphological, and nomenclatural investigations.

The full introduction incorporates sections on diseases and disease management in humans and plants, mating studies, molecular investigations, and cultural parameters. A suite of keys includes ones to genera similar to the teleomorph and anamorph, as well as to treated species; these keys are supplemented by tables comparing cultural and micromorphological features, and there is also an online identification database (www.cbs.knaw.nl/phaeoacremonium.htm).

Ten species of *Togninia* are accepted, six described for the first time, and all but one of which have a *Phaeoacremonium* anamorph; three of the latter are unfortunately given new scientific names, contrary to Rec. 59A.3 of the *Code*, but at least the same epithets are employed (and *vice versa* for newly coined teleomorph names). Twelve species of *Phaeoacremonium* in which no teleomorphs have yet been found are recognized, of which three are newly described. The identities of other fungi referred to *Togninia* are treated as a result of examination of type material: five were found to belong in *Calosphaeria* and one in *Jattaea*. Somewhat unexpected, but most welcome, is a synopsis of the 11 accepted genera of *Calosphaeriales*.

The whole work is beautifully illustrated in colour, and the micrographs are particularly superb. It is sure to be the key work on these important fungi for both medical mycologists and tree pathologists for many years to come.

Hawksworth, D. L., Gibson, I. A. S. & Gams, W. (1976) *Phialophora parasitica* associated with disease conditions in various trees. Transactions of the British Mycological Society 66: 427-431.

## Lichen-forming fungi

**Parmelioid Lichens in India (a revisionary study).** By Pradeep K. Divakar & Dalip K. Upreti. 2005. Bishen Singh Mahendra Pal Singh, 23A new Connaught Place, Dehra Dun, 248001 India (e-mail: bsmps@vsnl.com). Pp. xii + 488, coloured plates 58, maps 194, tables 3. ISBN 81 211 0389 4. Price: US$ 95.

While this is primarily a traditional monograph, treating 22 genera and 192 species of parmelioid lichens in the Indian subcontinent, it also has features of wider interest. These concern the history of the study of these lichens in India, narrowing generic concepts, a proposal to establish eight "lichen sanctuaries", a table giving the regions, altitudes, number of localities and status of each species, and uses in traditional medicine. Anatomical and morphological characters are described, illustrated and discussed, the use of microcrystal tests and standard thin-layer chromatography procedures for identifying lichen compounds is explained, and there is an extensive glossary.

What did surprise me was that I could find no discussion on the issue of whether all the genera should or should not be accepted, especially as molecular data now make it clear that many should not, and the first author has made major contributions to tackling this problem in recent years (Blanco et al. 2004a, b, 2005; Divakar et al. 2006). This cannot just be explained only by the work being in press for a long time as the Foreword and Preface are both dated July 2004, the Literature Cited section includes some titles from 2003, and pertinent molecular work suggesting synonymizing would be necessary started to appear in 2001 (Crespo et al. 2001). An opportunity to promulgate the new generic concepts now being implemented has sadly been missed.

Having said that, the dated generic taxonomy does not detract from the value of this work for identification and information on the ecology, distribution and status of the species. For each species information is provided on the place of publication of the name, selected synonyms, type collections (where it would have been useful to indicate which had been examined and which had not), habit photographs in colour, chromatographic profiles also in colour (the first time I have seen this done in a monograph), a description, chemical reagent tests and compounds present, remarks on identification, notes on habitat, altitude and distribution, distribution map (with states indicated), and details of specimens examined (including extra-Indian ones). Many of the habit photographs have evidently been prepared from dried reference specimens which means that the colours do not always reflect those in nature, for example, *Punctelia borreri* (pl. 51 fig. 1) is olive-grey not brown in the field. The keys are generally clear, though I would have preferred to see chemical characters used less often, especially when reagent tests cannot be used to make the distinctions. In all, some 36 species are added to the previous Indian checklist (Awasthi 2000) for this group. There is also one new combination, *Parmelinopsis nagalandica* (syn. *Parmelia nagalandica*) comb. nov., hiding on p. 288.

This is clearly a landmark work for the identification of parmelioid lichens at species level, not only in India but in south-east Asia more generally, as many species have wide distributions. If you work on Asian macrolichens, this is a "must-have", but I do fear it may delay the take-up of the refreshing new generic scheme being developed by the first author and his colleagues and which is already being embraced internationally.

Awasthi, D. D. (2000) *Lichenology in Indian Subcontinent*. Bishen Singh Mahendra Pal Singh, Dehra Dun.

Blanco, O., Crespo, A., Divakar, P. D., Elix, J. A. & Lumbsch, H. T. (2005) Molecular phylogeny of parmotremoid lichens (*Ascomycota, Parmeliaceae*). Mycologia 97: 150-159.

Blanco, O., Crespo, A., Divakar, P. K., Esslinger, T. L., Hawksworth, D. L. & Lumbsch, H. T. (2004a) *Melanelixia* and *Melanohalea*, two new genera segregated from *Melanelia* (*Parmeliaceae*) bsed on molecular and morphological data. Mycological Research 108: 873-884.

Blanco, O., Crespo, A., Elix, J. A., Hawksworth, D. L. & Lumbsch, H. T. (2004b) A molecular phylogeny and a new classification of parmelioid lichens containing *Xanthoparmelia*-type lichenan (*Ascomycota, Lecanorales*). Taxon 53: 959-975.

Crespo, A., Blanco, O. & Hawksworth, D. L. (2001) The potential of mitochondrial DNA for establishing phylogeny and stabilising generic concepts in the parmelioid lichens. Taxon 50: 807-819.

