Fungal Diversity
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Fungal diversity notes 111–252—taxonomic and phylogenetic contributions to fungal taxa

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Abstract This paper is a compilation of notes on 142 fungal taxa, including five new families, 20 new genera, and 100 new species, representing a wide taxonomic and geographic range. The new families, *Ascocylindricaceae*, *Caryosporaceae* and *Wicklowiaceae* (Ascomycota) are introduced based on their distinct lineages and unique morphology. The new Dothideomycete genera *Pseudomassariosphaeria* (*Amniculicolaceae*), *Heracleicola*, *Neodidymella* and *Pseudomicrosphaeriopsis* (*Didymellaceae*), *Pseudopithomyces* (*Didymosphaeriaceae*), *Brunneoclavispora*, *Neolophiostoma* and *Sulcosporium* (*Halotthiaceae*), *Lophiohelichrysum* (*Lophiostomataceae*), *Galliicola*, *Populocrescentia* and *Vagicola* (*Phaeosphaeriaceae*), *Ascocylindrica* (*Ascocylindricaceae*), *Elongatopedicellata* (*Roussoellaceae*), *Pseudoasteromassaria* (*Latoruaceae*) and *Pseudomonodictys* (*Macrodiplodiopsidaceae*) are introduced. The newly described species of Dothideomycetes (Ascomycota) are *Pseudomassariosphaeria bromicola* (*Amniculicolaceae*), *Flammeascoma lignicola* (*Anteagloniaceae*), *Ascocylindrica marina* (*Ascocylindricaceae*), *Lembosia xyliae* (*Asterinaceae*), *Diplodia crataegicola and Diplodia galiicola* (*Botryosphaeriaceae*), *Caryospora aquatica* (*Caryosporaceae*), *Heracleicola premilcurensis and Neodidymella thailandicum* (*Didymellaceae*), *Pseudopithomyces palmicola* (*Didymosphaeriaceae*), *Floricola viticola* (*Floricolaceae*), *Brunneoclavispora bambusae*, *Neolophiostoma pigmentatum and Sulcosporium thailandica* (*Halotthiaceae*), *Pseudoasteromassaria fagi* (*Latoruaceae*), *Keissleriella dactylidicola* (*Lentitheciaceae*), *Lophiohelichrysum helichrysi* (*Lophiostomataceae*), *Aquasubmersa japonica* (*Lophiotremataceae*), *Pseudomonodictys tectonae* (*Macrodiplodiopsidaceae*), *Microthyrium buxicola and Tumidispora shoreae* (*Microthyriaceae*), *Alloleptosphaeria clematidis*, *Allophaeosphaeria cytisi*, *Allophaeosphaeria subcylindrospora*, *Dematiopleospora luzulae*, *Entodesmium artemisiae*, *Galiicola pseudophaeosphaeria*, *Loratospora*

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luzulae, *Nodulosphaeria senecionis*, *Ophiosphaerella aquaticus*, *Populocrescentia forlicesenensis and Vagicola vagans* (*Phaeosphaeriaceae*), *Elongatopedicellata lignicola*, *Roussoella magnatum and Roussoella angustior* (*Roussoellaceae*) and *Shrungabeeja longiappendiculata* (*Tetraploasphaeriaceae*). The new combinations *Pseudomassariosphaeria grandispora*, *Austropleospora archidendri*, *Pseudopithomyces chartarum*, *Pseudopithomyces maydicus*, *Pseudopithomyces sacchari*, *Vagicola vagans*, *Punctulariopsis cremeoalbida* and *Punctulariopsis efibulata* Dothideomycetes. The new genera *Dictyosporella* (*Annulatascaceae*), and *Tinhaudeus* (*Halosphaeriaceae*) are introduced in Sordariomycetes (Ascomycota) while *Dictyosporella aquatica* (*Annulatascaceae*), *Chaetosphaeria rivularia* (*Chaetosphaeriaceae*), *Beauveria gryllotalpidicola* and *Beauveria loeiensis* (*Cordycipitaceae*), *Seimatosporium sorbi* and *Seimatosporium pseudorosarum* (*Discosiaceae*), *Colletotrichum aciculare*, *Colletotrichum fusiforme* and *Colletotrichum hymenocallidicola* (*Glomerellaceae*), *Tinhaudeus formosanus* (*Halosphaeriaceae*), *Pestalotiopsis subshorea* and *Pestalotiopsis dracaenea* (*Pestalotiopsiceae*), *Phaeoacremonium tectonae* (*Togniniaceae*), *Cytospora parasitica* and *Cytospora tanaitica* (*Valsaceae*), *Annulohypoxylon palmicola*, *Biscogniauxia effusae* and *Nemania fusoideis* (*Xylariaceae*) are introduced as novel species to order Sordariomycetes. The newly described species of Eurotiomycetes are *Mycocalicium hyaloparvicellulum* (*Mycocaliciaceae*). *Acarospora septentrionalis* and *Acarospora castaneocarpa* (*Acarosporaceae*), *Chapsa multicarpa* and *Fissurina carassensis* (*Graphidaceae*), *Sticta fuscotomentosa* and *Sticta subfilicinella* (*Lobariaceae*) are newly introduced in class Lecanoromycetes. In class Pezizomycetes, *Helvella pseudolacunosa* and *Helvella rugosa* (*Helvellaceae*) are introduced as new species. The new families, *Dendrominiaceae* and *Neoantrodiellaceae*

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(Basidiomycota) are introduced together with a new genus *Neoantrodiella* (*Neoantrodiellaceae*), here based on both morphology coupled with molecular data. In the class *Agaricomycetes*, *Agaricus pseudolangei*, *Agaricus haematinus*, *Agaricus atrodiscus* and *Agaricus exilissimus* (*Agaricaceae*), *Amanita melleialba*, *Amanita pseudosychnopyramis* and *Amanita subparvipantherina* (*Amanitaceae*), *Entoloma calabrum*, *Cora barbulata*, *Dictyonema gomezianum* and *Inocybe granulosa* (*Inocybaceae*), *Xerocomellus sarnarii* (*Boletaceae*), *Cantharellus eucalyptorum*, *Cantharellus nigrescens*, *Cantharellus tricolor and Cantharellus variabilicolor* (*Cantharellaceae*), *Cortinarius alboamarescens*, *Cortinarius brunneoalbus*, *Cortinarius ochroamarus*, *Cortinarius putorius* and *Cortinarius seidlii* (*Cortinariaceae*), *Hymenochaete micropora* and *Hymenochaete subporioides* (*Hymenochaetaceae*), *Xylodon ramicida* (*Schizoporaceae*), *Colospora andalasii* (*Polyporaceae*), *Russula guangxiensis* and *Russula hakkae* (*Russulaceae*), *Tremella dirinariae*, *Tremella graphidis* and *Tremella pyrenulae* (*Tremellaceae*) are introduced. Four new combinations *Neoantrodiella gypsea*, *Neoantrodiella thujae* (*Neoantrodiellaceae*), *Punctulariopsis cremeoalbida*, *Punctulariopsis efibulata* (*Punctulariaceae*) are also introduced here for the division Basidiomycota. Furthermore *Absidia caatinguensis*, *Absidia koreana* and *Gongronella koreana* (*Cunninghamellaceae*), *Mortierella pisiformis* and *Mortierella formosana* (*Mortierellaceae*) are newly introduced in the Zygomycota, while *Neocallimastix cameroonii* and *Piromyces irregularis* (*Neocallimastigaceae*) are introduced in the Neocallimastigomycota. Reference specimens or changes in classification and notes are provided for *Alternaria ethzedia*, *Cucurbitaria ephedricola*, *Austropleospora*, *Austropleospora archidendri*, *Byssosphaeria rhodomphala*, *Lophiostoma caulium*, *Pseudopithomyces maydicus*, *Massariosphaeria*, *Neomassariosphaeria* and *Pestalotiopsis montellica*.

Keywords Fungi · Taxonomy · New genus · New species · Phylogeny

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194. ***Colletotrichum aciculare*** Jayawardena, Y. Than, N. Tangthir., K.D. Hyde, ***sp. nov.***
195. ***Colletotrichum fusiforme*** Jayawardena, J. Bhat, N. Tangthir., K.D. Hyde, ***sp. nov.***
196. ***Colletotrichum hymenocallidicola*** Chethana, Tangthirasunun, Jayawardena & K.D. Hyde, ***sp. nov.***

Halosphaeriaceae

197. ***Tinhaudeus*** K.L. Pang, S.Y. Guo & E.B.G. Jones, ***gen. nov.***

198. ***Tinhaudeus formosanus*** K.L. Pang, S.Y. Guo & E.B.G. Jones, ***sp. nov.***

Pestalotiopsiceae

199. ***Pestalotiopsis subshorea*** Yong Wang bis, Y. Song, K. Geng & K.D. Hyde, ***sp. nov.***
200. ***Pestalotiopsis dracaenea*** Yong Wang bis, Y. Song, K. Geng & K.D. Hyde, ***sp. nov.*** Wang Yong
201. ***Pestalotiopsis montellica*** (Sacc. & Voglino) Tak.Kobay. ***Togniniaceae***
202. ***Phaeoacremonium tectonae*** Doilom & K.D. Hyde, ***sp. nov.***

Valsaceae

203. ***Cytospora parasitica*** Norphanphoun, Bulgakov & K.D. Hyde, ***sp. nov.***
204. ***Cytospora tanaitica*** Norphanphoun, Bulgakov & K.D. Hyde, ***sp. nov.***

Xylariaceae

205. ***Annulohypoxylon palmicola*** J.K Liu & K.D Hyde, ***sp. nov.***
206. ***Biscogniauxia effusae*** Q.R. Li, J.C. Kang & K.D. Hyde, ***sp. nov.***
207. ***Nemania fusoideis*** Q.R. Li, J.C. Kang & K.D. Hyde, ***sp. nov.***

Basidiomycota
Class *Agaricomycetes*
Subclass *Agaricomycetidae*
Order *Agaricales*
Agaricaceae

208. ***Agaricus pseudolangei*** K.D. Hyde & R.L. Zhao, ***sp. nov.***
209. ***Agaricus haematinus*** K.D. Hyde & R.L. Zhao, ***sp. nov.***
210. ***Agaricus atrodiscus*** L.J. Chen, Callac, R.L. Zhao & K.D. Hyde, ***sp. nov.***
211. ***Agaricus exilissimus*** L.J. Chen, Callac, R.L. Zhao & K.D. Hyde, ***sp. nov.***

Amanitaceae

212. ***Amanita melleialba*** Zhu L. Yang, Q. Cai & Yang Y. Cui, ***sp. nov.***
213. ***Amanita pseudosychnopyramis*** Yang Y. Cui, Q. Cai & Zhu L. Yang, ***sp. nov.***
214. ***Amanita subparvipantherina*** Zhu L. Yang, Q. Cai & Yang Y. Cui, ***sp. nov.***

Entolomataceae

215. ***Entoloma calabrum*** Battistin, Marsico, Vizzini, Vila & Ercole, ***sp. nov.***

Hygrophoraceae

216. ***Cora barbulata*** **Lücking,** Dal-Forno & Lawrey, ***sp. nov.***
217. ***Dictyonema gomezianum*** Lücking, Dal-Forno & Lawrey, ***sp. nov.***

Inocybaceae

218. ***Inocybe granulosa*** Jacobsson & E. Larss. ***sp. nov.***

Order *Boletales*
Boletaceae

219. ***Xerocomellus sarnarii*** Simonini, Vizzini & Eberhardt, ***sp. nov.***

Order *Cantharellales*
Cantharellaceae

220. ***Cantharellus eucalyptorum*** Buyck, Randrianjohany & V. Hofstetter ***sp. nov.***
221. ***Cantharellus nigrescens*** Buyck, Randrianjohany & V. Hofstetter ***sp. nov.***
222. ***Cantharellus tricolor*** Buyck, Randrianjohany & V. Hofstetter ***sp. nov.***
223. ***Cantharellus variabilicolor*** Buyck, Randrianjohany & V. Hofstetter ***sp. nov.***

Order *Cortinariales*
Cortinariaceae

224. ***Cortinarius alboamarescens*** Kytöv., Niskanen & Liimat., ***sp. nov.***
225. ***Cortinarius brunneoalbus*** Ammirati, Liimat. & Niskanen, ***sp. nov.***
226. ***Cortinarius ochroamarus*** Niskanen, Kytöv. & Liimat., ***sp. nov.***
227. ***Cortinarius putorius*** Niskanen, Liimat. & Ammirati, ***sp. nov.***
228. ***Cortinarius seidlii*** Ammirati, Niskanen & Liimat., ***sp. nov.***

Dendrominiaceae

229. ***Dendrominiaceae*** Ghobad-Nejhad, ***fam. nov.***

Punctulariaceae

230. ***Punctulariopsis cremeoalbida*** (M.J. Larsen & Nakasone) Ghobad-Nejhad, ***comb. nov.***
231. ***Punctulariopsis efibulata*** (M.J. Larsen & Nakasone) Ghobad-Nejhad, ***comb. nov.***

Order *Hymenochaetales*
Hymenochaetaceae

232. ***Hymenochaete micropora*** L.W. Zhou & Y.C. Dai, ***sp. nov.***
233. ***Hymenochaete subporioides*** L.W. Zhou & Y.C. Dai, ***sp. nov.***

Neoantrodiellaceae

234. ***Neoantrodiellaceae*** Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan, ***fam. nov.***
235. ***Neoantrodiella*** Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan, ***gen. nov.***
236. ***Neoantrodiella gypsea*** (Yasuda) Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan, ***comb. nov.***
237. ***Neoantrodiella thujae*** (Y.C. Dai & H.S. Yuan) Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan, ***comb. nov.***

Schizoporaceae

238. ***Xylodon ramicida*** Spirin & Miettinen, ***sp. nov.***

Order *Polyporales Polyporaceae*

239. ***Colospora*** Miettinen & Spirin, ***gen. nov***
240. ***Colospora andalasii*** Miettinen & Spirin, ***sp. nov***

Order *Russulales*
Russulaceae

241. ***Russula guangxiensis*** G. J. Li, H.A. Wen & R.L. Zhao, ***sp. nov.***
242. ***Russula hakkae*** G. J. Li, H. A. Wen & R.L. Zhao, ***sp. nov.***

Order *Tremellales*
Tremellaceae

243. ***Tremella dirinariae*** Diederich, Millanes & Wedin, ***sp. nov.***
244. ***Tremella graphidis*** Diederich, Millanes, Wedin & Common, ***sp. nov.***
245. ***Tremella pyrenulae*** Diederich, Millanes, Wedin & Common, ***sp. nov.***

Zygomycota
Mucoromycotina
Order *Mucorales*
Cunninghamellaceae

246. ***Absidia caatinguensis*** D.X. Lima & A.L. Santiago, ***sp. nov.***
247. ***Absidia koreana*** H.B. Lee, H.W. Lee & T.T.T. Nguyen, ***sp. nov***
248. ***Gongronella koreana*** H.B. Lee & T.T.T. Nguyen, ***sp. nov***

Mortierellaceae

249. ***Mortierella pisiformis*** H.M. Ho, S.F. Wei & K. Voigt, ***sp. nov.***
250. ***Mortierella formosana*** S.F. Wei, H.M. Ho & K. Voigt, ***sp. nov.***

Neocallimastigomycota
Neocallimastigomycetes
Order *Neocallimastigales*
Neocallimastigaceae

251. ***Neocallimastix cameroonii*** G.W. Griff., Dollhofer, Veronika & Callaghan, Tony, ***sp. nov.***
252. ***Piromyces irregularis*** Fliegerová, K. Voigt & P.M. Kirk, ***sp. nov.***

Introduction

This is the second in a series of papers where we provide notes on new species, reference specimens and other taxonomic changes.

Materials and methods

The phylogenetic analyses were performed based on up to date ex-type, or otherwise authentic sequence data available in GenBank as a concerted effort of multiple contributors listed in the authors section. New and reference species were sequenced based on the genomic DNA which was extracted from the growing mycelium. For lichenized and lichenicolous fungi and fungi not readily cultivatable, DNA was extracted directly from the ascomata or basidiomata. Gene sequences and genetic markers used for each genus were selected based on current publications and have commonly been used for each of the genera and families. Multiple sequence alignments were generated with MAFFT v. 6.864b (http://mafft.cbrc.jp/alignment/server/index.html) or BioEdit 7.0 (Hall 2004). The alignments were checked visually and improved manually where necessary. All introns and exons were aligned separately. Regions containing many leading or trailing gaps were removed from the alignments prior to tree building. The single gene alignments were then concatenated and used to construct the backbone trees of each group listed. The phylogenetic analyses were performed for maximum parsimony in PAUP v. 4.0b10 (Swofford 2002), maximum likelihood in CIPRES webportal (Miller et al. 2009) using RAxML v. 7.2.7 -HPC2 or RAxML 7.4.2 Black Box (Stamatakis 2006; Stamatakis et al. 2008) or RAxML GUI (Stamatakis 2006; Silvestro and Michalak 2011), PhyML 3.0 (Guindon et al. 2010) and Bayesian inference in MrBayes v. 3.2 (Huelsenbeck and Ronquist 2001) as specified in the legend of each phylogenetic tree. The trees used to represent each order, family and genus were analysed by multiple contributors based on the selection of genes in given publications under each description. The newly generated sequence data are listed in Table 1.

Colour terminology and alphanumeric codes are those of Kornerup and Wanscher (1978) and Seguy (1936). Faces of fungi numbers and Index Fungorum numbers were obtained as detailed in Jayasiri et al. (2015) and Index Fungorum (2015).

Results and discussion

Phylogeny

The data for the aligned sequence matrices for the trees obtained in the different studies are provided below. In the case that alignments of multi-genes are involved, the topologies of the obtained trees for each gene were compared manually to confirm that the overall tree topology of the individual datasets were similar to each other and to that of the tree obtained from the combined alignment.

Contributions to Ascomycota

Dothideomycetes

Amniculicolaceae Y. Zhang et al.

The family was introduced in Zhang et al. (2009a) and comprised *Amniculicola*, *Rubicola* and *Neomassariosphaeria*. Wanasinghe et al. (2015) added six new species to *Murispora* and provided a backbone tree to the family (Fig. 1). In this paper we transfer *Neomassariosphaeria* to *Lindgomycetaceae* and *Massariosphaeria* to Thyridariaceae and introduce a new genus *Pseudomassariosphaeria*. Members of this family are generally distributed in aquatic habitat as saprobes (Ingold 1942; Voglmayr 2004; Zhang et al. 2009a, b). The family *Amniculicolaceae* is characterized by ascomata with a rough black surface, usually staining the woody substrate purple, and short-pedicellate asci bearing hyaline, reddish-brown or pale, 1 to multi-septate or muriform ascospores, generally with a hyaline mucilaginous sheath (Zhang et al. 2009b).

111. ***Pseudomassariosphaeria*** Phukhamsakda, Ariyawansa, Camporesi & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551367; *Facesoffungi number*: FoF00916

Etymology: In reference to its similarity with *Massariosphaeria*.

Saprobic on dead stems. **Sexual morph**: *Ascomata* solitary, globose, erumpent or rarely superficial, black to dark brown, smooth-walled, papillate, ostiolate with periphyses. *Peridium* comprising two strata, outer stratum composed of 3–5 layers of light to dark brown cells of *textura angularis*, inner stratum comprising 1–2 layers of hyaline flattened cells. *Hamathecium* comprising 1.2–2.6 μm wide, filiform, anastomosing, hyaline, transversely septate, long, cellular pseudoparaphyses, embedded in a gelatinous matrix. *Asci* (7-)8-spored, bitunicate, fisitunicate, cylindrical to clavate, short pedicellate, apically rounded with an ocular chamber. *Ascospores* biseriate or overlapping, hyaline, fusiform to lunate, narrow towards the apex, 8–9-septate, constricted at septum, granulate, surrounded by a wide mucilaginous sheath. **Asexual morph**: Undetermined.

Type species: ***Pseudomassariosphaeria bromicola*** Phukhamsakda, Ariyawansa, Camporesi & K.D. Hyde

Notes: *Pseudomassariosphaeria bromicola*, is introduced from a dead terrestrial stem of *Bromus sterilis* L. (*Poaceae*). The ascospores are 21–36 × 4–9 μm, $\bar{x} = 31 \times 7\,\mu m$, $n=50$, and have fewer septa (8–9), and are not strongly constricted at the septa. *Pseudomassariosphaeria bromicola* is somewhat similar to *Neomassariosphaeria grandispora sensu* Zhang et al. (2009a). Both *Pseudomassariosphaeria* species group with *Murispora rubicola* with weak support, with various other genera in a well-supported subclade in the family *Amniculicolaceae*. The putatively named sequence of *Pseudomassariosphaeria grandispora* (Zhang et al. 2009a) is based on sequence data from a specimen collected from driftwood of *Alnus glutinosa* from the banks of Garonne River in France. In this French specimen (JF 07103), the ascospores are 38–42 × 6–6.8 μm, narrowly fusiform with acute ends,

Table 1 Newly generated sequence data from this study

Species name	LSU	SSU	ITS	EF	RPB-2	β-tubulin -	Actin (ACT)	GADPH	CHS	mtSSU
Agaricus atrodiscus			KT284912							
Agaricus exilissimus			KT284910							
Agaricus exilissimus			KT284911							
Agaricus haematinus			KT284913							
Absidia caatinguensis	KT308170		KT308168							
Absidia koreana	KR030056	KT321298	KR030062	KR030060			KR030058			
Acarospora castaneocarpa	LN836019		LN836019			LN836021				LN836023
Acarospora septentrionalis	LN836018		LN836018			LN836020				LN836022
Allophaeosphaeria clematidis	KT306953	KT306956	KT306949							
Allophaeosphaeria cytisi	KT306950	KT306954	KT306947							
Allophaerosphaeria subcylindrospora	KT314183	KT314185	KT314184							
Alternaria ethzedia	KT281914	KT281916	KT281913		KT281913					
Annulohypoxylon palmicola	KT369003	KT369004	KT369002							
Aquasubmersa japonica	LC061586	LC061581	LC061591							
Aquasubmersa japonica	LC061587	LC061582	LC061592							
Aquasubmersa japonica	LC061588	LC061583	LC061593							
Ascocylindrica marina	KT252906	KT252907								
Ascocylindrica marina	KT252905									
Beauveria gryllotalpidicola	–	–	FJ459787	FJ459795	–	–				
Beauveria gryllotalpidicola	–	–	FJ584321	FJ584323	–	–				
Beauveria loeiensis	–	–	FJ459784	FJ459792	–	–				
Beauveria loeiensis	–	–	FJ459785	FJ459793	–	–				
Beauveria loeiensis	–	–	FJ459786	FJ459794	–	–				
Byssosphaeria rhodomphala	KT313008			KT313006						
Brunneoclavispora bambusae	KT426562									
Chaetosphaeria rivularia	KR347357		KR347356							
Colletotrichum aciculare			KT290265			–	KT290250	KT290254	KT290252	
Colletotrichum fusiforme			KT290266			KT290256	KT290251	KT290255	KT290253	
Colletotrichum hymenocallidicola			KT290264			KT290261	KT290260	KT290263	KT290262	
Colospora andalasii	KT361629		KT361629							
Cora barbulata			KJ780605							
Cora barbulata			KJ780606							
Cora barbulata			KJ780604							
Cora barbulata			EU825961							
Cora barbulata			KJ780602							

Table 1 (continued)

Species name	LSU	SSU	ITS	EF	RPB-2	β-tubulin -	Actin (ACT)	GADPH	CHS	mtSSU
Cordyceps gryllotalpidicola			FJ459787	FJ459795						
Cordyceps gryllotalpidicola			FJ584321	FJ584323						
Cortinariusalboamarescens			KR011134							
Cortinariusalboamarescens			KR011135							
Cortinariusalboamarescens			KR011136							
Cortinariusalboamarescens			KR011137							
Cortinariusbrunneoalbus			KR011128							
Cortinariusbrunneoalbus			KR011129							
Cortinariusochroamarus			KR011131							
Cortinariusochroamarus			KR011132							
Cortinariusochroamarus			KR011133							
Cortinariusputorius			KR011123							
Cortinariusputorius			KR011124							
Cortinariusseidlii			KR011125							
Cortinariusseidlii			KR011126							
Cortinariusseidlii			KR011127							
Cucurbitaria ephedricola	KT313007	KT313005								
Cytospora parasitica	KT459409	KT459408					KT459410			
Cytospora tanaitica	KT459412	KT459411					KT459413			
Dematiopleospora luzulae	KT306951									
Dictyosporella aquatica	KT241022	KT241023								
Diplodia crataegicola			KT290244	KT290248		KT290246				
Diplodia galiicola			KT290245	KT290249		KT290247				
Entodesmium artemisiae	KT315509		KT315508							
Entoloma calabrum	KT271742		KT271741							
Erythromyces crocicreas			KT361630							
Fissurina carassensis										JX421044
Flammeascoma lignicola	KT324583	KT324584	KT324582	KT324585	KT324586					
Floricola viticola	KT305993	KT305995	KT305997							
Galliicola pseudophaeosphaeria	KT326693	–	KT326692							
Gongronella koreana	KP835542	KT321301	KP835545	KP835544			KP835543			
Heracleicola premilcurensis	KT326695	–	KT326694							
Helvella pseudolacunosa			KR 493476							
Helvella rugosa			KR494375	KT254518	KT254582					
Hymenochaete porioides (Cui 8555)			KT238049							

Table 1 (continued)

Species name	LSU	SSU	ITS	EF	RPB-2	β-tubulin -	Actin (ACT)	GADPH	CHS	mtSSU
Hymenochaete porioides (LWZ 20140719-1)			KT238050							
Hymenochaete subporioides (Cui 10163)			KT238051							
Inocybe granulosa	KR029725		KR029725							
Inocybe granulosa	KR029726		KR029726							
Inocybe granulosa	KR029727		KR029727							
Inocybe granulosa	KR029728		KR029728							
Inocybe granulosa	KR029729		KR029729							
Keissleriella dactylidicola	KT315506	KT315505		KT315507						
Lembosia xyliae	KT283685									
Lophiohelichrysum helichrysi	KT333436	KT333437	KT333435							
Lophiostomacaulium	KT328493	KT328494								
Loratosporaluzulae	KT328495	KT328496	KT328497							
Microthyrium buxicola	KT306551	KT306549								
Microthyrium buxicola	KT306552	KT306550								
Mortierella formosana	KP744410	–	KP744428							
Mortierella pisiformis	KP744395	–	KP744416							
Mycocalicium hyaloparvicellulum	KR920005		KR920004							
Neoantrodiella gypsea	KT203311		KT203290		KT210367					KT203332
Neoantrodiella gypsea	KT203312		KT203291		–					
Neoantrodiella gypsea	KT203313		KT203292		–					
Neoantrodiella thujae	KT203314		KT203293		KT210368					KT203333
Neocallimastix cameroonii	KR920745	–	–							
Neolophiostoma pigmenatum	KT324588	KT324589	KT324587	KT324590						
Nodulosphaeria senecionis	KT290257	KT290259	KT290257							
Pestalotiopsis montelica			JX399012	JX399076		JX399043				
Phaeoacremonium tectonae						KT285563	KT285555			
Phaeoacremonium tectonae						KT285564	KT285556			
Phaeoacremonium tectonae						KT285565	KT285557			
Phaeoacremonium tectonae						KT285566	KT285558			
Phaeoacremonium tectonae						KT285567	KT285559			
Phaeoacremonium tectonae						KT285568	KT285560			
Phaeoacremonium tectonae						KT285569	KT285561			
Phaeoacremonium tectonae						KT285570	KT285562			
Phaeoacremonium tectonae	KT285573	KT285574		KT285572	KT285571					

Table 1 (continued)

Species name	LSU	SSU	ITS	EF	RPB-2	β-tubulin -	Actin (ACT)	GADPH	CHS	mtSSU
Piromyces irregularis	KT305990	KT305989	KT305991							
Populocrescentia forlicesenensis	KT306952	KT306955	KT306948							
Pseudoasteromassaria fagi	LC061589	LC061584	LC061594							
Pseudoasteromassaria fagi	LC061590	LC061585	LC061595							
Pseudomassariosphaeria bromicola	KT305994	KT305996	KT305998	KT305999						
Punctulariopsis cremeoalbida			KR494275							
Punctulariopsis efibulata	KR494277		KR494276							
Roussoella angustior	KT28197									
Roussoella magnatum	KT281980									
Russula guangxiensis			KT286852							
Russula guangxiensis			KT286853							
Russula guangxiensis			KT286854							
Russula guangxiensis			KT286855							
Russula hakkae			KT286847							
Russula hakkae			KT286848							
Russula hakkae			KT286849							
Russula hakkae			KT286850							
Russula hakkae			KT286851							
Saagaromyces abonnis	KT159902									
Saagaromyces abonnis	KT159903									
Saagaromyces abonnis	KT159904	KT159900								
Saagaromyces abonnis	KT159905	KT159901								
Seimatosporium pseudorosarum	KT281912		KT284775							
Seimatosporium sorbi	KT281911		KT284774							
Shrungabeeja longiappendiculata	KT376472	KT376471	KT376474							
Shrungabeeja longiappendiculata	KT376473		KT376475							
Sticta fuscotomentosa			KC732661							
Sticta subfilicinella			KT354937							
Sulcosporium thailandica	KT426563	KT426564								
Theleporus venezuelicus			KT361631							
Tinhaudeus formosanus	KT159899	KT159897								
Tinhaudeus formosanus	KT159898	KT159896								
Tremella dirinariae	KR058785		KR058780							
Tremella graphidis	KR058786		KR058781							
Tremella phaeographinae-a	KR058787		KR058782							

Table 1 (continued)

Species name	LSU	SSU	ITS	EF	RPB-2	β-tubulin -	Actin (ACT)	GADPH	CHS	mtSSU
Tremella phaeographinae-b	KR058788		KR058783							
Tremella pyrenulae	KR058789		KR058784							
Xerocomellus cisalpinus			KT271743							
Xerocomellus porosporus			KT271744							
Xerocomellus sarnarii			KT271745							
Xerocomellus sarnarii			KT271746							
Xerocomellus sarnarii			KT271747							
Xerocomellus sarnarii			KT271748							
Xerocomellus sarnarii			KT271749							
Xerocomellus sarnarii			KT271750							
Xerocomellus sarnarii			KT271751							
Xylodon quercinus			KT361633							
Xylodon quercinus			KT361632							
Xylodon ramicida			KT361634							

Fig. 1 Phylogram generated from maximum likelihood analysis based ▶ on combined LSU, SSU, RPB2 and EF sequence data of *Pleosporales*. Maximum likelihood bootstrap support values greater than 50 % are near the nodes. The ex-type strains are in *bold* and the new isolates are in *blue*. The tree is rooted with *Hysterium angustatum* CBS 236.34

hyaline, 10-septate, each cell guttulate and strongly constricted at all septa, and have a wide gelatinous sheath (J. Fournier, pers. comm.). In the type protologue of *Leptosphaeria grandispora* Sacc. ascospores are reported as 45×8–9 *μm*, fusoid, hyaline and 10-septate and the host is *Typha latifolia* L. (Saccardo 1878). In collections of *Massariosphaeria grandispora* by Tanaka and Harada (2004), ascospores were 35–41 (−44)×6.5–8 *μm*, 9- to 12-septate, hyaline, smooth-walled, granulate, with a sheath up to 20 μm wide, becoming brown at germination and the host was *Phragmites australis*.

112. ***Pseudomassariosphaeria bromicola*** Phukhamsakda, Ariyawansa, Camporesi & K.D. Hyde, ***sp. nov.***

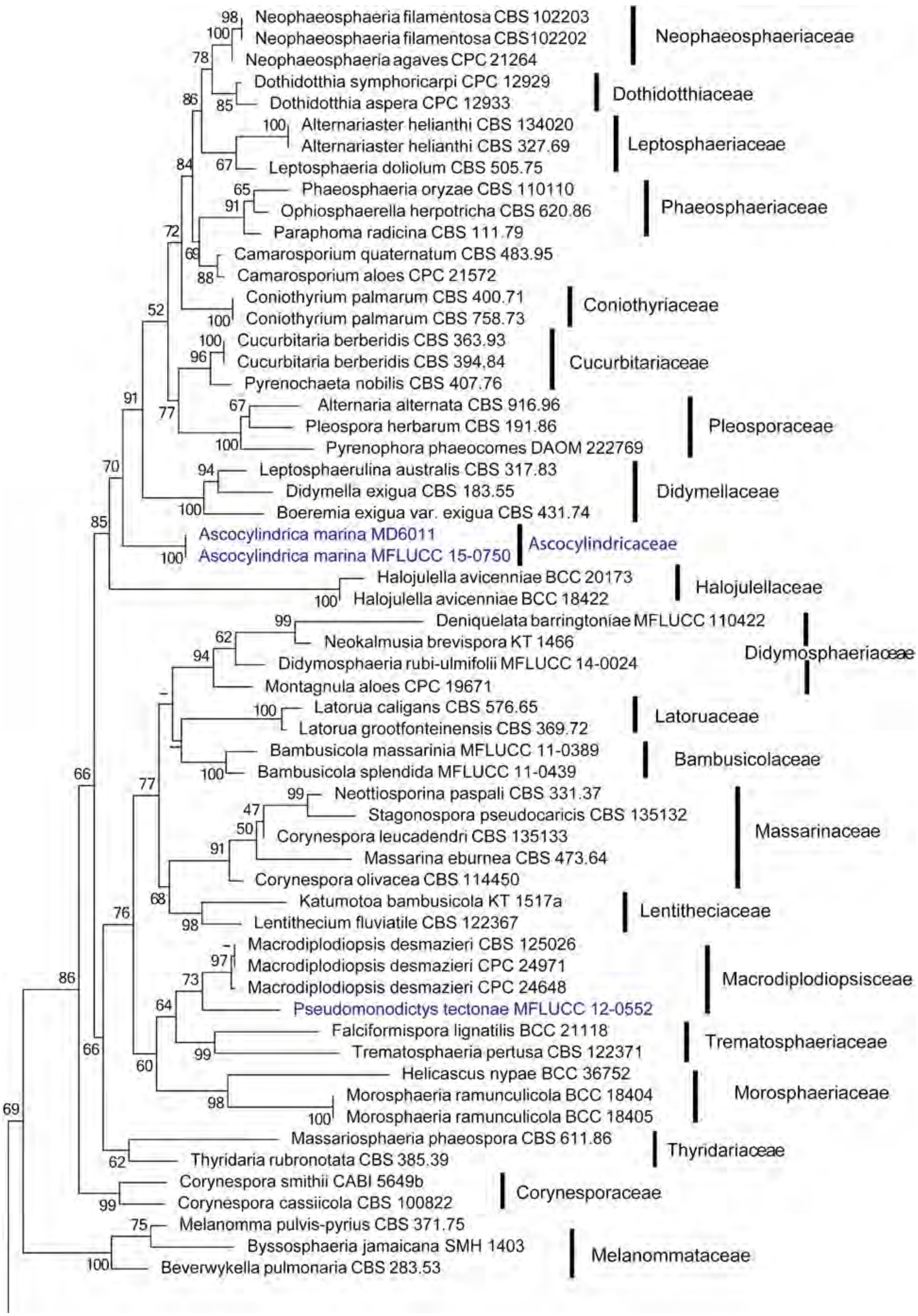
Index Fungorum number: IF551368; *Facesoffungi number*: FoF00917; Fig. 2

Holotype: MFLU 15–1403

Saprobic on dead stem of *Bromus sterilis*. **Sexual morph**: *Ascomata* 205–249 μm high×194–223 μm diam. ($\bar{x}$ = 233×208 μm, *n*=10), on the surface of the host, solitary, scattered or gregarious, globose, erumpent or rarely superficial, black to dark brown, smooth, papillate, ostiolate with periphysoids. *Peridium* comprising two strata, outer stratum composed of 3–5 layers of dark brown to light brown cells of *textura angularis*, inner stratum comprising with 1–2 layers of hyaline flattened cells. *Hamathecium* of dense, 1.2–2.6 μm ($\bar{x}$ = 2 μm, *n*=20), broad, filiform, anastomosing, hyaline, transversely septate, long, cellular psedoparaphyses, embedded in a gelatinous matrix. *Asci* 82–115×12–19 μm ($\bar{x}$ = 101×15 μm, *n*= 20), (7-)8-spored, bitunicate, fisitunicate, cylindrical to clavate, short pedicellate, apically round with ocular chamber up to 1–2 μm wide, 1–2 μm high. *Ascospores* 21–36×4–9 μm ($\bar{x}$ = 31×7 μm, *n*=50), bi-seriate or overlapping, hyaline, fusiform to lunate, narrow towards the apex, 8–9-septate, constricted at septum, granulate, surrounded with wide mucilaginous sheath, 5–7 μm wide at apex and base, and 10–12 μm wide at sides. **Asexual morph**: Undetermined.

Culture characteristics: Colonies on PDA, reaching 4 cm diam. after 4 weeks at 16 °C, with dense mycelia, circular, rough margin white, becoming dark olive brown (4F8) after 2 weeks, flat on the surface, without aerial mycelium, producing black oil droplets after 4 weeks, lobate at lower margin, dark brown to black. Hyphae septate branched, containing small granules, brown.

Material examined: ITALY, Forlì-Cesena Province, Fiumicello-Premilcuore, on dead stem of *Bromus sterilis* (*Poaceae*), 15 June 2013, E. Camporesi (MFLU 15–1403,


98
100
Neophaeosphaeria filamentosa CBS 102203
Neophaeosphaeria filamentosa CBS102202
78
Neophaeosphaeria agaves CPC 21264
Neophaeosphaeriaceae
Dothidotthia symphoricarpi CPC 12929
86
85
Dothidotthia aspera CPC 12933
Dothidotthiaceae
100
Alternariaster helianthi CBS 134020
Alternariaster helianthi CBS 327.69
84
67
Leptosphaeria doliolum CBS 505.75
Leptosphaeriaceae
65
Phaeosphaeria oryzae CBS 110110
91
Ophiosphaerella herpotricha CBS 620.86
72
Paraphoma radicina CBS 111.79
Phaeosphaeriaceae
69
Camarosporium quaternatum CBS 483.95
88
Camarosporium aloes CPC 21572
Coniothyrium palmarum CBS 400.71
52
100
Coniothyrium palmarum CBS 758.73
Coniothyriaceae
100
Cucurbitaria berberidis CBS 363.93
96
Cucurbitaria berberidis CBS 394.84
Pyrenochaeta nobilis CBS 407.76
Cucurbitariaceae
91
77
67
Alternaria alternata CBS 916.96
Pleospora herbarum CBS 191.86
100
Pyrenophora phaeocomes DAOM 222769
Pleosporaceae
70
94
Leptosphaerulina australis CBS 317.83
Didymella exigua CBS 183.55
100
Boeremia exigua var. exigua CBS 431.74
Didymellaceae
85
Ascocylindrica marina MD6011
100
Ascocylindrica marina MFLUCC 15-0750
Ascocylindricaceae
Halojulella avicenniae BCC 20173
100
Halojulella avicenniae BCC 18422
Halojulellaceae
99
Deniquelata barringtoniae MFLUCC 110422
62
Neokalmusia brevispora KT 1466
94
Didymosphaeria rubi-ulmifolii MFLUCC 14-0024
Didymosphaeriaceae
Montagnula aloes CPC 19671
-
100
Latorua caligans CBS 576.65
Latorua grootfonteinensis CBS 369.72
Latoruaceae
-
Bambusicola massarinia MFLUCC 11-0389
66
100
Bambusicola splendida MFLUCC 11-0439
Bambusicolaceae
77
99
Neottiosporina paspali CBS 331.37
47
Stagonospora pseudocaricis CBS 135132
50
Corynespora leucadendri CBS 135133
91
Massarina eburnea CBS 473.64
Massarinaceae
Corynespora olivacea CBS 114450
68
Katumotoa bambusicola KT 1517a
76
98
Lentithecium fluviatile CBS 122367
Lentitheciaceae
-
Macrodiplodiopsis desmazieri CBS 125026
97
Macrodiplodiopsis desmazieri CPC 24971
86
73
Macrodiplodiopsis desmazieri CPC 24648
Macrodiplodiopsisceae
64
Pseudomonodictys tectonae MFLUCC 12-0552
Falciformispora lignatilis BCC 21118
66
99
Trematosphaeria pertusa CBS 122371
Trematosphaeriaceae
60
Helicascus nypae BCC 36752
98
Morosphaeria ramunculicola BCC 18404
69
100
Morosphaeria ramunculicola BCC 18405
Morosphaeriaceae
Massariosphaeria phaeospora CBS 611.86
62
Thyridaria rubronotata CBS 385.39
Thyridariaceae
Corynespora smithii CABI 5649b
99
Corynespora cassiicola CBS 100822
Corynesporaceae
75
Melanomma pulvis-pyrius CBS 371.75
Byssosphaeria jamaicana SMH 1403
100
Beverwykella pulmonaria CBS 283.53
Melanommataceae

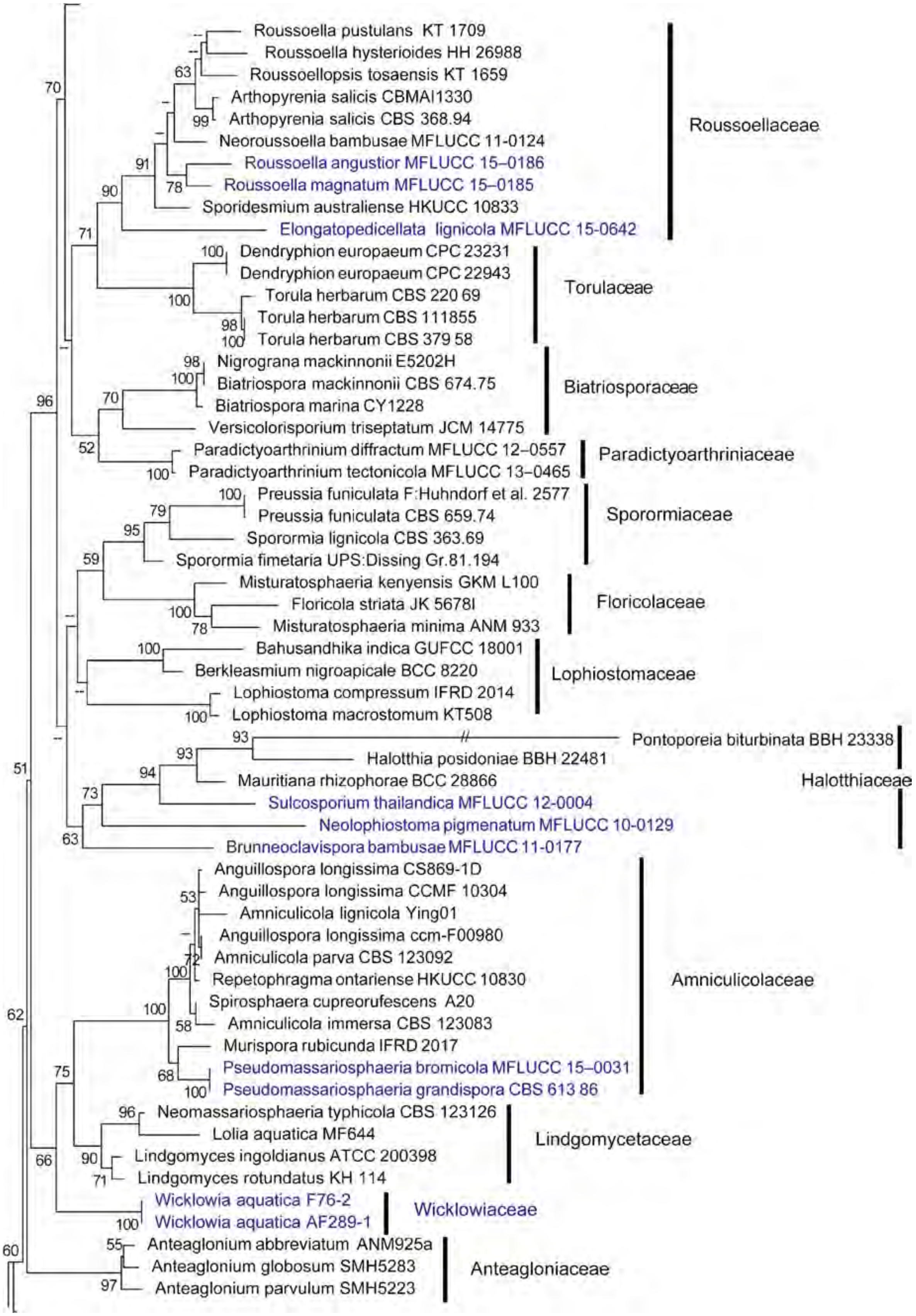


Fig. 1 (continued)

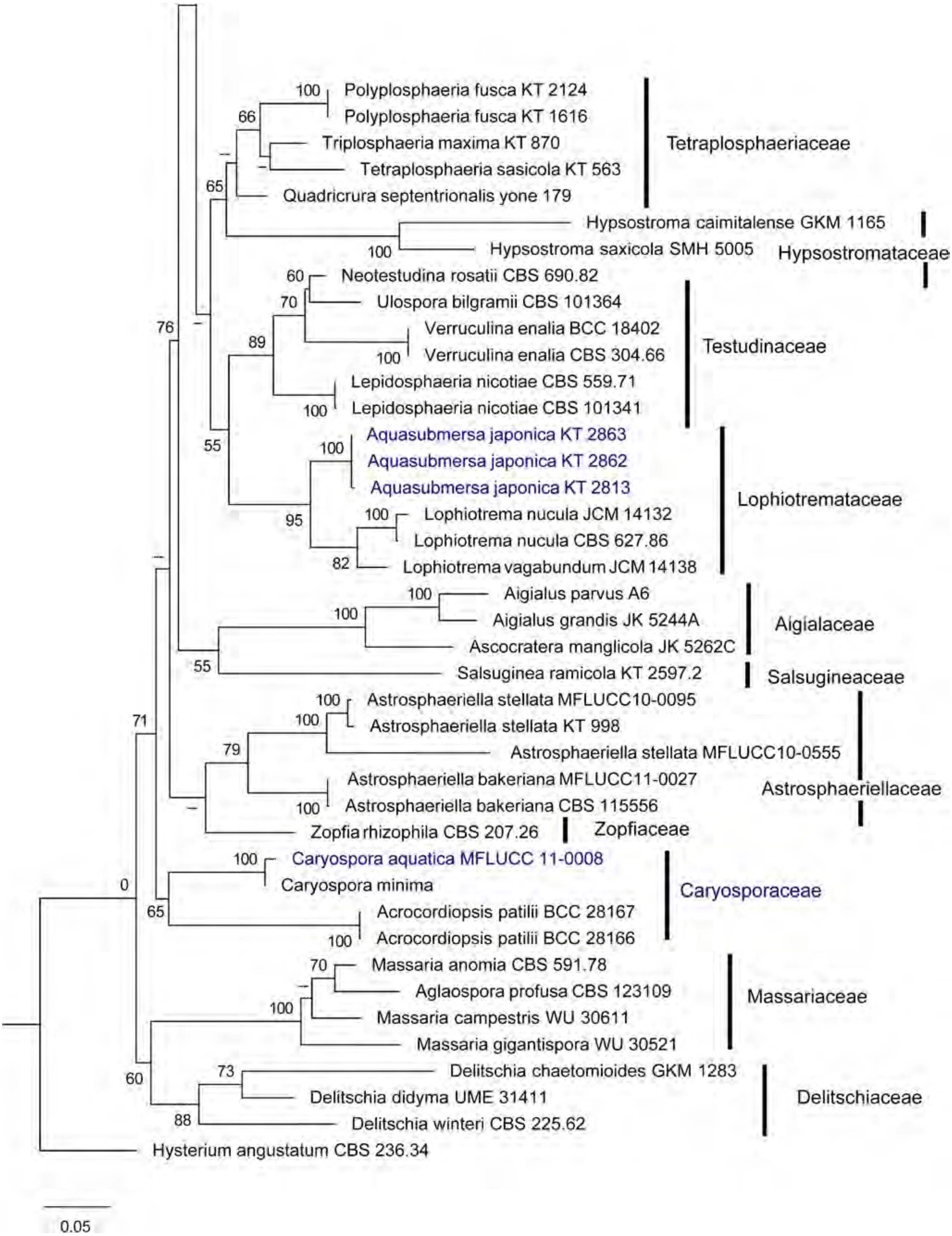


Fig. 1 (continued)

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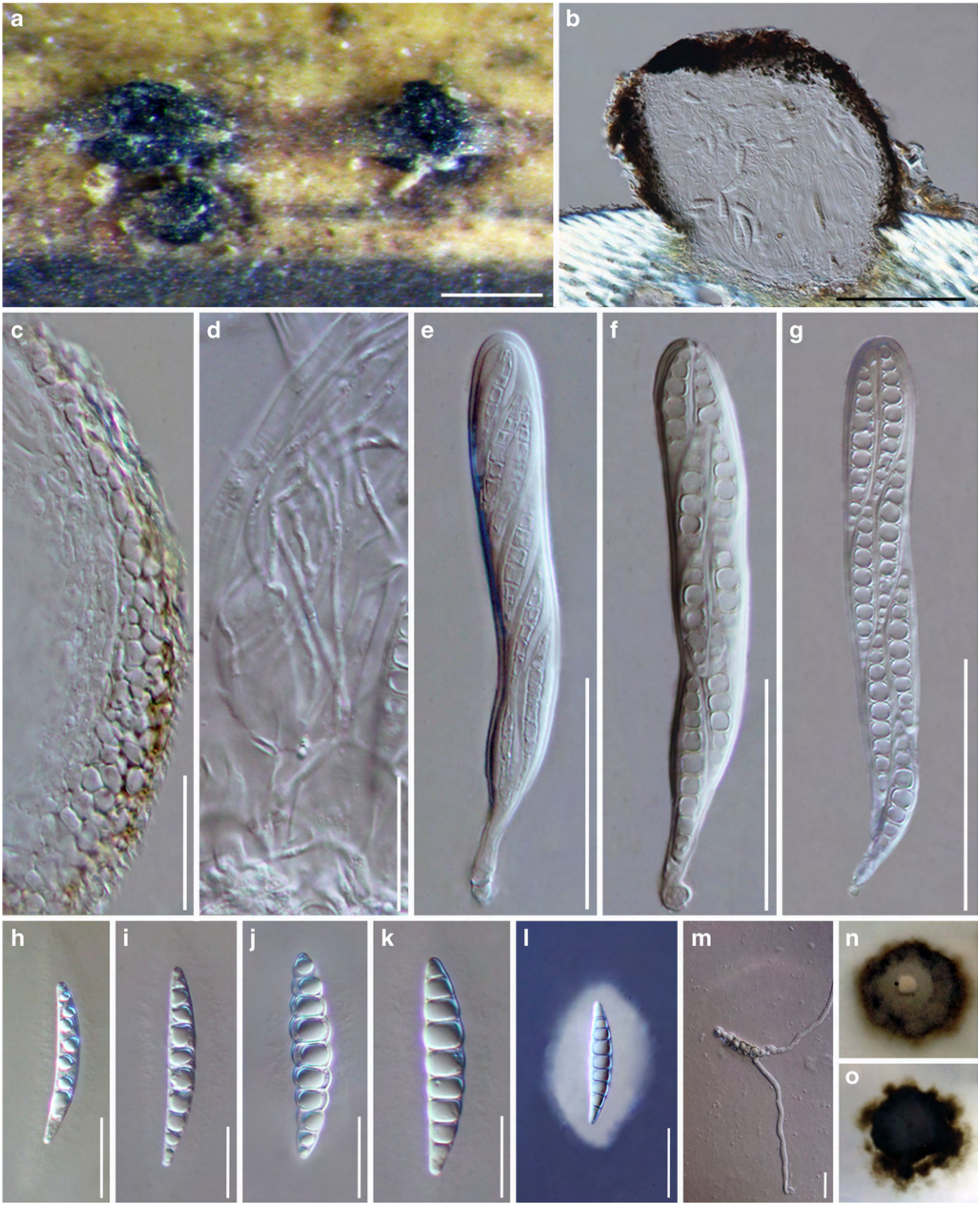


Fig. 2 *Pseudomassariosphaeria bromicola* (holotype) **a** Ascomata on host surface **b** Section of ascomata **c** Section of partial peridium layer. The peridium comprising *textura angularis* **d** Hyaline pseudoparaphyses **e** Immature asci **f**, **g** Mature asci with short pedicels **h**–**k** Hyaline ascospores with visible mucilaginous sheath **l** Ascospore stained with Indian ink to show sheath **m** Germinating ascospore **n**, **o** Colonies on PDA from surface and reverse. Scale bar: **a**=200 μm, **b**=100 μm, **c**=50 μm, **d**–**g**=50 μm, **e**–**g**=20 μm, **h**–**k**=10 μm, **l**–**m**=20 μm

holotype), (**isotype in HKAS**, under the code of HKAS88969), ex-type living culture, MFLUCC 15–0031.

113. ***Pseudomassariosphaeria grandispora*** (Sacc.) Phukhamsakda, Ariyawansa & K.D. Hyde, ***comb. nov***.

Index Fungorum number: IF551442; *Facesoffungi number*: FoF01042

Basionym: *Leptosphaeria grandispora* Sacc., Michelia 1(no. 3): 341 (1878)

≡ *Massariosphaeria grandispora* (Sacc.) Leuchtm., Sydowia 37: 172 (1984)

Anteagloniaceae K.D. Hyde & A. Mapook

The family *Anteagloniaceae* was introduced in Hyde et al. (2013), while previously taxa in this family had been placed under *Pleosporales* genera *incertae sedis*. The type is *Anteaglonium*. The hysteriothecial ascomata of *Anteaglonium* are characteristic of *Hysteriaceae*, however, the genus clusters as a distinct lineage in *Pleosporales* (Mugambi and Huhndorf 2009b), showing a parallel evolution of hysteriothecial ascomata in the class Dothideomycetes. A similar topology was shown in the study of Schoch et al. (2009), Zhang et al. (2012a), Mugambi and Huhndorf (2009a) and was confirmed by Hyde et al. (2013) and Wijayawardene et al. (2014).

114. ***Flammeascoma lignicola*** S. Boonmee & K.D. Hyde, ***sp. nov***.

Index Fungorum number: IF551379; *Facesoffungi number*: FoF00852; Fig. 4

Etymology: *Lignicola*, referring to the habitat on wood.

Holotype: MFLU 10-0061

Saprobic on dead wood in terrestrial habitats. **Sexual morph**: *Ascomata* (173-)278–362 μm high × 108–259 μm diam. ($\bar{x}$ = 297 × 192 μm, *n*=5), immersed, erumpent through the host tissue at maturity, scattered, subglobose to ovoid, carbonaceous, dark brown, with a small, *ca*. 9–10 μm diam. ostiole. *Peridium* 30–40 μm wide, comprising carbonaceous, occluded dark cells, easily cracking. *Hamathecium* comprising 0.5–1 μm wide, numerous, filiform, septate, branched, pseudoparaphyses, anastomosing between and above the asci. *Asci* (121-)128–163 × 18–24.5 μm ($\bar{x}$ = 143 × 21.5 μm, *n*=20), 8-spored, bitunicate, cylindrical to subclavate, apedicellate, rounded at the apex, with an ocular chamber. *Ascospores* 46–55 × 10–13 μm ($\bar{x}$ = 52 × 11.5 μm, *n*=20), overlapping biseriate, ellipsoid-fusiform, tapering towards the sub-acute ends, slightly curved, 1-septate, not constricted at the septum, hyaline, later becoming olivaceous-brown at maturity, containing two refractive globules when immature, lacking a mucilaginous sheath, smooth-walled. **Asexual morph**: Undetermined.

Culture characteristics: Ascospores germinating on MEA within 36 h. Colonies growing on MEA, rather slow-growing, reaching 0.2 mm diam. in 1 week at 28 °C. *Mycelium* superficial, felty, gummy, edge undulate, brownish grey, olive brown.

Material examined: THAILAND, Chiang Mai, Mae Taeng, Huai Nam Dang, on dead wood of *Pinus* L. (*Pinaceae*), 8 September 2009, Saranyaphat Boonmee, HND-01 (MFLU 10-0061, **holotype**); ex-type living culture, MFLUCC 10-0128, IFRDCC 2200.

Notes: Phylogenetic analysis of LSU and TEF sequence data indicates that *Flammeascoma lignicola* belongs in *Anteagloniaceae* (Figs. 1 and 3). *Flammeascoma lignicola* is closely related to *F. bambusae* Phookamsak & K.D. Hyde (Liu et al. 2015) with moderate bootstrap support. However, *F. lignicola* differs from *F. bambusae* in having uniloculate, carbonaceous ascomata, in lacking a sheath and in having larger ascospores (Fig. 4).

115. ***Ascocylindricaceae*** Abdel-Wahab, Bahkali, E.B.G. Jones, Ariyawansa & K.D. Hyde, ***fam. nov***.

Index Fungorum number: IF551416; *Facesoffungi number*: FoF01041

Saprobic on lignicolous substrates in marine habitats. **Sexual morph**: *Ascomata* small (less than 300 μm), scattered, immersed, erumpent to superficial, globose to subglobose, dark-brown to black, papillate, ostiolate, periphysate. *Peridium* thin. *Pseudoparaphyses* trabeculate, embedded in mucilage, numerous, septate, branched. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical, short pedicellate, uniseriate to overlapping uniseriate, with ocular chamber, developing at the base of the ascomatal venter. *Ascospores* ellipsoidal, dark-brown to black, one-septate, constricted at the septum, rough and ornamented, small. **Asexual morph**: Undetermined.

Type genus: ***Ascocylindrica*** Abdel-Wahab, Bahkali & E.B.G. Jones

Notes: The family *Ascocylindricaceae* is introduced to accommodate the monotypic marine genus, *Ascocylindrica*, based on both phylogeny and morphology. *Ascocylindricaceae* forms a well-supported clade within the suborder *Pleosporineae*, sister to the monotypic marine family *Halojulellaceae* (Fig. 1). Marine taxa in the order *Pleosporales* belong to 21 families (Jones et al. 2009, 2015) of which many new families were recently established to accommodate marine taxa, i.e., *Aigialaceae*, *Biatriosporaceae*, *Halojulellaceae*, *Halotthiaceae* and *Salsugineaceae* (Hyde et al. 2013; Jones et al. 2015). A marine taxon with small ascomata, cylindrical asci and bi-celled dark brown to black ascospores was recently collected from Saudi Arabia mangroves and its 18 and 28 s rDNA sequenced. Phylogenetic analyses of both genes placed the taxon in a new lineage in *Pleosporales* and is described herein as a new genus and family.

116. ***Ascocylindrica*** Abdel-Wahab, Bahkali & E.B.G. Jones, ***gen. nov.***

Index Fungorum number: IF551414; *Facesoffungi number*: FoF00954

Etymology: In reference to the cylindrical asci.

Saprobic on drift and submerged mangrove wood. **Sexual morph**: *Ascomata* globose to subglobose, immersed, erumpent to superficial, solitary, ostiolate, papillate, periphysate, coriaceous, dark-brown to black. *Peridium* comprising two strata, outer stratum a thin, black, amorphous layer, inner stratum comprising hyaline thick-walled cells arranged in a *textura angularis*. *Hamathecium* comprising numerous, 0.5–1 μm wide, septate, branched, trabeculate pseudoparaphyses, within a gelatinous matrix. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical, short pedicellate, apically rounded, with a wide, shallow ocular chamber. *Ascospores* uniseriate to overlapping uniseriate, dark-brown to black, 1-septate. **Asexual morph**: Undetermined.

Type species: ***Ascocylindrica marina*** Abdel-Wahab, Bahkali & E.B.G. Jones

Notes: The two *Ascocylindrica marina* isolates form a new lineage in *Pleosporales* (Fig. 1). *Ascocylindrica marina* closely resembles *Halokirschsteiniothelia maritima* (Linder) Boonmee & K.D. Hyde in having small ascomata and bi-celled brown ascospores. However, the latter species has subconical ascomata with a flattened base, clavate to oblong ellipsoidal asci and longer, smooth ascospores, with a submedian septum. Phylogenetic analyses placed *H. maritima* in the family *Mytilinidiaceae* (Suetrong et al. 2009; Boonmee et al. 2012; Fig. 1). *Ascocylindrica marina* is reminiscent of *Didymosphaeria* species. The genus *Didymosphaeria*, typified by *D. futilis* (Berk. & Br.) Rehm, is mainly confined to herbaceous stems and its species have immersed clypeate ascomata, a two-layered peridium that is cellular on the inside, and pseudostromatous and filamentous on the outside; asci without an ocular chamber or ring structure and brown, smooth ascospores with one central septum (Scheinpflug 1958; Eriksson 1981; Hawksworth 1985; Barr 1987; Kohlmeyer and Volkmann-Kohlmeyer 1990). *Didymosphaeria futilis* is distantly placed from *Ascocylindrica marina* (Fig. 1). However, the phylogenetic placement of *D. futilis* is confusing with putatively named strains of *D. futilis* obtained from GenBank clustered in different families (Zhang et al. 2012a; Ariyawansa et al. 2014a, b). Fresh collections of *D. futilis* are needed so that molecular data can be used to validate the natural taxonomic affinities of this genus (Ariyawansa et al. 2014a, b). Schatz (1984) established the genus *Lautitia* for the marine species *Didymosphaeria danica* (Berl.) I.M. Wilson & Knoyle. *Lautitia danica* (Berl.) S. Schatz is a parasite of the alga *Chondrus crispus* Stackh. and has larger asci and ascospores than *Ascocylindrica marina*.

Bicrouania is a genus of *Melanommataceae* with superficial ascomata, a peridium of *textura epidermoidea* and with a hymenial one-celled alga in the dome of the locule (Kohlmeyer and Volkmann-Kohlmeyer 1990). *Lineolata rhizophorae* (Kohlm. & E. Kohlm.) Kohlm. & Volkm.-Kohlm. differs from *Ascocylindrica marina* in having a multi-layered refractive ascal ring (Kohlmeyer and Volkmann-Kohlmeyer 1990). *Verruculina enalia* Kohlm.) Kohlm. & Volkm.-Kohlm. differs from *Ascocylindrica marina* in having carbonaceous, clypeate ascomata and ascospores with small, hyaline tubercles at each apex (Kohlmeyer and Kohlmeyer 1979) and is phylogenetically distant from *A. marina*, where it groups with *Ulospora bilgramii* (D. Hawksw. et al.) D. Hawksw. et al. and *Neotestudina rosatii* Segretain & Destombes, in the family *Testudinaceae* (Suetrong et al. 2009).

117. ***Ascocylindrica marina*** Abdel-Wahab, Bahkali & E.B.G. Jones, ***sp. nov.***

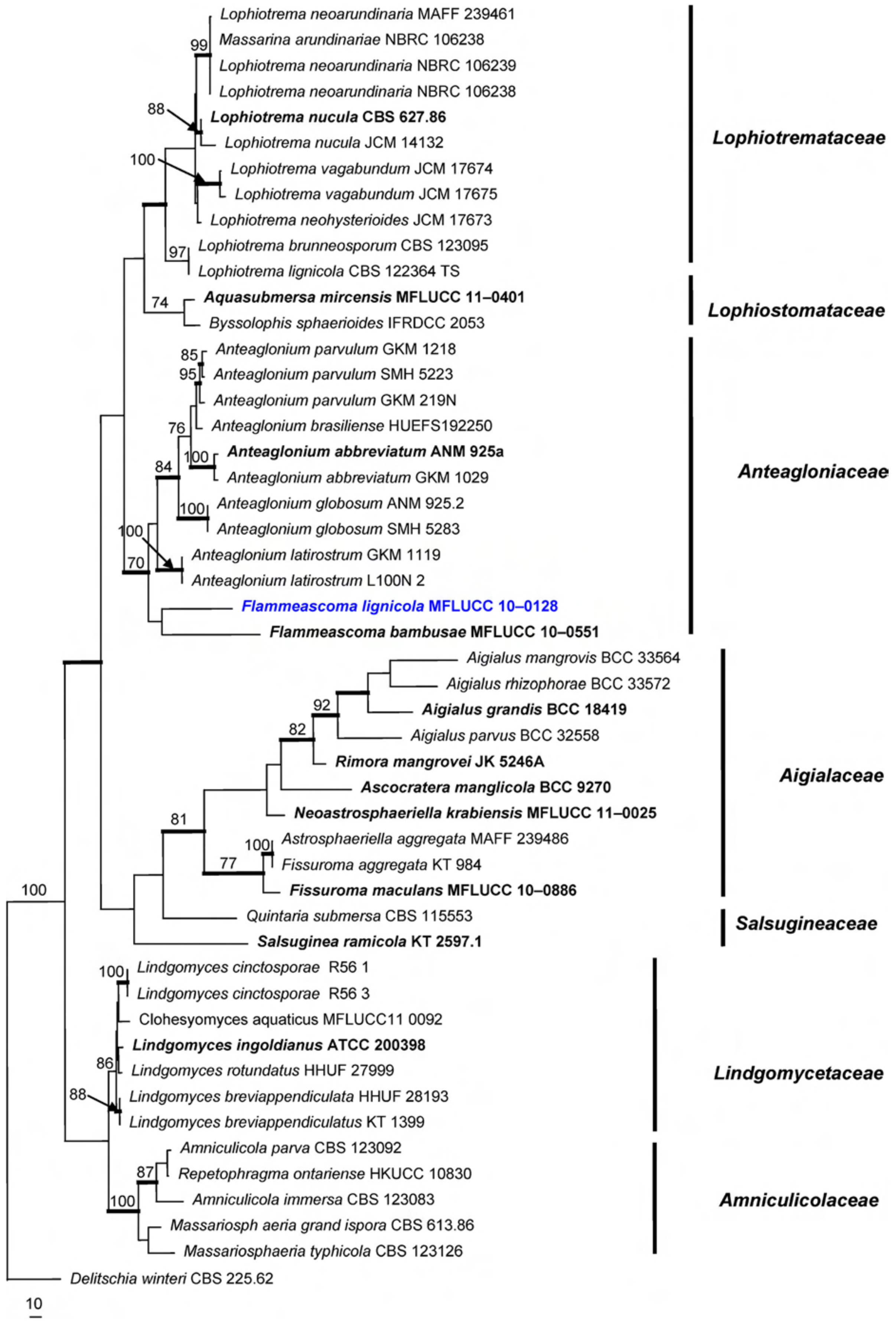
Index Fungorum number: IF551415; *Facesoffungi number*: FoF00955; Fig. 5

Etymology: In reference to the habitat where the fungus was first collected.

Holotype: MFLU 15-0750

Saprobic on drift and submerged mangrove wood. **Sexual morph**: *Ascomata* 90–240 μm diam. ($\bar{x}$ = 148.6 μm, n=10), globose to subglobose, immersed, erumpent to superficial, solitary, coriaceous, dark-brown to black, ostiolate. *Ostiole* papillate, 75–187 μm long, 50–122 μm wide, ostiolar canal 31–54 μm wide, filled with hypha-like periphyses, that are embedded in a gel. *Peridium* 8–21 μm wide, comprising two strata, outer stratum a thin, black, amorphous layer, inner stratum comprising 4–6 layers of hyaline thick-walled cells arranged in a *textura angularis*. *Hamathecium* comprising numerous, 0.5–1 μm wide, septate, branched, trabeculate pseudoparaphyses, embedded in a gelatinous matrix. *Asci* 62–97×8–12 μm ($\bar{x}$ = 75×10.1 μm, n= 15), 8-spored, bitunicate, fissitunicate, cylindrical, short pedicellate, apically rounded, with a wide, shallow

Fig. 3 Phylogram generated from Maximum Parsimony analysis based on combined LSU and EF sequence data of *Anteagloniaceae* and other related families. Parsimony bootstrap support values for MP≥70 % are shown above the nodes and Bayesian posterior probabilities ≥95 % are indicated in *bold* branches. The tree is rooted with *Delitschia winteri* CBS 225.62 (*Delitschiaceae*). All ex-types and reference strains are in *bold* and new isolate is in *blue* ▶


Lophiotrema neoarundinaria MAFF 239461
Massarina arundinariae NBRC 106238
Lophiotrema neoarundinaria NBRC 106239
Lophiotrema neoarundinaria NBRC 106238
Lophiotrema nucula CBS 627.86
Lophiotrema nucula JCM 14132
Lophiotrema vagabundum JCM 17674
Lophiotrema vagabundum JCM 17675
Lophiotrema neohysterioides JCM 17673
Lophiotrema brunneosporum CBS 123095
Lophiotrema lignicola CBS 122364 TS
Aquasubmersa mircensis MFLUCC 11–0401
Byssolophis sphaerioides IFRDCC 2053
Anteaglonium parvulum GKM 1218
Anteaglonium parvulum SMH 5223
Anteaglonium parvulum GKM 219N
Anteaglonium brasiliense HUEFS192250
Anteaglonium abbreviatum ANM 925a
Anteaglonium abbreviatum GKM 1029
Anteaglonium globosum ANM 925.2
Anteaglonium globosum SMH 5283
Anteaglonium latirostrum GKM 1119
Anteaglonium latirostrum L100N 2
Flammeascoma lignicola MFLUCC 10–0128
Flammeascoma bambusae MFLUCC 10–0551
Aigialus mangrovis BCC 33564
Aigialus rhizophorae BCC 33572
Aigialus grandis BCC 18419
Aigialus parvus BCC 32558
Rimora mangrovei JK 5246A
Ascocratera manglicola BCC 9270
Neoastrosphaeriella krabiensis MFLUCC 11–0025
Astrosphaeriella aggregata MAFF 239486
Fissuroma aggregata KT 984
Fissuroma maculans MFLUCC 10–0886
Quintaria submersa CBS 115553
Salsuginea ramicola KT 2597.1
Lindgomyces cinctosporae R56 1
Lindgomyces cinctosporae R56 3
Clohesyomyces aquaticus MFLUCC11 0092
Lindgomyces ingoldianus ATCC 200398
Lindgomyces rotundatus HHUF 27999
Lindgomyces breviappendiculata HHUF 28193
Lindgomyces breviappendiculatus KT 1399
Amniculicola parva CBS 123092
Repetophragma ontariense HKUCC 10830
Amniculicola immersa CBS 123083
Massariosph aeria grand ispora CBS 613.86
Massariosphaeria typhicola CBS 123126
Delitschia winteri CBS 225.62
Lophiotremataceae
Lophiostomataceae
Anteagloniaceae
Aigialaceae
Salsugineaceae
Lindgomycetaceae
Amniculicolaceae
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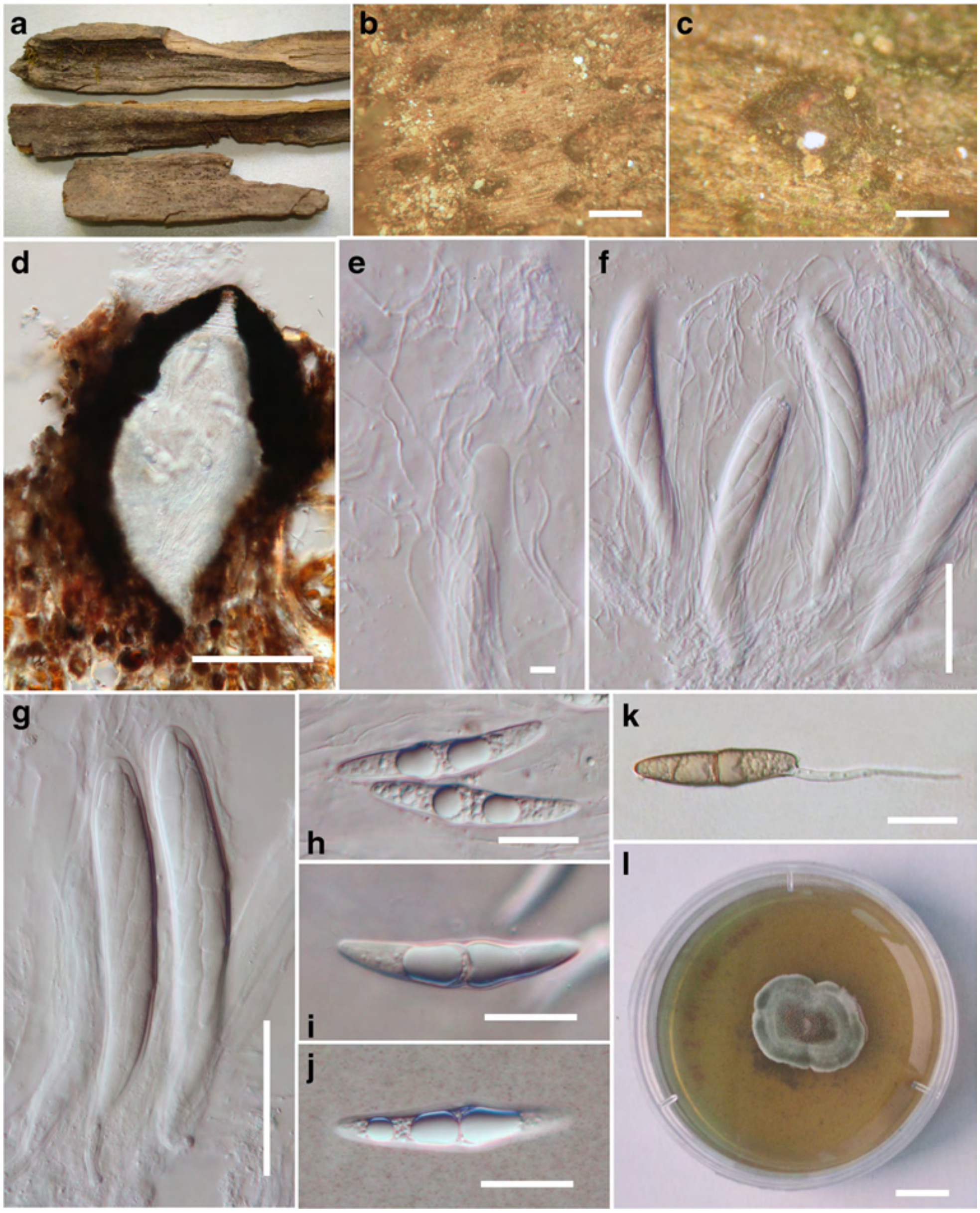


Fig. 4 *Flammeascoma lignicola* (holotype). **a** Specimens **b**, **c** Appearance of ascomata on wood and close up of ascoma erumpent through the host tissues **d** Section of ascoma and peridium **e** Pseudoparaphyses **f g** Asci. **h**–**j** Ascospores—note j stained in India Ink **k** Germinating ascospore **l** Colony on MEA. Scale bars: **b**=200 μm, **c**–**d**=100 μm, **e**=5 μm, **f**–**g**=50 μm, **h**–**k**=20 μm, **l**=10 mm

ocular chamber. *Ascospores* 11–14×5–7 μm ($\bar{x}$ = 13.03×6.1 μm, *n*=50), uniseriate to overlapping uniseriate, dark-brown to black, 1-septate, wall, thick, rough and ornamented. **Asexual morph**: Undetermined.

Culture characteristics: Colonies on PDA reaching a 25–30 mm radius after 15 days at 25 °C, with white to gray aerial and immersed mycelium, brown from below and producing fertile ascomata with dimensions similar to those recorded on natural wood.

Material examined: SAUDI ARABIA, Arabian Gulf, Al-Khobar City, on decayed wood at a sandy beach, 28 March 2013, M.A. Abdel-Wahab (MFLU 15-0750, **holotype**); ex-type living culture, MFLUCC 15-0750; SAUDI ARABIA, Al-Lith City, Al-Lith mangrove, on submerged decayed wood of the mangrove tree *Avicennia marina* (Forssk.) Vierh., 7 April 2015, M.A. Abdel-Wahab (MFLU 15-1508, **paratype**); EGYPT, Red Sea, Marsa Alam City, Marsa Alam mangrove, on balsa wood incubated with the pure culture of the fungus, and was originally isolated from submerged decayed wood of the mangrove tree *Avicennia marina*, 9 December 2003, M.A. Abdel-Wahab (MFLU 15-1509, **paratype**).

Asterinaceae Hansf.

The order *Asterinales* and family *Asterinaceae* has been revised by Hongsanan et al. (2014b) and *Lembosia* was regarded as a valid genus in the group.

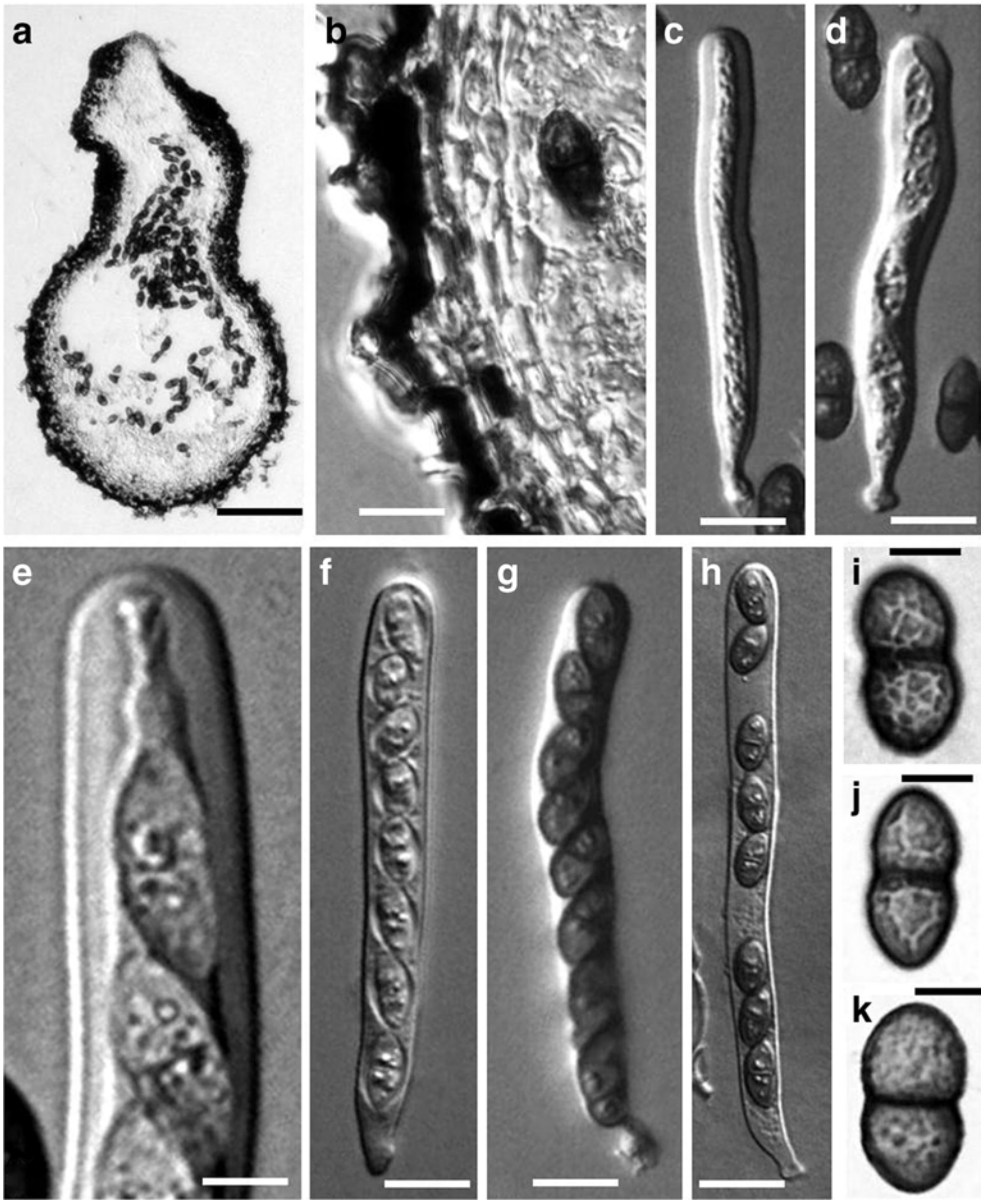


Fig. 5 *Ascocylindrica marina* (holotype). **a** Vertical section of ascoma **b** Magnified part of the vertical section of the ascoma showing the peridium structure **c**, **d**, Immature asci **e** Ocular chamber in ascus **f**, **g** Mature ascus **h** Fissitunicate dehiscence in ascus **i**–**k** Ascospores. Scale bars: **a**=50 μm, **b**–**d**, **f**–**g**=7 μm, **h**=15 μm, **i**–**k**=5 μm

Lembosia Lév., Annls Sci. Nat., Bot., sér. 3 3: 58 (1845)

Notes: *Lembosia* was established by Leveillé (1845) with descriptions of *L. dendrochili*, *L. drimydis*, *L. macula* and *L. tenella* and has been detailed in Hongsanan et al. (2014b). The genus is characterized by oval, elongated thyriothecia with X- or Y-shaped, or longitudinal dehiscence and with lateral appressoria on the hyphae (Hosagoudar and Goos 1991; Hosagoudar 2012). Hosagoudar (2012) segregated the family *Lembosiaceae* based on these characters and included *Lembosia*, while Hongsanan et al. (2014b) referred the genus in *Asterinaceae* and treated *Lembosiaceae* as a synonym. There are 173 epithets in *Lembosia* (Index Fungorum 2015), but sequence data is available for only two species in GenBank. Previous introduction of species in this genus were based on morphology; partly because *Lembosia* species have never before been cultured.

Lembosia species found on *Fabaceae* include *L. dalbergiicola*, *L. erythrophlaei*, *L. hormosiana*, *L. humboldtiae*, *L. humboldtiicola*, *L. humboldtiigena*, *L. ormosiae*, *L. ormosiicola*, *L. sclerolobii*, *L. sophorae* and *L. verrucosa*. *Lembosia xyliae* is the only species known on *Xylia* (Mimosoideae subfamily of *Fabaceae*), and is most similar to *L. erythrophlaei*. However it differs in having smaller appressoria and densely grouped ascomata. In the phylogenetic analyses (Fig. 6), there are two clades in the family

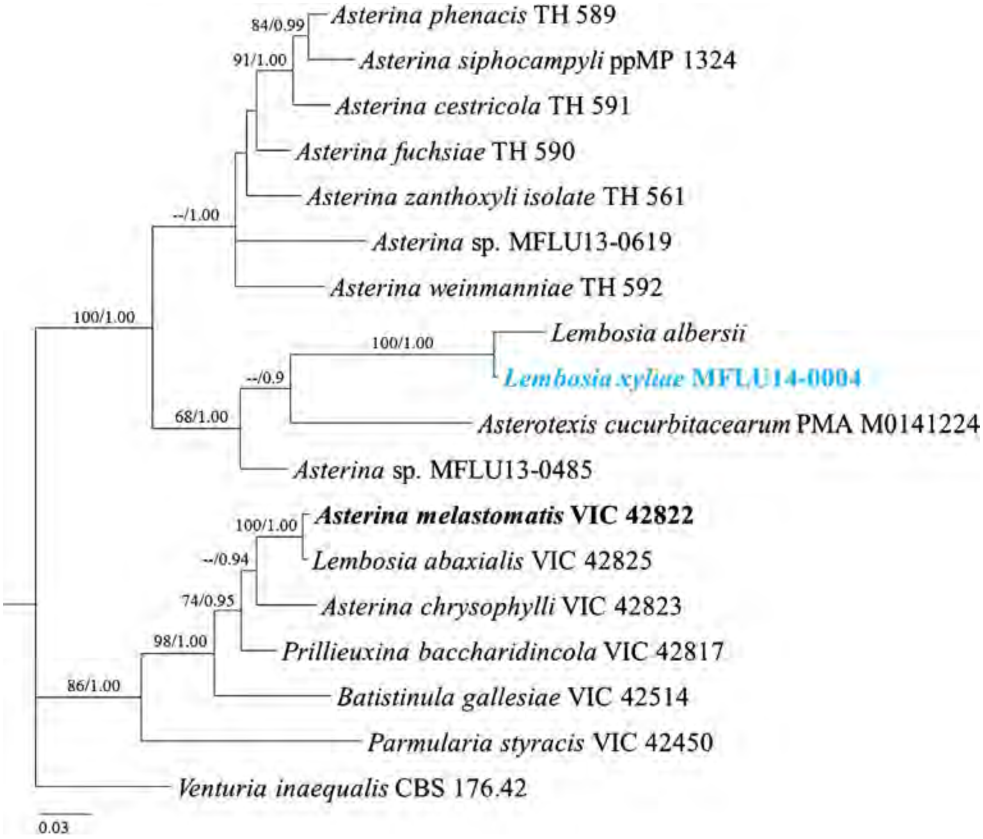


Fig. 6 Phylogram generated from Bayesian inference analyses of LSU sequenced data of taxa of *Asterinaceae*. Bootstrap values higher than 50 % are shown on the *left*, while values of Bayesian posterior probabilities above 90 % are shown on the right. The ex-type strains are in *bold*, the new isolates are in *blue*. The *scale bar* indicates 0.03 changes. The tree is rooted with *Venturia inaequalis* CBS 176.42

Asterinaceae. One clade includes the type species of *Asterina* (Guatimosim et al. 2015), while the other clade includes our collection and several other species of *Asterinaceae*. *Lembosia xyliae* clustered with *L. albersii* with 100 % bootstrap and 1.00 posterior probabilities support.

118. ***Lembosia xyliae*** X.Y. Zeng & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551345; *Facesoffungi number*: FoF00933; Fig. 7

Etymology: From the host *Xylia* on which the taxon was observed.

Holotype: MFLU 14-0004

Epiphytic on leaves, forming circular or irregular blackened areas on the host surface. *Colonies* epiphyllous, circular, dense, single to confluent. *Hyphae* superficial, straight to substraight, dark brown, branching alternate to opposite at acute to wide angles, reticulate. *Appressoria* 1 celled, alternate, straight to substraight, lateral, antrorse. **Sexual morph**: *Thyriothecia* (315-)350–500(−724)×200–300 μm ($\bar{x}$ = 400×250 μm, n=20), elongate, dimidiate to tripartite, soft, dense, borne on the surface of mycelium. *Asci* 40–60×30–50 μm ($\bar{x}$ = 50×40 μm, n=30), 8-spored, bitunicate, ellipsoid to subglobose, sessile. *Ascospores* (11-)25–32×(5-)10–17 μm ($\bar{x}$ = 28×13 μm, n=30), 3–5-seriate, hyaline, 2-celled, constricted at the septum, obovoid to ellipsoid, lower cell slightly longer and narrower, with two oil drops in each cell when immature, becoming brown at maturity. **Asexual morph**: Undetermined.

Material examined: THAILAND, Chiang Rai, Mae Fah Luang University, on leaves of *Xylia* sp. (*Fabaceae*), 18 January 2014, XY Zeng (MFLU 14-0004, **holotype**).

Botryosphaeriaceae Theiss. & Syd.

The order *Botryosphaeriales* was reviewed by Liu et al. (2012b) and is not discussed further here.

Diplodia Fr., in Montagne, Annls Sci. Nat., Bot., sér. 2 1: 302 (1834)

Diplodia species are known to be pathogens, endophytes and saprobes on a wide range of woody hosts (Crous et al. 2006; Slippers and Wingfield 2007; Phillips et al. 2008). The genus was introduced by Montagne (1834) and typified by *D. mutila* (Fr.) Mont., which has hyaline, aseptate conidia that can become brown and septate with age. *Diplodia* comprises a large genus with more than 1000 names currently recognized. A search of MycoBank (2015) revealed 1339 names, while a search of Index Fungorum (2015) lists 1247 names. Based on up to date holotype or ex-type sequence data available in GenBank, Hyde et al. (2014) provided a backbone tree for 20 *Diplodia* species. Most of *Diplodia* species were defined on the basis of host association (Phillips et al. 2008). Host

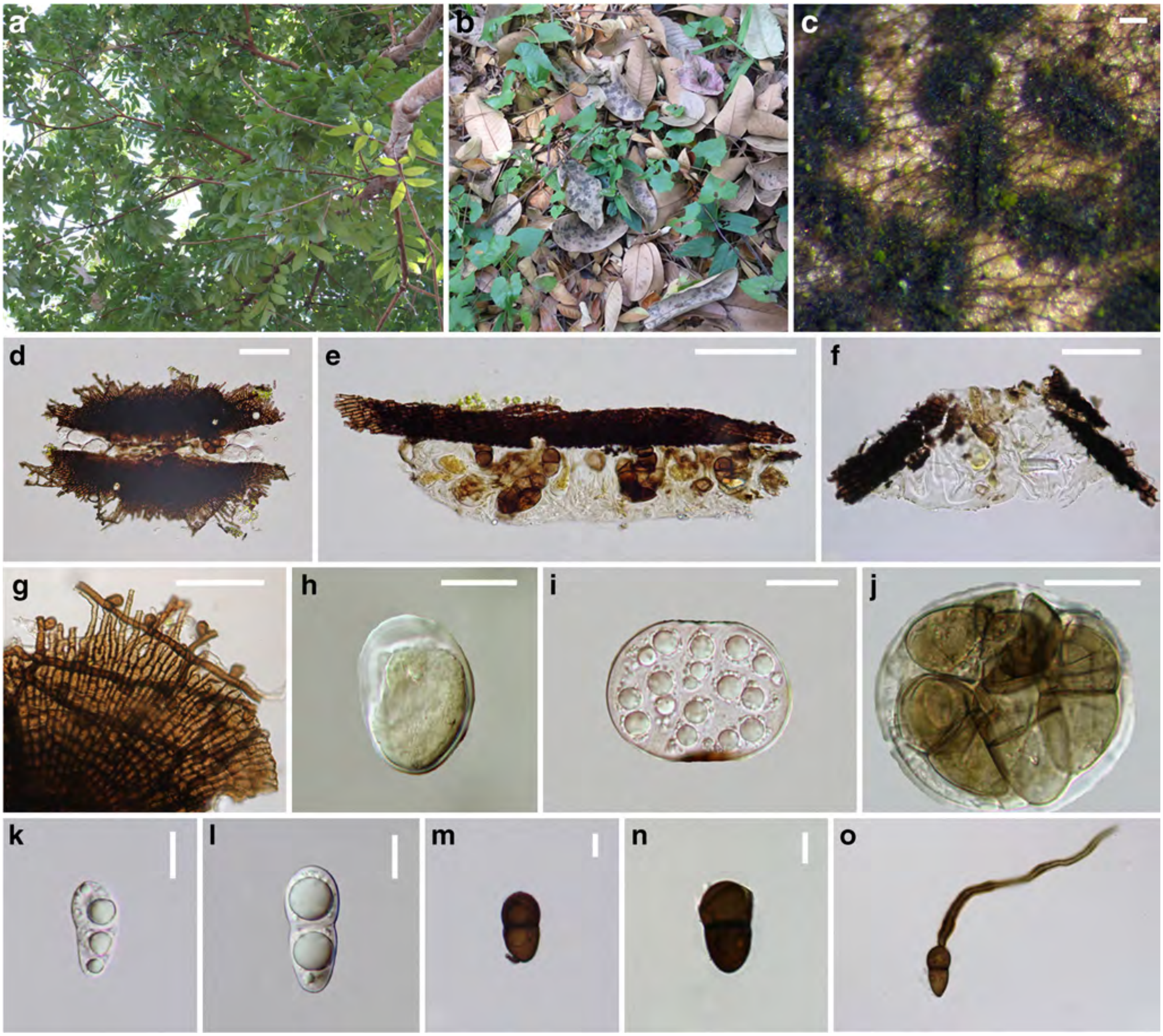


Fig. 7 *Lembosia xyliae* (holotype) **a** Host **b** Habit **c** Ascomata on fallen dried leaves **d** Squash mount of ascoma **e** Ascoma in longitudinal section **f** Ascoma in cross section **g** Peridium **h**–**j** Immature to mature asci **k**–**n** Immature to mature ascospores **o** Germinating ascospore. Scale Bars: **c**–**e**=100 μm, **f**–**g**=50 μm, **h**–**j**=20 μm, **k**–**n**=10 μm

association is not a reliable feature for species differentiation in the *Botryosphaeriaceae*, nonetheless many species in *Diplodia* do show some host preference (Slippers et al. 2004). Phillips et al. (2013) stated that there are two distinct conidial morphologies in *Diplodia* species. The first type of conidia is initially hyaline and aseptate and later becomes pale to dark brown and 1-septate. Pigmentation is often delayed and in some species dark conidia are never seen. In the second type, the conidia become pigmented at an early stage of development, even they are still enclosed within the pycnidia and these conidia only rarely become septate. These two morphological groups are supported by two distinct phylogenetic lineages (Phillips et al. 2013, Fig. 8).

119. ***Diplodia crataegicola*** Dissanayake, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551316; *Facesoffungi number*: FoF00885; Fig. 9 *Etymology*: Referring to the host *Crataegus* sp.

Holotype: MFLU 15-1311

Saprobic on dead branch of *Crataegus* sp. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 220–265 *μm* high × 260–380 *μm* diam. ($\bar{x}$ = 245 × 340 *μm*, *n* = 10), pycnidial, stromatic, solitary or clustered, immersed in the host, erumpent at maturity, dark brown to black, ostiolate, apapillate. *Peridium* 25–35 *μm* wide, outer and inner layers

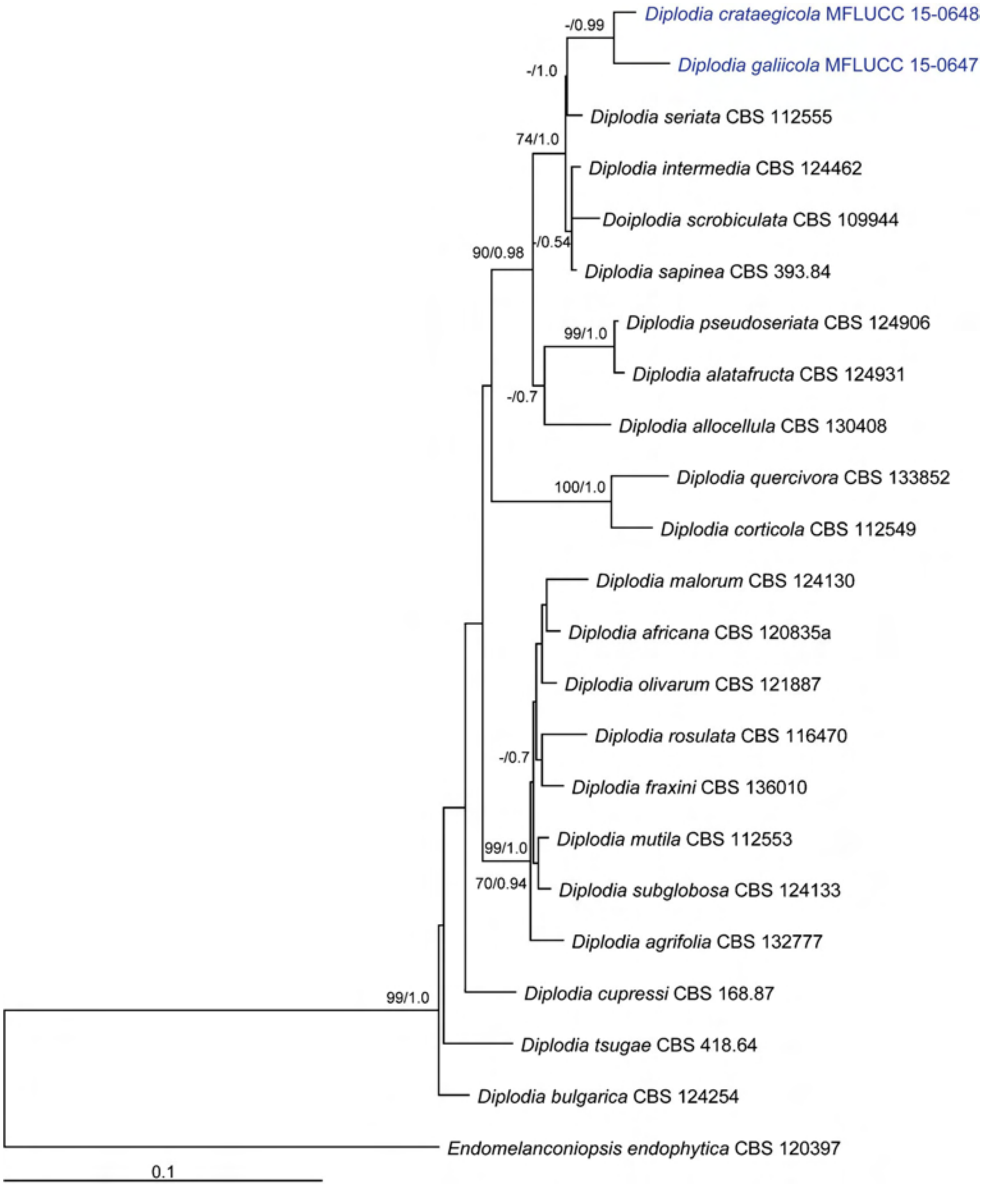


Fig. 8 Phylogram generated from RAxML based on combined ITS, EF and β-tubulin sequenced data for *Diplodia* species. Maximum likelihood bootstrap support values and Bayesian posterior probabilities greater than 50 % and 0.90 are indicated above the nodes. Only ex-type and voucher strains are used and the new isolates are in *blue*. The tree is rooted with *Endomelanconiopsis endophytica* CBS 120397

composed of dark brown and thin-walled hyaline *textura angularis*. *Conidiogenous cells* 10–22 μm high × 4–6 μm wide, hyaline, thin-walled, smooth, cylindrical, swollen at the base, discrete, producing a single conidium at the apex. *Conidia* 11–16 × 6–10 μm ($\bar{x}$ = 14 × 9 μm, n=50), aseptate, globose to subglobose, widest in the center, with rounded apex, initially hyaline, becoming dark brown before release from the pycnidia, wall moderately thick, externally smooth, internally roughened. *Spermatia* rod-shaped with obtuse ends, hyaline, thin-walled, smooth, 3–5 × 1.5–2 μm.