Divakar, P. D., Crespo, A., Blanco, O. & Lumbsch, H. T. (2006) Phylogenetic significance of morphological characters in the tropical *Hypotrachyna* clade of parmelioid lichens (*Parmeliaceae, Ascomycota*). Molecular Phylogenetics and Evolution 40: 448-458.

**Die Flechten Vorarlbergs.** By Veronika Pfefferkorn-Dellali & Roman Türk. 2005. Inatura Erlebnis Naturschau, Jahnstrasse 9, A-6850 Dornbirn, Austria. [Vorarlberger Naturschau, Forschen und Entdecken No. 17.] Pp. 247. ISSN 1024-9613. Price: 18.18 €.

This provides an up-to-date checklist of the Voralberg district of Austria, well-known to be exceptionally rich in lichens, based on both literature reports and new field work. Following a short introduction including information on climate and maps and photographs of some rare and endangered species. The total number of taxa treated is 1069, of which five are new reports for Austria; lichenicolous fungi are not covered. The entries for each species include information on growth-form, ecology, where appropriate conservation status, literature sources, and distribution maps. This section is also interspersed with superb colour photographs of selected species. The nomenclature is generally current, though the latest results for generic re-circumscriptions in parmelioid lichens published in 2004 were not caught before the text went to press; I also wonder if the acceptance of *Lobarina* is premature. An important handbook for all lichenologists visiting the region, which will also be an important tool in developing and implementing conservation policies.

**Shetland Lichens.** By D. H. "Kery" Dalby & Claire Dalby. 2005. Shetland Amenity Trust, Garthspool, Lerwick, Shetland ZE1 0NY, UK (e-mail: shetamenity.trust@zetnet.co.uk). Pp. vii + 120, illustrated. ISBN 0 9543246 3 3, Price: £ 15.

This is much more than a survey of the lichens recorded in the Shetland Islands, the UK's northernmost outposts where the nearest rail station is in Norway, and very much a book for the enquiring general naturalist wanting to know more about lichens. It consequently starts with the issue of "What are lichens?", which includes accounts of lichen structures, aspects of their biology, and numerous tid-bits of observations that have fascinated the authors – and all well-illustrated by not only photographs but superb line drawings (a few in colour) by Claire Dalby – an established and justifiably renowned botanical artist. The tit-bits include contact zones between lichens, zonate growth, *Lichina confinis* as a pathogen of *Verrucaria maura*, and the separation of *Ramalina cuspidata* and *R. siliquosa*. Sections on lichen communities of different substrates follow, along with short chapters on effects of grazing (with a fine photograph of almost crustose *R. siliquosa* on p. 42), weather, human influences and uses, distribution types, and conservation. There are some statements that specialists would wish to amend, and I doubt the photograph labelled as *V. maura* on p. 16 is that species as it lacks the cracked-areolate thallus and the perithecia are too prominent. However, these small things do not detract from the main aim of these sections, to fascinate and encourage general naturalists into taking more note of lichens.

The more traditional information to be expected in regional "floristic" studies does not start until almost the middle of the book, with a history of studies in Shetland, but one that surprisingly omits mention of the records made by either George Low on his tour in 1774, or of Gunnar Degelius' visit in 1956. The individual species entries mention the individual islands from which species are known (and whether they are also recorded from the Orkney Islands just to the south is also indicated), and include ecological notes and references to recorders and published reports. A novel aspect is the printing of entries for Red data book threatened species in red! A draft if the checklist was checked by Brian C. Coppins (Royal Botanic Gardens, Edinburgh), and some records made by others remain doubtful in the absence of voucher specimens. There are surely more crustose species still to be found on rocks in the islands, but with hardly any trees able to get to more than 1-2 m in height, and those mainly in specially-protected sites, the list of those on bark and wood is unlikely to be swelled significantly by future work.

The Dalby's have been visiting the Shetland Islands annually since 1978, and the book reflects the love they clearly developed for the islands and their lichens – something I can very much relate to from my visits there in 1965-66!

**Els Líquens Epífits com a Indicadors de l'Estat de Conservaciço del Bosc Mediterrani: proposa metodológica per als alzinars de Catalunya.** By Àngels Longán Seminago. 2006. Institut d'Estudis Catalans, Carrer del Carme 47, E-08001 Barcelona, Spain (e-mail: informacio@iec.cat). [Arxius de les Seccions de Ciències, Secció de Ciències Biològiques No. 137.] Pp. 633, figs 33, coloured photos 16, tables 25, maps 166. ISBN 84 7283 837 4. Price: 30 €.

This book is based on a PhD thesis prepared under the supervision of A. Gómez-Bolea in the Universitat de Barcelona, and gained the Institut d'Estudis Catalans' award for ecology in 2003. Although the primary focus is the use of lichens as indicators of ecological continuity in *Quercus ilex* forests in Catalunya, attention is drawn to it here as just under half of the book consists of treatments of 166 different species; these include information on identification and ecology, but further distribution maps and details of specimens examined. Eighteen species are first records for Catalunya, six are new to the Iberian Peninsula, and one was new to science (*Byssoloma llimoniae*, but previously published elsewhere). In addition, four species differed from the ones they were closest to in some features (*Agonimia allobata, Lecanora strobilinoides, Lecanora expallens*, and *Psoroglaena stigonemoides*), and two could be named beyond genus (*Catillaria* sp. and *Micarea* sp.). It is not appropriate to discuss the ecological reeults in detail here, but detailed information is given on the 45 plots studied, and a novel Index Liquénic (IL; Lichen index of conservation status) is introduced using positive and negative indicator species. This is a land-mark publication for assessing the conservation status of these special forests, and the approaches merit emulation in evergreen oak forests throughout the Iberian Peninsula. Although the work is in Catalan, there is a 42 page (!) English summary, and the tables and figures all have titles in both languages, so making the content more accessible to an international audience than would otherwise have been the case.

**Flora Polski: Porosty, Mszaki, Paprotniki.** By Hanna Wójciak. 2003. Multico Oficyna Wydawnicza, ul. Lektykarska 4a, PL-01-687 Warsawa, Poland (e-mail: biuro@multicobooks.com.pl). Pp. 368, illustrated. ISBN 83 7073 223 2. Price: 64 zl.

This semi-popular guide to lichens, bryophytes, and pteridophytes, was prepared by a lichenologist at the Uniwersytetu Marii Curie-Skłodowskiej in Lublin, who is clearly also a most competant photographer. Over half of the work is devoted to lichens, and starts with an introduction to lichen structure and ecology, including a comparison of air pollution lichen zones in Kraków in 1950 and 1990. It then treats around 350 species, arranged systematically, rather than alphabetically or by thallus-type, which makes a particular species difficult to find without recourse to the index. The Polish common names are given prominence, followed by the scientific name and often used synonyms, the family placement, a description, notes on ecology, distribution, and conservation status, and the colour photographs. Most of the photographs are fine, but in some the colour balance has sadly been skewed to the extent that users might be misled (e.g. *Pertusaria pertusa, Phylctis argena, Physcia dubia*). In some other cases, colour problems may well arise from herbarium specimens probably having been used (e.g. *Physconia distorta*). As so many Polish works on lichens lack any photographs, this book is sure to do much to help naturalists start to take an interest in lichens. I hope Hanna will be encouraged by the success of this work in promoting lichenology, and consider preparing a volume solely devoted to lichens.

## Conidial fungi

**Phylogenetic relationships and morphology of *Cytospora* species and related teleomorphs (*Ascomycota, Diaporthales, Valsaceae*) from *Eucalyptus*.** By Gerard C. Adams, Michael J. Wingfield, Ralph Common & Jolanda Roux. 2005. Centraalbureau voor Schimmelcultures, P.O. Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [Studies in Mycology No. 52.] Pp. x + 147. ISBN 10: 90 70351 57 9, 13: 978 90 70351 571. Price: 55 €.

The *Diaporthales* and their coelomycete anamorphs have long presented major problems in identification, with few mycologists prepared to tackle them because of the scale of the task. This contribution, however, aiming to resolve the situation by focussing on one anamorph type and its teleomorphs on particular hosts, is commendable – and even more so because it combines critical morphological studies with work on cultures and molecular phylogenetic approaches. However, the first third of this work is devoted to categorizing the conidioma and ascoma types, culture methods, and cycloheximide sensitivities that will make this a pivotal work in all future investigations on these fungi on any hosts.

Studies on ITS sequences from material on *Eucalyptus*, where these fungi are often associated with cankers, yielded 33 unique sequences placed in at least 15 unrelated groups, but a pragmatic nomenclatural approach is adopted which accepts *Luecostoma, Valsella*, and *Valseutypella* all as synonyms of *Valsa*. One *Cytospora* was placed close to the *Phomopsis* anamorphs of *Diaporthe* – suggesting there may be more surprises when more molecular date is available on those fungi. In the taxonomic part of the work, 23 *Cytospora* species are accepted, nine of which have known teleomorphs in *Valsa*, together with data on some yet undetermined specimens. All are described in detail with superb drawings and micrographs, almost all in colour, along with photographs of cultures. Eight new *Cytospora* and four new *Valsa* species are described, and emended descriptions of previously described species provided.

With the care taken to synthesize morphological, molecular, cultural, and nomenclatural investigations as a team, and further provide so many superb illustrations in colour, this is a superb example of how systematic studies of the 21st century should be conducted and presented.

**Grzyby z rodzaju *Ramularia* występujące w Polsce [Fungi of the genus *Ramularia* in Poland].** By Agata Wołczańska. 2005. Polish Botanical Society, Łódź, Poland. Pp. 154, figs 18, plates 7. [Monographiae Botanicae Vol. 95.] In Polish. ISSN 0077-0655, ISBN 83 86292 67 9. Price: 5 €.

*Ramularia* is a large genus of mucedinacous hyphomycetes, as far as is known comprising anamorphs of the ascomycete genus *Mycosphaerella* (*Mycosphaerellaceae*). About 330 mainly hemibiotrophic, leaf-spotting species have been assigned to this genus, and they predominantly occur in temperate regions of the Northern Hemisphere. Numerous economically important plant diseases of phytopathological significance are involved.

Wołczańska carried out a careful, detailed revision of this genus in Poland, based on re-examinations of collections deposited in Polish herbaria as well as data spread in literature. Introductory chapters contain surveys of the history of *Ramularia* in general and in Poland in particular, material and methods, biology, including some scanning electron microscopic pictures of conidiophores and conidia, an analysis of *Ramularia* species found in Poland in relation to host plant families, as well as a key to *Ramularia* and allied genera. Six colour plates show symptoms and fungal colonies of various *Ramularia* species. Following a general description of the genus *Ramularia*, the particular species are arranged according to host plant families, supplemented by keys to species when two or more species are known. The species are treated in the best traditions of classic fungal monographs, comprising bibliographic references, synonyms, exsiccatae, descriptions of morphological features and detailed data on host range and distribution, including literature references and herbarium samples, and comments following the monograph of *Ramularia* published by Braun (1998). Illustrations of microscopic features are confined to drawings of conidia, giving impressions of the conidial shapes and sizes. However, because complete pictures of the particular species, including conidiophores, stromata, etc., are lacking, it would have been useful to give references to appropriate illustrations in the literature, for example to those in Braun (1998) whose descriptions and drawings from that work are now freely available via internet through MycoBank.