Cultural characteristics: Conidia germinating on WA within 12 h and germ tubes produced from lower end. Colonies growing on PDA, covering the entire plate in 5 days at 28 °C, mycelium grey to olivaceous black at the surface and olivaceous black from below.

Material examined: ITALY, Province of Forlì-Cesena [FC], Passo del Barbotto–Mercato Saraceno, on dead branch of *Crataegus* sp. (*Rosaceae*), 3 November 2012, E. Camporesi, IT 875 (MFLU 15-1311, **holotype**), ex-type living cultures, MFLUCC 15–0648, KUMCC15-0075, CFTCC 15-0002.

Notes: Conidial length of all reported *Diplodia* species range from 21.5 to 52.5 μm and width vary from 10 to 22 μm (Phillips et al. 2013). The small conidia of *Diplodia crataegicola* (14 × 9 μm, L/W ratio = 1.55) clearly distinguish this species from all other reported species (Fig. 9). *Diplodia crataegicola* is phylogenetically most closely related to *D. seriata* (Fig. 8), and the two species can be separated on the shapes and dimensions of their conidia.

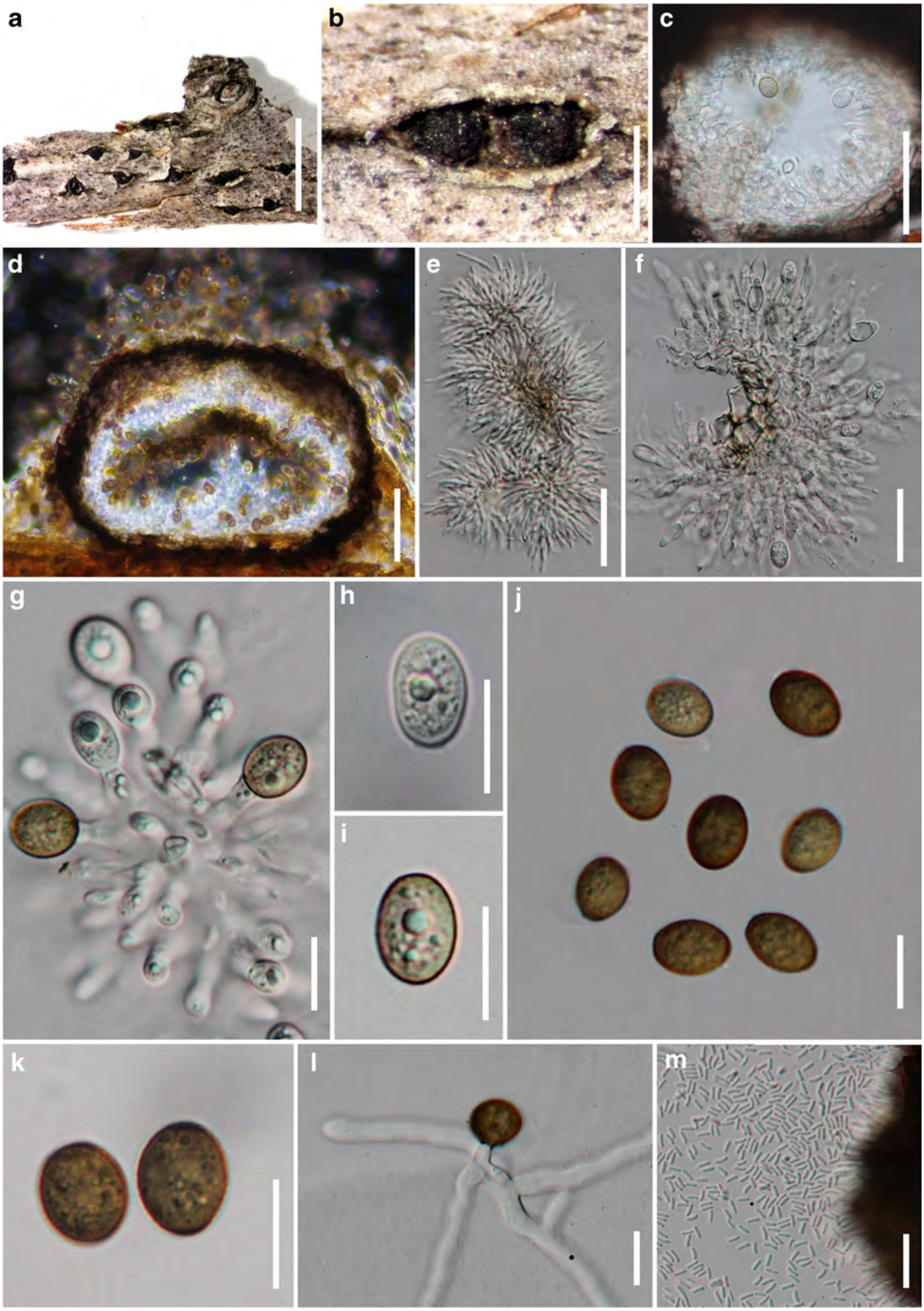


Fig. 9 *Diplodia crataegicola* (holotype) **a**, **b** Conidiomata on host substrate **c**, **d** Cross section of conidiomata **e**, **g** Immature and mature conidia attached to conidiogenous cells **h** Immature conidium **i**–**k** Mature conidia **l** Germinating conidia **m** Spermatogenous cells and spermatia. Scale bars: **a**=2 mm, **b**=500 μm, **c**=100 μm, **d**=75 μm, **e**, **f**=50 μm, **g**–**m**=15 μm

120. *Diplodia galiicola* Dissanayake, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551315; *Facesoffungi number*: FoF00884; Fig. 10 *Etymology*: Referring to the host *Galium* sp.

Holotype: MFLU 15-1310

Saprobic on stem of *Galium* sp. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 320–385 μm high × 425–490 μm diam. ($\bar{x}$ = 350 × 470 μm, n = 10), stromatic, solitary, immersed in the host, dark brown to black, slightly depressed, uniloculate, globose to subglobose, ostiole central, apapillate. *Peridium* 25–35 μm wide, outer layer composed of dark brown cells of *textura angularis*, inner layers of thin-walled hyaline cells of *textura angularis*. *Conidiogenous cells* 8–15 μm high × 5–7 μm wide, hyaline, thin-walled, smooth, cylindrical, swollen at the base, discrete, producing a single conidium at the apex. *Conidia* 17–23 × 11–13 μm ($\bar{x}$ = 20 × 12 μm, n = 50), initially hyaline, becoming dark brown, moderately thick-walled, wall externally smooth, roughened on the inner surface, aseptate, ovoid, widest in the center, apex obtuse, base truncate or rounded.

Cultural characteristics: Conidia germinating on WA within 24 h and germ tubes produced from lower end. Colonies growing on PDA, covering the entire plate in 1 week at 28 °C, developing dense aerial mycelium with age, become pale olivaceous-grey to olivaceous black at the surface, and olivaceous black from below.

Material examined: ITALY, Province of Forlì-Cesena [FC], Strada San Zeno, Galeata, on dead stem of *Galium* sp. (*Rubiaceae*), 30 October 2013, E. Camporesi, IT 1495 (MFLU 15-1310, **holotype**), ex-type living cultures, MFLUCC 15–0647, KUMCC15-0074, CFTCC 15-0001.

Notes: In the combined phylogenetic analysis (ITS, EF1-α and β-tubulin genes), *Diplodia galiicola* is phylogenetically most closely related to *D. seriata* with high bootstrap support (1.0 Bayesian posterior probability) (Fig. 8). The conidia of *D. galiicola* differ from *D. seriata* in being shorter. The average conidia of *D. seriata* are longer than or equal to 25 μm (Phillips et al. 2013), while the conidia of *D. galiicola* are never 25 μm long (Fig. 10).

121. *Caryosporaceae* Huang Zhang, K.D. Hyde & Ariyawansa, ***fam. nov.***

Index Fungorum number: IF551417; *Facesoffungi number*: FoF00957

Saprobic on submerged wood in freshwater or mangrove habitats or on decaying terrestrial seeds. **Sexual morph**: *Ascomata* pseudothecial, erumpent, superficial, hemispherical, large, dark brown to black, carbonaceous, ostiolate, solitary or clustered. *Ostiole* central, circular, brown to black. *Peridium* thick, carbonized, dark brown, composed of rectangular, often occluded cells. *Hamathecium* comprising numerous, narrow (less than 1 μm wide), hyaline, trabeculate, anastomosing pseudoparaphyses, embedded in a gelatinous matrix. *Asci* 8-spored, bitunicate, broadly cylindrical to clavate, pedicellate, with an ocular chamber. *Ascospores* 1–3-seriate, relatively large, hyaline when young, hyaline or brown when mature, 1−(−3)-septate, constricted at the central septa, broad-fusiform, ovoid or ellipsoidal, ends often papillate, often with polar germ pores at each end, with relatively thick walls, smooth-walled, with or without a mucilaginous sheath. **Asexual morph**: Undetermined.

Type genus: ***Caryospora*** De Not., Micr. Ital. Nov. 9: 7 (1855)

Notes: The family *Caryosporaceae* is established here to accommodate two marine genera *Acrocordiopsis* and *Caryospora*, which forms a distinct lineage in the order *Pleosporales* (Fig. 1). In previous studies (Zhang et al. 2012a, b; Hyde et al. 2013) *Acrocordiopsis* formed a relatively poorly supported clade with *Salsuginea*, but these studies did not include molecular data of *Caryospora* for the phylogenetic analysis. In this study *Acrocordiopsis* forms relatively highly supported clade with *Caryospora*, while *Salsuginea* forms a sister clade to *Aigialaceae*. Morphologically, *Caryosporaceae* is characterized by large, erumpent and conical to hemisphaerical ascomata. The structure of the ascomata is most similar to *Astrosphaeriella* and *Trematosphaeria*. However, the ascospores are broadly fusiform, with relatively thick walls in *Caryospora*, elongate-fusiform and thin-walled in *Astrosphaeriella* and fusoid and thin-walled in *Trematosphaeria* (Boise 1985; Hyde and Frohlich 1998; Liu et al. 2011). *Acrocordiopsis patilii* is a marine taxon. *Caryospora aquatica* and the putative strain of *C. minima* are from freshwater. This suggests that *Caryosporaceae* might be used for taxa often found in aquatic habitats as well as those from peach stones.

Caryospora De Not., Micr. Ital. Nov. 9: 7 (1855)

Caryospora was placed in Phaeophragmiae due to its terminal septa (Jeffers 1940) and later in *Zopfiaceae* in several studies (Lumbsch and Huhndorf 2010; Hyde et al. 2013). However, very little phylogenetic data is available for species of *Caryospora* (Cai and Hyde 2007). Three species of *Caryospora*, i.e., *C. minima* Jeffers, *C. callicarpa* (Curr.) Nitschke ex Fuckel and *C. obclavata* Raja & Shearer are known from freshwater.

Type species: ***Caryospora putaminum*** (Schwein.) De Not., Micr. Ital., Dec. 9: 7 (1855) De Not., Micr. Ital. Nov. 9: 7 (1855)

122. *Caryospora aquatica* Huang Zhang, K.D. Hyde & Ariyawansa, ***sp. nov.***

Index Fungorum number: IF551418; *Facesoffungi number*: FoF00958; Fig. 11

Fig. 10 *Diplodia galiicola* (holotype) **a**, **b** Conidiomata on host substrate **c** Cross section of conidioma **d** Mature and immature conidia with conidiogenous cells **e** Immature conidia attached to conidiogenous cells **f** Mature conidia attached to conidiogenous cells **g**, **h** Mature and immature conidia **i**, **j** Immature conidia **k**, **l** Mature conidia. Scale bars: **c**=200 μm, **d**–**l**=20 μm

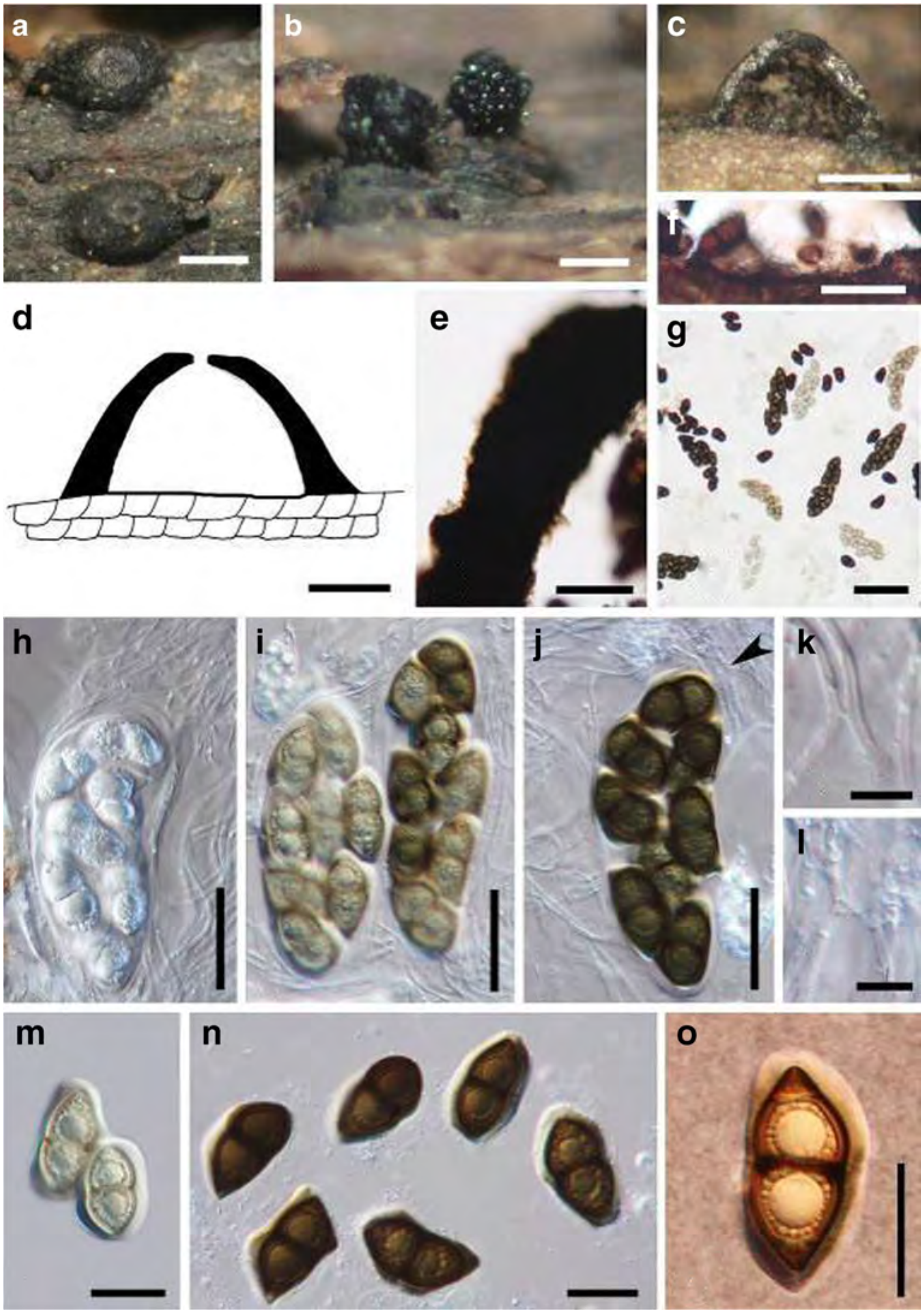


Fig. 11 *Caryospora aquatica* (holotype) **a**, **b** Appearance of ascomata on the host surface. Note the plume of ascospores in b. **c** Section of an ascoma on wood **d** Section of ascoma e Peridium **f** Base of ascoma **g** Different ages of asci **h** Young ascus with trabeculate pseudoparaphyses **i** Nearly mature ascus **j** Mature ascus with anastomosing pseudoparaphyses (*arrowed*) **k** Trabeculate pseudoparaphyses **l** Anastomosing pseudoparaphyses **m**, **n**, **o** Ascospores. Note the polar germ pores in **o**. Scale bars: **a**, **b**, **c**, **g**=200 μm, **d**, **f**=100 μm, **e**, **h**, **i**, **j**=50 μm, **k**, **l**=10 μm, **m**, **n**, **o**=30 μm

Etymology: in reference to the aquatic habitat.

Holotype: MFLU 11-1083

Saprobic on submerged wood. **Sexual morph**: *Ascomata* 350–600 μm high, 450–750 μm diam., solitary or clustered, erumpent, nearly superficial, hemisphaerical, base flattened, dark brown to black, carbonaceous, with ostiolate papilla. *Papillae* 50 μm long, 150 μm diam., apex truncate. *Ostiole* central, relatively broad, up to 0.1 mm diam., circular, brown to black. *Peridium* up to 90 μm wide at the sides and 10 μm wide at the base, strongly carbonized, composed of a black amorphous layer that cannot be differentiated, whose cells are rectangular, uninucleate, and often occluded. *Hamathecium* comprising numerous, up to 1 μm wide, filiform, trabeculate, anastomosing pseudoparaphyses, embedded in a gelatinous matrix. *Asci* 160–190×60–80 μm ($\bar{x}$ = 179.6×63.4 μm, *n*= 12), 8-spored, bitunicate, fissitunicate, broadly cylindric-clavate, usually slightly curved, pedicellate, apically rounded, with an ocular chamber. *Ascospores* 44–52×20–27 µm ($\bar{x}$ = 47.4×23.4 µm, *n*=15), 2−3-seriate, 1-septate, broad-fusiform and hyaline when young, becoming irregularly diamond-shaped and dark brown at maturity, ends acute, slightly constricted at the septum, with polar germ pores at each end, relatively thick-walled, smooth-walled, with large globule in each cell, surrounded by narrow thin gelatinous mucilaginous sheath. **Asexual morph**: Undetermined.

Material examined: THAILAND, Chiang Rai Province, Hui Kang Pla Waterfall, on submerged wood, 18 January 2010, Huang Zhang (MFLU 11-1083, **holotype**); ex-type culture, MFLUCC 11-0008.

Notes: *Caryospora minima* Jeffers was first mentioned by Ellis and Everhart (1892) from peach stones, but they thought it was an 8-spored version of the type species of *Caryospora*, *C. putaminum*. Jeffers (1940) redescribed it as a new species when studying *C. putaminum*. The perithecia in *C. minima* are smaller than in *C. putaminum* (400–750 vs. 500–1200 µm). In this paper, we introduce a new species *C. aquatica* from submerged wood in freshwater. *Caryospora aquatica* is similar to the type species, *C. putaminum* in having erumpent, superficial, dark brown to black, carbonaceous, ostiolate ascomata, a thick and carbonized peridium, and relatively large and thick-walled ascospores, but can be distinguished in the smaller ascoma (350–600 vs. 500–1200 µm in *C. putaminum*) and 8-spored asci (2-spored in *C. putaminum*). *Caryospora aquatica* also differs from *C. minima* in its freshwater habitat. At maturity, the ascospores of *C. minima* are light brown with 3 septa, while in *C. aquatica* they become irregularly diamond-shaped and dark brown with polar germ pores. *Caryospora* easily produces perithecia in culture. Jeffers obtained perithecia in *C. minima* in peach-stone culture and we also found these in *C. aquatica* on PDA media. Under moist condition the spores easily discharge through the circular ostiole and form the plume on top of the perithecium.

In the phylogenetic tree (Fig. 1), *C. aquatica* clusters with a putatively named strain of *C. minima*, which was also isolated from submerged wood, and is sister to *Acrocordiopsis* clade. *Caryospora* has been collected from wood in freshwater on numerous occasions (Cai et al. 2003; Hyde et al. 1998; Kurniawati et al. 2010; Luo et al. 2004; Zhang et al. 2011) and was usually named as *C. minima*. The *Caryospora* species from freshwater are likely to comprise several taxa as has been shown for the freshwater species of *Helicascus* (Zhang et al. 2013a, b, 2014; Shearer 1993; Cai et al. 2003). This is the first time to confirm the natural placement of *Caryospora* species with verified strains, at the family level with molecular data.

Cucurbitariaceae G. Winter

The family *Cucurbitariaceae* was introduced by Winter (1885) and is typified by *Cucurbitaria berberidis* (Pers.) Gray. *Cucurbitariaceae* is characterized by aggregated ostiolate, ascomata on a basal stromatic structure, fissitunicate and cylindrical asci and pigmented, phragmosporous or muriform ascospores (Hyde et al. 2013). Recent studies based on molecular data have shown that the *Cucurbitariaceae* forms a well-supported clade in order *Pleosporales* (Doilom et al. 2013; Hyde et al. 2013).

Cucurbitaria Gray, Nat. Arr. Brit. Pl. (London) 1: 508, 519 (1821)

Cucurbitaria ephedricola was initially introduced as *Fenestella ephedrae* Rehm from material collected by G. Nevodovsky in Tbilisi Botanic Garden in 1913 on roots of *Ephedra procera*. Esfandiari (1947) placed the species in the genus *Cucurbitaria* where it fits the generic concept of *Cucurbitaria* in having black, papillate ascomata, that are grouped and immersed to erumpent on the substrate, and brown ascospores, with longitudinal and transverse septa, that are narrower at the median septum.

In our molecular analyses, *Cucurbitaria ephedricola* (MFLU 15-1516) forms a well-supported clade, sister to the *C. berberidis* clade, in the family *Cucurbitariaceae* (Fig. 12). Our material of *C. ephedricola* fits well with the description provided by Esfandiari (1947). In our collection of *C. ephedricola* the asci are slightly smaller than in the type, but peridium and ascospores are in the given size range (Esfandiari 1947). The ascomata, asci and ascospores of the reference specimen provided here are typical of the *C. ephedricola* protologue (Esfandiari 1947), but the location (Italy) differs. Thus we propose our collection as a reference specimen (*sensu* Ariyawansa et al. 2014c) until collections from the same host and location can be obtained.

123. *Cucurbitaria ephedricola* Esfand., Sydowia 1(4–6): 162 (1947)

Facesoffungi number: FoF00934; Fig. 13

Saprobic on wood. **Sexual morph**: *Ascomata* 300–800 µm diam., immersed to erumpent, grouped, subglobose or flask-shaped and often flattened, with rounded papillate ostiole up to 50 µm diam., black. *Peridium* 60–100 µm wide, composed of 2–3 layers of pseudoparenchymatous cells, outer layer comprising of thick-walled, dark brown cells of *textura angularis* to *textura globulosa*, inner layer comprising of thin-walled, hyaline to pale brown, flattened cells of *textura angularis*. *Hamathecium* composed of 2 µm wide, numerous, hyaline, cellular, branched, septate pseudoparaphyses. *Asci* 150–200×13–20(−25) µm ($\bar{x}$ = 176×16 µm, *n*=20), 8-spored, bitunicate, fissitunicate, arising from the base of the inner ascomatal wall, numerous, cylindrical, with a broadly rounded apex with an ocular chamber. *Ascospores* 20–30(−35)×10–15 µm, ellipsoidal, oblong ovoid, broadly fusiform, often asymmetrical, with obtuse to acute ends, straight or slightly curved, mostly 7-septate, sometimes 5- or 6- or 8- or 9-septate, with 1 or 2 longitudinal septa, often distinctly narrower at the median septum, initially colourless or

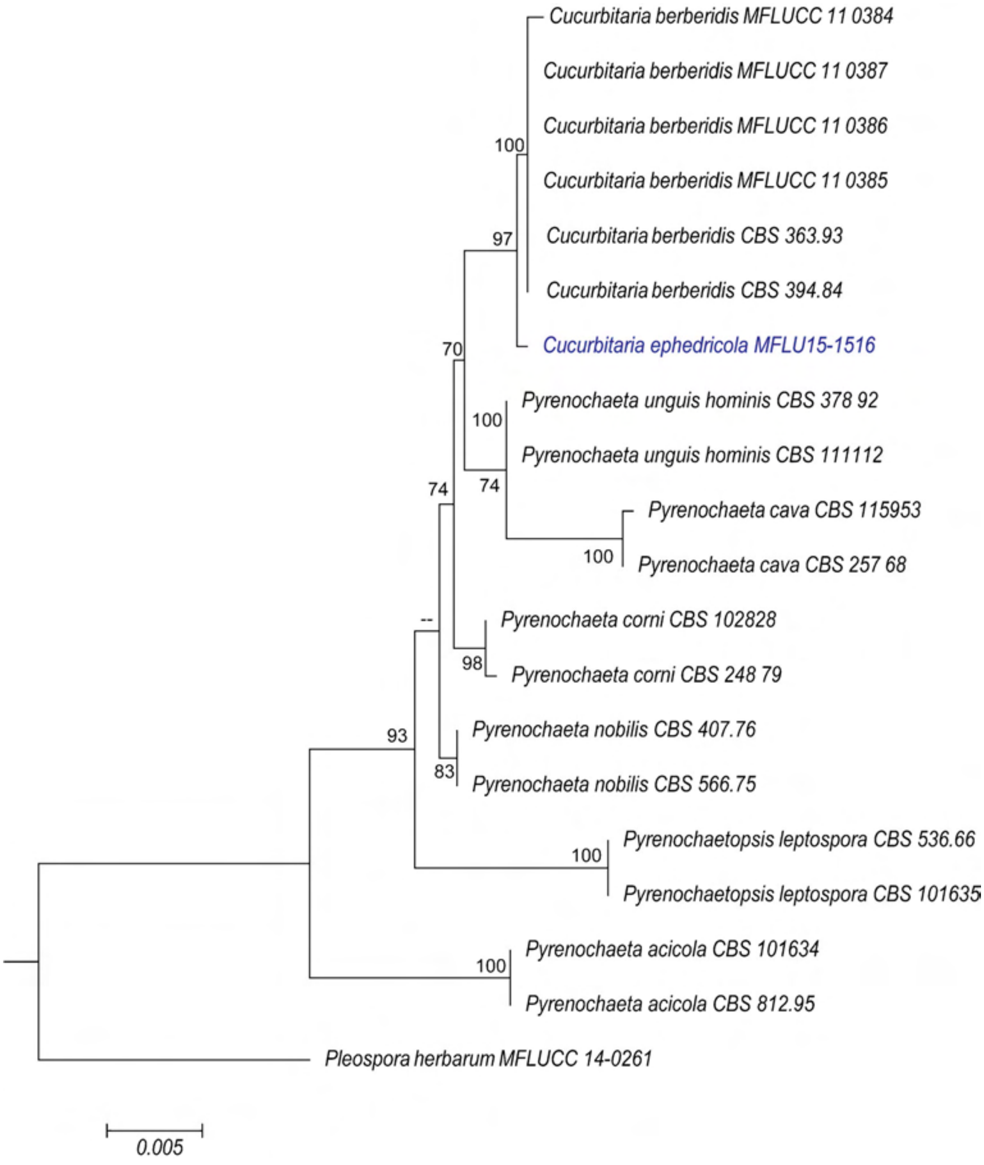


Fig. 12 Phylogram generated from maximum likelihood analysis based on combined LSU and SSU sequenced data from the family *Cucurbitariaceae*. Maximum likelihood bootstrap support values greater than 50 % are near the nodes. The ex-type strains are in *bold* and the new isolates are in *blue*. The tree is rooted with *Pleospora herbarum* MFLUCC 14-0261

yellowish, later olivaceous brown to dark brown. **Asexual morph**: undetermined.

Material examined: ITALY, Province of Forlì-Cesena [FC], Strada San Zeno, Galeata, on dead stem, 30 October 2013, E. Camporesi (MFLU 15–1516, **reference specimen designate here**).

Didymellaceae Gruyter et al.

The most recent treatment of *Didymellaceae* is that of Hyde et al. (2013)

124. ***Heracleicola*** Tibpromma, Camporesi & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551380; *Facesoffungi number*: FoF00921

Etymology: refers to the host genus.

Saprobic on decaying plant stems. **Sexual morph**: *Ascomata* immersed, visible as shiny, raised dots on the host surface, vase-like, solitary or scattered, with central short papilla, dark brown to black. *Peridium* a single stratum, comprising relatively large, thick-walled, dark brown cells of *textura angularis* to *textura globulosa. Hamathecium* comprising numerous, 0.7–1.3 μm wide, long, filiform, frequently anastomosing, cellular, pseudoparaphyses. *Asci* 8-spored, bitunicate, fissitunicate, cylindric-clavate, short pedicellate, rounded at the apex, with a wide, shallow, ocular chamber. *Ascospores* overlapping 1–2-seriate, hyaline, 3-septate, fusiform, cell above central septum often enlarged, constricted at the septum. **Asexual morph**: undetermined.

Type species: ***Heracleicola premilcurensis*** Tibpromma, Camporesi & K.D. Hyde

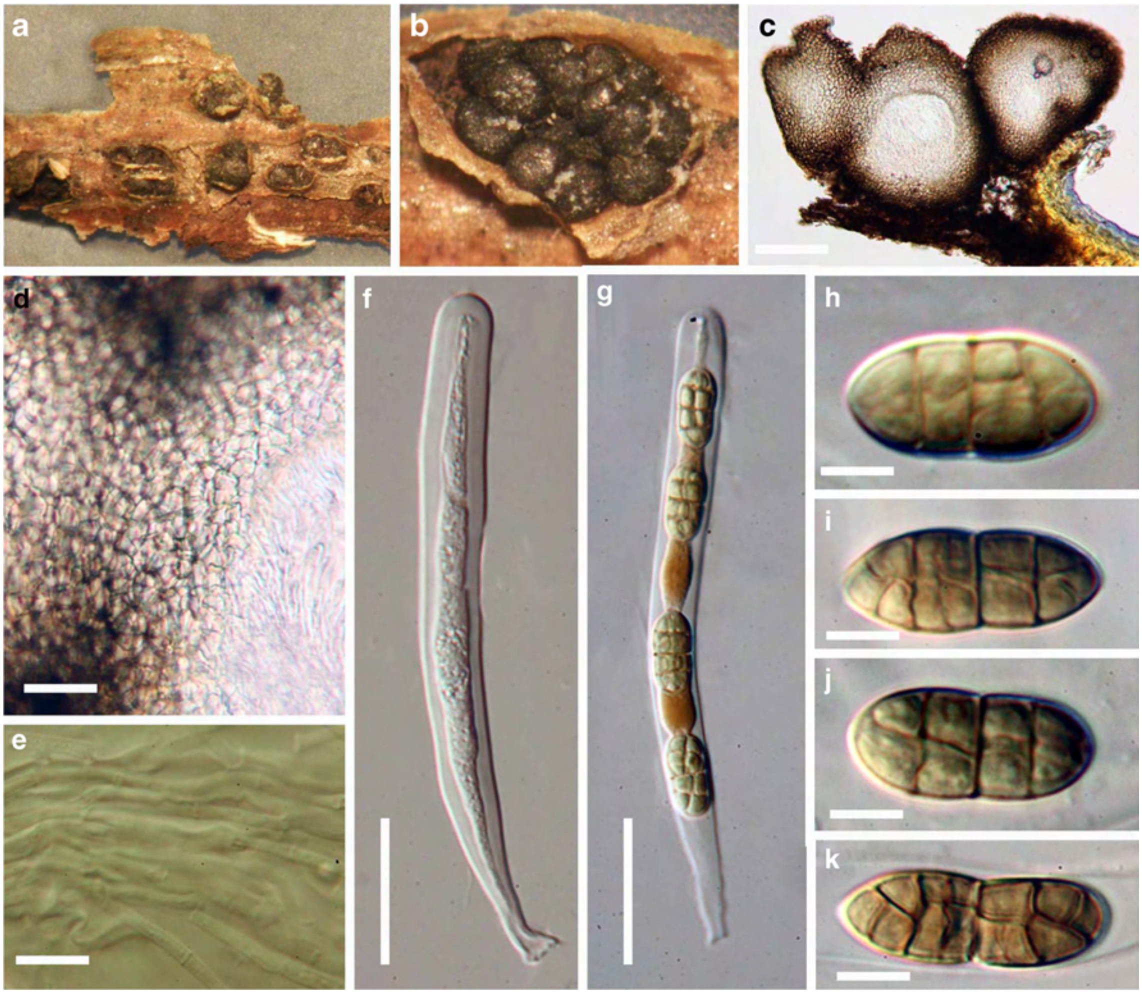


Fig. 13 *Cucurbitaria ephedricola* (reference specimen) **a** Appearance of ascomata on the host tissue **b** Close up of ascoma **c** Section of ascoma **d** Peridium cells **e** Hamathecium of septate, cellular pseudoparaphyses **f**, **g** Asci **h**–**k** Mature yellowish brown ascospores. Scale bars: **c**=200 μm, **d**=50 μm, **e**=10 μm, **f**, **g**=20 μm, **h**–**k**=5 μm

Notes: Molecular data places *Heracleicola* in the family *Didymellaceae* with moderate support (Fig. 14). Its closest relatives are *Didymella rabiei* and *Phoma medicaginis*. *Heracleicola* is however, distinct in its vase-shaped ascomata and 4-celled hyaline ascospores and forms a distant clade from *Didymella sensu stricto*.

125. ***Heracleicola premilcurensis*** Tibpromma, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551381; *Facesoffungi number*: FoF00921; Fig. 15

Etymology: refers to the name of the municipality in Italy where the species was collected.

Holotype: MFLU 14-0725

Saprobic on decaying plant stem of *Heracleum sphondylium*. **Sexual morph**: *Ascomata* 211–272 μm high× 150–221 μm diam. ($\bar{x}$ = 254×196 μm, n=5), immersed, visible as shiny, raised dots on the host surface, vase-like, solitary or scattered, with central short papilla, dark brown to black. *Peridium* 37–43 μm wide, a single stratum, comprising relatively large (6–9 μm), thick-walled, dark brown cells of *textura angularis* to *t. globulosa*. *Hamathecium* comprising numerous, 0.7–1.3 μm wide, long, filiform, frequently anastomosing, cellular, pseudoparaphyses. *Asci* 50–94×11–16 μm ($\bar{x}$ = 72×14 μm, n=10), 8-spored, bitunicate, fissitunicate, cylindric-clavate, short pedicellate, rounded at the apex, with a wide, shallow, ocular chamber. *Ascospores* 23–36×6–9 μm ($\bar{x}$ = 27×7 μm, n=15), overlapping 1–2-seriate, hyaline, 3-septate, fusoid with rounded ends, cell above central septum often enlarged, constricted at the septum, guttulate, smooth-walled, lacking a mucilaginous sheath. **Asexual morph**: undetermined.

Culture characteristics: on MEA reaching 4 cm diam. after 1 week at 16 °C, later with dense mycelium, with irregular, rough margin, flattened, brown to black; hyphae septate, branched, light-brown, thick-walled.

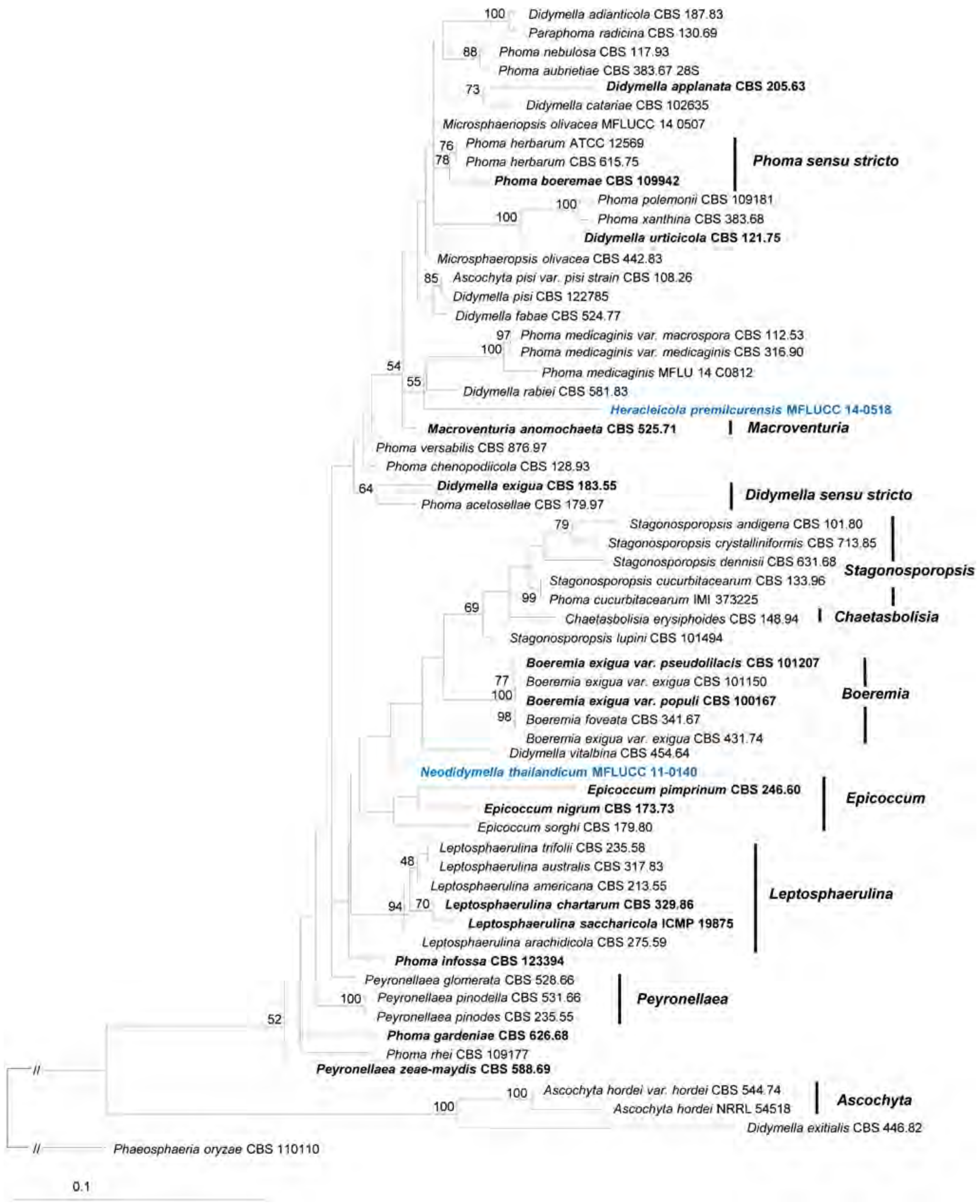


Fig. 14 Phylogram generated from maximum likelihood analysis based on combined LSU, SSU and ITS sequenced data of the family *Didymellaceae*. Maximum likelihood bootstrap support values greater than 50 % are near the nodes. The ex-type strains are in *bold* and the new isolates are in *blue*. The tree is rooted with *Phaeosphaeria oryzae* CBS 110110

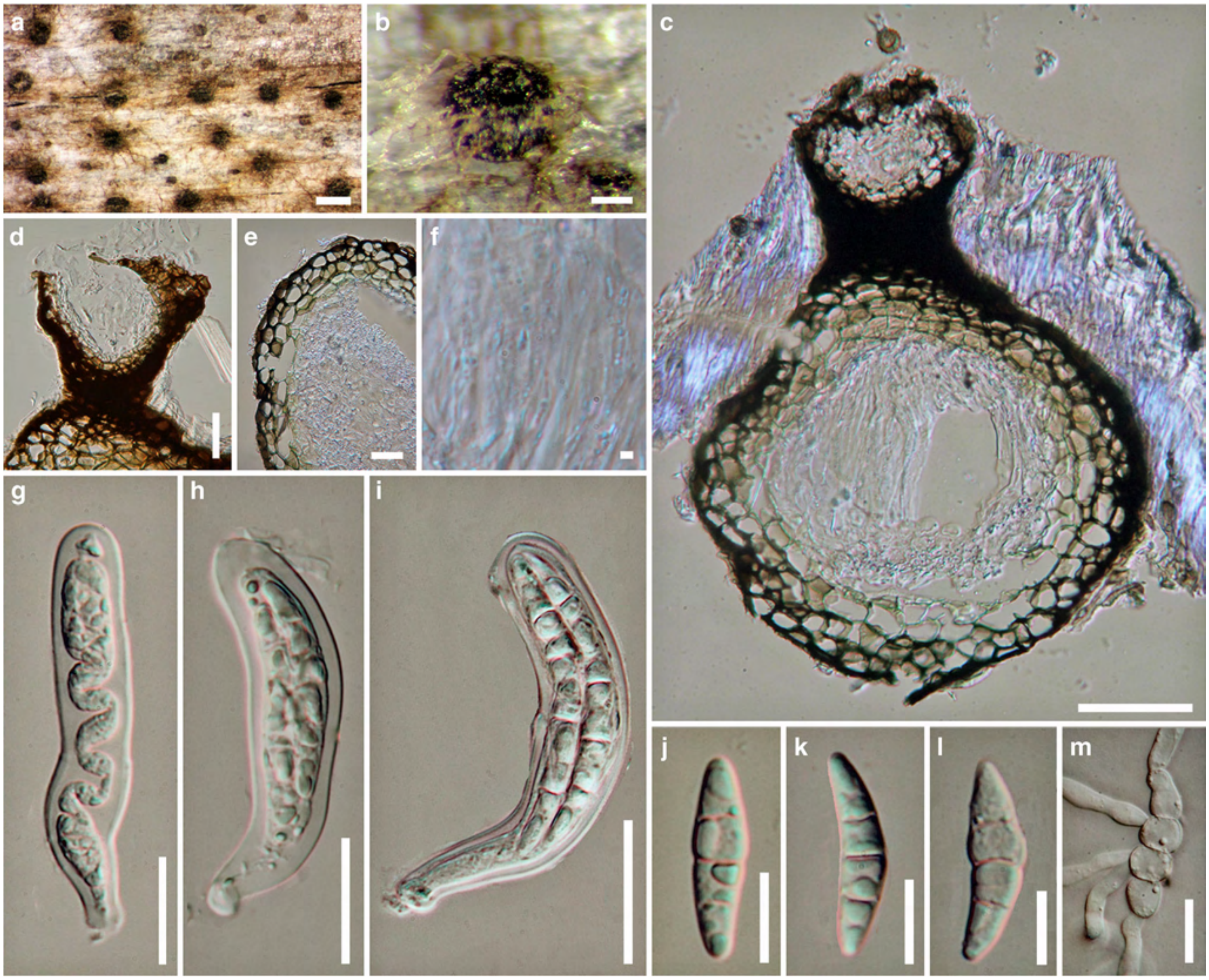


Fig. 15 *Heracleicola premilcurensis* (holotype) **a**, **b** Appearance of fungus on host surface **c** Cross section of ascoma **d** Ostiole **e** Section of peridium **f** Pseudoparaphyses **g**–**i** Asci **j**–**l** Ascospores **m** Germinating ascospore. Scale bars: **a**=400 μm, **b**=100 μm, **c**=50 μm, **d**–**e**=20 μm, **f**=2 μm, **g**–**i**=20 μm, **j**–**l**=10 μm, **m**=20 μm

Material examined: ITALY, Premilcuore, Province of Forlì-Cesena,, Valbura, on dead stem of *Heracleum sphondylium* (*Apiaceae*), 6 June 2014, Erio Camporesi IT1916 (MFLU 14-0725, **holotype**, HKAS, **isotype**); ex-type living culture, MFLUCC 14-0518, KUN; *Ibid*. (MFLU 15-1475, HKAS, **isotypes**); (MFLU 15-1476 bis, MFLU 15-1477 tris, **paratypes**).

126. ***Neodidymella*** Phookamsak, R.H. Perera & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551389; *Facesoffungi number*: FoF00904

Etymology: The generic epithet "*Neodidymella*" refers to the similarity with *Didymella*.

Biotrophic or hemibiotrophic on living leaves. **Sexual morph**: *Ascomata* scattered, solitary to gregarious, visible as black dots on the lower epidermis, globose to subglobose, uniloculate, glabrous, ostiole central, with pore-like opening. *Peridium* thin-walled, of equal thickness, composed of 2–3 layers of large, brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* composed of dense, broad, distinctly septate, cellular pseudoparaphyses, constricted at the septum, branched, anastomosing at the apex, embedded in a gelatinous matrix. *Asci* 8-spored, bitunicate, fissitunicate, broadly cylindrical to cylindric-clavate, sessile to subsessile, or short bulbous pedicel, apically rounded, with an indistinct ocular chamber. *Ascospores* overlapping bi-seriate, hyaline, ellipsoidal to clavate, or fusiform with rounded ends, 1-septate, slightly constricted at the septum, walls echinulate. **Asexual morph**: Undetermined.

Type species: ***Neodidymella thailandicum*** Phookamsak & K.D. Hyde

Notes: *Neodidymella* is introduced as a monotypic genus to accommodate a Dothideomycete species forming hyaline, didymosporous ascospores with pseudothecial ascomata. The genus belongs in the family *Didymellaceae* and forms a distinct lineage from *Didymella sensu stricto* with relatively low bootstrap support (Fig. 14). The family *Didymellaceae* was introduced by De Gruyter et al. (2009) to accommodate the sexual genera *Didymella*, *Leptosphaerulina* and *Macroventuria*, and the asexual genera *Phoma* and phoma-like species in *Pleosporales* (Zhang et al. 2012a; Hyde et al. 2013; Wijayawardene et al. 2014; Liu et al. 2015). The species of this family include various important plant pathogens such as *Ascochyta*, *Didymella* and *Phoma* (Kaiser et al. 2008; Aveskamp et al. 2010; De Gruyter et al. 2009, 2012; Zhang et al. 2012a; Hyde et al. 2013; Liu et al. 2015). *Didymella*, *Leptosphaerulina* and *Macroventuria* differ from *Neodidymella* in morphology. Hyde et al. (2013) examined the generic type of *Didymellaceae*, *Didymella exigua* (Niessl) Sacc. and described *Didymella* as lacking pseudoparaphyses. *Neodidymella* differs from *Didymella* in having pseudoparaphyses. *Neodidymella* differs from *Leptosphaerulina* in having didymosporous ascospores and producing pseudoparaphyses, while *Leptosphaerulina* species have dictyospores and lack pseudoparaphyses (Zhang et al. 2012a; Phookamsak et al. 2013). *Neodidymella* is most similar to *Macroventuria* due to its didymosporous ascospores and presence of pseudoparaphyses (Zhang et al. 2012a). However, *Macroventuria* differs from *Neodidymella* in having setose immersed to erumpent, nearly superficial ascomata, and fusiform ascospores. *Neodidymella* has immersed, glabrous ascomata, and ellipsoidal to clavate ascospores. Multigene phylogenetic analyses shows that *Neodidymella* forms a robust clade at base of the *Didymella vitalbina* Petr. clade (CBS 454.64 and MFLUCC 13-0877) and does not cluster with other sexual genera (Fig. 14).

Woudenberg et al. (2009) observed *Didymella vitalbina* in vitro on V8 media agar and described the morphological characters as producing superficial, globose to pyriform, perithecial ascomata with papilla; cylindrical asci with pseudoparaphyses and hyaline, ovoid to obpyriform, smooth-walled ascospores. According to the protologue of *Didymella vitalbina* (Petrak 1940) and Woudenberg's description (2009), *Neodidymella thailandicum* is similar to *D. vitalbina* in its morphological characters. However, *N. thailandicum* has smaller ascomata, asci and ascospores (Petrak 1940; Woudenberg et al. 2009). Woudenberg et al. (2009) reported the asexual morph of *D. vitalbina* as *Ascochyta vitalbae* Briard & Har., while the asexual morph of *N. thailandicum* is undetermined. Based on the morphological characters, *D. vitalbina* might be related to *N. thailandicum*. However, these species do not cluster closely together in the tree, which may be a result of the limited number of taxa.

127. ***Neodidymella thailandicum*** Phookamsak, R.H. Perera & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551390; *Facesoffungi number*: FoF00905; Fig. 16

Etymology: The generic epithet "*thailandicum*" refers to the country where the species was collected.

Holotype: MFLU 11-0176

Biotrophic or hemibiotrophic on living leaves of *Calathea*. **Sexual morph**: *Ascomata* 65–110 μm high, 80–130 μm diam., scattered, solitary to gregarious, visible as black dots on the lower epidermis, globose to subglobose, uni-loculate, glabrous, ostiole central, with pore-like opening. *Peridium* 8–20 μm wide, of equal thickness, composed of 2–3 layers of large, brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* composed of dense, 2–5 μm wide, broad, cellular pseudoparaphyses, distinctly septate, constricted at the septum, branched, anastomosing at the apex, embedded in a gelatinous matrix. *Asci* (46–)50–60(−70)×(12–)13–15(−18) μm ($\bar{x}$ = 54.8×13.8 μm, *n*=25), initially 8-spored, bitunicate, fissitunicate, broadly cylindrical to cylindric-clavate, sessile to subsessile, or short, bulbous pedicellate, with furcate pedicel, apically rounded, with indistinct ocular chamber. *Ascospores* (11)12–13(−14)×4–5(−6) μm ($\bar{x}$ = 12.6×5.5 μm, *n*=30), overlapping bi-seriate, hyaline, ellipsoidal to clavate, or fusiform with rounded ends, 1-septate, slightly constricted at the septum, wall echinulate. **Asexual morph**: Undetermined.

Culture characteristics: Colonies on MEA fast growing, 80–85 mm diam. after 2 weeks at 25–30 °C, colonies circular, medium dense, flat, smooth with entire edge, fairly fluffy to granular, slightly radiating; colonies in the upper part:white to cream at the margin, yellowish grey to pale yellowish at the middle and greyish yellow at the centre; reverse pale white to olive at the margin, yellowish greyish yellow at the centre; not producing pigmentation.

Material examined: THAILAND, Chiang Rai, Muang District, Pakha Village, on living leaves of *Calathea* sp. (*Marantaceae*), 4 August 2010, R. Phookamsak RP0056 (MFLU11-0176), living culture MFLUCC 11-0140, KUMCC.

Didymosphaeriaceae Munk
= *Montagnulaceae* M.E. Barr

The ascomycetous family *Didymosphaeriaceae* was introduced by Munk A (1953) and typified by the genus *Didymosphaeria* Fuckel. The family was characterized by 1-septate ascospores and trabeculate pseudoparaphyses which anastomosed mostly above the asci (Ariyawansa et al. 2014a, b). Ariyawansa et al. (2014b) synonymised *Montagnulaceae* under *Didymosphaeriaceae* which is the oldest name and has priority and provided an updated account for the family. Ariyawansa et al. (2014b) accepted

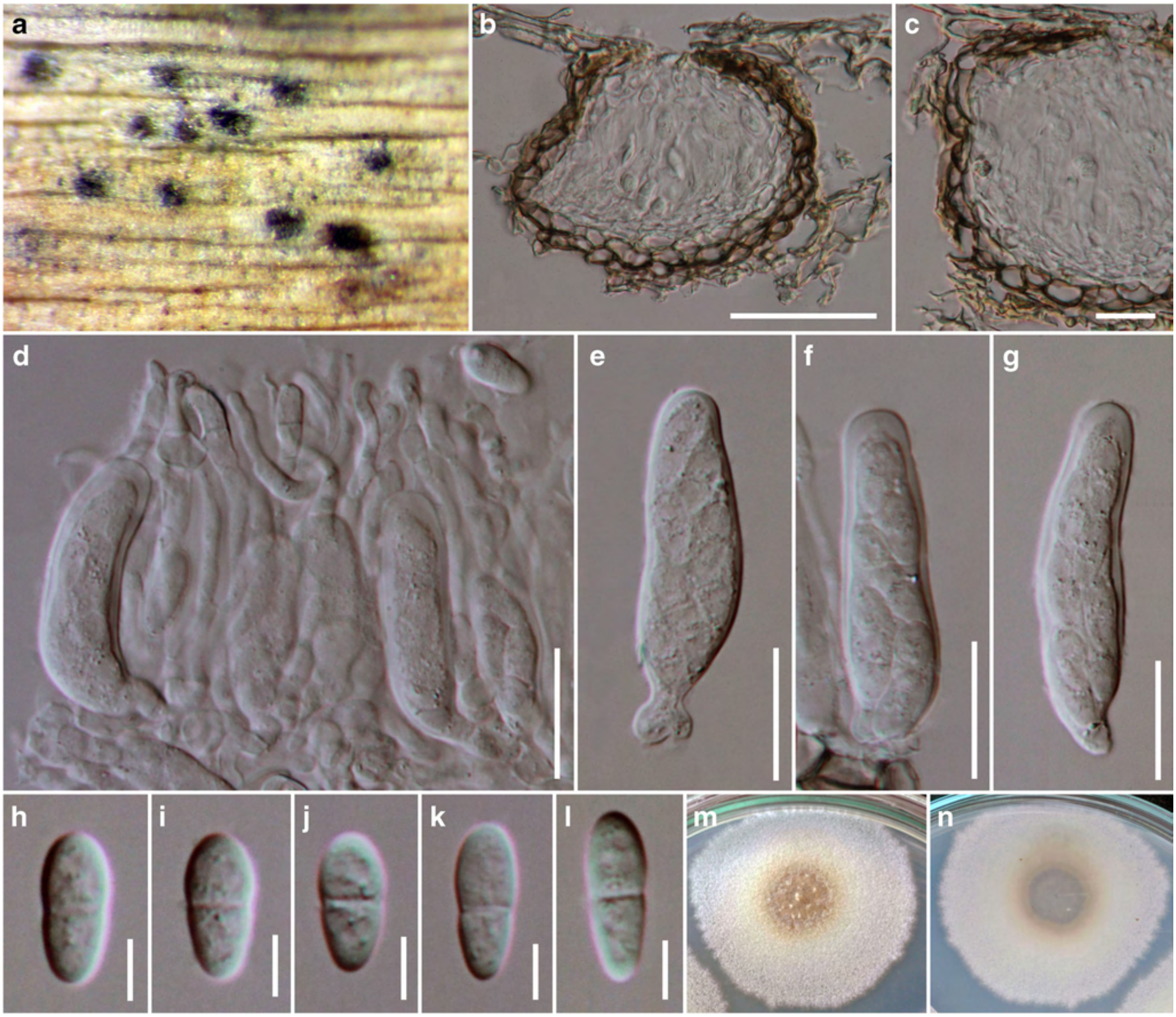


Fig. 16 *Neodidymella thailandicum* (holotype). **a** Appearance of ascomata on lower epidermis **b** Section through ascoma **c** Section through peridium **d** Asci with pseudoparaphyses **e**–**g** Asci **h**–**l** Ascospores **m**, **n** Culture characteristics (**m** = from above, **n** = from below). Scale bars: **b**=50 *μm*, **c**–**g**=20 *μm*, **h**–**l**=5 *μm*

16 asexual and sexual genera based on analyses of concatenated internal transcribed spacer (ITS) with LSU, SSU and β-tubulin gene sequence data (Fig. 17).

Austropleospora R.G. Shivas & L. Morin, in Morin et al., Fungal Diversity 40(1): 70 (2010).

Type species: ***Austropleospora osteospermi*** R.G. Shivas & L. Morin

128. ***Austropleospora osteospermi*** R.G. Shivas & L. Morin, Morin et al., Fungal Diversity 40(1): 70 (2010).

Facesoffungi number: FoF00935; Fig. 18

Parasitic on stem and leaves of *Chrysanthemoides monilifera* (L.) Norlindh. **Sexual morph**: *Ascomata* 75–110×130–200 μm ($\bar{x}$ = 100×146 μm, n=10), subglobose, sometimes slightly flattened, solitary or in groups, scattered, immersed immediately below the stem epidermis, ostiole 60–90 μm long, with a protruding neck. *Peridium* 8–18 μm ($\bar{x}$ = 12 μm, n=10) wide, composed of dark brown to black cells of *textura angularis. Hamathecium* of 2–3 μm wide, dense, filamentous, anastomosing, aseptate, hyaline pseudoparaphyses. *Asci* 75–120×13–18 μm ($\bar{x}$ = 92×16 μm, n=20), bitunicate, fissitunicate, 6–8-spored, cylindrical to clavate, with a short, broad, pedicel, rounded at the apex, with a minute ocular chamber. *Ascospores* 16.5−21× 6–8.4 μm ($\bar{x}$ = 18×7.7 μm, n=25), biseriate to overlapping uniseriate, yellowish brown, ellipsoidal, muriform, mostly with 3-transverse septa, 0–2 longitudinal septa, slightly constricted at median septum, not or very slightly constricted at other septa, apex rounded to slightly tapered, base tapered to rounded, smooth. **Asexual morph**: *Conidiomata* 75–110×100–130 μm ($\bar{x}$ = 88×115 μm, *n*=10), pycnidial, globose, superficial on stem, immersed in the host tissue and becoming erumpent at maturity, globose, dark brown in the erumpent part, with a single ostiole. *Conidiomata wall* 9–16 μm wide, brown to reddish-brown, thin-walled, comprising several layers with cells of *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* 10–12×2.5−3.5 μm ($\bar{x}$ = 11×2 μm, *n*=15), inconspicuously annellidic, discrete, cylindrical. *Conidia* 14–18×4.8−6.5 μm ($\bar{x}$ = 15.8×5.7 μm, *n*=25), cylindrical to narrowly ellipsoidal, initially hyaline and aseptate, becoming yellowish-brown at maturity, mostly transversely 1–3-septate, ends rounded.

Material examined: AUSTRALIA, New South Wales, Bellinger Head, Kalang River mouth, on stem and leaves of *Chrysanthemoides monilifera* ssp. *rotundata* (*Asteraceae*), 5 March 2008, L. Morin (BRIP 52234, **holotype**).

Notes: *Austropleospora* was introduced by Morin et al. (2010) to accommodate *A. osteospermi* and is monotypic. In the same study Shivas and Morin (in Morin et al. 2010) observed *Hendersonia osteospermi* Wakef. on the same host and identified it as the asexual morph of *A. osteospermi* both in culture and by DNA sequence analysis. Morin et al. (2010) placed *Austropleospora* in *Pleosporales* without assigning it to any family based on ITS sequence analysis. Thambugala et al. (2014) tentatively referred *Austropleospora* to *Pleosporaceae* based on morphological similarities but Ariyawansa et al. (2015) excluded *Austropleospora* from *Pleosporaceae* and tentatively referred it to *Didymosphaeriaceae*.

In the present study we found that the type strain of *Austropleospora osteospermi* forms a separate clade together with the type strain of *Paraconiothyrium archidendri* Verkley et al., sister to *Paracamarosporium* and *Paraconiothyrium fuckelii* (Sacc.) Verkley & Gruyter species complex clades in the family *Didymosphaeriaceae*. Thus we assign *Austropleospora* to the family *Didymosphaeriaceae* as a distinct genus. *Austropleospora* forms a distant clade from the generic type of *Paraconiothyrium*, *P. estuarinum* and this is also supported by morphology. *Paraconiothyrium* is paraphyletic within the family *Didymosphaeriaceae*.

We synonymise *Paraconiothyrium archidendri* under *Austropleospora* by giving the priority for the oldest epithet.

129. ***Austropleospora archidendri*** (Verkley et al.) Ariyawansa & K. D. Hyde, ***comb. nov.***

Facesoffungi number: FoF01038.

Fig. 17 Phylogram generated from maximum parsimony analysis based on combined LSU, SSU, β-tubulin and ITS sequenced data of *Didymosphaeriaceae*. Maximum parsimony bootstrap support values greater than 50 % and Bayesian posterior probabilities greater than 0.90 are near the nodes. The ex-type strains are in *bold* and the new isolates are in *blue*. The tree is rooted with *Trematosphaeria pertusa* CBS 122368 ▶

Basionym: *Paraconiothyrium archidendri* Verkley et al., in Verkley et al., Persoonia, Mol. Phyl. Evol. Fungi 32: 37 (2014).

130. ***Pseudopithomyces*** Ariyawansa & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551392; *Facesoffungi number*: FoF00937

Etymology: *Pseudo*, refers to the similarity to *Pithomyces*.

Saprobic or *parasitic* on dead leaves, stems of plants and humans. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiophores* micronematous or semi-macronematous, mononemous, flexuous, thin-walled, hyaline to subhyaline, aseptate, smooth, branch or unbranched, normally closely packed together. *Conidiogenous cells* arising perpendicularly from repent hyphae, monoblastic or blastic, closely aggregated, globose or subglobose, integrated, terminal, determinate, disintegrating at maturity to liberate conidia. *Conidia* acrogenous, dark fuligineous, septate to multi-septate, fusiform or subglobose, fusiform, verruculose to echinulate, walls ornamented, thin-walled, sometimes wide in the middle.

Type species: ***Pseudopithomyces chartarum*** (Berk. & M.A. Curtis) J.F. Li, Ariyawansa & K. D. Hyde

Notes: The genus Pithomyces is polyphyletic with species grouping in many different families in the Pleosporales such as *Didymellaceae*, *Didymosphaeriaceae* and *Astrosphaeriellaceae* (da Cunha 2014; Pratibha and Prabhugaonkar 2015). *Pseudopithomyces* is introduced as a new genus to accommodate *Pithomyces chartarum* (Berk. & M.A. Curtis) M.B. Ellis, *P. maydicus* (Sacc.) M.B. Ellis, *P. sacchari* (Speg.) M.B. Ellis and some unidentified *Pithomyces* strains, that group together in *Didymosphaeriaceae*. Morphological characters of *Pseudopithomyces* are similar to *Pithomyces*. The type species of the *Pithomyces*, *P. flavus* has been epitypified by Pratibha and Prabhugaonkar (2015), and the epitype strain of *P. flavus* (MTCC 12224) clustered in the family *Astrosphaeriellaceae*. Thus, these two genera are phylogenetically distinct.

Leptosphaerulina chartarum was mentioned as the sexual morph of *Pithomyces chartarum* (da Cunha 2014). da Cunha (2014) showed that the ex-type strain of *Leptosphaerulina*

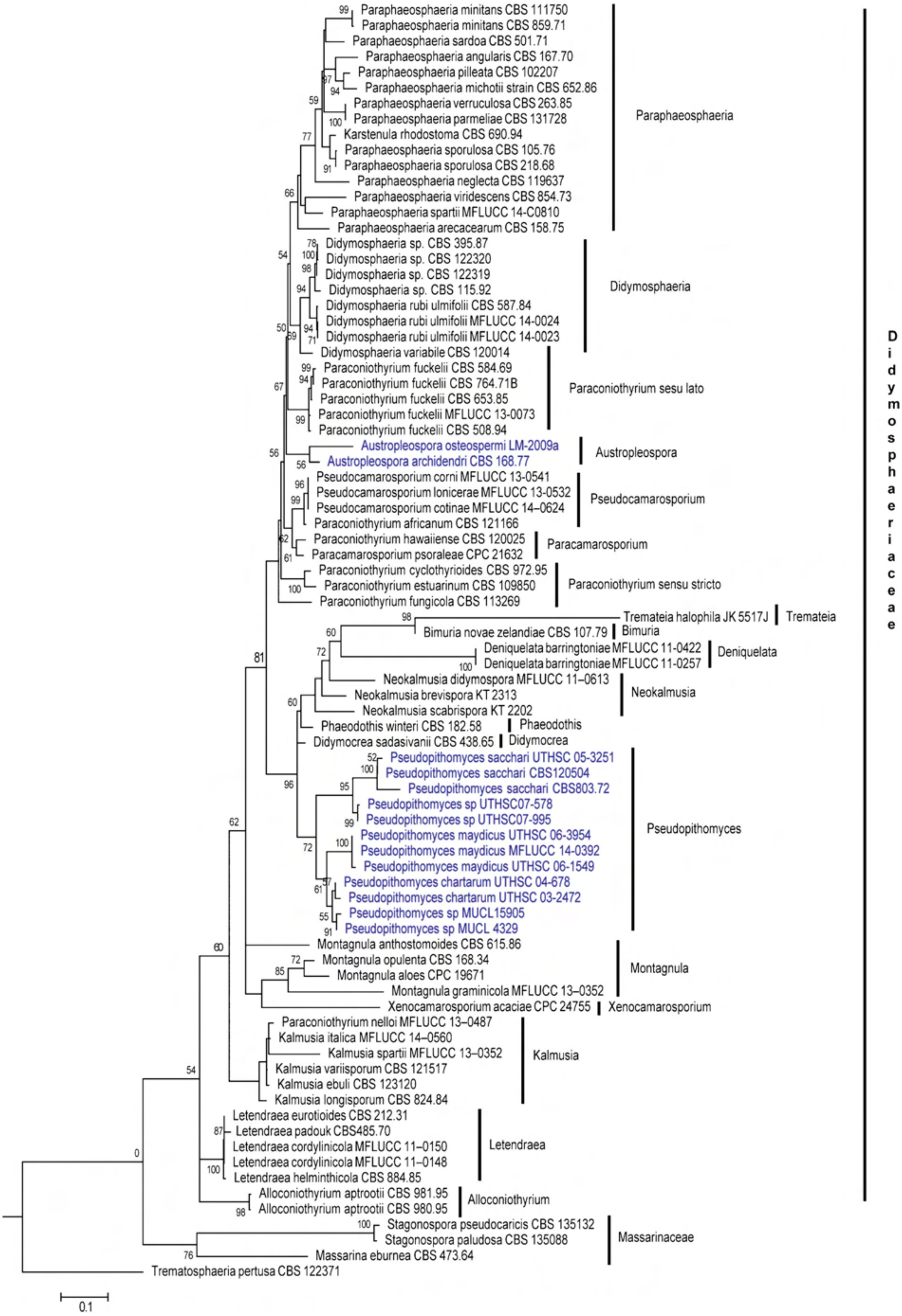

Paraphaeosphaeria minitans CBS 111750
Paraphaeosphaeria minitans CBS 859.71
Paraphaeosphaeria sardoa CBS 501.71
Paraphaeosphaeria angularis CBS 167.70
Paraphaeosphaeria pilleata CBS 102207
Paraphaeosphaeria michotii strain CBS 652.86
Paraphaeosphaeria verruculosa CBS 263.85
Paraphaeosphaeria parmeliae CBS 131728
Karstenula rhodostoma CBS 690.94
Paraphaeosphaeria sporulosa CBS 105.76
Paraphaeosphaeria sporulosa CBS 218.68
Paraphaeosphaeria neglecta CBS 119637
Paraphaeosphaeria viridescens CBS 854.73
Paraphaeosphaeria spartii MFLUCC 14-C0810
Paraphaeosphaeria arecacearum CBS 158.75
Paraphaeosphaeria
Didymosphaeria sp. CBS 395.87
Didymosphaeria sp. CBS 122320
Didymosphaeria sp. CBS 122319
Didymosphaeria sp. CBS 115.92
Didymosphaeria rubi ulmifolii CBS 587.84
Didymosphaeria rubi ulmifolii MFLUCC 14-0024
Didymosphaeria rubi ulmifolii MFLUCC 14-0023
Didymosphaeria variabile CBS 120014
Didymosphaeria
Paraconiothyrium fuckelii CBS 584.69
Paraconiothyrium fuckelii CBS 764.71B
Paraconiothyrium fuckelii CBS 653.85
Paraconiothyrium fuckelii MFLUCC 13-0073
Paraconiothyrium fuckelii CBS 508.94
Paraconiothyrium sesu lato
Austropleospora osteospermi LM-2009a
Austropleospora archidendri CBS 168.77
Austropleospora
Pseudocamarosporium corni MFLUCC 13-0541
Pseudocamarosporium lonicerae MFLUCC 13-0532
Pseudocamarosporium cotinae MFLUCC 14–0624
Paraconiothyrium africanum CBS 121166
Pseudocamarosporium
Paraconiothyrium hawaiiense CBS 120025
Paracamarosporium psoraleae CPC 21632
Paracamarosporium
Paraconiothyrium cyclothyrioides CBS 972.95
Paraconiothyrium estuarinum CBS 109850
Paraconiothyrium fungicola CBS 113269
Paraconiothyrium sensu stricto
Trematateia halophila JK 5517J
Trematateia
Bimuria novae zelandiae CBS 107.79
Bimuria
Deniquelata barringtoniae MFLUCC 11-0422
Deniquelata barringtoniae MFLUCC 11-0257
Deniquelata
Neokalmusia didymospora MFLUCC 11–0613
Neokalmusia brevispora KT 2313
Neokalmusia scabrispora KT 2202
Neokalmusia
Phaeodothis winteri CBS 182.58
Phaeodothis
Didymocrea sadasivanii CBS 438.65
Didymocrea
Pseudopithomyces sacchari UTHSC 05-3251
Pseudopithomyces sacchari CBS120504
Pseudopithomyces sacchari CBS803.72
Pseudopithomyces sp UTHSC07-578
Pseudopithomyces sp UTHSC07-995
Pseudopithomyces maydicus UTHSC 06-3954
Pseudopithomyces maydicus MFLUCC 14-0392
Pseudopithomyces maydicus UTHSC 06-1549
Pseudopithomyces chartarum UTHSC 04-678
Pseudopithomyces chartarum UTHSC 03-2472
Pseudopithomyces sp MUCL15905
Pseudopithomyces sp MUCL 4329
Pseudopithomyces
Montagnula anthostomoides CBS 615.86
Montagnula opulenta CBS 168.34
Montagnula aloes CPC 19671
Montagnula graminicola MFLUCC 13–0352
Montagnula
Xenocamarosporium acaciae CPC 24755
Xenocamarosporium
Paraconiothyrium nelloi MFLUCC 13–0487
Kalmusia italica MFLUCC 14–0560
Kalmusia spartii MFLUCC 13–0352
Kalmusia variisporum CBS 121517
Kalmusia ebuli CBS 123120
Kalmusia longisporum CBS 824.84
Kalmusia
Letendraea eurotioides CBS 212.31
Letendraea padouk CBS485.70
Letendraea cordylinicola MFLUCC 11–0150
Letendraea cordylinicola MFLUCC 11–0148
Letendraea helminthicola CBS 884.85
Letendraea
Alloconiothyrium aptrootii CBS 981.95
Alloconiothyrium aptrootii CBS 980.95
Alloconiothyrium
Stagonospora pseudocaricis CBS 135132
Stagonospora paludosa CBS 135088
Massarina eburnea CBS 473.64
Massarinaceae
Trematosphaeria pertusa CBS 122371
Didymosphaeriaceae
0.1

Fig. 18 *Austropleospora osteospermi* (holotype) **a** Herbarium material **b** Ascomata on host surface **c** Section through ascoma **d** Section of peridium **e** Cellular pseudoparaphyses **f** Mature bitunicate asci **g** Muriform ascospores **h** Section of pycnidium **i** Pycnidial wall **j** Conidiogenous cells and developing conidia **k** Brown 3-septate conidia. Scale bars: **c**=50 μm, **d** = 25 μm, **e**, **g**=10 μm, **f**=25 μm, **g**=5 μm, **h**= 20 μm, **i**–**k**=5 μm

chartarum (CBS 329.86 ^{T}) clustered within the family *Didymellaceae* and did not belong in the *Pithomyces chartarum* clade or to be related to any of the *Pithomyces* lineages (da Cunha 2014).

In this study *Pithomyces chartarum* is selected as the generic type of *Pseudopithomyces*. *Pseudopithomyces* differs from *Pithomyces* in having echinulate or fusiform, verruculose dark conidia and producing brown to black colonies on the host. *Pithomyces* produces obovate to oblong, verruculose to spinulose, comparatively lighter conidia and forms whitish to yellowish colonies on the host (Ellis 1960; Pratibha and Prabhugaonkar 2015).

In the present study we introduced a novel species of *Pseudopithomyces*, *Pse. palmicola* and re-described *Pse. maydicus* from our fresh collection obtained from dead palm leaves in Northern Thailand (Fig. 19).

131. ***Pseudopithomyces chartarum*** (Berk. & M.A. Curtis) J.F. Li, Ariyawansa & K.D. Hyde, ***comb. nov.***

Basionym: *Sporidesmium chartarum* Berk. & M.A. Curtis, in Berkeley, Grevillea 3(no. 26): 50 (1874).

≡ *Pithomyces chartarum* (Berk. & M.A. Curtis) M.B. Ellis, Mycol. Pap. 76: 13 (1960).

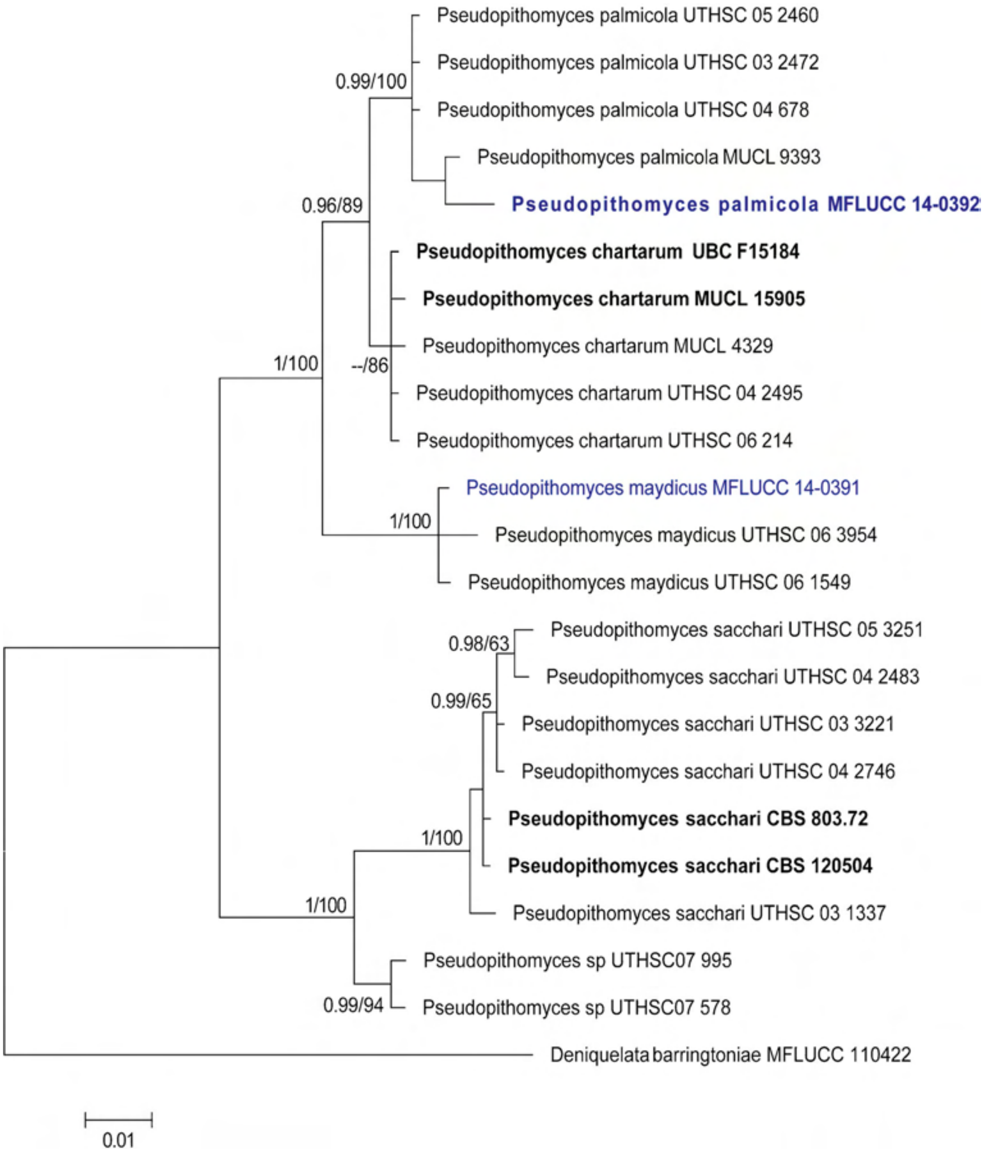


Fig. 19 Phylogram generated from Bayesian analysis based on ITS and LSU sequence data. Bayesian posterior probabilities (PP) greater than 0.90 are indicated above or below the nodes. The ex-type and reference strains are in *bold*, the new isolates are in *blue*. The tree is rooted with *Deniquelata barringtoniae* (MFLUCC 11-0422)

Index Fungorum number: IF551393; *Facesoffungi number*: FoF00938

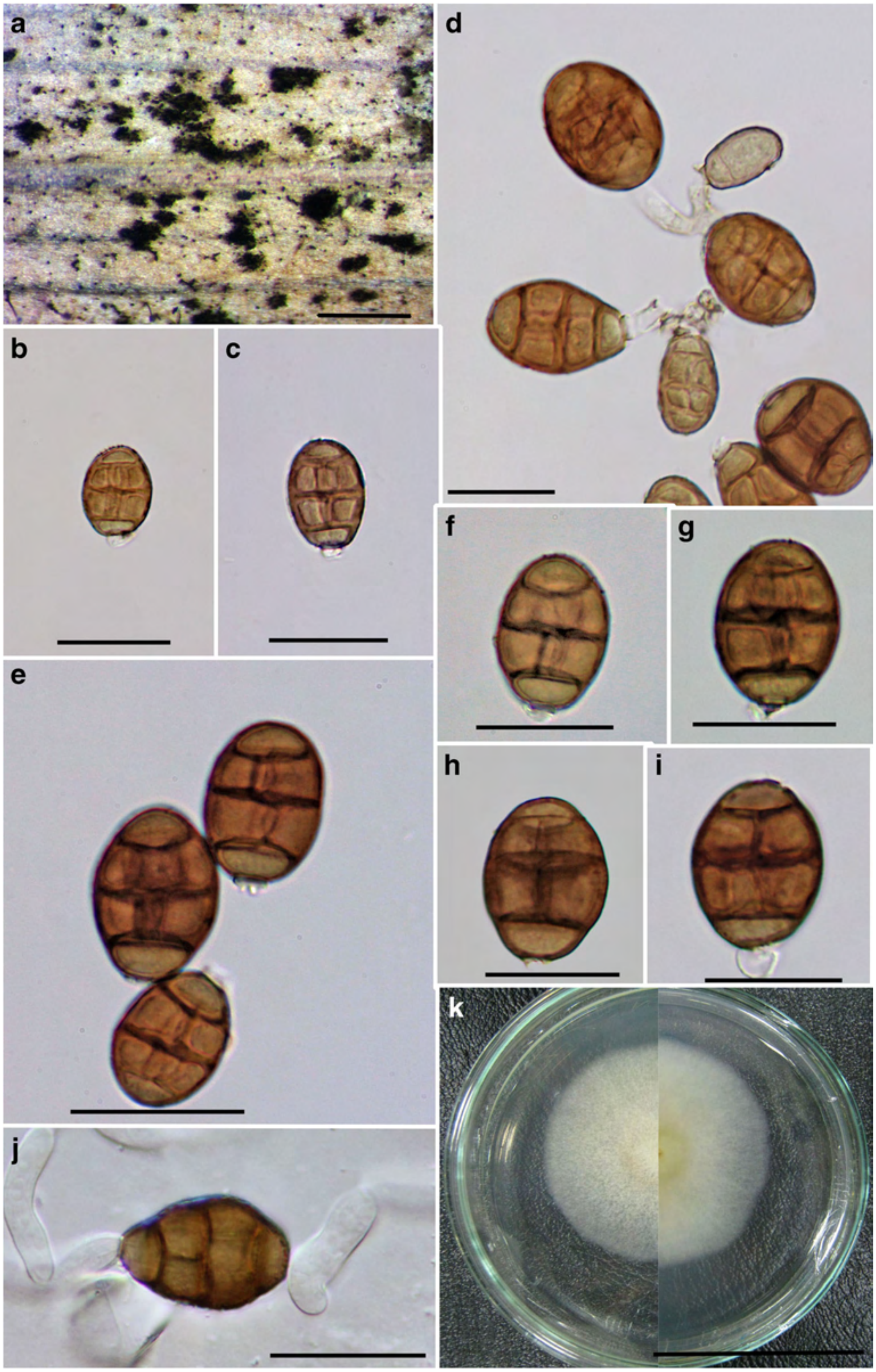
Pathogenic on human or sheep skin. *Colonies* black, separate, later becoming confluent, up to 0.5 mm diam. *Conidiophores* 2–5 × 1.5–2.5 µm. micronematous or semi-macronematous, mononematous, branched and anastomosing, pale olive, smooth or occasionally verruculose. *Conidiogenous cells* integrated. *Conidia* 18–29 × 10–17 µm, acropleurogenous, mainly pleurogenous, broadly ellipsoid, 3-septate to multi-septate, mainly with 3–4 transverse septa and usually divided by longitudinal septum, often constricted at the septa, mid brown to dark brown, finely echinulate to verruculose, rhexolytic, smooth or occasionally verruculose, a small piece of the denticle invariably remains attached to the base of the conidium (Ellis 1971; Dingley 1962).

Notes: *Pseudopithomyces chartarum* was introduced as *Sporidesmium chartarum* by Berkeley and Curtis (1874). In this study we used the reference strain of *Pse. chartarum* for our phylogenetic analysis, which was used by da Cunha (2014). Our results clearly show that the strains of *Pse. chartarum* (MUCL 15905 and UBC F15184) forms a separate clade sister to the *Pse. palmicola* clade, including some other putative strains of *Pse. chartarum* (MUCL 4329, UTHSC 04 2495 and UTHSC 06 214), which we rename.

132. ***Pseudopithomyces palmicola*** J.F. Li, Ariyawansa & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551421; *Facesoffungi number*: FoF00939; Fig. 20

Fig. 20 *Pseudopithomyces palmicola* (holotype) **a** Colonies on palm leaves **b**, **c** Immature conidia **d** Conidiophores bearing conidia **e**–**i** Conidia **j** Germinating conidium **k** Upper and lower view of colony. Scale bars: **a**=500 µm, **b**–**j**=20 µm, **k**=5 cm



Etymology: The name *palmicola*, refers to the common host name and Latin *cola* meaning loving.

Holotype: MFLU 15-1474

Saprobic on leaves of *Acoelorrhaphe wrightii* (Griseb. & H. Wendl.) H. Wendl. ex Becc. **Sexual morph**: Undetermined. **Asexual morph**: *Colonies* effuse, dark brown to black. *Mycelium* superficial or partly immersed on the substrate, composed of septate, branched, smooth, thin-walled, pale to grey hyphae. *Conidiophores* 3.6–6×3.2–3.5 µm ($\bar{x}$ = 5.5×3.3 µm, n=100), micronematous, mononemous, closely packed, hyaline, thin-walled, aseptate, smooth, branched, flexuous. *Conidiogenous cells* 3.5–5.5×2.5–3.5 μm ($\bar{x}$ = 4.5×3.3 μm, *n*=100), monoblastic, phialidic, integrated, terminal, determinate, hyaline, globose or subglobose. *Conidia* 21.5–30.5×10–16.5 μm ($\bar{x}$ = 27.9×14.2 μm, *n*=100), acrogenous, muriform, subglobose, 6–8-septate, verruculose to echinulate, amygdaliform or ovoid, thin-walled, light brown to brown.

Cultural characteristics: Conidia germinating on PDA within 14 h and germ tubes produced from end cells. Colonies growing on PDA, cottony, grey to brown, reaching 5 mm in 20 days at 25 °C, mycelium superficial, effuse, radially striate, with regular edge, hyphae pale to yellow white; asexual spores and sexual spores were not formed within 60 days.

Material examined: THAILAND, Chiang Rai Provice, Mae Fah Luang, on leaves of *Acoelorrhaphe wrightii* (Griseb. & H. Wendl.) H. Wendl. ex Becc. (*Arecaceae*), 26 January 2014, J.F. Li, H-4l (MFLU 15-1474, **holotype**), ex-type living culture, MFLUCC 14-0392, KUMCC 15-0100.

Notes: Phylogenetic analysis based on ITS and LSU sequence data showed that *Pseudopithomyces palmicola* is closely related to, but forms a distinct lineage from the *Pse. chartarum* clade (Fig. 19). *Pseudopithomyces palmicola* is similar to *P. chartarum* in having three constricted transverse septa and 1–2 longitudinal septa in the central cells. *Pseudopithomyces palmicola* differs from *Pse. chartarum* in having thick and hyaline conidiophores and mostly globose, pale brown conidia with slightly constricted septa, while *Pse. palmicola* has thin and heavily pigmented conidiophores with dark brown conidia which are comparatively more constricted at the septa (da Cunha 2014). Furthermore *P. palmicola* forms pale to yellow white colonies on PDA, while *Pse. chartarum* forms white to dark grey colonies on PDA (Supplementary Table 2).

133. ***Pseudopithomyces maydicus*** (Sacc.) J.F. Li, Ariyawansa & K.D. Hyde, ***comb. nov.***

Basionym: *Clasterosporium maydicum* Sacc., Nuovo G. bot. ital. 23(2): 213 (1916)

≡ *Pithomyces maydicus* (Sacc.) M.B. Ellis, *Mycol. Pap.* 76: 15 (1960)

For other synonyms see Index Fungorum (2015)

Index Fungorum number: IF551395; *Facesoffungi number*: FoF00940; Fig. 21

Saprobic on leaves of *Acoelorrhaphe wrightii*. **Sexual morph**: Undetermined. **Asexual morph**: *Colonies* effuse, dark brown to black. *Mycelium* superficial or partly immersed in the substrate, composed of septate, branched, smooth, thin-walled, white hyphae. *Conidiophores* 4–6×2.5–3 μm ($\bar{x}$ = 4.4×2.7 μm, *n*=100), semi-micronematous, mononemous, closely packed, hyaline to subhyaline, thin-walled, aseptate, smooth, unbranched, flexuous. *Conidiogenous cells* 3.5–5× 1.4–4 μm ($\bar{x}$ = 3.6×2.2 μm, *n*=100), monoblastic, integrated, terminal, determinate, hyaline, globose or subglobose. *Conidia* 13.5–24.5×5.5–8.5 μm ($\bar{x}$ = 21.8×5.6 μm, *n*=100), wide in the middle, acrogenous, muriform, 3–4-septate, thin-walled, brown to dark brown, fusiform to pyriform, clavate.

Cultural characteristics: Conidia germinating on PDA within 14 h and germ tubes produced from apical cells. Colonies growing on PDA, hairy or cottony, white to dark grey, reaching 5 mm in 20 days at 25 °C, mycelium superficial, effuse, radially striate, with regular edge, hypha white to grey. Asexual spores and sexual spores not formed within 60 days.

Material examined: THAILAND, Chiang Rai Provice, Mae Fah Luang, on dead leaves of *Acoelorrhaphe wrightii* (*Arecaceae*), 26 Janurary 2014, J.F. Li, H-4e (MFLU 15-1473, **reference specimen designated here**), living culture, MFLUCC 14-0391, KUM-15-0101.

Notes: *Pseudopithomyces maydicus* is characterised by cylindrical or slightly clavate, pale brown to dark brown, verrucose conidia with two to three transverse septa, rarely with one oblique or longitudinal septum and in its white to grayish yellow colonies on PDA. The characters of our collection are typical with that of *Clasterosporium maydicum* (Ellis 1960). Furthermore our phylogeny also concluded that the putative strains of *Pse. maydicus* (UTHSC 06 3954 and UTHSC 06 1549) clustered with our strain (Fig. 19).

134. ***Pseudopithomyces sacchari*** (Speg.) Ariyawansa & K.D. Hyde, ***comb. nov.***

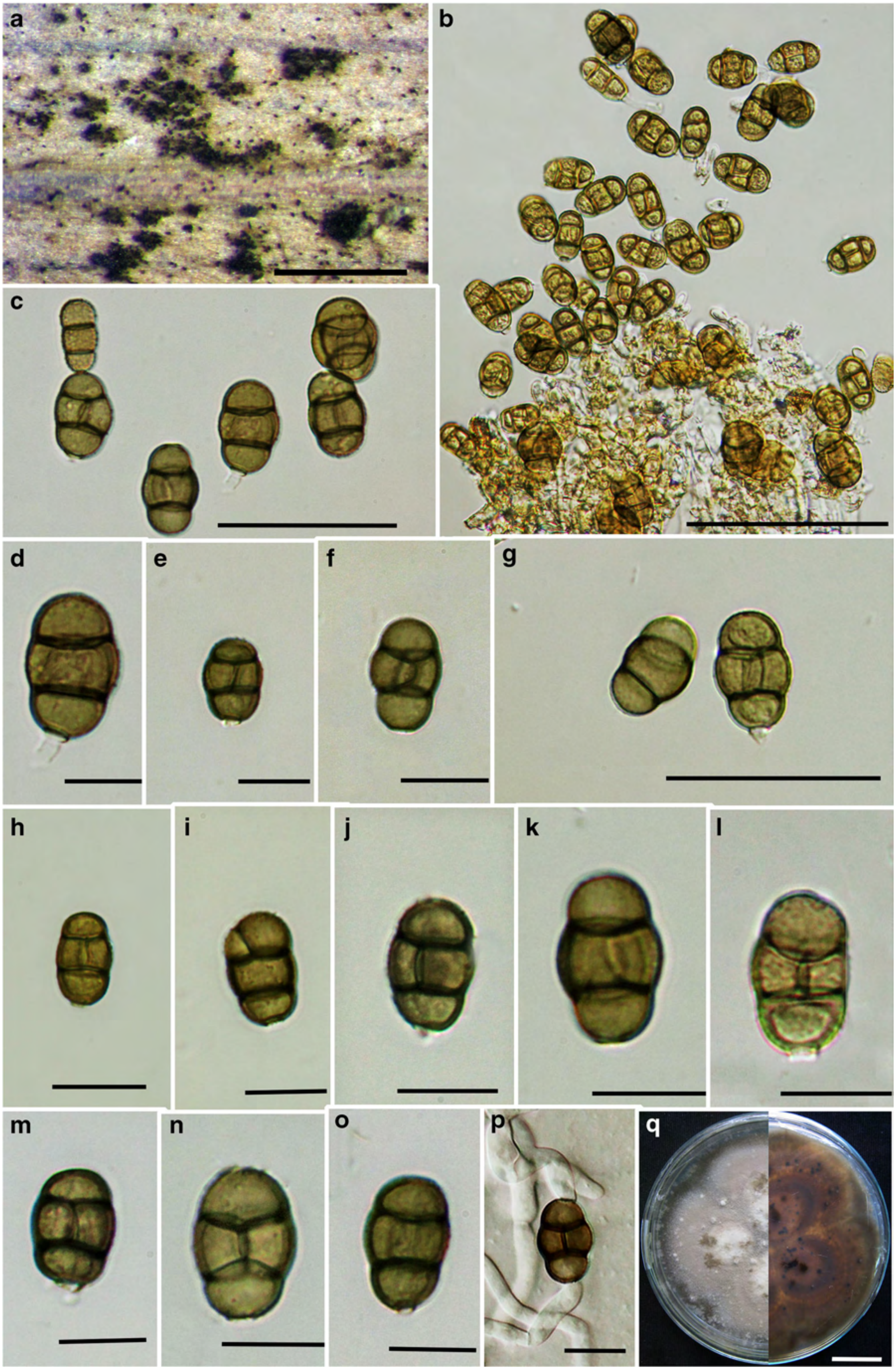
Basionym: *Sporidesmium sacchari* Speg., Anal. Mus. nac. B. Aires, Ser. 3 13: 443 (1911).

≡ *Pithomyces sacchari* (Speg.) M.B. Ellis, Mycol. Pap. 76: 17 (1960).

Index Fungorum number: IF551397

Floricolaceae Thambugala et al.

Notes: *Floricola* was introduced as a monotypic genus by Kohlmeyer and Volkmann-Kohlmeyer (2000) with *F. striata* Kohlm. & Volkm.-Kohlm. as the type species. Thambugala et al. (2015) noted that coelomycetous asexual morphs are characteristic of the family *Floricolaceae. Floricola striata* is characterized by immersed, pycnidial, ostiolate conidiomata, conidiophores that are reduced to phialidic conidiogenous cells and 3-septate, dark brown conidia. *Floricola viticola* is similar to *F. striata* except that conidiomata are larger and conidia smaller. *Floricola striata* grouped with *Misturatosphaeria* species in *Lophiostomataceae* (Hyde et al. 2013), but a further molecular study refers them to a new family *Floricolaceae* (Thambugala et al. 2015). Kohlmeyer and Volkmann-Kohlmeyer (2000) mentioned that *F. striata* frequently occurs on old inflorescences. Phylogenetic analysis (Fig. 22) supports the distinctness of this species and thus we introduced *F. viticola* as a new species.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◀ **Fig. 21** *Pseudopithomyces maydicus* (reference specimen) **a** Colonies on palm stem **b** Conidiogenous cells and conidiophores bearing conidia **c**–**o** Conidia **p** Germinated conidium **q** Upper and lower view of colony. Scale bars: **a**=500 μm, **b**=100 μm, **c**, **g**=50 μm, **d**–**n**=20 μm, **q**=3 cm

135. ***Floricola viticola*** Phukhamsakda, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551366; *Facesoffungi number*: FoF00896; Fig. 23

Etymology: named after the host genus, *Vitis*.

Holotype: MFLU 15–1404

Saprobic on dead branch of *Vitis vinifera* L. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 220–239 μm high × 154–202 μm ($\bar{x}$ = 237 × 177 μm, n=10) diam., solitary, pycnidial, unilocular, scattered, immersed to erumpent, subglobose, dark brown to black. *Pycnidial wall* 13–35 μm (−40 μm at apex), externally merging with host tissues, composed of brown cells of *textura angularis* with a hyaline inner lining bearing conidiogenous cells. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* 2–10 × 2–9 μm ($\bar{x}$ = 4 × 5 μm, n=20) diam., enteroblastic, phialidic, determinate, solitary, doliform, smooth-walled, hyaline. *Conidia* 7–12 × 2–6 μm ($\bar{x}$ = 9 × 4 μm, n=50), initially hyaline, dark brown at maturity, oblong, subfusiform, occasionally curved at the apex, with slight abscission scar at base of conidia, with 1–3 longitudinal septa, constricted at some septa, narrowly rounded at both ends, smooth-walled.

Cultural characteristics: Colonies on PDA reaching 20 mm diam. after 4 weeks at 16 °C, cream to orangish-white at the margins; reverse white to cream and orangish-white at the center, medium dense, circular, umbonate, fimbriate, fluffy, slightly radiating in the lower part, without diffusible pigments.

Material examined: ITALY, Forlì-Cesena Province, near Galeata, on dead branch of *Vitis vinifera* (*Vitaceae*). 16 October 2014, E. Camporesi (MFLU 15–1404, **holotype**), (**isotype in HKAS**, under the code of HKAS88971), ex-type living culture, MFLUCC 15–0039.

Halotthiaceae Ying Zhang et al.

The family *Halotthiaceae* was introduced by Zhang et al. (2013a, b) to accommodate freshwater and maritime Dothideomycetes. *Halotthia*, *Mauritiana*, *Phaeoseptum* and *Pontoporeia* were included in this family (Hyde et al. 2013; Zhang et al. 2013a, b; Wijayawardene et al. 2014). *Halotthiaceae* species were characterized by an aquatic habitat, large erumpent to superficial ascomata (>600 μm diam.), sometimes immersed in a pseudoclypeus, a thin-walled peridium, narrow pseudoparaphyses, and brown to dark brown, phragmosporous or dictyosporous ascospores (Hyde et al. 2013; Zhang et al. 2013a, b). Based on multigene phylogenetic analyses, the family formed a monophyletic clade close to *Sporormiaceae*, *Roussoellaceae* and *Lophiostomataceae* in *Pleosporales* (Suetrong et al. 2009; Zhang et al. 2012a, 2013a, b; Hyde et al. 2013; Wijayawardene et al. 2014). In this paper we introduce a new genus, *Brunneoclavispora*, to *Halotthiaceae* In this paper we introduce the novel genera *Brunneoclavispora Neolophiostoma* and *Sulcosporium* in *Halotthiaceae*, based on its phylogenetic placement and distinct characters (Fig. 1).