The treatment of Polish *Ramularia* species is finished by a survey of excluded former *Ramularia* species, a host/fungus list, references, and indexes of scientific fungal and host names.

In total, 115 *Ramularia* species, including one species on a fern, three on five rust fungi, and 111 on 304 angiosperm species belonging to 38 families, are described and illustrated from Poland.

The present monograph represents an important, useful contribution to the knowledge of the genus *Ramularia*, and is recommendable to mycologists and phytopathologists interested in leaf-spotting hyphomycetes.

UWE BRAUN
*Institut für Biologie, Bereich Geobotanik, Martin-Luther-Universität*
*Neuwerk 21, D-06099 Halle/Salle, Germany*

Braun, U. (1998) *A Monograph of* Cercosporella, Ramularia, *and allied Genera*.IHW-Verlag, Eching.

**The Missing Lineages: phylogeny and ecology of endophytic and other enigmatic root-associated fungi.** Edited by Richard C. Summerbell, Randolph S. Currah & Lynne Sigler. 2005. Centraalbureau voor Schimmelcultures, P.O. Box 85167, 3508 AD Utrecht, The Netherlands (e-mail: info@cbs.knaw.nl). [Studies in Mycology No. 53.] Pp. vi + 262. ISBN 10: 90 70351 58 7, 13: 978 7989979870351 58 8. Price: 65 €.

This number of *Studies in Mycology* brings together a series of contributions shedding new light on the identities and positions of a range of mainly dematiaceous often sterile fungi encountered as endophytes or associated with plant roots. The papers are wide-ranging. Sterile fungi from ericaceous roots fall into different subclades of what is clearly a complex of taxa going under the designation *Hymenoscyphus ericae*; a new genus name *Melinomyces* with three species which are totally sterile and form subclades distinct from *H. ericae s.str.* is introduced (Sarah Hambleton & Lynne Sigler, pp. 1-27). The new genus *Leohumicola*, with four species, three newly described and one recombined have been isolated from heat-treated soils in Canada; they have lateral or terminal brown aleuroconidia which can be smooth or warted and molecular data shows them to belong to a monophyletic group in *Leotiomycetes* (Sarah Hambleton et al., pp. 29-52). Isolates from ericaceous roots in North America were encouraged to sporulate in culture and found to represent two new species of *Cryptosporiopsis* (Lynne Sigler et al., pp. 53-62). A method for identifying the ericoid mycobiont *Oidiodendron maius* by colony characteristics under precise conditions has been developed (Lynne Sigler & Connie Fe Gibas, pp. 63-74). A new *Oidiodendron* species is described from mushroom compost, and a synopsis of the 23 named species and related anamorphs of *Myxotrichum* is provided along with descriptions, illustrations, and keys (Adrianne Rice & Randolph Currah, pp. 75-82 and 83-120, respectively).

Richard Summerbell (pp. 121-145) examined the endophytes and mycorhizosphere fungi of *Picea mariana* growing in sites with different conditions, and concludes that the soil and the microbial community are the determinants of the assemblages and not the mycorrhizosphere. Jantineke et al. (pp, 147-162) compared the root endophytes of ericaceous plants and *Deschampsia flexuosa* in the Dutch heathlands, also carrying out inoculation experiments; the fungi were mainly helotialean and overlapped phylogenetically and in function. Lawrence Zettler et al. (pp. 163-171) set out to determine if the protocorm mycobiont of the orchid *Platanthera leucophaea* was also present in and encouraged growth in seedlings; it was *Ceratorhiza goodyerae-repentis* and it did.

The issue closes with two review papers: one by Keerthi Mandyam & Ari Jumpponen (pp. 173-189) on the importance and possible roles of dark septate endophytes; and an amazing *tour de force* by Richard Summerbell (pp. 191-256) in which heassembles and anaylzes the scattered pre-1985 literature (which extends over 14 pages) on endophytic and saprotrophic fungi associated with ectomycorrhizal roots.

With its combination of contributions on systematics, ecology and biology, and reviews, this will be an important reference work for all fungal ecologists battling with dark septate endophytes.

**Fungi of Australia: *Septoria*..** By Michael J. Priest. 2006. Australian Biological Resources Study and CSIRO Publishing, PO Box 1139, 150 Oxford Street, Collingwood, Victoria 3066, Australia (e-mail: publishing.sales@csiro.au). Pp. vi +259, figs 136. ISBN 0 643 05702. Price: A$ 110.

This book, according to the author is based on his thesis submitted for a PhD degree at the University of New England, Armidale, NSW. It is a reassessment of *Septoria* species reported in Australia on the basis of previously published morphological and pathological data and contains accounts of 132 *Septoria* species occurring on flowering plants representing 54 plant families.

The first part (pp. 1-13) of the book has an Introduction which includes a résumé on the history of the name *Septoria*, taxonomic characters including conidiomata, the current interpretation of conidiogenesis, conidia, host specificity, brief notes on closely related genera, host relationship, and biogeography. Although the generic characters of *Septoria* previously accepted by mycologists have been reviewed and recent findings about conidiogenous cells in the type species *S. cytisi* and *S. chrysanthemella* have been noted, and current terminology elucidated, a clear and concise generic description of *Septoria* defined for this book does not appear before the start of the reassessment of *Septoria* species on a host family basis.

Apparently not consulted in the preparation of this book are relevant or recent or fairly major publications on *Septoria* which include a publication by Teterevnikova-Babayan (1987) which deals with 850 taxa from the former

USSR, and the more recent publication by Muthumary (1999[7]) which deals with 83 Indian *Septoria* species including new species from *Hydrocotyle* and has good illustrations, and Markevičius & Treigienė's (2003[8]) treatment of Lithuanian *Septoria* species.

The main part and bulk of this book contains descriptions of accepted *Septoria* species in Australia with line drawings (pp.15-214). There are separate, mini keys to *Septoria* species on members of *Apiaceae* (6), *Asteraceae* (22), *Caryophyllaceae* (4), *Fabaceae* (4), *Mimosaceae* (4), and *Poaceae* (14). Unfortunately there is no organism-based single key independent of the host to accepted *Septoria* species occurring in Australia. A single key is essential since it would reveal at a glance morphologically similar groups having similar conidial dimensions and septation but regarded as different entities or species on hosts basis. Apparently no attempt has been made to group *Septoria* species on the basis of the conidiogenous.

The taxonomic criteria adopted in this book seem to vary in places as the following example demonstrates. In the text, five taxa, *Stagnosospora avenae*, *S. nodorum*, and *Septoria capillepedii* and *S. cryptica* and *S. cymbopogonis* have identical descriptions for the conidiogenous cells, i.e. "arising from the inner wall layer, hyaline . . . producing 1 or more conidia holoblastically; secession schizolytic, subsequent proliferation of the conidiogenous locus not observed", but in this book *Septoria avenae* and *S. nodorum* are accepted in *Stagonospora* and the other three species are included in *Septoria*. Bissett (1982) transferred *Septoria avenae* to *Stagonospora* because he believed that *S. avenae* was congeneric with *Stagonospora nodorum* but not with the type species of *Septoria*, *Septoria cytisi*. Castellani & Germano (1977) transferred *Septoria nodorum* to *Stagonospora* on the basis of conidial width and not on the basis of conidiogenous cells. The obvious reason for the placement of the two *Septoria* species in *Stagonospora* in publications is not influenced by the type of conidiogenous cells or conidiogenesis, but because the two taxa have *Leptosphaeria* teleomorphs. This logic, however, does not explain the placement of taxa with similar generic characters in different anamorph genera.

It is interesting that the leaf scorch fungus of *Azalea* (i.e. *Rhododendron*), *Septoria azaleae*, was described and illustrated by Voglino (1899: pl. 2-3) with good line drawings showing pycnidial conidiomata and the early stages of pycnidial development. Also, he illustrated an immature pycnidum showing a well-formed pycnidial cavity (pl. 3). It is also worth noting that Voglino (1899) described the conidia of *S. azaleae* as 0-3-septate and 12-18 x 1.5-2 µm. Grove (1935) gave the measurements for the same species as 15-20 x 2.5 µm, and

[7] Reviewed in *Mycotaxon* 85: 486 (2003).
[8] Reviewed in *Mycotaxon* 90: 492 (2004).

from another collection recorded measurements of 11-34 x 1.5-2.5 µm. Grove also reported that 'on damp leaves, spores give rise to secondary conidia, 7-11 x 2 -3 µm by which the disease is spread'. Priest widened the measurements of conidia to (11-)15-35(-43) and illustrated them as having a wide range of shapes and sizes (p. 105, fig. 61). It therefore seems that *S. azaleae* and other species reported from *Rhododendron* are in need of an in-depth study. It is amusing to note that, in *S. varia* (p. 151) conidia are described as having 'a rounded base tapering to a subacute apex', but conidia from the holotype are illustrated (p. 152, fig. 94C) with a distinctly acute base like the sharp point of a needle, gradually tapering towards the apices.

Although all accepted species are illustrated by line drawings, their quality is not up to standard; the lines are finely serrated giving the impression that conidia and ascospores have roughened cell walls when they are smooth (figs 2, 8, 11, 27-28, 34, 48-49, 54, 56, 62, 65, 110, 114, 120, 131). When working with a single genus like *Septoria*, it is always helpful to illustrate conidia at the same magnification for ease of comparison, but unfortunately in this book the conidia are illustrated at different magnifications. It is also a pity that important structures are not illustrated by photomicrographs. For example, the line drawing of a part of a conidioma of *S. petroselini* (p. 27, fig. 9B) shows a simple holoblastic condiogenous cell next to a sympodially proliferating conidigenous cell, which in turn is next to a 'phialide' or enteroblastic conidiogenous cell (or percurrently proliferating cell). Such an occurrence of three types of conidiogenous cells aligned next to each other in the correct sequence within a single pycnidium is not a common feature and would be best illustrated by photomicrographs. It is also interesting to note that the illustration of the vertical section of the pycnidial conidioma of the same species (p. 27, fig. 9A) shows only holoblastic conidiogenous cells arising from the innermost cell layers lining the pycnidial cavity.