136. ***Brunneoclavispora*** Phookamsak & K.D. Hyde, ***gen. nov.***

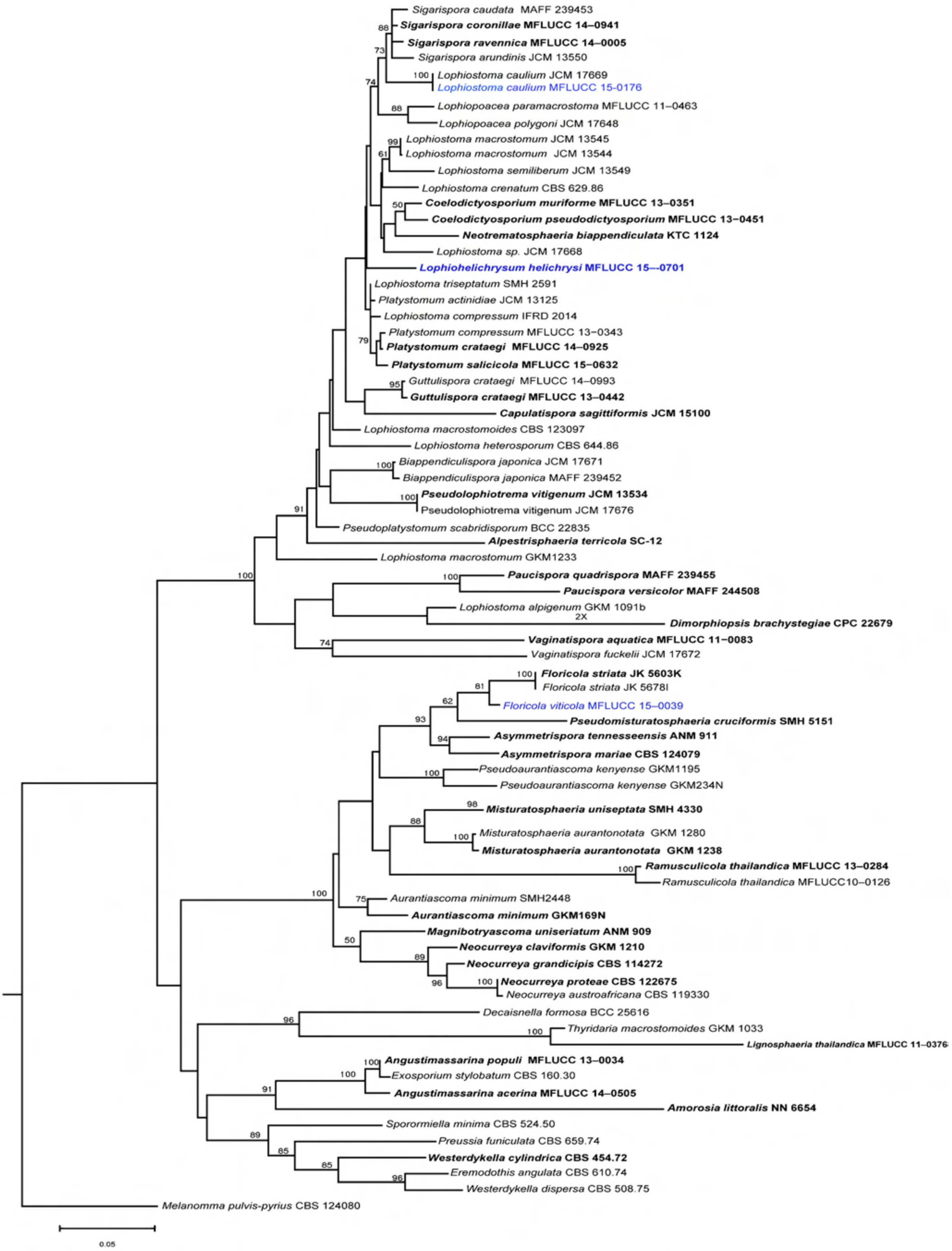
Index Fungorum number: IF551326; *Facesoffungi number*: FoF00892

Etymology: The generic epithet "*Brunneoclavispora*" refers to the brown, clavate ascospores.

Saprobic on bamboo. **Sexual morph**: *Ascomata* solitary to gregarious, immersed in pseudoclypeus to superficial, raised, uni-loculate, elongate conical with a flattened base, ostiole central, with slit-like opening. *Peridium* thin-walled, composed of several layers, of brown to dark brown, pseudoparenchymatous cells, arranged in *textura angularis* to *textura prismatica. Hamathecium* composed of dense, narrow, cellular pseudoparaphyses, anastomosing. *Asci* 8-spored, bitunicate, fissitunicate, clavate, pedicelate, apically rounded with ocular chamber. *Ascospores* overlapping, uni- to biseriate, phragmosporous or dictyosporous, clavate with rounded upper part and tapered lower part, straight or slightly curved, brown to dark brown, septate, slightly constricted at the septum, smooth-walled. Asexual morph: Undetermined.

Type species: ***Brunneoclavispora bambusae*** Phookamsak & K.D. Hyde

Notes: *Brunneoclavispora* is introduced to accommodate a terrestial Dothideomycete species in *Halothiaceae* and is typified by *B. bambusae* Phookamsak & K.D. Hyde. The genus is unique in its clavate ascospores and combination of other characters. Ascospores of *Brunneoclavispora* are similar to species in *Massariosphaeria* in having large, clavate to fusiform, muriform or multi-septate ascospores (Crivelli 1983; Tanaka and Harada 2004; Wang et al. 2007). However, *Brunneoclavispora* differs from *Massariosphaeria* in its elongate conical ascomata, with a slit-like opening. Multigene phylogenetic analyses (Fig. 1), indicates that *Brunneoclavispora* belongs in *Halotthiaceae*, while *Massariosphaeria* species are polyphyletic and form clades in *Amniculicolaceae*, *Lindgomycetaceae* and *Thyridariaceae* (Wang et al. 2007; Hyde et al. 2013; Wijayawardene et al. 2014; this paper). *Brunneoclavispora* is similar to *Phaeoseptum* in *Halotthiaceae* but differs in its habitat, host, and ascospores with appendages. *Brunneoclavispora* is terrestial on bamboo, and has clavate, muriform ascospores (with 1–4 longitudinal septa) and a tail-like basal appendage.


Sigarispora caudata MAFF 239453
88
Sigarispora coronillae MFLUCC 14–0941
73
Sigarispora ravennica MFLUCC 14–0005
Sigarispora arundinis JCM 13550
100
Lophiostoma caulium JCM 17669
74
Lophiostoma caulium MFLUCC 15-0176
88
Lophiopoacea paramacrostoma MFLUCC 11–0463
Lophiopoacea polygoni JCM 17648
99
Lophiostoma macrostomum JCM 13545
61
Lophiostoma macrostomum JCM 13544
Lophiostoma semiliberum JCM 13549
Lophiostoma crenatum CBS 629.86
50
Coelodictyosporium muriforme MFLUCC 13–0351
Coelodictyosporium pseudodictyosporium MFLUCC 13–0451
Neotrematosphaeria biappendiculata KTC 1124
Lophiostoma sp. JCM 17668
Lophiohelichrysum helichrysi MFLUCC 15–-0701
Lophiostoma triseptatum SMH 2591
Platystomum actinidiae JCM 13125
Lophiostoma compressum IFRD 2014
Platystomum compressum MFLUCC 13–0343
79
Platystomum crataegi MFLUCC 14–0925
Platystomum salicicola MFLUCC 15–0632
95
Guttulispora crataegi MFLUCC 14–0993
Guttulispora crataegi MFLUCC 13–0442
Capulatispora sagittiformis JCM 15100
Lophiostoma macrostomoides CBS 123097
Lophiostoma heterosporum CBS 644.86
100
Biappendiculispora japonica JCM 17671
Biappendiculispora japonica MAFF 239452
100
Pseudolophiotrema vitigenum JCM 13534
91
Pseudolophiotrema vitigenum JCM 17676
Pseudoplatystomum scabridisporum BCC 22835
Alpestrisphaeria terricola SC-12
Lophiostoma macrostomum GKM1233
100
100
Paucispora quadrispora MAFF 239455
Paucispora versicolor MAFF 244508
Lophiostoma alpigenum GKM 1091b
2X
Dimorphiopsis brachystegiae CPC 22679
74
Vaginatispora aquatica MFLUCC 11–0083
Vaginatispora fuckelii JCM 17672
100
Floricola striata JK 5603K
81
Floricola striata JK 5678I
62
Floricola viticola MFLUCC 15–0039
93
Pseudomisturatosphaeria cruciformis SMH 5151
94
Asymmetrispora tennesseensis ANM 911
Asymmetrispora mariae CBS 124079
100
Pseudoaurantiascoma kenyense GKM1195
Pseudoaurantiascoma kenyense GKM234N
98
Misturatosphaeria uniseptata SMH 4330
88
100
Misturatosphaeria aurantonotata GKM 1280
Misturatosphaeria aurantonotata GKM 1238
100
Ramusculicola thailandica MFLUCC 13–0284
Ramusculicola thailandica MFLUCC10–0126
100
75
Aurantiascoma minimum SMH2448
Aurantiascoma minimum GKM169N
Magnibotryascoma uniseriatum ANM 909
50
Neocurreya claviformis GKM 1210
89
Neocurreya grandicipis CBS 114272
96
100
Neocurreya proteae CBS 122675
Neocurreya austroafricana CBS 119330
96
Decaisnella formosa BCC 25616
100
Thyridaria macrostomoides GKM 1033
Lignosphaeria thailandica MFLUCC 11–037
100
Angustimassarina populi MFLUCC 13–0034
100
Exosporium stylobatum CBS 160.30
91
Angustimassarina acerina MFLUCC 14–0505
Amorosia littoralis NN 6654
89
Sporormiella minima CBS 524.50
85
Preussia funiculata CBS 659.74
85
Westerdykella cylindrica CBS 454.72
96
Eremodothis angulata CBS 610.74
Westerdykella dispersa CBS 508.75
Melanomma pulvis-pyrius CBS 124080
0.05

◀ **Fig. 22** Phylogram generated from maximum likelihood analysis based on combined LSU, ITS, EF and SSU sequenced data for the family *Lophiostomataceae*. Maximum likelihood bootstrap support values greater than 50 % are above the nodes. The ex-type strains are in *bold* and the new isolates are in *blue*. The tree is rooted to *Melanomma pulvis-pyrius* (strain CBS 124080)

Phaeoseptum was found on *Robinia pseudoacacia* in freshwater fungi and has ellipsoidal to fusiform ascospores with longitudinal septa in each cell, and lacks appendages. In the phylogenetic tree (Fig. 1) *Brunneoclavispora* clusters in *Hallothiaceae*, close to *Mauritiana rhizophorae*.

137. ***Brunneoclavispora bambusae*** Phookamsak & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551327; *Facesoffungi number*: FoF00893; Fig. 24

Etymology: The specific epithet "*bambusae*" refers to the host.

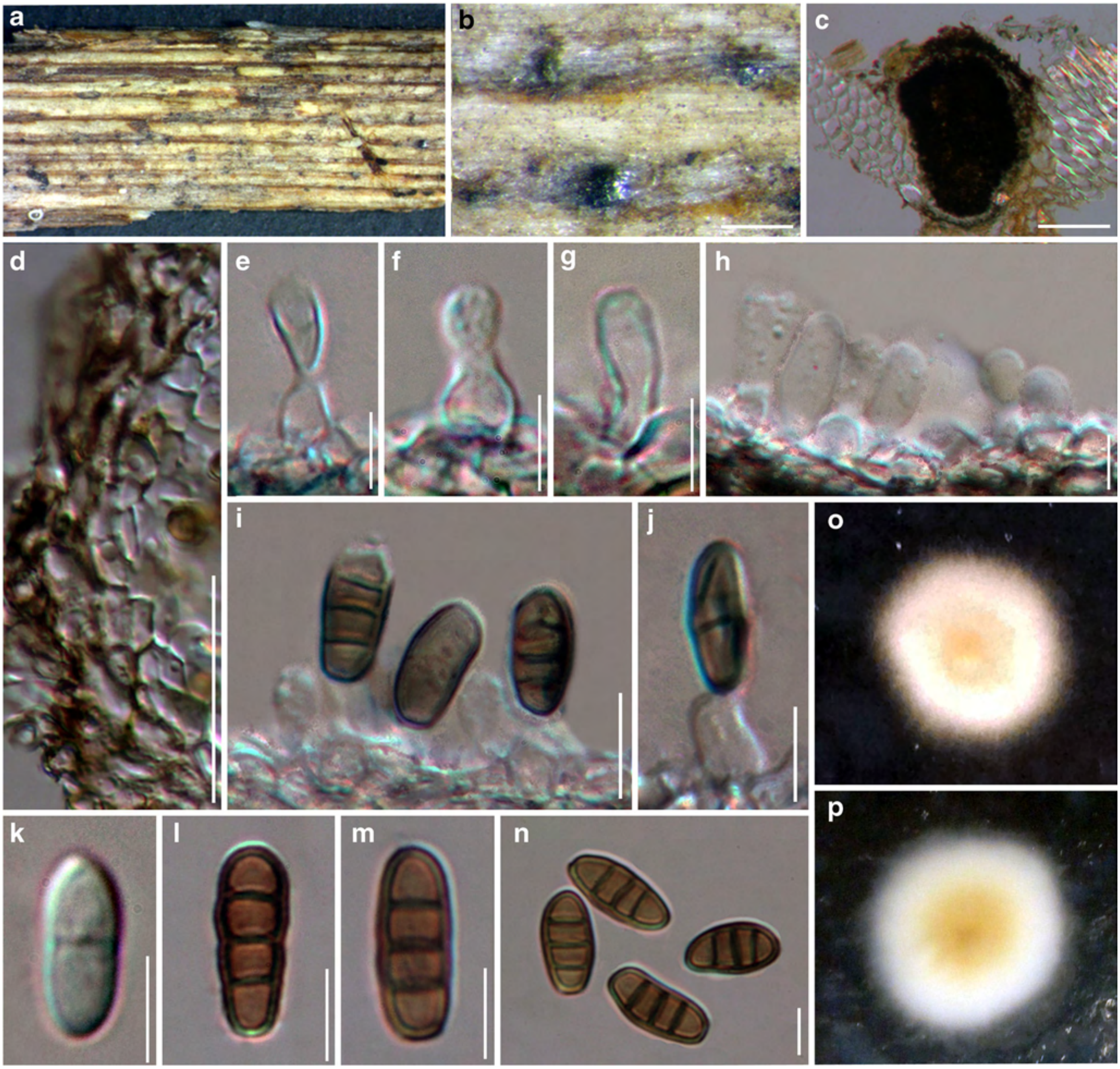


Fig. 23 *Floricola viticola* (holotype) **a** Habit of *Floricola viticola* on *Vitis vinifera* L. **b** Close up of conidiomata below surface of host **c** Vertical section through the conidioma **d** Part of conidiomata peridium **e**–**j** Developing state of conidiogenous cells **k**–**n** Conidia **o**–**p** Culture character on PDA. Scale bar: **b**=200 μm, **c**=100 μm, **d**=50 μm, **e**–**n**=5 μm

Holotype MFLU 11-0213

Saprobic on bamboo. **Sexual morph**: *Ascomata* 220–330 μm high, 800–1100 μm diam., solitary to gregarious, immersed in pseudoclypeus, visible as raised darkened, elongate areas on host surface, uni-loculate, elongate conical with a flattened base, glabrous, ostiole central, with slit-like opening. *Peridium* 7–18.5 μm wide, of unequal thickness, slightly thick at the sides, composed of several layers of pseudoparenchymatous cells, outer layers comprising several layers of brown to dark brown cells, arranged in *textura angularis* to *textura prismatica*, inner layers comprising several layers of flattened, hyaline cells, arranged in textura prismatica to t. porrecta. Hamathecium composed of dense, 1–2.5 μm wide, cellular pseudoparaphyses, indistinctly septate, not constricted at the septum, anastomosing at the apex, embedded in a mucilagenous matrix. *Asci* (120–)130–170(−185)×(12–)13–15(−16) μm ($\bar{x}$ = 147×13.9 μm, *n*=25), 8-spored, bitunicate, fissitunicate, clavate, short to long pedicellate, apically rounded, with well-developed ocular chamber. *Ascospores* (23–)25–28(−30)×5–7 μm ($\bar{x}$ = 26.4×5.8 μm, *n*=30), overlapping uni- to bi-seriate, brown to dark brown, clavate or fusuform, with rounded upper part and tapering lower part, straight or slightly curved, with 7–8 transverse septa, and 1–4 longitudinal septa, slightly constricted at the septum, deeply constricted at the third septum, the third cell usually large and having longitudinal septa, smooth-walled, with tail-like appendage at lower end (3–5 μm long). **Asexual morph**: Undetermined.

Culture characteristics: Colonies on PDA slow growing, reaching 12–18 mm diam. after 4 weeks at 25–30 °C, colonies irregular, dense, low convex, dull with undulate edge, velvety, slightly radiating, redially furrowed, colonies from above white to grey (5A1–5E1) at the margin, orange grey to grey-orangish (5B2–5B3) in the middle, and light brown to yellowish brown at the centre (5D6–5E6); from below yellowish brown to blackish brown (5 F8–6G8), not producing pigment on PDA, but producing dark brown pigment in V8 media and yellowish white to yellowish grey pigment in MEA.

Material examined: THAILAND, Chiang Rai Province, Mae Jun District, Huai Kang Pla Waterfall, on dead stem of bamboo, 25 October 2010, R. Phookamsak RP0093 (MFLU 11-0213, **holotype**), ex-type living culture, MFLUCC 11-0177, BCC.

138. ***Neolophiostoma*** S. Boonmee & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551404; *Facesoffungi number*: FoF00961

Etymology: *Neolophiostoma*, referring to a new genus similar to *Lophiostoma*.

Saprobic on dead wood in terrestrial habitats. **Sexual morph**: *Ascomata* immersed, scattered to gregarious, partially erumpent at maturity, subglobose, unilocular, black, apically carbonaceous, with wide papilla, ostiolate. *Peridium* 24.5–27 μm wide, composed of dark brown, carbonaceous, occluded cells. *Hamathecium* comprising 1–1.5 μm wide, filiform, septate, branched, pseudoparaphyses. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical to subclavate, pedicellate or apedicellate, apically rounded, with an ocular chamber. *Ascospores* overlapping biseriate, hyaline, elongate-fusiform, narrow towards the sub-acute ends, 3–5-septate, constricted at the median septum. **Asexual morph**: Undetermined.

Type species: ***Neolophiostoma pigmentatum*** S. Boonmee & K.D. Hyde

Notes: *Neolophiostoma* is similar to *Lophiostoma* species in having immersed, ascomata with minute crest-like papilla and elongate-fusiform ascospores with a thin gelatinous sheath (Mugambi and Huhndorf 2009a; Hirayama and Tanaka 2011; Thambugala et al. 2015). The genus is typified by *Neolophiostoma pigmentatum* and is characterized by hyaline, fusiform ascospores and immersed ascomata with a carbonaceous peridium, and in producing gummy mycelia and reddish brown pigmentation in culture (Fig. 25k–l). Phylogenetic analysis places *Neolophiostoma* with *Mauritiana rhizophorae* (GU 371824), *Pontoporeia biturbinata* (GU 479796), *Halotthia posidoniae* (GU 371824), and two novel genera *Brunneoclavispora* and *Sulcosporium* with moderate support (Fig. 1).

139. ***Neolophiostoma pigmentatum*** S. Boonmee & K.D. Hyde, ***sp. nov.***

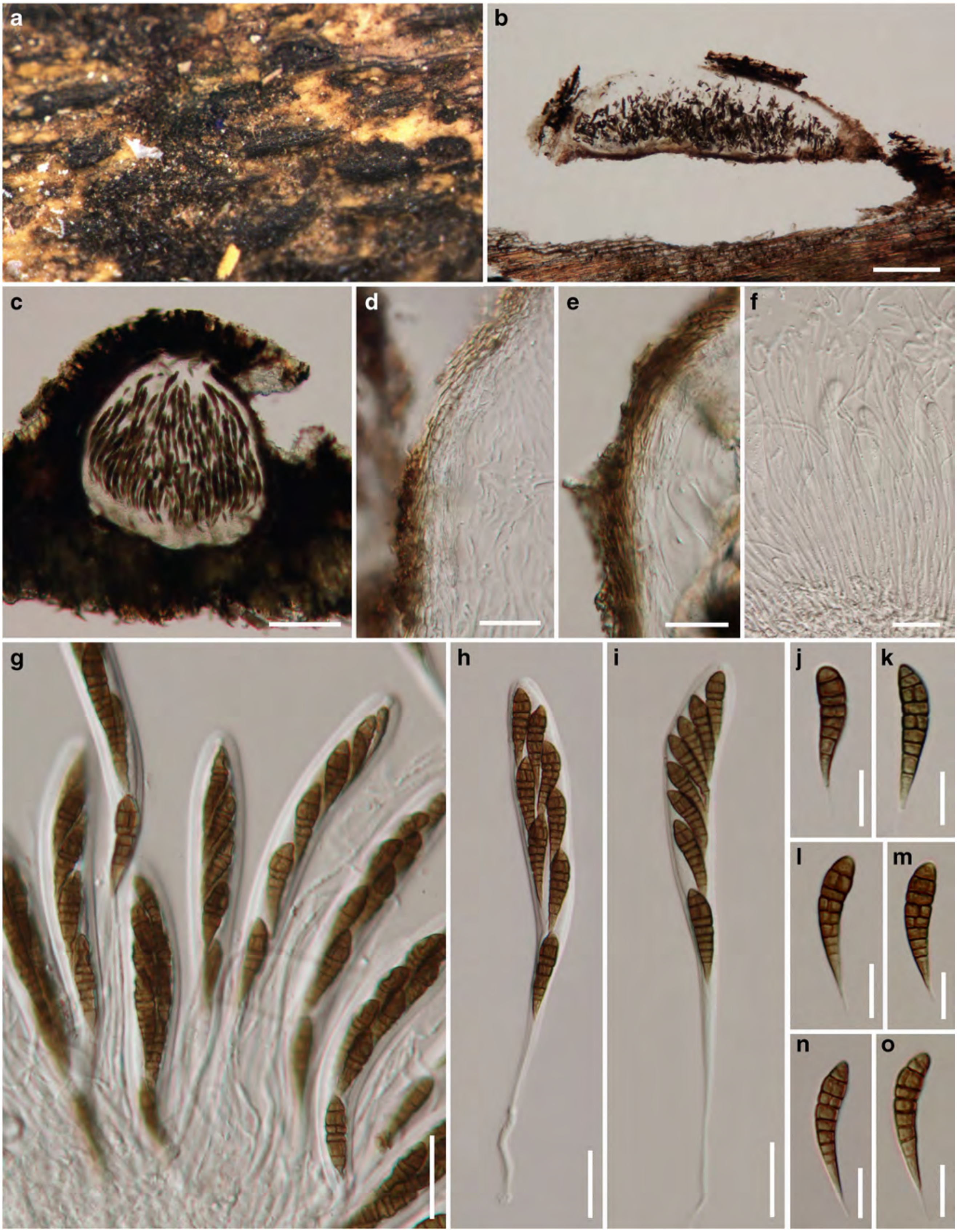
Index Fungorum number: IF551405; *Facesoffungi number*: FoF00962; Fig. 25

Etymology: *Pigmentatum*, referring to the pigmentation produced in the culture media.

Holotype: MFLU 10-0062.

Saprobic on dead wood in terrestrial habitats. **Sexual morph**: *Ascomata* 146–231.5 μm high×188–395 μm diam. ($\bar{x}$ = 207×314 μm, *n*=5), immersed, scattered to gregarious, partially erumpent at maturity, subglobose, unilocular, black, apically carbonaceous, with wide papilla, ostiolate. *Peridium* 24.5–27 μm wide, composed of dark brown, carbonaceous, occluded cells. *Hamathecium* comprising 1–1.5 μm wide, filiform, septate, branched, pseudoparaphyses. *Asci* 60–79×11–13.5 μm ($\bar{x}$ = 68×12 μm, *n*=10), 8-spored, bitunicate, fissitunicate, cylindrical to subclavate, narrow towards the base, pedicellate or apedicellate, apically rounded,

Fig. 24 *Brunneoclavispora bambusae* (holotype) **a** Ascomata visible as raised black oval areas, on host surface **b** Longitudinal section through an ascoma **c** Vertical section through an ascoma **d**, **e** Section through peridium **f** Pseudoparaphyses **g**–**i** Asci **j**–**o** Ascospores. Scale bars: **b**= 200 μm, **c**=100 μm, **d**–**i**, **m**=20 μm, **j**–**o**=10 μm ▶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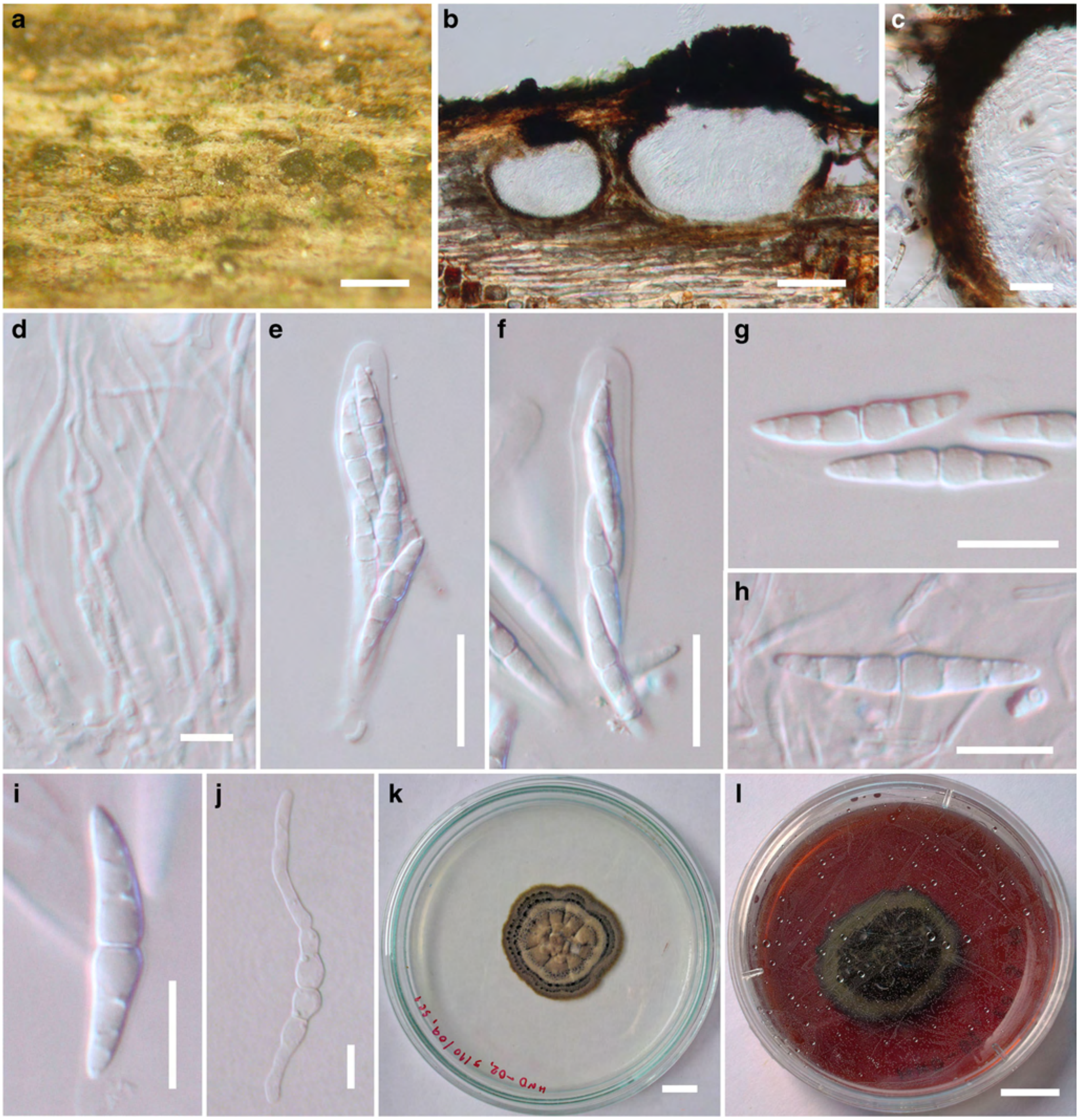


Fig. 25 *Neolophiostoma pigmentatum* (holotype) **a** Appearance of ascomata on substrate **b** Section of ascomata **c** Close up of carbonaceous peridium **d** Pseudoparaphyses **e**, **f** Asci **g**–**i** Ascospores **j** Germinating ascospore **k**–**l** Colonies on MEA; note pigmentation in aged culture. Scale bars: **a**=500 μm, **b**=100 μm, **c**, **e**–**f**=20 μm, **d**=5 μm, **g**–**j**=10 μm, **k**–**l**=10 mm

with an ocular chamber. *Ascospores* 24–31×5–7 μm ($\bar{x}$ = 28×6 μm, n=20), overlapping biseriate, hyaline, elongate-fusiform, narrow towards the sub-acute ends, slightly curved, 3–5-septate, constricted at the median septum, surrounded by a thin gelatinous sheath, smooth-walled. **Asexual morph**: Undetermined.

Culture characteristics: Ascospores germinating on MEA within 12 h. Colonies growing on MEA, reaching 5 mm diam. in 1 week at 28 °C. *Mycelium* superficial, slightly effuse, thinly hairy, with mucous, radially striate with lobate edge, brown to dark brown, with reddish brown pigmented in media after 60 days.

Material examined: THAILAND, Chiang Mai, Mae Taeng, Huai Nam Dang, on dead wood of unidentified plant, 8 September 2009, Saranyaphat Boonmee, HND-02 (MFLU 10-0062, **holotype**); ex-type living culture, MFLUCC 10-0129, BCC 52149, IFRDCC 2185.

140. ***Sulcosporium*** Phookamsak & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551328; *Facesoffungi number*; FoF00894

Etymology: The generic epithet "*Sulcosporium*" refers to the striate ascospores.

Holotype: MFLU 11-0243

Pathogen on grasses, causing necrotic leaf spots. **Sexual morph**: *Ascomata* solitary, scattered, immersed, globose to subglobose, uni-loculate, membranous, with minute central papilla erumpent through host surface, ostiolate. *Peridium* thin, composed of several layers of thick-walled, brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* comprising dense, 2–4 μm wide, cellular pseudoparaphyses, anastomosing at the apex, embedded in mucilagenous matrix. *Asci* 8-spored, bitunicate, fissitunicate, broadly fusiform to clavate, saccate or ampulliform, with a short blunt pedicel, apically rounded, with well-developed ocular chamber. *Ascospores* overlapping bi- to tri-seriate, initially hyaline, becoming very pale brown, ellipsoidal to fusiform, or slightly clavate, 1-septate. **Asexual morph**: Undetermined.

Type species: ***Sulcosporium thailandica*** Phookamsak & K.D. Hyde

Notes: *Sulcosporium* is introduced as a monotypic genus in to accommodate a Dothideomycete species in the family *Halottiaceae*, causing leaf spots on grasses, with immersed ascomata and two-celled, striate, thick-walled ascospores. The phylogenetic analyses show that *Sulcosporium* forms a well-supported clade, basal to the *Mauritiana* clade, in the family *Halotthiaceae*.

The species is most similar to *Sulcispora* (Shoemaker and Babcock 1989; Senanayake et al. 2015), which is unrelated as it belongs in *Phaeosphaeriiaceae. Sulcosporium* may be similar to *Mixtura* in causing leaf spot disease on *Poaceae*, and having pseudoparaphyses with saccate asci (Eriksson and Yue 1990; Phookamsak et al. 2014). However, *Sulcosporium* differs from *Mixtura* in having two-celled ascospores, while *Mixtura* has muriform ascospores.

141. ***Sulcosporium thailandica*** Phookamsak & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551330; *Facesoffungi number*: FoF00895; Fig. 26

Etymology: The generic epithet "*thailandica*" refers to the country where the fungus was first collected.

Holotype: MFLU 11-0243

Pathogen on *Axonopus compresus* (Sw.) P. Beauv., causing necrotic leaf spots. *Lesions* 3–5 cm long, usually forming from leaf margins, irregular in shape, visible as pale brown to brown regions, separated from healthy part of leaf by reddish brown margins. **Sexual morph**: *Ascomata* 70–130 μm high, 80–140 μm diam., solitary, scattered, immersed, globose to subglobose, uni-loculate, membranous, with minute central papilla erumpent through host surface, ostiolate. *Peridium* 8–20 μm wide, composed of several layers of thick-walled, brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* comprising dense, 2–4 μm wide, cellular pseudoparaphyses, constricted at the septum, with distinct septa, anastomosing at the apex, embedded in mucilagenous matrix. *Asci* (70–)80–100(−110)×(24.5–)27–33(−36) μm ($\bar{x}$ = 86.2×30.4 μm, *n*=25), 8-spored, bitunicate, fissitunicate, broadly fusiform to clavate, saccate or ampulliform, with a short blunt pedicel, apically rounded, with well-developed ocular chamber. *Ascospores* (27–)29–35(−37)×8–10 μm ($\bar{x}$ = 33.4×9.8 μm, *n*=30), overlapping bi- to tri-seriate, initially hyaline, becoming very pale brown, ellipsoidal to fusiform, or slightly clavate, with rounded ends, 1-septate, not constricted at the septum, rough, furrowed, thick-walled, slightly swollen above septa. **Asexual morph**: Undetermined.

Culture characteristics: Colonies on PDA slow growing, 20–28 mm diam. after 4 weeks at 25–30 °C, colonies irregular, sparse to mediun dense, flattened, slightly raised, smooth with fimbriate to rhizoid edge, thinly hairy to woolly, smooth, from above dark greenish to dark brown at the margin, grey to dark grey in the centre; reverse dark brown at the margin, black at the centre, not producing pigment in PDA.

Material examined: THAILAND, Chiang Rai Province, Muang District, Khun Korn Waterfall, on living leaves of *Axonopus compresus* (*Poaceae*), 21 June 2011, R. Phookamsak RP0125 (MFLU 11-0243, **holotype**), ex-type living culture, MFLUCC 12-0004, BCC.

Latoruaceae Crous

This family was introduced by Crous et al. (2015a, b) to accommodate *Latorua* and *Polyschema* in order *Pleosporales*. In this paper we add *Pseudoasteromassaria* to the family (Fig. 27).

142. ***Pseudoasteromassaria*** Matsumura & Kaz. Tanaka, ***gen. nov.***

Index Fungorum number: IF551448; *Facesoffungi number*: FoF00963

Etymology: Referring to the similarity of the sexual morph with that of *Asteromassaria*.

Parasitic on twigs. **Sexual morph**: *Ascomata* mostly scattered, immersed, compressed globose, with central,

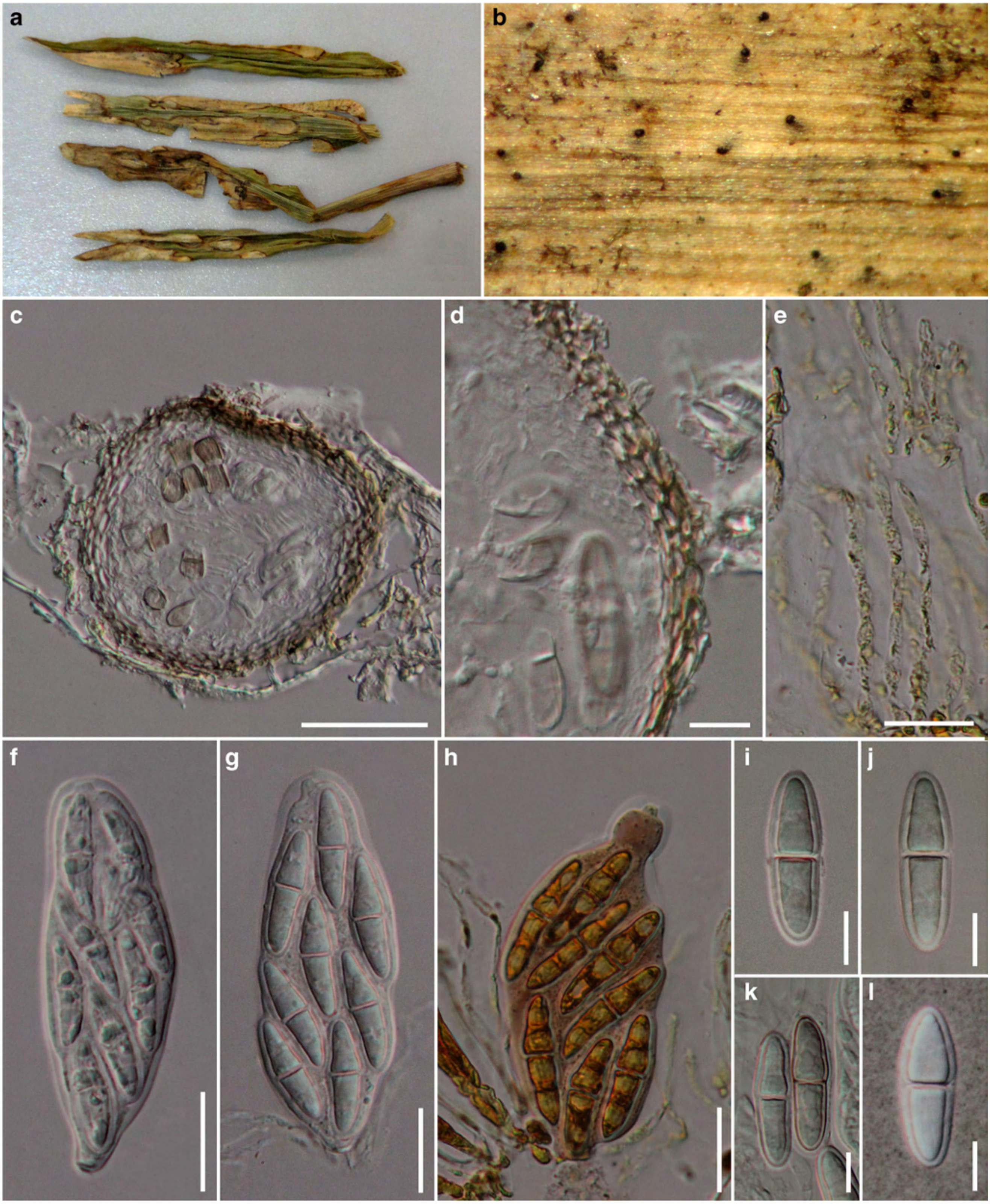


Fig. 26 *Sulcosporium thailandica* (holotype) **a** Lesions on host leaves **b** Papilla of ascomata visible as black spots on host surface **c** Vertical section through an ascoma **d** Section through peridium **e** Pseudoparaphyses stained in Melzer's reagent **f**, **g** Asci **h** Ascus stained in Melzer's reagent **i**–**k** Ascospores **l** Ascospore stained in Indian ink. Scale bars: **c**=50 μm, **e**–**h**=20 μm, **d**, **i**, **j**, **k**, **l**=120 μm

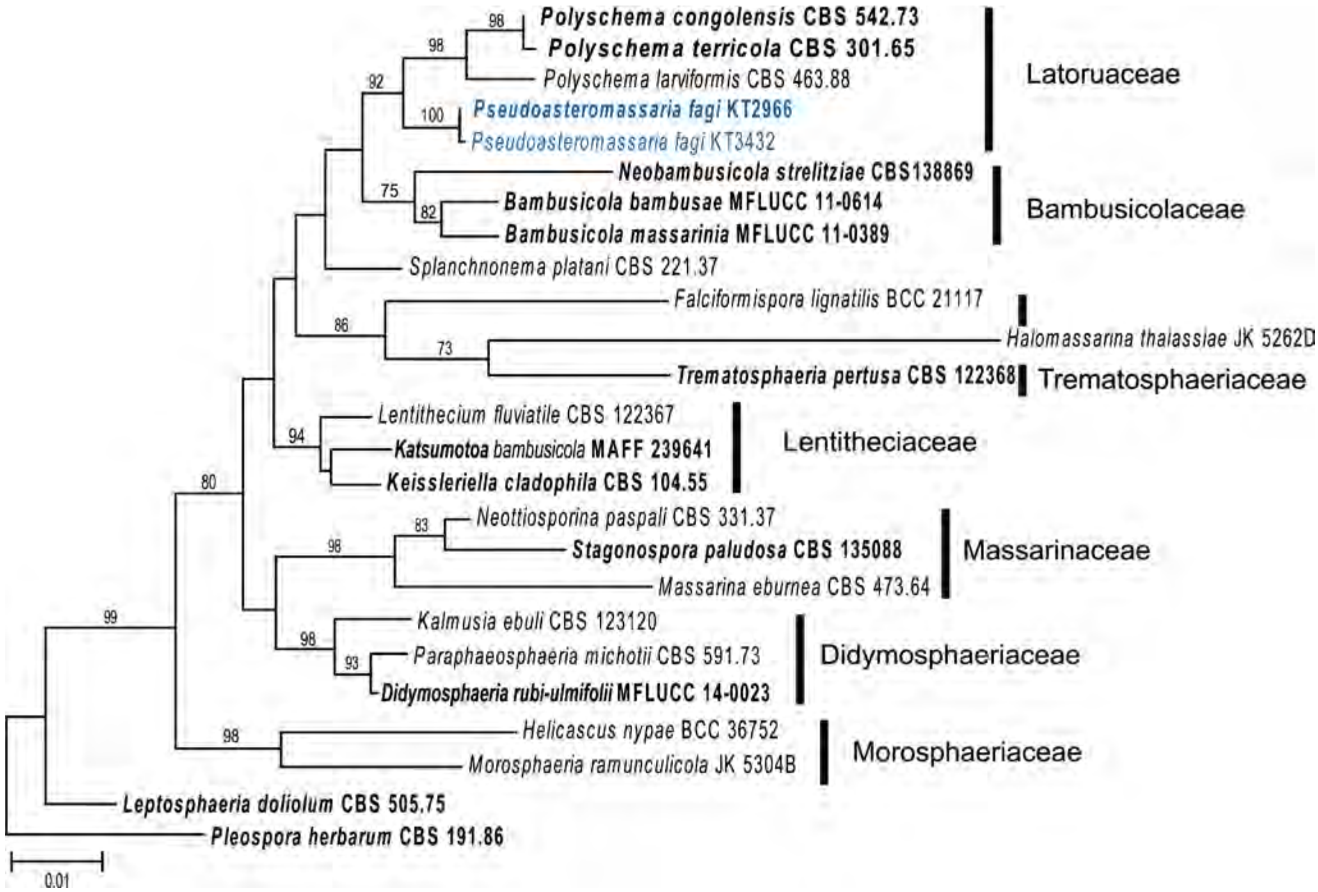


Fig. 27 Phylogram generated from Maximum Likelihood analysis based on combined SSU and LSU gene regions of *Massarineae*. Bootstrap values greater than 50 % are indicated above the nodes. The ex-type strains) are in *bold*, the new taxon is in *blue*. The tree is rooted with *Pleospora herbarum* CBS 191.86

papillate ostiole. *Peridium* composed of two layers. *Hamathecium* comprising numerous, hyaline, septate, branched, cellular pseudoparaphyses. *Asci* 8-spored, bitunicate, fissitunicate, cylindric to clavate, pedicellate, apically rounded, with an ocular chamber. *Ascospores* 2–3 overlapping seriate, brown, fusiform, 1–3-septate. **Asexual morph**: *Conidiomata* pycnidial, scattered, immersed or superficial, globose, ostiolate. *Peridium* composed of 2 strata; outer stratum composed of 3–5 layers of polygonal, brown to pale brown cells; inner stratum composed of 2–3 layers of polygonal, hyaline cells. *Conidiophores* absent. *Conidiogenous cells* enteroblastic, phialidic, doliform to ampulliform. *Conidia* cylindric, truncate at the base, 6–7-septate, hyaline.

Type species: ***Pseudoasteromassaria fagi*** Matsumura & Kaz. Tanaka

Notes: *Pseudoasteromassaria* is superficially similar to *Asteromassaria* (*Pleomassariaceae*). The type species of *Asteromassaria*, *A. macrospora* (Desm.) Höhn., also has large ascomata and occurs on twigs of *Fagus* (Sivanesan 1984), but the asexual morph, which is referred to as *Scolicosporium*, is quite distinct from that of *Pseudoasteromassaria* in having acervular conidiomata and fusiform, pigmented conidia (Fischer 1944; Spooner and Kirk 1982). The globose pycnidia and cylindrical, hyaline conidia of *Pseudoasteromassaria* resemble those of *Stagonospora* in the family *Massarinaceae*, but the latter genus has a didymella-like sexual morph, with small ascomata (up to 300 μm diam.), clavate to fusoid-ellipsoidal asci, and hyaline ascospores, and occurs on leaves of *Carex* (Quaedvlieg et al. 2013).

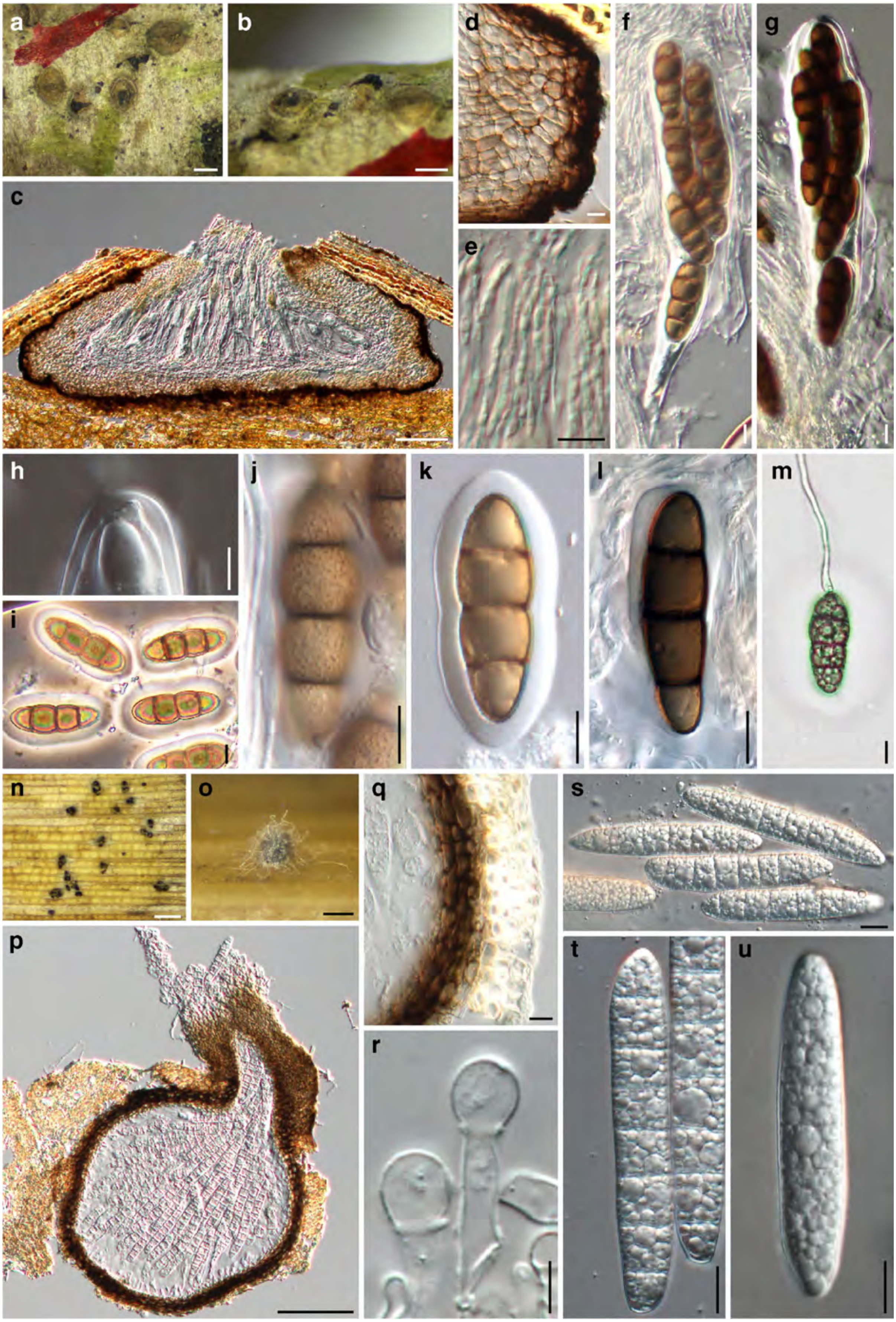
143. ***Pseudoasteromassaria fagi*** Matsumura & Kaz. Tanaka, ***sp. nov.***

Index Fungorum number: IF551435; *Facesoffungi number*: FoF00964; Fig. 28

Etymology: In reference to the host genus *Fagus*.

Holotype: HHUF 30471

Parasitic on twigs of *Fagus crenata* Blume. **Sexual morph**: *Ascomata* 250–310 μm high, 700–760 μm diam., mostly scattered, immersed, compressed globose in section, with central, papillate ostiole. *Peridium* 37.5–50 μm wide at the base, 45–100 μm wide at the sides, composed of two strata; outer stratum thin, composed of dark brown cells; inner stratum composed of 4–7 layers of hyaline, angular cells (7.5–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◀ **Fig. 28** *Pseudoasteromassaria fagi* (**a**, **b**, **f**–**j** HHUF 30472; **c**–**e**, **k** HHUF 30471 **holotype**; **l**, **m**, **p**, **s**, **u** culture MAFF 245222; **n**, **o**, **q**, **r**, **t** culture MAFF 245221) **a**, **b** Appearance of ascomata on host surface **c** Ascoma in longitudinal section **d** Peridium **e** Pseudoparaphyses **f**, **g** Asci **h** Ascus apex **i**–**l** Ascospores **m** Germinating ascospore **n**, **o** Conidiomata on rice straw in culture **p** Conidioma in longitudinal section **q** Peridium **r** Conidiogenous cells **s**–**u** Conidia. Scale bars: **a**, **b**, **n**=500 μm, **o**=200 μm, **c**, **p**=100 μm, **d**–**m**, **q**–**u**=10 μm

15×5–13 μm). *Hamathecium* comprising numerous, 1–2.5 μm wide, hyaline, septate, branched, cellular pseudoparaphyses. *Asci* 139.5–195.5×35–40 μm ($\overline{x}$ = 168.1×36.7 μm, *n*=10), 8-spored, bitunicate, fissitunicate, cylindric to clavate, pedicellate (24.5–38.5 μm long), apically rounded, with an ocular chamber. *Ascospores* 38.5–47×11–15 μm ($\overline{x}$ = 43.5×13.3 μm, *n*=20), L/W 2.9–3.8 ($\overline{x}$ = 3.3, *n*=20), 2–3 overlapping seriate, brown, fusiform, mostly straight, 1–3-septate, thick-walled, verrucose, with a prominent surrounding sheath. **Asexual morph**: *Conidiomata* pycnidial, 230–340 μm high, 140–240 μm diam., scattered, immersed or superficial, globose, ostiolate. *Peridium* 30–52.5 μm wide, composed of 2 strata; outer stratum composed of 3–5 layers of polygonal, brown to pale brown cells (8–17.5×5–10 μm); inner stratum composed of 2–3 layers of polygonal, hyaline cells (8–10×4.5–6 μm). *Conidiophores* absent. *Conidiogenous cells* 6–16×5–7 μm, enteroblastic, phialidic, doliform to ampulliform. *Conidia* (52–)61–71×10–12.5 μm ($\overline{x}$ = 66.1×11.6 μm, *n*=20), L/W (4.3–)5.1–7.0 ($\overline{x}$ = 5.8, *n*=20), cylindric, truncate at the base, 6–7-septate, hyaline, smooth-walled, lacking a sheath.

Material examined: JAPAN, Aomori, Towada, Tsuta hot-spring, on twigs of *Fagus crenata* (*Fagaceae*), 6 November 2011, K. Tanaka, KT 2966 (HHUF 30471, **holotype designated here**); living culture, MAFF 245221; Kagoshima, Tarumizu, Mt. Oonogara, on twigs of *Fagus crenata*, 25 October 2013, K. Tanaka, KT 3432 (HHUF 30472, **paratype**), ex-type living culture, MAFF 245222.

Lentitheciaceae Y. Zhang et al.

The family *Lentitheciaceae* was introduced by Zhang et al. (2009b) and is typified by *Lentithecium* with *L. fluviatile* as the type species. The family also includes the genera *Katumotoa*, *Keissleriella* and *Tingoldiago*. Wanasinghe et al. (2014) introduced the new genus *Murilentithecium* from dead branches of *Clematis vitalba* to accommodate a single species with muriform ascospores and a coelomycetous asexual morph. Singtripop et al. (2015) introduced *Keissleriella dactylidis* from *Dactylis* sp., while Liu et al. (2015) introduced *Keissleriella sparticola* Singtripop & K.D. Hyde with hyaline muriform ascospores, in this family, from a dead stem of *Dactylis* sp. Phookamsak et al. (2015) introduced a new genus *Poaceascoma helicoides* Phookamsak & K.D. Hyde, as a single species with scolecospores. A phylogenetic tree for the family is presented in Fig. 29.

144. ***Keissleriella dactylidicola*** Mapook, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551391; *Facesoffungi number*: FoF00941; Fig. 30

Etymology: The specific epithet *dactylidicola* is named after the host *Dactylis*.

Holotype: MFLU 15–1518

Saprobic on dead stem of *Dactylis* sp. **Sexual morph**: *Ascomata* (140–)160–210 high, (150–)200–230 μm diam. ($\overline{x}$ = 176.5×203 μm, *n*=5), superficial, solitary or scattered, oval to ellipsoidal, globose to subglobose, brown to dark brown, without a subiculum covering the host. *Ostiole* (15–)25–30×3–4 μm, slightly protruding, with apical dark brown setae, with blunt or acute apex. *Peridium* (14–)15–25 (−30) μm wide, comprising 2–4 layers, outer layer comprising irregular brown cells, inner layers comprising brown, flattened cells of *textura angularis*. *Hamathecium* comprising 1.5–2 μm wide, cylindrical to filiform, septate, branched, pseudoparaphyses. *Asci* (50–)60–80×8–10 μm ($\overline{x}$ = 65.5×9 μm, *n*=10), 8-spored, bitunicate, cylindric-clavate, slightly curved, with short bulbose pedicel, apically rounded, with a wide ocular chamber. *Ascospores* 15–19×4–5 μm ($\overline{x}$ = 18.5×4 μm, *n*=10), overlapping 1–2-seriate, hyaline, broadly fusiform, 1-septate, deeply constricted at the septum, widest at the middle and tapering towards the narrow ends, straight or slightly curved, guttulate, surrounded by hyaline, gelatinous sheath, observed only mounted in Indian ink. **Asexual morph**: Undetermined.

Material examined: ITALY, Arezzo Province, Papiano - Stia, on dead stem of *Dactylis* sp. (*Poaceae*), 27 August 2013, E. Camporesi (MFLU 15–1518, **holotype**), ex-type living cultures, MFLUCC 13–0866; ITALY, Arezzo Province, Papiano - Stia, on dead stem of *Dactylis* sp. (*Poaceae*), 16 September 2013, E. Camporesi (MFLU 15–1519, **paratype**).

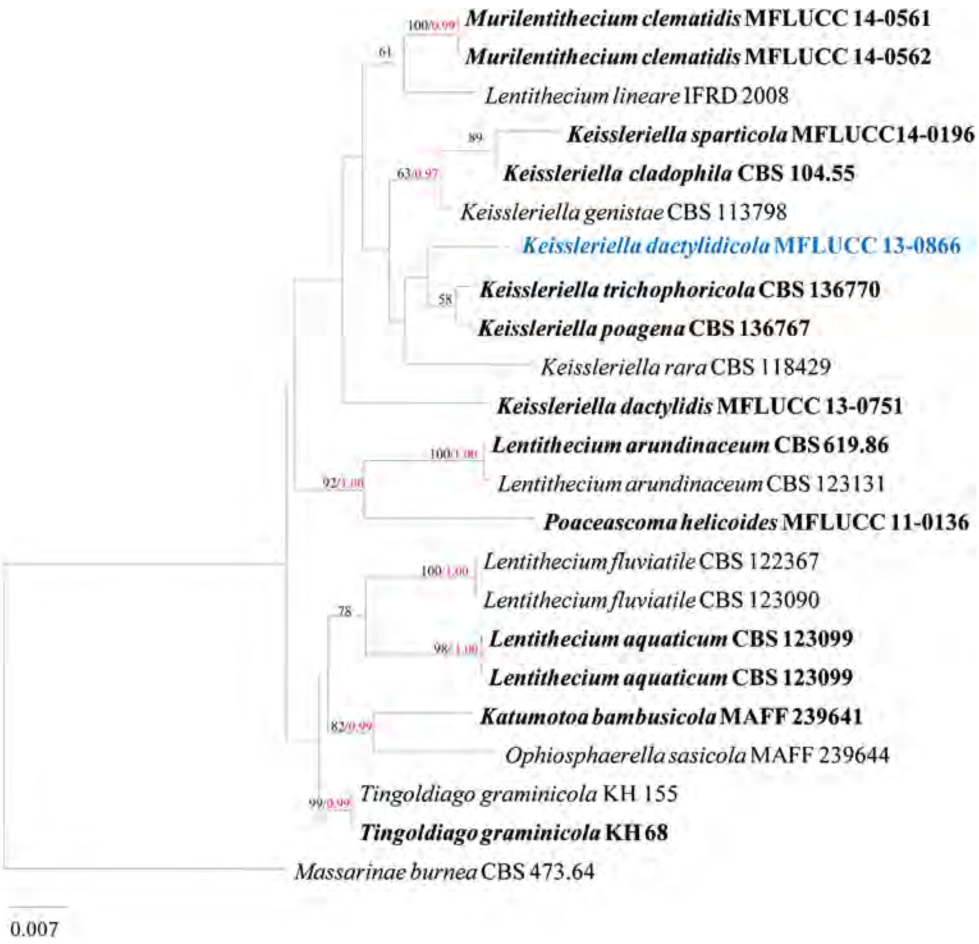
Notes: *Keissleriella dactylidicola* was collected as a saprobe from dead stems of *Dactylis* sp. *Keissleriella dactylidicola* is similar to *K. dactylidis* but differs in having shorter, dark brown setae and in the size, shape and septation of the ascospores (Supplementary Table 3). *Keissleriella dactylidicola* is similar to *K. caudata* E. Müll. (Corbaz 1957) in having apical, dark brown setae and hyaline, 1-septate ascospores, with a sheath. It is distinct from *K. caudata* in having larger ascomata with dark brown setae and a hyaline, mucilaginous sheath surrounding the ascospores (Supplementary Table 3).

Lindgomycetaceae K. Hiray., Kaz. Tanaka & Shearer

Details of this family can be seen in Zhang et al. (2012a) and Hyde et al. (2013).

145. ***Neomassariosphaeria*** Y. Zhang et al., in Zhang et al., Stud. Mycol. 64: 96 (2009b)

Fig. 29 Phylogram generated from RAxML analysis based on combined LSU, SSU and EF sequence data with bootstrap support values greater than 50 % indicated above the nodes (ML, *black*) and Bayesian posterior probabilities (PP, *red*) ≥95 % indicated in *bold* branches. The ex-type strains are in *bold*; the new isolates in *blue*. The tree is rooted with *Massarina eburnea* (CBS 473.64)



Type species: ***Neomassariosphaeria typhicola*** (P. Karst.) Y. Zhang et al., Stud. Mycol. 64: 96 (2009b)

Notes: *Neomassariosphaeria* was introduced by Zhang et al. (2009b) to accommodate *Massariosphaeria typhicola* (generic type) and *M. grandispora* in family *Amniculicolaceae*, because the generic type of *Massariosphaeria*, *M. phaeospora*, formed a distant clade outside the family *Amniculicolaceae*. Recent studies (Abdel-Aziz and Abdel-Wahab 2010; Hirayama et al. 2010; Raja et al. 2013), as well as our phylogenetic analyses (Fig. 1) showed that *N. typhicola* forms a distinct clade within the family *Lindgomycetaceae*, sister to the *Lolia* clade. Therefore in order to resolve the polyphyletic nature of *Neomassariosphaeria* in the order *Pleosporales* we transfer *Neomassariosphaeria* to the family *Lindgomycetaceae*. Furthermore we propose a novel genus, *Psuedomassariosphaeria* to accommodate *Massariosphaeria grandispora* in the family *Amniculicolaceae*.

Lophiostomataceae Sacc.

Thambugala et al. (2015) provided a revision of this family and introduce several new genera and species. The family is characterized by immersed to erumpent, carbonaceous to coriaceous ascomata, with rounded or slit-like ostioles, with a small to large, compressed, crest like apex and fusiform or ellipsoid to fusiform, 1 to multi-septate, or muriform ascospores (Thambugala et al. 2015). A backbone to the family is provided in this paper (Fig. 22).

146. ***Lophiostoma caulium*** (Fr.) Ces. & De Not., Schem. di Classif. Sferiacei: 45 (1863)

Facesoffungi number: FoF00881; Fig. 31.

Saprobic on *Salvia*. **Sexual morph**: *Ascomata* 190–210 μm high × 122–190 μm diam. ($\bar{x}$ = 198 × 171 μm, n=5), scattered to gregarious, semi-immersed to erumpent, dark brown to black, globose to subglobose, ostiolate. *Ostiole*

Fig. 30 *Keissleriella dactylidicola* (holotype) **a**, **b** Appearance of oval ascomata on the host tissue **c** Section through ascoma **d** Ostiole with external, dark brown setae **e** Dark brown setae **f** Peridium **g** Pseudoparaphyses **h**–**k** Immature and mature asci **l**–**n** Ascospores **o** Ascospore in Indian ink surrounded by hyaline gelatinous sheath **p** Germinating ascospore. Scale bars: **a**=500 μm, **b**=200 μm, **c**=50 μm, **d**, **e**, **h**–**k**=20 μm, **f**, **l**–**p**=10 μm, **g**=5 μm ▶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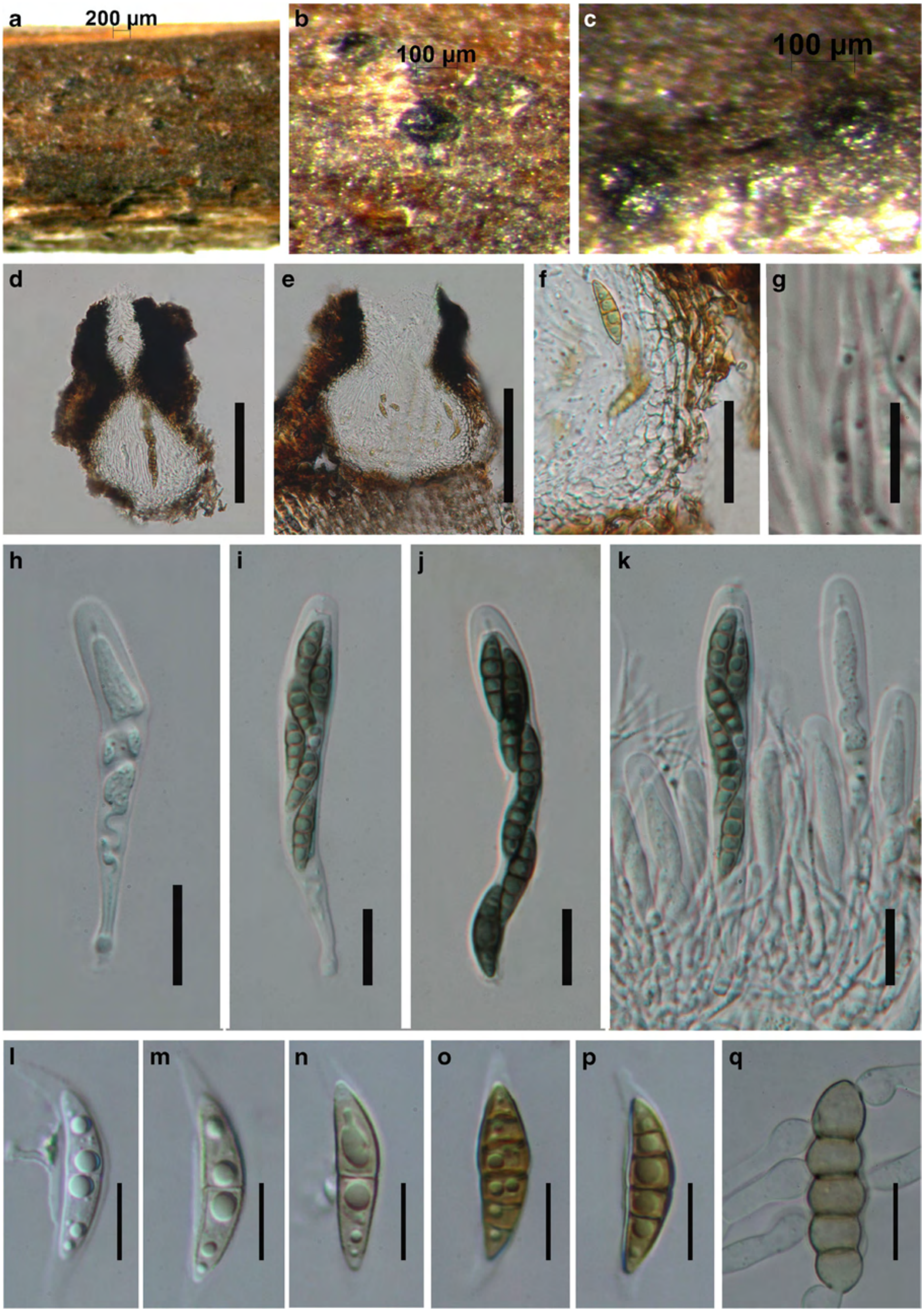


Fig. 31 *Lophiostoma caulium* (reference specimen) **a**–**c** Appearance of immersed ascomata on host surface **d**, **e** Hand sections of ascomata. Note the ostiole, with a small to large, flat, crest-like apex **f** Peridium **g**. Hamathecium **h**–**k** Asci with ascospores **l**–**p** Ascospores **o**. Germinating ascospore. Scale bars: **d**, **e**=100 µm, **f**, **h**–**k**=20 µm, **g**=10 µm, **l**–**q**=10 µm

80–90 µm high, 83–110 µm diam. (x̄ = 84×95 µm, *n*=5), slit-like, with a small, to large, flat, crest-like apex, which is variable in shape; apex composed of pseudoparenchymatous cells. *Peridium* 19–23 µm thick at the sides, broad at the apex, thinner at the base, composed of 4–5 layers of brown to dark brown cells, arranged in a *textura angularis*, fusing at the outside with the host cells. *Hamathecium* of 1.5–2.5 µm diam., septate, long, anastomosing and branched, cellular pseudoparaphyses, embedded in gelatinous matrix. *Asci* 64–91×8–10 µm (x̄ = 82×9 µm, *n*=30), 8-spored, bitunicate, fissitunicate, cylindrical to clavate, with furcate pedicel, rounded at the apex, with an ocular chamber. *Ascospores* 20–24×4–6 µm (x̄ = 22×5 µm, *n*=30), uniseriate or overlapping biseriate, pale brown to dark brown, narrowly fusiform with acute ends, 3–5-septate, slightly constricted at each septum, with a distinct guttule in each cell, smooth-walled, with mucilaginous appendages, drawn out at the ends. **Asexual morph**: Coelomycetous. *Conidiomata* superficial, dark brown to black, globose, uniloculate, solitary to scattered. *Pycnidial* wall thick-walled, multi-layered, with inner layer comprising several cell-layers, comprising brown-walled cells of *textura angularis*. No spores were produced.

Culture characteristics: Ascospores germinating on MEA within 36 h. Colonies growing on MEA, rather slow growing, reaching 0.2 mm diam. in 1 week at 28 °C. Mycelium superficial, felty, gummy, grey.

Material examined: ITALY, Forlì-Cesena Province, Teodorano di Meldola, dead stem of *Salvia* sp., 13 October 2013, E. Camporesi (MFLU 15-1074, **reference specimen designate here**); ex-type living culture, MFLUCC 15-0176, BIOTEC.

Notes: Our material of *Lophiostoma caulium* (Fr.) Ces. de Not. fits well with the description provided by Cesati and De Notaris (1863). In our collection of *L. caulium*, the ascomata are slightly smaller than that in the type, but the size of peridium and ascospores are in the range given. The ascomata, asci and ascospores of our reference specimen provided here are also typical of the *L. caulium*. Our specimen of *L. caulium* was collected from a different host than that of the type, thus we propose this as reference specimens until collections from the same host and location can be obtained. In our phylogeny *Lophiostoma caulium* (MFLUCC 15-0176) forms a well-supported (BS 100) clade sister to *Lophiostoma caulium* "var. a" (JCM 17669) in the family *Lophiostomataceae* (Fig. 22).

147. ***Lophiohelichrysum*** Dayarathne, Camporesi & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551400; *Facesoffungi number*: FoF00913

Etymology: In reference to a new genus in *Lophiostomataceae* and its host genus *Helichrysum*.

Saprobic on dead plant stems. *Ascomata* scattered to gregarious, semi-immersed to erumpent, coriaceous, dark brown to black, globose to subglobose, ostiolate, periphysate. *Ostiole* slit-like, with a flat, crest-like apex. *Peridium* comprising 4–5 layers of brown cells, arranged in a *textura angularis*, fusing at the outside with the host cells, where cells are occluded and black. *Hamathecium* comprising numerous, 0.5–1.5 *µm* wide, aseptate, long, filiform pseudoparaphyses, embedded in gelatinous matrix. *Asci* 8-spored, bitunicate, cylindric-clavate, pedicellate, rounded at the apex, with an ocular chamber. *Ascospores* overlapping biseriate, hyaline, faintly brown when mature, fusiform, 1-septate, asymmetrical, upper cell wider than lower cell. **Asexual morph**: undetermined.

Type species: ***Lophiohelichrysum helichrysi*** Dayarathne, Camporesi & K.D. Hyde

Notes: *Lophiohelichrysum* is clearly different from other genera of the family *Lophiostomataceae* based on molecular data and morphological characters. This monotypic genus is introduced to accommodate taxa characterized by semi-immersed to erumpent ascomata, with a flat, crest-like apex, and fusiform, 1-septate, hyaline ascospores. It differs from *Lophiostoma macrostomum*, the type of *Lophiostoma* having coriaceous ascomata, a peridium of *textura angularis*, 1-septate, asymmetrical, hyaline to faintly brown ascospores, lacking appendages (Thambugala et al. 2015).

148. ***Lophiohelichrysum helichrysi*** Dayarathne, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551401; *Facesoffungi number*: FoF00914; Fig. 32

Etymology: named after the host genus on which the fungus occurs.

Holotype: MFLU 15–0175

Saprobic on dead stems of *Helichrysum* sp. **Sexual morph**: *Ascomata* 225–260 *µm* high, 140–200 *µm* diam., scattered to gregarious, semi-immersed to erumpent, coriaceous, dark brown to black, globose to subglobose, ostiolate, periphysate. *Ostiole* slit-like, with a flat, crest-like apex. *Peridium* 35–45 *µm* wide, comprising 4–5 layers of brown cells, arranged in a *textura angularis*, fusing at the outside with the host cells, where cells are occluded and black. *Hamathecium* comprising numerous, 0.5–1.5 *µm* wide, aseptate, long, filiform pseudoparaphyses, embedded in gelatinous matrix. *Asci* 45–100×11–20 *µm* ($\bar{x}$ = 72.5×15.5 *µm*; *n*=30), 8-spored, bitunicate, cylindric-clavate, pedicellate, rounded at the apex, with an ocular chamber.

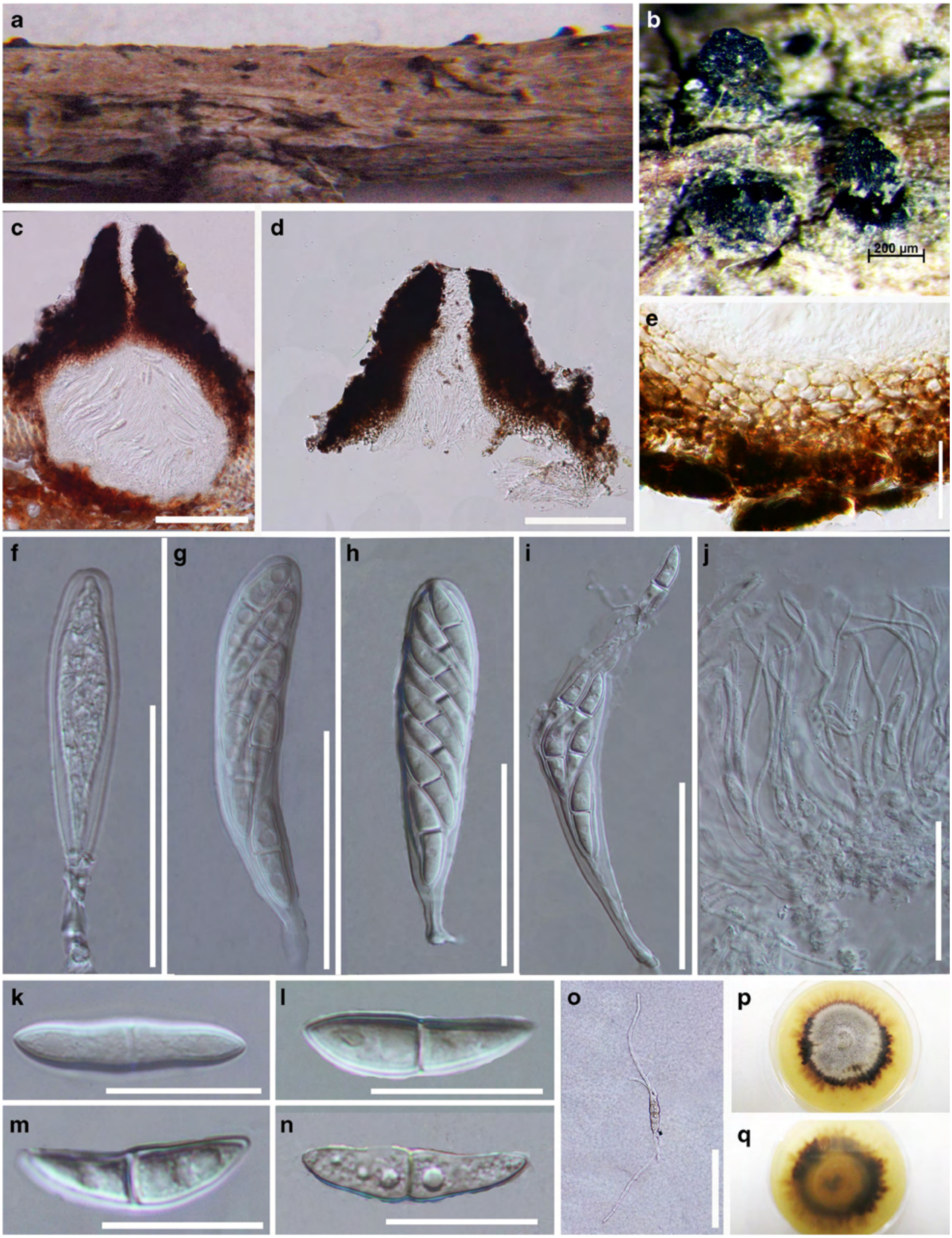


Fig. 32 *Lophiohelichrysum helichrysi* (holotype) **a** Specimen **b** Ascomata immersed to semi immersed in host tissue **c** Section through ascoma **d** Section through neck region **e** Section through peridium **f**–**i** Asci. **j** Pseudoparaphyses **k**–**n** Ascospores with polar appendages **o** Germinating ascospore **p**, **q** Culture on MEA, p from above, n from below. Scale bars: **b**=200 µm, **c**=100 µm, **d**, **e**, **j**=20 µm, **f**–**i**=50 µm, **k**–**o**=20 µm

Ascospores 15–30×11–16 μm ($\bar{x}$ = 22.5×13.5 μm; *n*=30), overlapping biseriate, hyaline, faintly brown when mature, fusiform, 1-septate, asymmetrical, upper cell wider than lower cell, slightly constricted at the septum, with guttules in each cell, smooth-walled, without a mucilaginous sheath, 1–3-septate at germination. **Asexual morph**: Undetermined.

Culture characteristics: *Colonies* growing on MEA, reaching 8 cm diam. after 2 weeks at 20–25 °C, with circular, grey, dense, mycelium on the surface, reverse brown to black.

Material examined: ITALY, Province of Forlì-Cesena [FC], Santa Sofia, Collina di Pondo, on dead stem of *Helichrysum* sp. (*Asteraceae*), 7 March 2014, Erio Camporesi, IT-1296 (MFLU 15-0175, **holotype**), ex-type living culture, MFLUCC 15-0701; on dead stem of *Helichrysum* sp., 3 July 2014, E. Camporesi (MFLU 15-1500, **paratype**).

Lophiotremataceae K. Hiray. & Kaz. Tanaka

This family was introduced in Hirayama and Tanaka (2011) and presently includes only the genus *Lophiotrema* (Hyde et al. 2013). In this paper we show that *Aquasubmersa* also belongs in the family.

Aquasubmersa K.D. Hyde & Huang Zhang, Cryptog. Mycol. 33(3): 340 (2012)

Saprobic on dead wood. **Sexual morph**: *Ascomata* scattered to grouped, subglobose, immersed to semi-immersed, ostiolate, short papillate. *Peridium* composed of flattened, thin-walled cells of *textura angularis*, black at the outside. *Hamathecium* comprising numerous, hyaline, septate, branched pseudoparaphyses. *Asci* 8-spored, bitunicate, cylindrical, with a short pedicel, apically rounded, with an ocular chamber. *Ascospores* biseriate, hyaline, broadly fusiform with rounded ends, straight, with a mostly median septum, with gelatinous sheath. **Asexual morph**: Coelomycetous. *Conidiomata* pycnidial, globose to subglobose, scattered, semi-immersed, solitary, black to brown, ostiolate. *Peridium* 20–25 μm wide, composed of polygonal, hyaline to brown cells. *Conidiophores* reduced. *Conidiogenous cells* holoblastic, lageniform, hyaline, smooth. *Conidia* hyaline, ellipsoidal, smooth-walled.

Notes: The genus *Aquasubmersa* was established to accommodate a freshwater coelomycete, *A. mircensis*, by Zhang et al. (2012b). The genus was characterized by the pycnidia, which have papilla, a peridium composed of thin-walled cells, and unicellular conidia; no sexual morph was reported.

Phylogenetic analyses including 18S and 28S rDNA sequence data, placed *A. mircensis* in *Pleosporales*, but the familial position was not clarified (Zhang et al. 2012b). Our phylogenetic analysis suggested that this genus has a close phylogenetic affinity with *Lophiotrema* (*Lophiotremataceae*) (Fig. 1). *Lophiotrema* can be distinguished from *Aquasubmersa* by having a compressed, slit-like ostiole, and a peridium composed of parallel rows of elongate cells. This is the first report of sexual morph of *Aquasubmersa*.

149. ***Aquasubmersa japonica*** A. Hashim. & Kaz. Tanaka, ***sp. nov.***

Index Fungorum number: IF551422; *Facesoffungi number*: FoF00956; Fig. 33

Etymology: named after the country of origin, Japan.

Holotype: HHUF 30469

Saprobic on dead wood. **Sexual morph**: *Ascomata* 180–210(−300) μm high, 115–175(−230) μm diam., scattered to grouped, subglobose, immersed to semi-immersed. *Ostiole* 10–16 μm high, short papillate, lacking a clypeus. *Peridium* 20–30 μm wide, composed of 4–7 layers of flattened, 8–12.5×2.5–5.5 μm, thin-walled cells of *textura angularis*, black at the outside. *Hamathecium* comprising numerous, 2–4.5 μm wide, hyaline, septate, branched pseudoparaphyses. *Asci* (60–)66–93×(4.5–)5.5–8 μm ($\bar{x}$ = 76×6.2 μm, *n*=17), 8-spored, bitunicate, cylindrical, with a short pedicel (9–14 μm long), apically rounded, with an ocular chamber. *Ascospores* 20–26×4–5.5(−6) μm ($\bar{x}$ = 23.2×4.6 μm, *n*=65), L/W (3.7–)4–6(−6.5) ($\bar{x}$ = 5.1, *n*=65), biseriate, hyaline, broadly fusiform with rounded ends, straight, with a mostly median septum (0.45–0.54; $\bar{x}$ = 0.50, *n*=65), smooth, guttulate when young, with an entire sheath; sheath when fresh condition diffuse, gelatinous, up to 10 μm wide, later becoming sharply delimited firm sheath of 1.5–4 μm thick. **Asexual morph**: Coelomycetous. *Conidiomata* pycnidial, globose to subglobose, up to 215 μm high in section, 115–195 μm diam., scattered, semi-immersed, solitary, black to brown. *Ostiole* 53–80 μm high, short papillate, circular, dark-brown, central. *Peridium* 20–25 μm wide, composed of 9.5–12.5×3–7.5 μm, polygonal, hyaline to brown cells; *Conidiophores* reduced. *Conidiogenous cells* holoblastic, 9–12×5.5–6.5 μm, lageniform, hyaline, smooth. *Conidia* ellipsoidal, 17–22(−23)×(7–)8–9 μm ($\bar{x}$ = 19.4×8.4 μm, *n*=50), L/W 1.9–2.7 ($\bar{x}$ = 2.3, *n*=50), hyaline, smooth, guttulate when young.

Culture characteristics: Ascospores formed in culture are similar to those on natural substrate.

Material examined: JAPAN, Okinawa, Isl. Ishigaki, Banna Park, on dead wood, 16 July 2011, K. Tanaka & K. Hirayama KT 2862 (HHUF 30469, **holotype**), ex-type living culture, MAFF 245219; *ibid*. KT 2863 (HHUF 30470, **paratype**), living culture, MAFF 245220. JAPAN, Okinawa, Isl., Iriomote, Oomija River, on submerged wood, 12 July 2011, K. Tanaka & K. Hirayama KT 2813(HHUF 30468, **paratype**), living culture, MAFF 245218.

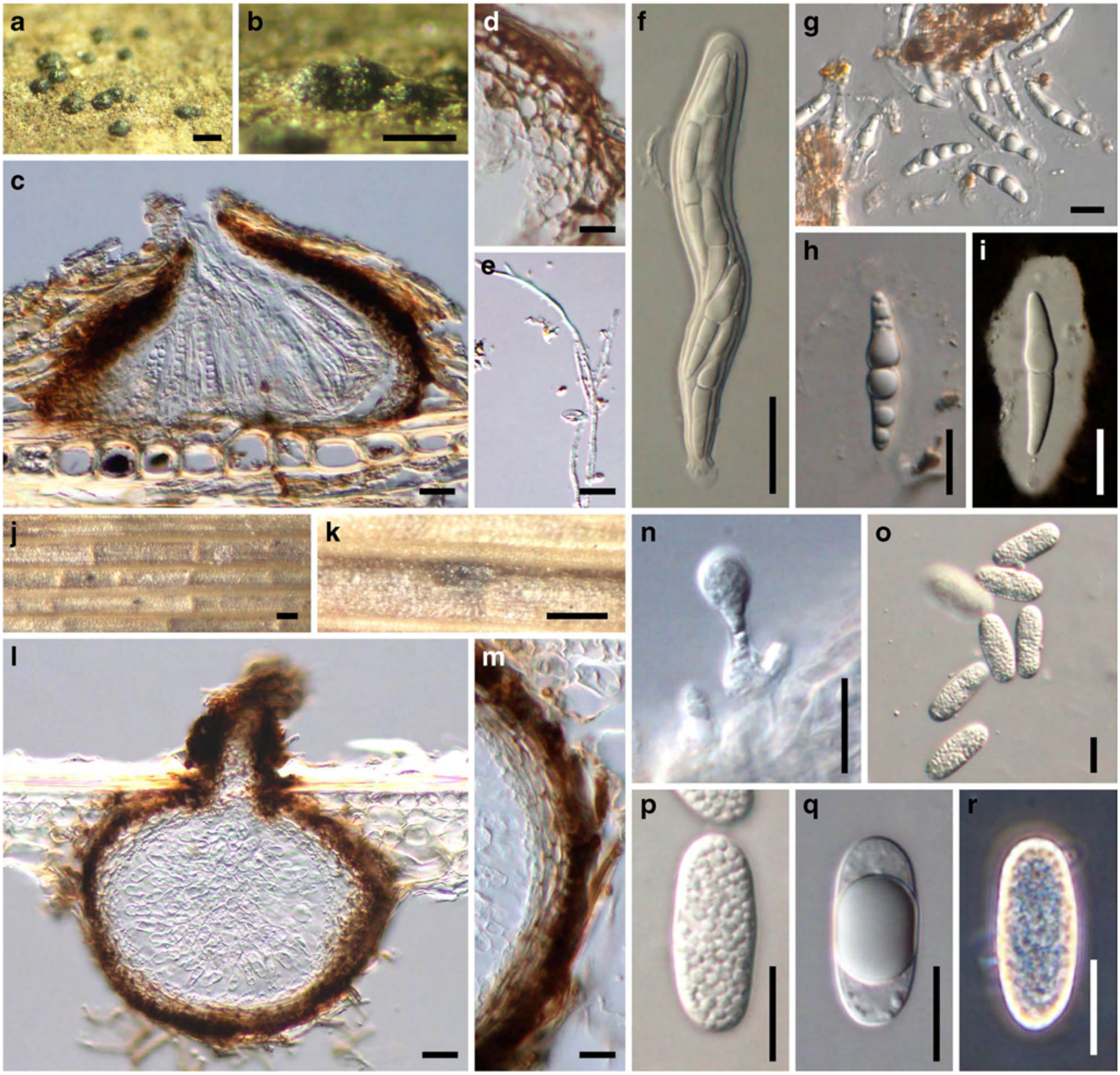


Fig. 33 *Aquasubmersa japonica* **a**, **b** Appearance of ascomata on substrate **c** Ascoma in longitudinal section **d** Peridium. **e** Pseudoparaphyses **f** Ascus **g**, **h** Ascospores with mucilaginous sheath **i** Ascospore in India ink **j**, **k** Conidiomata in culture **l** Conidioma in longitudinal section **m** Peridium of conidioma **n** Conidiogenous cell and immature conidium **o**–**r** Conidia. **a**, **b**, **e**, **h**, **i** from HHUF 30469; **c**, **d**, **g** from HHUF 30470; **f** from HHUF 30468; **j**–**r** from culture MAFF 245220. Scale bars: **a**, **b**=200 μm, **c**, **f**, **l**=20 μm, **d**, **e**, **g**–**i**, **m**–**r**=10 μm, **j**, **k**=300 μm

Notes: The asexual characters of *A. japonica* show a good match with the generic concepts of *Aquasubmersa*. The conidia of *A. japonica* differ in being slightly larger than those of *A. mircensis* (18.3×9.4 μm; Zhang et al. 2012b). ITS sequence differences between our materials of *A. japonica* and the ex-type strain of *A. mircensis* (NR 121545) were found at 27–28 positions with three gaps.

Macrodiplodiopsidaceae Voglmayr et al.

This family was introduced by Crous et al. (2015a, b) to accommodate a single genus *Macrodiplodiopsis*. In this paper we add *Pseudomonodictys* to the family.

150. ***Pseudomonodictys*** Doilom, Ariyawansa, D.J. Bhat & K.D. Hyde, ***gen nov.***

Index Fungorum number: IF551348; *Facesoffungi number*: FoF00906

Etymology: In reference to the similarity to *Monodictys*.

Saprobic on dead wood. **Sexual morph**: Undetermined. **Asexual morph**: *Colonies* on natural substrate, superficial, scattered, solitary to gregarious, black. *Conidiophores* semi-macronematous to sometimes macronematous, septate, branched, pale brown to brown. *Conidiogenous cells* holoblastic, doliform, integrated, terminal or intercalary, indeterminate, pale brown. *Conidia* dictyosporous, muriform, top-shaped, reddish-brown to dark brown, solitary, with a protruding basal cell; truncate to slightly rounded at the base.

Notes: *Pseudomonodictys* is introduced as a monotypic genus with *P. tectonae* as the type species. The new genus is somewhat similar to *Monodictys* in having semi-macronematous, erect or flexuous, unbranched or irregularly branched conidiophores, holoblastic conidiogenous cells and dictyosporous conidia, but the conidia of *Pseudomonodictys* have granular contents and colonies on PDA produce red pigments which has not been reported for *Monodictys* species (Ellis 1971; Day et al. 2006). The conidiophores of *Monodictys* are mostly micronematous. There is no sequence data available for *Monodictys putredinis*, the type species of the genus *Monodictys*, in GenBank. Therefore, comparative phylogenetic analyses between *Pseudomonodictys tectonae* and the type of *Monodictys* cannot be carried out at this time. In this study, isolate MFLUCC 12-0552 (from *P. tectonae*) grouped next to, but separate from *Macrodiplodiopsis desmazieri* (strains CAP 24971, CBS 125026 and CPC 24648) with 73 % MLBP support in the combined LSU, SSU, EF and RPB2 phylogeny (Fig. 1). Phylogenetic analysis of combined SSU and ITS sequence data place *Monodictys arctica* within the Dothideomycetidae and grouping within species of *Leptosphaeria* (Day et al. 2006). *Monodictys castanea* shows affinities with the Sordariomycetidae (Barr and Huhndorf 2001). *Monodictys pelagica* has *Nereiosproa cristata* as its sexual morph, which groups in *Halosphaeriaceae* (Sordariomycetes, Mouzouras and Jones 1985; Jones et al. 2015). Our strain cannot be placed in *Leptosphaeria* or Sordariomycetidae (Fig. 1) and we therefore introduce the monotypic genus *Pseudomonodictys* in *Macrodiplodiopsidaceae*, *Pleosporales* with *P. tectonae*. Further representative taxa analyses and increased sampling as well as molecular studies are required in the future to strengthen the phylogenetic status of these taxa and confirm the polyphyletic nature of *Monodictys*.

Pseudomonodictys also shows some resemblance to dictyosporous genera such as *Acrodictys* and *Dictyoarthrinium*. It differs from *Acrodictys* in having semi-macronematous conidiophores producing several conidia, whereas in *Dictyoarthrinium*, as the name indicates, the terminal conidiogenous cell of macronematous conidiophores produces a muriform holoblastic conidium. *Dictyoarthrinium* differs from *Pseudomonodictys* by its basauxic conidiophores. The phylogenetic analyses support the distinction between these genera.

Type species: ***Pseudomonodictys tectonae*** Doilom, Ariyawansa, D.J. Bhat & K.D. Hyde

151. ***Pseudomonodictys tectonae*** Doilom, Ariyawansa, D.J. Bhat & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551349; *Facesoffungi number*: FoF00907; Fig. 34

Etymology: Name refers to the host genus *Tectona* on which the fungus was collected.

Holotype: MFLU 15-1413

Saprobic on dead wood of *Tectona grandis* L.f. **Sexual morph**: Undetermined. **Asexual morph**: *Colonies* on natural substrate, superficial, scattered, solitary to gregarious, black. *Conidiophores* up to 60 μm long, 2.5–5 μm wide, semi-macronematous to sometimes macronematous, erect to slightly curved, septate, branched, slightly constricted at the septa, pale brown to brown. *Conidiogenous cells* holoblastic, doliform, integrated, terminal or intercalary, indeterminate, smooth to verrucose, pale brown. *Conidia* (13–) 16–17 (−22)×(14–) 16–19 (−25) diam. μm ($\bar{x}$ = 16×17 μm, n=20), dictyosporous, muriform, top-shaped, initially subglobose with 1–2 cells, becoming ellipsoidal to irregular with several cells, acropleurogenous, reddish-brown to dark brown, solitary, with granules, with a protruding basal cell; truncate to slightly rounded at the base.

Culture characteristics: Conidia germinating on PDA within 24 h. Germ tubes produced from the basal cells. *Colonies* on PDA reaching 21–23 mm diam. after 7 days in the dark at 25 °C ($\bar{x}$ = 22.5 mm n=5), with entire edge, raised, circular, superficial at the centre, velvety, medium dense, olive grey (3 F2) at the centre, white (3A1) at the edge after 7 days. *Mycelium* comprising 2–3 μm wide, partly superficial, verrucose, pale brown to dark brown, septate, branched hyphae. *Conidiophores* semi-macronematous to macronematous, erect to slightly curved, mostly creeping, initially subhyaline, later becoming brown to pale brown. *Conidiogenous cells* holoblastic, doliform, integrated, terminal, terminal or intercalary, indeterminate. *Conidia* (8–) 15–19 (−22)×(9–) 14–16 (−19) diam. μm ($\bar{x}$ = 16×14 μm, n=30), produced on aerial mycelium, dictyosporous, pale brown to reddish-brown, initially subglobose with 1–2 cells, becoming ellipsoidal or cylindrical to irregular with several cells, solitary or rarely catenate, with granular contents, with a protruding basal cell; truncate to slightly rounded at the base. *Chlamydospores* develop in culture,

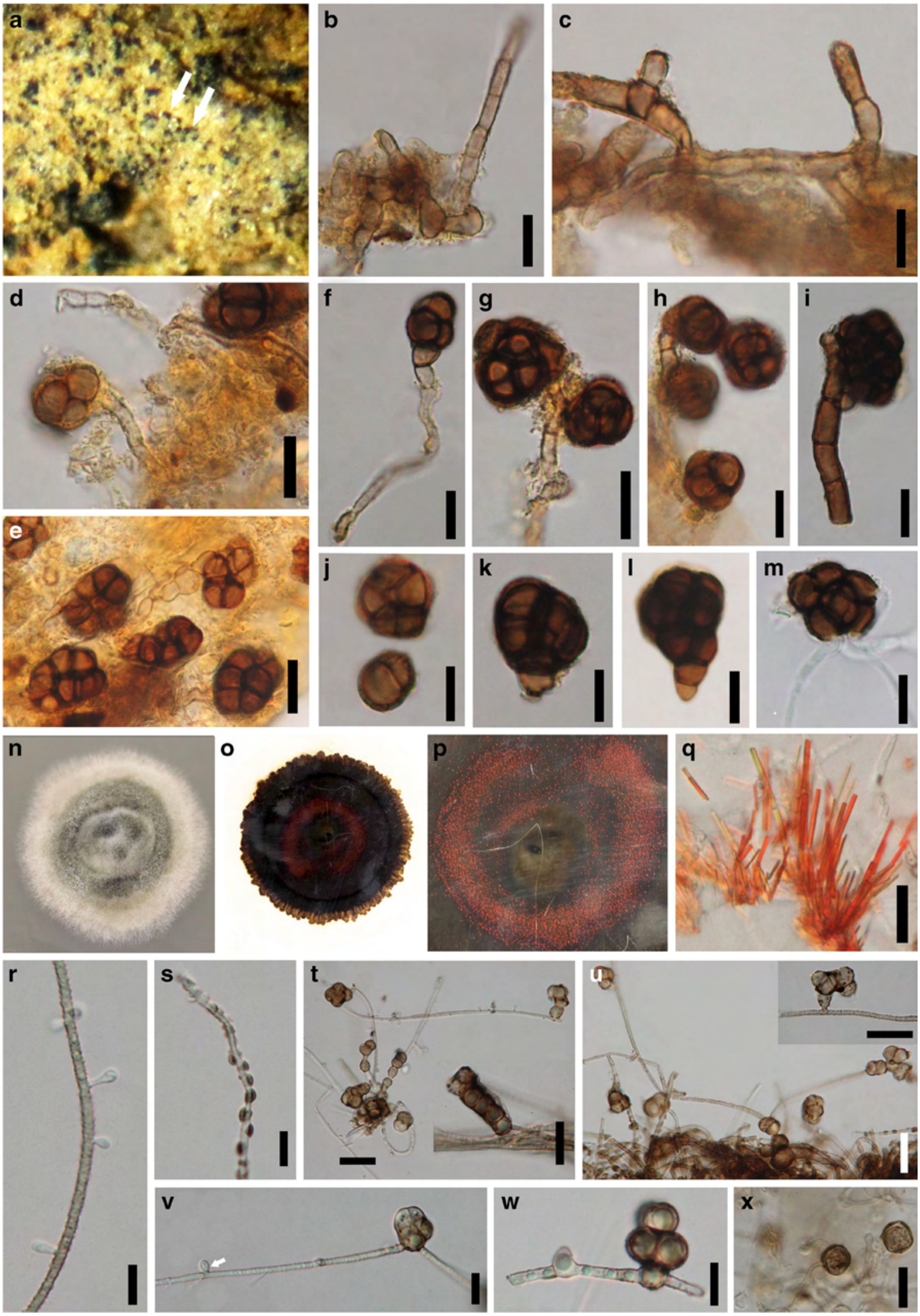


Fig. 34 *Pseudomonodictys tectonae* (holotype) **a** Conidia on dead wood of *Tectona grandis* (*arrows*) **b**, **c** Mycelia bearing conidiophores **d**–**i** Conidia attached to conidiophores **e**–**l** Conidia **m** Germinating conidia **n** Seven day-old colony (from above) on PDA **o** Eight month-old colony (reverse view) on PDA **p** Close-up red pigment on PDA **q** Crystals of red pigment **r** Conidiophores producing immature conidia **s** Conidiophores **t**–**w** Conidiophores with conidia and immature conidia (*arrow*) **x** Chlamydospores. Scale bars: **b**–**m**, **r**, **s**, **v**–**x**=10 μm, **q**, **t**, **u**=20 μm

catenate, intercalary or terminal, initially hyaline and becoming brown to dark brown with maturity, subglobose to ellipsoidal, thick-walled, smooth. *Mycelium* with rod shaped, septate, erect hyphae, up to 60 μm long, 0.6–1.7 μm diam., producing red pigments in PDA medium.

Material examined: THAILAND, Chiang Rai Province, Mae Suai District, Mae Lao garden, on dead wood of *Tectona grandis*, 18 August 2012, M. Doilom MKT 68 (MFLU 15-1413, **holotype**), ex-type living culture, (MFLUCC 12-0552).