There are several line drawings of conidiomata devoid of contents and which do not show any conidiogenous cells arising from the innermost cell layer lining the pycnidial cavity (figs 13A, 14A, 19A, 20A-25A, 27A, 28A, 31A, 32A, 34A, 36A-39A, 41A-43A, 45A-48A, 49A- 55A, 57A-59A, 61A , 63A, 64A-82A, 84A-109, 111A-136A). It is doubtful if these illustrations serve a useful purpose here. Further, the sketch of a vertical section of a conidioma of *Clypeopycnis lepidospermatis* (syn. *Septoria lepidospermatis*; p. 102, fig. 59A) is entirely different from the very well-produced line drawings of the same species published by Sutton & Pascoe (1989) which clearly show that the conidiomatal wall (p. 183, fig. 4) has two distinct types of cell layers. It is also worth noting here that the correlation between *Mycosphaerella lepidospermatis* and *C. lepidospermatis* is not conclusively established but only circumstantial, as pointed out by Sutton & Pascoe (1989).

Doubtful and Excluded names take up eight pages (pp. 215-222), followed by a four-page appendix (pp. 223-226) that deals with new species, combinations and lectotypifications. Towards the end there is a Glossary (pp. 227-230) followed by an adequate list of references (pp. 231-244). Abbreviations and contractions used (pp. 245-248) are followed by fungus (pp. 49-254) and host (pp. 255-259) indices. The fungus index is almost free of errors, but *Pycnofusarium* is on p. 9 and not on p. 10, *Pyrenopeziza brassicae* is on p. 7 and not p. 8, *Septoria ceratoniae* is on p. 216 and not p. 215, and *S. eucalypti* is on p. 217 and not p. 216.

This book, produced with an attractive hard cover, brings together records of accepted and doubtful Australian *Septoria* species and excluded names in a single publication. It is a significant and useful contribution that will be appreciated by mycologists and plant pathologists.

Bissett, J. (1982) *Stagonospora avenae* [as '*avena*']. Fungi Canadenses No. 239. National Mycological Herbarium, Biosystematics Research Institute, Agriculture Canada, Ottawa.

Grove, W.B. (1935) *British Stem and Leaf Fungi.* Vol. 1. *Sphaeropsidales.* Cambridge University Press, Cambridge.

Castellani E. & Germano, G. (1977) Le Stagonosporae graminicole. Annali della Facoltá di Scienze Agraria della Universitá degli Studi di Torino 10: 1-135.

Markevičius, V. & Treigiene, A. (2004) ['2003'] *Septoria.* [Spuogagrybiečiai (*Sphaeropsidales*): Gentis *Septoria.*] [Mycota Lithuaniae/Lietutvos Grybai Vol.10 (3).] Botanikas Institutas, Vilnius.

Muthumary, J. (1999) *First Contribution to a Monogtraph of Septoria species in India.* Centre for Advanced Studies in Botany, University of Madras, Chennai.

Sutton, B. C. & Pascoe, I. G. (1989) Some *Septoria* species on native Australian plants. Studies in Mycology 31: 177-186.

Teterevnikova-Babajan, D. M. (1987) Griby roda Septoriya v SSSR [Fungus of the genus *Septoria* in the USSR]. Akademiya Nauk Armyanoskoi SSR Institut Botaniki Izd. an Armyanskoi SSR, Erevan

Voglino, P. (1899) Di una nuova malattia dell' *Azalea indica.* Malpighia 13: 73 – 86.

Eliyathamby Punithalingam
*7 Brook Court, Parkleys, Richmond, Surrey TW10 5LX, UK.*

## Miscellaneous

**International Code of Botanical Nomenclature (Vienna Code) adopted by the Seventeenth International Botanical Congress Vienna, Austria, July 2005.** Edited by John McNeill, Fred R. Barrie, Hervet M. Burdet, Vincent Demoulin, David L. Hawksworth, K. Marhold, Dan H. Nicolson, José Prado, Paul C. Silva, Judy E. Skog, John H. Wiersma & Nicholas J. Turland. 2006. A. R. G. Ganter Verlag, Ruggell, Liechtenstein. [Distributed by Koeltz Scientific Books, P. O. Box 1360, D-61453 Koenigstein, Germany (e-mail: koeltz@t-online.de).] [Regnum Vegetabile No. 146.] Pp. xviii + 568. ISBN 3 906166 48 1. Price: 48 €.

This new edition of the Code replaces the St Louis Code published in 2000[9]. The main changes affecting mycologists relate to new provisions in Art. 59 relating to the epitypification of anamorphs by material with the teleomorph, and accepting as validly published names of fungi (such as microsporidians and *Pneumocystis*), which were originally described under the zoological *Code* in the belief that they were animals (Art. 45.5). The Preface also encourages the use of italics for scientific names of all ranks, which has been its practice for many decades, "in the interest of international uniformity" (p. viii). There are also clarifications over the effective publication of theses, the validity of new combinations, and electronic publication. A glossary of nomenclatural terms used and defined in the *Code* is included for the first time.

**Solomon P. Wasser (in honour of his 60th birthday).** Edited by K. M. Sytnik. 2006. N. G. Kholodny Institute of Botany, Kiev, Ukraine. Pp. 120 pp. ISBN Not indicated. Price: Not indicated.