Melanommataceae G. Winter

Based on globose or depressed perithecial ascomata, bitunicate and fissitunicate asci, pigmented phragmosporous ascospores, as well as the trabeculate pseudoparaphyses, Winter (1885) introduced the family *Melanommataceae*, which is typified by *Melanomma* (Hyde et al. 2013; Tian

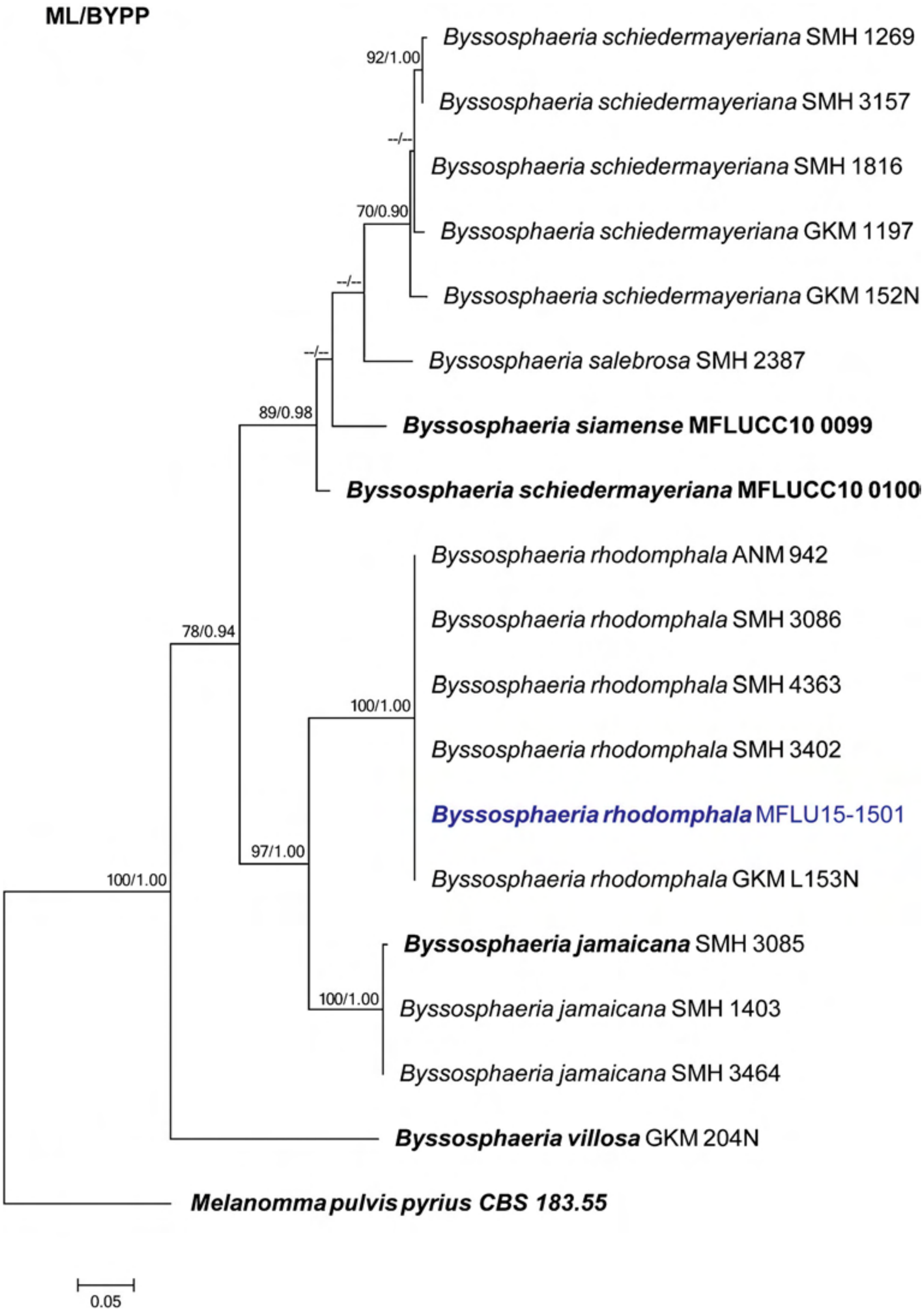


Fig. 35 Phylogram generated from maximum likelihood analysis based on combined LSU and EF sequenced data of *Byssosphaeria*. Maximum likelihood bootstrap support values greater than 50 % and Bayesian posterior probabilities greater than 0.75 are near the nodes. The ex-type strains are in *bold* and the new isolates are in *blue*. The *scale bar* indicates 10 changes. The tree is rooted with *Melanoma pulvis-pyrius* CBS 183.55

et al. 2015). Barr (1983) treated *Melanommataceae* as a separate order, but recent molecular phylogenetic studies do not give any support to the separation of *Melanommatales* from *Pleosporales* (Liew et al. 2000; Mugambi and Huhndorf 2009a; Zhang et al. 2012a; Hyde et al. 2013). Currently, the family comprises 16 genera and is considered a well-supported family in the order *Pleosporales*, based on both phylogeny and morphology (Tian et al. 2015).

Byssosphaeria Cooke, Grevillea 7(no. 43): 84 (1879)

Byssosphaeria is a widespread melanommataceous genus containing approximately 20 species with pyrenochaeta-like coelomycetous asexual morphs (Kirk et al. 2001; Tian et al. 2015). The species are saprobic on decorticated wood, bark of fallen branches, old leaves and various other plant substrates (Kirk et al. 2001; Tian et al. 2015). *Byssosphaeria* was introduced by Cooke and Plowright (1879) based on its superficial ascomata, seated on a "tomentose subiculum of interwoven threads", including various species in *Sphaeria* and *Byssisedae*, and was validly typified by *B. keitii* (Cooke and Plowright 1879). *Byssosphaeria* was assigned to *Herpotrichia sensu lato*, and *Byssosphaeria schiedermayeriana* was transferred to *H. schiedermayeriana* Fuckel (Zhang et al. 2012a). After studying *Herpotrichia* in North America, Barr (1984) accepted a relatively narrow generic concept, *Herpotrichia sensu stricto*, and revived *Byssosphaeria*; this proposal is supported by phylogenetic study (Mugambi and Huhndorf 2009a). Morphologically, *B. keitii* is characterized by large ascomata with orange to reddish, flat apices, and is closely related to *B. rhodomphala* (Berk.) Cooke (Barr 1984).

In our phylogeny *Byssosphaeria rhodomphala* and *B. jamaicana*, each represented by several collections including our strain MFLU 15-1501, occur in a strongly supported sister relationship (Fig. 35). Our material of *B. rhodomphala* fits well with the descriptions provided by Barr (1984) and Chen and Hsieh (2004). In *B. rhodomphala* the asci are slightly larger than that in the type, but the peridium and ascospores

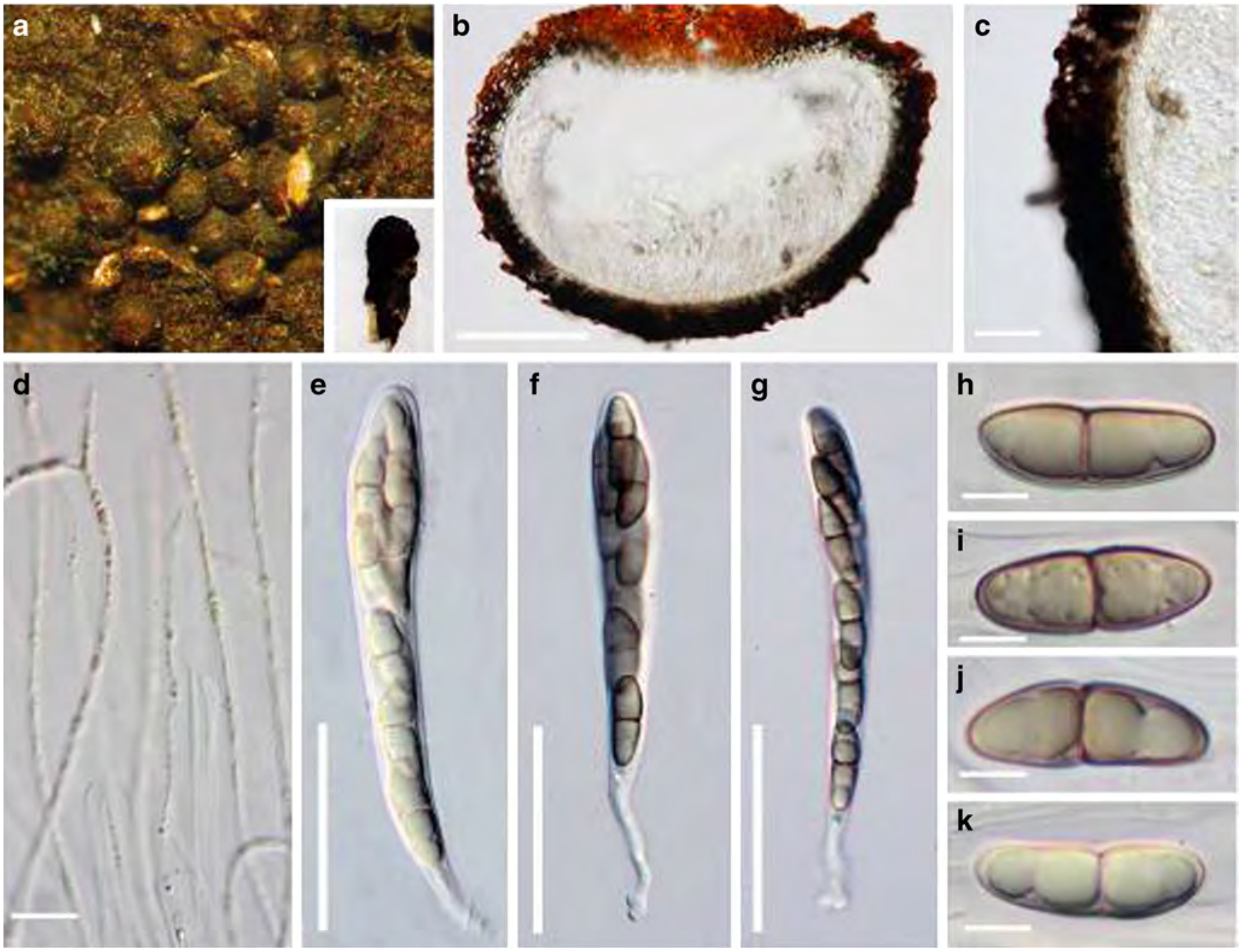


Fig. 36 *Byssosphaeria rhodomphala* (reference specimen) **a** Habitat of the taxon on host substrate **b** Vertical section through ascoma. Note the reddish region around the ostiole **c** Close up of the peridium **d** Pseudoparaphyses **e**, **f** Asci **h**–**k** Ascospores. Scale bars: **b**=200 μm, **c**=50 μm, **d**=10 μm, **e**–**f**=10 μm, **h**–**k**=20 μm

are in the given range (Barr 1984; Chen and Hsieh 2004). *Byssosphaeria rhodomphala* was collected from a different host and location to that of the protologue; thus we propose our collection as a reference specimen (*sensu* Ariyawansa et al. 2014c) until collections from the same host and location can be obtained for epitypification.

152. ***Byssosphaeria rhodomphala*** (Berk.) Cooke, Grevillea 15(no. 75): 81 (1887)

Facesoffungi number: FoF00942; Fig. 36

Saprobic on dead stems of *Senecio* spp. **Sexual morph**: *Ascomata* 360–500(−600) µm high × 300–500 µm diam. ($\bar{x}$ = 450 × 470 µm, n=10), scattered or in small groups, superficial with basal subiculum anchoring them to the substrate, globose, subglobose to turbinate, apapillate, with pore-like ostiole, ostiolar region flat, often orange or greenish. *Peridium* 20–55 µm wide, comprising two cell types, outer layer composed of brown, thick-walled cells of *textura epidermoidea*, inner layer composed of hyaline to pale brown cells of *textura angularis*. *Hamathecium* of dense, 0.5–1.5 µm broad, long trabeculate pseudoparaphyses, embedded in mucilage, anastomosing between and above the asci. *Asci* 90–120 × 10–14 µm ($\bar{x}$ = 100 × 12 µm, n=20), 8-spored, bitunicate, fissitunicate, cylindric-clavate, pedicel 15–20 (−53) µm long, immature asci usually with a longer and furcate pedicel, apically rounded with an ocular chamber. *Ascospores* 18–23 × 5.5–8 µm ($\bar{x}$ = 20 × 6 µm, n=40), overlapping biseriate above and uniseriate below, pale brown, fusoid to ellipsoidal with rounded ends, 1-septate, with hyaline, smooth-walled. **Asexual morph**: Undetermined.

Material examined: THAILAND, Chiang Rai Province, Bandu, on dead stem, 12 January 2012, H.A. Ariyawansa (MFLU 15-1501, **reference specimen designate here**).

Microthyriaceae Sacc.

The family *Microthyriaceae* was introduced by Saccardo (1883), with the generic type *Microthyrium*. The family is characterized by ascomata which appear as small black dots on host plants, which are the flattened ostiolate thyriothecia, with poorly developed bases and cells radiating from the prominent central ostiole. Asci are bitunicate and ascospores are hyaline to brown, 1-septate, and with or without ciliate appendages (Doidge 1942; Müller and von Arx 1962; Luttrell 1973; Hofmann and Piepenbring 2006; Hofmann 2010; Wu et al. 2011, 2014; Hyde et al. 2013; Hongsanan et al. 2014a). Combinations of morphological and phylogenetic analyses indicate that *Microthyriaceae* is a distinct family in *Microthyriales*, Dothideomycetes (Schoch et al. 2009; Hyde et al. 2013; Hongsanan et al. 2014a; Wijayawardene et al. 2014; Fig. 37).

153. ***Microthyrium buxicola*** Hongsanan & K.D. Hyde, ***sp. nov.***

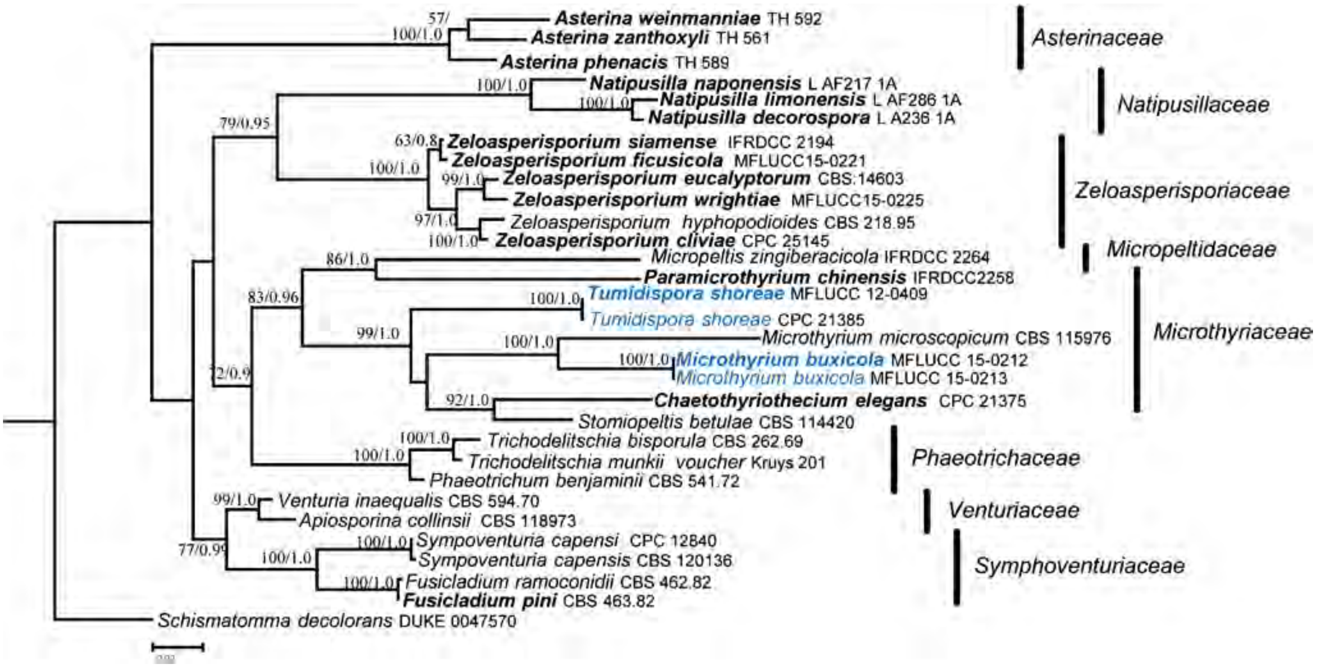


Fig. 37 Phylogram generated from maximum likelihood analysis based on combined LSU and SSU sequenced data. The first set of numbers above the nodes are maximum likelihood values above 50 % shown. The second set of numbers above the nodes are Bayesian posterior probabilities, with values above 0.9 shown. *Strain numbers* are indicated after species names. New sequence data are in *blue bold*, and ex-type strains are in *black bold*

Index Fungorum number: IF551429; *Facesoffungi number* FoF00943; Fig. 38

Etymology: *buxicola* referring to the host on which the taxon was found.

Holotype: MFLU 15-0052

Epiphytic on the upper surface of dead fallen leaves, rarely on the lower surface, appearing as small black dots. *Superficial hyphae* absent. **Sexual morph**: *Thyriothecia* 190–

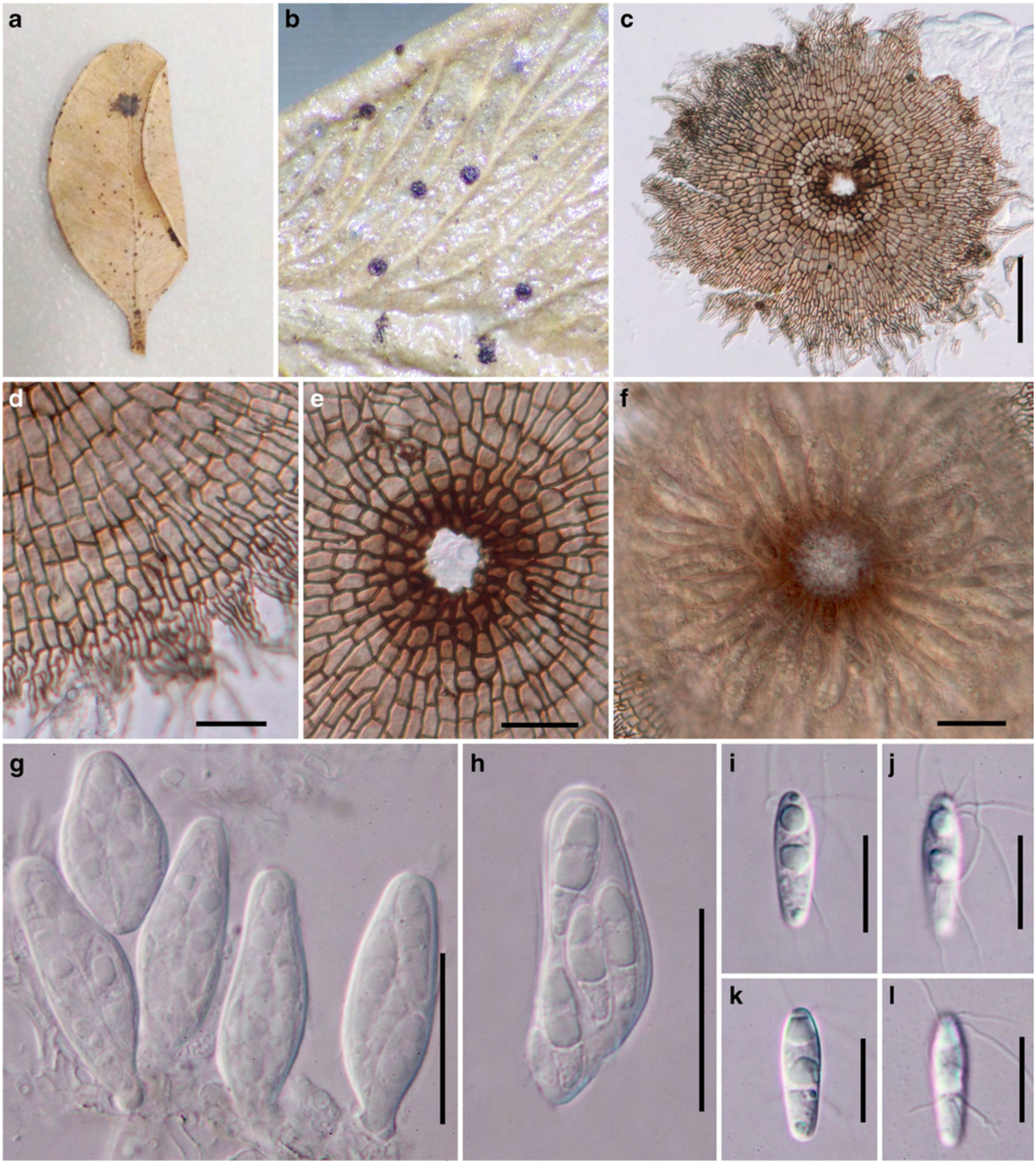


Fig. 38 *Microthyrium buxicola* (holotype). **a** Substrate **b** Thyriothecia on the surface of leaves **c**, **f** Thyriothecium when viewed in squash mounts and close-up of ascal arrangement **d** Upper wall when viewed in squash mount **e** Prominent darkened ring around the central ostiole **g**, **h** Asci with 4-spores **i**, **l** Ascospores with appendages. Scale bars: **c**=50 μm, **d**, **i**–**l**= 10 μm, **e**–**h**=20 μm

240 µm diam. ($\bar{x}$ = 215 µm, n=5), superficial, mostly solitary, sometimes gregarious, light brown to brown, circular, flattened, basal peridium poorly developed, easily removed, with prominent, darker, central ostiole, pale brown and meandering and branched at the margin. *Upper wall* comprising brown cells of *textura angularis*, radiating in parallel lines from center to the outer rim. *Pseudoparaphyses* not seen. *Asci* 20–32×10–12 µm ($\bar{x}$ = 30×11 µm, n=10), 4-spored, bitunicate, fissitunicate, fusiform to clavate, short pedicellate or apedicellate, apically rounded, with an ocular chamber. *Ascospores* 14–15×4–5 µm ($\bar{x}$ = 14.4×4.6 µm, n=10), 2–3-seriate, fusiform to ellipsoidal, hyaline, 1-septate, not constricted at the septum, or slightly constricted at the septum when in 10 % lactic acid, apical cell slightly wider and longer than lower cell, smooth-walled, 2–3-guttulate, with 3–6-appendages near the apex, and 3–4-appendages at the septum. **Asexual morph**: Undetermined.

Culture characteristics: Ascospores germinating on PDA at 25–30 °C in 12 h of light/12 h of dark, at first hyaline to brownish, becoming brown to reddish. Colonies slow growing reaching 1.5 cm diam. after 10 days, colony superficial to erumpent, very thin, surface smooth, difficult to remove, darker at the center.

Material examined: ITALY, on leaves of *Buxus* sp. (*Buxaceae*), 9 December 2014, E. Camporesi (MFLU 15-0052, **holotype**); *ibid*., (KIB, **isotype**); ex-type living cultures MFLUCC 15-0212, MFLUCC 15-0213.

Notes: *Microthyrium buxicola* is most similar to *M. nolinae* A.W. Ramaley, but differs in lacking superficial hyphae (Ramaley 1999). Ascospores have up to 20 appendages around the upper cells in *M. nolinae*, while in *M. buxicola* there are 3–6-appendages around the upper cell and 3–4-appendages at the septum. The species is also similar to *M. guadalupensis* A.W. Ramaley. *Microthyrium guadalupensis* has ascospores with 1–4 appendages at both ends, unlike in *M. buxicola*. Combined gene analysis of LSU and SSU sequences data indicate that *M. buxicola* groups in the *Microthyriaceae* clade sister to *Micropeltidaceae* clade and is a distinct species (Fig. 37).

154. ***Tumidispora*** Hongsanan & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551375; *Facesoffungi number*: FoF00944

Etymology: refers to the swollen cell of the ascospores.

Epiphytic on the upper surface of leaves, appearing as small black dots. *Superficial hyphae* absent. **Sexual morph**: *Thyriothecia* superficial, mostly solitary, light brown to brown, circular, flattened, basal peridium poorly developed, easily removed, darker around the central ostiole, dark brown towards the outer lighter rim, irregularly rounded at the margin. *Upper wall* comprising brown cells of *textura angularis*, radiating in slightly irregular, but parallel lines from center to the outer rim. *Hamathecium* comprising 2 *µm* wide, branched pseudoparaphyses, asci inclined towards the central ostiole. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded, with an ocular chamber. *Ascospores* 1–2-seriate, hyaline, narrowly fusiform with subpapillate ends, 1-septate, apical cell swollen and wider and subpapillate, basal cell subconical. **Asexual morph**: Undetermined.

Type species: ***Tumidispora shoreae*** Hongsanan & K.D. Hyde

Notes: Phylogenetic analyses of LSU and SSU sequence data indicate that *Tumidispora* is a distinct genus in *Microthyriaceae* which forms a well-supported clade sister to the *Microthyrium* clade (99 % ML, 1.0 PP support). *Tumidispora shoreae* is similar to *Microthyriaceae* in having superficial thyriothecia, with a central ostiole and hyaline, 1-septate ascospores. *Tumidispora shoreae* is most typical of *Paramicrothyrium chinensis* H.X. Wu & K.D. Hyde, but differs in having a prominent darkened area around the central ostiole and also in the shape of the ascospores. There are few sequences for species of *Microthyriaceae* in GenBank, thus *Tumidispora* is an important addition.

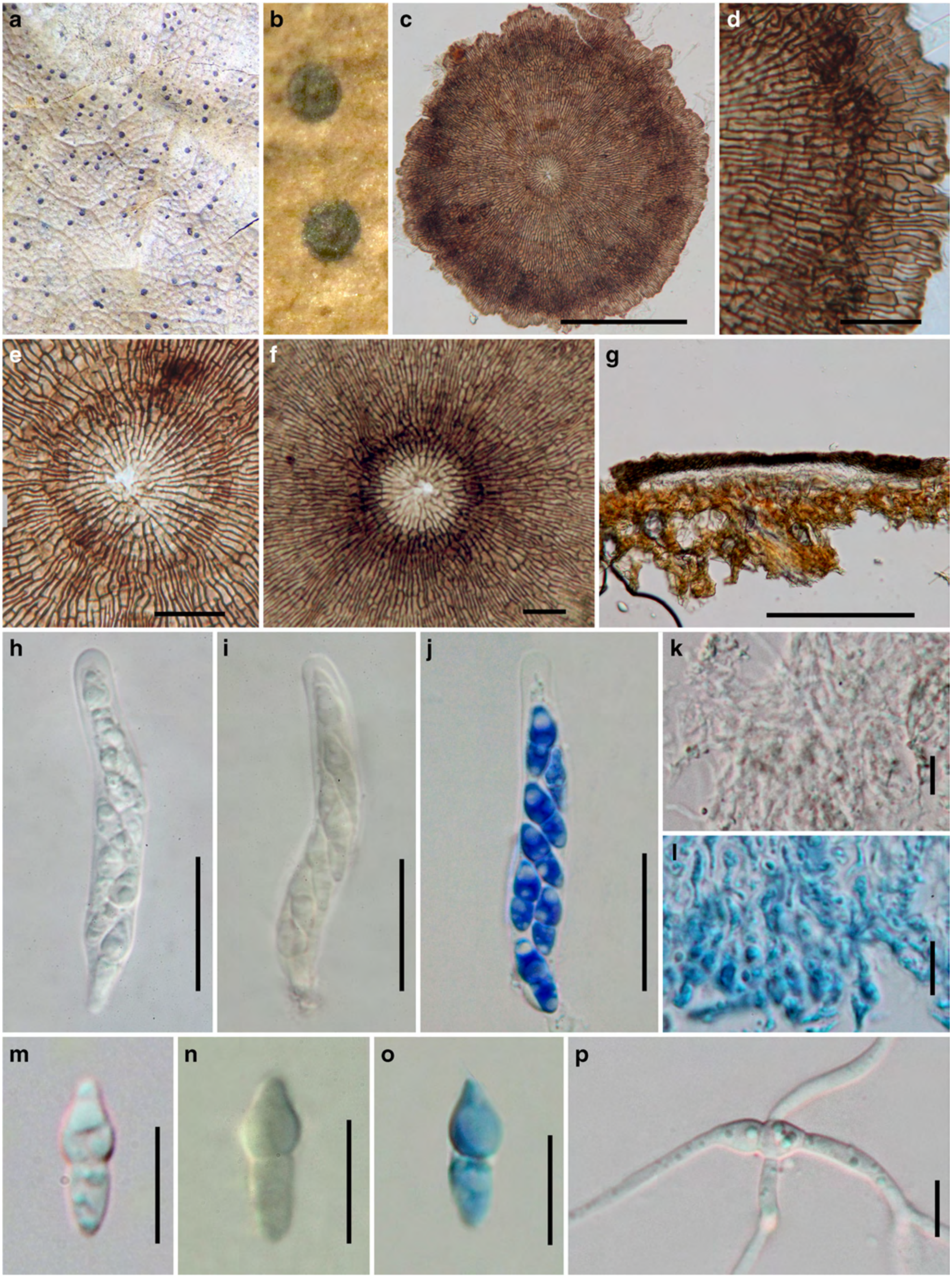
155. ***Tumidispora shoreae*** Hongsanan & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551376; *Facesoffungi number*: FoF00945; Fig. 39

Etymology: *shoreae* referring to the host on which the taxon was collected.

Holotype: MFLU 15-1391

Epiphytic on the upper surface of leaves, appearing as small black dots. *Superficial hyphae* absent. **Sexual morph**: *Thyriothecia* 261–283 µm diam. ($\bar{x}$ = 268 µm, n=10), superficial, mostly solitary, light brown to brown, circular, flattened, basal peridium poorly developed, easily removed, darker around the central ostiole, dark brown towards the outer lighter rim, irregularly rounded at the margin. *Upper wall* comprising brown cells of *textura angularis*, radiating in slightly irregular, but parallel lines from center to the outer rim. *Hamathecium* comprising 2 *µm* wide, branched pseudoparaphyses, asci inclined towards the central ostiole. *Asci* 53–55×7–8 µm ($\bar{x}$ = 54×7 µm, n=10), 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded, with an ocular chamber. *Ascospores* 14–15×4–5 µm ($\bar{x}$ = 14×5 µm, n=10), 1–2-seriate, hyaline, narrowly fusiform with subpapillate ends, 1-septate, constricted at the septum, apical cell swollen and wider and subpapillate,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◀ **Fig. 39** *Tumidispora shoreae* (holotype) **a**, **b** Thyriothecia on surface of leaf **c** Thyriothecium when viewed in squash mount **d** Upper wall of thyriothecium when viewed in squash mount **e**, **f** Central ostiole with darkened cells **g** Section through thyriothecium **h** Ascus with 8 ascospores **i** Ascus in Melzer's reagent **j** Ascus in cotton blue reagent **k** Pseudoparaphyses **l** Pseudoparaphyses in cotton blue reagent **m** Ascospore in water **n** Ascospore in Melzer's reagent **o** Ascospore in cotton blue reagent **p** Germinating ascospore. Scale bars: **c**, **g**=100 μm, **d**–**f**, **h**–**j**=20 μm, **k**–**p**=10 μm

basal cell subconical, smooth-walled. **Asexual morph**: Undetermined.

Culture characteristics: *Ascospores* germinating on PDA at 28 °C for 12 h of light/12 h of dark, hyaline to grayish at first, becoming gray. Colonies slow growing, reaching 1.5 cm diam. after 5 days, colony erumpent, velvety, difficult to remove, with dark grey to black mycelium at margin, greyish to grey at the center.

Material examined: THAILAND, Chiang Rai, Doi Mae Salong (Site 1), on dead leaves of *Shorea* sp. (*Dipterocarpaceae*), 18 July 2012, N. Tangteerasunan DMSL13 (MFLU 15-1391, **holotype**); *ibid.* (KIB, **isotype**); ex-type living culture, MFLUCC 12-0409, CPC 21385.

Notes: *Tumidispora shoreae* is most similar to *Paramicrothyrium chinensis* in having similar thyriothecia and hyaline, 1-septate ascospores. *Tumidispora shoreae* has brown to dark brown thyriothecia, with a prominent darkened area around the central ostiole, and 1–2-seriate ascospores which are strongly constricted at the septum, with an apical swollen cell, which is wider than the lower cell and with a subpapillate apex. *Paramicrothyrium chinensis* has black thyriothecia, and uniseriate ascospores which are not strongly constricted at the septum (Wu et al. 2011).

Phaeosphaeriaceae M.E. Barr

The family *Phaeosphaeriaceae* (*Pleosporales*) was introduced by Barr (1979) and typified by *Phaeosphaeria* with *P. oryzae* as the type species (Zhang et al. 2012a; Hyde et al. 2013; Phookamsak et al. 2014). Members of this family include plant pathogens, saprobes and endophytes associated with a wide variety of plant hosts, especially monocotyledons, although some have also been reported from dicotyledonous hosts (Zhang et al. 2012a; Hyde et al. 2013; Ariyawansa et al. 2014a, b, c; Phookamsak et al. 2014). *Phaeosphaeriaceae* has often been confused with *Leptosphaeriaceae* and *Didymosphaeriaceae* (Khashnobish and Shearer 1996; Zhang et al. 2012a; Hyde et al. 2013; Phookamsak et al. 2014). Barr (1979) introduced the family with 15 genera, which now has been increased to more than 35 sexual and asexual genera (Hyde et al. 2013; Phookamsak et al. 2014). Various phylogenetic studies have shown that *Phaeosphaeriaceae* is a heterogeneous group of taxa and recent studies have introduced several new genera and transferred some genera to other families (Zhang et al. 2012a; Hyde et al. 2013; Phookamsak et al. 2014; Trakunyingcharoen et al. 2014; Crous et al. 2015a, b; Ertz et al. 2015). In the present study, a backbone tree for the family is presented (Fig. 40) including the genera *Allophaeosphaeria*, *Ampelomyces*, *Chaetosphaeronema*, *Dematiopleospora*, *Didymocyrtis*, *Entodesmium*, *Leptospora*, *Loratospora*, *Muriophaeosphaeria*, *Neosetophoma*, *Neostagonospora*, *Nodulosphaeria*, *Ophiobolus*, *Ophiosphaerella*, *Paraphoma*, *Parastagonospora*, *Phaeosphaeria*, *Phaeosphaeriopsis*, *Sclerostagonospora*, *Septoriella*, *Setomelanomma*, *Setophoma*, *Stagonospora*, *Vrystaatia*, *Wojnowicia*, *Xenophoma*, *Wojnowiciella* and *Xenoseptoria*.

Allophaeosphaeria Ariyawansa et al., in Liu et al., Fungal Diversity 72(1): 137 (2015)

The genus *Allophaeosphaeria* was introduced by Liu et al. (2015) to accommodate *A. muriformia* Ariyawansa et al. and *A. dactylidis* Wanasinghe et al. *Allophaeosphaeria* also resembles many species of *Phaeosphaeria* in having a peridium comprising 2–3 layers of brown to dark brown cells of *textura angularis* and multi-septate ascospores with a gelatinous sheath, but differs in having muriform ascospores (Liu et al. 2015). Multigene phylogenetic analyses (ITS, LSU and SSU sequence data) indicates that *Allophaeosphaeria* belongs in *Phaeosphaeriaceae*, but is distinct from *Phaeosphaeria sensu stricto* (Fig. 40). A key to *Allophaeosphaeria* species is provided.

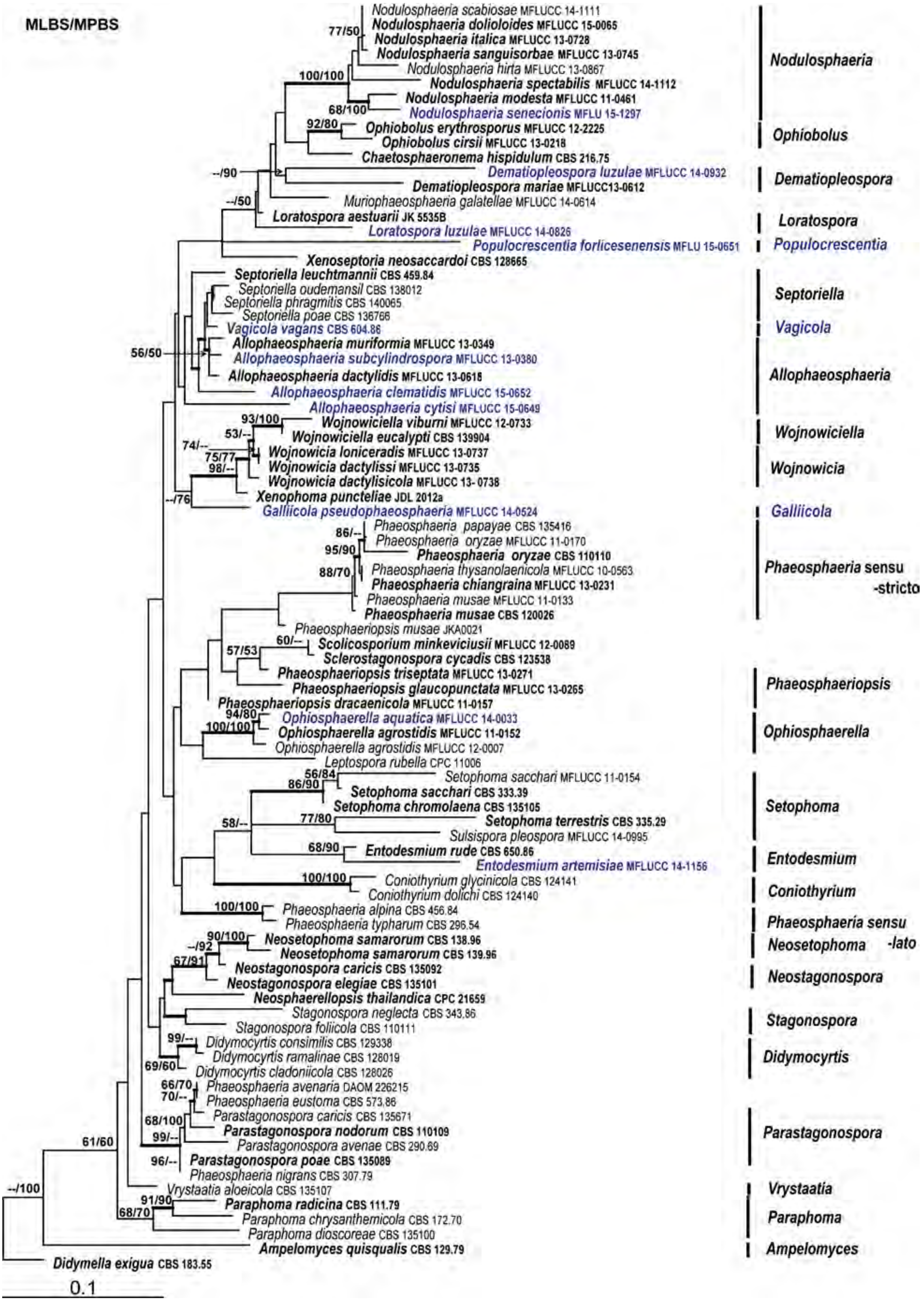
156. ***Allophaeosphaeria cytisi*** Wanasinghe, Camporesi, E.B.G. Jones & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551409; *Facesoffungi number*: FoF00946; Fig. 41

Etymology: Name reflects the host genus *Cytisus*, from which the species was collected.

Holotype: MFLU 15-1502

Saprobic on dead herbaceous branches. **Sexual morph**: *Ascomata* 500–550 μm high, 400–450 μm diam. ($\bar{x}$ = 526.3×423.3 μm, *n*=10), solitary, scattered, immersed to erumpent, obpyriform, dark brown to black, coriaceous, ostiolate. *Ostiole* 190–220 μm high, 150–200 μm diam. ($\bar{x}$ = 206.4×172 μm, *n*=5), papillate, black, smooth, filled with hyaline cells, appearing as a white ring around ostiole. *Peridium* 10–20 μm wide at the base, 20–40 μm wide in sides, comprising 6–8 layers, outer layer heavily pigmented, comprising blackish to dark brown, thick-walled cells of *textura angularis*, inner layer composed of brown, thin-walled cells of *textura angularis*. *Hamathecium* comprising numerous, 2–2.5 μm (*n*=30) wide, filamentous, branched, septate, pseudoparaphyses. *Asci* 110–140×10–15 μm ($\bar{x}$ = 124.2×13.1 μm, *n*=40), 8-spored, bitunicate, fissitunicate, cylindrical, pedicel furcate and up to 15–25 μm long, rounded and thick-walled at the apex, with a ocular chamber. *Ascospores* 20–25×8–10 μm ($\bar{x}$ =


MLBS/MPBS
Nodulosphaeria scabiosae MFLUCC 14-1111
Nodulosphaeria dolioloides MFLUCC 15-0065
Nodulosphaeria italica MFLUCC 13-0728
Nodulosphaeria sanguisorbae MFLUCC 13-0745
Nodulosphaeria hirta MFLUCC 13-0867
Nodulosphaeria spectabilis MFLUCC 14-1112
Nodulosphaeria modesta MFLUCC 11-0461
Nodulosphaeria senecionis MFLU 15-1297
Ophiobolus erythrosporus MFLUCC 12-2225
Ophiobolus cirsii MFLUCC 13-0218
Chaetosphaeronema hispidulum CBS 216.75
Dematiopleospora luzulae MFLUCC 14-0932
Dematiopleospora mariae MFLUCC13-0612
Muriophaeosphaeria galatellae MFLUCC 14-0614
Loratospora aestuarii JK 5535B
Loratospora luzulae MFLUCC 14-0826
Populocrescentia forlicesenensis MFLU 15-0651
Xenoseptoria neosaccardoi CBS 128665
Septoriella leuchtmannii CBS 459.84
Septoriella oudemansii CBS 138012
Septoriella phragmitis CBS 140065
Septoriella poae CBS 136766
Vagicola vagans CBS 604.86
Allophaeosphaeria muriformia MFLUCC 13-0349
Allophaeosphaeria subcylindrospora MFLUCC 13-0380
Allophaeosphaeria dactylidis MFLUCC 13-0618
Allophaeosphaeria clematidis MFLUCC 15-0652
Allophaeosphaeria cytisi MFLUCC 15-0649
Wojnowiciella viburni MFLUCC 12-0733
Wojnowiciella eucalypti CBS 139904
Wojnowicia loniceradis MFLUCC 13-0737
Wojnowicia dactylissi MFLUCC 13-0735
Wojnowicia dactylisicola MFLUCC 13- 0738
Xenophoma puncteliae JDL 2012a
Galliicola pseudophaeosphaeria MFLUCC 14-0524
Phaeosphaeria papayae CBS 135416
Phaeosphaeria oryzae MFLUCC 11-0170
Phaeosphaeria oryzae CBS 110110
Phaeosphaeria thysanolaenicola MFLUCC 10-0563
Phaeosphaeria chiangraina MFLUCC 13-0231
Phaeosphaeria musae MFLUCC 11-0133
Phaeosphaeria musae CBS 120026
Phaeosphaeriopsis musae JKA0021
Scolicosporium minkeviciusii MFLUCC 12-0089
Sclerostagonospora cycadis CBS 123538
Phaeosphaeriopsis triseptata MFLUCC 13-0271
Phaeosphaeriopsis glaucopunctata MFLUCC 13-0265
Phaeosphaeriopsis dracaenicola MFLUCC 11-0157
Ophiosphaerella aquatica MFLUCC 14-0033
Ophiosphaerella agrostidis MFLUCC 11-0152
Ophiosphaerella agrostidis MFLUCC 12-0007
Leptospora rubella CPC 11006
Setophoma sacchari MFLUCC 11-0154
Setophoma sacchari CBS 333.39
Setophoma chromolaena CBS 135105
Setophoma terrestris CBS 335.29
Sulsispora pleospora MFLUCC 14-0995
Entodesmium rude CBS 650.86
Entodesmium artemisiae MFLUCC 14-1156
Coniothyrium glycinicola CBS 124141
Coniothyrium dolichi CBS 124140
Phaeosphaeria alpina CBS 456.84
Phaeosphaeria typharum CBS 296.54
Neosetophoma samarorum CBS 138.96
Neosetophoma samarorum CBS 139.96
Neostagonospora caricis CBS 135092
Neostagonospora elegiae CBS 135101
Neosphaerellopsis thailandica CPC 21659
Stagonospora neglecta CBS 343.86
Stagonospora foliicola CBS 110111
Didymocyrtis consimilis CBS 129338
Didymocyrtis ramalinae CBS 128019
Didymocyrtis cladoniicola CBS 128026
Phaeosphaeria avenaria DAOM 226215
Phaeosphaeria eustoma CBS 573.86
Parastagonospora caricis CBS 135671
Parastagonospora nodorum CBS 110109
Parastagonospora avenae CBS 290.69
Parastagonospora poae CBS 135089
Phaeosphaeria nigrans CBS 307.79
Vrystaatia aloeicola CBS 135107
Paraphoma radicina CBS 111.79
Paraphoma chrysanthemicola CBS 172.70
Paraphoma dioscoreae CBS 135100
Ampelomyces quisqualis CBS 129.79
Didymella exigua CBS 183.55
77/50
100/100
68/100
92/80
--/90
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56/50
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53/--
74/--
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99/--
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61/60
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91/90
68/70
0.1
Nodulosphaeria
Ophiobolus
Dematiopleospora
Loratospora
Populocrescentia
Septoriella
Vagicola
Allophaeosphaeria
Wojnowiciella
Wojnowicia
Galliicola
Phaeosphaeria sensu -stricto
Phaeosphaeriopsis
Ophiosphaerella
Setophoma
Entodesmium
Coniothyrium
Phaeosphaeria sensu -lato
Neosetophoma
Neostagonospora
Stagonospora
Didymocyrtis
Parastagonospora
Vrystaatia
Paraphoma
Ampelomyces

◀ **Fig. 40** Phylogram generated from maximum likelihood analysis based on combined LSU and ITS sequenced data of *Phaeosphaeriaceae*. Maximum parsimony and maximum likelihood bootstrap support values greater than 50 % and Bayesian posterior probabilities greater than 0.75 are near the nodes. The ex-type strains are in **bold** and the new isolates are in blue. The scale bar indicates 0.1 changes. The tree is rooted with *Didymella exigua* CBS 183.55

21.5×9.3 μm, *n*=50), mostly uniseriate, initially hyaline, becoming yellowish brown at maturity, ellipsoidal, muriform with 6–8 transverse septa and 3–7 vertical septa, strongly constricted at the central septa, weakly constricted at the other septa, with conical and narrowly rounded ends, lacking a mucilaginous sheath. **Asexual morph**: Undetermined.

Culture characteristics: Colonies on PDA reaching 20–25 mm diam. in 21 days, olivaceous-grey in center, pale olivaceous-grey in outer region, spreading with moderate aerial mycelium, and smooth, even margins; olivaceous-grey from below.

Material examined: ITALY, Arezzo Province, Casuccia di Micheli in Quota, dead and hanging branches of *Cytisus* sp. (*Fabaceae*), 20 June 2012, E. Camporesi (MFLU 15-1502, **holotype**), ex-type living culture, MFLUCC 15-0649.

Notes: *Allophaeosphaeria cytisi* has muriform ascospores and cylindrical asci similar to those characterized in *Cucurbitaria*, *Camarosporium arezzoensis* Tibpromma et al., *Mycoporum elabens* (A. Massal.) Flot. ex Nyl. and *Teichospora trabicola* Fuckel. Multigene analyses of ITS, LSU and SSU sequence data (Fig. 40) indicate that *A. cytisi* belongs in *Phaeosphaeriaceae*. *Allophaeosphaeria cytisi* forms a distinct clade from *Phaeosphaeria sensu stricto*. *Allophaeosphaeria cytisi* differs from *A. clematidis* and *A. dactylidis* in its uniseriate ascospores arranged in cylindrical asci, and having 6–8 transverse septa and 3–7 vertical septa, while *A. clematidis* and *A. dactylidis* have cylindric-clavate asci with 1–2-seriate ascospores having 4–6 transverse septa, 3–4 vertical septa or 3–5 transverse septa, with 1–3 vertical septa, respectively. *Allophaeosphaeria muriformia* differs from *A. clematidis* in having overlapping 2–3-seriate, comparatively large (x̄ = 56×26 μm), oblong to narrowly oblong ascospores.

157. ***Allophaeosphaeria clematidis*** Wanasinghe, Camporesi, E.B.G. Jones & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551408; *Facesoffungi number*: FoF00947; Fig. 42

Etymology: Name reflects the host genus *Clematis*, from which the species was collected.

Holotype: MFLU 15-1505

Saprobic on dead branches of *Clematis vitalba* L. **Sexual morph**: *Ascomata* 110–130 μm high, 150–180 μm diam. (x̄ = 124.1×166 μm, *n*=10), superficial, solitary, scattered, broadly oblong and flattened, dark brown to black, coriaceous, ostiolate. *Ostiole* 25–35 μm high, 25–40 μm diam. (x̄ = 29.5×32.7 μm, *n*=5), papillate, black, smooth, comprising short, hyaline setae. *Peridium* 4–6 μm wide at the base, 9–10 μm wide in sides, comprising 3–4 layers, of heavily pigmented, thin-walled, blackish to dark brown, cells of *textura angularis*. *Hamathecium* comprising numerous, 2–2.5 μm (*n*=30) wide, filamentous, branched, septate, pseudoparaphyses. *Asci* 60–100×15–30 μm (x̄ = 79.7×20.3 μm, *n*=40), 8-spored, bitunicate, fissitunicate, cylindric-clavate, short pedicellate, rounded and thick-walled at the apex, with an ocular chamber. *Ascospores* 20–25×8–10 μm (x̄ = 23.2×9.1 μm, *n*=50), overlapping 1–2-seriate, initially hyaline, becoming brown at maturity, mostly ellipsoidal, curved, muriform with 4–6 transverse septa, and 3–4 vertical septa, strongly constricted at the central septa, the cells above the central septum wider, weakly constricted at the other septa, with conical, narrowly rounded ends, lacking a mucilaginous sheath. **Asexual morph**: Undetermined.

Culture characteristics: Colonies on PDA reaching 30–35 mm diam. in 21 days, surface dirty white, spreading with moderate aerial mycelium, and smooth even, margins; reverse pale luteous.

Material examined: ITALY, Forlì-Cesena Province, Fiumicello in Premilcuore, dead and hanging branches of *Clematis vitalba* (*Ranunculaceae*), 5 December 2013, E. Camporesi (MFLU 15-1505, **holotype**), ex-type living culture, MFLUCC 14-0652.

Notes: *Allophaeosphaeria clematidis* differs from *A. dactylidis* in having 23.2×9.1 μm, mostly ellipsoidal, curved ascospores, with 4–6 transverse septa, and 3–4 vertical septa, while *A. dactylidis* has 18.2×6.3 μm, ellipsoidal to subfusiform, ascospores with 3–5 transverse septa, and 1–3 vertical septa. *Allophaeosphaeria muriformia* differs from *A. clematidis* in having large, oblong to narrowly oblong, 56×26 μm ascospores.

Key to species of *Allophaeosphaeria*

1. Peridium comprising two cell layers, outwardly heavily pigmented, inwardly hyaline 2
1. Peridium comprising a single heavily pigmented cell layer 3
2. Ascospores ellipsoidal, with 4–6 transverse septa, and 3–4 vertical septa .... ***A. clematidis***
2. Ascospores subfusiform, with 3–5 transverse septa, and 1–3 vertical septa .... ***A. dactylidis***
3. Ascospores mostly uniseriate, with 6–8 transverse septa, and 3–7 vertical septa .... ***A. cytisi***
3. Ascospores mostly overlapping 2–3-seriate, with 2–3 transverse septa, and 1–2 vertical septa .... ***A. muriformia***

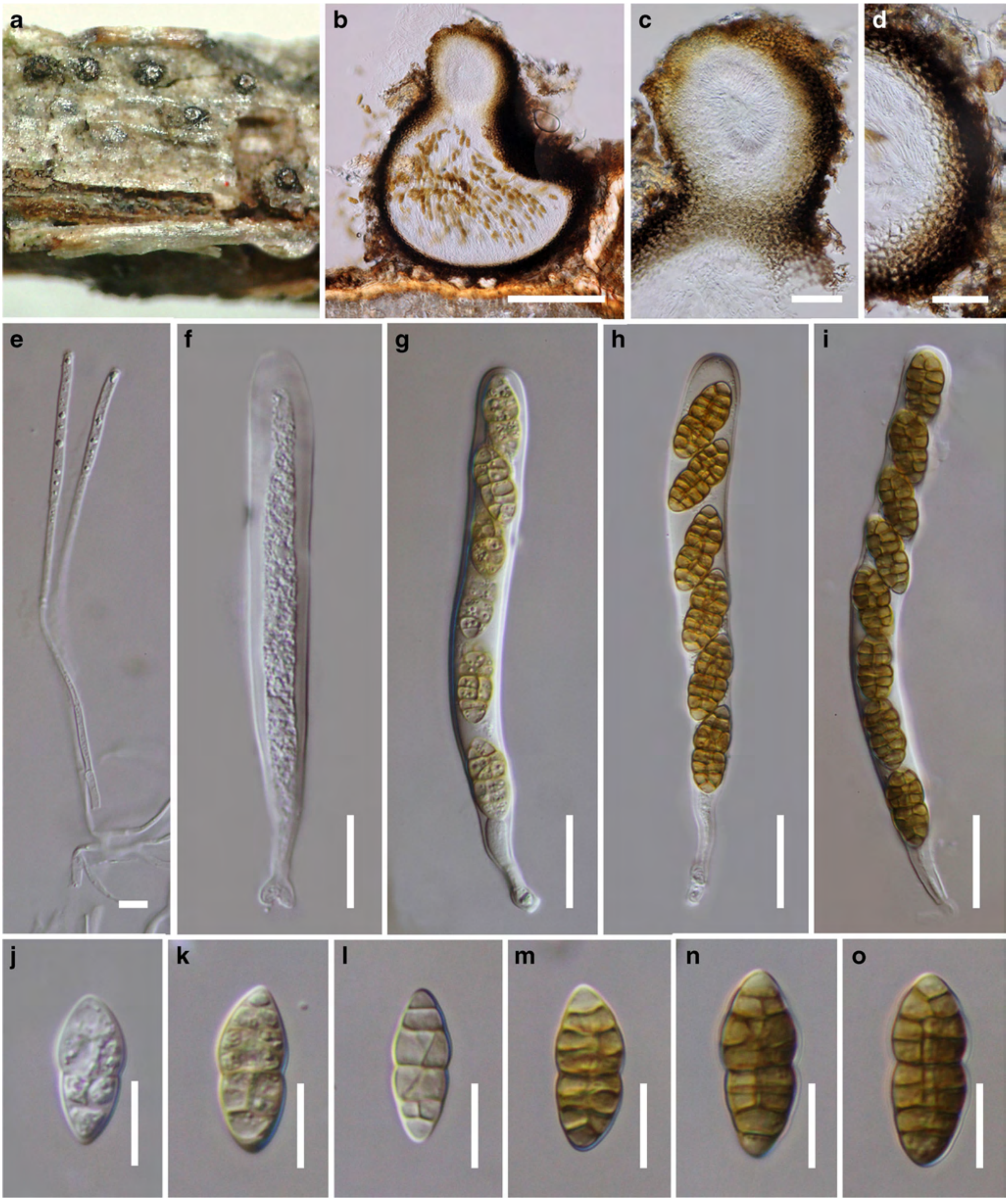


Fig. 41 *Allophaeosphaeria cytisi* (holotype) **a** Appearance of ascomata on host substrate. Note the papilla with white circle around the ostiole **b** Section of ascoma **c** Close up of ostiole **d** Peridium **e** Pseudoparaphyses **f–i** Asci **j–o** Ascospores. Scale bars: **b**=200 μm, **c**, **d**=50 μm, **e**=5 μm, **f–i**=20 μm, **j–o**=10 μm

158. ***Allophaeosphaeria subcylindrospora*** W.J. Li, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551396; *Facesoffungi number*: FoF00948; Fig. 43

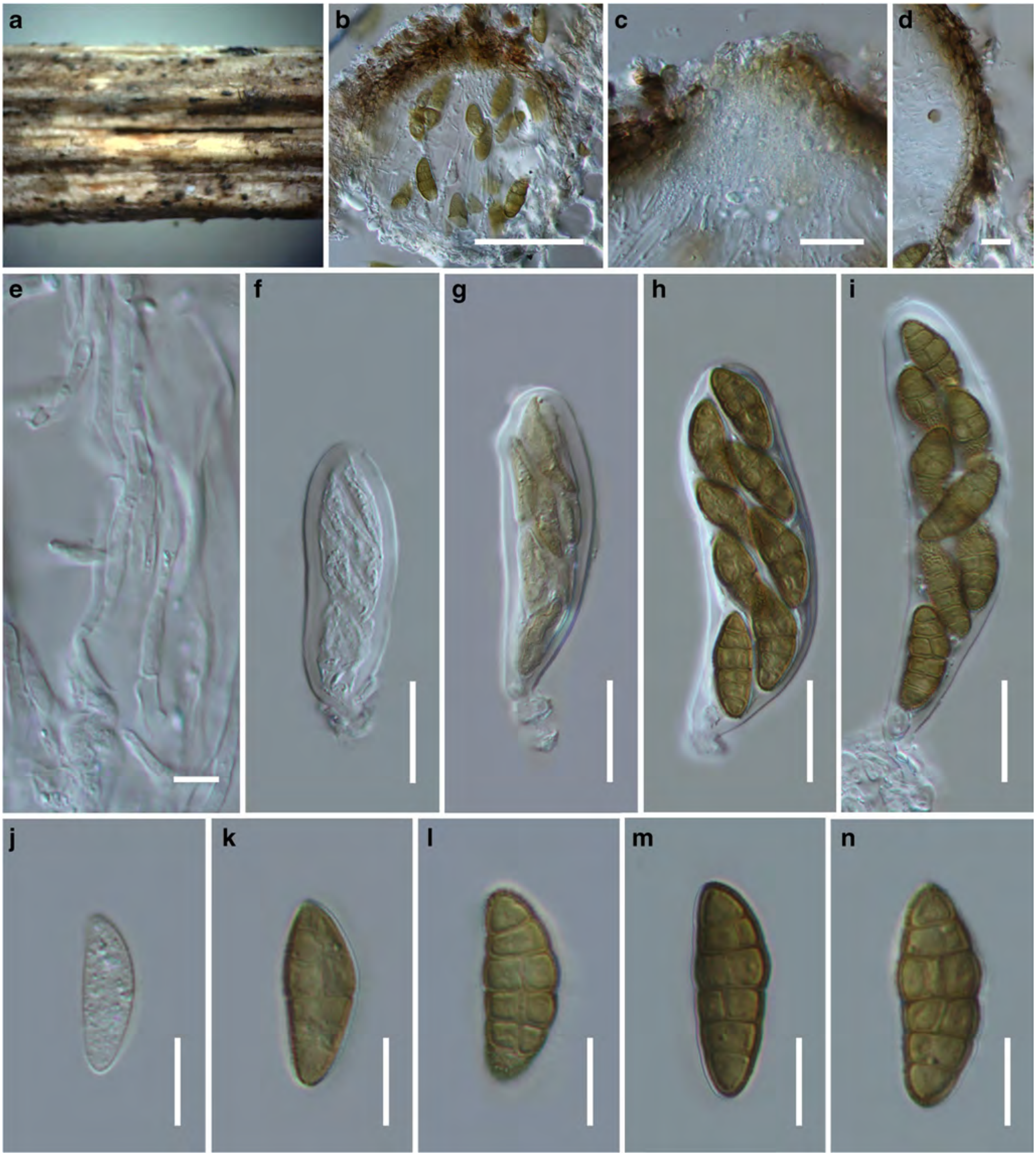
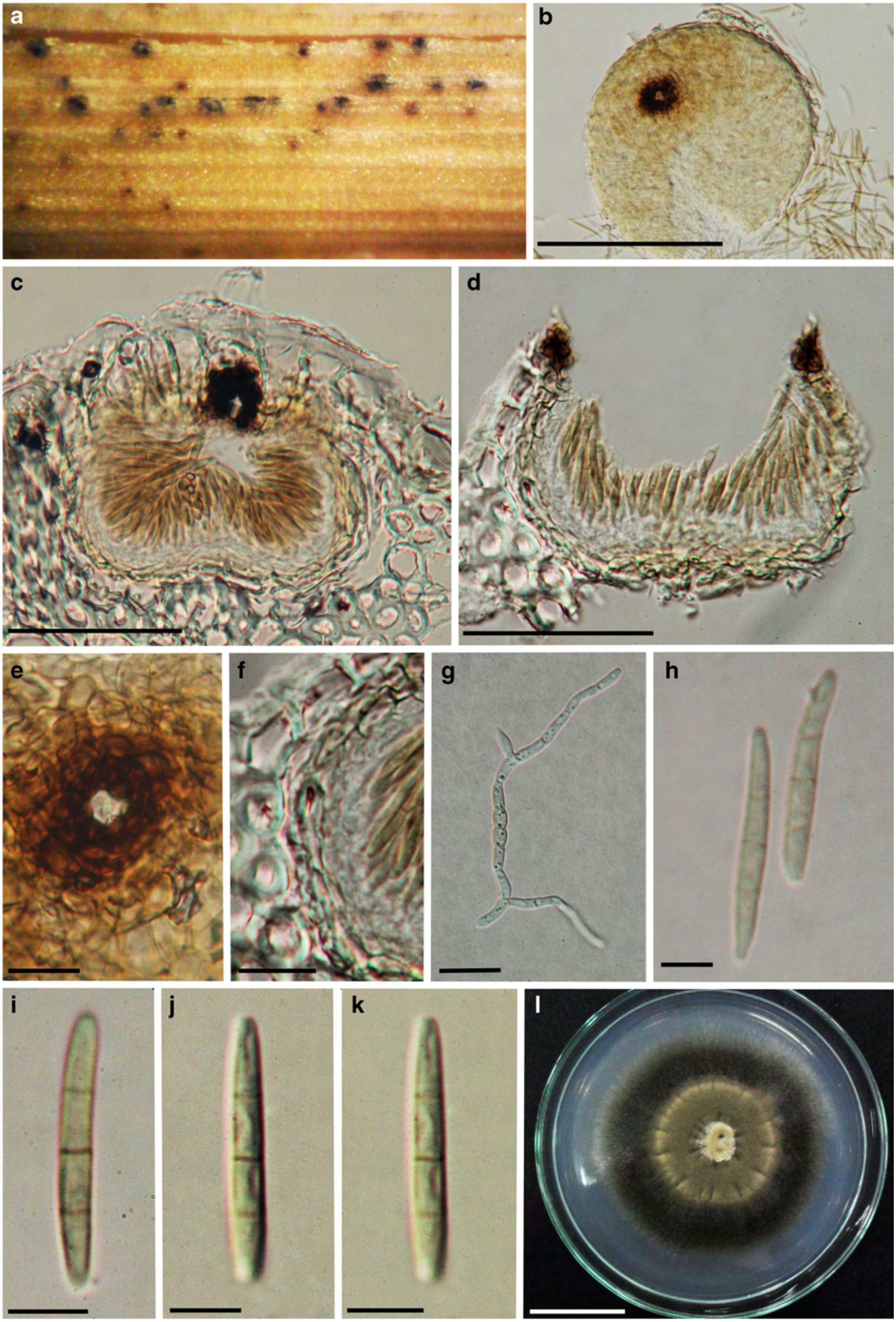


Fig. 42 *Allophaeosphaeria clematidis* (holotype). **a** Appearance of ascomata on host substrate. **b** Section of ascoma **c** Close up of ostiole **d** Peridium **e** Pseudoparaphyses **f**–**i** Asci **j**–**n** Ascospores. Scale bars: **b**=50 μm, **c**=20 μm, **d**=10 μm, **e**=5 μm, **f**–**i**=20 μm, **j**–**n**=10 μm

Etymology: In reference to the subcylindrical conidia.

Holotype: MFLU 15–0697

Saprobic on dead stem of *Dactylis glomerata* L. (*Poaceae*), forming conspicuous, small, rounded, black fruiting bodies. **Sexual morph**: Undetermined. **Asexual morph**: Coelomycetous. *Conidiomata* 65–70 μm high, 83–93 μm diam., pycnidial, solitary, gregarious or confluent, subepidermal, immersed to semi-immersed, globose, pale brown to brown, unilocular, ostiolate. *Wall of conidiomata* 6–11 μm wide, composed of 4–5-layers,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b
c
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◀ **Fig. 43** *Allophaeosphaeria subcylindrospora* (holotype) **a** Specimen showing appearance of taxon on host **b** Surface view of conidioma **c**, **d** Vertical section of conidioma with conidiogenous cells and developing conidia **e** Surface view of ostiole **f** Section of peridium **g** Germinating conidia **h**–**k** Conidia **l** Culture on PDA. Scale bars: **b**=100 μm, **c**–**d**=50 μm, **e**–**f**=10 μm, **g**=20 μm, **h**, **i**, **k**=5 μm, l=25 μm

thin-walled cells of *textura angularis*, with cells of outer 1–2 layers pale brown, gradually merging with inner 1–2 hyaline layers. *Ostiole* 5–7 μm wide, rounded, central, comprising dark brown to black cells. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, subcylindrical, hyaline, arising from inner region of conidiomata. *Conidia* 14–22×1.6–3.7 μm ($\bar{x}$ = 19×2.6 μm; *n*=30), fusiform to subcylindrical, with an obtuse and narrow apex, and a truncate base, pale brown, mostly 3-septate, occasionally 1-septate, not constricted at septa, thick-walled, smooth-walled.

Culture characteristics: Colonies on PDA flat, circular, with dull green margin, mouse-grey in the middle and pale mouse-grey at the center; reverse dull green.

Material examined: ITALY, Province of Trento [TN], Val di Sole, Cogolo, on dead stem of *Dactylis glomerata* (*Poaceae*), 30 June 2012, Erio Camporesi, IT-520 (MFLU 15–0697, **holotype**); ex-type living culture, MFLUCC 13-0380, KUMCC 15–0090; *ibid*. (KUN! HKAS 89500, **isotype**).

Notes: In the present paper, we introduce an asexual morph taxon, *A. subcylindrospora*, which is phylogenetically close to, but distinct from *A. muriformia* (Fig. 31). *Allophaeosphaeria* lacks any known asexual morph (Liu et al. 2015). *Allophaeosphaeria subcylindrospora* resembles *P. papayae* (Speg.) Quaedvl. et al. in having pycnidial, brown, globose conidiomata and subcylindrical, pale brown conidia with an obtuse apex, and truncate base. However, *A. subcylindrospora* is further characterized by cylindrical conidiogenous cells, and mostly 3-septate, occasionally 1-septate conidia, which are shorter than *P. papaya* (15–)26–32(−35)×(2.5–)3 μm (Quaedvlieg et al. 2013).

Dematiopleospora Wanasinghe et al., Crypt. Mycol. 35: 110 (2014)

Dematiopleospora was introduced by Wanasinghe et al. (2014) to accommodate *D. mariae* Wanasinghe et al. The genus is characterized by thick, brown, periphyses in the ostiole, superficial ascomata and muriform ascospores. Multigene phylogenetic analyses indicated that *Dematiopleospora* belongs to *Phaeosphaeriaceae* which forms a separate clade from *Phaeosphaeria* species and groups with *Chaetosphaeronema*, *Entodesmium*, *Loratospora* and *Nodulosphaeria* (Phookamsak et al. 2014; Wanasinghe et al. 2014; Fig. 40).

159. ***Dematiopleospora luzulae*** Wanasinghe, Camporesi, E.B.G. Jones & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551410; *Facesoffungi number*: FoF00949; Fig. 44

Etymology: Name reflects the host genus *Luzula* from which the species was collected.

Holotype: MFLU 15-1503

Saprobic on dead stem of *Luzula* sp. **Sexual morph**: *Ascomata* 140–160 μm high, 175–200 μm diam. ($\bar{x}$ = 148.4×184.5 μm, *n*=10), immersed, solitary, scattered, globose, brown to dark brown, coriaceous, fusing with the host tissue, ostiolate. *Ostiole* 25–40 μm high, 30–50 μm diam. ($\bar{x}$ = 29.5×36.2 μm, *n*=5), black, smooth, upper covering of ostiole, comprising short, light brown setae-like structures. *Peridium* 10–20 μm wide at the base, 10–15 μm wide at the sides, comprising 3–4 cell layers of thin-walled, brown cells of *textura angularis*, inwardly lighter. *Hamathecium* comprising numerous, 2–3 μm (*n*=30) wide, filamentous, branched, septate, pseudoparaphyses. *Asci* 70–80×15–20 μm ($\bar{x}$ = 76.4×18.1 μm, *n*=40), 8-spored, bitunicate, fissitunicate, cylindric-clavate, short pedicellate, rounded and thick-walled at the apex, with an ocular chamber. *Ascospores* 15–20×7–10 μm ($\bar{x}$ = 19.3×8.6 μm, *n*=50), overlapping biseriate, initially hyaline, becoming brown at maturity, ellipsoidal to oval, some curved, muriform with 4–6 transverse septate and 3–4 vertical septa, strongly constricted at the central septa, the two cells rows above the central septum wider, weakly constricted at the other septa, conical and narrowly rounded at the ends, surrounded by a thick, hyaline, mucilaginous sheath. **Asexual morph**: Undetermined.

Culture characteristics: Colonies on PDA reaching 30–35 mm diam. in 21 days, olivaceous-grey, spreading with moderate aerial mycelium, with smooth, even, margins; reverse iron-grey.

Material examined: ITALY, Trento Province, Mezzana, Marilleva 1400, on dead stem of *Luzula* sp. (*Juncaceae*), 1 August 2013, E. Camporesi (MFLU 15-1503, **holotype**); ex-type living culture, MFLUCC 14-0932.

Notes: *Dematiopleospora luzulae* is introduced as a second species of *Dematiopleospora* and has muriform ascospores similar to those characterized in *Pleospora* (Zhang et al. 2009a, b). *Dematiopleospora luzulae* resembles *D. mariae* in having brown, periphyses in the ostiole, a peridium comprising brown to dark brown cells of *textura angularis* and muriform ascospores, but differs in having ascospores without light end cells.

Entodesmium Riess, Hedwigia 1(6): 28 (1854)

Entodesmium was introduced by Reiss (1854) and is typified by *E. rude* Riess. *Entodesmium* is characterized by immersed, globose ascomata, and filiform, multi-septate

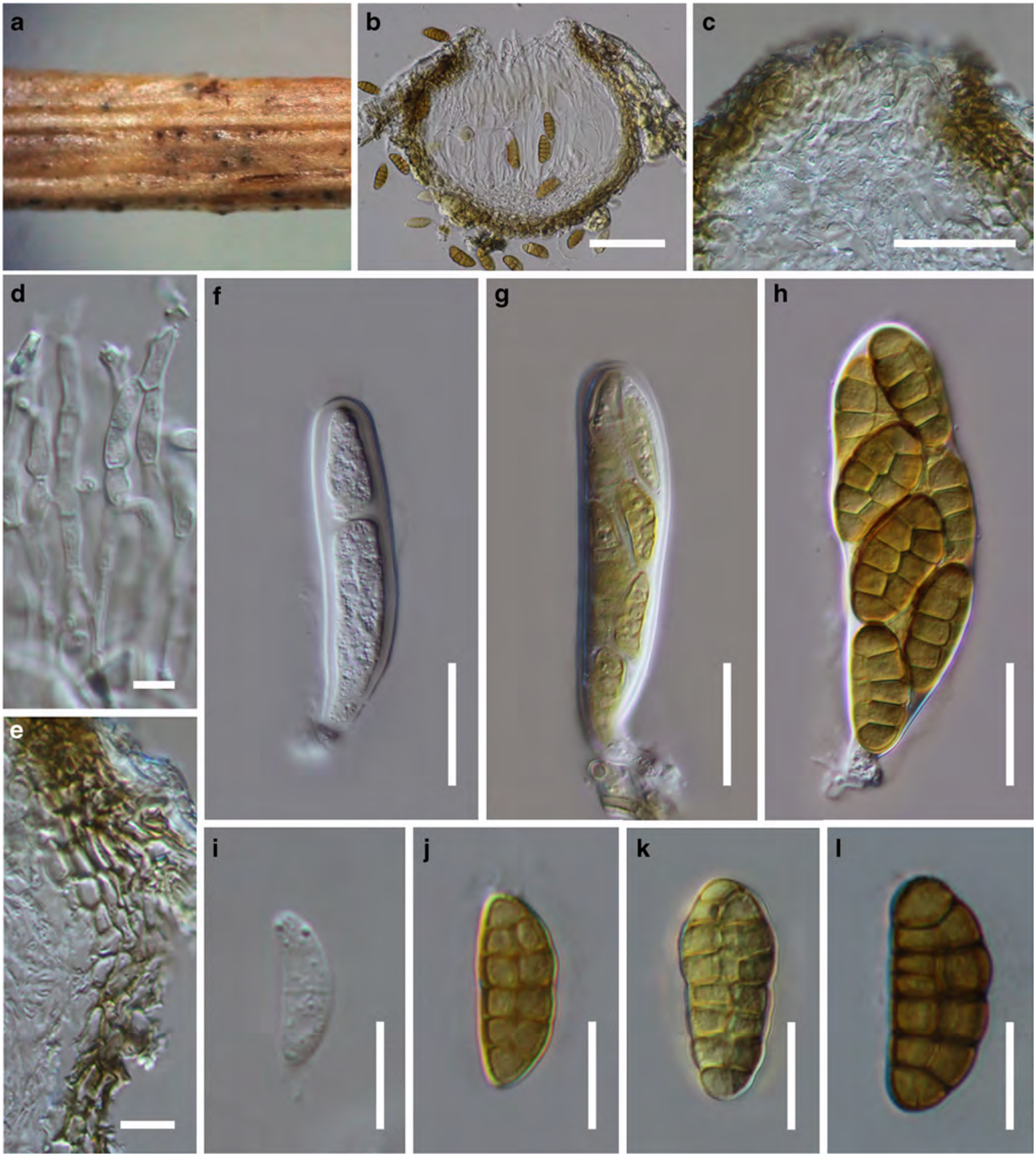


Fig. 44 *Dematiopleospora luzulae* (holotype). **a** Appearance of ascomata on host substrate **b** Section of ascoma **c** Close up of ostiole **d** Peridium **e** Pseudoparaphyses **f**–**h** Asci **i**–**m** Ascospores. Scale bars: **b**=50 μm, **c**=20 μm, **d**=10 μm, **e**=5 μm, **f**–**h**=20 μm, **i**–**m**=10 μm

ascospores, some breaking into part spores (Shoemaker 1984; Barr 1992a; Zhang et al. 2012a; Phookamsak et al. 2014). Our new species, *Entodesmium artemisiae* has a close phylogenetic relationship with *E. rude* (Fig. 40). However, our new species differs in host, ascomata, periphyses, asci and/or ascospore characters. No species of *Entodesmium* have been described from *Artemisia* sp. (Index Fungorum 2015).

160. ***Entodesmium artemisiae*** S. Konta, Bulgakov & K.D. Hyde. ***sp. nov.***

Index Fungorum number: IF551450; *Facesoffungi number*: FoF00950; Fig. 45

Etymology: The specific epithet refers to the host genus *Artemisia*.

Holotype: MFLU 15-0007

Saprobic on on dead stems of *Artemisia*. **Sexual morph**: *Ascomata* 205–292 μm wide, 177–258 μm high ($\bar{x}$ = 231.3 μm×207 μm), scattered, solitary, dark brown, semi-immersed to erumpent, subglobose, ostiolate. *Ostiole* lined with hyaline periphyses. *Peridium* 26–41 μm wide ($\bar{x}$ = 35.08 μm), comprising two strata, outer stratum comprising black, thick-walled, occluded cells, inner stratum comprising 3–4 layers of black, thick-walled cells of *textura angularis*. *Hamathecium* comprising numerous, 1.5–2.5 μm wide ($\bar{x}$ = 2 μm), filamentous, branched, septate pseudoparaphyses. *Asci* 80.5–112.5×9–14 μm ($\bar{x}$ = 95.6×11.22 μm, n=20), 8-spored, bitunicate, cylindric-clavate, pedicellate, apically rounded, with an ocular chamber. *Ascospores* 61.5–96.5×2.5–4 μm ($\bar{x}$ = 82.96×2.13 μm, n=40), fasciculate, initially hyaline, becoming yellowish brown to brown at maturity, filiform, slightly curved, widest and curved approximately 1/3rd from apex, 13–20-septate, lacking a sheath or appendages, not breaking into part spores. **Asexual morph**: Undetermined.

Culture characteristics: Colonies on MEA, reaching 5.5 cm diam. after 2 weeks at 16 °C, olive brown in the middle, yellowish white at the edges, and reverse olive brown at the margins, medium dense, irregular, flattened to slightly raised, with rough surface, crenated radiating margins, floccose to fairly fluffy, brown pigment produced in agar.

Material examined: RUSSIA, Rostov region, Shakhty City, Salty Hollow, stony steppe, dead stems of *Artemisia campestris* L., 3 June 2014, T. Bulgakov, T109 (MFLU 15-0007, **holotype**); ex-type living culture, MFLUCC 14-1156.

161. ***Galiicola*** Tibpromma, Camporesi & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551383; *Facesoffungi number*: FoF00923

Etymology: refers to the host genus from which the taxon was collected.

Saprobic on *Galium*. **Sexual morph**: *Ascomata* solitary, semi-immersed or slightly erumpent though the host surface, appearing as black dots on the host surface globose to subglobose, with a small central ostiole. *Ostiole* short, shiny, apapillate. *Peridium* composed of 3–5 layers of thin-walled, yellow to orange brown, flattened cells. *Hamathecium* comprising numerous 1.7–2.3 μm wide, filamentous, branched, anastomosing, septate pseudoparaphyses. *Asci* 8-spored, bitunicate, cylindric-clavate, with short pedicel, apex rounded an ocular chamber. *Ascospores* overlapping 1−3-seriate, initially hyaline, becoming orange brown at maturity, elongate fusiform, with 4–5 transverse septate, some with 1–2 vertical septa, constricted at central septum, cell above central septum slightly swollen. **Asexual morph**: Undetermined.

Type species: ***Galiicola pseudophaeosphaeria*** Tibpromma, Camporesi & K.D. Hyde

Notes: The genus *Galliicola* belongs in the family *Phaeosphaeriaceae* (Fig. 40) where it is basal to *Xenophoma*. The genus is unique in *Phaeosphaeriaceae* in having a peridium of 3–5 layers of thin-walled, yellow to orange brown, flattened cells and orange-brown ascospores.

162. ***Galiicola pseudophaeosphaeria*** Tibpromma, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551384; *Facesoffungi number*: FoF00924; Fig. 46

Etymology: Refers to the similarity to *Phaeosphaeria*.

Holotype: MFLU 15-1027

Saprobic on *Galium*. **Sexual morph**: *Ascomata* 109–137 μm high, 134–148 μm diam. ($\bar{x}$ = 127×142 μm, n=5), scattered or sometimes clustered, solitary, semi-immersed or slightly erumpent though the host surface, appearing as black dots on the host surface, globose to subglobose, with a central ostiole. *Ostiole* short, shiny, apapillate. *Peridium* 6–10 μm, a single stratum composed of 3–5 layers of thin-walled, yellow to orange brown, flattened cells. *Hamathecium* comprising numerous, 1.7–2.3 μm, filamentous, branched, anastomosing, septate pseudoparaphyses. *Asci* 45–62×7–9 μm ($\bar{x}$ = 53×8 μm, n=15), 8-spored, bitunicate, fissitunicate, cylindric-clavate, with short bulbous pedicel, apex rounded with an ocular chamber. *Ascospores* 15–18×3–5 μm ($\bar{x}$ = 16×4 μm, n=15), overlapping 1–3-seriate, initially hyaline, becoming orange brown at maturity, elongate fusiform with acute ends, some slightly curved, with 4–5 transversely septate, some with 1–2 vertical septa, constricted at the central septum, cell above central septum slightly swollen, lacking a mucilaginous sheath. **Asexual morph**: Undetermined.

Culture characteristics: on MEA reaching 2 cm diam. after 2 weeks at 16 °C, later with dense mycelium, with circular colony, rough entire margin, surface smooth but raised; hyphae septate, branched, hyaline to light-brown, thick-walled.

Material examined: ITALY, Forlì Province, Selva di Ladino, on dead stem of *Galium* sp. (*Rubiaceae*), 19 April 2014, E.

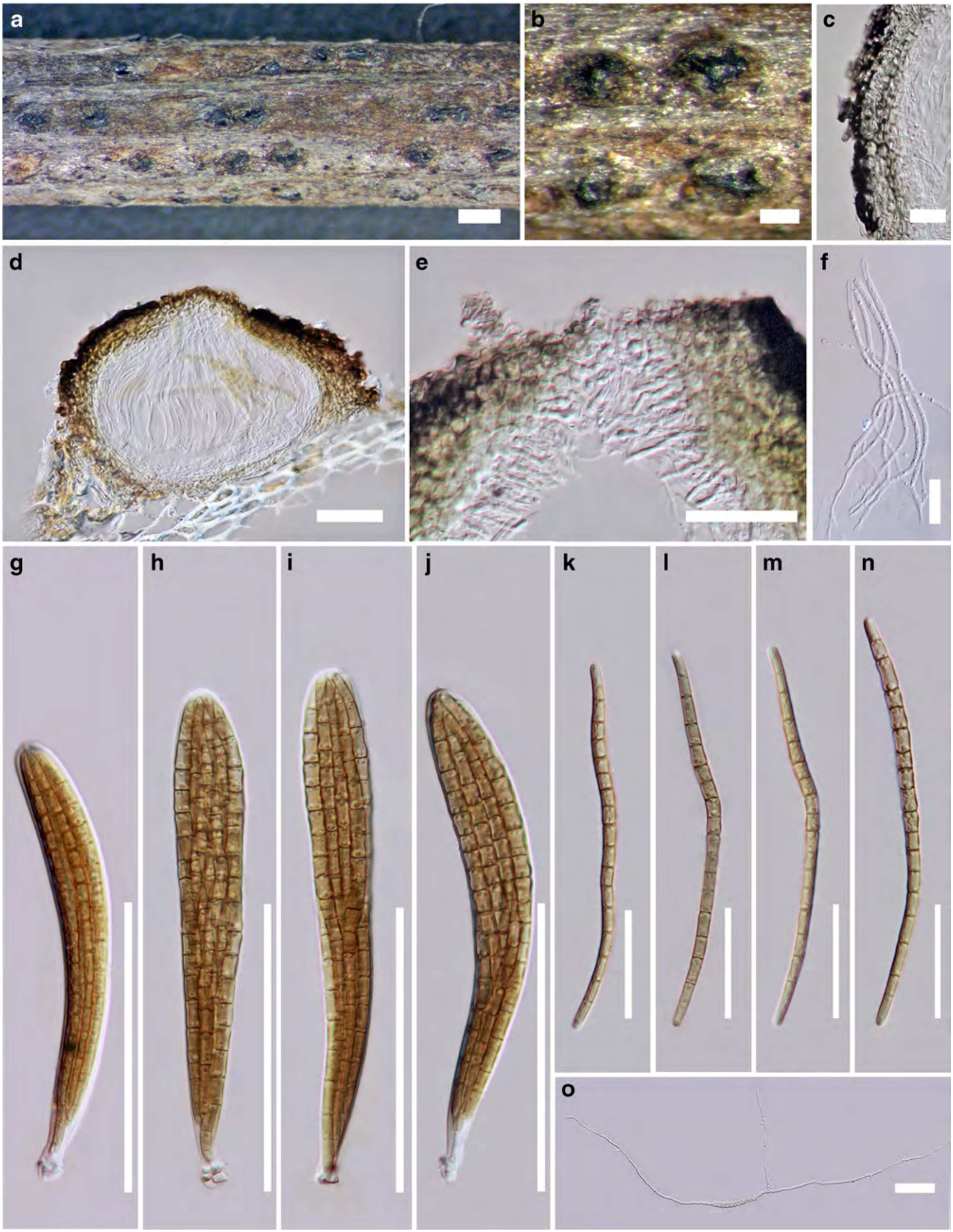


Fig. 45 *Entodesmium artemisiae* (holotype) **a** Appearance of ascomata on host substrate **b** Close up of ascomata which are erumpent through host epidermis **c** Cell arrangement of peridium **d** Section of ascoma **e** Periphyses **f** Pseudoparaphyses **g**–**j** Asci **k**–**n** Ascospores **o** Germinating ascospore. Scale bars: **a**=500 μm, **b**=200 μm, **c**=20 μm, **d**=50 μm, **e**–**f**=20 μm, **g**–**j**=50 μm, **k**–**n**=20 μm, **o**=50 μm

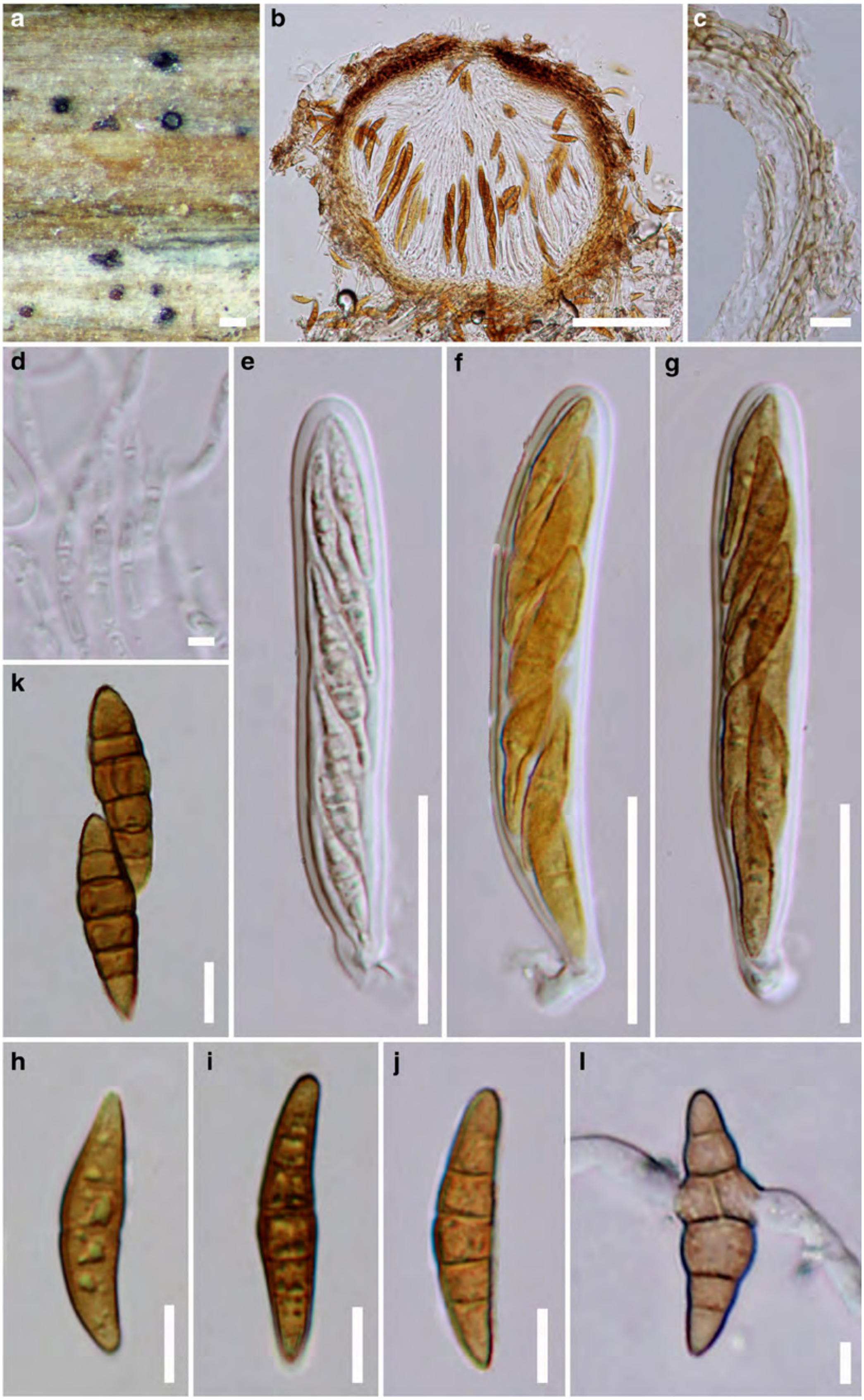


Fig. 46 *Galiicola pseudophaeosphaeria* (holotype) **a** Appearance of ascomata on host surface **b** Cross section of ascoma **c** Section of peridium **d** Pseudoparaphyses **e**–**g** Asci **h**–**k** Ascospores **l** Germinating ascospore. Scale bars: **a**=200 μm, **b**=50 μm, **c**=10 μm, **d**=2 μm, **e**–**g**=20 μm, **h**–**l**=5 μm

Camporesi IT1916 (MFLU 15-1027, **holotype**); ex-type living culture, MFLUCC 14-0524; *ibid*. (MFLU 15-1487, KUM, **isotypes**); (MFLU 15-1498bis, MFLU 15-1499tris, **paratypes**).

163. ***Loratospora luzulae*** Jayasiri, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum Number: IF551325; *Facesoffungi number*: FoF00882; Fig. 47

Etymology: In reference to host genus.

Holotype: 15-1394

Saprobic on dead stem of *Luzula nivea* (*Juncaceae*). **Sexual morph**: *Ascomata* 112–120×93–100 μm (x̄ = 98×115 μm, *n*=5), scattered to clustered, solitary, immersed, visible as small, black spots on the host surface, uni-loculate, globose to subglobose, glabrous, brown to dark brown, ostiole central, with a minute papilla containing hyaline periphyses. *Peridium* 8–20 *μm* wide, of unequal thickness, thickened at the apex, composed of several layers of brown to dark brown, pseudoparenchymatous cells, arranged in a *textura globulosa. Hamathecium* of 1.5–2 *μm* wide, septate, long, cellular pseudoparaphyses, embedded in a gelatinous matrix. *Asci* 64–75×14–16 μm (x̄ = 70×15 μm, *n*=10), 8-spored, bitunicate, fissitunicate, short pedicellate, apically rounded and thick-walled, with an ocular chamber. *Ascospores* 14–19×4–7 μm (x̄ = 16×4.6 μm, *n*=30), overlapping 2–4-seriate, initially hyaline to subhyaline, pale yellowish at maturity, fusiform with rounded ends, 3-septate, slightly curved, constricted at the septa, wall rough, surrounded by a mucilaginous sheath. **Asexual morph**: Undetermined.

Culture characteristics: Ascospores germinating on MEA within 36 h. Colonies growing on MEA, slow-growing, reaching 0.5 mm diam. in 1 week at 28 °C. Mycelium superficial, felty, grey.

Material examined: ITALY, Province of Forlì-Cesena [FC], Campigna-Santa Sofia, on dead stems of *Luzula nivea* (Nathh.) DC (*Juncaceae*), 8 June 2014, E. Camporesi, IT 1918 (MFLU 15-1394, **holotype**, BBH), ex-type living culture MFLUCC 14-0826, BCC.

Notes: *Loratospora* was introduced by Kohlmeyer and Volkmann-Kohlmeyer (1993) as a monotypic genus, with *Loratospora aestuarii* Kohlm. & Volkm.-Kohlm. Suetrong et al. (2009) transferred *Loratospora* to *Phaeosphaeriaceae* based on phylogenetic data, whereas based on morphology it had previously been placed in *Planistromellaceae* (Barr 1996). This group was not well-resolved in Phookamsak et al. (2014). In this study we introduce a new species to the genus because it is morphologically and phylogenetically different to *Loratospora aestuarii. Loratospora luzulae* forms a separate branch with *Loratospora aestuarii* in the phylogenetic analysis (Fig. 40).

Nodulosphaeria Rabenh., Klotzschii Herb. Viv. Mycol., Edn 2: no. 725 (in sched.) (1858)

Nodulosphaeria was established by Rabenhorst (1858) to accommodate species with ascomata with setae in the papilla and ascospores with three or more transverse septa with an enlarged cell near to the apex (Barr 1992; Holm 1961). The genus was previously considered as a synonym of *Leptosphaeria* (Clements and Shear 1931). However, Holm (1957) reinstated the genus *Nodulosphaeria* and *N. hirta* Rabenh. was selected as the type species (Zhang et al. 2012a; Phookamsak et al. 2014). Identification of species belonging in this genus has been complicated due to the unavailability of molecular data (Shoemaker 1984; Zhang et al. 2012a; Ariyawansa et al. 2014c; Phookamsak et al. 2014). There are 64 epithets listed under *Nodulosphaeria* (Index Fungorum 2015), but sequence data is available for only a single species in GenBank (Phookamsak et al. 2014).

164. ***Nodulosphaeria senecionis*** Chethana, Camporesi, E.B.G. Jones & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551310; *Facesoffungi number*: FoF: 00871; Fig. 48

Etymology: The specific epithet *senecionis* is named after the host *Senecio* from which the taxon was collected.

Holotype: MFLU 15–1297

Saprobic on dead stems of *Senecio* spp. **Sexual morph**: *Ascomata* 189–275 μm high (including papilla), 257–299 μm diam. (x̄ = 238.31×284.06 μm, *n*=10), scattered, solitary, semi-immersed to superficial, dark brown to black, globose to subglobose, wall rough, with hairs at the base, ostiole central, papillate. *Papilla* 36–47 μm high, 30–38 μm diam. (x̄ = 34.1×39.9 μm, *n*=10), protruding from substrate if immersed, with numerous, brown to dark brown, 25–40 μm long setae. *Peridium* 37–59 μm thick at side walls, up to 45–79 μm thick near the apex and 36–66 μm thick at the base, composed of 4–5 layers of thick-walled, dark brown cells of *textura globularis. Hamathecium* composed of numerous, 2–3 μm broad, filiform, anastomosing, septate, pseudoparaphyses, embedded in a gelatinous matrix. *Asci* 33–113×4–14 μm (x̄ = 82.93×10.89 μm, *n*=20), 8-spored, bitunicate, fissitunicate, cylindric-clavate, short pedicellate, apically rounded, with an ocular chamber. *Ascospores* 30–45×3–5 μm (x̄ = 38.39×4.22 μm), overlapping biseriate to tri-seriate, initially hyaline, becoming yellowish brown at maturity, long fusiform to almost cylindrical, enlarged at the third cell from the apex, tapering towards the rounded ends, 8-septate, slightly curved, constricted at the third septum, smooth-walled, with small guttules and small, curved, cylindrical

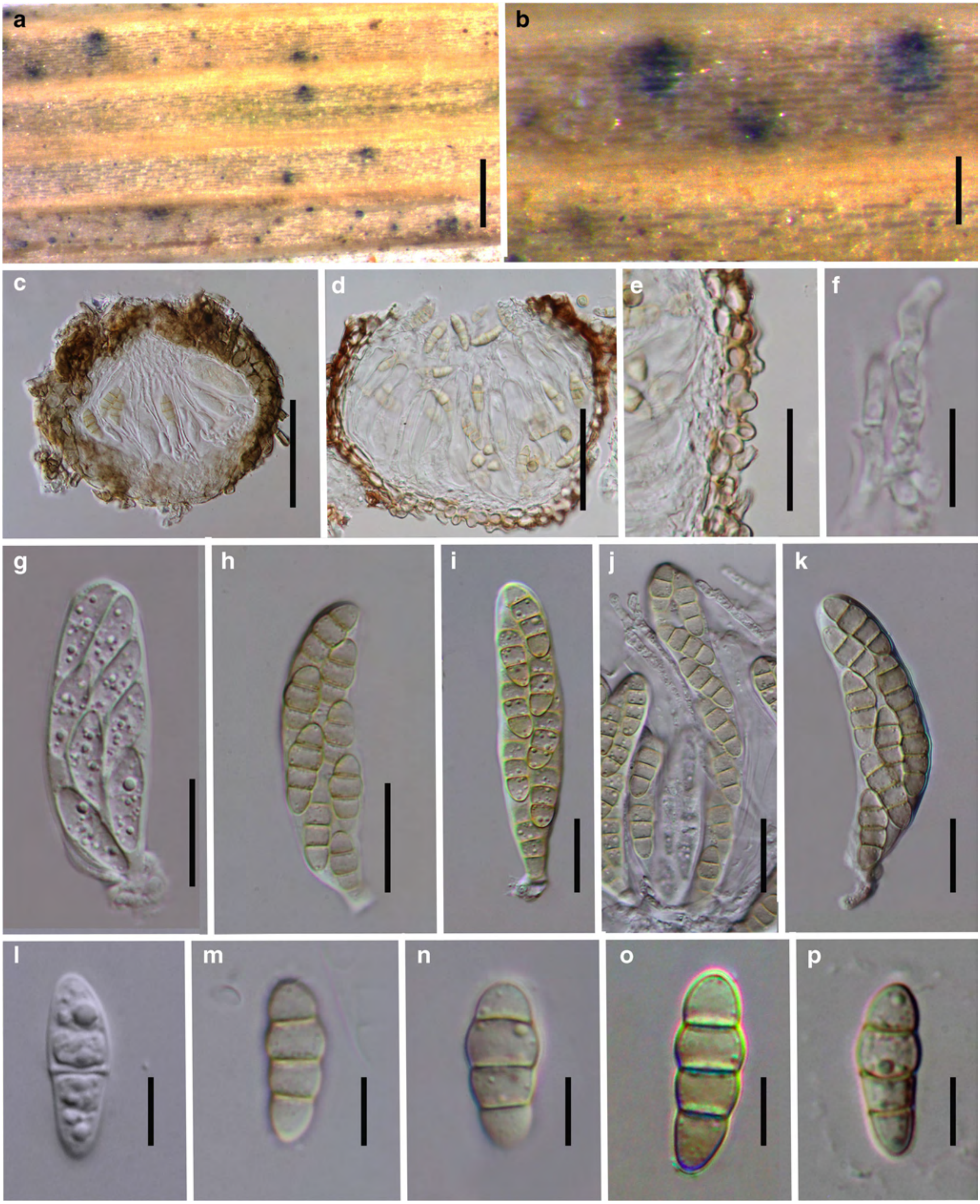


Fig. 47 *Loratospora luzulae* (holotype) **a**, **b** Appearance of ascomata on host surface **c**, **d** Section through ascomata **e** Peridium **f** Pseudoparaphyses **g** Immature ascus **h**–**k** Mature asci **l**–**p** Ascospores. Scale bars: **a**=400 μm, **b**=100 μm, **c**, **d**=50 μm, **e**, **g**–**k**=30 μm, **l**–**p**, **f**=5 μm

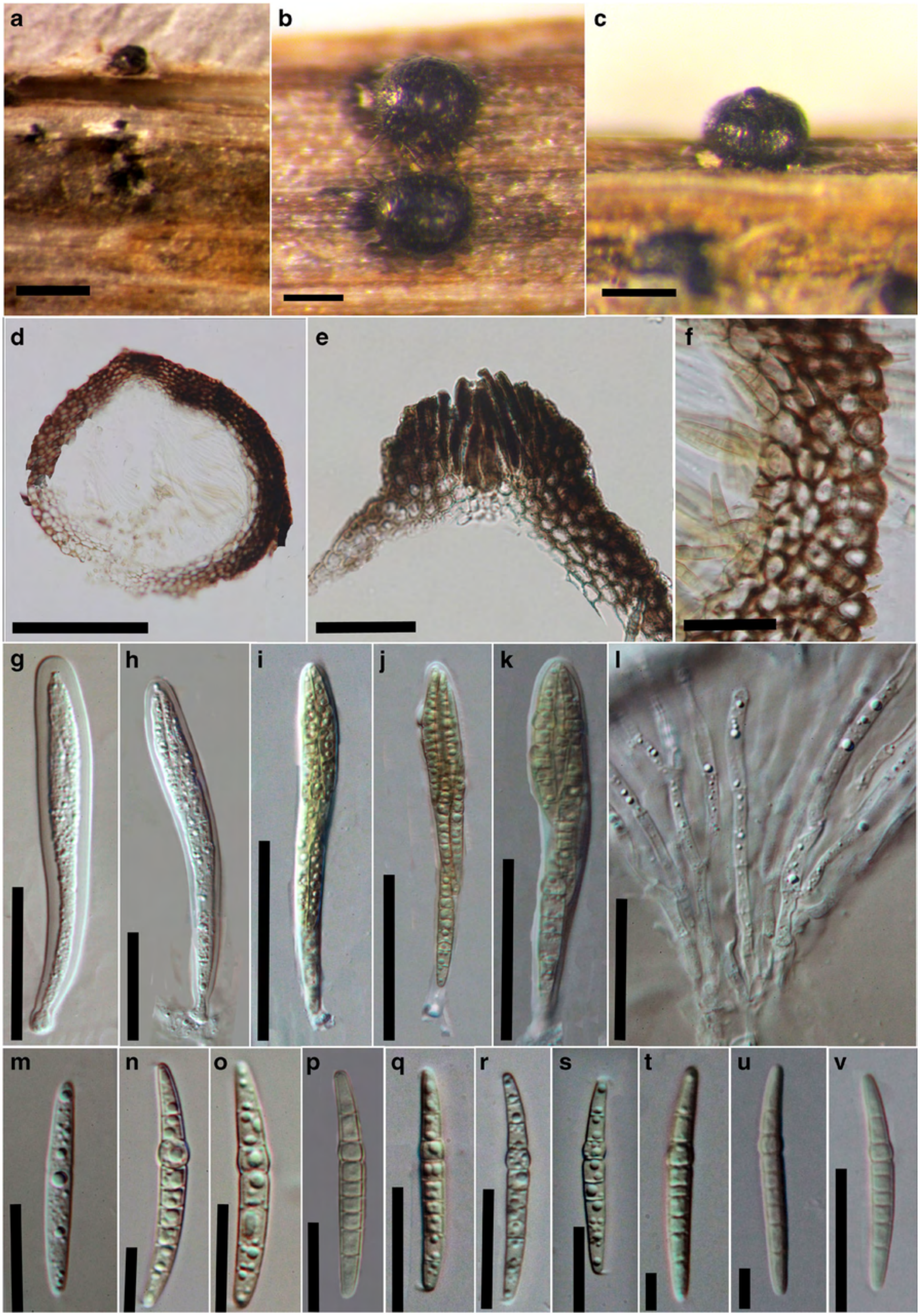


Fig. 48 *Nodulosphaeria senecionis* (holotype) **a**, **b** Appearance of ascomata on the host substrate **c** Close up of ascoma **d** Section of the ascoma **e** Section of the ostiole with setae **f** Peridium **g**, **h** Immature asci **i**–**k** Mature asci **l** Hamathecium of septate, cellular pseudoparaphyses **m** Immature hyaline ascospore **n**–**v** Mature hyaline to yellowish brown ascospores. Scale bars: **a**=500 μm, **b**, **c**=200 μm, **d**=100 μm, **e**= 25 μm, **f**, **m**–**v**=10 μm, **g**–**k**=20 μm, **l**=5 μm

appendages at both ends. **Asexual morph**: Undetermined.

Material examined: ITALY, Forlì-Cesena Province, Fiumicello-Premilcuore, on dead stem of *Senecio* sp. (*Asteraceae*), 12 May 2013, E. Camporesi (MFLU 15–1297, **holotype**); *ibid*. (**isotype** in BBH); on dead stem of *Senecio* sp., 3 June 2013, E. Camporesi (MFLU 15–1312, **paratype**); ITALY. Province of Forlì-Cesena, Fiumicello-Premilcuore, on a dead stem of *Centaurea* sp. (*Asteraceae*), 8 July 2013, E. Camporesi (MFLU 15–1313).

Notes: Based on our phylogenetic analyses (Fig. 40) and morphological comparison, our isolate belongs in *Nodulosphaeria* in *Phaeosphaeriaceae*. *Nodulosphaeria senecionis* is distinct from *N. hirta* in having larger ascospores. *Nodulosphaeria pellita* (Fr.) Shoemaker, *N. octoseptata* (Wehm.) L. Holm, *N. derasa* (Berk. & Broome) L. Holm and *Leptosphaeria senecionis* (Fuckel) G. Winter have also been isolated from *Senecio* sp. and should be compared. *Nodulosphaeria pellita* and *N. octoseptata* differ from *N. senecionis* in having larger ascomata, longer ascospores constricted at the first septum, and with the fourth cell from the apex being enlarged (Shoemaker 1984). *Nodulosphaeria derasa* differs from *N. senecionis* in having ascospores, which are constricted at the first septum and with the fourth cell from the apex being enlarged (Shoemaker 1984). *Leptosphaeria senecionis* differs from *Nodulosphaeria senecionis* in having 3-septate, hyaline ascospores (Saccardo 1884). *Nodulosphaeria centaureae* differs from *N. senecionis* in having 6-septate ascospores (Shoemaker 1984).

Ophiosphaerella Speg., *Anal. Mus. nac. B. Aires*, Ser. 3 12: 401 (1909)

Ophiosphaerella is a confused genus lacking sequence data for the type species in GenBank (Phookamsak et al. 2014) with 11 species listed in Index Fungorum (2015). Sequence data is available for *Ophiosphaerella agrostidis* Dern et al. and *Ophiosphaerella herpotricha* (Fr.) J. Walker and our new species cluster with these taxa (Fig. 40).

165. ***Ophiosphaerella aquaticus*** Z.L. Luo, H.Y. Su & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551441; *Facesoffungi number*: FoF00951; Fig. 49

Etymology: With reference to the aquatic habitat.

Holotype: MFLU 15–0071

Saprobic on decaying wood submerged in freshwater. **Sexual morph**: *Ascomata* 420–470 μm high, 265–360 μm diam., scattered, solitary, immersed to semi-immersed or erumpent through host tissue, with minute papilla, visible as raised, small black dots on host surface, uni-loculate, pyriform, pilous, dark brown to black, ostiole central, with periphyses. *Peridium* 20–37 μm wide, of unequal thickness, composed of several layers of pseudoparenchymatous cells, outer part comprising dark brown, occluded thickened cells, fusing with the host, inner part comprising several layers of thin-walled, flattened, brown-walled cells. *Hamathecium* composed of numerous, 3–6 μm wide, filamentous, septate pseudoparaphyses, embedded in a mucilaginous matrix, anastomosing at the apex. *Asci* 146–174×10–12.5 μm ($\bar{x}$ = 160×11 μm, *n*=20), 8-spored, bitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded, with an ocular chamber. *Ascospores* 143–162×2.5–3.5 μm ($\bar{x}$ = 152.5×3 μm, *n*=20), fasciculate, scolecosporous, parallel or spiral, filiform, pale brown to brown, aseptate, smooth-walled. **Asexual morph**: Undertermined.

Material examined: THAILAND, Chiang Mai Province, saprobic on decaying wood submerged in a stream, November 2013, Z.L. Luo ZL-4 (MFLU 15–0071, **holotype**), ex-type culture, MFLUCC 14-0033, KIBCC, DLUCC; *ibid*. (HKAS 86446, **isotype**).

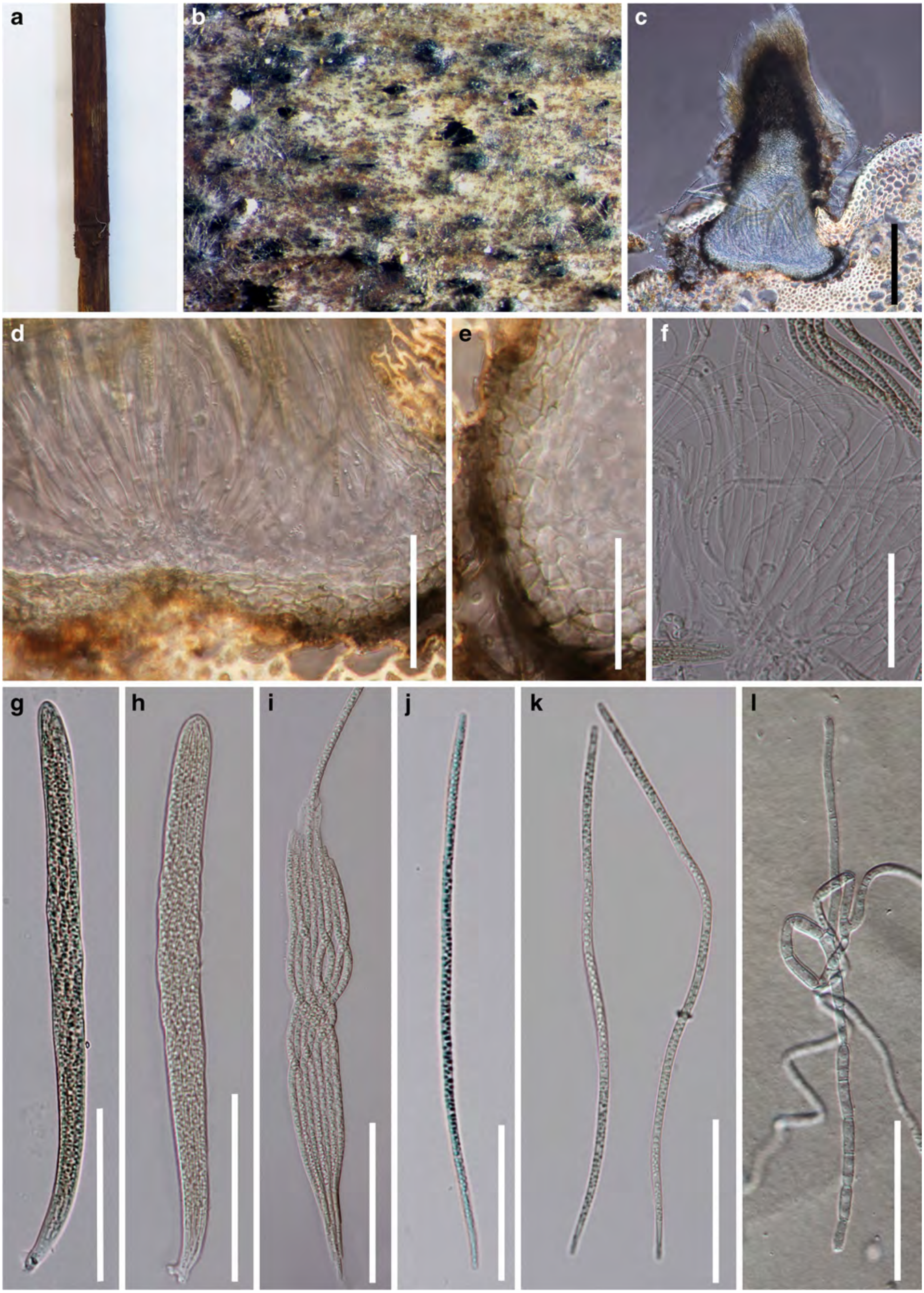
Notes: This scolecosporous *Ophiosphaerella* species was collected from a decaying stem of bamboo submerged in freshwater in Thailand. *Ophiosphaerella aquaticus* is characterized by semi-immersed, ascomata with a central ostiole, and filiform ascospores. In the phylogenetic analysis, *O. aquaticus* clusters with *O. agrostidis* in the family *Phaeosphaeriaceae* but in a distinct clades. *Ophisphaerella aquaticus* is compatible with *O. agrostidis*. However, *O. aquaticus* differs in having a pyriform ascomata, larger aseptate ascospores and in its aquatic habit (Phookamsak et al. 2014).

166. ***Populocrescentia*** Wanasinghe, E.B.G. Jones & K.D. Hyde, ***gen. nov.***

Index Fungorum number: IF551411; *Facesoffungi number*: FoF00952

Etymology: from the Latin crescit, meaning growing on, referring to its ecological habit, growing on *Populus*.

Saprobic on dead herbaceous branches in terrestrial habitats. **Sexual morph**: *Ascomata* solitary, scattered, immersed to semi-erumpent, globose or subglobose, dark brown to black, coriaceous, cupulate when dry, ostiolate. *Ostiole* papillate, black, smooth, ostiolar canal filled with sparse periphyses. *Peridium* comprising 6–8 layers, outer part heavily pigmented, thick-walled, comprising blackish to dark brown cells of *textura angularis*, inner part composed of hyaline, thin-walled cells of *textura angularis*. *Hamathecium* comprising 2–3 μm wide, filamentous,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◀ **Fig. 49** *Ophiosphaerella aquaticus* (holotype). **a** Host specimen **b** Ascomata on submerged wood **c** Section of ascoma **d**, **e** Section through peridium **f** Pseudoparaphyses **g**–**i** Asci **j**–**k** Ascospores **l** Germinating ascospore. Scale bars: **c**=150 μm, **d**=50 μm, **e**–**f**=30 μm, **g**–**l**=50 μm

branched septate, cellular pseudoparaphyses. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, short pedicellate, rounded and thick-walled at the apex, with a minute ocular chamber. *Ascospores* overlapping 1–2-seriate, initially hyaline, becoming yellowish brown at maturity, broad fusiform, muriform, deeply constricted at the middle septum, slightly constricted at the remaining septa. **Asexual morph**: Undetermined.

Type species: ***Populocrescentia forlicesenensis*** Wanasinghe, Camporesi, E.B.G. Jones & K.D. Hyde

Notes: *Populocrescentia* is introduced as a new genus in the family *Phaeosphaeriaceae* with *P. forlicesenensis* as the type species. Both morphology and phylogeny (Fig. 40) indicate this is a distinct genus from *Dematiopleospora* and *Allophaeosphaeria* (Wanasinghe et al. 2014; Liu et al. 2015). *Allophaeosphaeria* differs from *Populocrescentia* in its peridium structure and papillate ostioles. *Populocrescentia* shares most similarities with *Dematiopleospora* in having flat, cupulate, globose to subglobose ascomata, a minute papilla, cylindrical asci and muriform ascospores. *Dematiopleospora* however, differs from *Populocrescentia* in having a wide, brown, periphysate ostiole, subfusiform ascospores with the upper part widest and light end cells. This is also phylogenetically supported as *Populocrescentia forlicesenensis* forms a distant clade from these taxa (Fig. 40).

167. ***Populocrescentia forlicesenensis*** Wanasinghe, Camporesi, E.B.G. Jones & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551412; *Facesoffungi number*: FoF00953; Fig. 50

Etymology: Name reflects the locality, Forlì-Cesena Province, where this species was collected.

Holotype: MFLU 15-1504

Saprobic on dead herbaceous branches of *Populus nigra* L. **Sexual morph**: *Ascomata* 150–270 μm high, 200–250 μm diam. ($\bar{x}$ = 213×234.7 μm, *n*=10), superficial, solitary, scattered, broadly oval, dark brown to black, coriaceous, cupulate when dry, ostiolate. *Ostiole* 30–60 μm high, 25–50 μm diam. ($\bar{x}$ = 45×38.3 μm, *n*=5), papillate, black, smooth, with short, light brown setae. *Peridium* 10–20 μm wide at the base, 20–35 μm wide at the sides, comprising 6–8 layers, outer part heavily pigmented, thick-walled, comprising blackish to dark brown cells of *textura angularis*, inner part composed of hyaline, thin-walled cells of *textura angularis. Hamathecium* comprising numerous, 2–3 μm (*n*=30) wide, filamentous, branched, septate, pseudoparaphyses. *Asci* 90–110×14–20 μm ($\bar{x}$ = 100.5×16.5 μm, *n*=40), 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, pedicellate, rounded and thick-walled at the apex, with an ocular chamber. *Ascospores* 17–22× 8–10 μm ($\bar{x}$ = 19.7×8.7 μm, *n*=50), overlapping 1–2-seriate, initially hyaline, becoming yellowish brown at maturity, broadly fusiform, lower part of spore longer, muriform, with 4–6 transverse septa and 3–4 vertical septa, constricted at the central septum, cells above central septum slightly swollen, weakly constricted at the other septa, ends conical, basal cell often lighter, lacking a mucilaginous sheath. **Asexual morph**: Undetermined.

Culture characteristics: Colonies on PDA reaching 30–35 mm diam. in 21 days, greenish-grey in the centre, with dirty white outer region, spreading with moderate aerial mycelium, and smooth, even margins; reverse rust coloured.

Material examined. ITALY, Forlì-Cesena Province, Bleda in Santa Sofia, dead and hanging branches of *Populus nigra* (*Salicaceae*), 11 October 2013, E. Camporesi (MFLU 15-1504, **holotype**), ex-type living culture, MFLUCC 14-0651.

168. ***Vagicola*** Chethana & K.D. Hyde, ***gen. nov.***

= *Phaeosphaeria* subgen. *Vagispora* Shoemaker & Babcock, Can. J. Bot. 67: 1500–1599 (1989)

Index Fungorum number: IF551346; *Facesoffungi number*: FoF: 00908.

Etymology: The subgenus *Vagispora* is moved to genus rank.

Saprobic on grass stems. **Sexual morph**: *Ascomata* scattered, immersed, mostly subepidermal, broadly ellipsoidal to globose, smooth-walled. *Papilla* central, terete, flush to papillate, intraepidermal, composed of brown polygonal cells around ostiole, lacking periphyses. *Peridium* surface composed of cells of *textura angularis*, lateral layers uniform, thick, composed of brown cells of *textura prismatica. Hamathecium* composed of numerous, 1–3 μm wide, pseudoparaphyses, with thin septa, and with slime coating. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical, pedicellate. *Ascospores* overlapping biseriate, yellowish brown, with L/W greater than or equal to 3, narrowly fusiform, enlarged at the third cell from the apex, multi-septate, straight or slightly curved, slightly constricted at the first septum, not constricted at other septa, with a prominent

Fig. 50 *Populocrescentia forlicesenensis* (holotype). **a** Ascomata on host substrate **b** Section of ascoma **c** Peridium **d** Pseudoparaphyses **e**–**h** Asci **i**–**m** Ascospores. Scale bars: **a**=500 μm, **b**=50 μm, **c**=20 μm, **d**=10 μm, **e**–**h**=20 μm, **i**–**m**=10 μm

sheath (description modified from Shoemaker and Babcock (1989)). **Asexual morph**: Undetermined.

Type species: ***Vagicola vagans*** (Niessl) O. Eriksson, Chethana & K.D. Hyde

Notes: The subgenus *Vagicola* (Shoemaker and Babcock 1989) is raised to generic rank to accommodate *Phaeosphaeria vagans*. In various molecular studies (Zhang et al. 2012a; Hyde et al. 2013; Phookamsak et al. 2014), as well as in the present study (Fig. 40) a strain of this taxon (CBS 604. 86) clustered away from *Phaeosphaeria sensu stricto*. This strain was isolated from *Calamagrostis arundinacea* (*Poaceae*) in Sweden by K. & L. Holm. Other collections linked to this strain (CBS 604. 86) is ETH 9280. Another voucher material for this strain has been isolated from *Ammophila arenaria* (*Poaceae*), Skåne, Åhus par., Yngsjö, Sweden by K. & L. Holm on 15 April 1989. The herbarium material is stored in UPS herbarium (UPS:BOT:F–169873) and cultures are deposited at CBS 114119, UPSC 2908 and UPSC 2907.

169. ***Vagicola vagans*** (Niessl) O. Eriksson, Chethana & K.D. Hyde, ***comb. nov.***

Index Fungorum number: IF551347; *Facesoffungi number*: FoF: 00909.

Basionym: *Pleospora vagans* Niessl, Verh. Naturf. Ver. Briinn 14: 174. 1876

≡ *Phaeosphaeria vagans* (Niessl) O.E. Erikss., Ark. Bot. 6: 430 (1967)

Saprobic on grass stems. **Sexual morph**: *Ascomata* 130–180 μm high, 250–350 μm diam., scattered, immersed, subepidermal, smooth, brown mycelium ramifying in the host tissue, broadly ellipsoidal to globose, smooth-walled. *Ostiole* papillate, 15–30 μm long, 20–25 μm wide, central, terete, flush to papillate, intraepidermal, of 2–6 layers of brown polygonal 4–7 × 3–6 μm cells around 10–50 μm diam., ostiole without periphyses. *Peridium* surface composed of cells of *textura angularis*, lateral layers uniform, 12–18 μm thick, composed of brown, 3–6 layers of *textura prismatica*, 6–11 × 3–5 μm pseudoparenchymatous cells, thicker above the smaller darker cells. *Hamathecium* composed of numerous, 1–3 μm broad, paraphyses with thin septa at 10–to 30 μm intervals without guttules and with thin copious slime coating. *Asci* 60–110 × 12–20 μm, 8-spored, bitunicate, fissitunicate, numerous, cylindrical and short pedicellate. *Ascospores* 23–28 × 8–10 μm (L/W 3), overlapping biseriate, yellowish brown, narrowly fusiform, enlarged at the third cell from the apex, 5-septate, straight or slightly curved, slightly constricted at the first septum which is sub-median, not constricted at the other septa, smooth-walled, without guttules and with a prominent sharply delimited 2–8 μm mucilaginous sheath (description from Shoemaker and Babcock 1989). **Asexual morph**: Undetermined.

Illustrations: Shoemaker and Babcock 1989

Pleosporaceae Nitschke

Multi-gene phylogenetic analyses have shown that the familial placement of *Pleosporaceae* with respect to other families in order *Pleosporales* is valid (Hyde et al. 2013; Ariyawansa et al. 2015). Taxa in *Alternaria*, *Bipolaris*, *Stemphylium* and phoma-like species are more common asexual morphs in *Pleosporaceae* and can be saprobic or parasitic on various hosts (Ariyawansa et al. 2015). Ariyawansa et al. (2015) accepted 22 genera in the family based on the analysis of combined 18S nrDNA, 28S nrDNA, ITS, GAPDH, RPB2 and EF sequence data.

Alternaria Nees, Syst. Pilze (Würzburg): 72 (1816) [1816–17]

Notes: *Alternaria* was introduced by Nees (1816) and is a ubiquitous genus that comprises saprobic, endophytic and pathogenic species, associated with a wide variety of substrates (Woudenberg et al. 2013; Ariyawansa et al. 2015). Based on analysis of combined GAPDH, RPB2 and EF sequence data, Woudenberg et al. (2013) and Ariyawansa et al. (2015) concluded that the *Alternaria* clade contains 24 internal clades and six monotypic lineages, the grouping of which are recognised as *Alternaria*.

Alternaria ethzedia was introduced by Simmons (1986) and named as the sexual morph *Lewia ethzedia*. Our strain (MFLUCC 13–0404) groups together with the type strain of *Alternaria ethzedia* (CBS 197.86) in section *Infectoriae* and our collection is from the same host genus (*Brassica*) as the holotype. Therefore we treat our isolate as *A. ethzedia* (≡ *Lewia ethzedia*) and illustrate the sexual morph here which has not been previously well-illustrated. *Alternaria ethzedia* is similar to *A. murispora* Ariyawansa & K.D. Hyde in having (4–6–)8-spored asci, ellipsoid to fusoid, muriform, brown ascospores with a mucilaginous sheath, but they differ as *A. murispora* has a two-layered peridium with heavily pigmented to hyaline cells and pale, dark brown ascospores which are constricted at the three major septa (Fig. 51).

170. ***Alternaria ethzedia*** E.G. Simmons, Mycotaxon 25(1): 300 (1986)

≡ *Lewia ethzedia* E.G. Simmons, Mycotaxon 25(1): 299 (1986)

Facesoffungi number: FoF00918; Fig. 52

Saprobic on dead stem. **Sexual morph**: *Ascomata* 96–162 μm high × 138–226 μm diam. ($\bar{x}$ = 131 × 193 μm, $n = 10$), scattered to clustered, semi-immersed to erumpent, dark brown to black, globose to subglobose, coriaceous, ostiolate. *Ostiole* central, papillate. *Peridium* 20–38 μm ($\bar{x}$ = 26.8 μm, $n = 10$) wide, comprising 3–5 layers of light to dark brown thick-walled cells of *textura angularis*. *Hamathecium* of 1.5–3 μm wide, cellular, septate pseudoparaphyses, anastomosing between and above asci. *Asci* 73–90 × 11.5–13.5 μm ($\bar{x}$ = 82 ×

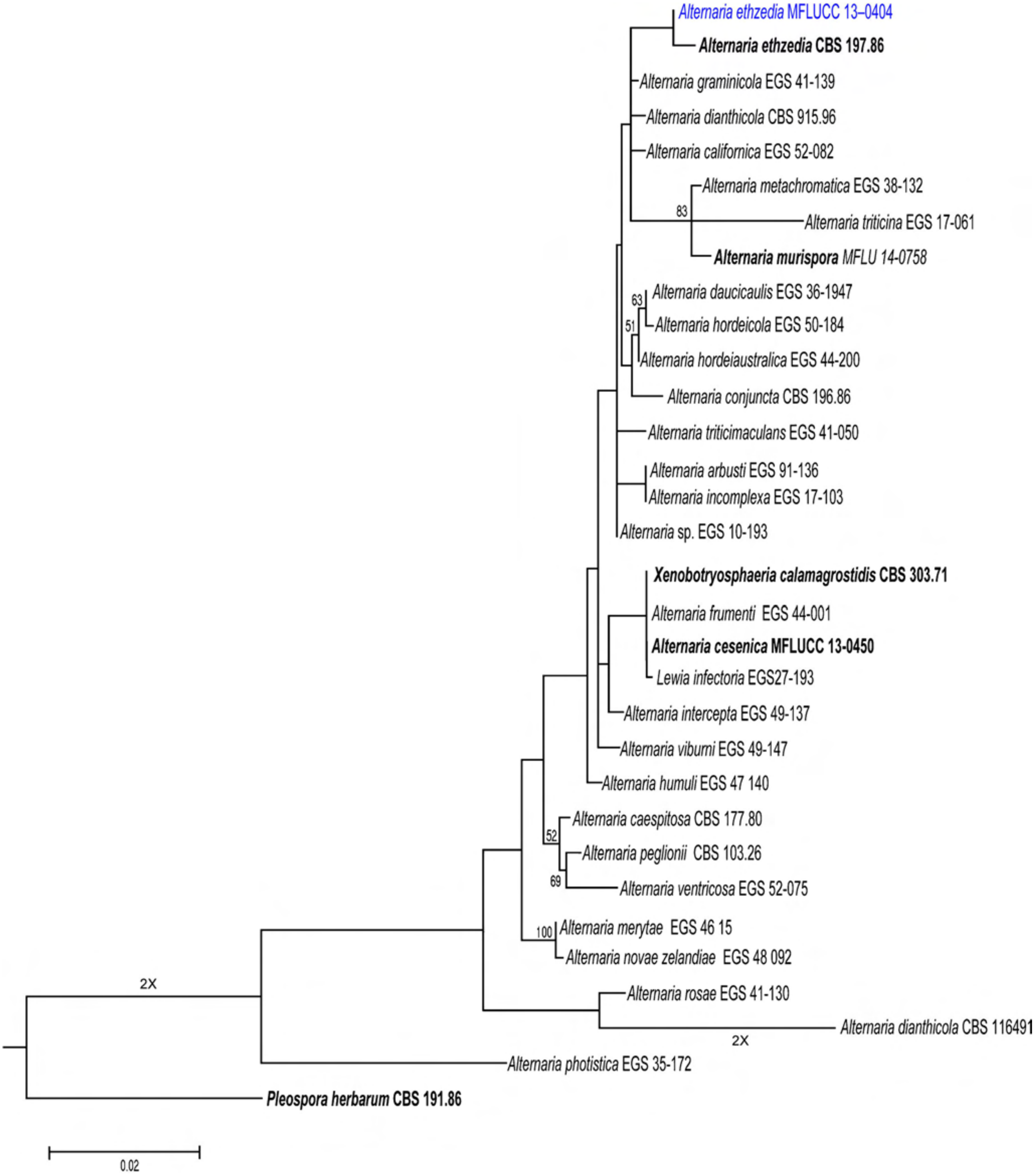


Fig. 51 Phylogram generated from Maximum Likelihood (RAxML) analysis based on combined LSU, ITS, EF and RPB2 sequence data of *Pleosporaceae*. Maximum likelihood bootstrap support values greater than 50 % are indicated above and below the nodes, and the ex-type strains are in *bold*; the new isolates are in *blue*. The tree is rooted with *Pleospora herbarum* (CBS 191.86)

12.5 μm, *n*=20), (4–6–)8-spored, bitunicate, fissitunicate, cylindrical to subcylindrical, straight or somewhat curved, with a short pedicel, apically rounded, with a minute ocular chamber. *Ascospores* 15.5–20× 7–8.5 μm ($\overline{x}$ = 18×7.8 μm, *n*=30), overlapping uni to biseriate, pale brown, ellipsoid to fusoid, muriform, initially with 3 transverse septa, become 4–5 at maturity, central 4 rows with a single longitudinal septum,

Fig. 52 *Alternaria ethzedia* (**MFLU** 15–1411) **a**, **b** Appearance of ascomata on the host surfacess **c**, **d** Sections through ascomata **e** Ostiole **f** Pseudoparaphyses **g**–**j** Bitunicate asci **k**–**n** Ascospores. Scale bars: **c**–**e**=50 μm, **f**=10 μm, **g**–**j**=25 μm, **k**–**n**=10 μm

constricted at the central septum, slightly constricted at the other septa, smooth-walled, surrounded by a mucilaginous sheath. **Asexual morph**: see asexual morph description in Simmons (1986).

Material examined: ITALY, Forlì-Cesena Province, Fiumicello di Premilcuore, on dead stem of *Brassica nigra* (*Brassicaceae*), 13 January 2013, Erio Camporesi IT 1007 (MFLU 15–1411), ex-type living culture, MFLUCC 13–0404, CFTCC.

Roussoellaceae J.K. Liu et al.

Roussoellaceae was introduced by Liu et al. (2014) and is characterized by immersed, gregarious, clypeate, ascostromata, cylindrical, bitunicate, asci and brown, 2-celled, ornamented ascospores. Wijayawardene et al. (2014) included five genera, viz. *Appendispora*, *Cytoplea*, *Neoroussoella*, *Roussoella* and *Roussoellopsis*, in this family and in this paper we introduce a new sexual genus, *Elongatopedicellata*, based on morphology and phylogeny (Figs. 1 and 53). Members of *Roussoellaceae* mostly occur on monocotyledons such as bamboo and palms (Liu et al. 2014). Crous et al. (2014) however, described a new species, *Roussoella acacia* Crous & M.J. Wingf., from *Acacia*. The asexual morphs of this family are linked to *Cytoplea*, *Melanconiopsis* and *Neomelanconium* (Liu et al. 2014). These three genera have aseptate conidia according to Sutton (1980), whereas in this study, two new asexual morph species of *Roussoella* with 1-septate conidia are described and illustrated. A phylogenetic tree, based on combined SSU, LSU and EF sequence data for the genus *Roussoella*, is presented in (Figs. 1 and 53).

171. ***Elongatopedicellata*** J.F. Zhang, J.K. Liu, K.D. Hyde & Z.Y. Liu, ***gen. nov.***

Index Fungorum number: IF551484; *Facesoffungi number*: FoF00959

Etymology: in reference to the Latin, to asci which have a long pedicel.

Saprobic on the dead wood. **Sexual morph**: *Ascomata* solitary to gregarious, scattered, immersed or erumpent, uniloculate, subglobose to obpyriform, coriaceous, with papillate ostiole. *Peridium* 14–21 μm wide, composed of several layers of brown to dark brown, thick-walled cells, arranged in a *textura angularis. Hamathecium* composed of 1–2 μm wide, filiform pseudoparaphyses, anastomosing between and above the asci, embedded in a gelatinous matrix. *Asci* 8-spored, bitunicate, fissitunicate, fusiform-clavate, with a long pedicel, apically rounded, with a well-developed ocular chamber. *Ascospores* 1–3 overlapping seriate, hyaline, fusiform, 1-septate, constricted at the septum, upper cell shorter and wider, lower cell long and narrow. As**exual morph**: Undetermined.

Type species: ***Elongatopedicellata lignicola*** J.F. Zhang, J.K. Liu, K.D. Hyde & Z.Y. Liu

Notes: This taxon is morphologically typical of *Didymosphaeria*, however, the phylogenetic analysis showed that the new taxon has a close relationship with *Roussoellaceae* (Fig. 1). Currently, *Roussoellaceae* comprises the genera *Neoroussoella*, *Roussoella* and *Roussoellopsis*. Phylogenetically, this taxa differs from *Roussoellaceae* in having cellular pseudoparaphyses and unequal ascospores surrounded with a gelatinous sheath, while *Roussoellaceae* has trabeculate pseudoparaphyses and brown, 2-celled, ornamented ascospores (Liu et al. 2014). We therefore introduce a new genus *Elongatopedicellata* in *Roussoellaceae* to accommodate *E. lignicola*.

172. ***Elongatopedicellata lignicola*** J.F. Zhang, J.K. Liu, K.D. Hyde & Z.Y. Liu, ***sp. nov.***

Index Fungorum number: IF551485; *Facesoffungi number*: FoF00960 Fig. 54

Etymology: from the Latin *lignin* and *cola*, in reference to its habit on wood.

Holotype: MFLU 15-2717

Saprobic on the dead wood. **Sexual morph**: *Ascomata* 294–387 μm high (including neck), 187–225 μm diam., solitary to gregarious, scattered, immersed or erumpent, uni-loculate, subglobose to obpyriform, coriaceous, visible on host surface as raised, dark spots, with papillate ostiole. *Ostiole* central, with pore-like opening and papilla to long neck. *Peridium* 14–21 μm wide, of unequal thickness, slightly thin at the base, composed of several layers of brown to dark brown, thick-walled cells, arranged in a *textura angularis. Hamathecium* composed of 1–2 μm wide, filiform pseudoparaphyses, anastomosing between and above the asci, embedded in a gelatinous matrix. *Asci* (59.5–)63–132(−137)×(9.5–)10–12.5(−13.5) μm ($\bar{x}$ = 98.7×12.2 μm, *n*=25), 8-spored, bitunicate, fissitunicate, fusiform-clavate, with a long foot-like or knob-like pedicel, apically rounded, with a well-developed ocular chamber. *Ascospores* (18.5–)19–21(−22)×(4.9)–5.2–6(−6.3) μm ($\bar{x}$ = 20.3×5.8 μm, *n*=30), 1–3 overlapping seriate, hyaline, fusiform with narrow ends, 1-septate, constricted at the septum, upper cell shorter and wider, lower cell long and narrow, slightly curved, surrounded by a mucilaginous sheath. As**exual morph**: Undetermined.

Material examined: THAILAND, Chiang Rai, Muang District, Mae Chang Hot Spring, on dead branch, 25 November, 2014, JF Zhang (MFLU 15-2717, **holotype**); ex-type living culture, MFLUCC 15-0642, CFTCC.

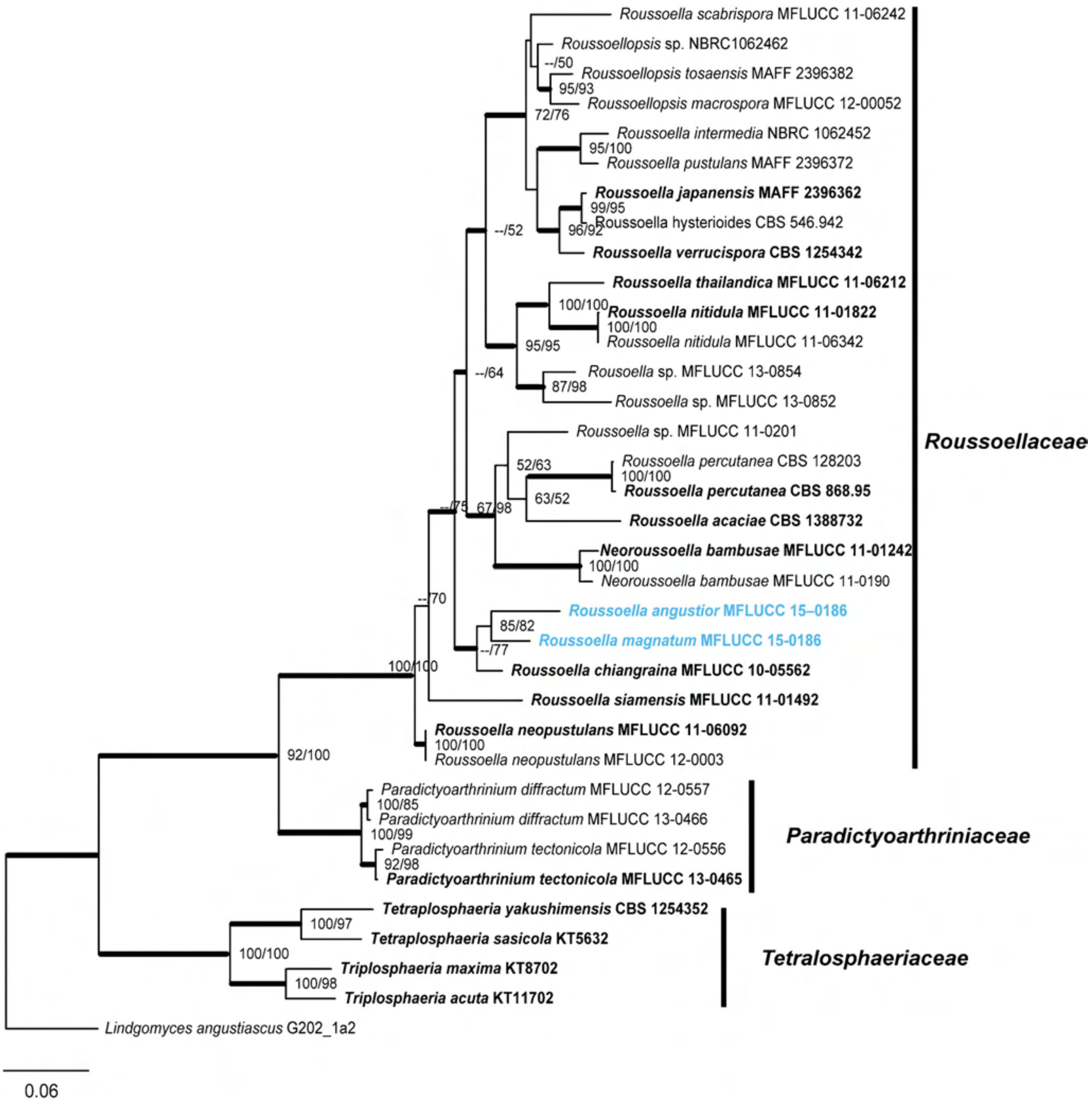


Fig. 53 Phylogenetic tree generated from maximum likelihood (lnL= −2561.341099) revealed by RAxML (GTR + G model) based on combined SSU, LSU and EF sequence data. MP/ML values (>50 %) resulting from 1000 bootstrap replicates are given at the nodes, and branches with Bayesian posterior probabilities greater than 0.90 are given in *bold*. The original isolate codes are noted after the species names. The tree is rooted to *Lindgomyces angustiascus* (G202_1a2). Ex-type strains are in *bold*, new isolates are in *blue*

Culture characteristics: Colonies on PDA fast growing, reaching 35–38 mm diam. after 2 weeks at 25 °C, cream to pale gray at the margin, buff pigment produced at the center, reverse cream to pale yellowish white at the margin, yellowish to pale reddish at the center, slighting radiating, medium dense, raised, dull with undulate edge, fairy fluffy at the margins, separating from agar.

173. ***Roussoella magnatum*** D.Q. Dai & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551342; *Facesoffungi number*: FoF00902; Fig. 55

Etymology: The he Latin, *magna*, meaning large, in reference to the large conidiomata.

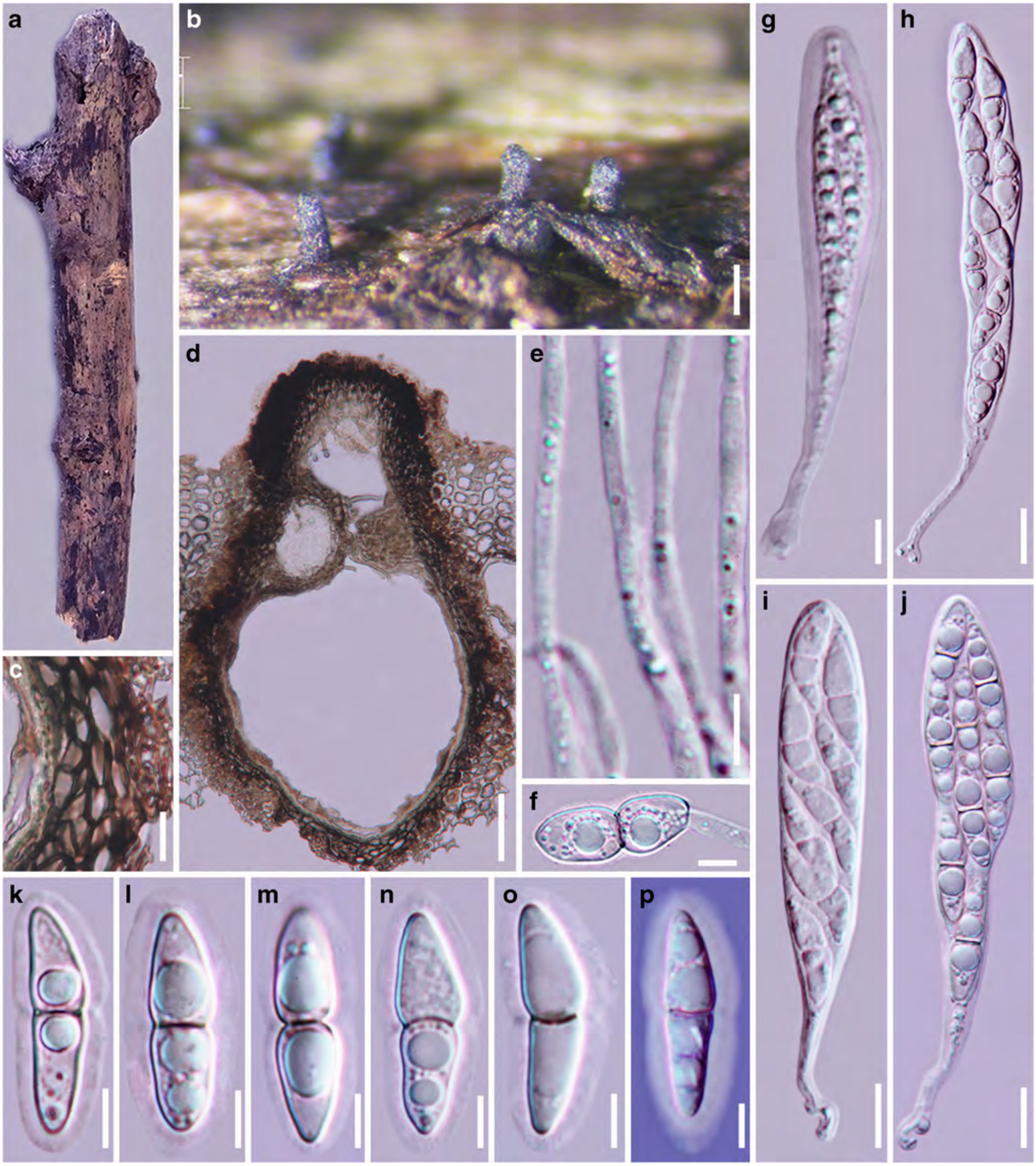


Fig. 54 *Elongatopedicellata lignicola* (holotype) **a**, **b** Appearance of ascomata on host surface **c** Section of peridium **d** Vertical section through ascoma **e** Pseudoparaphyses **f** Germinating spore **g**–**j** Asci **k**–**o** Ascospores **p** Ascospore in Indian ink showing sheath. Scale bars: **b**= 200 μm, **c**, **h**, **j**=10 μm, **d**=50 μm, **e**–**g**, **i**, **k**–**p**=5 μm

Holotype: MFLU 15–1213

Saprobic on bamboo culms, forming dark spots on the host surface, with pustule-like raised conidiomata. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 2–3 mm long, 1–2 mm wide, 300–500 μm high, eustromatic, immersed in the host tissue, partly erumpent

Fig. 55 *Roussoella magnatum* (holotype) **a** Conidiomata on bamboo culms **b**, **c** Conidiomata in culture **d** Conidiomata after cutting away top part **e** Conidiogenous inner layer **f**, **g** Conidiogenous cells **h**–**j** Paraphyses **k**–**n** Conidia **o** Germinated conidium **p** Conidia **q**, **r** Cultures on PDA after 60 days. Scale bars: **a**–**c**=1 mm, **d**=100 μm, **e**=50 μm, **f**–**k**, **m**, **n**=10 μm, **l**=5 μm

when mature, solitary, scattered, multi-loculate, ellipsoid to wide-fusiform, coriaceous, with fissure-like ostiole. *Conidiomatal wall* thin, 15–30 μm wide, with dark brown to hyaline, conidiogenous, inner layer, comprising cells of *textura angularis*. *Paraphyses* 45–80 μm long, 2–5.5 μm wide, hyaline, septate, straight to flexuous, wide at base. *Conidiophores* 6–15.5 × 4–7 μm ($\bar{x}$ = 12.1 × 5.1 μm, n=10), cylindrical, subglobose to irregular, smooth, hyaline, occasionally branched. *Conidiogenous cells* 5–22 × 2.5–7 μm ($\bar{x}$ = 12.6 × 4.8 μm, n=20), enteroblastic, phialidic, cylindrical to subglobose, or ampulliform, determinate, discrete, smooth, hyaline. *Macroconidia* 16.5–21 × 5.5–6 μm ($\bar{x}$ = 18.9 × 5.6 μm, n=20), pale brown to dark brown, 1-septate, cylindrical, obtuse at both ends, occasionally truncate at the lower end, smooth to slightly warty, straight, with many guttules. *Microconidia* 2.5–4 × 1.5–2.5 μm ($\bar{x}$ = 3.4 × 2.1 μm, n=20), subglobose, hyaline, smooth, guttulate.

Culture characteristics: Ascospores germinating on PDA within 24 h and germ tubes produced from lower cell. Colonies growing slowly on PDA, reaching 5 mm in 60 days at 28 °C, circular, floccose, with uneven margin, white from above, yellowish brown to dark brown from below. Mycelium immersed and superficial in the media, composed of branched, septate, smooth-walled, hyaline aerial hyphae and verrucose, dark brown hyphae near or within the media, producing black conidial masses and subglobose to irregular conidiomata with multi-locules in the center and at the margin.

Material examined: THAILAND, Phang-Nga, Doi Nang Hong, Tham Thong Lang, Thap Put District, 8°32′11″N 98°33′35″E, on dead culm of bamboo, 6 December 2014, K.D. Hyde DDQ00282 (MFLU 15–1213, **holotype**); *Ibid.* (KUN, HKAS 88720, **isotype**), ex-type living culture at MFLUCC 15–0185, KUMCC.

Notes: *Roussoella magnatum* is characterized by large, black, eustromatic, ellipsoid to wide fusiform conidiomata, and dark, warty, 1-septate conidia. This new taxon forms 2–3 × 1–2 mm conidiomata on the host. Such large conidiomata are not so far observed in any other species of *Roussoella* (Hyde et al. 1996; Liu et al. 2014).

174. ***Roussoella angustior*** D.Q. Dai & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551344; *Facesoffungi number*: FoF00903; Fig. 56

Etymology: Refers to the narrow conidia.

Holotype: MFLU 15–1214

Saprobic on bamboo culms, forming darkened spots on the host surface with pustule-like raised conidiomata. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 1–2.5 mm long, 0.8–1.2 mm wide, 300–500 μm high, eustromatic, immersed in the host tissue, partly erumpent when mature, solitary, scattered, multi-loculate, ellipsoid to wide fusiform, coriaceous. *Conidiomatal wall* 15–30 μm wide, with dark brown to hyaline conidiogenous inner layer, comprising cells of *textura angularis*. *Paraphyses* 15–35 μm long, 2–3.5 μm wide, hyaline, septate, straight to curved. *Conidiophores* 2–6.5 × 2.5–3.5 μm ($\bar{x}$ = 4.4 × 3.2 μm, n=10), short, cylindrical, smooth, hyaline. *Conidiogenous cells* 2–10 × 2.5–3.5 μm ($\bar{x}$ = 5.9 × 3.3 μm, n=20), enteroblastic, phialidic, cylindrical to ampulliform, determinate, discrete, smooth, hyaline. *Macroconidia* 17.5–24 × 3.5–5 μm ($\bar{x}$ = 19.6 × 4.2 μm, n=20), pale brown to dark brown, 1-septate, cylindrical, obtuse at both ends, occasionally truncate at lower end, smooth, straight, with many guttules. *Microconidia* 3.5–4.5 × 1.5–2.5 μm ($\bar{x}$ = 4.1 × 2.2 μm, n=20), subglobose, hyaline, smooth, guttulate.

Culture characteristics: Ascospores germinating on PDA within 24 h and germ tubes produced from lower cell. Colonies growing slowly on PDA, reaching 7 mm in 60 days at 28 °C, circular, floccose, with uneven margin, white from above, yellowish brown to dark brown from below. Mycelium immersed and superficial in the media, composed of branched, septate, smooth-walled, hyaline aerial hyphae and verrucose, dark brown hyphae near or within the media, producing a few black conidial masses.

Material examined: THAILAND, Phang-Nga, Doi Nang Hong, Tham Thong Lang, Thap Put District, 8°32′11″N 98°33′35″E, on dead culm of bamboo, 6 December 2014, K.D. Hyde DDQ00286 (MFLU 15–1214, **holotype**); *Ibid.* (KUN, HKAS 88721, **isotype**), ex-type living culture at MFLUCC 15–0186, KUMCC.

Notes: This new taxon is morphologically and phylogenetically close to *Roussoella magnatum* in having black, ellipsoid to wide fusiform conidiomata, hyaline, septate pseudoparaphyses and brown, cylindrical, 1-septate conidia. However, *R. angustior* has narrower (19.6 × 4.2 μm vs. 18.9 × 5.6 μm) and smooth-walled conidia. These two species are phylogenetically separated by the combined genes analyses (Figs. 1 and 53). *Roussoella* species usually produce short (not more than 15 μm long), oblong to ellipsoidal conidia (Hyde et al. 1996; Liu et al. 2014). The new species collected by us from bamboo has longer (more than 16.5 μm long), cylindrical conidia. (Crous et al. 2014) described *R. acacia* with 7–10 × 4–5 μm conidia from *Acacia*. Moreover, in these two new taxa, *R. magnatum* and *R. angustior*, microconidia and macroconidia are formed in the same conidiomata. Such characters are not reported in other species in the genus *Roussoella* (Hyde et al. 1996; Crous et al. 2014; Liu et al. 2014).

Tetraplosphaeriaceae Kaz. Tanaka & K. Hiray.

The family *Tetraplosphaeriaceae* was introduced by Tanaka et al. (2009). Members of the family are mainly isolated

Fig. 56 *Roussoella angustior* (holotype) **a**–**c** Conidiomata on bamboo culms **d** Conidiomata after cutting away top part **e**, **f** Conidial masses on PDA **g** Conidiogenous inner layer **h**–**k** Paraphyses and conidiogenous cells **l**, **m** Conidia **n** Germinating conidium **o** Micro-conidia **p**, **q** Cultures on PDA after 60 days. Scale bars: **a**=5 mm, **b**, **e**, **f**=1 mm, **c**, **d**=500 µm, **g**=50 µm, **h**–**o**=10 µm

from bamboo or grasses and include *Polyplosphaeria*, *Pseudotetraploa*, *Quadricrura*, *Tetraplosphaeria* and *Triplosphaeria*. Members of this family are characterized by immersed to superficial, globose to subglobose ascomata, cellular or trabeculate pseudoparaphyses, cylindrical to clavate asci, and narrowly fusiform to broadly cylindrical, 1–3-septate, hyaline to pale brown ascospores, surrounded by an entire mucilaginous sheath or narrow appendage-like sheath. A phylogenetic tree for the family is presented in Figs. 57 and 58.

The genus *Shrungabeeja* was established by Rao and Reddy (1981), and was collected from dead culms of *Bambusa* sp. and three species (*S. begonia* K. Zhang & X.G. Zhang, *S. melicopes* K. Zhang & X.G. Zhang and *S. vadirajensis* V.G. Rao & K.A. Reddy) were accepted by Zhang et al. (2009d). This genus is typified by *S. vadirajensis*. The genus is characterised by effuse, dark, hairy colonies, distinct, dark coloured conidiophores and integrated, monoblastic, lageniform, conidiogenous cells that produce solitary, aseptate, subglobose or turbinate conidia with filiform or horn-like appendages.

175. ***Shrungabeeja longiappendiculata*** Sommai, Pinruan, Nuankaew & Suetrong, ***sp. nov.***

Index Fungorum Number: IF551322; *Facesoffungi number*: FoF00967; Fig. 59

Etymology: *longiappendiculata* referring to the long appendages.

Holotype: BBH 39513

Saprobic on dead culm of *Bambusa* sp. in evergreen forest. *Colonies* effuse, brown to dark brown. *Mycelium* partly superficial, partly immersed in the substratum, composed of branched, septate, pale brown, smooth-walled hyphae, 2–4 μm wide. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiophores* macronematous, mononematous, erect, straight or flexuous, unbranched, smooth, thick-walled, 132.5–225 μm long, 11.25–15 μm wide at the base, 6.25–10 μm wide in the middle, up to 5 μm wide at the apex, 3–4-septate. *Conidiogenous cells* monoblastic, terminal, lageniform, determinate or percurrent, pale brown to brown, smooth, 12.5–25 μm long, 6–7.5 μm broad at base, up to 5–7.5 μm. broad at apex. *Conidia* solitary, dry, acrogenous, subglobose or turbinate, aseptate, hollow, pedicellate, with 4–7 filiform appendages in the anterior region which are continuous or sometimes 4–21-septate, smooth, pale brown to brown, conidia 32.5–50 μm long, 40–60 μm wide, 5–7.5 μm broad at the base, broader than long, appendages (47.5–82.5) 100–360 (400–480) μm long, 5–7.5 μm broad at base, and 1.25 μm at apex.

Culture characteristics: Colonies on PDA attaining 4–4.5 cm diam. after 20 days at room temperature (25 °C), cottony, grey, with entire margin, reverse almost black, no pigment produced, sporulating.

Material examined: THAILAND, Nakhon Nayok Province, on dead culm of *Bambusa* sp. (*Poaceae*), 3 September 2014, S. Sommai (BBH 39513, **holotype**); ex-type living culture, BCC 76463.

Notes: *Shrungabeeja* species have dark conidiophores with integrated, terminal, monoblastic, determinate or percurrent conidiogenous cells and lageniform, acrogenous, solitary, aseptate, globose or turbinate conidia, with filiform or horn-like appendages (Rao and Reddy 1981). There are no known sexual morphs. *Shrungabeeja longiappendiculata* differs from all species of *Shrungabeeja* as it has 40–60 × 32.5–50 μm conidia, with 4–7 very long appendages. Maximum parsimony, likelihood and Bayesian analyses of combined SSU and LSU gene region of 80 taxa from the Dothideomycetes place *Shrungabeeja longiappendiculata* in *Tetraplosphaeriaceae* with *Tetraplosphaeria* and *Pseudotetraploa* species with 63 % BSMP, 78 % BSBL and 1.00 B.P. (Fig. 57). ITS rDNA gene analysis shows two isolates of *Shrungabeeja longiappendiculata* clustered with species of *Triplosphaeria* and *Quadricrura* and *Polyplosphaeria fusca* in *Tetraplosphaeriaceae* (Fig. 58). Based on the above morphological and molecular characteristics, *Shrungabeeja longiappendiculata* is introduced as a new species and placed in *Tetraplosphaeriaceae*.

Thyridariaceae Q. Tian & K.D. Hyde

This family was introduced by Hyde et al. (2013).

176. ***Massariosphaeria*** (E. Müll.) Crivelli, Diss. Eidgenöss. Techn. Hochschule Zürich 7318: 141 (1983)

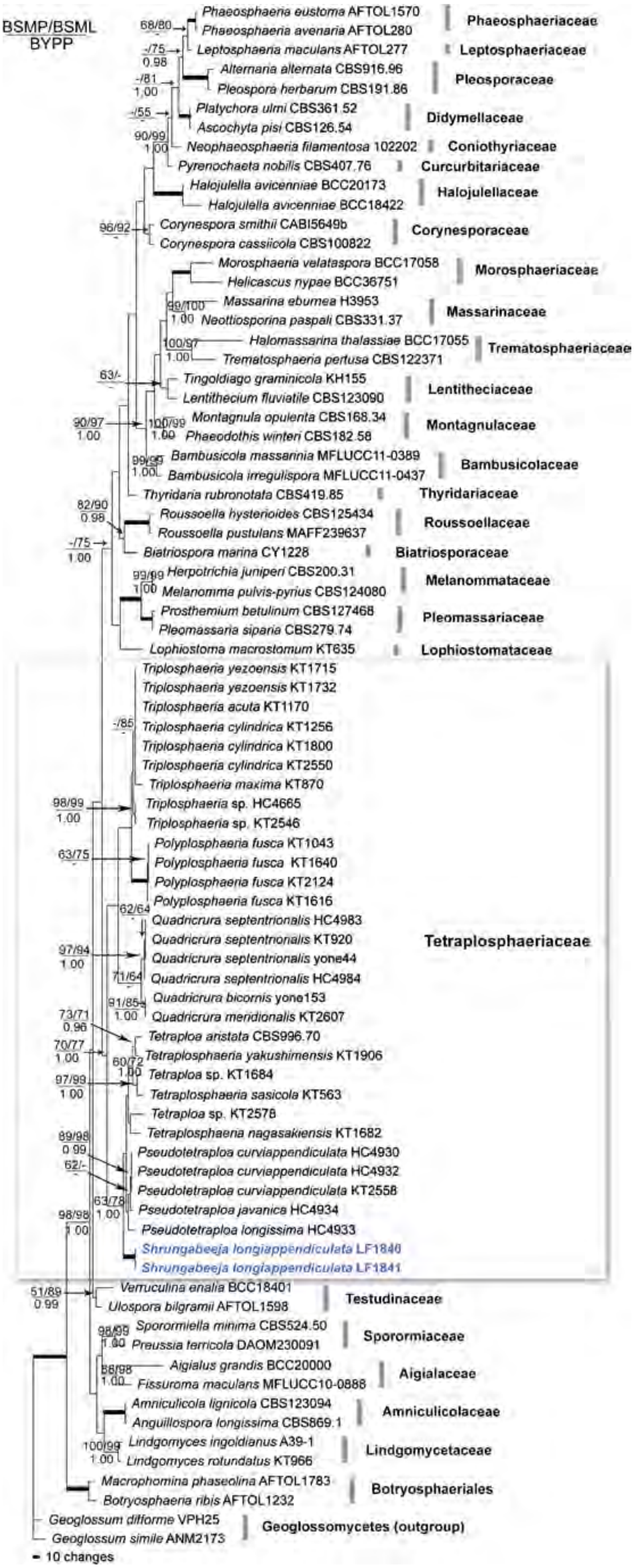
Type species: ***Massariosphaeria phaeospora*** (E. Müll.) Crivelli, Ueber die Heterogene Ascomycetengattung Pleospora Rabh.; Vorschlag für eine Aufteilung (Diss. Eid genössischen Technischen Hochschule Zürich 7318): 141 (1983)

Basionym: *Leptosphaeria phaeospora* E. Müll., Sydowia 4(1–6): 208 (1950)

Notes: The genus *Massariosphaeria* was established by Müller (1950) as a section of *Leptosphaeria* based on its large, thick-walled ascospores, with a mucilaginous sheath, as well as its ascomata with a thick apex. Crivelli (1983) treated *Massariosphaeria* as a separate genus characterized by its wide peridial apex, comprising thick-walled cells, compressed to round papilla, and relatively large, thick-walled, reddish brown to brown, multi-septate to dictyosporous ascospores, usually surrounded by a sheath (Crivelli 1983; Huhndorf et al. 1990; Leuchtmann 1984). Crivelli (1983) noted that species of *Massariosphaeria* often stain the woody substrate (or culture) purple.

Recent studies based on multigene phylogenies revealed that *Massariosphaeria* is not monophyletic and

Fig. 57 One of three MPTS inferred from combined SSU and LSU rDNA sequence data of Dothideomycetes, generated with maximum parsimony. Maximum parsimony (BSMP, *left*) and likelihood (BSML, *right*) bootstrap values >50 % are given above the nodes. Bayesian posterior probabilities >0.95 are given below each node (BYPP). The internodes that are highly supported by all bootstrap (100 %) and posterior probabilities (1.00) are shown as a *thicker line*



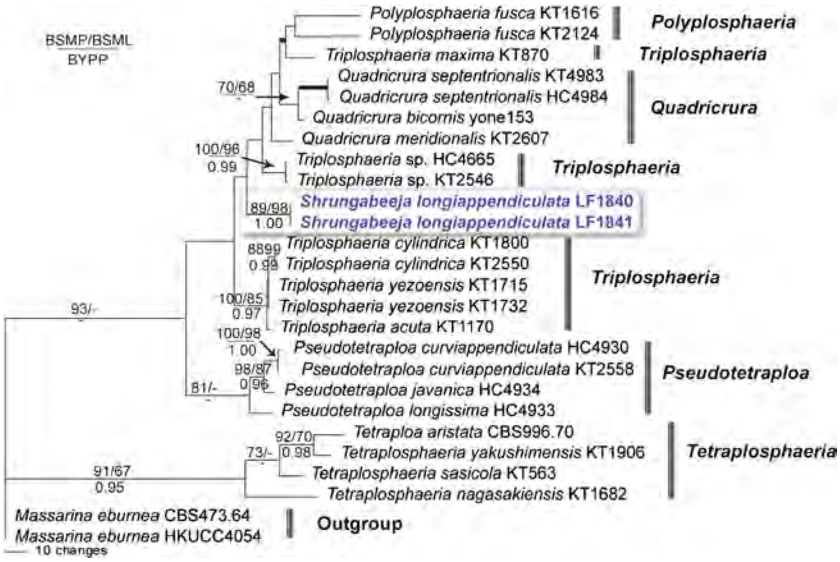


Fig. 58 One of 26 MPTS inferred from ITS rDNA sequence data from *Tetraplosphaeriaceae* generated with maximum parsimony. Maximum parsimony (BSMP, *left*) and likelihood (BSML, *right*) bootstrap values >50 % are given above the nodes. Bayesian posterior probabilities >0.95 are given below each node (BYPP). The internodes that are highly supported by all bootstrap (100 %) and posterior probabilities (1.00) are shown as a thicker line

results are in disagreement with existing morphological-based classification schemes (Wang et al. 2007). Characters, such as ascomata shape and ascospore morphology and staining the woody substrate (or culture) purple have evolved more than once within the families of *Pleosporales* (Abdel-Aziz and Abdel-Wahab 2010; Shoemaker and Babcock 1989; Tanaka and Harada 2004; Wang et al. 2007; Zhang et al. 2009a, b, 2012a, b).

Based on DNA sequence data in combination with a review of literature, as well as the present study (Fig. 1), we conclude that the generic type of *Massariosphaeria*, *M. phaeospora* (E. Müll.) forms a well-supported clade within the family *Thyridariaceae* (Hyde et al. 2013; Zhang et al. 2009b, 2012a, b). Therefore we place *Massariosphaeria* in *Thyridariaceae*. Other species in this genus need to be sequenced to establish their affinities.

177. *Wicklowiaceae* Ariyawansa & K.D. Hyde, ***fam. nov.***

Index Fungorum number: IF551445; *Facesoffungi number*: FoF00966

Saprobic on submerged decorticated woody debris in aquatic habitats. **Sexual morph**: *Ascomata* immersed, becoming erumpent, solitary to gregarious, appearing as a black, oval to circular, shallow, crater-like depressions on the substrate, subglobose, ostiolate. *Peridium* comprising 4–5 layers of small pseudoparenchymatous cells, arranged in a *textura angularis*, fusing at the outside with the host cells. *Hamathecium* of dense, septate, cellular pseudoparaphyses, embedded in a gelatinous matrix. *Asci* 8-spored, bitunicate, fissitunicate, broadly clavate, pedicellate, rounded at the apex, with a wide, shallow, ocular chamber. *Ascospores* overlapping 2–3-seriate, hyaline, ellipsoidal, 1-septate, slightly constricted at the septum, surrounded by a gelatinous sheath that expands in water; with a gelatinous curtain extending downwards from the base, that fragments into filamentous appendages, forming a subapical fringe. **Asexual morph**: Undetermined.

Type genus: ***Wicklowia*** Raja et al., in Raja et al., Mycoscience 51(3): 210 (2010).

Notes: The new family *Wicklowiaceae* is introduced here to accommodate the monotypic freshwater ascomycetous genus *Wicklowia* (Raja et al. 2010). The genus is characterized by subglobose, immersed to erumpent, black ascomata, a peridium composed of 4–5 layers of darkened pseudoparenchymatous cells and cellular pseudoparaphyses in a gelatinous matrix with broadly clavate asci bearing cylindrical, hyaline, one-septate ascospores having rounded apices and surrounded by a gelatinous sheath (Raja et al. 2010). Raja et al. (2010) placed the genus in the order *Pleosporales* based on 28S rDNA sequence data, without assigning it to any family.

The strains of *Wicklowia aquatica* (F76-2^{T} and AF289-1) form a well-supported clade basal to the familial clade of *Lindgomycetaceae* (Fig. 1). A similar topology was shown in the study of Schoch et al. (2009), Zhang et al. (2012a), Hyde et al. (2013). We therefore introduce a new family to accommodate this distinct lineage.

Type: ***Wicklowia*** Raja et al., in Raja et al., Mycoscience 51(3): 210 (2010).

Type species: ***Wicklowia aquatica*** Raja et al., in Raja et al., Mycoscience 51(3): 210 (2010)

Eurotiomycetes

Mycocaliciaceae A.F.W. Schmidt

Mycocaliciaceae is a family of calicioid fungi and a heterogeneous grouping of ascomycetes included in the order *Mycocaliciales* with *Mycocalicium* as the type genus (Angeles Vinuesa et al. 2001). This family represents ascomycetes, with

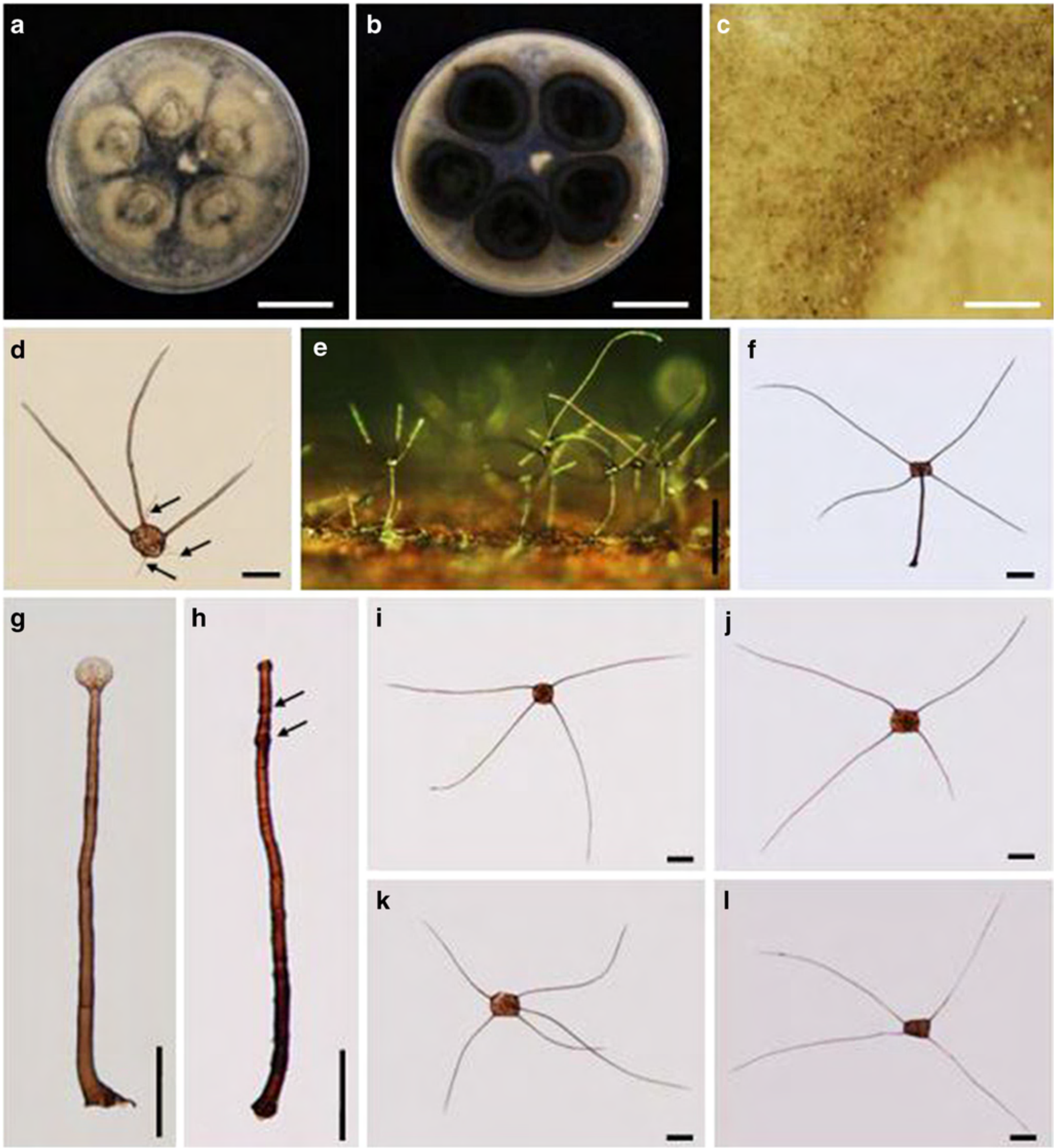


Fig. 59 *Shrungabeeja longiappendiculata* (holotype) **a**, **b** Colony on PDA, **a** from above, **b** from below **c** Sporulation on PDA **d** Germinating conidium (*arrowed*) **e** Colonies on natural substratum **f** Conidiophore with mature conidium **g** Conidiophore with developing conidium **h** Conidiophore showing percurrent proliferation (*arrowed*) **i**–**l** Conidia with appendages. Scale bars: **a**–**c**=10 mm, **d**, **g**, **h**, **i**–**l**=50 μm, **e**–**f**=10 μm

small, usually stalked apothecia, where both lichenized and non–lichenized species are involved (Rikkinen 2003). This family includes *Chaenothecopsis*, *Mycocalicium*, *Phaeocalicium* and *Stenocybe* (Lumbsch and Huhndorf 2010). The members of *Mycocaliciaceae* are saprophytic, parasitic on free-living algae or lichens, or parasymbiotic with lichens. Most species inhabit the bark of old trees or wood and occur in cool-temperate and temperate regions, but some occur in subtropical and tropical areas (Tibell and Titov 1995) (Fig. 60).

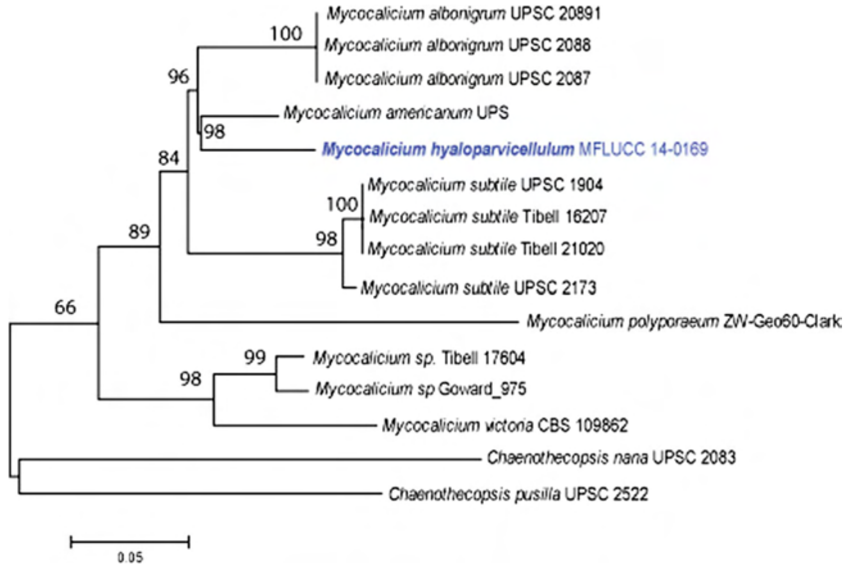


Fig. 60 Phylogram inferred from likelihood analysis of genus *Mycocalicium* using ITS sequence data. Strain/culture numbers are given following the taxon names. The bootstrap support values from likelihood analysis >70 % from 1000 RAxML replicates are shown above the branches. The tree is rooted with *Chaenothecopsis nana* and *C. pusilla* (out group). The new species is highlighted in *blue*

Mycocalicium Vain., Acta Soc. Fauna Flora fenn. 7(no. 2): 182 (1890)

The genus was introduced by Vainio (1890) to accommodate species from *Calicium* which are not lichenized. Schmidt (1970) emended the generic concepts in the *Mycocaliciaceae*, thus characterized *Mycocalicium* as having non-septate spores, short asci, periclinal hyphae in the ascoma stalk, and an evenly thickened ascus apex. However with the discovery of more species this characterization was not consistent and a delimitation of *Mycocalicium* from *Phaeocalicium* and *Chaenothecopsis* as suggested by Schmidt was not reliable (Angeles Vinuesa et al. 2001). There are 52 epithets listed in *Mycocalicium* (Index Fungorum 2015).

178. ***Mycocalicium hyaloparvicellulum*** Daranagama & K. D. Hyde, ***sp. nov.***

Index Fungorum number: IF551202; *Facesoffungi number*: FoF00707; Figs. 61 and 62

Etymology: Refers to the hyaline small celled ascospores; *hyalo* = hyaline; *parvus* = small; *cellula* = cell.

Holotype: MFLU 15-0667

Saprobic on cone of *Pinus halepensis* Miller. **Sexual morph**: *Thallus* crustaceous, solitary, erumpent, consist with a head and stipe. *Apothecia* 1000–1100 μm high ($\bar{x}$ = 1083 μm, n=10), black, subglobose. *Capitulum* shiny, black, lenticular to subsphaerical, often irregular, with a granular surface. *Hypothecium* 80–95 μm wide ($\bar{x}$ = 88 μm, n=10), dark brown to olivaceous brown. *Excipulum* 15–26 μm wide ($\bar{x}$ = 21 μm, n=10), light brown, poorly–developed, arranged as a continuation of the outer layers of the stalk, comprising a few cell layers of *textura irregulata*, darker than the hyphae from the stalk. *Stalk* 1300–1500 μm high ($\bar{x}$ = 1487 μm, n=10), brown to pale brown, consisting of light brown periclinal parallel hyphae, with a gelatinous coat. *Asci* 56–83×4.3–5.8 μm ($\bar{x}$ = 72.5×4.8 μm, n=20), 8–spored, unitunicate, cylindrical, short pedicellate, apex strongly thickened, round, inconspicuously bluing in Meltzer's reagent, apical apparatus, globose. *Ascospores* 10–15×4–6 μm ($\bar{x}$ = 12.9×5.3 μm, n=20), uniseriate, ellipsoidal, one pointed end and rounded end, light brown, with a hyaline dwarf cell at one side (upper side), smooth-walled, with thin mucilaginous sheath. **Asexual morph**: *Conidiophores* 55–80×2.6–3.4 μm ($\bar{x}$ = 77×3.1 μm, n=20), some are longer, emerging through the thick mycelium, which formed into hyphal aggregates, immature conidiophores hyaline, becoming light brown at maturity, complex, dichotomously branched, septate. *Conidiogenous cells* 10–14×3.2–4.5 μm ($\bar{x}$ = 12.9×4.3 μm, n=20), terminal, single, cylindrical and elongated, with smoothly curved apex. *Conidia* 5.2–7.5 μm diam. ($\bar{x}$ = 6.3 μm, n=20), light brown, globose, always occurs as conidial chains of 4–5 conidia, rarely observed single conidia.

Culture characteristics: Colonies on Difco OA plates reaching 5 cm edge Petri dish in 1 month at 25–28 °C, at first citrine or grey olivaceous, felty, zonate, with diffuse margins, after three weeks become olivaceous and isebelline and zonate; reverse turning brown and then to dark brown almost black, zonate.

Material examined: ITALY, Cosenza Province, Rocca Imperiale, on cone of *Pinus halepensis* (*Pinaceae*), 5 April 2013, Lugaresi Renzo (MFLU 15-0667, **holotype**), living culture, MFLUCC 14-0169.

Notes: *Mycocalicium hyaloparvicellulum* has a close relationship with *Mycocalicium subtile* (Pers.) Szatala, but differs in apothecium size, colour and structure of stalk, ascus size and spore dimensions and colour (Muniz and Hladun 2007).

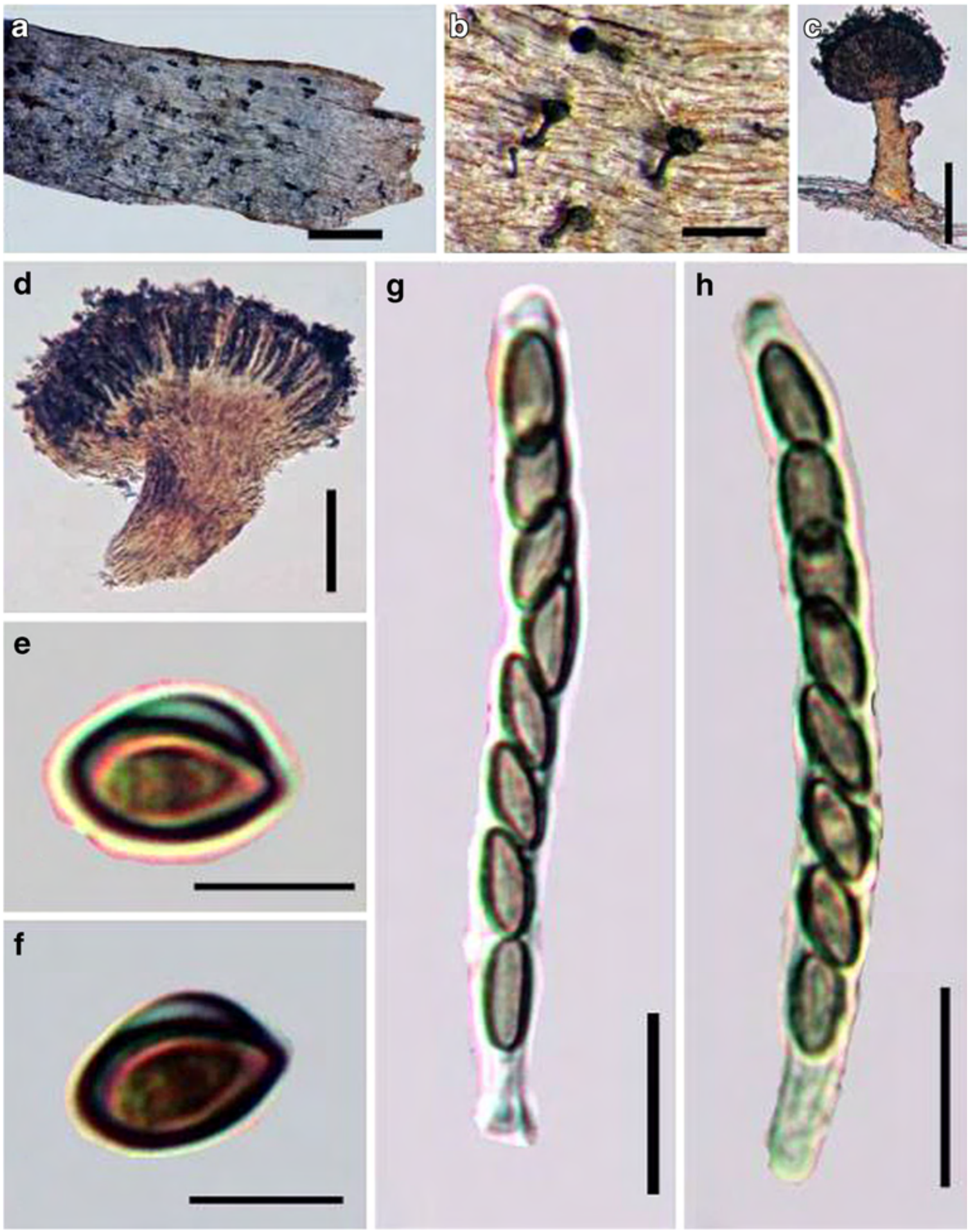


Fig. 61 *Mycocalicium hyaloparvicellulum* (holotype) **a**, **b** Habit on wood **c**, **d** Vertical section of apothecium showing the exciple **e**, **f** Ascospores in water with hyaline dwarf cell at the side of the spore **g** Ascus in water **h** Ascus in Melzer's reagent showing apical thickening. Scale bars: **a**=1 cm, **b**=1500 μm, **c**, **d**= 500 μm, **e**–**h**=10 μm

Like *Mycocalicium llimonae*, *M. hyaloparvicellulum* was also isolated from a cone of *Pinus halepensis*. *Mycocalicium llimonae* is a saprobe on pine cones on dry branches of *Pinus halepensis* and several other *Pinus* spp. (Muniz and Hladun 2007). *Mycocalicium llimonae* differs from *M. hyaloparvicellulum* in having smaller apothecia with hyaline stalks. In the phylogenetic analysis (Fig. 60), *M. hyaloparvicellulum* is a distinct species with high bootstrap support within the *Mycocalicium* clade.

Lecanoromycetes

Acarosporaceae Zahlbr.

Two major phylogenetic studies covering this group were published recently (Miadlikowska et al. 2014; Westberg et al. 2015). The phylogeny presented in Fig. 63 is based on the matrix of Westberg et al. (2015), where citations of samples and sequences used can be found. The two new species described here all belong to the *Acarospora glaucocarpa* group (including e.g., *A. cervina* and *A. badiofusca*), which is not part of *Acarospora* in the strict sense (type: *A. schleicheri*). The morphologically defined *A. glaucocarpa* group is nested with species currently placed in *Sarcogyne*. The new species are provisionally placed in *Acarospora* according to the current morphological concept of the genus, but will likely not be classified here in the future. A generic revision is, however, not possible at this stage.

179. ***Acarospora septentrionalis*** M. Westb. & Wedin, ***sp. nov.***

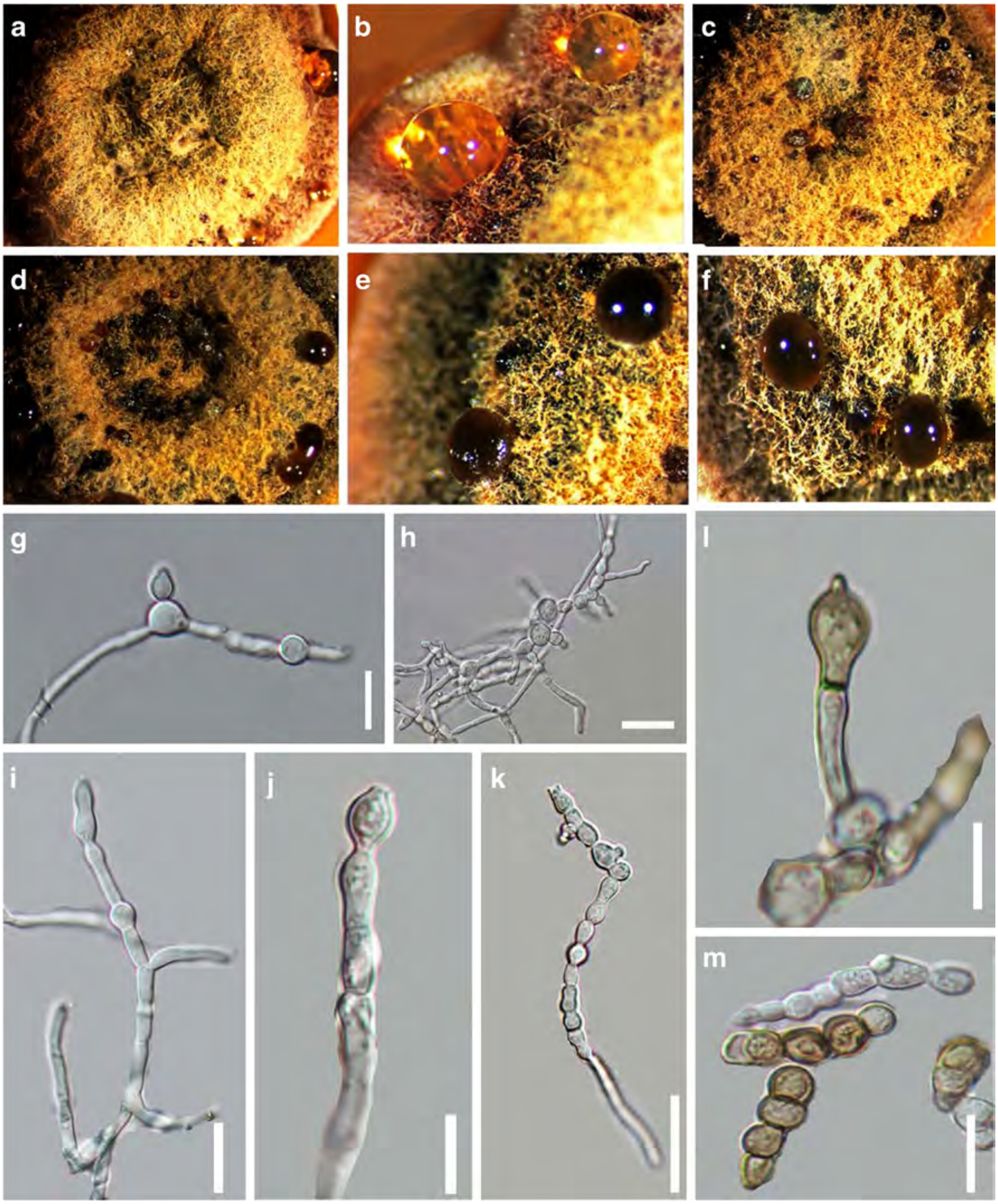


Fig. 62 *Mycocalicium hyaloparvicellulum* (ex-type culture) Colony on OA after 4 weeks **a** Reverse of the colony **b** Oil droplets deposited on the mycelium masses **c** Sporulating regions after 14 days **d** Sporulating regions after 21 days **e**, **f** Sporulating regions after 30 days **g**, **h** Development of conidiophores **i**, **j** Conidiogenous cells **k** Immature conidial chains **l** Mature conidiogenous cells with attached conidia **m** Conidial chains. Scale bars: **g**–**m**=10 μm

MycoBank number: MB 813043; *Facesoffungi number*: FoF00927; Fig. 64a–e

Etymology: In reference to the northern distribution of the species.

Holotype: NORWAY, Sogn og Fjordane, Årdal, along Tindeveien between Øvre Årdal and Turtagrø, UTM (WGS84) 32V 0431788 6807104, alt. 984 m, on cement, 12 June 2008, Martin Westberg 08-148 (S F132535).

Synonym: *Acarospora badiofusca* v. *glaucocarpoides* H. Magn., Göteborgs Kungl. Vetensk. Samhälles handl., ser. 4, 28: 117 (1924). Type: Sweden. Torne Lappmark, Jukkasjärvi par., prope Torne träsk, Jebrinjokk, 600 m. 16 July 1919, *Magnusson 3310* (UPS L-522388, **lectotype**, **here designated**).

Lichenized, photobiont a chlorococcoid alga. *Thallus* epilithic, areolate to rarely subsquamulose; areoles rounded at first, becoming irregular in outline, to 0.55 mm thick, 0.3–0.8(−1.5) mm across, the largest becoming subsquamulose with edges raised from the substrate; upper surface pale brown to medium brown, smooth, mat, epruinose, but sometimes with large, pruina-like flakes formed by detaching epinecral layer; epinecral layer present, colourless, 0–40 μm thick; cortex, paraplectenchymatous, 25–60 μm thick, uppermost cell-layer reddish brown, below colourless, cells distinct, rounded to elongated or somewhat irregular, lumina up to 7 μm across; algal layer continuous; medulla white, hyphae with rounded to elongated, thin-walled cells, lower cortex lacking. *Apothecia* lecanoroid, at first immersed with a sunken disc, soon expanding and becoming raised and often darker brown than the thallus (in a similar way to *A. badiofusca*); disc, brown, at first concolourous with the thallus, later often becoming darker brown, plane, round, epruinose, 0.3–1 mm diam.; true exciple at first invisible from the outside, becoming distinct in later stages and then concolourous with the disc, I−, in section prosoplectenchymatous, below the hymenium composed of elongated, narrow, rather indistinct cells forming a very compact layer, to c. 25 μm thick, towards the surface expanding, becoming fan-shaped and composed of small, rounded to somewhat elongated cells, the uppermost cells rounded, 2–4 μm wide, laterally merging with the cortex; epithecium, medium brown–reddish brown; hymenium colourless, I+ blue, 65–90 μm tall; paraphyses, easily distinguished in water, 1.5–2 μm wide in mid hymenium, tips cylindrical to weakly clavate, rarely up to 5 μm wide; subhymenial layers colourless, wedge-shaped, up to 80 μm tall centrally, composed of small, more or less rounded cells; with numerous, colourless oil-drops. *Asci* 70–80 × 15–18 μm (few well-developed seen), narrowly clavate, >100-spored. *Ascospores* colourless, simple, narrowly ellipsoid–ellipsoid, 3–5 × 1.5–2 μm. *Pycnidia* rare; conidia ellipsoid–ovoid, 2–2.5 × 1.5 μm. All spot tests negative.

Material examined: ICELAND, Nordur-Island, East side of Eyjafjörður, on ledge above a brook, 10 June 2007, L. Fröberg (LD); NORWAY, Finnmark: Varanger Peninsula, Vardø, Bukkemoltangen, 1 July 2014, M. Westberg VAR043 (S F263442); Varanger Peninsula, Båtsfjord, Skogdalen, 2 July 2014, M. Westberg VAR048 (S F263443); SWEDEN, Lule Lappmark, Jokkmokk par., Padjelanta National Park, north side of lake Virihaure (Virihávrre), at the foot of Mt Allak, c. 3.5 km SSW of the peak Allaktjåhkkå and c. 10 km N of Staloluokta, 590 m alt., 31 July 2004, M. Westberg 3064 (LD); Torne Lappmark: Jukkasjärvi par., Jebrinjokk, 400 m, 16 July 1919, Magnusson 3310 (UPS L-514336); near Torneträsk, Nuolja. 2 August 1921, Magnusson 6199a (UPS L-514869).

Ecology and distribution: *Acarospora septentrionalis* is currently known from the montane regions of northern Scandinavian and from Iceland. It has been collected on calcareous schist, dolomite and cement.

Notes: Magnusson (1924) first described this taxon as a variety of *A. badiofusca* (var. *glaucocarpoides*), but later changed his mind and considered it to be a peculiar form of *A. glaucocarpa* (Magnusson 1929). We find that this is a morphologically distinct taxon and molecular data support the distinction of *A. septentrionalis* as a species. The epithet *glaucocarpoides* is not appropriate to use due to the already existing name *Sarcogyne glaucocarpoides* Flagey (1896) and hence we describe it as a new species here. It is somewhat similar to *A. badiofusca*, especially when the apothecia becomes superficial and darker than the surrounding thallus. *Acarospora badiofusca*, however, usually has larger and more distinctly sessile apothecia, which typically become dark brown to almost black. The paraphyses in *A. badiofusca* are wider (2–3 μm) and the spores are also wider (2–3 μm). The molecular data clearly show that *A. septentrionalis* is not conspecific with *A. badiofusca* or its close relative *A. cervina*. *Acarospora septentrionalis* may also be confused with *A. glaucocarpa*. However, *A. septentrionalis* (like *A. badiofusca*), has an algal layer that is continuous and not interrupted by hyphal bundles as in *A. glaucocarpa* and some other species (Knudsen et al. 2014). A further difference to *A. glaucocarpa* is the paraplectenchymatous cortex consisting of rounded, thin-walled cells. *Acarospora glaucocarpa* on the other hand has a prosoplectenchymatous cortex of irregular hyphae with narrow lumina.

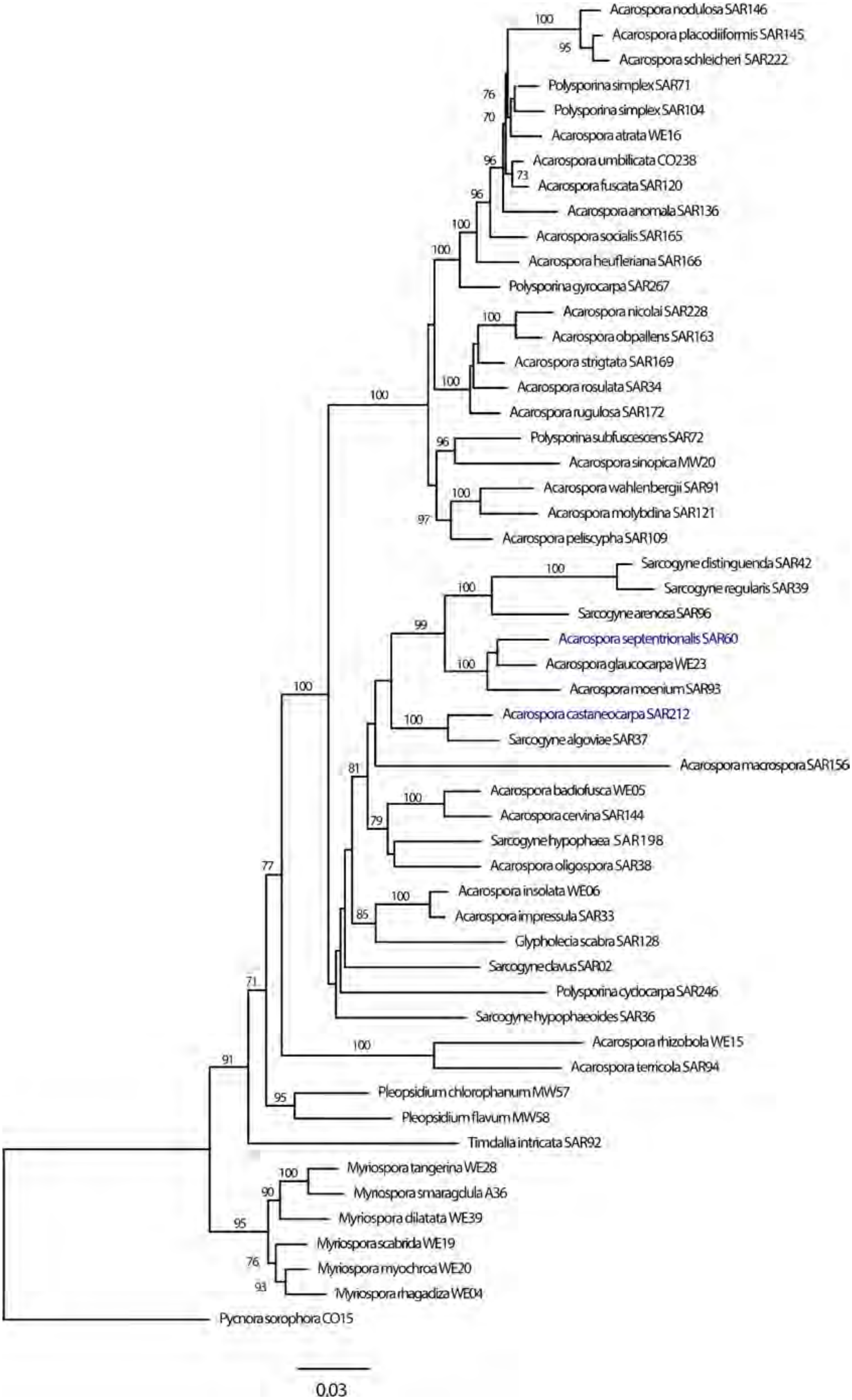
180. ***Acarospora castaneocarpa*** M. Westb. & Wedin, ***sp. nov.***

MycoBank number: MB 813044; *Facesoffungi number*: FoF00928; Fig. 64f–i.