This little book is a record of a remarkable figure in mycology and algology. It comprises an editorial, a detailed biography by Irena Dudka and Asya Buchalo (presented in Ukrainian and English), publications list, and a remarkable collection of photographs from Wasser's personal and scientific life. Unusually, he has continued to be active in both mycology and algology, though edible mushrooms, especially *Agaricus* species and their applications have long been his main passion. The publications list includes 417 titles, amongst which are some 40 books (including several well-illustrated semi-popular mushroom guides). All titles are given in English, will help make those in Russian and Ukrainian more accessible. Within these, 128 new species, 55 new varieties, and 22 new forms of agarics are described. And he also holds 12 patents concerned with mushroom products. Since 1995, he has been part of the Institute of Evolution in Haifa, where he is head of the International Center of Biotechnology and Biodiversity of Fungi and Algae, but he keeps in contact with his colleagues in Kiev bringing refreshing ideas to them on his visits back (according to the editor). In addition to editing two phycological journals, in 1999 he founded the *International Journal of Medicinal Mushrooms,* and subsequently was instrumental in establishing the series of international congresses of medicinal mushrooms, the first of which was held in Kiev in 2001. A fine tribute and record of achievement for a very special figure in mushrooms and their applications, which all who know his work but do not know the man will find fascinating. *Mycotaxon* joins in sending him its best wishes in his future endeavours.

[9] Reviewed in *Mycotaxon* 76: 496 (2000).

## Erratum

**Die Pilzflora des Ulmer Raumes.** By Manfred Enderle. 2004. [Reviewed in *Mycotaxon* 94: 375-376 (2005).]

The e-mail address for orders was incomplete in the published review and should have been: manfred.enderle@gmx.de. I apologise for any inconvenience caused.

## Nomenclatural novelties proposed in Mycotaxon 98

*Astrosphaeriella linguiformis* Chi Y. Chen & J.W. Huang, p. 120
*Beauveria malawiensis* S.A. Rehner & Aquino de Muro, p. 140
*Chroodiscus himalayanus* Nayaka & Upreti, p. 247
*Coprinus doverii* L. Nagy, p. 148
*Cystolepiota fumosifolia* (Murrill) Vellinga , p. 226
*Cystolepiota oregonensis* (H.V. Sm.) Vellinga , p. 228
*Cystolepiota petasiformis* (Murrill) Vellinga , p. 228
*Haradaea moehringiae* (Togashi & Y. Maki) Denchev, p. 182
*Kirschsteiniothelia reticulata* Chi Y. Chen, C.L. Wang & J.W. Huang, p. 154
*Kirschsteiniothelia smilacis* Chi Y. Chen, C.L. Wang & J.W. Huang, p. 156
*Lepiota rhodophylla* Vellinga, p. 206
*Leucoagaricus amanitoides* R.M. Davis & Vellinga, p. 198
*Lysurus pakistanicus* S.H. Iqbal, Kasuya, Khalid & Niazi, p. 164
*Monodictys arctica* M.J. Day & Currah p. 264
*Mycosphaerella sapii* D.J. Soares, Parreira & R.W. Barreto, p. 170
*Mycosphaerella sapiicola* D.J. Soares, Parreira & R.W. Barreto, p. 172
*Oidium perseae-americanae* Liberato & R.W. Barreto, p. 190
*Pachyphloeus austro-oregonensis* J.L. Frank & Trappe, p. 254
*Phaeoramularia papaveris* F.Y. Zhai, Y.L. Guo & Yu Li, p. 233
*Phoma adonidicola* Yan Li, Q. Wang & G.Z. Lu, p. 237
*Phyllachora peltaticola* O.L. Pereira & R.W. Barreto, p. 242
*Septoria malagutii* Ciccar. & Boerema ex E.T. Cline, p. 132
*Urocystis chifengensis* L. Guo & T. Z. Liu, p. 193

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Aphyllophoraceous wood-inhabiting fungi on *Arbutus unedo* in Italy. 98: 159–162. 2007 ('2006').

**Punithalingam, Eliyathamby.** Book Review: Fungi of Australia: *Septoria* [Priest 2006]. 98: 303-306. 2007 ('2006').

**Rehner, Stephen A., Marilena Aquino de Muro & J.F. Bischoff.** Description and phylogenetic placement of *Beauveria malawiensis* sp. nov. (*Clavicipitaceae, Hypocreales*). 98: 137-.145. 2007 ('2006').

**Rossman, Amy Y.** see Cline & Rossman

**Shin, Hyeon-Dong,** see Denchev & al.

**Soares, Dartanha J., Douglas F. Parreira & Robert W. Barreto.** Two new species of *Mycosphaerella* on milk tree, *Sapium glandulosum*, from Brazil. 9 98: 169-176. 2007 ('2006').

**Southworth, Darlene,** see Frank & al.

**Tellería, M. Teresa,** see García-Blázquez & al.

**Trappe, James M.,** see Frank & al.

**Upreti, D.K.,** see Nayaka & Upreti

**Vellinga, Else C.** Lepiotaceous fungi in California, U.S.A. 2. *Lepiota rhodophylla* sp. nov. 98: 205–211. 2007 ('2006').

**Vellinga, Else C.** Lepiotaceous fungi in California, U.S.A. – 3. Pink and lilac species in *Leucoagaricus* sect. *Piloselli* . Mycotaxon 98: 213–224. 2007 ('2006').

**Vellinga, Else C.** Lepiotaceous fungi in California, U.S.A. 3. Lepiotaceous fungi in California, U.S.A. 4. Type Studies of *Lepiota fumosifolia* and *L. petasiformi.* Mycotaxon 98: 225–232. 2007 ('2006').

**Vellinga, Else C. & R. Michael Davis.** Lepiotaceous fungi from California, U.S.A. 1. *Leucoagaricus amanitoides* sp. nov. 98: 197–204. 2007 ('2006').

**Wang, Chih Li,** see Chen & al.

**Wang, Qi,** see Li & al.

**Yağız, Dursun, Ahmet Afyon, Muhsın Konuk & Stephan Helfer.** Contributions to the macrofungi of Kastamonu province, Turkey 98: 177–180 2007 ('2006').