Etymology: In reference to the chest-nut coloured ascocarps.

Holotype: FINLAND, Varsinais-Suomi (Regio Aboensis), Lohja, Paavola, NE of Rautaniemi, stony SE-slope, young *Pinus sylvestris* plantation, on calcareous stone, 50 m alt., 21 May 2005, Juha Pykälä 26880 (H).

Lichenized, photobiont a chlorococcoid alga. *Thallus* only present as a thalline margin in the ascocarps. *Apothecia*


100
Acarospora nodulosa SAR146
95
Acarospora placodiiformis SAR145
Acarospora schleicheri SAR222
76
Polysporina simplex SAR71
70
Polysporina simplex SAR104
Acarospora atrata WE16
96
Acarospora umbilicata CO238
73
Acarospora fuscata SAR120
96
Acarospora anomala SAR136
100
Acarospora socialis SAR165
100
Acarospora heufleriana SAR166
Polysporina gyrocarpa SAR267
100
Acarospora nicolai SAR228
Acarospora obpallens SAR163
Acarospora strigtata SAR169
100
Acarospora rosulata SAR34
100
Acarospora rugulosa SAR172
96
Polysporina subfuscescens SAR72
Acarospora sinopica MW20
100
Acarospora wahlenbergii SAR91
97
Acarospora molybdina SAR121
Acarospora peliscypha SAR109
100
Sarcogyne distinguenda SAR42
100
Sarcogyne regularis SAR39
Sarcogyne arenosa SAR96
99
Acarospora septentrionalis SAR60
100
Acarospora glaucocarpa WE23
100
Acarospora moenium SAR93
Acarospora castaneocarpa SAR212
100
Sarcogyne algoviae SAR37
Acarospora macrospora SAR156
81
Acarospora badiofusca WE05
100
79
Acarospora cervina SAR144
Sarcogyne hypophaea SAR198
Acarospora oligospora SAR38
77
Acarospora insolata WE06
100
85
Acarospora impressula SAR33
Glypholecia scabra SAR128
Sarcogyne clavus SAR02
71
Polysporina cyclocarpa SAR246
Sarcogyne hypophaeoides SAR36
100
Acarospora rhizobola WE15
91
Acarospora terricola SAR94
95
Pleopsidium chlorophanum MW57
Pleopsidium flavum MW58
Timdalia intricata SAR92
100
Myriospora tangerina WE28
90
Myriospora smaragdula A36
95
Myriospora dilatata WE39
Myriospora scabrida WE19
76
Myriospora myochroa WE20
93
Myriospora rhagadiza WE04
Pycnora sorophora CO15
0.03

◀ **Fig. 63** Phylogram generated from maximum likelihood analysis (implemented in RAxMLGUI 1.3) based on combined ITS, nuLSU, mtSSU and beta-tubulin sequenced data of the family *Acarosporaceae*. Maximum likelihood bootstrap values ≥70 % are indicated over the branches. Newly described species are in *blue*. The tree is rooted with *Pycnora sorophora*

lecanoroid, rounded or more often irregular in outline, 0.6–1.1 mm diam., margin distinct, raised above the disc, up to c. 0.12 mm thick, reddish brown, shiny, in the paratype with a bluish white pruina along the inner rim (adjacent to the disc); disc concolourous with the margin, flat, smooth, shiny, epruinose; true exciple indistinct from the outside, I–, prosoplectenchymatous, below the hymenium of thick-walled cells with narrow lumina, towards the surface expanding and becoming fan-shaped, composed of branching, narrow, elongated cells, becoming shorter and rounded towards the surface, uppermost cells rounded, up to c. 5 µm diam., with a reddish-brown colour; epithecium reddish brown; hymenium colourless, I+ blue, 65–80 µm tall; paraphyses, easily distinguished in water, 1–1.5 µm in mid

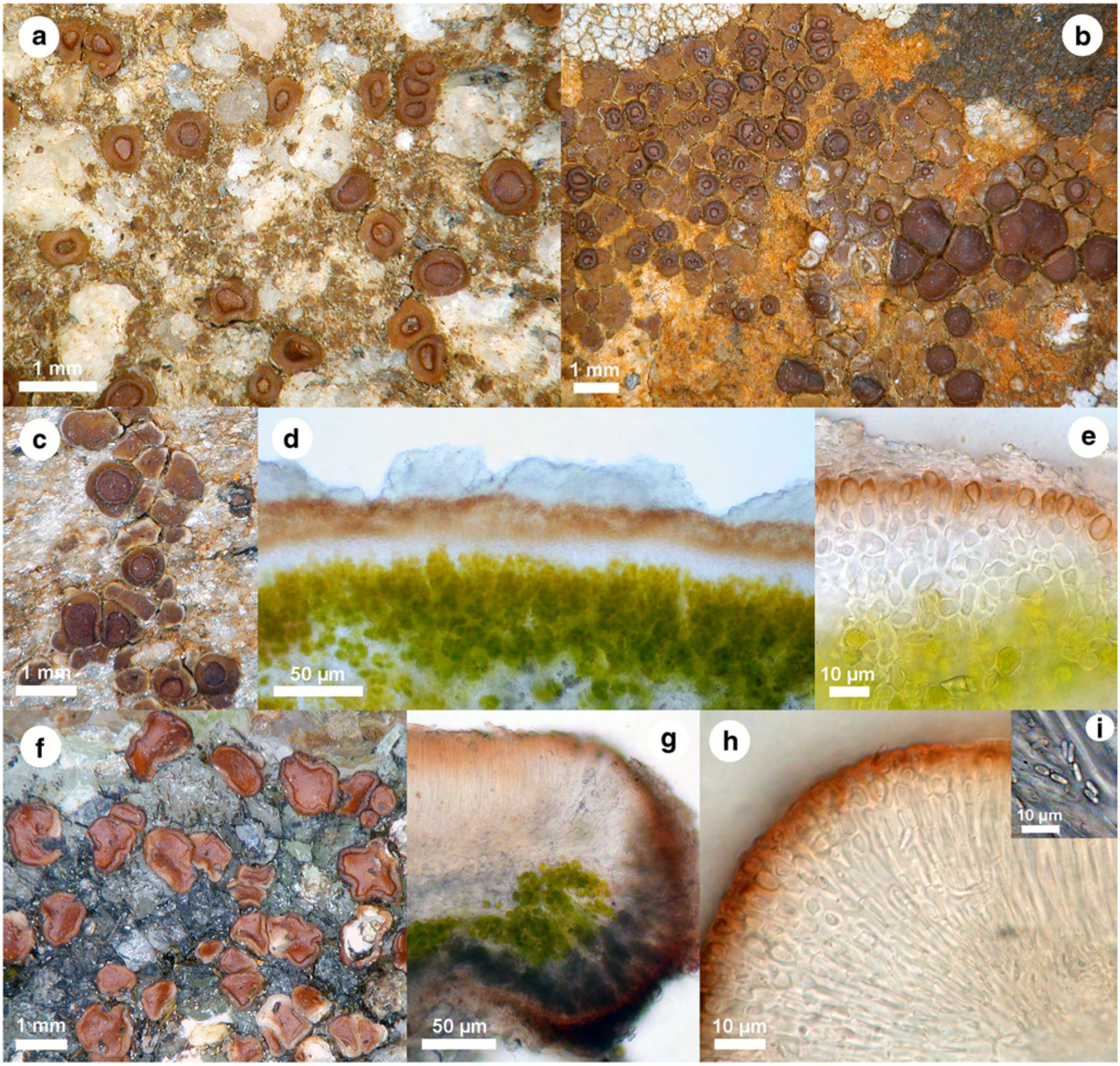


Fig. 64 **a**–**e** *Acarospora septentrionalis* **a** Norway, Westberg 08-148 (S holotype) **b** Iceland, Fröberg (LD) **c** Sweden, Westberg 3064 (LD) **d**, **e** (holotype) Section through thallus showing continuous algal layer, a paraplectenchymatous cortex and thick, uneven epinecral layer **f**–**i** *Acarospora castaneocarpa* **f**–**i** Finland, Pykälä 26880 (H holotype) **g**, **h** Section through apothecium showing dense layer of crystals in the cortex and anatomy of the true exciple **i** Spores. Scale bars: **a**–**c**, **f**=1 mm, **c**=50 µm, **e**=10 µm, **g**=50 µm, **h**–**i**=10 µm. Photographs by M. Westberg

hymenium, tips clavate, up to 4.5 µm wide, upper part of the top cell often reddish brown; subhymenial layers, colourless, flat (i.e., not forming a wedge-shaped structure), up to c. 40 µm thick, prosoplectenchymatous, compact, of small, indistinct cells, oil-drops colourless, small, very few seen; *Asci* clavate, multi-spored (no well-developed asci found). *Ascospores* 3.5–5 × 1–1.5 µm (only few spores found), colourless, simple, narrowly ellipsoid–cylindrical. *Pycnidia* not seen. All spot tests negative.

Material examined: FINLAND, Varsinais-Suomi (Regio Aboensis), Lohja, Torhola, 300 m N-NE of Kallioranta, young pine plantation, S-slope, small rock wall of calcareous rock, 60 m alt., 22 July 2004, Juha Pykälä 25280 (H).

Ecology and distribution: *Acarospora castaneocarpa* is so far only known from two localities near the lake Lohjanjärvi in southernmost Finland where it was collected on calcareous rocks in young *Pinus sylvestris* forests.

Notes: Surprisingly this characteristic species is closely related to *Sarcogyne algoviae*, a very different species with black, lecideine apothecia with a strongly carbonized margin. In *A. castaneocarpa* the margin of the apothecium has a cortical layer that is densely filled with small, colourless crystals (calcium oxalate?). We have not seen this character in any other species in *Acarosporaceae* and as far as we know this is a very unusual character in the family.

Graphidaceae Dumort.

Graphidaceae is the second largest family of lichenized fungi, after *Parmeliaceae*, with 2100 species (Rivas Plata et al. 2012; Lücking et al. 2014; Lumbsch and Lücking 2015). The family is chiefly tropical, with a few taxa occurring in extratropical regions. After a thorough phylogenetic revision, the family now also includes the previously separate family *Thelotremataceae* and comprises 77 genera, now excluding the separate family *Gomphillaceae* which had previously also been synonymized with *Graphidaceae* (Lumbsch and Lücking 2015). Lücking et al. (2014) predicted that the family might contain another 1800 undescribed species and 175 new species were recently described in a single, compiled work (Sohrabi et al. 2014). Here we described two further new species based on recent molecular phylogenetic analyses (Rivas Plata et al. 2013).

181. ***Chapsa multicarpa*** Lücking, Parnmen & Lumbsch, ***sp. nov.***

Index Fungorum number: IF551486; *Facesoffungi number*: FoF00968; Fig. 66a, c, e

Etymology: Referring to the usually aggregate ascomata.

Holotype: R. Lücking 24007 (RAMK).

Diagnosis: Differing from *Chapsa leprocarpa* and *C. patens* in the smaller, aggregate ascomata with layered excipulum.

Thallus corticolous on tree trunks and branches, endoperidermal, continuous, smooth to uneven, following the contours of the bark, brownish to greenish depending on bark type, opaque. *Photobiont* endoperidermal, *Trentepohlia*; cells rounded to irregular in outline, in irregular groups, yellowish green, 6–12 × 5–10 µm. **Sexual morph**: *Ascomata* aggregated, groups erumpent, angular to elongate, 0.5–1.5 mm across, usually composed of 2–5 individual ascomata; individual ascomata angular-rounded, 0.2–0.3 mm diam. and 0.15–0.18 mm high; disc mostly covered by concentric layers of excipula, grey-brown, thickly white-pruinose; proper margin distinct, white, forming several excipular layers; thalline margin formed by shallow, erect lobules, pale yellowish. *Columella* absent. *Excipulum* paraplectenchymatous, 15–20 µm wide, hyaline, fused with thalline margin; thalline margin 40–70 µm thick; hypothecium prosoplectenchymatous, 15–20 µm high, hyaline; hymenium 130–150 µm high, hyaline, clear; epithecium with large crystal clusters, 20–30 µm high, grey. *Paraphyses* unbranched, smooth; lateral paraphyses up to 15 *µm* long; asci ellipsoid to fusiform, 120–140 × 25–30 µm. *Ascospores* 1 per ascus, richly muriform, hyaline, ellipsoid to fusiform, with thin septa and rectangular lumina, 80–130 × 20–25 µm, I–. **Asexual morph**: Undetermined. *Secondary chemistry*: No substances detected by TLC.

Material examined: THAILAND, Nakhon Ratchasima, Khao Yai National Park, 200 km NE of Bangkok, Khao Keaw scenic lookout; 14° 22′ N, 101° 24′ E; 1140 m; tropical submontane moist evergreen forest dominated by *Dipterocarpaceae*; 13 March 2008; R. Lücking 24007 (RAMK **holotype**; F **isotype**); same locality and date, R. Lücking 24009 (F **paratype**).

Notes: *Chapsa multicarpa* is characterized by the small ascomata aggregate in irregular to linear groups, containing two to five individual ascomata, with a layered excipulum and large, muriform ascospores occurring singly in each ascus. Molecular sequence data place the new species in *Chapsa sensu stricto* (Parnmen et al. 2012; Rivas Plata et al. 2013), unsupported sister to the type species, *C. indica* A. Massal. (Fig. 65). The large, single, muriform ascospores and the lack of secondary substances would key out *C. multicarpa* close to *C. leprocarpa* (Nyl.) Frisch and *C. patens* (Nyl.) Frisch (Rivas Plata et al. 2010), but both these species have larger, solitary ascomata and the excipulum is not layered. Molecular sequence data including mtSSU, nuLSU and RPB2 also show that all three species are phylogenetically distinct (Rivas Plata et al. 2013; Fig. 65). *Chapsa multicarpa* also resembles *Astrochapsa kalbii* Poengsungnoen et al. (2014), which also features aggregate ascomata with a layered

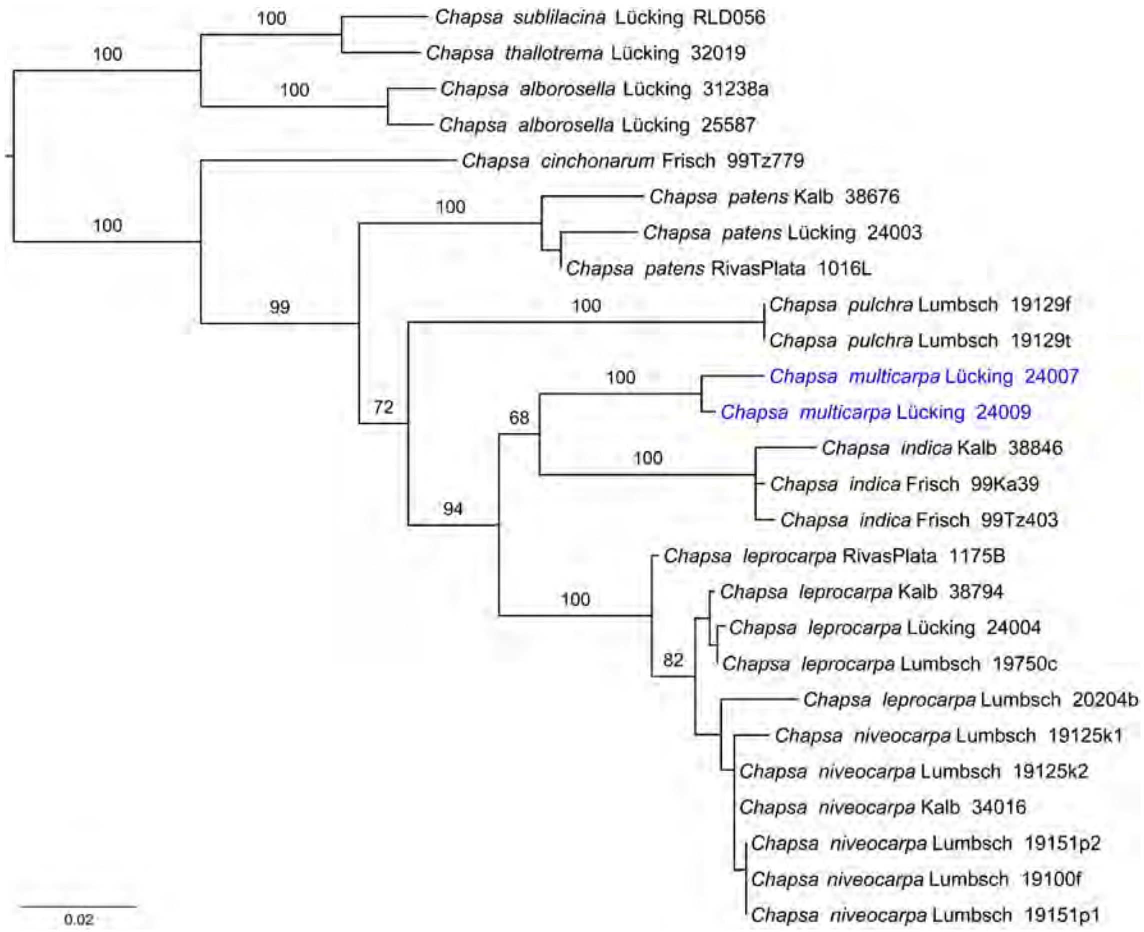


Fig. 65 Best-scoring maximum likelihood tree with bootstrap support values computed with RAxML 8.2 of selected species of *Graphidaceae* subfamily *Graphidoideae* tribe *Thelotremateae* genus *Chapsa sensu stricto*, including the new species *C. multicarpa*, using *Dyplolabia afzelii* as the outgroup. For GenBank numbers based on voucher information indicated in the tree, see (Parnmen et al. 2012) and (Rivas Plata et al. 2013)

excipulum. However, the latter forms an epiperidermal thallus with a thin, loose cortex, the hymenium is formed in the outermost ring of the concentric excipulum layers (not in a central disc), and the ascospores are smaller (less than half the size) and with 1–2 per ascus. Phylogenetically, the two species are only distantly related, as *A. kalbii* is closely related to the type species of *Astrochapsa*, *A. astroidea* (Berk. & Broome) Parnmen et al. (2012; Poengsungnoen et al. 2014).

182. ***Fissurina carassensis*** Lücking, Parnmen & Lumbsch, ***sp. nov.***

Index Fungorum number: IF551487; *Facesoffungi number*: FoF00969; Fig. 66b, d, f

Etymology: Referring to the type locality.

Holotype: R. Lücking 31224a (SP).

Diagnosis: Differing from *Fissurina dumastii* in the apically smooth paraphyses and the more strongly I+ violet-blue ascospores, and from *F. amazonica*, *F. coarctata* and *F. subcoarctata* in the larger ascomata and I+ violet-blue ascospores.

Thallus corticolous on tree trunks, epiperidermal, up to 10 cm diam., continuous; surface smooth to uneven, mottled yellowish green to silvery grey, glossy; prothallus absent; thallus in section 70–130 μm thick, with prosoplectenchymatous cortex, 15–25 μm thick, photobiont layer 25–50 μm thick, and medulla, 30–50 μm thick, filled with numerous small, grey crystals that dissolve in K; large clusters of calcium oxalate crystals only present at the base of the ascomata. *Photobiont Trentepohlia*; cells rounded to irregular in outline, in irregular groups, yellowish green, 6–11 × 5–9 μm. **Sexual morph**: *Ascomata* lirellate, immersed-erumpent, irregularly branched and rather dense, with thin labia (fissurine), closed to very slightly gaping, 1–3 mm long, 0.15–0.25 mm broad, 0.1–0.13 mm high; disc more or less concealed; proper margin indistinct; thalline margin

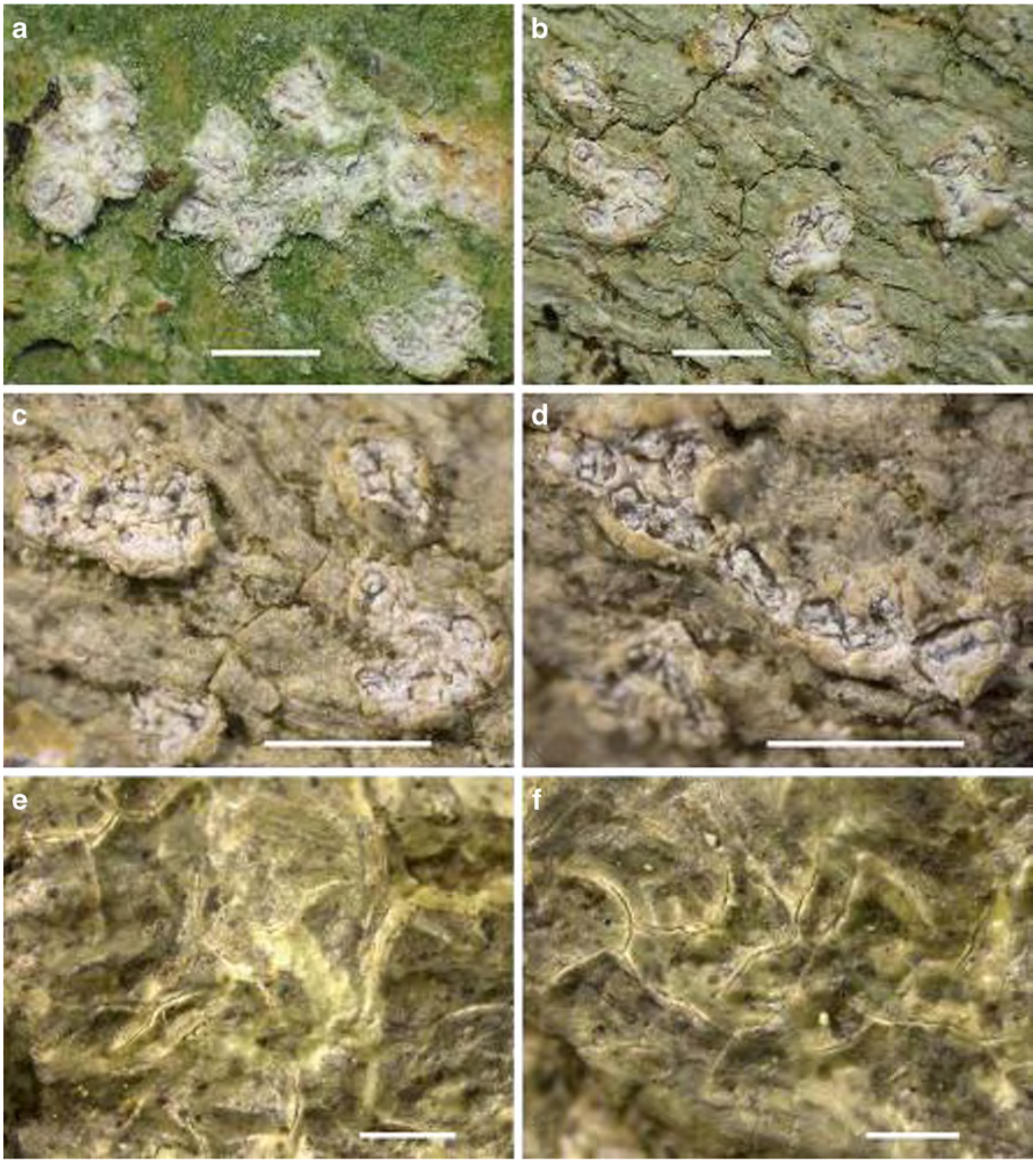


Fig. 66 *Chapsa multicarpa* (paratype) **a** Thallus surface view with ascomata. *Chapsa multicarpa* (holotype) **b**–**d** Thallus surface view with ascomata. *Fissurina carassensis* (holotype) **e**, **f** Thallus surface view with ascomata. Scale bars: **a**–**f**=1 mm

slightly ascending, entire, whitish to light yellowish grey. *Excipulum* orange-yellow, 20–30 µm wide, prosoplectenchymatous, fused with thalline margin; thalline margin 50–70 µm thick, anatomically similar to thallus; hypothecium prosoplectenchymatous, 10–15 µm high, hyaline; hymenium 70–80 *µm* high, hyaline, clear; epithecium indistinct, 5–10 µm high, hyaline. *Paraphyses* unbranched, smooth; periphysoids present, rather distinct, shallowly and indistinctly warty; asci cylindrical, 70–80 × 8–10 µm. *Ascospores* 8 per ascus, uniseriate, ellipsoid, 3-septate, 10–13 × 5–6 µm, 1.8–2.3 times as long as wide, hyaline, distoseptate with lens-shaped lumina, I+ violet-blue. **Asexual morph**: Undetermined. *Secondary chemistry*: No substances detected by TLC; medulla P–, microscopic section K–.

Material examined: BRAZIL, Minas Gerais, Serra do Caraça, Reserva Particular do Patrimônio Natural (RPPN) Santuário do Caraça, trail through forest to chapel; 20° 06′ S, 43° 29′ W, 1300–1400 m, Atlantic Rain Forest, relatively well-preserved gallery forest (mata de galeria or floresta ombrófila densa montana) along small river, 27 July 2010, R. Lücking 31224a (SP **holotype**; F **isotype**).

Notes: *Fissurina carassensis* belongs in a complex of species centered around *F. dumastii* Fée, characterized by immersed-erumpent, fissurine ascomata, 3-septate, very small ascospores, and lack of secondary substances. Within this complex, the new species is characterized by its distinctly I+, violet-blue ascospores, whereas in *F. dumastii* the ascospores are only weakly I+ violet-blue and in the other species of this complex, *F. amazonica* M. Cáceres et al. (2014) and *F. coarctata* Makhija and Adawadkar (2007), they are I–. *Fissurina dumastii* also differs in its apically spinulose paraphyses (Staiger 2002), whereas *F. amazonica* and *F. coarctata* have very small lirellae (up to 1 mm long only). Molecular sequence data show that *F. carassensis* and *F. dumastii* are phylogenetically distinct (Rivas Plata et al. 2013; Fig. 67).

Lobariaceae Chevall.

The family *Lobariaceae* traditionally comprised the three genera *Lobaria*, *Pseudocyphellaria* and *Sticta*, but the genus concept has recently been revised to accept 12 genera (Moncada et al. 2013; Galloway 2015; Lumbsch and Lücking 2015). In addition, phylogenetic and morphological studies also suggest that species richness in this family is much higher than previously accepted and that names applied to supposedly widespread taxa, such as *Lobariella crenulata* (Hook. in Kunth) Yoshim., *Pseudocyphellaria crocata* (L.) Vain. and *Sticta fuliginosa* (Dicks.) Ach., actually represent many different, often unrelated species (Moncada et al. 2013, 2014a, b). Especially the genus *Sticta* is now believed to contain several hundred species (Moncada et al. 2014a), two of which are described here.

183. ***Sticta fuscotomentosa*** Moncada, Coca & Lücking, ***sp. nov.***

Index Fungorum number: IF551488; *Facesoffungi number*: FoF: 00929; Fig. 69a–d

Etymology: Referring to the superficial similarity with *Sticta tomentosa*.

Holotype: L.F. Coca 1207 (FAUC).

Diagnosis: Differing from *Sticta tomentosa* and *S. leucoblepharis* in the brown to dark tomentum and the 2–4 papillae on the cells of the basal membrane of the cyphellae.

Thallus epiphytic, corticolous. *Primary photobiont* a cyanobacterium (*Nostoc*). *Basal stipe* absent or indistinct. *Thallus* palmate to irregular, up to 10 cm across, moderately branched. *Lobes* laciniate to ligulate, ascendant to erect, adjacent to imbricate, plane to involute, with rounded tips; margins straight

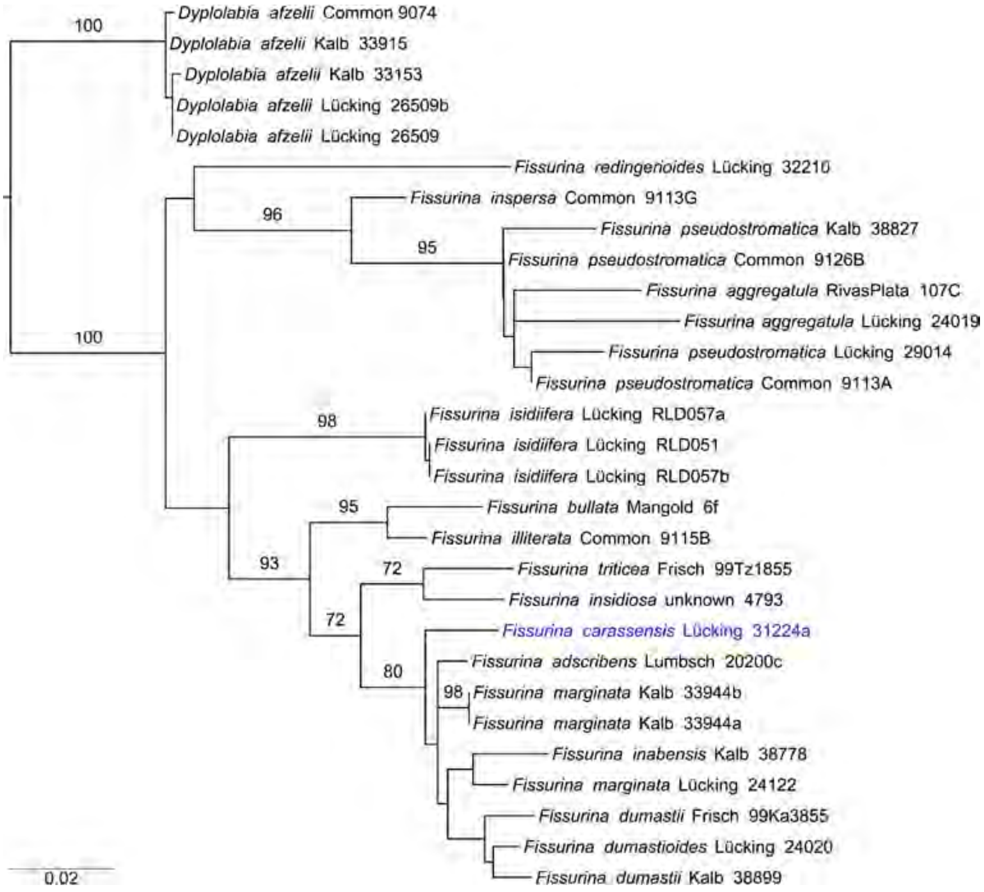


Fig. 67 Best-scoring maximum likelihood tree with bootstrap support values computed with RAxML 8.2 of selected species of *Graphidaceae* subfamily *Fissurinoideae*, including the new species *Fissurina carassensis*, using *Dyplolabia afzelii* as outgroup. For GenBank numbers based on voucher information indicated in the tree, see (Rivas Plata et al. 2013)

to sinuose; lobe internodes 4–12 mm long and (5–)10–20 mm broad. *Upper surface* even to shallowly foveolate (point-impressed), dark green when fresh and bluish grey in the herbarium, opaque to slightly glossy, glabrous, with scattered, irregular, cream-coloured maculae; cilia abundant, dark greyish brown, up to 1 mm long. *Vegetative propagules* absent. *Apothecia* abundant, mostly laminal, substipitate, up to 1.3 mm diam. and 330 μm high; disc reddish brown; margin entire, cream-coloured. Excipulum up to 120 μm broad; hymenium up to 100 μm high; epithecium up to 5 μm high, orange. *Ascospores* fusiform, 1–3-septate, 20–35 × 7–8 μm, hyaline. *Medulla* loose in surface view, whitish to cream-coloured, K+ yellow, C–, KC–, P–. Upper cortex paraplectenchymatous, 20–30 μm thick; upper layer with smaller, thicker-walled cells and lower layer with larger, thinner-walled cells; photobiont layer 10–20 μm thick; medulla 75–120 μm thick, with yellow-orange crystals; lower cortex paraplectenchymatous, 15–20 μm thick. *Lower surface* even to slightly undulate, whitish to cream-coloured, but becoming darker towards the center. *Primary tomentum* irregular, thick, becoming sparse and thin towards the margin, arachnoid to spongy, beige to dark greyish brown towards the center, hairs 120–750 μm long, forming fascicles of 12–20 unbranched, septate hyphae; secondary tomentum absent. *Rhizines* absent. *Cyphellae* abundant, 1–20 per cm^2 towards the center and 41–60 per cm^2 towards the margin, dispersed, angular-rounded, urceolate with wide pore, (0.25–)0.4–0.7(−1.3) mm diam., immersed to prominent but remaining below the level of the tomentum, with involute, whitish to cream-coloured, glabrous margin; basal membrane finely pubescent, with 2–4 papillae per cell, pale yellowish, K+ yellow, C–, KC–, P–. *Pycnidia* not observed. *Secondary chemistry*: No substances detected by TLC but medulla and basal membrane of the cyphellae with dispersed, orange-yellow pigment granules in anatomical sections.

Material examined: COLOMBIA, Risaralda, Mun. Santuario, Tatamá National Natural Park, close to Monte Zancudo, 2600 m, 13 January 2011, L.F. Coca et al. 1207 (FAUC **holotype**; UDBC **isotype**); Quindío, Mun. Salento, Navarco Alto trail, Piscícola station, trail to the line, 3000 m, 4 November 1991, J. Uribe & A. Bonilla 2173 (COL); Risaralda, Mun. Pereira, Otún Quimbaya Fauna and Flora Sanctuary, La Florida, La Suiza trail, 1820 m, 2 September 2003, B. Moncada & R. Dávila 1908b (UDBC); Tolima, Mun. Ibagué, Las Juntas, El Silencio to El Rancho road, 2600 m, 18 May 2008, B. Moncada 2531b (UDBC).

Distribution and Ecology: *Sticta fuscotomentosa* is thus far known from the Colombian Andes, in the upper montane cloud forest zone between 1820 and 3000 m altitude. The species is typically found epiphytically in shady to semi-exposed microsites.

Notes: *Sticta fuscotomentosa* belongs in the *S. tomentosa* clade (Moncada et al. 2014a, b; Fig. 68) and is most similar to *S. tomentosa* (Sw.) Ach. and *S. leucoblepharis* (Nyl.) Tuck. & Mont. and differs chiefly in the dark lower tomentum towards the thallus center and the dark marginal cilia (Moncada 2012). The apothecial margin is glabrous, whereas young apothecia in *S. tomentosa* and apothecia in *S. leucoblepharis* have tomentose margins.

184. ***Sticta subfilicinella*** Moncada, Coca & Lücking, ***sp. nov.***

Index Fungorum number: IF551576; *Facesoffungi number*: FoF00930; Fig. 69e–f

Etymology: Referring to the similarity and close relationship with *Sticta filicinella*.

Holotype: L.F. Coca 1110 (FAUC).

Diagnosis: Differing from *Sticta filicinella* in the absence of isidia.

Thallus epiphytic, corticolous. *Primary photobiont* a cyanobacterium (*Nostoc*). *Basal stipe* absent or indistinct. *Thallus* irregular to suborbicular, up to 5 cm across, moderately branched. *Lobes* laciniate to ligulate, ascendant, adjacent to imbricate, plane to canaliculate, with rounded, revolute tips; margins straight to sinuose; lobe internodes 4–10(−15) mm long and 4–10 mm broad. *Upper surface* even to shallowly scrobiculate-rugose, greenish grey when fresh and bluish to greenish grey in the herbarium, opaque to slightly glossy, glabrous, with abundant, irregular, cream-coloured maculae; cilia sparse to abundant, dark brown, up to 1 mm long. *Vegetative propagules* absent. *Apothecia* sparse, mostly submarginal, substipitate, up to 1.5 mm diam. and 330 μm high; disc orange; margin entire, cream-coloured to light yellowish. Excipulum up to 130 μm broad; hymenium up to 160 μm high; epithecium up to 5 μm high, orange. *Ascospores* not observed. *Medulla* loose in surface view, cream-coloured, K+ yellow, C–, KC–, P–. Upper cortex paraplectenchymatous, 30–45 μm thick, with uniform layers; photobiont layer 25–35 μm thick; medulla 50–120 μm thick, with yellow-orange crystals; lower cortex paraplectenchymatous, 15–30 μm thick. *Lower surface* undulate, cream-coloured to pale yellowish. *Primary tomentum* vein-like, thick, becoming sparse and thin towards the margin, spongy, dark brown, hairs 75–900 μm long, forming fascicles of 12–20 unbranched, septate hyphae; secondary tomentum absent. *Rhizines* absent. *Cyphellae* abundant, 21–40 per cm^2 towards the center and 100–200 per cm^2 towards the margin, dispersed, angular-rounded, thelotremoid to urceolate with narrow pore, 0.1–0.25 mm diam., erumpent to prominent but remaining below the level of the tomentum, with involute, cream-coloured to pale yellowish, glabrous margin; basal membrane finely pubescent, with papillum per cell, cream-coloured to pale yellowish,

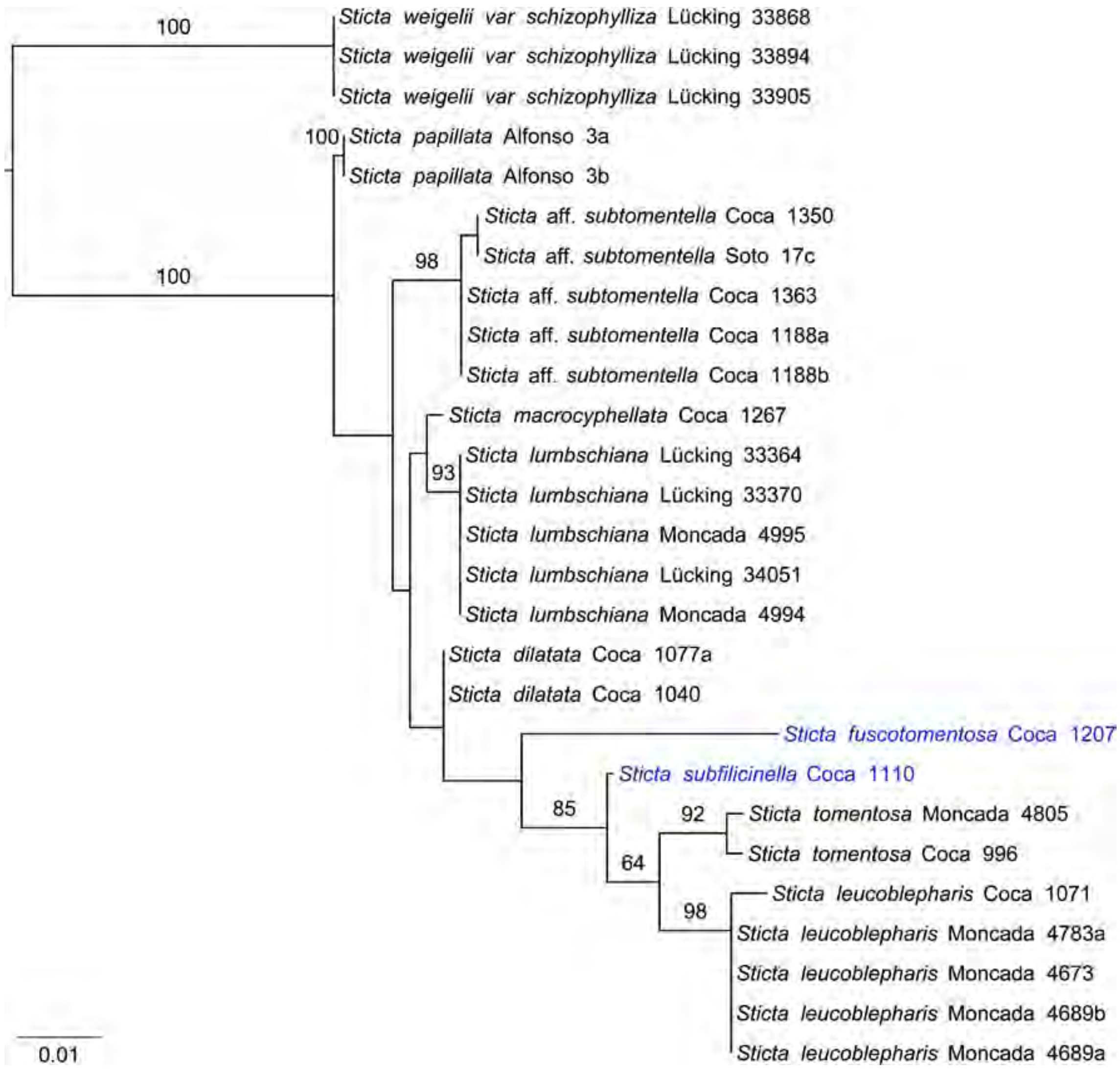


Fig. 68 Best-scoring maximum likelihood tree with bootstrap support values computed with RAxML 8.2 of selected species of *Sticta* (*Lobariaceae*), including the new species *S. fuscotomentosa* and *S. subfilicinella*. GenBank numbers and voucher information are indicated in the tree (see Moncada et al. 2014 for full tree)

K+ yellow, C–, KC–, P–. *Pycnidia* not observed. *Secondary chemistry*: No substances detected by TLC but medulla and basal membrane of the cyphellae with dispersed, orange-yellow pigment granules in anatomical sections.

Material examined: COLOMBIA, Risaralda, Mun. Santuario, Tatamá National Natural Park, close to Monte Zancudo, 2600 m, 13 January 2011, L.F. Coca et al. 1110 (FAUC **holotype**; UDBC **isotype**); Caldas, Mun. Pacora, Filobonito trial, La Quinta section, 2123 m, 2010, L.F. Coca 177 (UDBC); Cundinamarca, Mun. Choachí, El Verjón, Matarredonda Ecological Park, 04° 34′ N, 74° 00′ W; 2900–3220 m, 8 May 2010, B. Moncada 3060 (UDBC); Magdalena, Mun. Santa Marta, Sierra Nevada de Santa Marta, Alto Buritaca transect, 2500 m, August 1977, G. van Reenen & O. Rangel 269 (COL, U); Same locality, Buritaca transect, 2500 m, August 1977, O. Rangel et al. 711 (COL, U); Nariño, Mun. Piedrancha, La Planada, San Isidro, S of Ricaurte (Pasto to Tumaco road), 1750 m, 2 June 1993, H. Sipman et al. 32849 (B, COL); Risaralda, Mun. Santuario, Tatamá National Natural Park, Planes de San Rafael, trail after hut, 2400 m, 12 January 2011, L.F. Coca et al. 1079 (FAUC); same locality, close to Monte Zancudo, 2600 m, 13 January 2011, L.F. Coca et al. 1139, 1213, 1214 (FAUC).

Distribution and Ecology: *Sticta subfilicinella* is thus far known from the Colombian Andes, in the upper montane cloud forest zone between 1750 and 3220 m altitude. The species is typically found epiphytically in semi-exposed microsites.

Distribution and Ecology: *Sticta subfilicinella* is thus far known from the Colombian Andes, in the upper montane

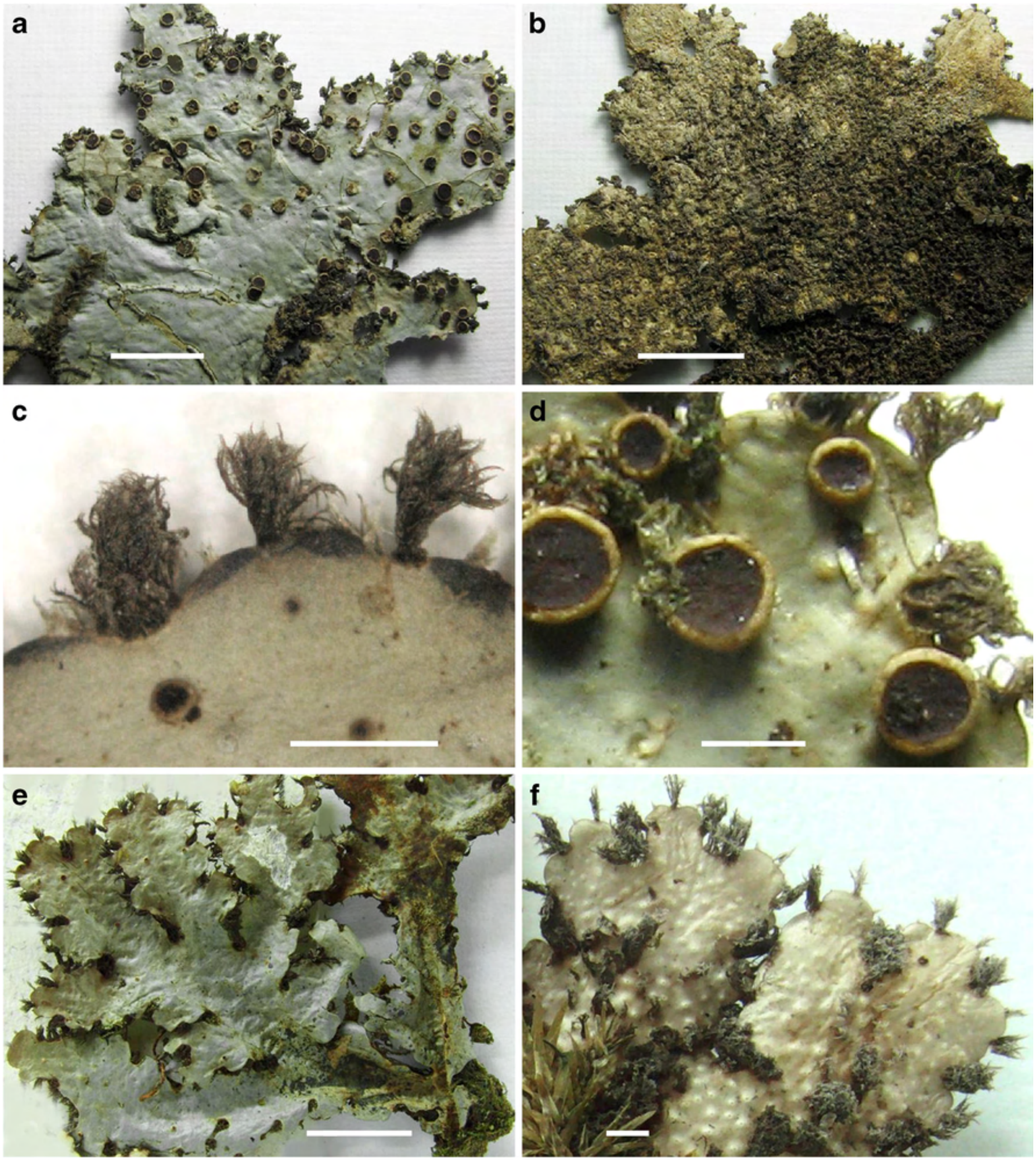


Fig. 69 *Sticta fuscotomentosa* (holotype) **a** Lobe upper side with apothecia **b** Lobe underside showing dark tomentum **c** Marginal cilia enlarged **d** Apothecia enlarged. *Sticta subfilicinella* (holotype) **e** Lobe upper side **f** Lobe underside showing marginal cilia and tomentum. Scale bars: **a**–**b**, **e**=10 mm, **c**–**d**, **f**=1 mm

cloud forest zone between 1750 and 3220 m altitude. The species is typically found epiphytically in semi-exposed microsites.

Notes: This new species belongs in a group characterized by an exclusively cyanobacterial photobiont forming small, thin, fragile grey thalli (often both fresh and in the herbarium), with marginal cilia, the lower tomentum often vein-like, and small, thelotremoid cyphellae. The lower margin is usually glabrous. This group is related to *Sticta tomentosa* and allies (Moncada et al. 2014a, b; Fig. 62). Most similar to *Sticta subfilicinella* is *S. filicinella* (Nyl.) Zahlbr., which produces abundant isidia instead of apothecia (Lumbsch et al. 2011; Moncada 2012). Another similar species is the recently described *S. venosa* Lücking et al. from Ecuador (Lumbsch et al. 2011), which has broader lobes and like *S. filicinella* also produces isidia.

Pezizomycetes

Helvellaceae Fr.

The family *Helvellaceae* was introduced by Fries (1822) to accommodate *Helvella* L.

185. *Helvella pseudolacunosa* Q. Zhao & K.D. Hyde, *sp. nov.*

Index Fungorum number: 551446; *Facesoffungi number*: FoF00971; Fig. 71

Diagnosis: Pileus has a grey to dark grey, pinched hymenium, margin fused with stipe in several places, and a creamy, glabrous sterile surface. Stipe is enlarged at base, rounded longitudinal ribs, near the base with enlarged deep furrows, grey-white.

Etymology: Named because of the resemblance with *Helvella lacunosa*.

Holotype: CHINA, Neimenggu Province, Axiangshan County, alt. 180 m, 16 August 2013, Qi Zhao 2012 (HKAS 87594, GenBank number: KR 493476).

Symbiotic in the coniferous forests of *Larix gmelinii* (Rupr.) Rupr. or *Pinus koraiensis* Sieb. et Zucc. **Sexual morph**: *Pileus* saddle-shaped to irregularly lobed when young, irregularly lobed or brain-like when maturity, 1–4 cm high, 2–3 cm broad, pinched at apex, margin fused with stipe, *hymenium* glabrous, grey to dark grey, becoming black when dried, *sterile surface* glabrous, creamy, becoming yellowish when dried. *Stipe* 2–8 cm long, 0.7–1.5 cm broad, enlarged at base (up to 3 cm), round-shaped longitudinal ribs, near the base with enlarged deeply furrows, glabrous, grey-white when young, becoming grey with age, sometimes ochraceous along the upper portions of the stipe, white mycelium at base. *Medullary excipulum* 180–260 μm broad, *textura intricata*, hyaline, hyphae 3–5.5 μm broad, walls thickened. *Ectal excipulum* 120–220 μm broad, hyaline, terminal cells 16–40 × 10–20 μm, blue in cotton blue. *Stipitipellis* 40–55 μm, hyaline, composed of enlarged parenchymal cells, terminal cells 14–30 × 8–12 μm, walls thickened, blue in cotton blue. *Asci* 230–280 × 13–20 μm, pleurorhynchous, 8-spored, subcylindrical to clavate, blue in cotton blue. *Ascospores* [H_2O] (14.5)15–19.5(20) × (9.5)10–12(12.5) μm [$\bar{x}$ = 17.5 × 11 μm *n*=40], ellipsoid, smooth. *Paraphyses* filiform, 3–4.5 μm broad, slightly exceeding the asci, brown, with a yellow refractive content in Melzer's reagent, blue in cotton blue; apex 3.5–5 μm broad. **Asexual morph**: Undetermined.

Material examined: CHINA, Jilin Province, Antu County, alt. 200 m, 26 August 2006, B. Tolgor 4533 (HMJAU 4533 **holotype**).

Notes: The genus *Helvella* (*Helvellaceae*, Pezizomycotina) is regarded as common macrofungi in most temperate forests, and have been widely reported from Europe, North America, Asia and Australia; very little is known about the trophic status of these fungi (Abbott and Currah 1997; Hwang et al. 2015). Identification of the species belonging in this genus has often been based on ascoma shape and colour and the presence or absence of projecting hyphae on the sterile surface of the apothecium (Abbott and Currah 1997; Dissing 1966; Hwang et al. 2015; Weber 1972). There are 476 epithets listed under *Helvella* (Index Fungorum 2015), but few molecular data are available in GenBank (Landerose and Korf 2012; Nguyen et al. 2013).

Based on phylogenetic analyses and morphological comparison, our isolate belongs to *H. lacunosa* complex in *Helvellaceae* (Fig. 70). *Helvella pseudolacunosa* is similar to *H. dryophila* N.H. Nguyen & Vellinga, *H. lacunosa* Afzel.: Fr and *H. vespertina* N.H. Nguyen & Vellinga (Fig. 71). However, *H. dryophila* differs from *H. pseudolacunosa* in having a dark, almost black, squat pileus, light stipe, and forms ectomycorrhiza with *Quercus* species (Nguyen et al. 2013). Morphological differences between *H. pseudolacunosa* and *H. lacunosa* are subtle, the stipe of *H. pseudolacunosa* is usually enlarged at base, with rounded, longitudinal ribs, grey-white when young, ochraceous along the upper portions, while the latter species generally has a sharp-edged ribs, inside of stipe with longitudinal chambers, pale greyish to greyish-brown to nearly black (Dissing 1966). *Helvella vespertina* differs from *H. pseudolacunosa* by its pileus, three-lobes and wavy, gigantic stipe, and in forming ectomycorrhiza associations with conifers (Nguyen et al. 2013).

186. *Helvella rugosa* Q. Zhao & K.D. Hyde, *sp. nov.*

Index Fungorum number: 551447; *Facesoffungi number*: FoF00972; Fig. 72

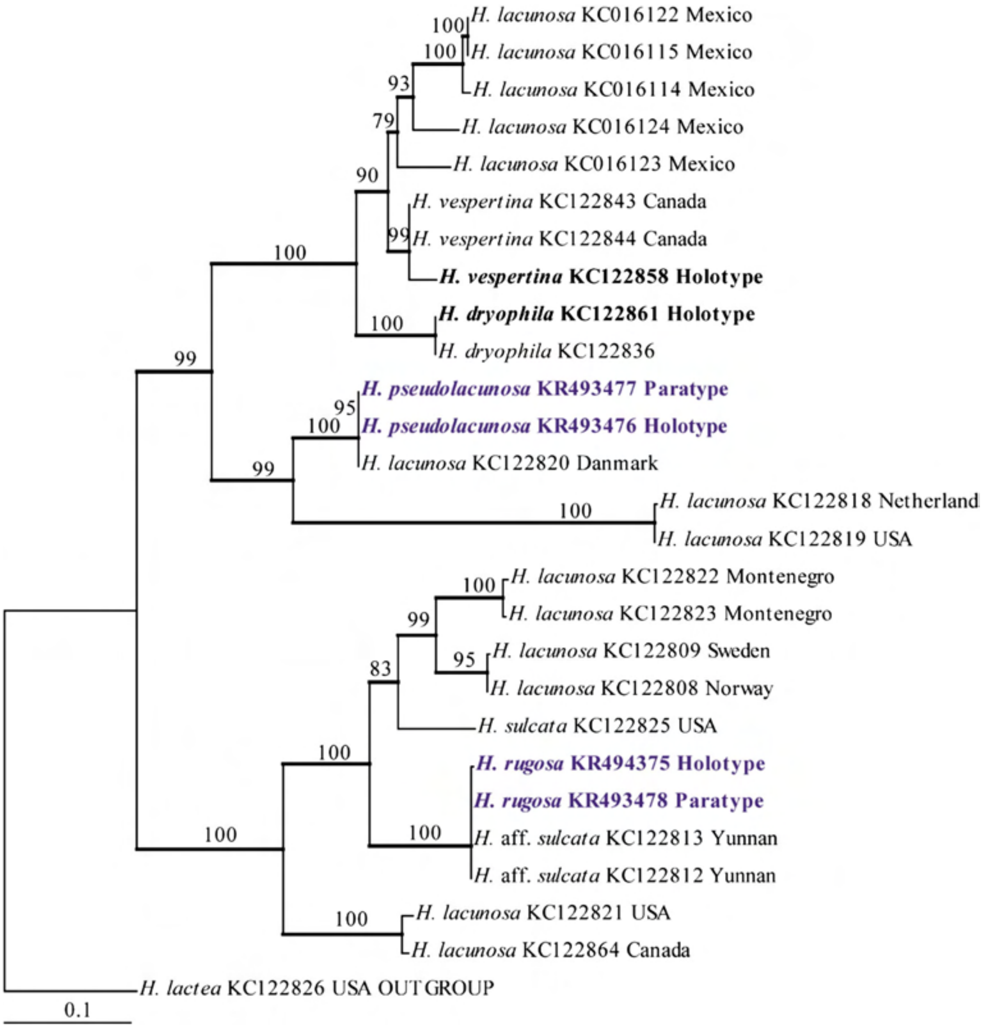
Diagnosis: Pileus has a pale to dark grey or greyish brown hymenium, margin reflexed and fused with stipe in several places, and a wrinkled-folded, white to pale sterile surface. Stipe is almost only has regularly longitudinal ribs, tapering downwards, greyish brown.

Etymology: Named because of its sterile surface wrinkled-folded.

Holotype: CHINA, Yunnan Province, Xishan County, *Quercus* spp. and bamboo forest, alt. 2600 m, 28 August 2009, Qi Zhao 481 (HKAS 75442).

Symbiotic in the coniferous forests of *Quercus* sp. **Sexual morph**: *Pileus* saddle-shaped to three-lobed, 1–2 cm high, 1–2 cm broad, margin reflexed and fused with stipe, *hymenium* glabrous, pale to dark grey or greyish brown when fresh, becoming black when dry. *Sterile surface* wrinkled-folded, white to pale when young, becoming yellowish when dried. *Stipe* 2–4 cm long, 0.4–0.7 cm broad, tapering downward, mainly longitudinal ribs and few lacunose, glabrous, greyish brown when young, becoming black when dry, white mycelium at base. *Medullary excipulum* 80–260 μm broad, *textura intricata* and *textura prismatica*, hyaline, hyphae 3–5.5 μm broad, enlarged cells 8–15 × 7–14 μm, walls thickened. *Ectal excipulum* 50–80 μm broad, outermost cells paliform, hyaline, terminal cells 16–40 × 8–16 μm. *Stipitipellis* 50–70 μm, hyaline, composed of textura prismatica, terminal cells 18–32 × 8–

Fig. 70 Phylogenetic tree inferred from most likelihood (ML) analysis using ITS data (−ln L=− 3752.387964). *JL* Jilin Province, *NMG* Neimenggu Province, *YN* Yunnan Province. Type species are indicated with *bold*



18 μm, walls thickened. *Asci* 220–260×13–17 μm, pleurorhynchous, 8-spored, subcylindrical to clavate, blue in cotton blue. *Ascospores* [in H_2O] (15)15.5–18(18.5)×(9.5)10–11(11.5) μm [($\bar{x}$ = 17×10 μm n=40)], ellipsoid, smooth, finely rugose under SEM. *Paraphyses* filiform, 4–5.5 μm broad, slightly exceeding the asci, brown, with a yellow refractive content in Melzer's reagent, blue in cotton blue; apex enlarged, 6–8 μm broad. **Asexual morph**: Undetermined.

Additional material examined: CHINA, Yunnan Province, Xishan County, alt. 2600 m, 28 August 2009, Qi Zhao 482 (HKAS 87587 **holotype**).

Notes: *Helvella rugosa* can be easily recognized by its small fruiting body, pale to dark grey or greyish brown hymenium, wrinkled-folded, white to pale sterile surface, and a tapering downward, mainly longitudinal ribs stipe.

The gross morphology of *H. rugosa* is very similar to that of *H. fusca* Gillet and *H. sulcata* Afzel., because they have lobed apothecia, a ribbed stipe and a glabrous stipitipellis. However, *H. fusca* has a pale brown hymenium, with ribs on the sterile surface that are branched or unbranched, extending near to the margin, stipe equal or slightly enlarged at the base, and are associated with *Populus* spp. (Landerose and Korf 2012). *Helvella sulcata*, has a pale to dark grey or greyish brown hymenium, a glabrous sterile surface and only the stipe has longitudinal ribs (Weber 1972).

Sordariomycetes

Annulatascaceae S.W. Wong et al.

Wong et al. (1998) introduced the family *Annulatascaceae* to accommodate saprobic ascomycetes mainly found on submerged wood in freshwater habitats. Species in the family are characterized by asci with massive, bipartite, apical ring and ascospores with or without sheaths or appendages (Wong et al. 1998). Phylogenetic analyses of ribosomal genes showed that *Annulatascaceae* is polyphyletic (Campbell and Shearer 2001, 2004; Raja et al. 2003; Abdel-Wahab et al. 2011). There is no asexual genus described in this family and most of the described sexual genera did not produce asexual morphs in culture. However, Zelski et al. (2011) described a new genus,

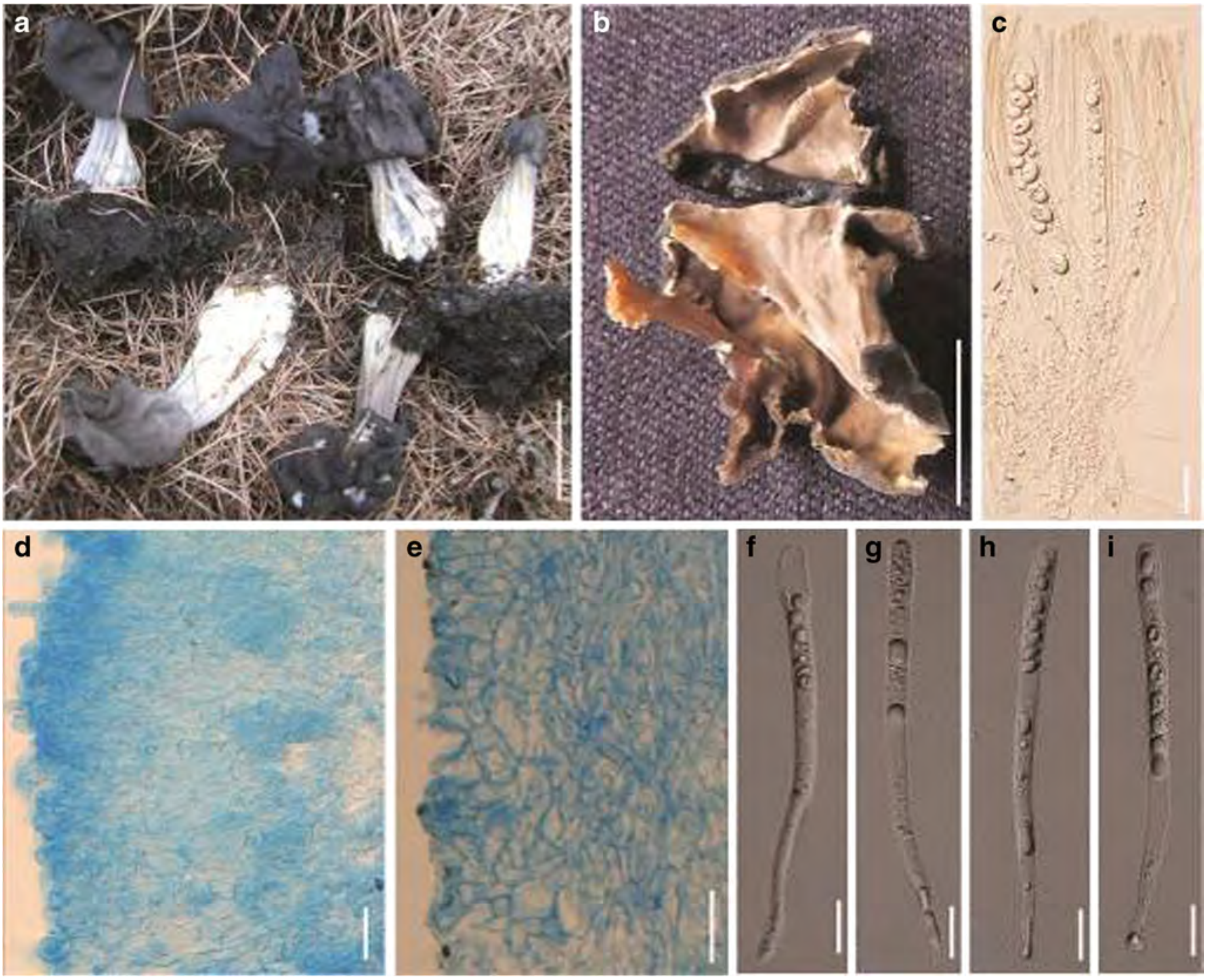


Fig. 71 *Helvella pseudolacunosa* (holotype) **a** Typical mature specimens **b**, **d** Sterile surface of pileus **c** Asci and paraphyses **e** Stipitipellis **f**–**i** Asci. Scale bars: **a**=2 cm, **b**=0.5 cm, **c**–**i**=30 μm

Chaetorostrum, in the family, with a taeniolella-like asexual morph and *Conlarium duplumascospora* F. Liu & L. Cai produced helicoid conidia in culture (Liu et al. 2012a). During an ongoing study of freshwater fungi from River Nile in Egypt, a fungus with helicoid conidia was commonly recorded. Phylogenetic analyses of ribosomal loci place the new fungus (*Dictyosporella aquatica*) in the family *Annulatascaceae*, but distantly placed from all genera in the family.

187. **Dictyosporella** Abdel-Aziz, ***gen. nov.***

Index Fungorum number: IF551480; *Facesoffungi number*: FoF00973

Etymology: In reference to the septation of the conidia.

Saprobic on grass stem in freshwater. **Sexual morph**: Undetermined. **Asexual morph**: *Mycelium* superficial and immersed in the substrate, yellow-brown to brown, septate, branched. *Conidiophores* reduced. *Conidiogenous cells* holoblastic. *Conidia* helicoid when young and quickly becoming a mass of cells, brown to black, terminal and lateral, single, determinate. Conidial cells are generally similar in shape, colour and size that are globose, subglobose, rounded or with truncate base, brown to dark-brown.

Type species: ***Dictyosporella aquatica*** Abdel-Aziz

Notes: *Dictyosporella aquatica* was frequently recorded on submerged decaying stems of *Phragmites australis* in the River Nile in Egypt. *Dictyosporella aquatica* is reminiscent of *Cirrenalia*, a marine genus with helicoid conidia that is commonly collected on driftwood and mangrove wood (Jones et al. 2009). Phylogenetic studies placed the type species, *C. macrocephala* in *Halosphaeriaceae* (Tsui and Berbee 2006; Abdel-Wahab et al. 2010). Other species belong to

Fig. 72 *Helvella rugosa* (holotype) **a**, **b** Typical mature specimens**c**, **f** Sterile surface of pileus d Hymenium **e** Ascospore **g** Stipitipellis **h** Asci and paraphyses **i** Ascus. Scale bars: **a**–**b**=1 cm, **c**=2.5 mm, **d**=150 μm, **e**=5 μm, **f**–**i**=30 μm

Juncigenaceae, *Lulworthiaceae*, and *Torpedosporaceae* (Abdel-Wahab et al. 2010; Jones et al. 2014). Phylogenetic analyses of SSU (data not shown) and LSU rDNA placed *D. aquatica* in a weakly supported clade with *Cyanoannulus petersenii* Raja et al. in the family *Annulatascaceae* (Fig. 73). The monotypic genus *Conlarium* is characterized by helicoid conidia, similar to those of *D. aquatica* (Liu et al. 2012a), however, *C. duplumascospora* is distantly placed from *D. aquatica* in the family *Annulatascaceae* (Fig. 73). Most of the species described under *Annulatascaceae* are from freshwater habitats (Wong et al. 1998).

188. ***Dictyosporella aquatica*** Abdel-Aziz, ***sp. nov.***

Index Fungorum number: IF551481; *Facesoffungi number*: FoF00974; Fig. 74

Etymology: From the Latin adjective *aquaticus*, in reference to the freshwater habitat of the fungus.

Holotype: 15-0751

Saprobic on decayed herbaceous stems in freshwater. **Sexual morph**: Undetermined. **Asexual morph**: *Mycelium* 2–4 µm diam., superficial and immersed in the substrate, yellow-brown to brown. *Conidiophores* reduced. *Conidiogenous cells* holoblastic. *Conidia* 12–22 µm ($\bar{x}$ = 18 µm, *n*=55) diam., helicoid when young, quickly becoming masses of cells, brown to black, terminal and lateral, single, determinate. Cells of conidia −13 µm ($\bar{x}$ = 7.09 µm, *n*=20) diam., generally increasing in size from basal to apical cells, but with similar colour, globose, subglobose, rounded or with truncate base, brown to dark brown. Number of conidial cells ranging between 4 and 18 ($\bar{x}$ = 10.3 µm, *n*=20).

Culture characteristics: Colonies on PDA reaching 20–25 mm diam. after 15 days at 25 °C, with grey to light brown mycelium, reverse brown, not sporulating in culture.

Material examined: EGYPT, Sohag, River Nile, on submerged decayed stem of *Phragmites australis* (*Poaceae*), 14 August 2014, F.A. Abdel-Aziz (CBS H-22127, **holotype**); *Ibid*. (MFLU 15-1510, **isotype**) ex-type living culture, MD1302 (Fig. 75).

Chaetosphaeriaceae Réblová, M.E. Barr & Samuels

Chaetosphaeria Tul. & C. Tul., Select. fung. carpol. (Paris) 2: 252 (1863)

The genus is a lignicolous perithecial ascomycete with a world-wide distribution. It is characterized by non-stromatic, dark, papillate ascomata, persistent paraphyses, unitunicate asci with a shallow, refractive J-apical annulus and hyaline, ellipsoidal, fusiform to filiform, one to several-septate hyaline ascospores, although several species with versicolorous ascospores are also accommodated in the genus.

The systematics of *Chaetosphaeria* is complicated by the diversity of morphological characters of the asexual morphs. To date around 30 asexually reproducing genera of dematiaceous phialidic hyphomycetes have been experimentally linked with members of the *Chaetosphaeriales* or their relationship was suggested based on molecular data. The majority of these asexual morphs is linked with *Chaetosphaeria*, and they represent the greatest variability within the genus.

189. ***Chaetosphaeria rivularia*** Réblová & J. Fourn., ***sp. nov.***

Index Fungorum number: IF551489; *Facesoffungi number*: FoF00975; Figs. 76 and 77

Etymology: *Rivularis* (L), referring to rivulets, the natural habitat of the fungus.

Holotype: PRM 933847

Saprobic on decaying wood submerged in freshwater. **Sexual morph**: *Ascomata* non-stromatic, semi-immersed, scattered to gregarious, often with confluent walls, venter 200–250 µm diam., 250–330 µm high, subglobose to broadly conical, brown, glabrous, papillate, opening by a rounded pore. *Ostiole* central, periphysate. *Peridium* leathery to fragile, carbonaceous, two layered, 30–60 µm thick near apex and at the sides, up to 50–60 µm thick at the base; outer wall composed of brown, brick-like cells of *textura prismatica*, cells opaque in the upper part, pale brown at the base, towards the interior grading into several rows of thin-walled, hyaline, flattened cells. *Hamathecium* composed of abundant, persistent, septate, hyaline paraphyses *ca*. 3.5–4.5 µm wide, tapering to 2.5−3 µm, longer than the asci. *Asci* (72–)75–95(−98)×7–8.5(−9) µm ($\bar{x}$ ± SD=86.7±8.2×8±0.6 µm), 8-spored, unitunicate, cylindrical-clavate, rounded, slightly tapering at the apex, short-pedicellate, with a distinct, non-amyloid apical annulus, ca. 1–1.3 µm high, 2–2.5 µm wide. *Ascospores* (15–)16−19×3–3.5 µm ($\bar{x}$ ± SD=16.8±1.3× 3.4±0.3 µm), ellipsoid to narrowly fusiform, slightly curved, 1-septate, septum indistinct, not constricted at the septum, hyaline to yellowish grey, smooth-walled, arranged obliquely uniseriate, often two-seriate only in the upper sporiferous part, with a hardly defined mucilaginous sheath swelling and diffusing in water. **Asexual morph**: *Thozetella*-like formed only in the axenic culture.

Culture characters: Colonies slow growing, reaching 10–15 mm diam. on PCA after 14 days at 25 °C. Colony circular, felty, zonate, brown-grey in the centre, brown towards the margin, reverse dark brown. *Vegetative hyphae* 2–3.5 µm wide, smooth, subhyaline or pale brown, thin-walled, septate, sparsely branched. Sporulation appears in a month. *Synnemata* scattered in circular zones around the centre and at the margin of the colony, composed of dark brown stalk bearing a slimy, glistening, white-grey mass of conidia. Stalk ca. 10–30 µm wide, composed of a brown, septate, sparsely branched conidiophores densely bunched and partly fused, ending in a monophialide, topped by a subglobose mass of conidia and sterile awn-shaped cells, so called microawns. *Microawns* produced from conidiophores and liberated with

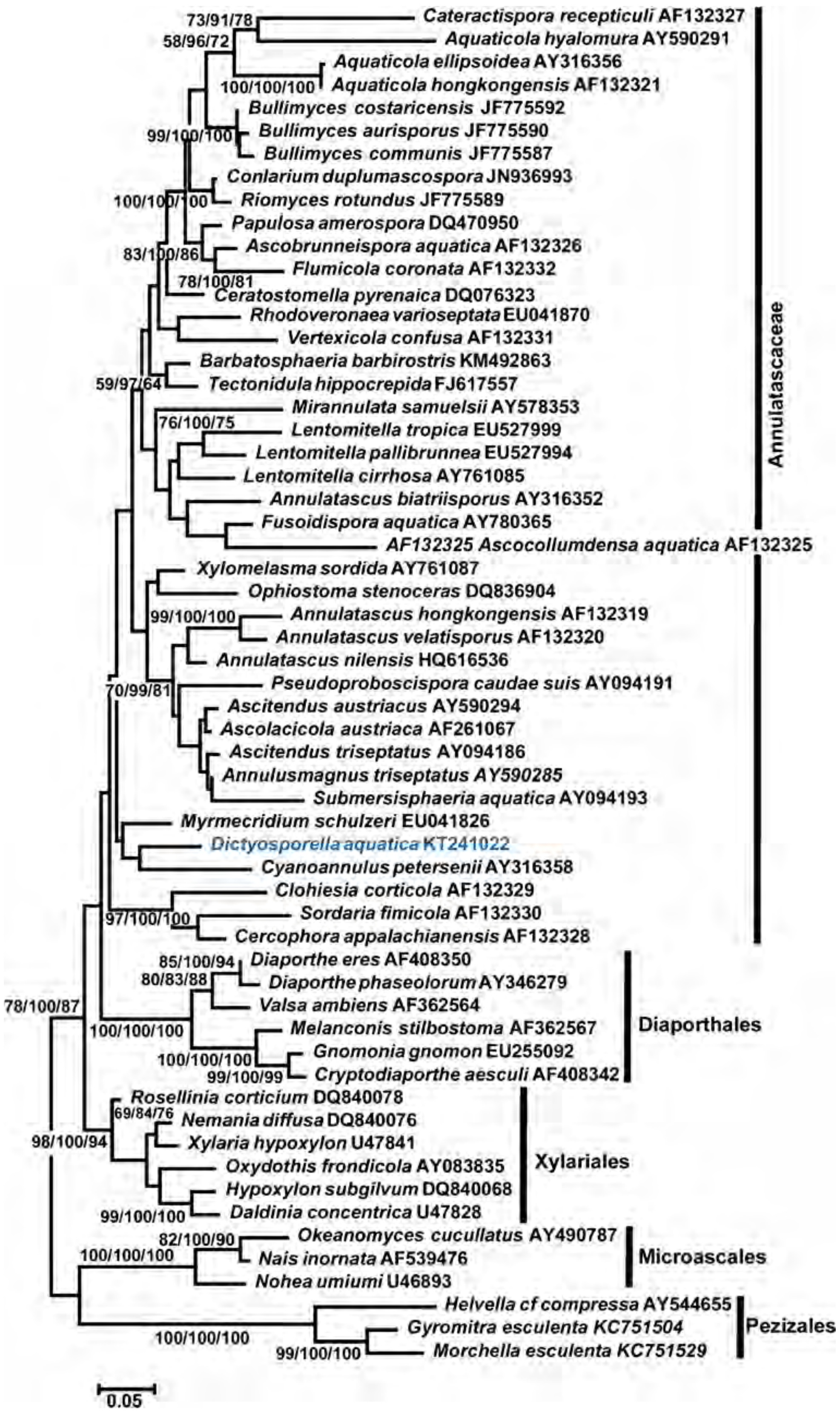


Fig. 73 Phylogram generated from maximum likelihood analysis (PAUP 6) based on LSU sequence data of *Dictyosporella aquatica* and related taxa in *Annulatascaceae*. Representatives of the order *Pezizales* were used as outgroup. Maximum Likelihood bootstrap support values greater than 50 % are indicated. The *numbers* above or below the nodes indicate ML, PP and MP bootstrap value s≥50 %. The new species, *D. aquatica* is in *blue*

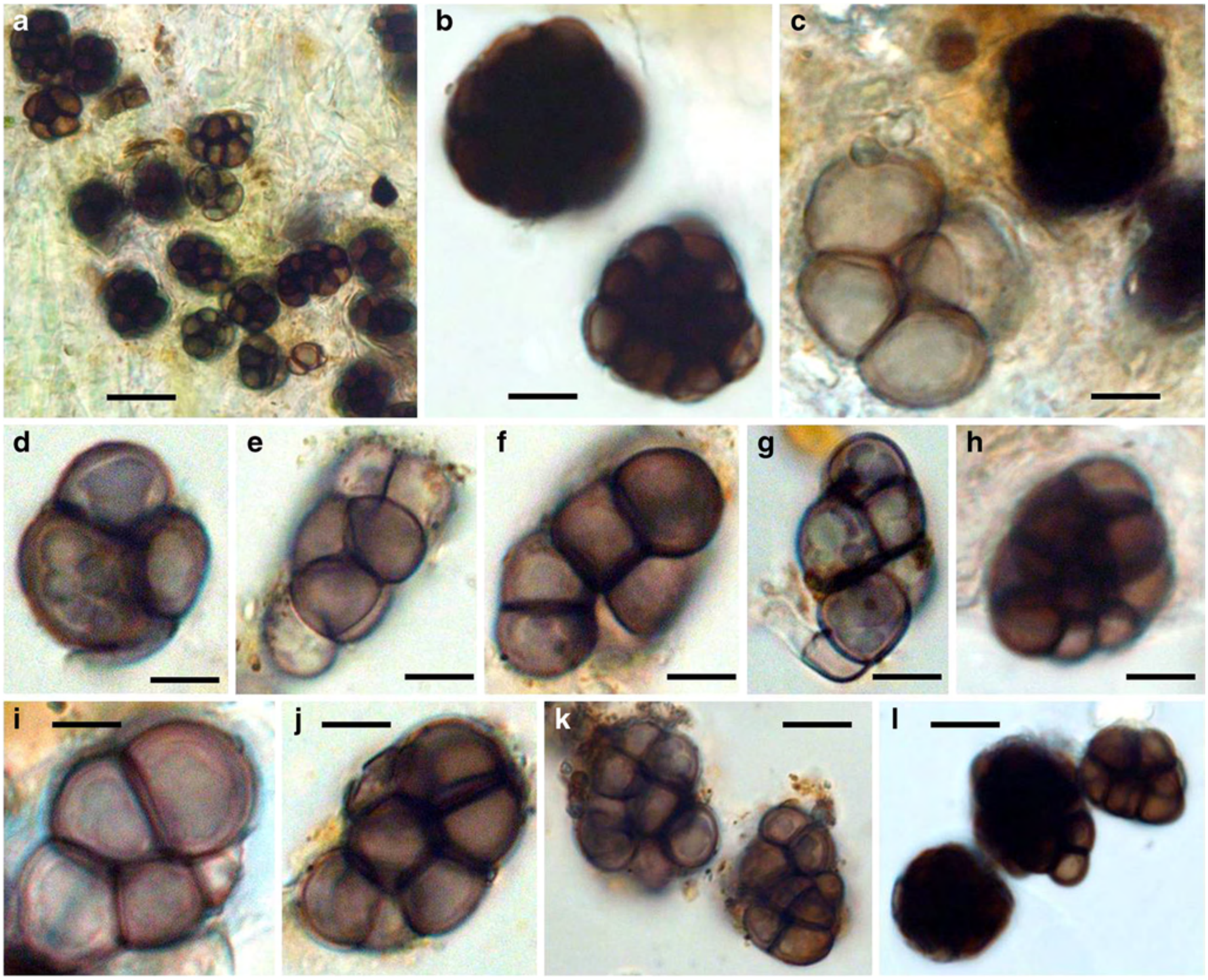


Fig. 74 *Dictyosporella aquatic* (holotype). **a**–**l** Variously shaped conidia at different stages of maturation. Scale bars: **a**=20 μm, **b**–**l**=10 μm

the conidia, straight to sigmoid or irregularly curved, basal part thin-walled, tapering towards the tip, thick-walled, pointed at the tip, 0–3-septate, hyaline, 65–130 μm long, 4–6.5 μm wide at the broadest point near the base, rigid, refractive. *Conidiophores* macronematous, up to 100 μm long, 2.5–3.5 μm wide, pale brown, septate, branched at intervals. *Conidiogenous cells* phialides, 16–35×2–2.4 μm ($\bar{x}$ ± SD= 23.8±7.5×4.5±0.4 μm), integrated, terminal, cylindrical to clavate, tapering to ca. 1.5 μm, bearing a single conidiogenous locus in a minute, indistinct collarette. *Conidia* (9.5−)11−13× 1.8−2.5 μm ($\bar{x}$ ± SD=12.2±0.7×2.2±0.2 μm), lunate to suballantoid, hyaline, aseptate, at each end slightly narrowed and provided with a single filiform setula 2.8−4.5(−5.5) μm long.

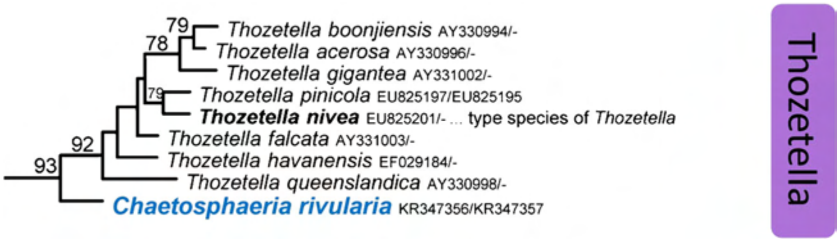


Fig. 75 Phylogenetic tree showing *Thozetella* clade comprising *C. rivularia* discerned in the phylogeny of the *Chaetosphaeriales*. Phylogram is generated from Maximum Likelihood analysis based on ITS and nuc28S rDNA sequences of originally 82 members of the *Chaetosphaeriales*. Maximum likelihood bootstrap support values greater than 50 % are indicated above the nodes. Four members of the *Glomerellales* were used to root the phylogeny

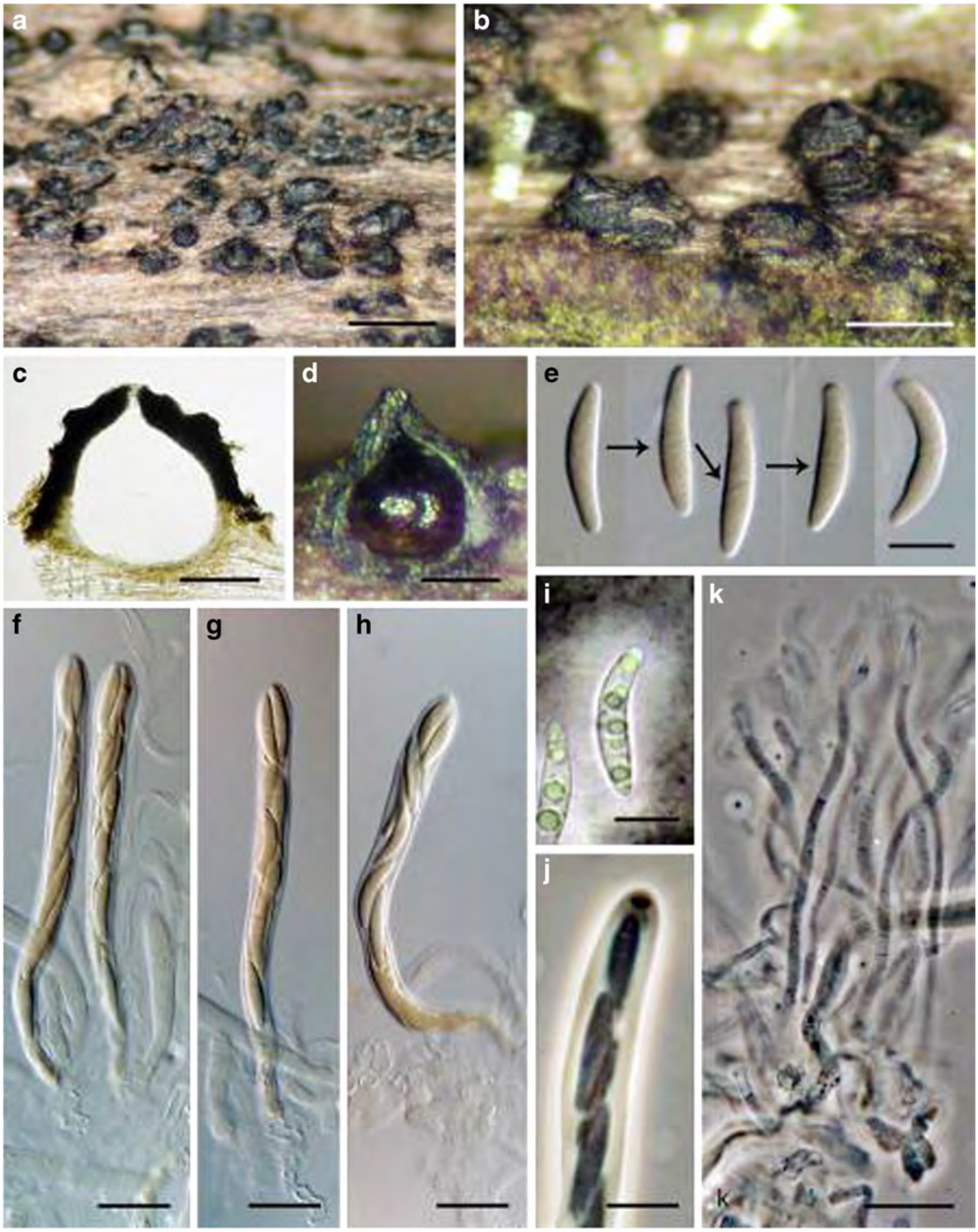


Fig. 76 *Chaetosphaeria rivularia* (holotype) **a**, **b** Ascomata **c**, **d** Vertical section of ascoma **e**, **i** Ascospores with indistinct middle septum (*arrows* indicate septum), e in Melzer's reagent, **i** in India ink) **f**–**h** Asci **j** Ascal apex with an apical annulus **k** Paraphyses. Scale bars: **a**=500 µm, **b**=250 µm, **c**, **d**=100 µm, **e**, **i**, **j**=10 µm, **f**–**h**, **k**=25 µm

Material examined: FRANCE, Midi-Pyrénées, Ariège, Rimont, Grand Bois forest, Maury brook, 650 m a.s.l., submerged wood of *Fagus sylvatica* associated with *Minutisphaera japonica*, 17 November 2009, J. Fournier J.F. 09308 (PRM 933847, **holotype**); ex-type living culture CBS 127686; *Ibid*., 24 November 2009, J. Fournier J.F. 09316 (PRM 933847). Ibid., 8 December 2009, J. Fournier J.F. 09327.

Notes: *Chaetosphaeria rivularia* was repeatedly collected on wood submerged in freshwater in southern France. No

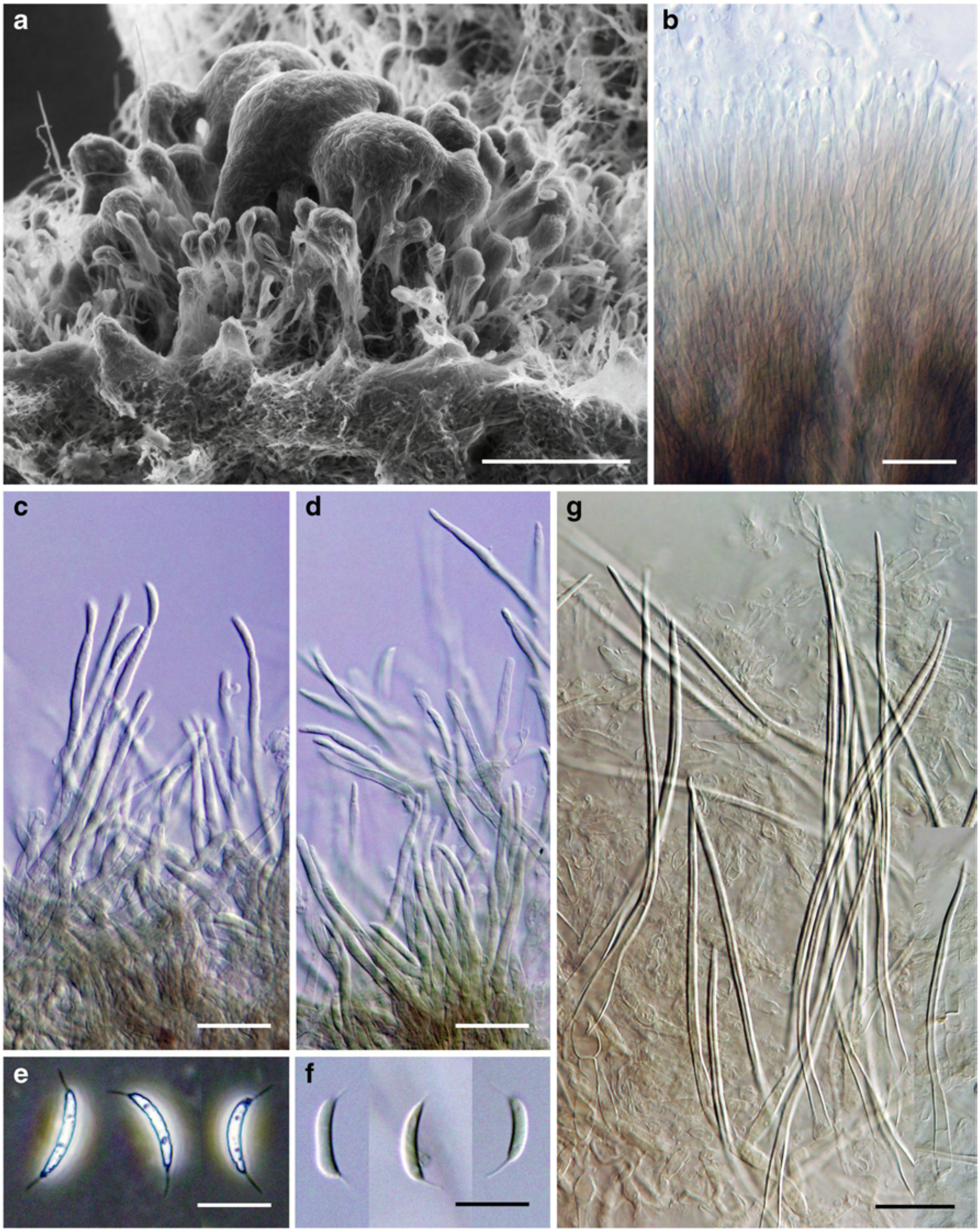


Fig. 77 *Chaetosphaeria rivularia* (holotype) **a** Conidiomata topped with masses of conidia in PCA culture (ESEM - Environmental Scanning Electron Microscope microscopy) **b** Palisade of branching conidiophores ending into a monophialide on PCA **c**, **d** Conidiogenous cells on PCA **e**, **f** Conidia on PCA **g** Microawns on PCA. Scale bars: **a**=100 µm, **b**–**f**=10 µm, **g**=25 µm

conidiophores were observed on the host. The living culture derived from ascospore isolates from a fresh collection of *C. rivularia* yielded synnematous conidiophores with long, thick-walled and pointed microawns and setulose, aseptate *Thozetella*-like conidia. The relationship between *Chaetosphaeria* Tul. & C. Tul. and the synnematous dematiaceous hyphomycete *Thozetella* Kuntze was suggested by Paulus et al. (2004), based on the phylogenetic analysis of ITS rDNA sequence data. *Thozetella* comprises to date 19 species occurring primarily as saprobes on decaying wood, herbs, litter, palm fronds and rarely as endophytes. The only species so far reported from wood submerged in freshwater is *T. nivea* (Berk.) Kuntze, the type species (Sivichai et al. 2002). In our phylogenetic analysis based on ITS and nuc28S rDNA sequences of 82 members of the *Chaetosphaeriales* a close relationship of *C. rivularia* with other permanently asexual *Thozetella* species is well-supported.

Chaetosphaeria rivularia resembles *C. ciliata*, *C. ovoidea* and *C. tortuosa* (Holubová-Jechová 1973; Réblová et al. 2006; Réblová and Seifert 2008) in the size and shape of the ellipsoid to narrowly fusiform, often curved, septate ascospores and setulose conidia. The three latter species differ from *C. rivularia* by 3-septate ascospores and formation of the *Menispora* asexual morphs with mononematous conidiophores. The ascospores of *C. rivularia* are 1-septate, the middle septum is rather indistinct. Ascospores possess a mucilaginous sheath that is visible only in fresh material; the sheath diffuses in water and it is visible when observed in India ink. The asexual morph of *C. rivularia* is characterized by synnematous branching conidiophores, long, pointed, curved to sigmoid microawns that contain 1–3 septa, but sometimes appear as septate and aseptate conidia. It resembles *T. gigantea* in the morphology of microawns and conidia, but the latter species differs by longer conidia and longer setulae (Paulus et al. 2004).

Cordycipitaceae Kreisel ex G.H. Sung et al.

The family *Cordycipitaceae* was introduced together with *Ophiocordycipitaceae* as a result of multi-gene (LSU, SSU, RPB1, RPB2, β-tubulin, TEF1, and ATP6) phylogeny which rejected the monophyly of the family *Clavicipitaceae* and the genus *Cordyceps* (Sung et al. 2007a, b). *Cordycipitaceae* comprises four sexual morph genera − *Ascopolyporus*, *Cordyceps*, *Hyperdermium*, and *Torrubiella*. They are characterized by pale to brightly coloured species having either soft, fleshy stromata (e.g., *C. militaris*), or highly reduced, loosely organized hyphae or subiculum on the host (e.g., *T. hemipterigena*). Asexual morphs found in this family include *Akanthomyces*, *Beauveria*, *Engyodontium*, *Evlachovaea*, *Gibellula*, *Isaria*, *Lecanicillium*, *Microhilum*, and *Simplicillium*.

Beauveria is a cosmopolitan, soil-borne entomopathogenic fungus that infects a wide range of arthropod hosts (Rehner and Buckley 2005) and can also be found as an endophyte and saprobe (Vega et al. 2008). It is characterized by basally inflated conidiogenous cells that sympodially produce conidia on divergent denticles (De Hoog 1972). The characteristics of the conidia are the main morphological features used to distinguish between species of *Beauveria*, which are typically globose, cylindrical, ellipsoidal, reniform, or comma-shaped and are 1.5–5.5 μm (Rehner et al. 2011). The combined analysis of ITS rDNA and EF places both *Beauveria gryllotalpidicola* and *B. loeiensis* in the *Cordycipitaceae* nesting among other *Beauveria* species. *Cordyceps loeiensis* is closely related to *Beauveria asiatica*, found on *Coleoptera* and *B. australis* on *Orthoptera* (*Acrididae*), while *B. gryllotalpidicola* is in a subclade with *B. sungii* and *B. malawiensis*, both species found on Coleoptera and in the soil. The new species are introduced based on both morphological and molecular differences among other *Beauveria* species. The phylogenetic tree is presented in Fig. 78.

190. ***Beauveria gryllotalpidicola*** Luangsa-ard, Ridkaew & Tasan., ***sp. nov.***

Index Fungorum number: IF551323; *Facesoffungi number*: FoF00976; Fig. 79

Etymology: The specific epithet refers to a mole dwelling fungus, '*gryllotalpidae*' = from the family of the mole cricket *Gryllotalpidae* and '*cola*' = dweller.

Holotype: BBH 23231

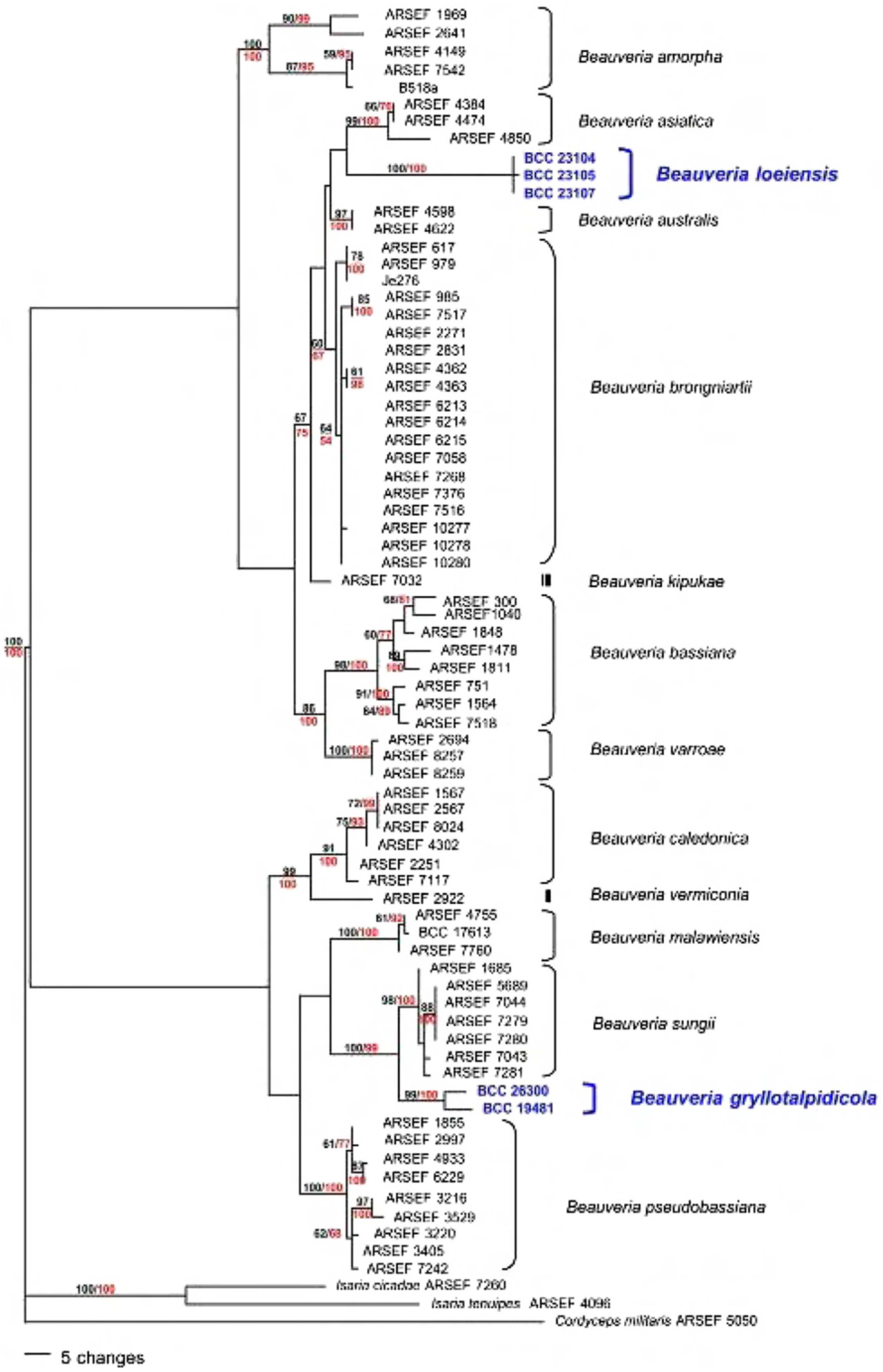
Parasitic in arthropods (Orthoptera, Gryllotalpidae). **Sexual morph**: *Stromata* simple to branched, clavate, fleshy, erect, protruding from the ground sometimes with one or several stromata loosely connected to the head, and to the tail of the host insect. Mycelia scarce, whitish covering the host, slightly rhizoid in the soil joining together to form a compact stipe upon emerging from the soil. *Perithecial heads* yellowish to reddish orange; perithecia narrowly ovoid, semi-immersed, 350–550×150–230 μm. *Asci* cylindrical, 390–430×5 μm, ascus tip 2.5 μm. *Ascospores* readily breaking into part-spores, 5–10×1 μm. **Asexual morph**: '*Beauveria*' asexual state is readily produced in culture with flask-shaped conidiogenous cells and globose conidia, 2×2 μm diam.

Culture characters: Colonies on PDA are relatively fast-growing, reaching 10 mm diam. after 14 days at 25 °C, cottony, pale yellow in the center and white at the colony edges, sporulating, reverse pale yellow.

Material examined: THAILAND, Nakhon Ratchasima Province, Km.33 (Nong Pakchi), Khao Yai National Park, 10 July 2007, T. Laessøe, J.J. Luangsa-ard, R. Ridkaew, B. Thongnuch, P. Srikitikulchai (BBH 23231, **holotype**); ex-type living culture, BCC 26300.

Other specimen examined: on mole cricket, 1 December 2005, K. Tasanathai, W. Tongsridom, B. Thongnuch and R. Ridkaew, BBH15091.

Fig. 78 Phylogram inferred from ITS and TEF1 gene regions of ▶ *Beauveria*, generated with Maximum Parsimony and Bayesian Posterior probabilities. Maximum Parsimony bootstrap support values greater than 50 % are indicated above the node in *black*. Bayesian Posterior probabilities greater than 50 % are given beside the MP bootstrap values in *blue*


90/99
100
100
59/95
67/95
ARSEF 1969
ARSEF 2641
ARSEF 4149
ARSEF 7542
B518a
Beauveria amorpha
66/76
99/100
ARSEF 4384
ARSEF 4474
ARSEF 4850
Beauveria asiatica
100/100
BCC 23104
BCC 23105
BCC 23107
Beauveria loeiensis
97
100
ARSEF 4598
ARSEF 4622
Beauveria australis
78
100
ARSEF 617
ARSEF 979
Jc276
85
100
ARSEF 985
ARSEF 7517
ARSEF 2271
ARSEF 2831
60
67
61
98
ARSEF 4362
ARSEF 4363
ARSEF 6213
ARSEF 6214
67
75
64
54
ARSEF 6215
ARSEF 7058
ARSEF 7268
ARSEF 7376
ARSEF 7516
ARSEF 10277
ARSEF 10278
ARSEF 10280
Beauveria brongniartii
ARSEF 7032
Beauveria kipukae
100
100
68/61
ARSEF 300
ARSEF1040
60/77
ARSEF 1848
89
100
ARSEF1478
ARSEF 1811
98/100
91/100
ARSEF 751
84/99
ARSEF 1564
ARSEF 7518
Beauveria bassiana
86
100
100/100
ARSEF 2694
ARSEF 8257
ARSEF 8259
Beauveria varroae
72/99
ARSEF 1567
ARSEF 2567
75/93
ARSEF 8024
ARSEF 4302
91
100
ARSEF 2251
ARSEF 7117
Beauveria caledonica
99
100
ARSEF 2922
Beauveria vermiconia
81/92
ARSEF 4755
100/100
BCC 17613
ARSEF 7760
Beauveria malawiensis
ARSEF 1685
ARSEF 5689
98/100
ARSEF 7044
88
100
ARSEF 7279
ARSEF 7280
100/99
ARSEF 7043
ARSEF 7281
Beauveria sungii
99/100
BCC 26300
BCC 19481
Beauveria gryllotalpidicola
ARSEF 1855
61/77
ARSEF 2997
ARSEF 4933
83
100
ARSEF 6229
100/100
97
100
ARSEF 3216
ARSEF 3529
62/68
ARSEF 3220
ARSEF 3405
ARSEF 7242
Beauveria pseudobassiana
100/100
Isaria cicadae ARSEF 7260
Isaria tenuipes ARSEF 4096
Cordyceps militaris ARSEF 5050
5 changes

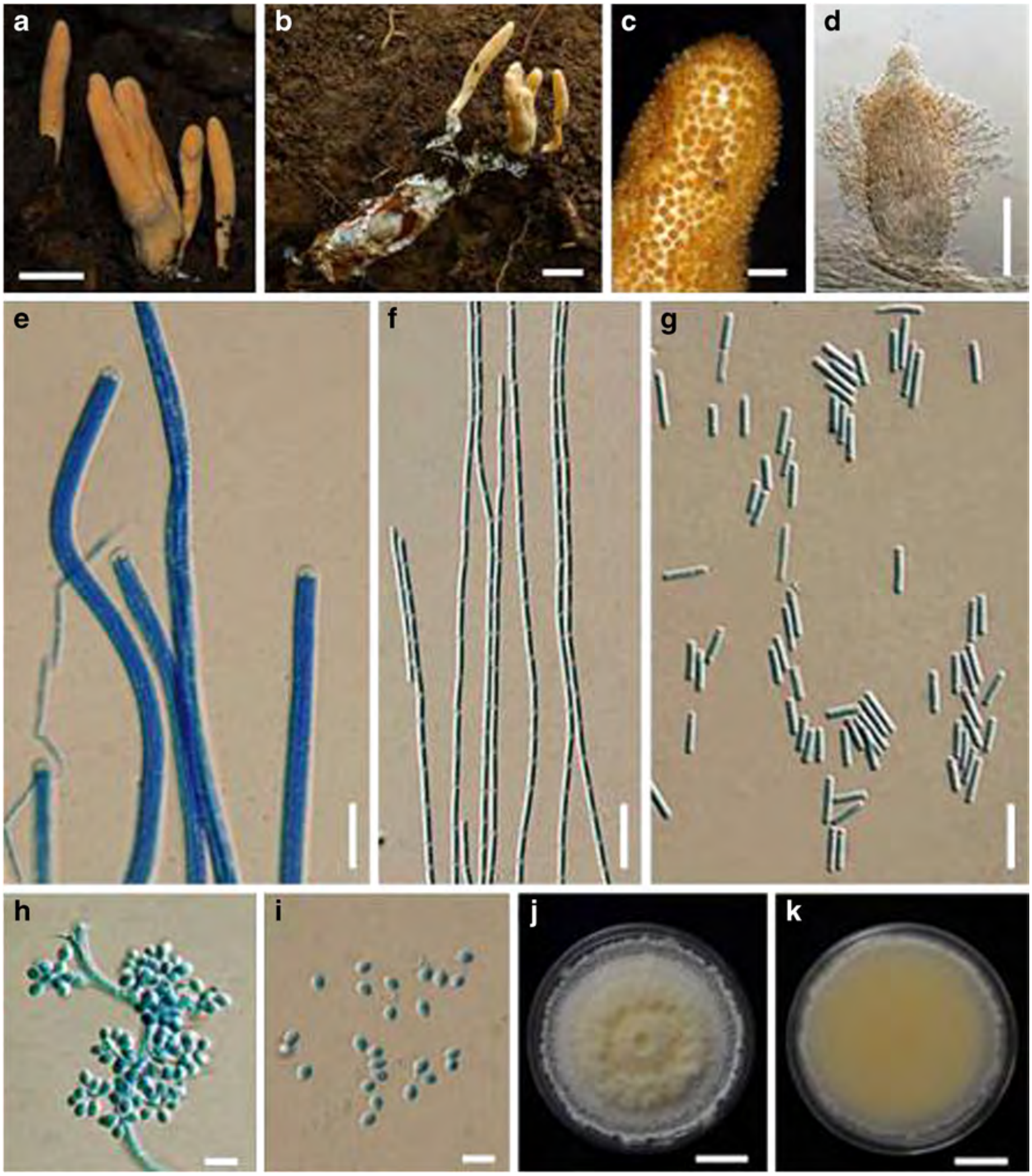


Fig. 79 *Beauveria gryllotalpidicola* (holotype) **a** Fleshy orange stromata emerging from the soil **b** Fungus on host **c** Semi-immersed perithecial heads emerging from the stroma **d** Perithecium **e** Asci and ascus caps **e**–**g** Part-spores **h** Conidiogenous structures bearing conidia **i** Conidia **j**, **k** Colony from above and below on PDA after 4 weeks. Scale bars: **a**–**b**, **j**–**k**=10 mm, **c**=1 mm, **d**=100 μm, **e**–**g**=10 μm, **h**–**i**=5 μm

191. ***Beauveria loeiensis*** Luangsa-ard, Ridkaew & Tasan. ***sp. nov***.

Index Fungorum number: IF551324; *Facesoffungi number*: FoF00977; Fig. 80

Etymology: named after the type locality.

Holotype: BBH 18836

Parasitic in arthropods (Orthoptera, Gryllacrididae). **Sexual morph**: *Stromata* on body and leg joints of adult Orthoptera several, scattered, simple or branched, cylindrical to enlarged at the apices, yellowish cream, 1–3 mm long, with perithecia in small clusters (20–30) at the apices. *Perithecia* narrowly ovoid with acute apices, 650–710×280–320 μm, superficial and crowded at the apex. *Asci* cylindrical, 370–450×5 μm, ascus caps 2.5 μm. *Ascospores* filiform, breaking into 32 part spores, 5–10×1 μm. Some of the specimens are accompanied with the *Beauveria* asexual morph. **Asexual morph**: *Synnemata* are

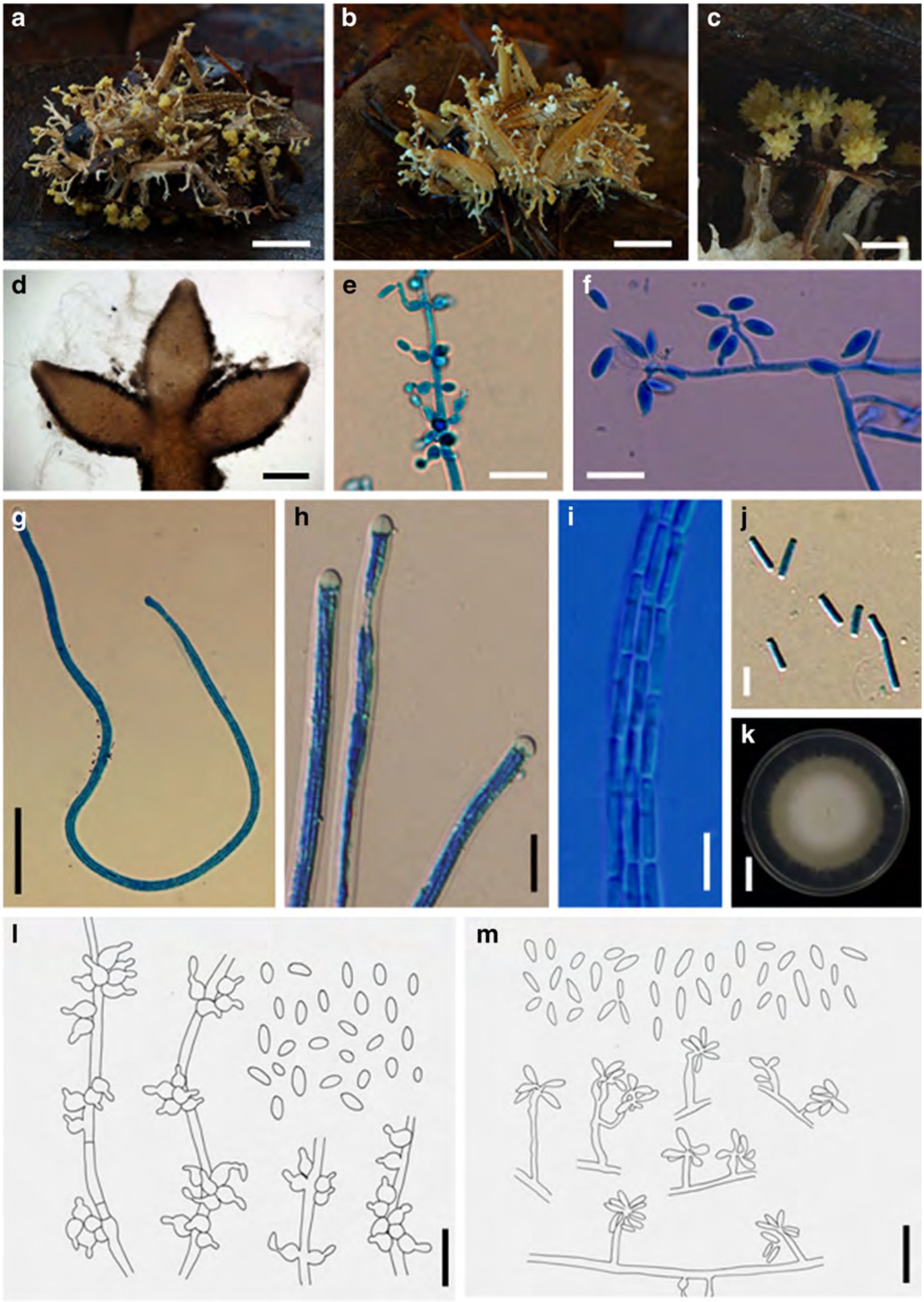


Fig. 80 *Beauveria loeiensis* (holotype) **a**, **b** Fungus on host **c** Clusters of superficial perithecia on host **d** Perithecia **e** Phialides on host **f** Phialides on PDA **g** Mature ascus **h** Asci and asci cap **i**, **j** Part-spores **k** Colony on PDA after 20 days **l** Conidiogenous structures on the host **m** Conidiogenous structures on PDA. Scale bars: **a**–**b**, **k**=10 mm, **c**= 2 mm, **d**=200 μm, **g**=50 μm, **e**–**f**, **l**–**m**=10 μm

scattered on the body and legs of the host, cream to yellowish brown, smooth-walled, 2–6 mm in length, the upper portion mealy with oblong-ellipsoid conidia, some concave to one side and flattened or convex to the other (2–4×1.2−1.5 μm), white; *conidiogenous cells* round or flask-shaped, producing conidia sympodially on divergent denticles, in whorls of two or more or singly, scattered along the hypha.

Culture characters: Colonies on PDA are relatively fast growing, reaching 10 mm diam. after 14 days at 25 °C; circular, dense, at first white and floccose, becoming cream to yellow cream in the center with age; conidiation starts as early as 12 h after inoculation. *Conidiophores* arise from the agar, white, smooth-walled, *conidiogenous structures* up to 12.5 μm long, cylindrical or narrowing at the tip producing ellipsoidal to cylindrical conidia (3.5−6×1.5−2 μm) with rounded ends.

Material examined: THAILAND, Phureua Mountain range, Loei Province, Chatchanat Farm, isolated on cricket on the leaf litter, 26 September 2006, K. Tasanathai, S. Mongkolsamrit, B. Thongnuch, R. Ridkaew, P. Srikitikulchai and C. Chuaseeharonnachai (BBH 18836, **holotype**); ex-type living culture, BCC 23107.

Other specimens examined: THAILAND, Loei Province, Chatchanat Farm, on Gryllacrididae, Orthoptera in forest habitat, (17° 27′ 17.99″N, 101° 21′ 47.99″E), BBH 18831 (BCC 23101), BBH 17765 (BCC 23102), BBH 17766 (BCC 23103), BBH 18834 (BCC 23105), BBH 18835 (BCC 23106) 26 September 2006, K. Tasanathai, S. Mongkolsamrit, B. Thongnuch, R. Ridkaew, P. Srikitikulchai, and C. Chuaseeharonnachai. BBH18832, (BCC23242), BBH18833, 26 September 2006, K. Tasanathai, S. Mongkolsamrit, B. Thongnuch, R. Ridkaew, P. Srikitikulchai, and C. Chuaseeharonnachai; Kaeng Krachan National Park, (12°54′ 24.00″N, 99°38′53.00″E), BBH 15059, (BCC 21108), 14 November 2005, K. Tasanathai, B. Thongnuch, R. Ridkaew.

Discosiaceae Maharachch. & K.D. Hyde

In their molecular data analyses, Senanayake et al. (2015) showed that *Discosia sensu stricto* groups as a distinct clade in *Amphisphaeriales*. Besides, *Discosia*, the clade comprises *Adisciso*, *Discostroma*, *Sarcostroma* and *Seimatosporium* (Fig. 81).

Seimatosporium Corda, Deutschl. Fl., 3 Abt. (Pilze Deutschl.) 3(13): 79 (1833)

Seimatosporium is characterized by fusiform or clavate or obovoid, (2−)3(−5)-septate, continuous or occasionally constricted, eguttulate, brown medium conidia (Sutton 1980; Nag Raj 1993; Maharachchikumbura et al. 2014; Norphanphoun et al. 2015). The species might have apical or/ and basal appendages or without any appendages (Sutton 1980; Nag Raj 1993).

192. ***Seimatosporium sorbi*** Wijayawardene, Camporesi & K.D. Hyde, ***sp. nov.***

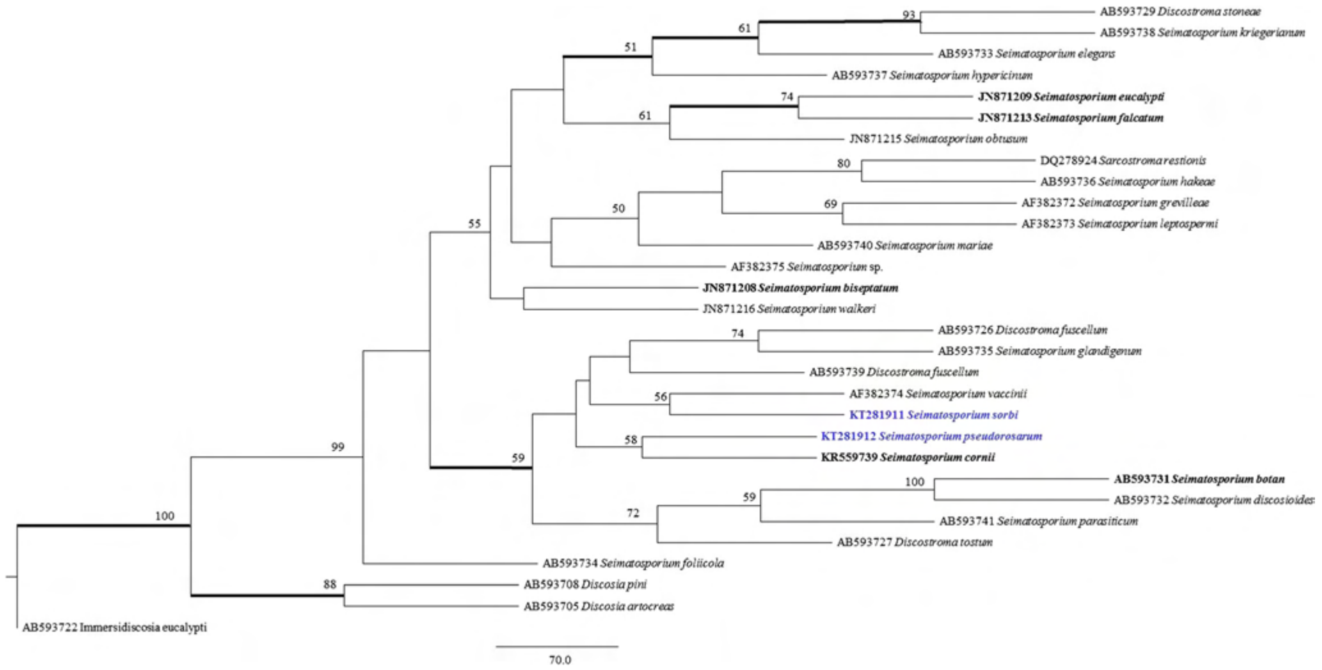


Fig. 81 Phylogram generated from Maximum Parsimony (MP) analysis based on combined LSU and ITS sequence data of *Seimatosporium* species. Maximum parsimony bootstrap support values greater than 50 % are indicated above the nodes, and branches with Bayesian posterior probabilities greater than 0.95 are given in bold. The ex-type strains are in *bold*; the new isolates are in *blue*. The tree is rooted with *Immersidiscosia eucalypti* (AB593722). We used GenBank accession numbers of LSU sequence data instead of culture collection numbers as most of the strains only have accession numbers. The tree is based on species in (Barber et al. 2011)

Index Fungorum number: IF551181; *Facesoffungi number*: FoF00669; Fig. 82

Etymology: Name after the host genus on which the taxon occurs.

Holotype: MFLU 15-0744

Saprobic on dead branches and stems of *Sorbus torminalis* L. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 280–340 μm diam., 180–220 μm high, acervular, unilocular, subglobose, superficial, solitary, dark brown to black, apapillate ostiolate, dehiscent irregular. *Conidiomata wall* multi-layered, outer 20–30 μm wide, composed of brown, thin-walled cells of *textura angularis*, inner wall thin, hyaline. *Conidiophores* 8–20×1.5−3 μm, long, cylindrical, branched, hyaline to sub-hyaline, smooth-walled. *Conidiogenous cells* holoblastic, annellidic, cylindrical, simple, integrated, determinate, hyaline. *Conidia* 13–16.5×5.5−7.5 μm ($\bar{x}$ = 14.95×6.47 μm, *n*=20), clavate or obovoid, occasionally truncate base, straight, with 3-septate, septa brown to dark brown, slightly constricted at the septa, eguttulate, pale brown, with hyaline to sub-hyaline basal cell, smooth-walled, lacking appendages.

Culture characteristics: On PDA slow growing, white to light brown from above, pale brown from below, with sparse mycelium, flat, margin uneven, attaining a diam. of 2 cm in 7 days at 18 °C.

Material examined: ITALY, Province of Forlì-Cesena [FC], Fiumicello–Premilcuore, on dead leaf of *Sorbus torminalis* (*Rosaceae*), 8 May 2013, Erio Camporesi, IT 1233 (MFLU 15-0744, **holotype**); *Ibid*. (HKAS 88745, **paratype**), living cultures MFLUCC 14-0469, GUCC 65.

Notes: Our collection from *Sorbus torminalis* morphologically resembles *Seimatosporium*, and molecular analyses (Fig. 81) showed that it groups with *Seimatosporium sensu stricto*, hence it is compared with taxa in Sutton (1980) and

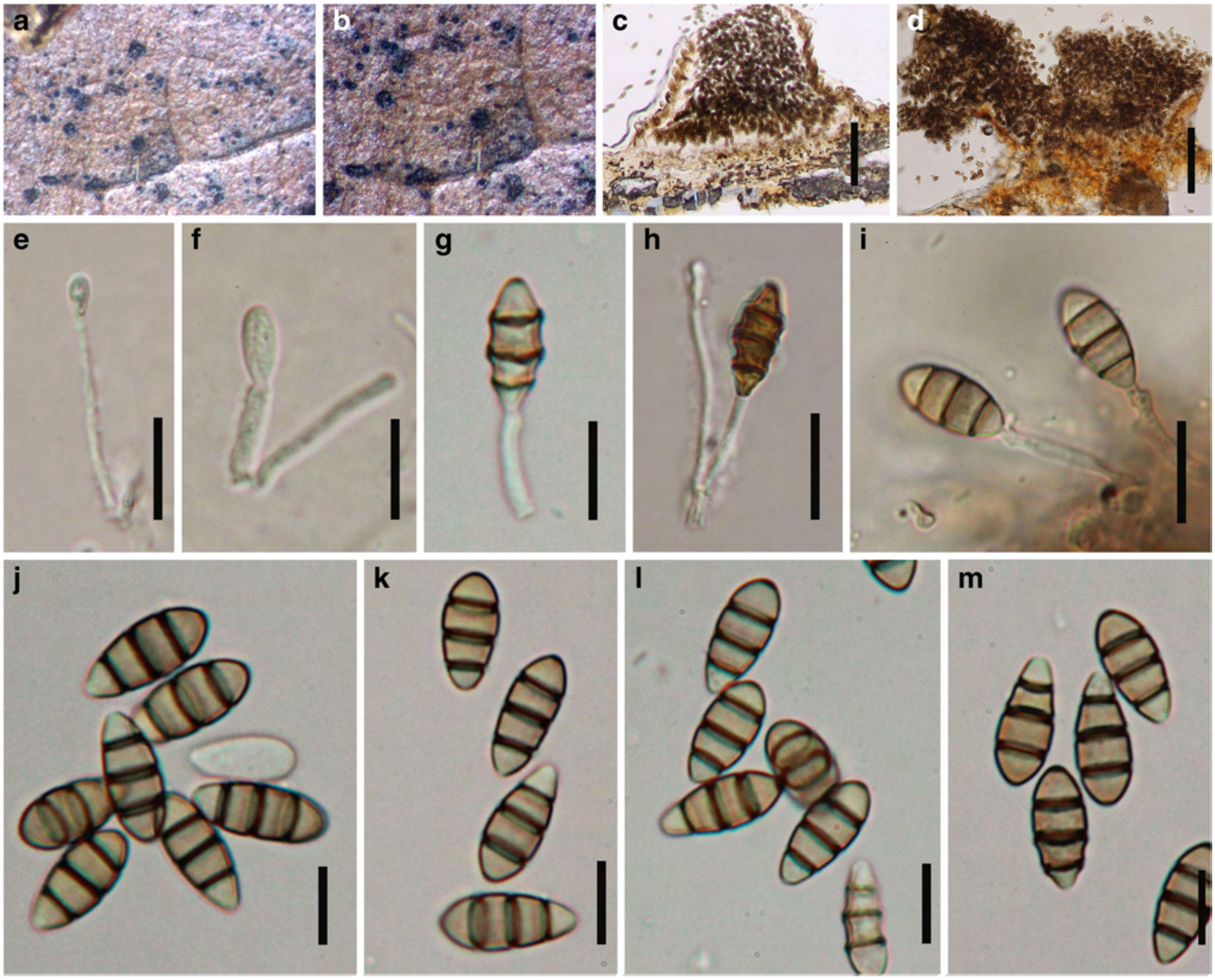


Fig. 82 *Seimatosporium sorbi* (holotype) **a**, **b** Conidiomata on dead leaf of *Sorbus torminalis* **c**, **d** Cross section of conidiomata **e**, **i** Different stages of conidiogenesis **j**–**m** Conidia. Scale bars: **c**, **d**=150 μm, **e**–**i**=10 μm, **j**–**m**=5 μm

Nag Raj (1993). Farr and Rossman (2015) reported *S. cassiopes* (Rostr.) B. Sutton (conidia 18.5−23×7.5−8.5 µm, *fide* Sutton 1980) and *S. dacicum* (Săvul. & Hulea) B. Sutton (conidia 12–15×4–6 µm, *fide* Sutton 1980) from *Sorbus* spp. Nevertheless, (Nag Raj 1993) listed both species under unexamined and excluded species. In molecular analyses, our taxon groups with *S. vaccinii* (Fuckel) B. Erikss. (conidia 13–18.5×4.5−5.5 µm, *fide* Sutton 1980). Our taxon is morphologically distinct from other species of *Seimatosporium* (Sutton 1980; Nag Raj 1993) and thus is introduced as a new species.

193. ***Seimatosporium pseudorosarum*** Wijayawardene, Camporesi & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551182; *Facesoffungi number*: FoF00670; Fig. 83

Etymology: Named as its morphological similarity to *Seimatosporium rosarum*.

Holotype: MFLU 15-0745

Saprobic or endophytic on living branches and stems of *Rosa canina* L. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 200–250 µm diam., 100–150 µm high, acervular, unilocular, subglobose, superficial to subepidermal, solitary, black, ostiolate, apapillate. *Conidiomata wall* multi-layered, outer wall thick, composed of dark brown cells of *textura angularis*, inner wall thin, hyaline. *Paraphyses* 10–22 µm, filiform, cylindrical, aseptate, hyaline, smooth-walled. *Conidiophores* 6–25×2–4 µm, long, cylindrical, branched, hyaline, smooth-walled. *Conidiogenous cells* holoblastic, annellidic, simple, integrated, determinate, hyaline. *Conidia* 9–14×4–6 µm ($\overline{x}$ = 11.31×6.06 µm, n=20), ellipsoid to obovoid, obtuse apex and base, straight, 2-septate, with brown to dark brown septa, constricted at the septa, eguttulate, medium brown, with hyaline to sub-hyaline basal cell, smooth-walled, with or without basal appendage, if present appendages 9–30 µm, unbranched.

Culture characteristics: On PDA slow growing, white from above, pale brown from below, flat, margin even, attaining a diam. of 2 cm in 7 days at 18 °C.

Material examined: ITALY, Province of Rimini [RN], near Pennabilli–Rimini, on dead branch of *Rosa canina* (*Rosaceae*), 22 March 2014, Erio Camporesi, IT 1770 (MFLU 15-0745 **holotype**), living cultures MFLUCC 14–0466, GUCC 66.

Notes: Farr and Rossman (2015) reported *Seimatosporium caudatum* (Preuss) Shoemaker, *S. discosioides* (Ellis & Everh.) Shoemaker, *S. lichenicola* (Corda) Shoemaker & E. Müll., *S. rosae* Corda, *S. rosarum* (Henn.) B. Sutton and *S. salicinum* (Corda) Nag Raj from *Rosa* spp. Our collection morphologically resembles *S. rosae*, *S. rosarum* and *S. salicinum* as it has conidia with only basal appendages. However, *S. pseudorosarum* has only 2-septate conidia, while all other species have 2–3 or 3 septa. Hence, we introduce our species as a new species of *Seimatosporium*. The following taxonomic key can be used to distinguish *S. pseudorosarum* from other species occurring on *Rosa* spp.

1. Conidia with either apical or basal appendages 2
    1. Conidia lacking apical or basal appendages .... ***S. lichenicola***
    2. Conidia with appendages at both ends .... ***S. discosioides***
2. Conidia with or lacking apical and/or basal appendages 3
3. Conidia with only basal appendages 4
    3. Conidia with or lacking basal or apical appendages .... ***S. caudatum***
4. Conidia only 2-septate .... ***S. pseudorosarum***
    4. Conidia with 2–3 septa 5
5. Conidia with only 3 septa .... ***S. rosae***
    5. Conidia with 2–3 septa 6
6. Conidia 9.5−12×3–5 µm .... ***S. rosarum***
    6. Conidia 11–17×4–6 µm .... ***S. salicinum***

Glomerellaceae Locq. ex Seifert & W. Gams

The family *Glomerellaceae* was invalidly published by Locquin (1984), validated in Zhang et al. (2006), and accepted as one of the three families of *Glomerellales* in Réblová et al. (2011). *Glomerellaceae* is a monotypic family characterized by the *Glomerella* sexual morph and a *Colletotrichum* asexual morph (Maharachchikumbura et al. 2015).

Colletotrichum Corda, in Sturm, Deutschl. Fl., 3 Abt. (Pilze Deutschl.) 3(12): 41, tab. 21 (1831)

This genus has been placed in *Glomerellaceae* by Réblová et al. (2011) which has also been confirmed by the recent study of Maharachchikumbura et al. (2015). Maharachchikumbura et al. (2015) used *Colletotrichum* over its sexual name *Glomerella*. The most recent treatment of this genus is by Hyde et al. (2014) which was based on multi-gene phylogeny (Fig. 84).

194. ***Colletotrichum aciculare*** Jayawardena, Tangthirasunun & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551298; *Facesoffungi number*: FoF: 00850; Fig. 85

Etymology: Based on the acicular conidia.

Holotype: MFLU 13-0280

Saprobic on leaves. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 200–450 µm ($\overline{x}$ = 370 µm, n=10) diam., solitary, an acervulus, black, globose, conidiophores and setae formed on a cushion of pale brown angular cells.

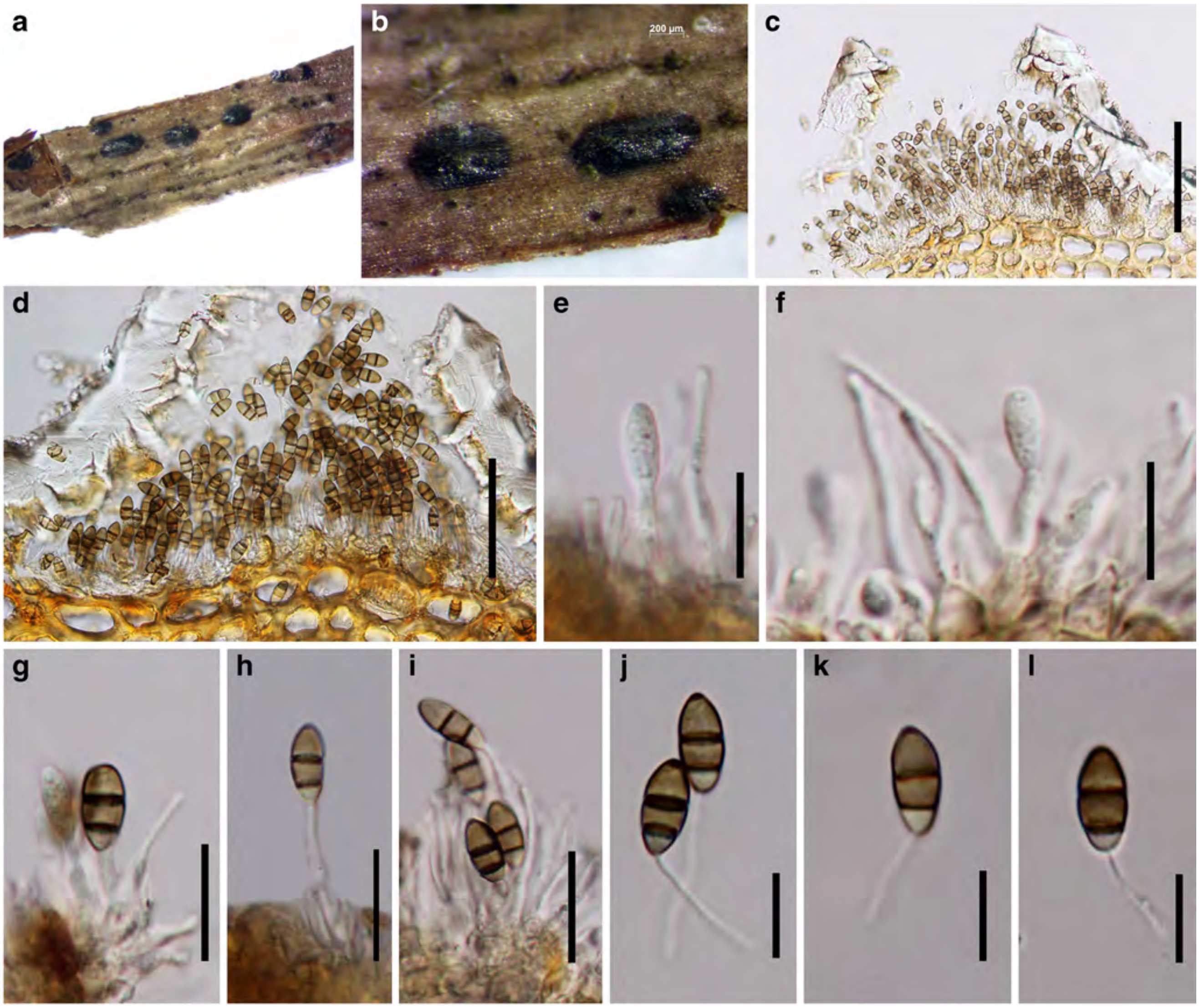


Fig. 83 *Seimatosporium pseudorosarum* (holotype) **a**, **b** Conidiomata on *Rosa villosa* **c**, **d** Cross sections of conidiomata **e**–**i** Different stages of conidiogenesis and paraphyses **j**–**l** Conidia. Scale bars: **c**, **d**=100 µm, **e**, **f**, **j**–**l**=10 µm, **g**–**i**=15 µm

Setae abundant, 109–215 µm long, dark brown to medium brown, paler towards the apex, smooth-walled to verruculose, straight or slightly curved, 1–4-septate, base cylindrical, conical with slightly inflated, 3–5 µm diam., apex slightly acute to roundish. *Conidiophores* septate, to 32 µm long, hyaline to pale brown, smooth–walled. *Conidiogenous cells* 17–26×3–4 µm ($\bar{x}$ = 21×3 µm, *n*=20), hyaline, smooth–walled, cylindrical to elongated ampulliform, opening 1–4 µm diam., collarette sometimes visible, periclinal thickening visible. *Conidia* 37–43×2–5 µm ($\bar{x}$ = 40×4 µm, *n*=40), hyaline, acicular, aseptate, curved, both sides gradually tapering towards the round to slightly acute apex and truncate base, guttulate, smooth-walled or verruculose, L/W ratio=8.9. *Appressoria* 8–12×2–4 µm ($\bar{x}$ = 12×3 µm, *n*=10), solitary to aggregated, globose to subglobose, pale brown, smooth-walled.

Cultural characteristics: Colonies on PDA reaching 60 mm in 7 days at 28 °C, margin feathery, white aerial mycelium becoming pale yellow towards the edge from above, reverse peach coloured (4), becoming black with age.

Material examined: THAILAND, Chiang Rai, on a dead leaf, host unknown, 15 July 2012, Yee Than NTCL91-2 (MFLU 13-0280, **holotype**); ex-type living cultures, MFLUCC 12–0425, KUMCC, CFTCC.

Notes: *Colletotrichum aciculare* clusters in the truncatum species complex (Fig. 85), forming a separate branch with 80 % bootstrap support and 0.95 Bayesian posterior probability. This species differs from *C. curcumae* (Syd. & P. Syd.) E.J. Butler & Bisby by having dark brown to medium brown setae, becoming pale towards the apex, while setae of *C. curcumae* are dark brown up to the apex (Damm et al. 2009). The L/W ratio of *C. aciculare* conidia (8.9) is larger

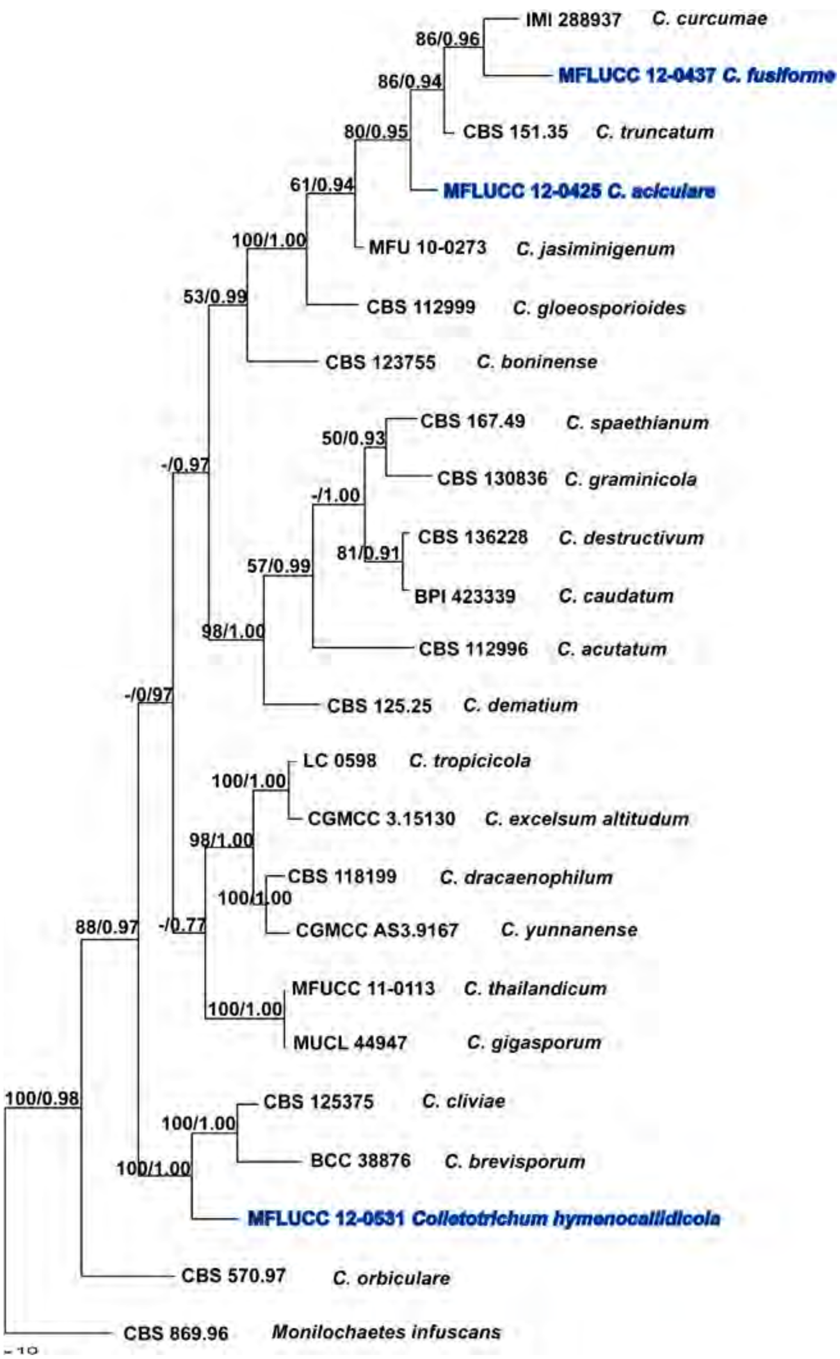


Fig. 84 Phylogram generated from parsimony analysis based on combined ITS, GADPH, CHS, ACT and β-tubulin sequence data of *Colletotrichum*. Parsimony bootstrap support values greater than 50 % and Bayesian posterior probabilities greater than 0.75 are indicated above or below the nodes. The ex-type strains are in *bold*; the new isolates are in *blue*. The tree is rooted with *Monilochaetes infuscans* CBS 869.96

than the L/W ratio of *C. curcumae* conidia (4.2) (Damm et al. 2009).

195. ***Colletotrichum fusiforme*** Jayawardena, Bhat, Tangthirasunun & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551299; *Facesoffungi number*: FoF00851; Fig. 86

Etymology: Based on the fusiform conidia.

Holotype: MFLU 13-0291

Saprobic on leaves. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 70–140 μm ($\bar{x}$ = 80 μm, n=10) diam., solitary, an acervulus, black, globose- oval with pale yellow spore mass. *Setae* abundant, 95–225 μm long, dark brown to medium brown, smooth-walled, curved, 1–4-septate, base cylindrical, conical with slightly inflated, 3–5 μm diam., apex acute. *Conidiophores* septate, to 31 μm long, hyaline to pale brown, smooth–walled densely clustered. *Conidiogenous cells* 6–9 × 1–2 μm ($\bar{x}$ = 7 × 2 μm, n=20), reduced,

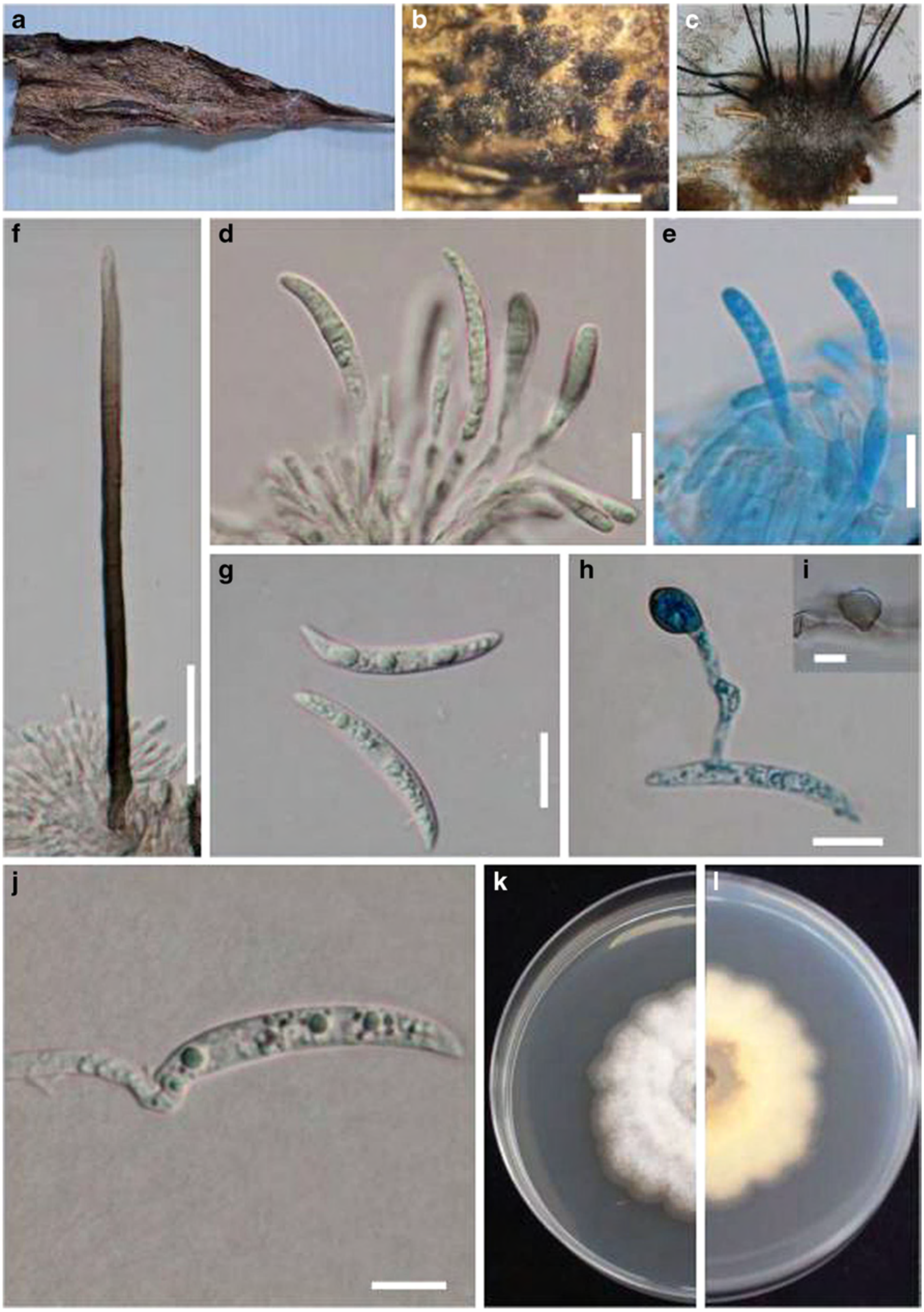


Fig. 85 *Colletotrichum aciculare* (holotype) **a** Herbarium specimen **b** Black acervuli on host **c** Section of the conidioma **d** Setae **e**, **f** Hyaline conidiogenous cells **g** Hyaline conidia **h**, **j** Germinating conidium **i** Appressoria **k** Upper view of the colony **l** Lower view of the colony. Scale bars: **b**=200 μm, **f**=50 μm, **c**=20 μm, **g**, **h**, **j**=15 μm, **d**, **e**=10 μm, **i**=5 μm

hyaline, smooth–walled, cylindrical, collarette rarely observed, periclinal thickening not observed. *Conidia* 34–44×3–5 μm ($\bar{x}$ = 35×4 μm, *n*=40), hyaline, fusiform, aseptate, curved, base rounded and truncate with a slightly acute apex, guttulate, smooth-walled or verruculose, L/W ratio=8.2. *Appressoria* 6–11×3–4 μm ($\bar{x}$ = 10×3 μm, *n*=10) solitary to aggregated, in short chains, oval, medium to dark brown, smooth-walled.

Cultural characteristics: Colonies on PDA reaching 55 mm in 7 days at 28 °C, margin undulate, white aerial mycelium becoming olivaceous green to dull green olivaceous green towards the edge from forward, reverse olivaceous green to dull green, concentric.

Material examined: THAILAND, Chiang Rai, on a dead leaf, host unknown, 14 July 2012, J. Bhat NTCL98, (MFLU 13-0291, **holotype**); ex-type living cultures, MFLUCC 12–0437, KUMCC, CFTCC.

Notes: *Colletotrichum fusiforme* clusters in the truncatum species complex (Fig. 86), forming a separate branch with 86 % bootstrap support and 0.96 Bayesian posterior probability. This species differs from its sister taxon *C. truncatum* (Schwein.) Andrus & W.D. Moore by having dark brown to medium brown setae, while the setae of *C. truncatum* are hyaline to pale brown. The L/W ratio of *C. fusiforme* conidia is larger (8.2) than that of *C. truncatum* (5.7). Conidia of *C. fusiforme* are curved, with a rounded and truncate base and slightly acute apex, while in *C. truncatum* conidia are strongly curved at the apex (Damm et al. 2009).

196. ***Colletotrichum hymenocallidicola*** Chethana, Tangthirasunun, Jayawardena & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551304; *Facesoffungi number*: FoF: 00870; Fig. 87

Etymology: The specific epithet *hymenocallidicola* is named after the host *Hymenocallis* from which the taxon was collected.

Holotype: MFLU 13–0292

Pathogenic on leaves. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* 100–130 μm ($\bar{x}$ = 116 μm, *n*=10) diam., solitary, an acervulus, black, oval. *Setae* 51–56 μm long, pale to dark brown, smooth-walled to verruculose, straight, 1–3-septate, base cylindrical, 2–4 μm diam., apex acute to roundish. *Conidiogenous cells* 10–20×3–5 μm ($\bar{x}$ = 13×4 μm, *n*=20), enteroblastic, hyaline, smooth-walled, cylindrical to clavate, collarette not visible. *Conidia* 11–19×4–6 μm ($\bar{x}$ = 16×5 μm, *n*=20), hyaline, cylindrical, aseptate, slightly curved, with rounded ends, guttulate, smooth-walled, L/W ratio 3.2. *Appresoria* not observed.

Cultural characteristics: Conidia germinating on water agar mostly from both ends. Colonies on PDA, edge entire, white to pale white, dense, cottony mycelium on the surface and reverse with pale white mycelium.

Material examined: THAILAND, Phang Nga, on a living leaf of *Hymenocallis* sp. (*Amaryllidaceae*), 3 August 2012, Narumon Tangthirasunun NTCL99 (MFLU 13–0292, **holotype**); ex-type living cultures, MFLUCC 12–0531, KUMCC 15–0076, CFTCC 15–0003.

Notes: Based on phylogenetic analyses and morphological comparison, our isolate belongs to *Colletotrichum*. *Colletotrichum hymenocallidicola* appears as a singleton species and forms a sister clade (Fig. 81) to *C. brevisporum* Noireung et al. (BCC 38876) with high bootstrap support (100 %) and Bayesian posterior probabilities (1.00). *Colletotrichum brevisporum* differs from *C. hymenocallidicola* in their smaller conidia (12–17×5–6 μm, L/W ratio 2.52) and fewer guttules. Original description of *C. brevisporum* does not contain setae characters (Noireung et al. 2012).

Halosphaeriaceae E. Müll. & Arx ex Kohlm.

The status and classification of the family was recently updated in Jones et al. (2015) and is not further discussed here (Fig. 88).

197. ***Tinhaudeus*** K.L. Pang, S.Y. Guo & E.B.G. Jones, ***gen. nov.***

MycoBank number: MB 812936; *Facesoffungi number*: FoF00980

Etymology: 'Tin Hau', Cantonese for the sea goddess and 'deus' meaning 'god' in Latin.

Saprobic on decaying wood in mangroves. **Sexual morph**: *Ascomata* globose to subglobose, immersed, ostiolate, with long necks, coriaceous, light- to dark-coloured. Necks periphysate. *Peridium* one-layered, composed of elongate cells with large lumina of *textura angularis. Catenophyses* present, persistent. *Asci* 8-spored, clavate, with a long stalk, unitunicate, thin-walled, slightly thickened at the apex, persistent, developing at the base of the ascoma venter on a convex cushion of ascogenous cells. *Ascospores* ellipsoidal, 1-septate, not or slightly constricted at the septum, hyaline. *Appendages* bipolar, initially adpressed to the ascospore wall and extended over the mid-septum, unravelling immediately in sea water to form a long thin filament. **Asexual morph**: Undetermined.

Type species: ***Tinhaudeus formosanus*** K.L. Pang, S.Y. Guo & E.B.G. Jones

Notes: Ascospores of *Tinhaudeus formosanus* with bipolar unfurling appendages superficially link this species to a number of genera in the *Halosphaeriaceae*, but with the retraction of plasmalemma in *T. formosanus*, it particularly resembles *Aniptodera*, *Phaeonectriella*, *Saagaromyces* and *Tirispora* (Pang et al. 2003). *Phaeonectriella* species have dark-coloured ascospores and its appendages, if present, may be ephemeral (Hyde et al. 1999). In *Tirispora* (*T. unicaudata*

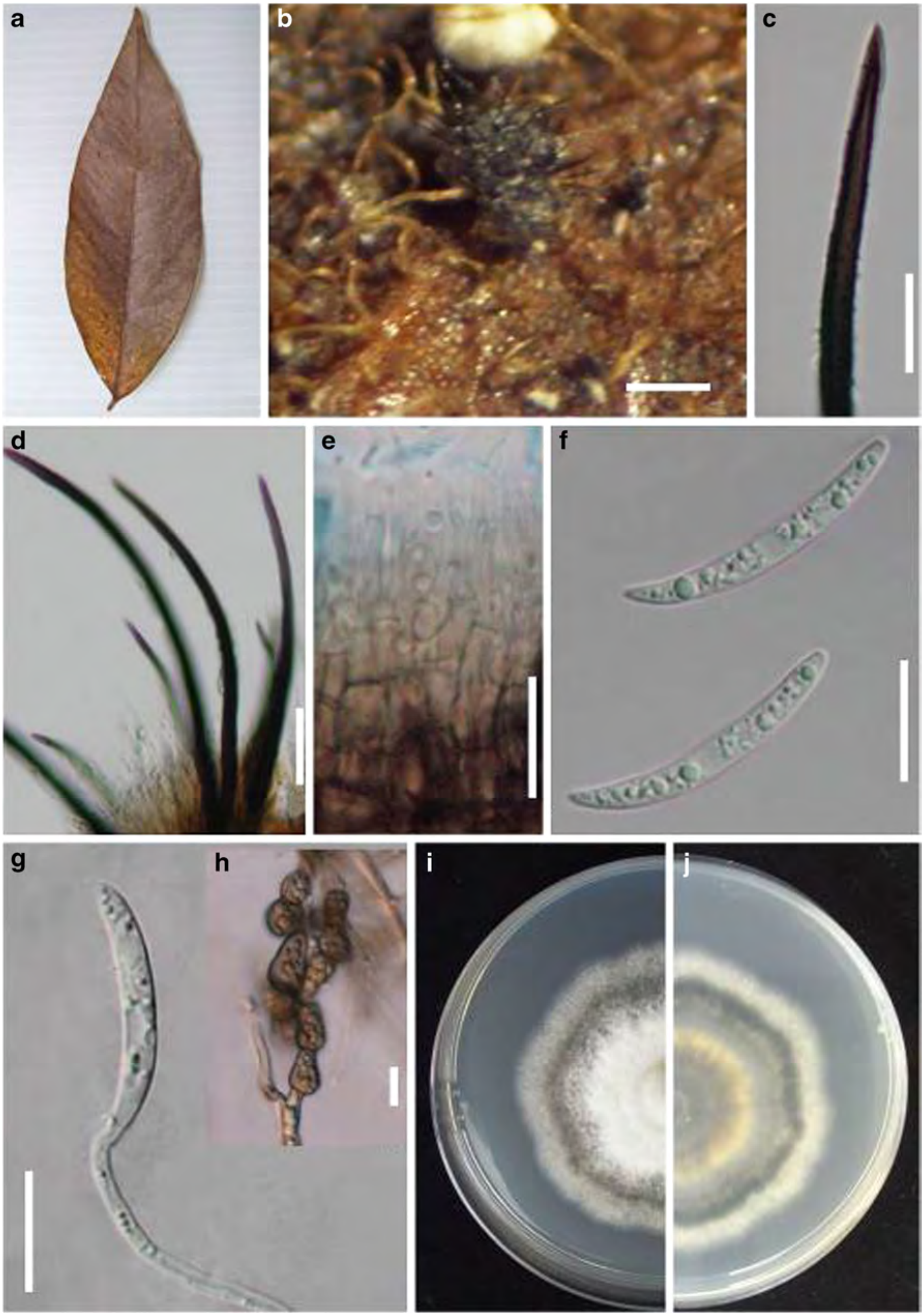


Fig. 86 *Colletotrichum fusiforme* (holotype) **a** Herbarium specimen **b** Black acervuli **c** Acute apex of the setae **d** Setae with conidiophores **e** Conidiophores **f** Hyaline conidia **g** Germinating conidium **h** Appressoria **i** Upper view of the colony **j** Lower view of the colony. Scale bars: **b**= 100 μm, **c**, **d**=20 μm, **e**–**g**=15 μm, *h*=10 μm

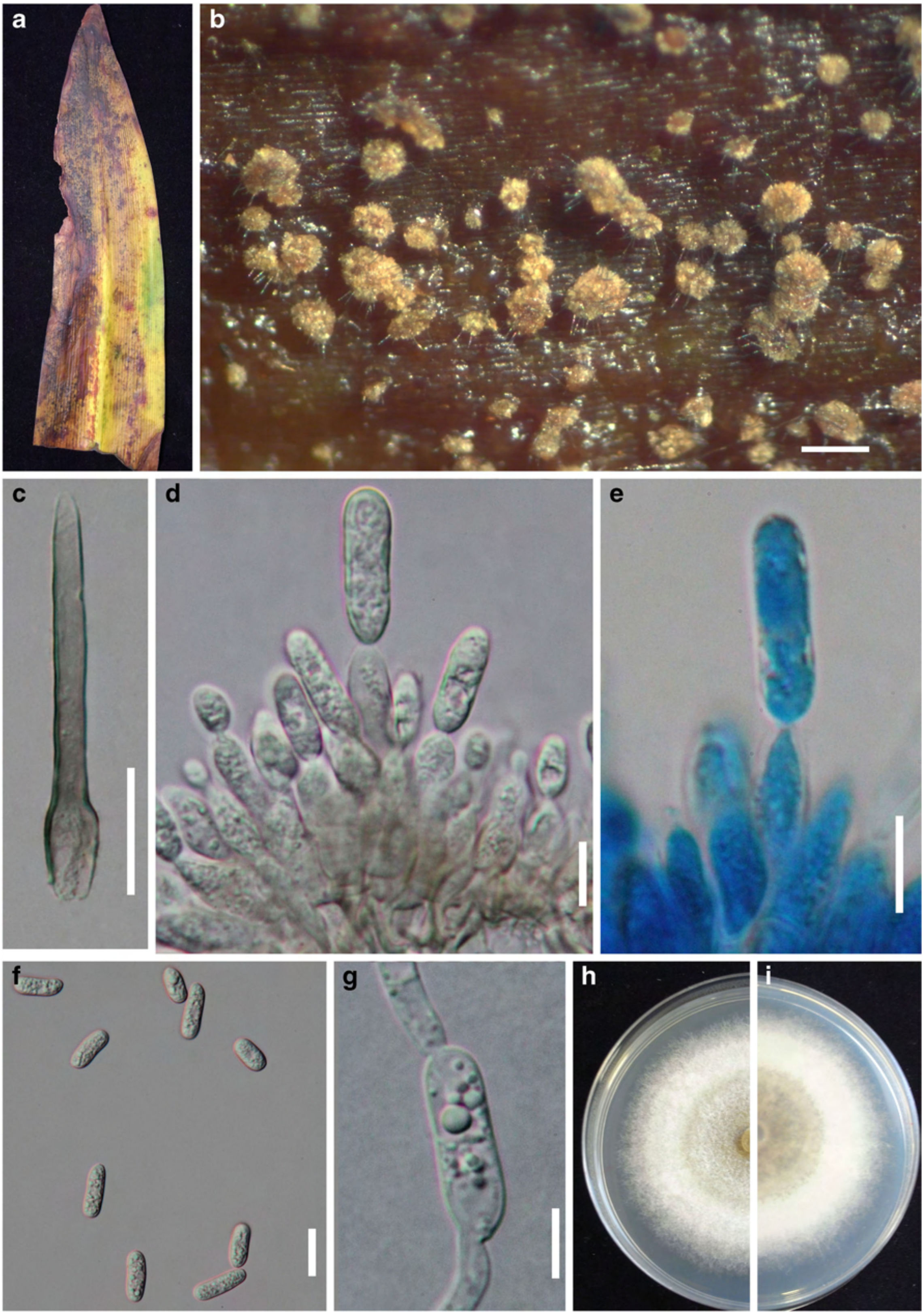


Fig. 87 *Colletotrichum hymenocallidicola* (holotype) **a** Specimen with conidiomata **b** Black acervuli on host **c** Light brown setae **d**, **e** Hyaline conidiogenous cells **f** Hyaline conidia **g** Germinating conidium **h** Upper view of the colony **i** Reverse view of the colony. Scale bars: **b**=100 µm, **c**, **f**=20 µm, **d**, **e**=10 µm, *g*=5 µm

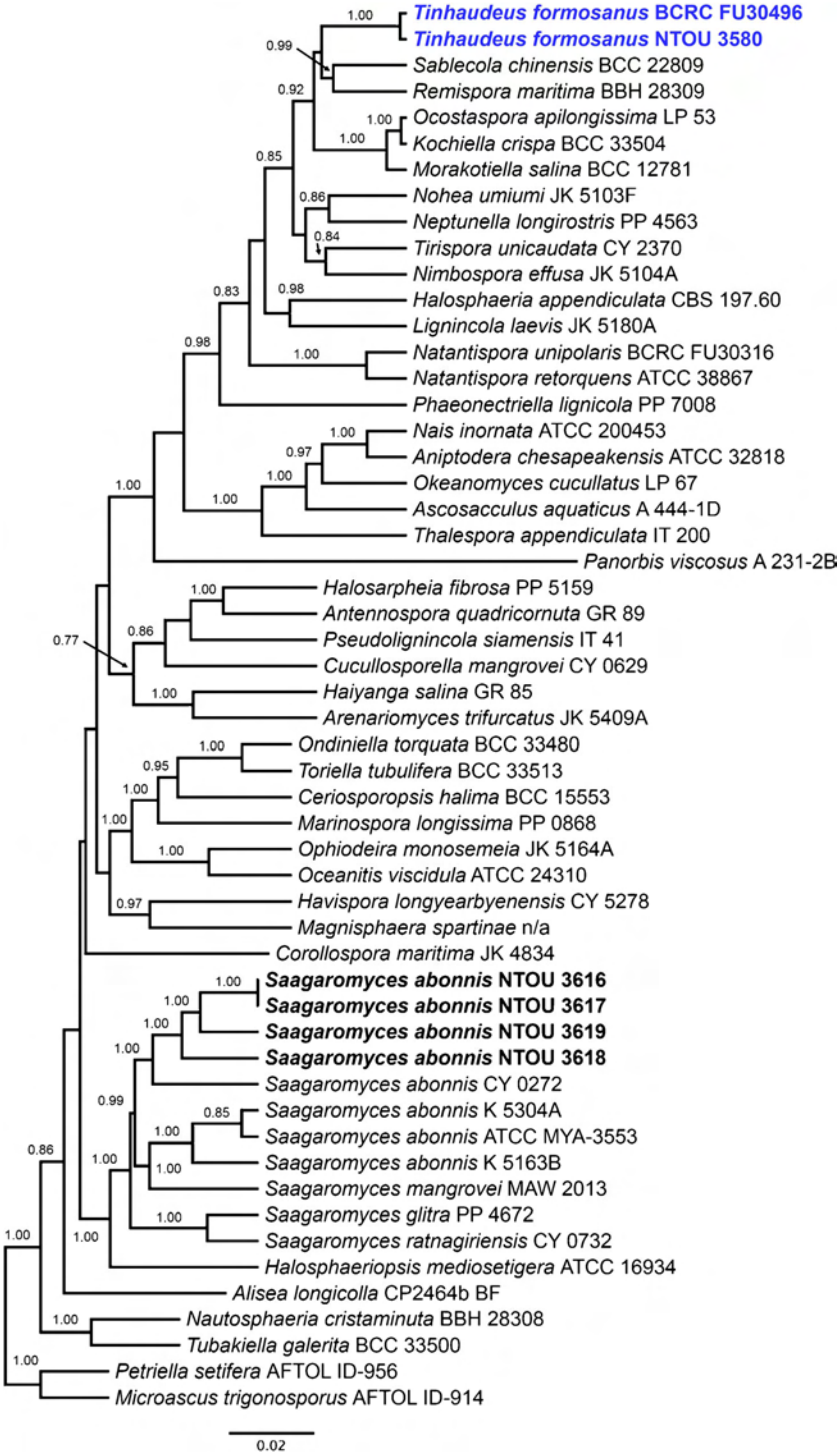


Fig. 88 Bayesian phylogenetic tree showing the placement of *Tinhaudeus formosanus* based on a combined analysis of the 18S and 28S rRNA genes (GenBank accession nos. after species name, respectively) in BEASTv.1.7.2 (Drummond & Rambaut 2007) with the following analytical settings: GTR, estimated base frequency, gamma + invariant sites, number of gamma categories set at 4, a strict clock with estimated evolutionary rate and normal rate distribution, Coalescent: Constant Size as the speciation model, 10 million generations with parameters and trees sampled every 1000 generations. Convergence of the analyses was checked in Tracer v1.5 (Drummond & Rambaut 2007) and the effective sample size (ESS) of the parameter statistics >200 was ensured. The first 10 % of the trees were treated as burn-in and discarded. A summary tree was produced using TreeAnnotator v1.7.2 (Drummond & Rambaut 2007) and viewed and edited in FigTree v1.3.1 (Rambaut 2009). Bayesian posterior probabilities greater than 0.75 are near the nodes. The ex-type strains are in *bold* and the new isolates are in *blue*. The tree is rooted with *Microascus trigonosporus* AFTOL-ID 914 and *Petriella setifera* AFTOL-ID 956

E.B.G. Jones & Vrijmoed), asci are apically with a pore and ascospores are thick-walled with one appendage (Jones et al. 1994). *Tinhaudeus formosanus* is morphologically similar to *Aniptodera mangrovei* K.D. Hyde and *A. salsuginosa* Nakagiri & Tad. Ito, but the ascospores of *T. formosanus* are intermediate in size between the two *Aniptodera* species (Jones et al. 2009).

Tinhaudeus formosanus also closely resembles *Saagaromyces*, in particular, *S. abonnis* (Kohlm.) K.L. Pang & E.B.G. Jones, including their mangrove wood occurrence, asci with a slightly thickened apex and retraction of plasmalemma, but the asci, ascospores and appendages of the former species are smaller. Therefore, additional sequences from collections of *S. abonnis* made in Hong

Kong and Taiwan were included in the phylogenetic analysis. Phylogenetically, two isolates of *T. formosanus*, collected from two different mangroves in Taiwan, are not related to *Aniptodera* (*A. chesapeakensis* Shearer & M.A. Mill.), *Phaeonectriella* (*P. lignicola* R.A. Eaton & E.B.G. Jones), *Saagaromyces* (*S. ratnagiriensis* (S.D. Patil & Borse) K.L. Pang & E.B.G. Jones) and *Tirispora* (*T. unicaudata*) (Fig. 2), but group with *Sablecola chinensis* E.B.G. Jones, K.L. Pang & Vrijmoed and *Remispora maritima* Linder, species with deliquescing asci and no unfurling ascospore appendages. *Saagaromyces abonnis* isolates formed a well-supported monophyletic clade with *S. mangrovei* Abdel-Wahab, Bahkali & E.B.G. Jones (Liu et al. 2015), but with no affinity with *T. formosanus*.

198. ***Tinhaudeus formosanus*** K.L. Pang, S.Y. Guo & E.B.G. Jones, ***sp. nov.***

MycoBank number: MB 812937; *Facesoffungi number*: FoF00981; Fig. 89

Holotype: F28727 (National Museum of Natural Science, Taiwan)

Etymology: In reference to Taiwan where the holotype was collected.

Saprobic on decaying mangrove wood. **Sexual morph**: *Ascomata* 211-(295)-442×114-(180)-263 μm (n=6), light- to dark-coloured when mature, globose to subglobose, solitary or gregarious, immersed, coriaceous, ostiolate. *Necks* 104-(141)-174 μm long, 38-(64)-80 μm diam. (n=2), periphysate. *Peridium* 7-(15)-31 μm (n=6), composed of one layer of elongate cells with large lumina of *textura angularis. Catenophyses* present, persistent. *Asci* 133-(159)-181×32-(39)-49 μm (n=15), clavate, unitunicate, 8-spored, thin-walled, persistent, with a long stalk, developing from inner wall of ascoma base, with a slightly thickened apex, plasmalemma retracted. *Ascospores* 26-(33)-38×10-(12)-14 μm (n=61), ellipsoidal, hyaline, 1-septate, not or slightly constricted at the septum. Appendages bipolar, initially adpressed to the ascospore wall and extended over the mid-septum, unravelling immediately in sea water to form a long thin filament. **Asexual morph**: Undetermined.

Material examined: TAIWAN, Chunan, on a piece of decaying mangrove wood, 27 January 2011, Ka-Lai Pang, F28727 (National Museum of Natural Science, Taiwan, **holotype**); ex-type living culture, BCRC FU30496 (Fig. 90).

Pestalotiopsidaceae Maharachch. & K.D. Hyde

Senanayake et al. (2015) resurrected the order *Amphisphaeriales* based on molecular data and morphology and found that *Pestalotiopsis* and related genera were distinct from the families *Bartaliniaceae* and *Discosiaceae*. Hence, the new family *Pestalotiopsidaceae* is introduced for the genera *Ciliochorella*, *Lepteutypa*, *Monochaetia*, *Neopestalotiopsis*, *Pestalotiopsis*, *Pseudopestalotiopsis* and *Seiridium*.

199. ***Pestalotiopsis subshorea*** Yong Wang bis, Y. Song, K. Geng & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551449; Facesoffungi number: FoF01045; Fig. 91

Etymology: The specific epithet is referring to *Pestalotiopsis shorea*, which is similar to this new taxon.

Holotype: HGUP d4118

Endophyte in leaves of *Micelia hedyosperma* Law. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiophores* indistinct. *Conidiogenous cells* discrete, simple, filiform, thin-walled, hyaline. *Conidia* fusoid, straight to slightly curved, 4-septate, 18–24.5×5.5–7 μm ($\bar{x}$ = 22×6 μm), basal cell conic, hyaline or pale olivaceous, thin-walled and verruculose, 3.3–5.3 μm long ($\bar{x}$ = 4.5 μm), with three median cells, doliform to cylindrical, constricted at the septa, concolourous, olivaceous to brown, septa and periclinal walls darker than the rest of the cell, wall rugose, together 12–16 μm long ($\bar{x}$ = 14 μm) second cell from base 3.5–6 μm ($\bar{x}$ = 5 μm); third cell 4–6 μm ($\bar{x}$ = 4.5 μm); fourth cell 4–6 μm ($\bar{x}$ =5 μm); apical cell hyaline, conic to subcylindrical 3–5.3 μm long ($\bar{x}$ = 4 μm); with 2–3 tubular apical appendages, arising from the apex of the apical cell, 10–28 μm long ($\bar{x}$ = 17 μm), unequal; basal appendage present 2–5.5 μm ($\bar{x}$ = 3.5 μm), rarely absent.

Culture characteristics: Colonies on PDA reaching 7 cm diam. after 6 days at 25 °C, edge entire, whitish, with dense aerial mycelium on surface, fruiting bodies black; reverse of culture whitish.

Material examined: CHINA, Guizhou Province, Guiyang City, Xiaohe District, on living leaves of unidentified tree, Kun Geng, 25 September 2012 (HGUP d4118, **holotype**); ex-type culture, HGUP4118; CHINA, Guangxi Province, on living leaves of *Micelia hedyosperma* (*Magnoliaceae*), Jiguang Wei, 2011 (HGUP4279, **paratype**).

Notes: Phylogenetic analysis of three combined gene loci (ITS+β-tubulin+EF) show *Pestalotiopsis subshorea* (HGUP 4118 and HGUP 4279) forming a separate branch as a sister taxon to *P. shorea* (Fig. 90). *Pestalotiopsis shorea* was isolated from *Shorea obtusa* in Thailand (Song et al. 2014). Both species produce concolourous conidia and their conidial size overlap. The morphological distinction of *P. subshorea* and *P. shorea* is based on the length of apical and basal appendages. Apical appendages of *P. subshorea* are longer than *P. shorea* (3–5 μm long), but the basal appendage is shorter than *P. shorea* or lacking. Thus, we confirm the novelty of *P. subshorea*.

200. ***Pestalotiopsis dracaenea*** Yong Wang bis, Y. Song, K. Geng & K.D. Hyde, ***sp. nov.***

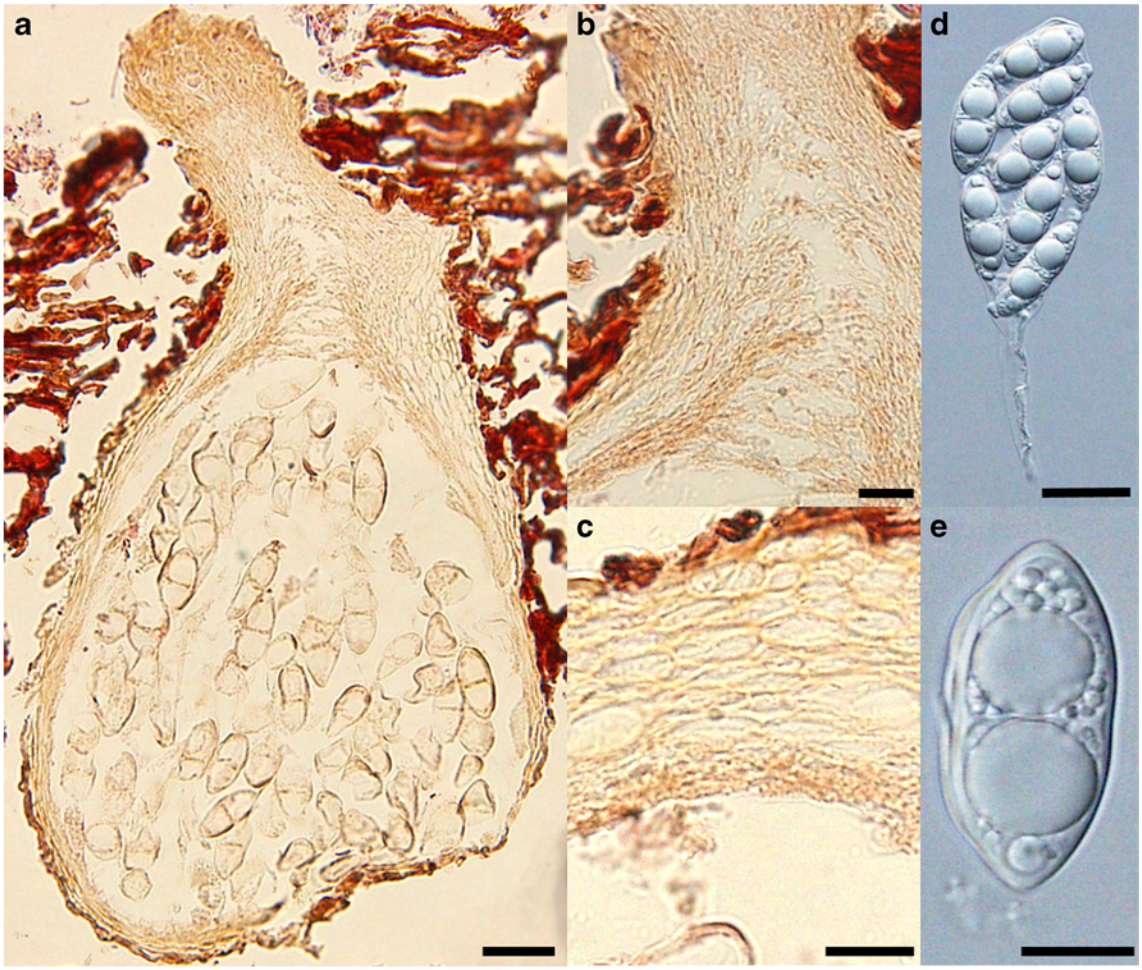


Fig. 89 *Tinhaudeus formosanus* (holotype) **a** Immersed ascoma with neck protruding to the surface **b** Periphysate neck **c** One-layered peridium of elongated cells with large lumina **d** Clavate ascus **e** Ascospores with bipolar unfurling appendages. Scale bars: **a**–**c**, **e**=10 μm, **d**=30 μm

Index Fungorum number: IF551444; Facesoffungi number: FoF01045; Fig. 92

Etymology: The specific epithet refers to the host, *Dracaena fragrans*, from which the taxon was isolated.

Holotype: HGUPd 4037

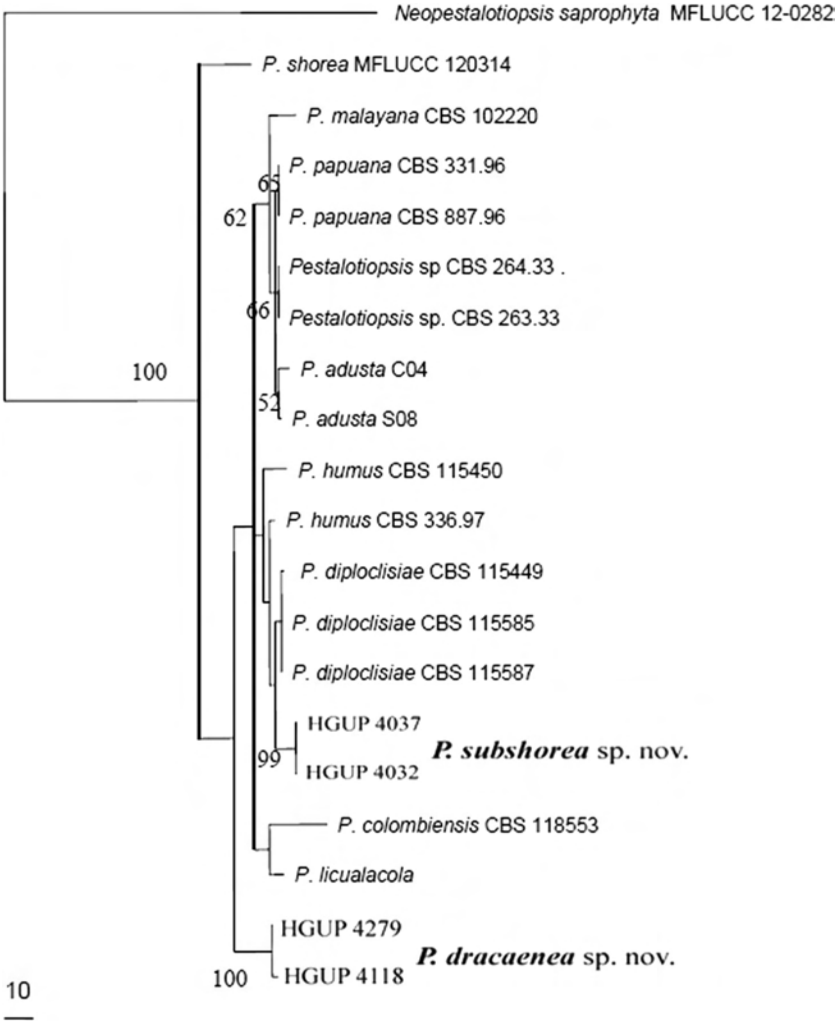
Associated with diseased leaves of *Dracaena fragrans* (L.) Ker Gawl. **Sexual morph**: undetermined. **Asexual morph**: *Conidiophores* indistinct. *Conidiogenous cells* lageniform. *Conidia* fusoid to ellipsoid, straight to slightly curved, 4-septate, 18–24×6.5–8.5 μm (x̄ = 20.5×7.5 μm), basal cell obconic, hyaline, thin-walled and verruculose, 3–4.5 μm long (x̄ = 4 μm), with three median cells, subcylindrical to cylindrical, verruculose, slightly constricted at the septa, concolourous, brown, together 11.5–16 μm long (x̄ = 13.5 μm) second cell from base 3.5–5.5 μm (x̄ = 4.5 μm); third cell 4–5.5 μm (x̄ = 5.5 μm); fourth cell 4–5.5 μm (x̄ = 4.5 μm); apical cell hyaline, obconic to subcylindrical, 3–5.5 μm long (x̄ = 4.4 μm); with 2–4 tubular appendages, 6.5–15.5 μm long (x̄ = 11 μm), arising from the apex of the apical cell, unequal; basal appendage present, filiform, 3–7 μm long (x̄ = 4.2 μm).

Culture characteristics: Colonies on PDA reaching 7 cm diam. after 7 days at 25 °C, edge crenate, whitish, with aerial mycelium on surface, with black, gregarious fruiting bodies; reverse of the culture white.

Material examined: CHINA, Hainan Province, Xinglong County, Tropical Botanical Garden, on living leaves of *Dracaena fragrans* (*Asparagaceae*), Kun Geng, 8 March 2012 (HGUP d4037, **holotype**); ex-type culture HGUP4037; CHINA, Hainan Province, Xinglong County, Tropical Botanic Garden, on living leaves of *Dracaena fragrans*, Kun Geng, 8 March 2012 (HGUP 4032, **paratype**).

Notes: We obtained two isolates of *P. dracaenea* (HGUP 4037 and HGUP 4032) which formed a relative independent branch with 100 % bootstrap value (Fig. 90), and had a close relationship with *P. diploclisiae P. diploclisiae* Maharachch., K.D. Hyde & Crous isolated on fruit of *Diploclisia glaucescens* and *Psychotria tutcheri* in Hong Kong, China and *P. humus* isolated on fruits of *Llex cinerea* in Hong Kong and soil in Papua New Guinea. *Pestalotiopsis dracaenea* differs from *P. humus* Maharachch., K.D. Hyde & Crous (18.5–22×5–7 μm) and *P. diploclisiae* (22–26.5×5–6.5 μm) by

Fig. 90 Phylogenetic tree for *Pestalotiopsis* based on combined sequences of ITS, β-tubulin and EF by Maximum Likelihood (ML) method on MEGA 6.0. Bootstrap support values <50 % were not shown. The tree is rooted with *Neopestalotiopsis saprophyta* (MFLUCC 12-0282)



conidial morphology, viz. wider conidia (6.5–8.5 µm) and longer apical (6.5–15.5 µm long) and basal (3–7 µm) appendages for *P. humus*, but shorter apical appendages than *P. diploclisiae* (13–19 µm).

201. ***Pestalotiopsis montellica*** (Sacc. & Voglino) Tak. Kobay., Trans. Mycol. Soc. Japan 15(4): 381 (1974)

Facesoffungi number: FoF01043; Fig. 93

= *Pestalotia montellica* Sacc. & Voglino, Atti Accad. Sci. Soc. Ven.-Trent. Sci. Nat. 9(2): 9 (1892)

Saprobic on dead plant material. **Sexual morph**: Undetermined. **Asexual morph**: *Conidiomata* pycnidial in culture on PDA, globose, scattered and confluent, semi-immersed, dark brown. *Conidiophores* indistinct. *Conidiogenous cells* lageniform to subcylindrical, colourless, smooth, proliferation once or twice. *Conidia* fusoid to ellipsoid, straight to slightly curved, 4-septate, 23–29×5.5–7 µm (x̅ = 25×6.1 µm), basal cell obconic, colourless, thin- and verruculose, 5–6 µm long (x̅ = 5.3 µm), with three median cells, subcylindrical, with thick verruculose walls, constricted at the septa, concolourous, pale brown, together 14–16.5 µm long (x̅ = 15.2 µm) second cell from base 4.5–6.5 µm (x̅ = 5.8 µm); third cell 4–6 µm (x̅ = 5.2 µm); fourth cell 5–6 µm (x̅ = 5.2 µm); apical cell colourless, obconic, acute at the apex, 4–5 µm long (x̅ = 4.3 µm); with 4 tubular appendages, 14–20 µm long, one arising from the apex and rest arising from just above the septum separating upper median and apical cell; basal appendage present, 4–5 µm long (x̅ = 4.5 µm).

Cultural characteristics: Colonies on PDA reaching 7 cm diam. after 7 days at 25 °C, edge lobate, whitish yellow, with dense, aerial mycelium on surface, with black, gregarious fruiting bodies; reverse of the colony whitish yellow.

Material examined: CHINA, Yunnan Province, on dead plant material, Wenping Wu (NN042849, MFLUCC 12-0279).

Notes: *Pestalotiopsis montellica* was described from the leaves of *Quercus* sp. in Italy and is well characterized and easily recognizable by the unique appendages attached to the apical cell. The arrangement of apical appendages in *P. montellica* is comparable with *P. jesteri* (Strobel et al. 2000). However, *P. jesteri* Strobel et al. differs from *P. montellica* by the presence of knobbed apical appendages.

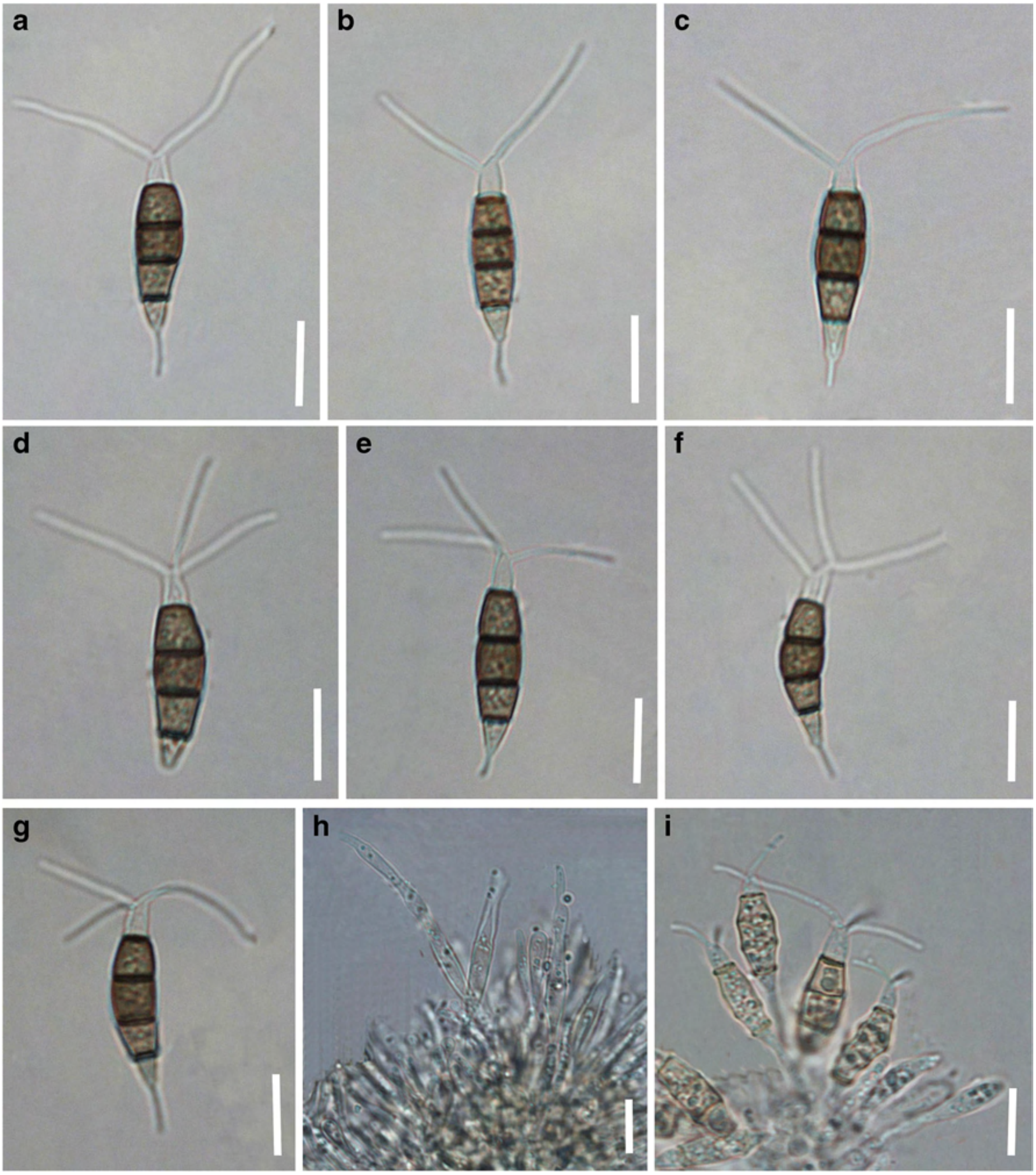


Fig. 91 *Pestalotiopsis subshorea* (holotype) **a**–**g** Conidia **h**, **i** Conidiophores / conidiogenous cells. Scale bars=10 μm

A megablast search of the NCBIs GenBank nucleotide sequence database using the sequences of *P. montellica* retrieves as closest hits *P. jesteri* (ITS: GenBank KM199380; Identities=512/536(96 %), Gaps=8/536(1 %); TUB GenBank KM199468; Identities=403/444(91 %), Gaps=7/444(1 %)). The attachment and arrangement of apical appendages at the apical cell are noticeably distinct in both species. Previously Maharachchikumbura et al. (2012) misidentified this isolate as a *P. montellica*.

***Togniniaceae* Réblová** et al.

The family *Togniniaceae* comprises three genera, including *Conidiotheca* and *Togninia* (Mostert et al. 2006; Réblová and Mostert 2007; Maharachchikumbura et al. 2015). Phylogenetic analysis of 18S small subunit (SSU) rRNA was used to confirm that *Togninia* is the sexual morph of *Phaeoacremonium* (Mostert et al. 2003). *Togniniaceae* is a single family in the order the *Togniniales* (see recently updated in Maharachchikumbura et al. 2015) (Fig. 94).

202. ***Phaeoacremonium tectonae*** Doilom & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551307; *Facesoffungi number*: FoF: 00880; Fig. 95

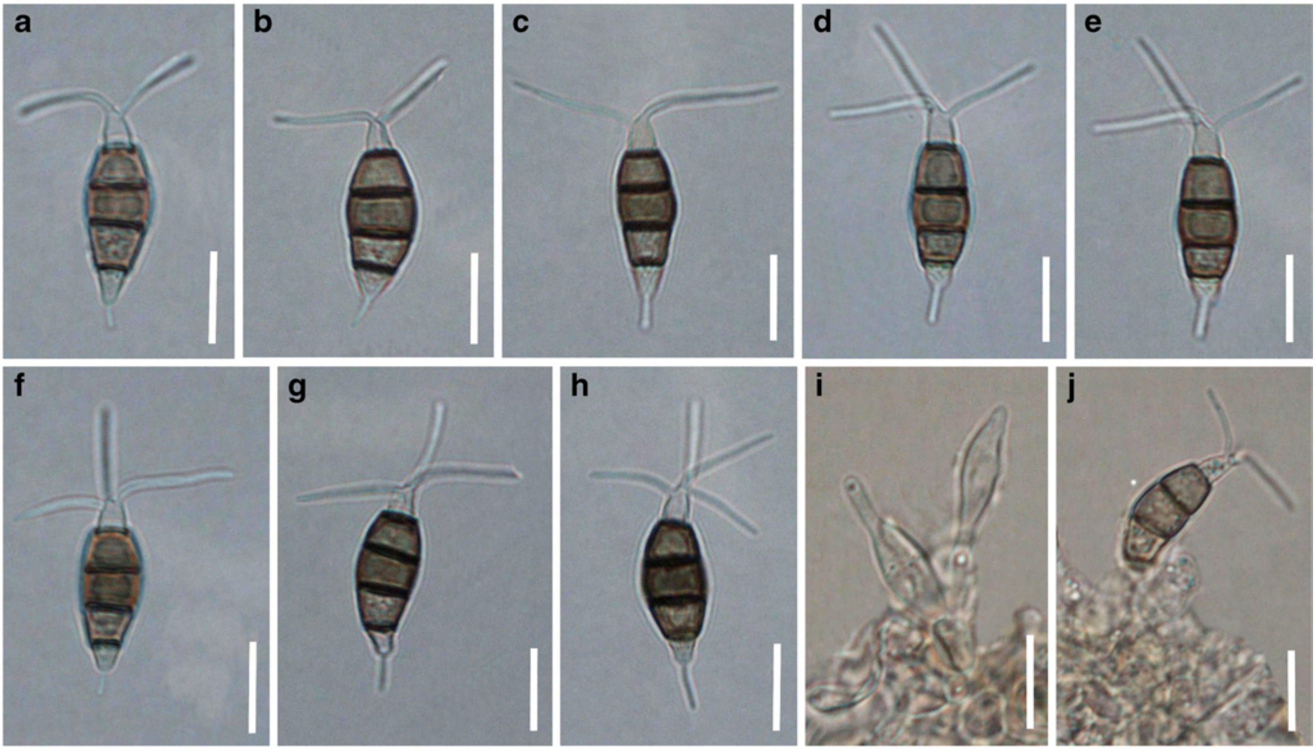


Fig. 92 *Pestalotiopsis dracaenea* (holotype) **a**–**h** Conidia **i**, **j** Conidiophores / conidiogenous cells. Scale bars=10 μm

Etymology: Name refers to the host genus *Tectona* on which the fungus was collected.