**Zhai, Feng-Yan, Ying-Lan Guo & Yu Li.** A new species of *Phaeoramularia* on *Papaveraceae.* 98: 233-235. 2007 ('2006').

## Reviewers, Volume Ninety-eight

The Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers appearing in this volume.

André Aptroot
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Solomon P. Wasser
Roy Watling
Zhu-Liang Yang
Tian-Yu Zhang

# *Errata*

## Volume 91

| | | |
|---|---|---|
| p. 369, line 9 | for: *G. argentius* | read: *G. argentea* |
| p. 371, line 28 | for: ***G. argentius*** | read: ***G. argentea*** |
| p.372, line 15 | for: ***Graphis argentius*** Makhija & Adaw., *sp. nov.* | |
| | read: ***Graphis argentea*** Makhija & Adaw., *sp. nov.* | |
| p.372, 6th from bottom | for: *Graphis argentius* | read: *Graphis argentea* |
| p. 373, line 3 | for: *G. argentius* | read: *G. argentea* |
| p. 374, legend, top line | for: **1.** *Graphis argentius* | read: **1.** *Graphis argentea* |
| p. 525, line 18 | for: ***Graphis argentius*** Makhija & Adaw., p. 372 | |
| | read: ***Graphis argentea*** Makhija & Adaw., p. 372 | |

## Volume 95

| | | |
|---|---|---|
| p. 76, line 7 | *for:* forma *conigena* | *read:* forma *conigenum* |
| | for: *Lophodermium congena* | read: *Lophodermium conigenum* |
| p. 123, line15 of tree | *for:* **macqregoriii** | *read:* **macgregorii** |
| p. 155, line 21 | for: *Microstoma insititia* | read: *Microstoma insititium* |
| p. 158, line 7 | for *Cookeina institia* | read: *Cookeina insititia* |
| p. 174, line 33 | for: ***elata*** *– Geoyxis* | *read:* ***elata*** *– Geopyxis* |
| p. 175, line 24 | for: *Pilocratera novo-guianensiis* | read: *Pilicratera novoguinansis* |
| p. 190, line 8 | for: *potentillae anserinae* | read *potentillae-anserinae* |
| line 9 | for: *potentillae sterilis* | read: *potentillae-sterilis* |
| line 11 | for: *viciae sativae* | read: *viciae-sativae* |
| p. 214, tree, 2 from bottom: | for: *A. flettii* | read: *Albatrellus flettii* |
| tree, bottom entry: | for: *G. aculeatum* | read: *Gloeocystidiellum aculeatum* |
| p. 341, after line 24 | insert: *Placopyrenium stanfordii* (Herre) K. Knudsen, p. 310 | |

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# From the *Editor-in-Chief*

## To our Readers

With this volume, we reluctantly bid bon voyage to Mycotaxon friend and co-founder Grégoire L. Hennebert, who has edited all French language manuscripts for our journal since its founding in 1974. We take this opportunity to wish Grégoire a happy (and well deserved) leisure from Mycotaxon duties.

At the same time, it is our pleasure to welcome — as new French Language Editor — Grégoire's fellow Belgian and 'hand-picked' successor: Cony Decock, Curator of MUCL (Mycothèque de l'Université catholique de Louvain), well-respected basidiomycete systematist, and frequent Mycotaxon contributor.

Mycotaxon 98 begins with Pennycook's two impeccably researched annotated indices (98: 1-117) to all the 'generic, specific, and varietal taxa' accepted in Fries's 1838 Epicrisis Systematis Mycologici that are bound to be welcomed by page-rifflers seeking to master friesian taxonomic concepts in a hurry. Our new running headers should help browsers find at least one paper of interest among the 25 other fine taxonomic contributions in the volume. We tantalize again with color (Frank & al., p. 256), summarize three more distributional weblists, and offer glimpses into 26 books that might possibly merit space on your library shelves. Enjoy.

## The '4-step' Mycotaxon submission process

Mycotaxon's instructions pdf (updated in 2006), which can be downloaded from the Instructions to Authors webpage on www.mycotaxon.com, provides more information than the abbreviated version last published in Mycotaxon (94: 401–411). As we continue to simplify submission protocols, we urge prospective authors to download other guides by clicking the 'file download page' link on the instructions page and to read the Editor's blog [www.mycotaxon.com/about/weblog.html] for last minute changes before submitting to the journal.

Step 1—PEER REVIEW: Authors send a formatted text document with illustration files and Mycotaxon Reviewer checklist to two experts for peer review. Authors should (i) make certain that both peer reviewers have Emailed the checklist forms to the *Editor-in-Chief* and (ii) revise their manuscript according to reviewer suggestions before submitting a master text file to the *Nomenclature Editor* for nomenclatural review.

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Lorelei L. Norvell, Editor-in-Chief
Pacific Northwest Mycology Service
6720 NW Skyline Boulevard
Portland, OR 97229, U.S.A

Shaun R. Pennycook, Nomenclature Editor
PennycookS@LandcareResearch.co.nz
Manaaki Whenua Landcare Research
Auckland, New Zealand

David L. Hawksworth
Book Review Editor
MycoNova, Calle Aguila 12
Colonia La Maliciosa, Mataelpino
ES-28411 Madrid, Spain

Karen D. Gettelman
Index Editor
510 Lake Blvd., Apt. 166
Davis, CA 95616
U.S.A.

Cony Decock
French Language Editor
Place Croix du Sud 3
B-1340 Louvain-la-Neuve
Belgium

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