Holotype: MFLU 15-1392

Associated with heart rot and laurel wilt symptoms of *Tectona grandis* L.f.. **Sexual morph**: Undetermined. **Asexual morph** Structures on MEA: *Mycelium* 1–2.5 μm broad, consisting of branched, septate, single or in bundles, partly superficial, partly immersed, hyaline to pale brown, verruculose. *Conidiophores* (19–) 40–55 (−62) μm long, 1.5–2.7 diam. ($\overline{x}$ = 41×2 μm), branched in the basal region,

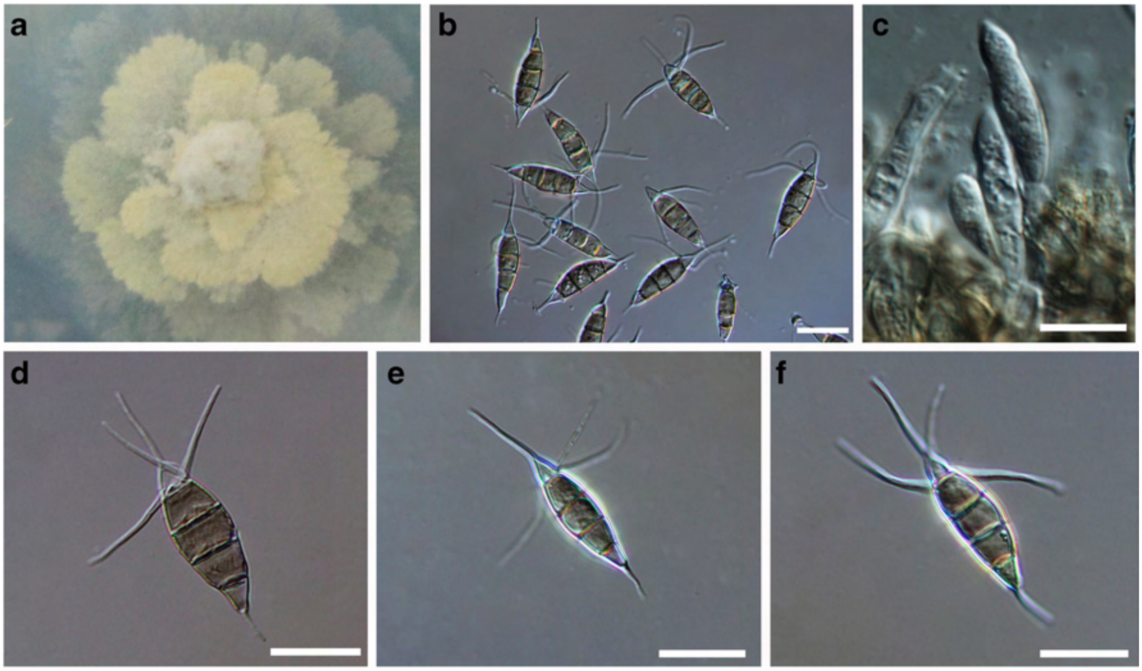


Fig. 93 *Pestalotiopsis montellica* (MFLUCC 12–0279) **a** Colony on PDA **b** Conidia on PDA **c** Conidiogenous cells **d**–**f** Conidia. Scale bars: **b**–**f**= 10 μm

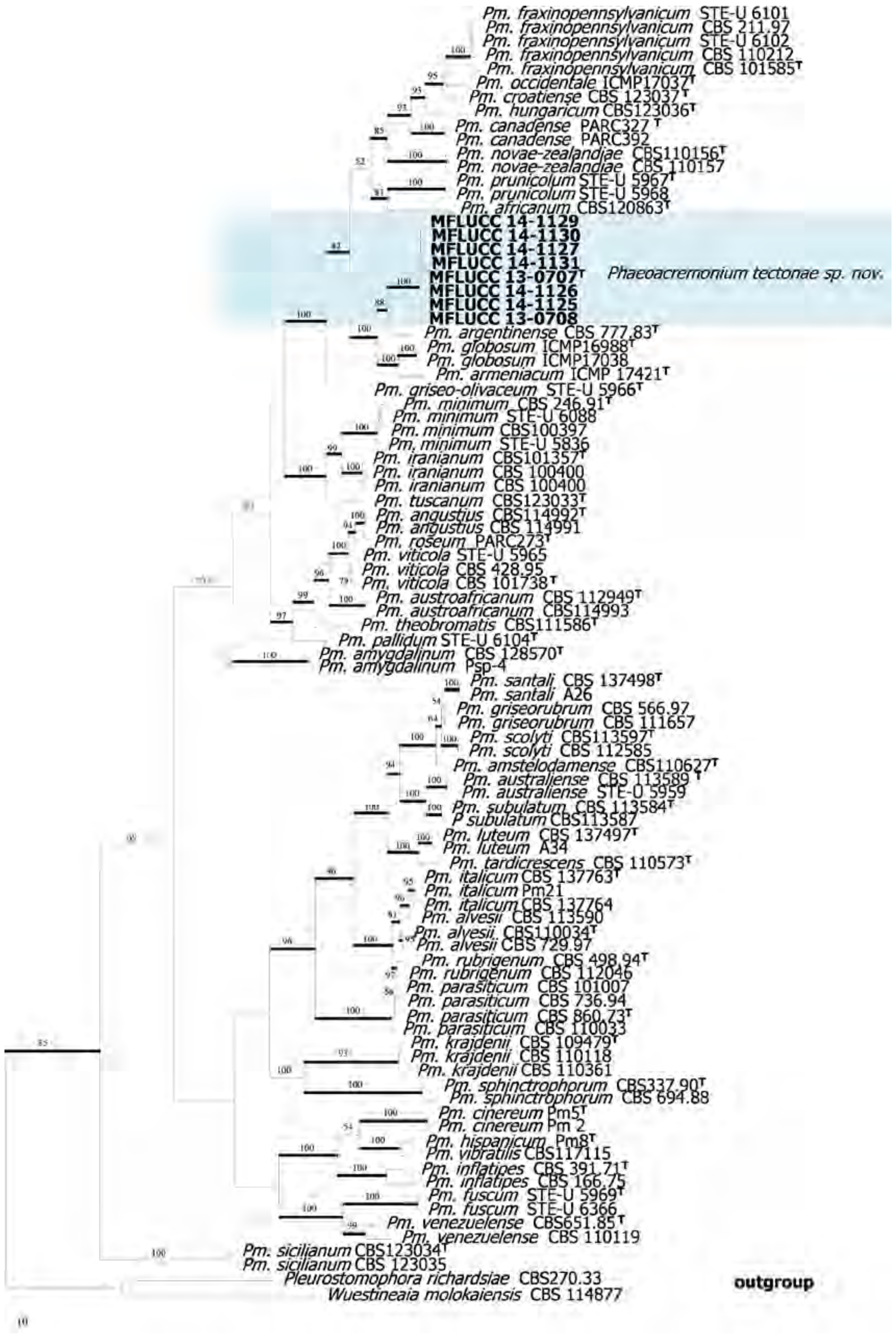
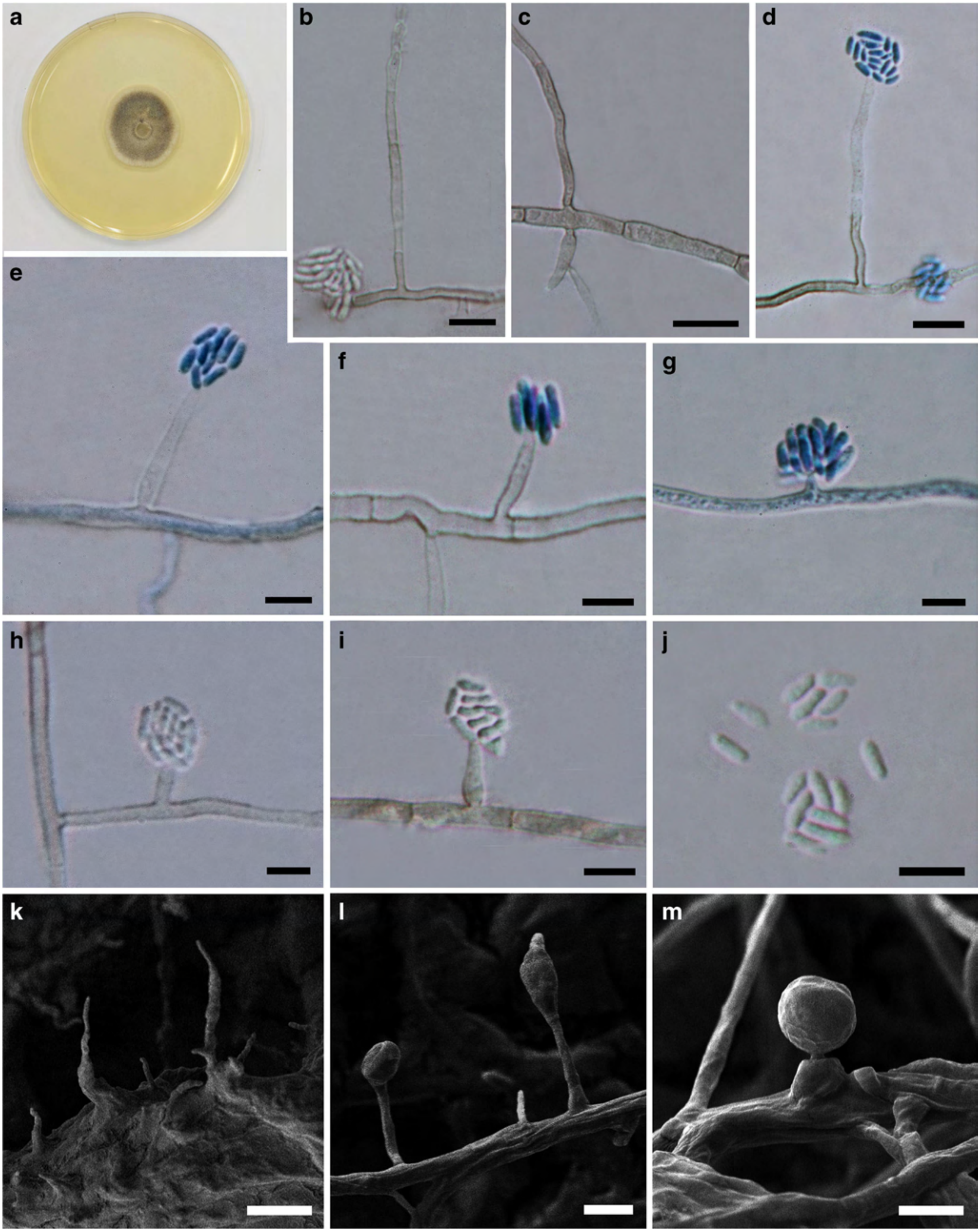


Fig. 94 The most parsimonious tree resulting from combined analysis of Actin and β- tubulin sequence data for 89 *Phaeoacremonium* species. The tree is rooted to *Pleurostomophora richardsiae*. Maximum parsimony bootstrap values ≥50 % are given at the nodes and ≥0.95 for Bayesian probability shown in *bold* branches. Isolates from this study are in *bold*. Type isolates are marked with^{T}. Obsolete names or sexual morph name are in *parentheses*


a
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◀ **Fig. 95** *Phaeoacremonium tectonae* (holotype) **a** Sixteen-day-old colony on MEA **b** Conidiophores with mycelia **c** Conidiophores with branched in the basal region **d** Conidiophore with conidia, gradually paler upwards **e**, **i** Type II phialides with conidia **f** Type I phialides with conidia and adjacent lateral phialides **g** Adelophialides with conidia **h** Type I phialides with conidia **j** Conidia **k** Conidiophores **l-m**. Conidiophores with conidia Notes: **d**–**g** in Lactophenol cotton blue. **k**–**m**. photos from Scanning electron microscope (SEM). Scale bars: **b**–**d**, **k**=10 μm, **e**–**j**, **l**, **m**=5 μm

arising from aerial or submerged hyphae, erect to slightly curved, up to 3-septate, mostly short, usually unbranched occasionally branched conidiophores, mostly slender, some swollen in the lower part, hyaline to pale brown, gradually paler upwards, smooth to verruculose. *Phialides* mostly monophialidic, smooth to verruculose; type I and type II phialides most common; type I phialides (1.5–) 3.5–6 (−13) high × (1.3–) 1.7–1.9 (−4) μm ($\bar{x}$ = 5×1.8 μm), most common, adelophialide, cylindrical, no basal septum; type II phialides (7–) 15–17 (−19) high × (1.5–) 2–2.3 (−3) μm ($\bar{x}$ = 15×2 μm), predominant, elongate-ampulliform attenuated at the base or subulate, constricted at the base, tapering towards the apex; type III phialides (30–) 48–58 (−62) high × (1.8–) 2.2–2.3 (−2.5) μm ($\bar{x}$ = 48×2.2 μm), subcylindrical, narrowing gradually to a long neck. *Conidia* (2–) 3.5–3.7 (−5) high × (0.9–) 1.5–1.7 (−2) μm ($\bar{x}$ ± S.D. = 3.5±0.5×1.5±0.4 μm, n=30), hyaline, allantoid to oblong ellipsoidal occasionally reniform, smooth to verrucose.

Culture characteristics: Pure culture was isolated by tissue transplanting technique. Colonies on MEA reaching 12–22 and 21–36 mm diam. after 8 and 16 days in the dark at 25 °C respectively (av = 17 and 26 mm for 8 and 16 days respectively n=5), circular, flat, woollen tufts forming on older mycelium plugs, edge entire to undulate; after 8 days, white (3A1) above, in reverse yellowish white (3A2); after 16 days white (4A1) in the centre, greyish brown (6D3) to brownish grey (7E2) at the edge, sometimes colony like v-shaped greyish brown (6D3) to brownish grey (7E2) projections above, in reverse greyish brown (6 F3) to yellowish white (4A2) to mixed brownish grey (4E2).

Material examined: THAILAND, Chiang Rai Province, Mae Chan District, on heart rot symptoms of *Tectona grandis* (*Lamiaceae*), 23 July 2013, M. Doilom (MFLU 15-1392, **holotype**: **dry culture**), ex-type living culture, (MFLUCC 13-0707, MUCL); Chiang Rai Province, Muang District, Mae Khon Subdistrict, on laurel wilt symptom of *T. grandis*, 23 July 2013, M. Doilom, living culture, (MFLUCC 13-0708); Chiang Rai Province, Mae Suai District, Mae Lao garden, on laurel wilt symptoms of *T. grandis*, 5 July 2014, M. Doilom (living cultures, MFLUCC 13-0708, MFLUCC 14-1125, MFLUCC 14-1126, MFLUCC 14-1127, MFLUCC 14-1129, MFLUCC 14-1130, MFLUCC 14-1131).

Notes: *Phaeoacremonium* was established as a hyphomycete genus by Crous et al. (1996) with *Pm. parasiticum* as the type species. There are several related genera such as *Acremonium*, *Exophiala* and *Phialophora*. However, a clear classification of *Phaeoacremonium* and its relatives was provided in Crous et al. (1996) and Mostert et al. (2006). Species of *Phaeoacremonium* are vascular plant pathogens causing wilting and dieback of several woody plants, moreover species can also cause of human disease (Baddley et al. 2006; Damm et al. 2008; Gramaje et al. 2012).

Phaeoacremonium tectonae is introduced here as a new species based on molecular evidence and morphological features. *Phaeoacremonium tectonae* (MFLUCC 13-0707, MFLUCC 13-0708, MFLUCC 14-1125, MFLUCC 14-1126, MFLUCC 14-1127, MFLUCC 14-1129, MFLUCC 14-1130 and MFLUCC 14-1131) grouped near to, but separate from *Pm. argentinense* L. Mostert et al. CBS 777.83 (sexual morph *Togninia argentinensis* L. Mostert et al.) with 88 % MPBP and 0.99 PP support in the combined actin and β-tubulin phylogeny (Fig. 94). All *Phaeoacremonium* isolates in this study were from heart rot and laurel wilt symptoms in three locations in Chiang Rai Province, Thailand. *Phaeoacremonium tectonae* differs from *Pm. argentinense* in conidiophores as in *Pm. tectonae* (19–) 40–55 (−62) av. 41 μm they are longer than in *Pm. argentinense* (15–) 16–35 (−44) av. 24 μm. Type I and II phialide are the predominant phialide type of *Pm. Tectonae*, while Type II and III are the predominant phialide type of *Pm. argentinense*.

Valsaceae Tul. & C. Tul.

The family *Valsaceae* was introduced by Tulasne and Tulasne (1861) and later recognized as a family of *Diaporthales* by Barr (1978). Most species are important pathogenic taxa causing canker and dieback disease on plants, with severe commercial and ecological damage and significant losses worldwide (Adams et al. 2005; Fan et al. 2014, 2015). Previously, *Valsaceae* was restricted to five genera, i.e., *Cytospora* with asexual morphs in *Valsa*, *Leucostoma*, *Valsella*, and *Valseutypella* (Fries 1822; Saccardo 1884; Gvritishvili 1982; Spielman 1985; Adams et al. 2002, 2005; Castlebury et al. 2002). However, all sexual genera were synonymized under *Valsa* as a subgenus or species with no additional infrageneric rank (Adams et al. 2005). *Cytospora* (1818) is an older name than *Valsa* (1849) and the asexual morph is more common in nature; therefore, *Valsa* species were treated as synonyms of *Cytospora* (Adams et al. 2005; Fotouhifar et al. 2010; Fan et al. 2015). *Cytospora* usually produce asexual fruiting bodies that contain either a single or labyrinthine of locules, filamentous conidiophores (or clavate to elongate obovoid asci), and allantoid hyaline conidia (or allantoid hyaline ascospores) (Spielman 1983, 1985; Adams et al. 2005). In moist conditions, the conidia emerge from the fruiting bodies as yellow, orange and later red gelatinous tendrils (Adams et al. 2005, 2006). *Cytospora* comprises an estimated 110 species in (Kirk et al. 2008a, b), although 570 epithets are recorded in Index Fungorum (2015). Ex-type sequence data, are however, available for few species, thus identification to species level is difficult (Liu et al. 2015). Therefore, a systematic account of the genus *Cytospora* is needed which takes into account morphology and research into cryptic species and a phylogenetic analysis for *Cytospora* as in other pathogenic genera is needed (Adams et al. 2002; Fotouhifar et al. 2010; Hyde et al. 2010, 2014; Liu et al. 2015). Phylogenetic trees for *Cytospora* are presented in Figs. 96 and 97.

Fig. 96 Phylogenetic tree based on an alignment of the sequences of the ITS regions of *Cytospora*, *Leucostoma*, and *Valsa* species, generated using the MP, ML and Bayesian posterior probabilities (PP) in PAUP. *Numbers separated by a slash* (or below and above branches) represent MP and ML bootstrap values >50 %. *Thickened branches* represent Bayesian posterior probabilities (PP) above 95 % are given at the nodes (MP/PP/ML). The tree is rooted in outgroup taxon *Phomopsis vaccinii* (ATCC 18451). The species obtained in this study are shown in *bold* ▶

203. ***Cytospora parasitica*** C. Norphanphoun, Bulgakov & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551378; *Facesoffungi Number*: FoF01022; Figs. 98 and 99

Etymology: The specific epithet parasitica reflects biological features of the fungus as parasite of trees.

Holotype: MFLU 14–0788

Aggressive necrotrophic pathogen on dying branches, causing canker of apple trees. **Sexual morph**: Undetermined. **Asexual morph**: *Stromata* multi-locules in a stroma, black, circular. *Locules* composed of numerous interconnecting chambers arranged radially or irregularly within a continuous mass of ectostromatic tissue, one conidiomata per multi-locule. *Conidiomata* 800–1000 μm diam. pycnidial, solitary, immersed, unilocular, dark brown, with an ostiole. *Pycnidial wall* 10–12 μm, brown, multi-layered, with 5–7 layers of brown, forming a *textura angularis* cell, with inner most layer thin, hyaline. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* blastic, phialidic, hyaline, smooth, formed from the inner most layer of pycnidium wall. *Conidia* (6–) 6.5–8×1.3–1.5(−2) μm ($\bar{x}$ = 7×1.75 μm, n=30) unicellular, allantoid to slightly curved, hyaline, 1–celled, aseptate, smooth–walled.

Culture characteristics: Colonies on PDA growing, reaching 4.5 cm diam. after 11 days at 25 °C, later producing dense mycelium, circular, margin rough white, flat or effuse on the surface, without aerial mycelium.

Material examined: RUSSIA, Rostov Region, Shakhty City, near Grushevsky pond, grove of feral trees in gully, on dead and drying branches of *Malus* cf. *domestica* Borkh, 18 May 2014, T. Bulgakov (MFLU 14–0788, **holotype**); *Ibid.* (PDD, **isotype**); ex-type living culture, MFLUCC 14-1055, KUMCC.

Notes: Phylogenetic analyses (Figs. 96 and 97) and morphological comparison indicate that our isolate belongs in *Cytospora*, where it groups with *Valsa malicola* and its presumed asexual morph *Cytospora schulzeri* and are probably species complexes. The latter species was considered as an asexual form of *Valsa malicola* Z. Urb. and its presumed asexual morph *Cytospora schulzeri* Sacc. & P. Syd. and are probably species complexes. The latter species was considered as an asexual form of *Valsa malicola*. *Cytospora parasitica* has multi-loculate conidiomata with a single ostiole. This distinguishes it from *Valsa malicola*/*Cytospora schulzeri* which has multi-loculate conidiomata with 2–11 ostioles (Mehrabi et al. 2011). *Cytospora parasitica* also has larger conidia. Species identification is difficult, because *Cytospora* fruiting and vegetative structures, as well as spore size, vary greatly even in the isolates of the same species (Spielman 1985). However, in PDA, *C. parasitica* produces dense mycelium, with a circular, rough margin comprising white mycelium, but *Valsa malicola* and its asexual morph produces light greenish yellow to moderate to strong yellow, felty, slightly raised colonies, lacking growth zones (Mehrabi et al. 2011). Thus we introduce *Cytospora parasitica* as a new species.

204. ***Cytospora tanaitica*** C. Norphanphoun, Bulgakov & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551377; *Facesoffungi Number*: FoF01021; Fig. 100

Etymology: The specific epithet *Tanaitica* refers to the traditional ancient Greek name 'Tanais' of Don River and Lower Don region (modern Rostov region of Russia) in which the fungus was first collected.

Holotype: MFLU 14–0790

Pathogenic and saprobic on branches. **Sexual morph**: Undetermined. **Asexual morph**: *Stromata* 2–3-locule in a stroma, semi-immersed in bark, ovoid to elongate ovoid. Locule composed of numerous interconnecting chambers arranged radially or irregularly within a continuous mass of ectostromatic tissue, one conidiomata per one locule. *Conidiomata* 500–1000 μm diam. pycnidial, solitary, immersed, unilocular, dark brown, with an ostiole. *Pycnidial* wall 30–80 μm, consists with brown to dark brown, multilayered of brown, forming a *textura angularis* cell, with inner most layer thin, hyaline. *Conidiophore* reduced to conidiogenous cells. *Conidiogenous cells* blastic, enteroblastic phialidic, hyaline, smooth, formed from the inner most layer of pycnidium wall. *Conidia* (3–) 3.5–4×0.6–0.7 (−1) μm ($\bar{x}$ = 3.4×0.7 μm, n=30) unicellular, allantoid to subcylindrical, hyaline, 1–celled, aseptate, smooth–walled.

Culture characteristics: Colonies on PDA growing, reaching 7 cm diam. after 11 days at 25 °C, later produce dense mycelium, circular, rough margin gray to dark green,

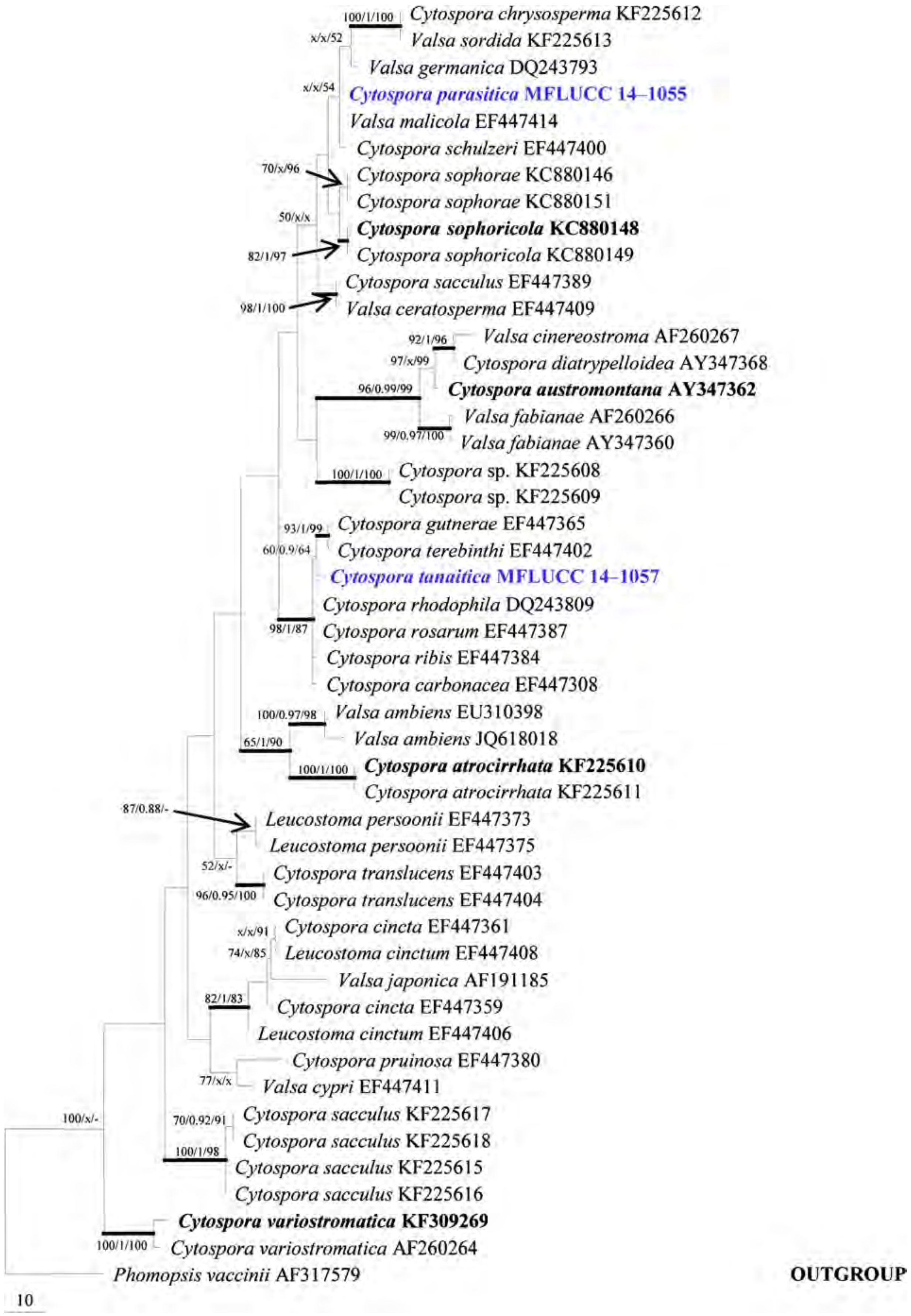
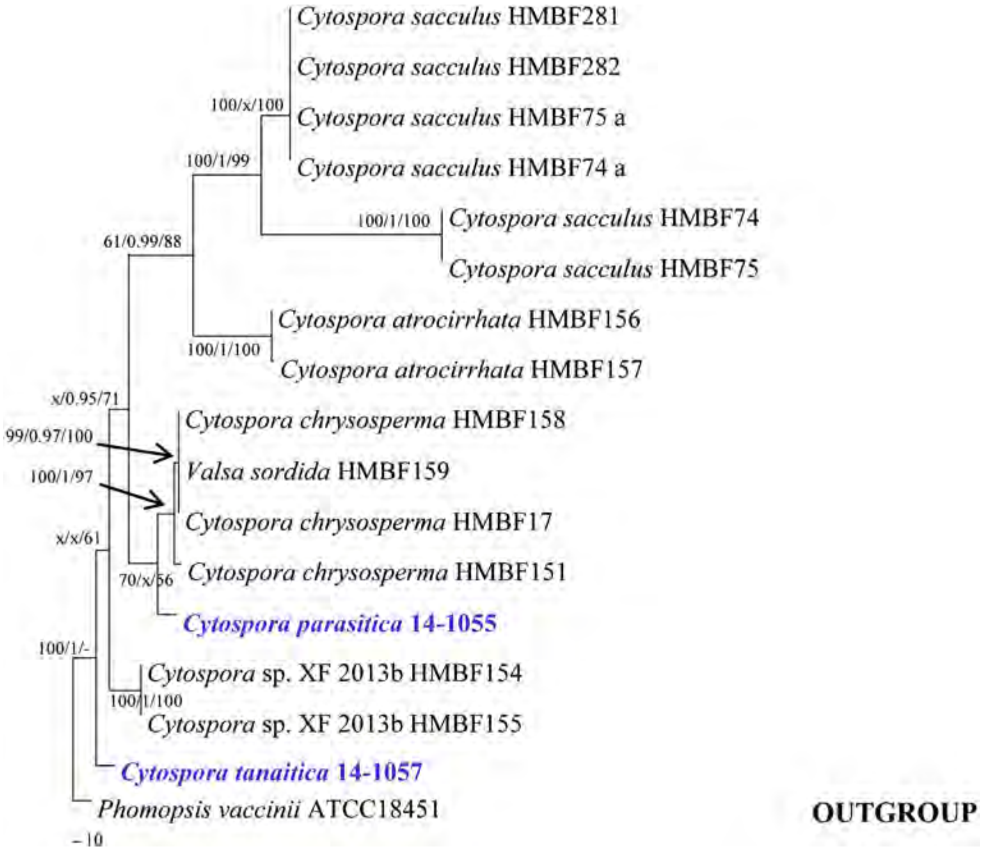

100/1/100
Cytospora chrysosperma KF225612
x/x/52
Valsa sordida KF225613
Valsa germanica DQ243793
x/x/54
Cytospora parasitica MFLUCC 14–1055
Valsa malicola EF447414
Cytospora schulzeri EF447400
70/x/96
Cytospora sophorae KC880146
Cytospora sophorae KC880151
50/x/x
Cytospora sophoricola KC880148
82/1/97
Cytospora sophoricola KC880149
Cytospora sacculus EF447389
98/1/100
Valsa ceratosperma EF447409
92/1/96
Valsa cinereostroma AF260267
97/x/99
Cytospora diatrypelloidea AY347368
96/0.99/99
Cytospora austromontana AY347362
Valsa fabianae AF260266
99/0.97/100
Valsa fabianae AY347360
100/1/100
Cytospora sp. KF225608
Cytospora sp. KF225609
93/1/99
Cytospora gutnerae EF447365
60/0.9/64
Cytospora terebinthi EF447402
Cytospora tanaitica MFLUCC 14–1057
Cytospora rhodophila DQ243809
98/1/87
Cytospora rosarum EF447387
Cytospora ribis EF447384
Cytospora carbonacea EF447308
100/0.97/98
Valsa ambiens EU310398
Valsa ambiens JQ618018
65/1/90
100/1/100
Cytospora atrocirrhata KF225610
Cytospora atrocirrhata KF225611
87/0.88/-
Leucostoma persoonii EF447373
Leucostoma persoonii EF447375
52/x/-
Cytospora translucens EF447403
96/0.95/100
Cytospora translucens EF447404
x/x/91
Cytospora cincta EF447361
74/x/85
Leucostoma cinctum EF447408
Valsa japonica AF191185
82/1/83
Cytospora cincta EF447359
Leucostoma cinctum EF447406
Cytospora pruinosa EF447380
77/x/x
Valsa cypri EF447411
100/x/-
70/0.92/91
Cytospora sacculus KF225617
Cytospora sacculus KF225618
100/1/98
Cytospora sacculus KF225615
Cytospora sacculus KF225616
Cytospora variostromatica KF309269
100/1/100
Cytospora variostromatica AF260264
Phomopsis vaccinii AF317579
OUTGROUP
10

Fig. 97 Maximum Parsimony (MP) majority rule consensus tree for the analyzed *Cytospora* isolates based on a combined dataset of ITS, LSU, β-tubulin and ACT sequence data. MP and ML bootstrap support values higher than 50 % and Bayesian posterior probabilities (PP) above 95 % are given at the nodes (MP/PP/ML). The tree is rooted with *Phomopsis vaccinii* (ATCC18451). The strain numbers are mentioned after the species names. New strains are in *blue bold* and ex-type strains are in *black bold*



after 5 days, flat or effused on the surface, without aerial mycelium.

Material examined: RUSSIA, Rostov region, Shakhty City, Central Park, on dead branches of *Betula pubescens* Ehrh. var. *glabrata* Wahlenb. (syn. *Betula borysthenica* Klokov, *Betulaceae*) in culture, 5 May 2014, T. Bulgakov (MFLU 14–0790, **holotype**; isotype PDD); ex-type living culture, MFLUCC 14–1057, KUMCC.

Notes: Based on phylogenetic analyses and morphological comparison, our isolate belongs to the genus *Cytospora* in *Valsaceae*. *Cytospora tanaitica* has multi-loculate conidiomata with a single ostiole and shares common walls, and is similar to *C. sacculus* (Schwein.) Gvrit. on *Juglans regia* L. in conidia size (4.2×1 μm) (Fan et al. 2015). However phylogenetic analysis, using ITS sequence data (Fig. 96) show that *Cytospora tanaitica* can clearly be distinguished from *C. gutnerae* Gvrit., *C. sacculus* (Schwein.) Gvrit. and *C. terebinthi* Bres. Combined analysis of ITS, LSU, β-tubulin and ACT sequence data groups *C. tanaitica* in a separate clade from these taxa (Fig. 97).

Xylariaceae Tul. & C. Tul.

Xylariaceae (*Xylariales*, Ascomycota) constitutes one of the largest families of pyrenomycetous fungi, with 94 accepted genera (Maharachchikumbura et al. 2015). The majority of xylariaceous taxa are saprobes and endophytes, sometimes with known insect association, and only a small number of species are plant pathogens (Stadler et al. 2013; Pažoutová et al. 2013). Morphological characters of stromata, asci and ascospores are widely used to define the limits within the family and to segregate the genera. Ju and Rogers (1996) have traditionally classified *Xylariaceae* in two major sections based on asexual morphs known as nodulisporium-like and geniculosporium-like. *Acanthodochium*, *Dematophora*, *Dicyma*, *Lindquistia*, *Periconiella*, *Virgariella*, *Xylocladium* and *Xylocoremium* have recently been assigned to corresponding sexual morphs or to one of the larger groups, but the status of some genera with "diatrypaceous" libertella-like conidiogeneous structures remains unsettled (Stadler et al. 2013) (Fig. 101).

Annulohypoxylon Y.M. Ju, J.D. Rogers & H.M. Hsieh

Annulohypoxylon was introduced by was introduced for the former sect. *Annulata sensu* Ju and Rogers (1996) (which comprised species with papillate ostioles and such ones with annular disks). Currently 52 species and varieties are recorded in Index Fungorum. Liu et al. (2015) introduced a new species *Annulohypoxylon thailandicum*.

205. ***Annulohypoxylon palmicola*** J.K Liu & K.D Hyde, ***sp. nov.***

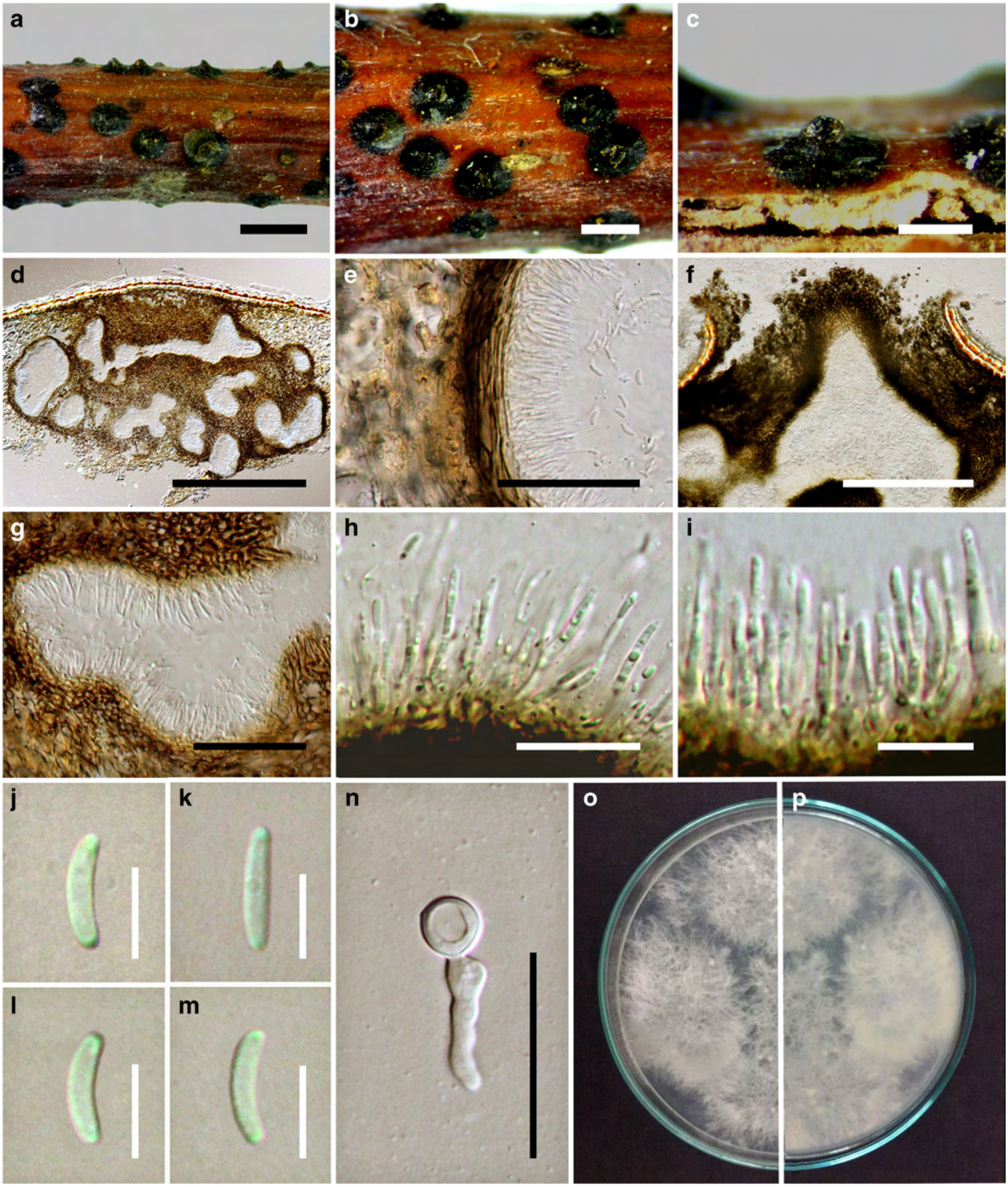


Fig. 98 *Cytospora parasitica* (holotype) **a** Stromatal habit in wood **b** Fruiting bodies on substrate **c** Surface view of fruiting bodies **d** Cross section of the stroma showing locules **e** Peridium **f** Apex of conidioma **g–i** Conidiogenous cell with attached conidia **j–m** Mature conidia **n** Germinating spore **o–p** Colonies on PDA (P from below). Scale bars: **a**=2 mm, **b**=1 mm, **c**=500 μm, **d**=400 μm, **e**=50 μm, **f**=200 μm, **g**=50 μm, **h**=20 μm, **i**=10 μm, **j–m**=5 μm, **n**=30 μm

Fig. 99 Habit of ***Cytospora parasitica*** **a**, **b** *Malus* tree with fruits **c**, **d** Dieback of branches with stromata on bark (holotype) **e** Immersed stromata on branch

Index Fungorum number: IF551428; *Facesoffungi number*: FoF00984; Figs. 102 and 103

Etymology: Named after the palm host on which the fungus was collected.

Holotype: MFLU 15-0040

Saprobic on palms. **Sexual morph** *Stromata* effuse-pulvinate, 3.5–93 mm long, 2.5–22 mm broad, 0.95–1.5 mm high (excluding ostiolar necks), with inconspicuous to 1/3 exposed perithecial mounds, developing within bark, erumpent through the periderm, yielding a dull green pigment in 7 % KOH; surface dull black, strongly uneven owing to stout; stromatal crust strongly carbonaceous; interperithecial tissue blackish, powdery, without visible granules. *Ascomata* 0.6–0.95 mm high, 0.3–0.7 mm diam., obovoid to flask-shaped, completely encased in thick carbonaceous tissue. *Ostioles* conical, papillate, encircled with a flattened truncatum-type disc, 0.1–0.2 mm diam. *Paraphyses* not seen. *Asci* 74–170×4.5−7 µm ($\overline{x}$ = 125×5.5 µm, *n*=25), 8-spored, unitunicate, cylindrical, fragile and readily deliquescing, with long pedicel, up to 50 µm, without a visible apparent apical apparatus, not bluing in Melzer's reagent. *Ascospores* 12–14.5×3.5−5 µm ($\overline{x}$ = 13.5×4 µm, *n*=60), fusiform, 1-septate, brown to dark brown, with a faint, curved, germ slit *ca*. 3/5th of the spore length, lacking cellular appendages or a gelatinous sheath; epispore smooth.

Material examined: THAILAND, Chiang Rai Province, Muang District, Khun Korn Waterfall, on dead sheath of *Arenga westerhoutii* Griff. (*Arecaceae*), 11 September 2010; Jian-Kui Liu, JKA 0037 (MFLU 15-0040, **holotype**), ex-type living culture, MFLUCC 11-0020.

Notes: This is a typical species of *Annulohypoxylon* in having pale brown fusoid ascospores and is most similar to *A. leptascum*, but differs by its slightly smaller ostiolar discs 0.1–0.2 vs 0.2–0.3 mm (Hsieh et al. 2005; Fournier et al. 2010). The phylogenetic analysis showed that the *Annulohypoxylon* species clustered together and formed a well-supported clade; within this clade, the new species *A. palmicola* clustered together with *A. urceolatum* (Rehm) Y.M. Ju, et al., and *A. leptascum* var. *macrosporum* and shows a close relationship with them?. These species share similar morphological characters, but form distinct species in the phylogenies (Fig. 101).

Biscogniauxia Kuntze, Revis. gen. pl. (Leipzig) 2: 398 (1891)

Biscogniauxia was resurrected and amended by Pouzar (1979, 1986) for a group of *Xylariaceae* with applanate dark stromata. The asexual morph varies from nodulisporium-like to periconiella-like (Callan and Rogers 1986; Jong and Rogers 1972; Ju and Rogers 1996). Ju et al. (1998) reviewed *Biscogniauxia* and recognized 49 taxa. Further species have since been introduced (Thienhirun et al. 2003; Tang et al. 2007; Okane et al. 2008; Ju and Rogers 2001).

206. ***Biscogniauxia effusa*** Q.R. Li, J.C. Kang & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551308; *Facesoffungi number*: FoF: 00875; Fig. 104

Etymology: In reference to the effuse stromata.

Holotype: GZUH0122

Saprobic on dead bark. **Sexual morph**: *Stromata* more than 5 cm long and 3 cm diam., widely effuse, crust-like, flat or slightly undulate, black, bipartite, confluent, without

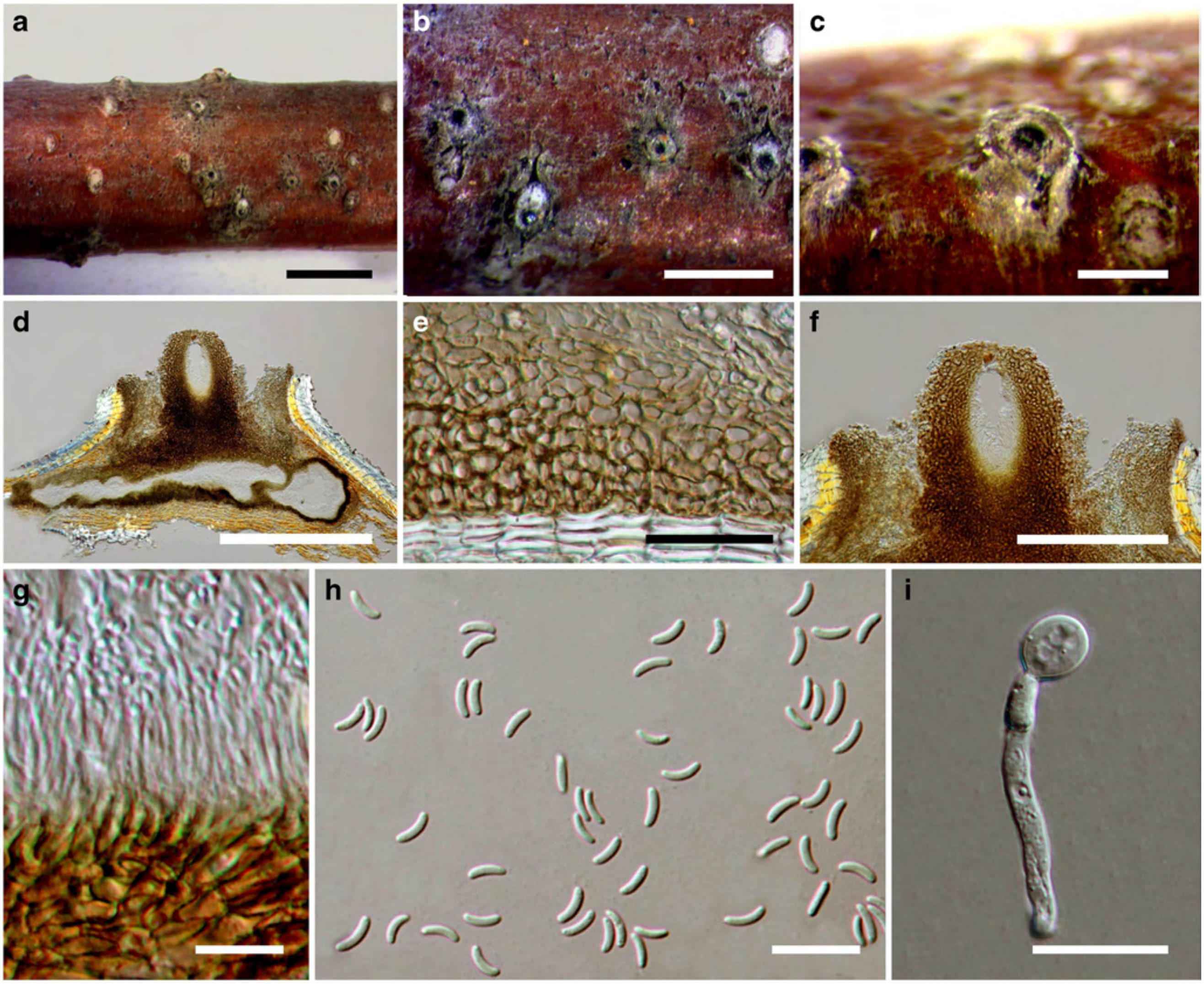


Fig. 100 *Cytospora tanaitica* (holotype) **a** Stromatal habit in wood **b** Fruiting bodies on substrate **c** Surface of fruiting bodies **d** Cross section of the stroma showing locules, median longitudinal section show locules with independent walls, ostiolar necks converging into a discrete ostiole, and locules surrounded by stroma tissue **e** Peridium **f** Apex of conidiomata **g** Conidiogenous cells **h** Conidia **i** Germinating spore. Scale bars: **a**=2 mm, **b**=1 mm, **c**–**d**=400 μm, **e**=30 μm, **f**=200 μm, **g**–**h**=10 μm, **i**=20 μm

raised margins, ascomatal mounds, with black ostioles. *Ascomata* 180–230 μm high, 320–450 μm diam. ($\bar{x}$ = 210×390 μm, *n*=10), solitary, obovoid, black, carbonaceous, immersed, encasing a single ascoma, in vertical section, globose to subglobose, ostiolate. *Peridium* 40–60 μm wide, black. *Paraphyses* not seen. *Asci* spore-bearing part 170–200×12–14 μm ($\bar{x}$ = 190×13 μm, *n*=30), 8-spored, unitunicate, cylindrical, stipes 25–30 μm long, apically rounded, with a J+, tubular, 7–8 μm high, 5–6 μm wide apical apparatus. *Ascospores* 25–31×8–10 μm ($\bar{x}$ = 28×9 μm, *n*=30), uniseriate, light brown, unicellular, equilateral ellipsoidal, with broadly rounded ends, smooth-walled, with a full length, straight, germ slit. **Asexual morph**: Undetermined.

Culture characteristics: Colonies growing slowly on PDA, reaching 2 cm diam. after 2 weeks at 25 °C, brown, black in reverse side, cottony, flat, low, dense, with slightly wavy margin.

Material examined: CHINA, Hainan Province, Sanya City, Jianfengling National Nature Reserve, on dead bark of unknown plant, March, 2015, Q.R. Li (GZUH0122, **holotype**); ex-type living culture, GZUCC0122.

Notes: *Biscogniauxia effusa* has flattened stromata and is similar to *B. atropunctata* (Schwein.: Fr.) Pouzar. and *B. weldenii* (J.D. Rogers) Whalley & Læssøe in ascospore size (Ju et al. 1998). *Biscogniauxia atropunctata* differs in having 16–22×7.5–11 μm, ellipsoid ascospores, with straight germ slits, and shorter 150–170 μm asci with a J+, discoid, apical apparatus (Ju et al. 1998). *Biscogniauxia weldenii* differs in having 25–28×9.5–10.5 μm ascospores ornamented with striations and with an appendage (Ju et al. 1998). *Biscogniauxia effusa* groups with *B. marginata* (Fr.) Pouzar and *B. arima* F.

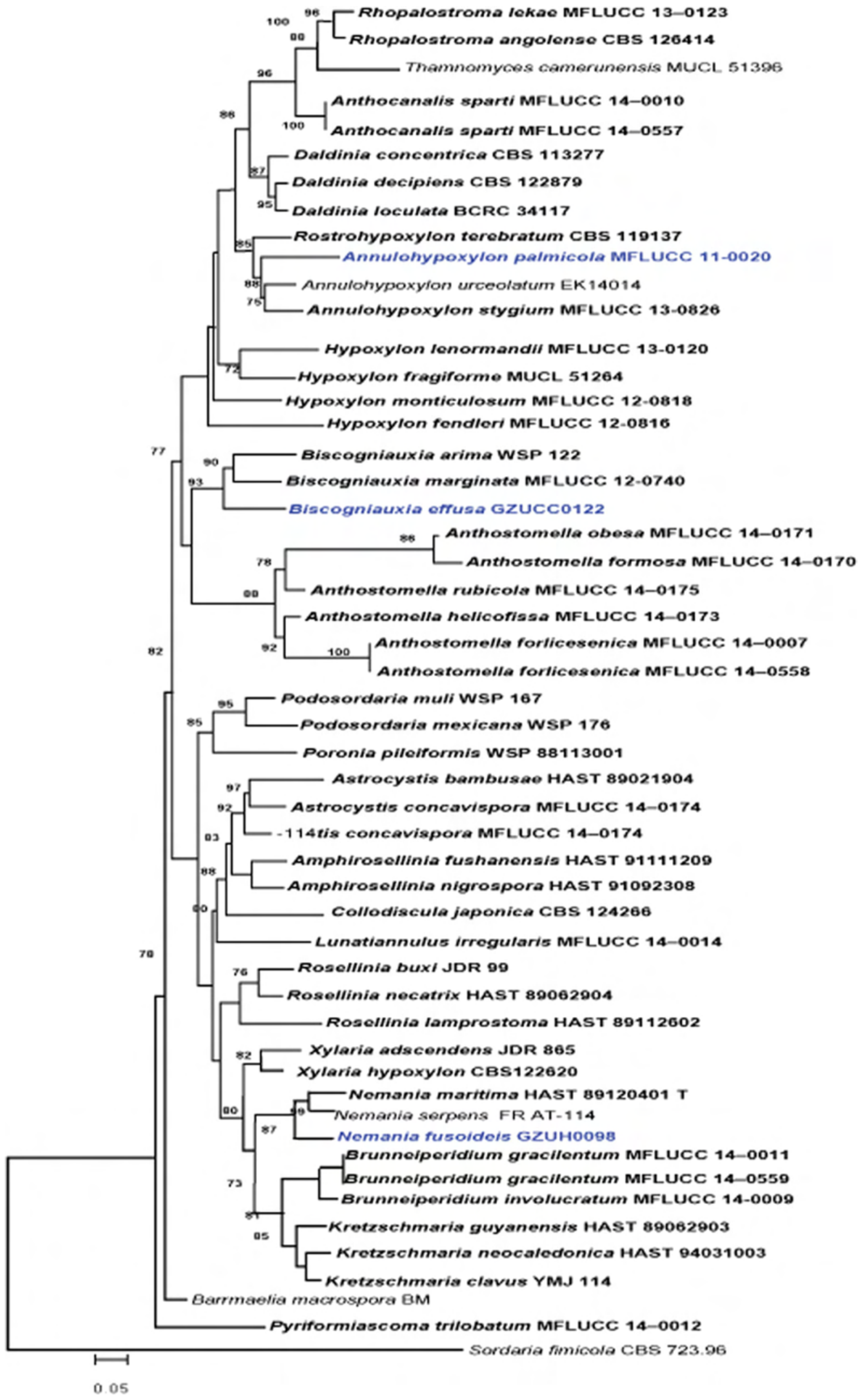


Fig. 101 Phylogram generated from RAxML based on combined ITS and LSU sequenced data for taxa of *Xylariaceae*. Maximum likelihood bootstrap support values greater than 50 % are indicated above the nodes. Only ex-type and voucher strains are used and the new isolates are in *blue*. The tree is rooted with *Sordaria fimicola*

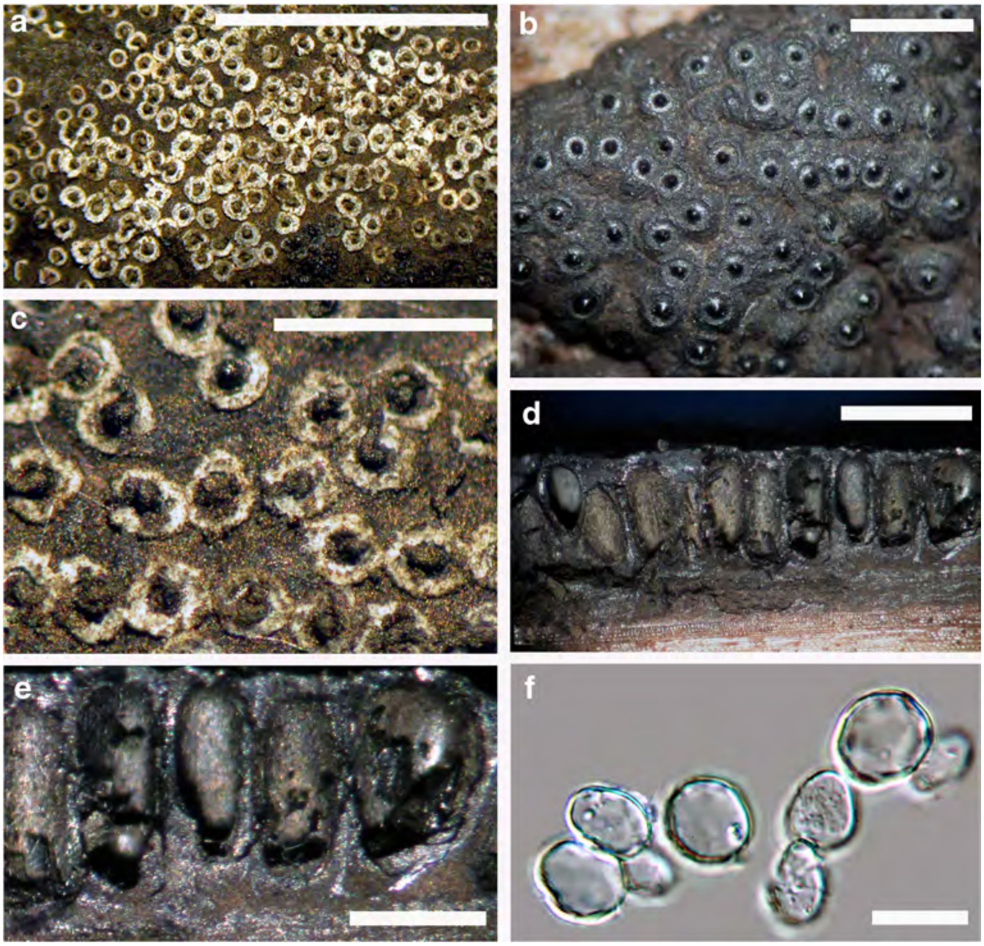


Fig. 102 *Annulohypoxylon palmicola* (holotype) **a**, **b** Stromatal habit **c** Necks **d**, **e** Section through stroma **f** The structure of the white deposit on the discs of the ascoma. Scale bars: **a**=3 mm, **b**, **c**=1 mm, **e**= 0.5 mm, **f**=10 μm

San Martín et al. and forms a well-supported monophyletic clade in the *Xylariaceae* with 93 % bootstrap support.

Nemania Gray, Nat. Arr. Brit. Pl. (London) 1: 508, 516 (1821)

Nemania is characterized by more or less carbonaceous, dark brown to black stromata that do not release coloured pigments in 10 % KOH, with frequently pale brown ascospores, mostly with an inconspicuous germ-slit (Ju and Rogers 2002). The asexual morph is geniculosporium–like.

207. ***Nemania fusoidispora*** Q.R. Li, J.C. Kang & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551309; *Facesoffungi number*: FoF: 00876; Fig. 105

Etymology: In reference to the fusoid ascospores.

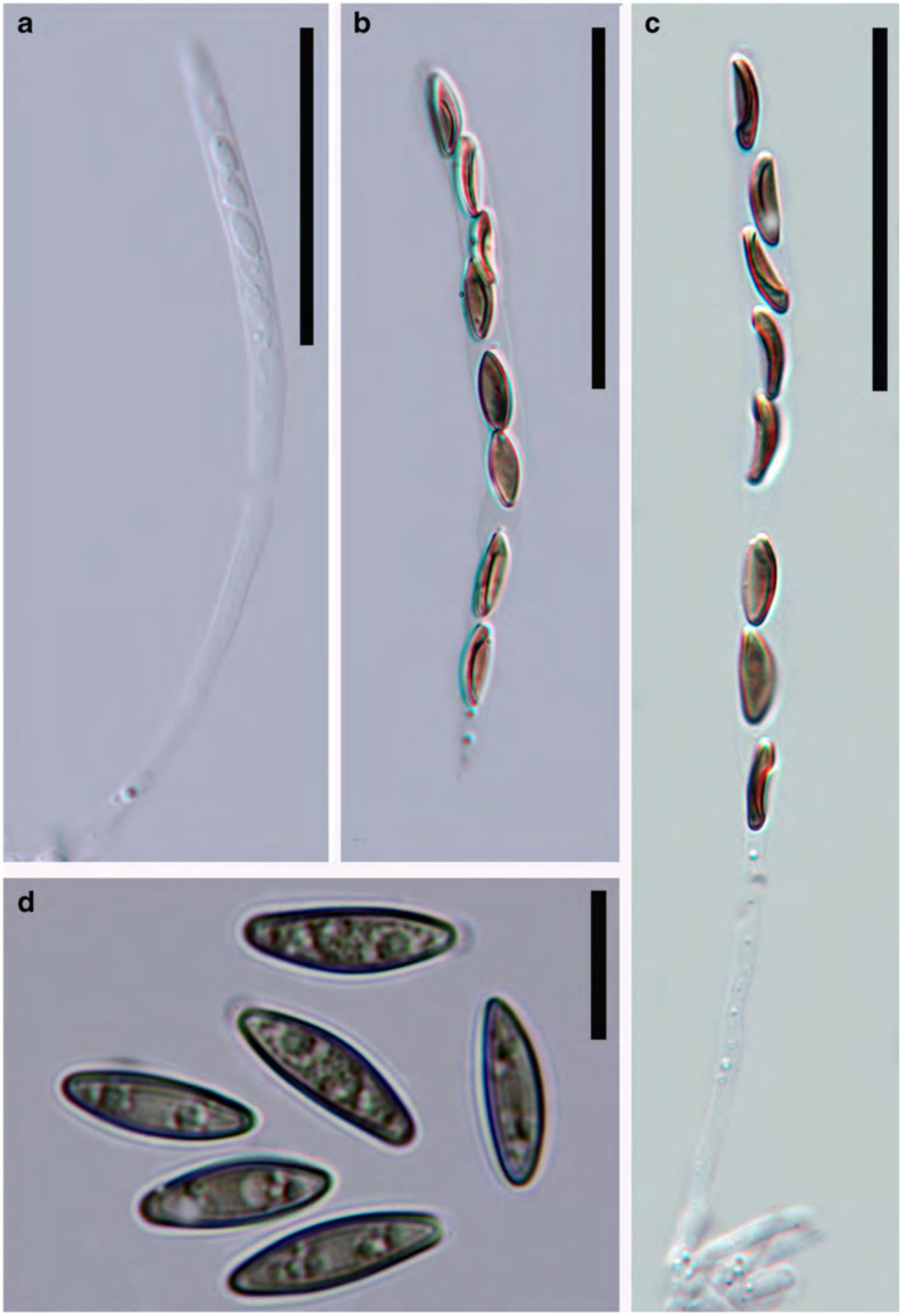
Holotype: GZUH0098

Saprobic on dead bark. **Sexual morph**: *Stromata* pulvinate, wide spreading, following contours of wood, surface around ostioles mouse grey to dark mouse grey, 1.5 mm high, with inconspicuous ascomatal mounds, internally white between ascomata, carbonaceous, tissue, soft-textured, up to 0.2 mm wide. *Ostioles* coarsely papillate in discoid areas. *Ascomata* 0.5–0.6 mm diam., sphaerical to ellipsoid. *Peridium* 35–55 μm wide, black. *Paraphyses* 3–5 μm, hyaline, unbranched, septate. *Asci* 150–240×5.5–9.5 μm ($\bar{x}$ = 236× 7.5 μm, *n*=30), 8-spored, unitunicate, cylindrical, long-pedicellate, the spore-bearing part 80 μm, apically rounded with J+, inverted, hat-shaped, apical apparatus, 2 μm high, 1.5 μm broad. *Ascospores* 13–16×3–4 μm ($\bar{x}$ = 14.1×3.3 μm, *n*=30), uniseriate to irregularly-biseriate, light brown, fusoid to inequilaterally ellipsoid, with acute ends, lacking a germ slit. **Asexual morph**: Undetermined.

Material examined: CHINA, Guiyang Province, Guiyang City, on dead bark of unknown plant, March, 2015, Q.R. Li (GZUH 0098, **holotype**).

Notes: *Nemania fusoidispora* is similar to *N. illita* (Schwein.) Pouzar in which ascospores are fusoid and lack a germ slit (Rogers et al. 2008; Ju and Rogers 2002) and differs from other species of *Nemania*. *Nemania fusoidispora* differs in having larger ascospores (13–16× 3–4 μm) than *N. illita* (11–12×3–4 μm). *Nemania fusoidispora* groups with other *Nemania* species and forms a monophyletic clade with 87 % bootstrap support. The genus *Nemania* appears as a sister clade to both *Brunneiperidium* and *Kretzschmaria*.

Fig. 103 *Annulohypoxylon palmicola* (holotype) **a**–**c** Ascus **d** Ascospores. Scale bars: **a**, **b**, **c**= 50 μm, **d**=10 μm



Contributions to Basidiomycota

Agaricomycetes

Agaricaceae Chevall (Fig. 106).

Agaricus L., Sp. pl. 2: 1171 (1753)

The genus *Agaricus*, the type of the family *Agaricaceae* contains many edible and medicinal species. Ten sections have been recognized within *Agaricus* based on molecular and morphological data (Parra 2008, 2013); Parra et al. 2014; Chen et al. 2015), and further lineages revealed by ITS sequences are potential new sections (Zhao et al. 2011). There are several morphological characters which are useful to separate those sections, such as the Schäffer's and KOH reactions, odour, character of annulus and discolouring on bruising and cutting (Parra 2008, 2013). For example, members from sections *Agaricus*, *Bivelares*, *Chitonioides*, *Sanguinolenti* and

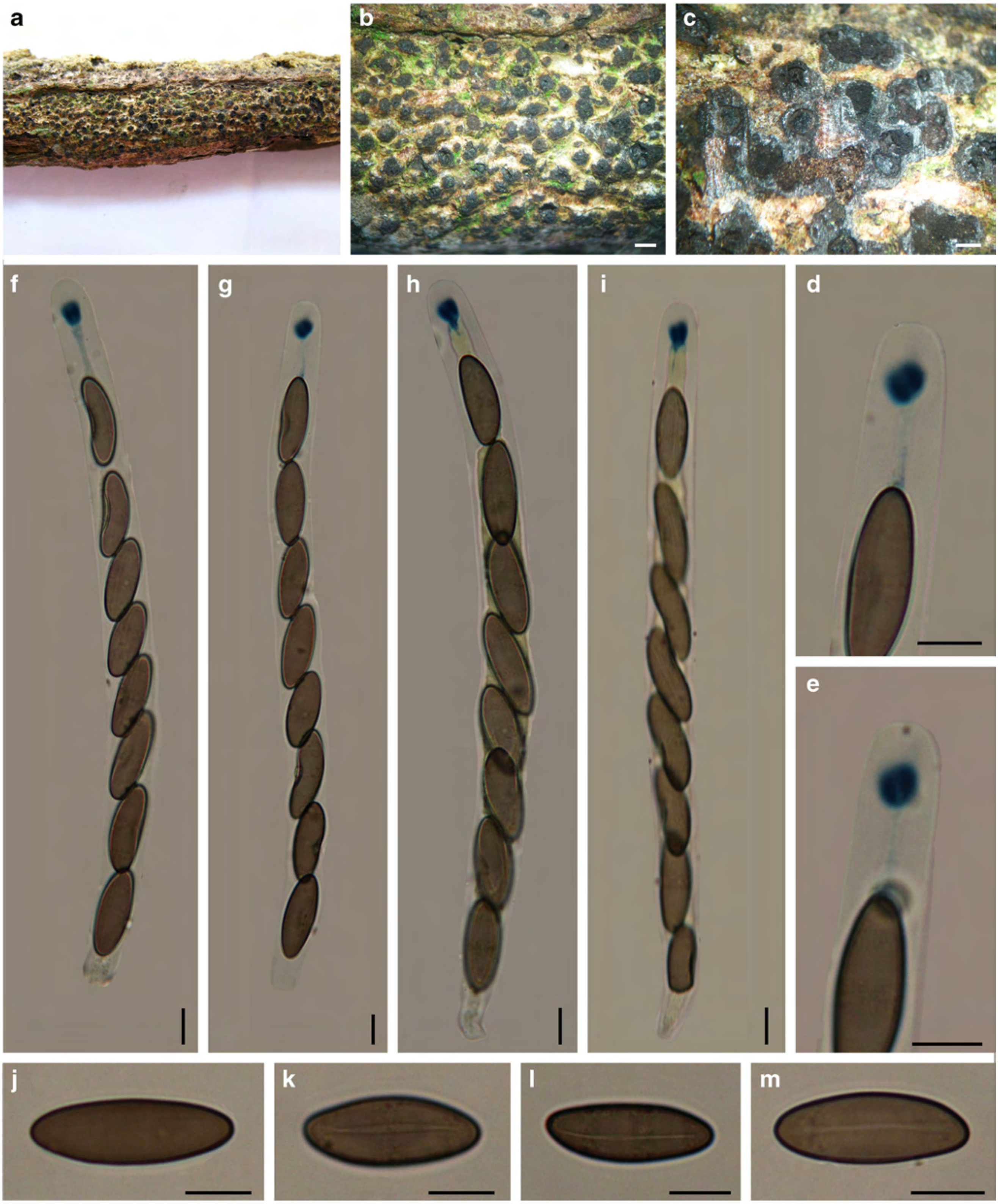


Fig. 104 *Biscogniauxia effusa* (holotype) **a** Herbarium sample **b** Stroma on the surface of host **c** Surface of stroma cut away to reveal ascomata **d**, **e** Ascus apex with a J+, apical apparatus **f**–**i** Asci with ascospores (stained in Melzer's reagent). **j**–**m** Ascospores. Scale bars: **b**, **c**=200 µm, **d**–**m**=10 µm

Nigrobrunnescentes exhibit a context turning pink or reddening on exposure (Didukh et al. 2005; Challen et al. 2003; Parra 2008). Recently two new species have been described from China, with reddening discolouration (Zhao et al. 2015).

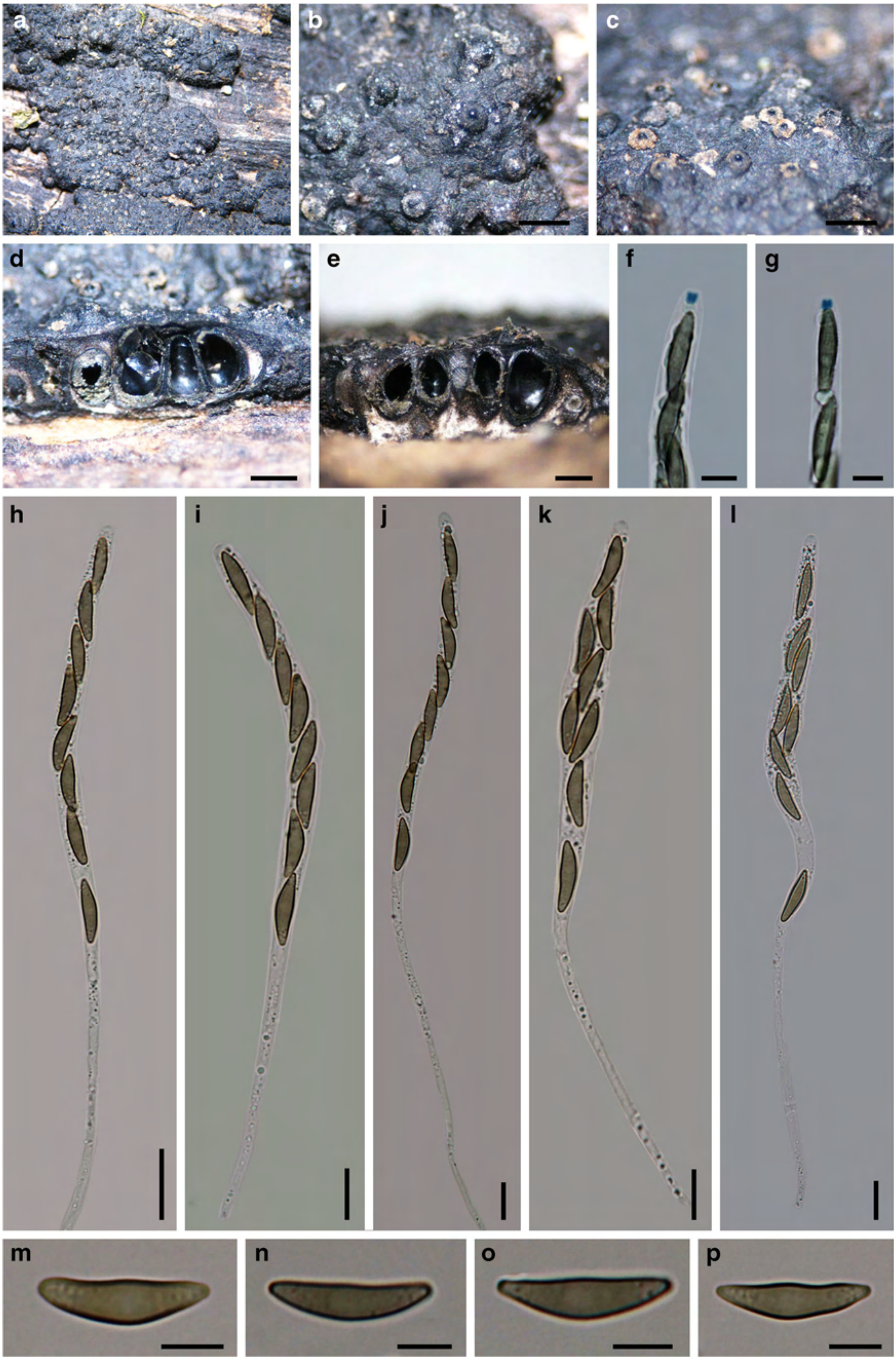


Fig. 105 ***Nemania fusoidispora*** **(holotype) a–c** Stromata on the surface of the host **d**, **e** Section of stroma **f**, **g** Ascus apex with a blue apical ring in Melzer's reagent **h–l** Asci with ascospores **m–p** Ascospores. Scale bars: **b–e**=200 μm, **f**, **g**=5 μm, **h–l**=10 μm, **m–p**=5 μm

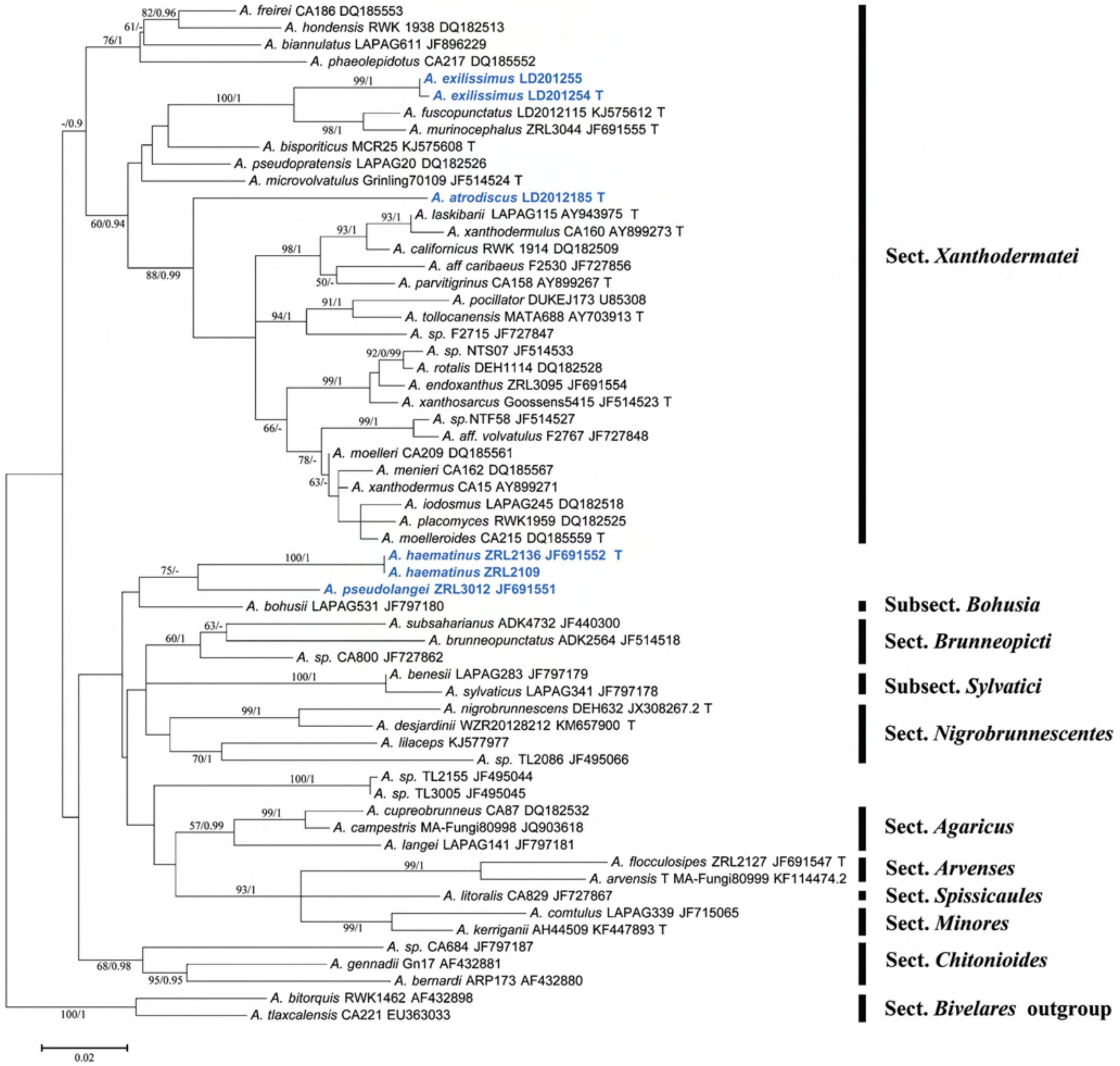


Fig. 106 Phylogram generated from Maximum likelihood (MEGA6) analysis based on ITS sequence data of *Agaricus*. Sequences used in this study have been sampled from previous studies to represent the ten known sections (Thongklang et al. 2014; Zhao et al. 2011; Wang et al. 2015) or newly generated from this work. Maximum likelihood bootstrap support values greater than 50 % and Bayesian posterior probabilities greater than 0.9 are indicated above or below the nodes (BS/PP), new species are annotated in blue. *T* type specimen

Herein, four new species with two new species with red discolouring are described from Thailand.

208. ***Agaricus pseudolangei*** K.D. Hyde & R.L. Zhao, ***sp. nov.***

Index Fungorum number: IF551478; *Facesoffungi number*: FoF00985; Figs. 107 and 109a–d.

Etymology: refers to the similarity to *Agaricus langei* in morphology.

Holotype: BBH 19529

Pileus 6–8 cm diam., and 7–9 mm thick, hemisphaerical, convex, plano-convex, sometimes slightly depressed at the disc; surface heavily fibrillose, and breaking into scales towards the margin, light brown (6C3, 6B2). *Lamellae* free, crowded, lamellulae with 7 series, 4 mm broad, narrow to normal, white, dull red (8C3), brown, edge colour lighter than gill. *Stipe* 50–90 × 8–12 (base 14–16) mm, cylindrical to subbulbous, long clavate, smooth to silky, white. *Annulus* thick, rigid, pendent, white, entire, up to 12 mm broad. *Odour*

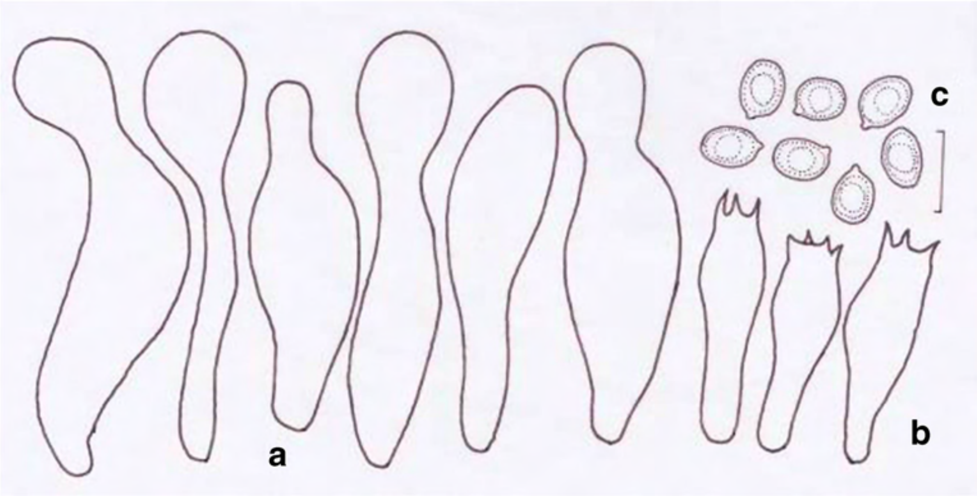


Fig. 107 Microcharacters of *Agaricus pseudolangei* (holotype) **a** Cheilocystidia **b** Basidia **c** Basidiospores. Scale bars: 10 µm

mushroomy. *Context* firm, white, no staining on touching, strong scarlet staining on cutting. *Macrochemical reaction*: KOH reaction negative. *Basidiospores* 5.5–7×4.5–5.2 µm [$\bar{x}$ = 6.3±0.5×5±0.2, Q=1.1–1.4, *n*=20], ovoid to broad ellipsoid, brown, smooth. *Basidia* 21–26×7–9 µm, clavate, hyaline, smooth. *Cheilocystidia* present or disrupted in some basidiomata, 20–35×5–10 µm, ventricose-capitate, and some with an elongate neck, hyaline, smooth. *Pleurocystidia* absent. *Pileipellis* a cutis of hyphae of 7–15 µm diam., cylindrical, light brown, smooth. *Annulus* hyphae of 7–15 µm diam., cylindrical, hyaline, smooth.

Habitat and distribution: solitary or scattered in small group on soil with excrements next to a chicken coop. Known only from Thailand.

Material examined: THAILAND, Chiang Mai Province, Mae Taeng, Ban Mae Sae Village, on Highway 1095, near 50 km marker, N19°14. 599′ E98°39.456′, elevation 962 m., 3 June 2006, collector Ruilin Zhao, ZRL3012 (BBH 19529, **holotype**), (HMAS and SFSU, **isotypes**); *Ibid*., Ban Pha Deng Village, N 19°17.123′ E 98°44. 009′, elev. 900 m, 3 October 2005, collector Ruilin Zhao, ZRL2137 (BBH 19507, HMAS and SFSU); same location, 5 August 2005, collector Ruilin Zhao, ZRL2122 (BBH 19501, HMAS and SFSU).

Notes: The phylogenetic analysis (Fig. 106) shows that this new species is sister to the species described below (see entry 142 of the present paper), but did not allow us to classify these two red staining new species in any known sections containing species exhibiting such a trait (sections *Agaricus*, *Bivelares*, *Brunneopicti*, *Chitonioides*, *Nigrobrunnescentes*, and *Sanguinolenti* subsections *Bohusia* and *Sylvatici*). Samples ZRL3012 and ZRL2136 have been included into the phylogenetic analysis but not named in our previous study (Zhao et al. 2011), and the results showed they were clustered together and loosely related to *A. bohusii* Bon, which is a red discoloring species from section *Sanguinolenti* subsection *Bohusia* (Parra 2008). In present study these two species form a clade with same topology as before. Extensive sampling and DNA sequences from other genes will be necessary to know if this clade would belong to one of the sections listed above or represents a new section.

This species is distinct by its strong blood red discolouring on cutting and capitate cheilocystidia. Compared with the red staining species from the sections listed above, the new species is morphologically highly similar to *A. langei* (F.H. Møller) F.H. Møller of the section *Agaricus* because both have light brown scales on the pileus, a pilleipellis that remains undisrupted at the disc, and similar sized spores. However, *A. pseudolangei* has capitate cheilocystidia, while those of *A. langei* are pyriform. *Agaricus pseudolangei* has wide ellipsoid spores, Q_m=1.27, while *A. langei* has ellipsoid to elongate ellipsoid spores, Q_m=1.67. In addition, the distance between the two species in the tree confirms that they are not phylogenetically closely related. In section *Sanguinolenti*, *A. depauperatus* (F.H. Møller) Pilátis (also has light brown squamules on the pileus), however, this species has larger basidiospores (7–9.6×4–6 µm) than those of *A. pseudolangei*, and its pyriform cheilocystidia also differ from those of *A. pseudolangei*. This new species also similar to *A. benesii* (Pilát) Pilát and *A. sylvaticus* Schaeff which both exhibit a strong reddish discoloring on cutting and can have a light brown or even a pure white cap (Parra 2008), however these known species have clavate cheilocystidia with 1–2 septa at base which is completely different from the new species.

209. ***Agaricus haematinus*** K.D. Hyde & R.L. Zhao, ***sp. nov.***

Index Fungorum number: IF551479; *Facesoffungi number*: FoF00986; Figs. 108 and 109e–j

Etymology: “heamatinus” means blood red, which refers to the blood red discolouring of the context on cutting.

Holotype: BBH 19516

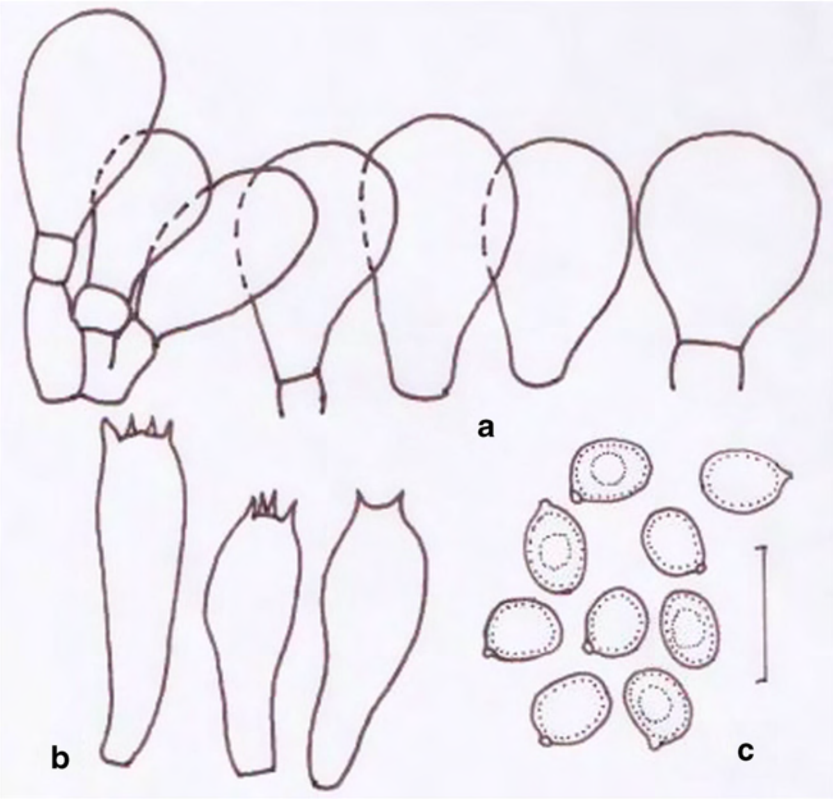


Fig. 108 Microcharacters of *Agaricus haematinus* (holotype) **a** Cheilocystidia **b** Basidia **c** Basidiospores. Scale bars: 10 μm

Pileus 4–7 cm diam., and 5–6 mm thick, convex with inrolled margin, or concave with flared margin with age, cuticle exceeding, covered by floccose scales, snow white. *Lamellae* free, crowded, lamellulae with 2–3 series, 4.5–6 mm broad, normal to slightly ventricose, dull red or reddish-brown, edge colour distinctly lighter than gills. *Stipe* 40–70×11–12 μm, cylindrical, taping to base, smooth above the annulus, floccose below the ring, but easy rubbed so appearing smooth in old fruiting bodies, white, small, hollow. *Annulus* fugacious, and often hanging along the pileus margin, middle or superior, torn. *Context* firm, white, no staining on touching, rubescence on cutting. *Macrochemical reaction*: KOH reaction negative. *Basidiospores* 5–7×4–5 μm [$\overline{x}$ = 5.9±0.4×4.6±0.4, *Q*=1.1–1.5, *n*=20], ovate with apiculus, broad ellipsoid, brown, reddish-brown, smooth. *Basidia* 17–20×7–8 μm, clavate, smooth, hyaline, 4-spored. *Cheilocystidia* 16–21×9–14 μm, broadly clavate, pyriform, some with 1–2 septa at the base, hyaline, smooth. *Pleurocystidia* absent. *Pileipellis* a cutis composed of hyphae of 7.5–10 μm diam., elongate cylindrical arranged in parallel, smooth, hyaline. *Annulus* consisted by slender hyphae of 2.5–5 μm diam., loose interwoven, hyaline, smooth, branched.

Habitat and distribution: scattered on soil with excrements next to a chicken coop. Known only from Thailand.

Material examined: THAILAND, Chiang Mai Province, Mae Taeng District, Ban Pha Deng Village, N 19°17.123′ E 98°44. 009′, elev. 900 m, 19 September 2005, collector Ruilin Zhao, ZRL2136 (BBH 19516, **holotype**), (HMAS and SFSU, **isotypes**); *Ibid*., 2 August 2005, collector Ruilin Zhao, ZR2109 (BBH 19489, SFSU).

The phylogenetic analysis (Fig. 106) shows that this new species forms a clade with the new species *A. pseudolangei* described above (see entry 141 of the present paper). As indicated in the notes on *A. pseudolangei*, further study will be necessary to know if this clade represent a new section or belong to a known section containing species exhibiting the red staining trait observed in these two species.

This new species is diagnosed by its pure white basidiomata and strong blood red discolouration on cutting. In the field, it quite resembles *A. campestris* L. in having a pure white pileus, the taping base of stipe, and the character of annulus. However it differs in having larger spores (6.7–8×4.6–5.3 μm, Kerrigan 1986; 6–8.5×4.6–6.7 μm, Parra 2008) and unchangeable context or which is slightly pink on exposure. *Agaricus andrewii* Freeman is another species having a pure white pileus and pinkish discoloration, however, it has larger spores (7.5–9.2×5.5–6 μm). Similarly *A. benesii* and *A. sylvaticus* can present the pure white caps sometimes, and septate cheilocystidia, but their lower side of annulus have cog-wheel scales.

210. ***Agaricus atrodiscus*** L.J. Chen, Callac, R.L. Zhao & K.D. Hyde, ***sp. nov.***

Fig. 109 Macrocharacters of *Agaricus* species **a**–**d** *A. pseudolangei* **a**–**c** ZRL3012, holotype; **d** ZRL2122 **e**–**j** *A. haematinus* **e**–**h** ZRL2136, holotype **i**–**j** ZRL2109. Scale bars: 10 mm

Index Fungorum number: IF551431; *Facesoffungi number*: FoF00987; Figs. 110a–d and 111

Etymology: *atrodicus* means black disc, and here refers to the dark disc of pileus surface.

Holotype: MFLU 12-1010.

Pileus 90–130 mm diam. and 9 mm thick, parabolic with truncated top when young, then hemispherical to plano-convex and finally applanate with age; surface dry, at first entirely covered with finely grey or dark grey fibrils, often densely arranged at the disc; sometimes with pileus expansion, the fibrils disrupted into tiny squamules radially distributed on a white background; margin decurved and shortly exceeding the lamellae. *Lamellae* free, crowded, lamellulae with more than 5 series, 7–8 mm broad, at first white, then pink, later pinkish brown and finally dark brown. *Stipe* 170–194 mm long, 12–21 (base to apex) mm wide, cylindrical and tapering towards the base, surface smooth, both above and below the annulus, silky, hollow, white, staining lightly yellowish when bruised. *Annulus* with two layers, membranous, pendent, superous, white, upper side smooth, lower side woolly, with flakes in a cogwheel arrangement, sometimes with a yellowish tinge. *Odour* phenolic. *Context* firm, white, colour unchanged when cut. *Macrochemical reactions*: KOH reaction positive orange. Schäffer's reaction negative. *Basidiospores* 4.7–5.9×3–3.6 μm, [$\overline{x}$ = 5.2±0.28×3.3±0.16, *Q*=1.44–1.78, *n*=20], ellipsoid, smooth, brown, thick–walled. *Basidia* 14–17×5–7 μm, clavate to broadly clavate, hyaline, smooth, 4-spored. *Cheilocystidia* 10.5–26×6–11 μm, simple, pyriform, broadly clavate, or sphaeropedunculate, hyaline, smooth. *Pleurocystidia* absent. *Pileipellis* a cutis

Fig. 110 **a**–**d** *Agaricus atrodiscus* (holotype) **a** General view of sporocarps **b** Annulus **c** Pileus characters **d** Tiny squamules on pileus surface **e**–**f** *Agaricus exilissimus* (holotype) **e** Pileus characters **f** Lamellae and slender stipe. Scale bars: **a**=20 mm, **e**, **f**=5 mm

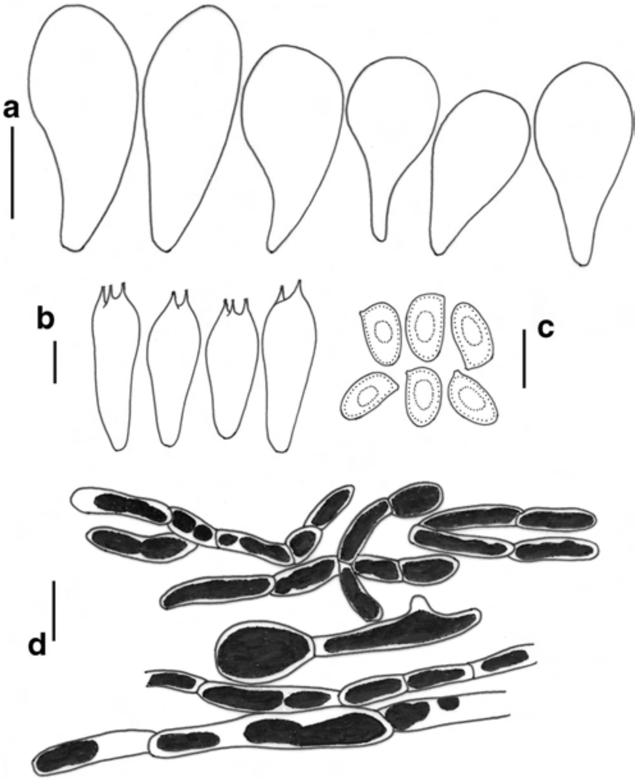


Fig. 111 *Agaricus atrodiscus* (holotype) **a** Cheilocystidia **b** Basidia **c** Basidiospores **d** Pileipellis. Scale bars: **a**, **d**=10 μm, **b**, **c**=5 μm

composed of hyphae of 5–10 μm wide, cylindrical, containing dark brown vacuolar pigments, smooth, often constricted at the septa; terminal element observed cylindrical to inflated, sometimes subglobose, up to 13–20 μm wide.

Habitat and distribution: scattered or gregarious on soil, under Bamboo. Known only from Thailand.

Material examined: THAILAND, Chiang Mai Prov., Mae Sa Waterfall, 14 September 2012, collector Jie Chen & Asanka Bandara, LD 2012185 (MFLU12-1010 **holotype**), (**isotype**, HMAS).

Notes: The positive KOH reaction and negative Schäffer's reaction, yellowish discolouration when bruised and phenolic odour, place *A. atrodiscus* in *Agaricus* section *Xanthodermatei*. It is macroscopically remarkable by its relatively robust sporocarps, with grey fibrils or tiny squamules on the pileus surface and its tapering stipe. Microscopically, the spores have an average size of 5.2×3.3 μm, and the pileipellis hyphae contain dark brown vacuolar pigments. In addition to its tropical habitat, the consecutively dark grey coloured pileus containing vacuolar pigments are also found in *A. endoxanthus* Berk. & Broome, *A. microvolvatulus* Heinem., *A. rotalis* K.R. Peterson, Desjardin & Hemmes and *A. xanthosarcus* Heinem. & Gooss.-Font (Heinemann 1956; Kerrigan et al. 2005; Zhao et al. 2012). However, *A. atrodiscus* can be easily distinguished in the field from *A. endoxanthus* and *A. rotalis* by its robust sporocarps and its faint yellowish discolouration on stipe surface (Heinemann 1956; Zhao et al. 2012). The pileus diameter of *A. microvolvatulus* and *A. xanthosarcus* can reach to 10 cm, but they differ in having a distinctively bulbous stipe (Heinemann 1956; Thongklang et al. 2014). According to the phylogenetic analysis (Fig. 106), *A. atrodiscus* appears as an unbranched lineage arising near the common ancestor of the clade named Xan III by Thongklang et al. (2014), which is one of the three major clades constituting the section *Xanthodermatei* also in our tree (Fig. 106).

211. ***Agaricus exilissimus*** L.J. Chen, Callac, R.L. Zhao & K.D. Hyde, ***sp. nov.***

Index Fungorum number: IF551432; *Facesoffungi number*: FoF00988; Figs. 110e–f and 112

Etymology: *exilissimus* means very thin and refers to the very thin pileus and stipe.

Holotype: MFLU 12-0895.

Pileus 25–35 mm diam. and 1 mm thick, applanate and subumbonate at disc; surface dry, with dark brown fibrils congregated on the disc, tiny fibrillose squamules more or less concentrically arranged at elsewhere, except towards the margin, on a light brown background; margin crenulate, uplifted. *Lamellae* free, crowded, lamellulae with 5 series, 3 mm broad, ventricose, pink to brown. *Stipe* 30–40×2–3 (4.5 at base) mm,

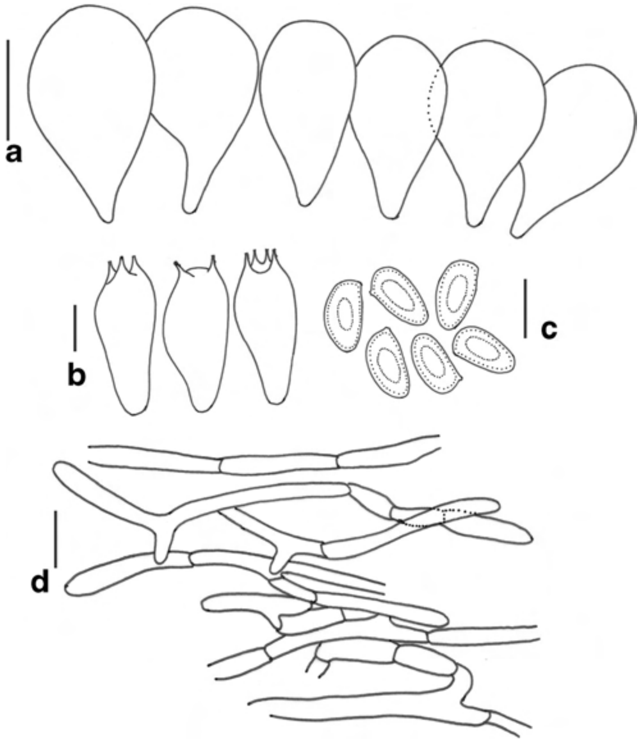


Fig. 112 *Agaricus exilissimus* (holotype) **a** Cheilocystidia **b** Basidia **c** Basidiospores **d** Pileipellis. Scale bars: **a**=10 μm, **b**–**d**=5 μm

cylindrical with a subbulbous base, surface smooth, both above and below the annulus, silky, hollow, white, changing to yellowish when cut or bruised. *Annulus* superous, single, membranous, upward, white, upper side smooth, lower side fibrillose. *Odour* of ink. *Context* firm, white, without colour change when cut. *Macrochemical reactions*: KOH reaction yellow. Schäffer's reaction negative. *Basidiospores* 5.3–6.2 × 3.2–3.8 μm, [$\overline{x}$ = 5.8±0.25 × 3.5±0.15, *Q*=1.43–1.72, *n*=20], ellipsoid, smooth, brown, thick-walled. *Basidia* 15–16 × 6.5–7 μm, broadly clavate, hyaline, smooth, 4-spored; *Cheilocystidia* 14–22 × 8.5–14 μm, simple, pyriform or sphaeropedunculate, hyaline, smooth. *Pleurocystidia* absent. *Pileipellis* a cutis composed of hyphae of 3.5–5 μm diam., cylindrical, with brown vacuolar pigments, smooth, rarely constricted at the septa.

Habitat and distribution: solitary on soil, in open area of forest. Known only from Thailand.

Material examined: THAILAND, Chiang Mai Prov., Mae La Noi Village, Mae Hong Song, highway 108, 26 June 2012, collector Jie Chen & Philippe Callac, LD 201254 (MFLU12-0895, **holotype**).

Notes: The positive KOH reaction and negative Schäffer's reaction, yellowish discolouration when bruised and ink odour, place *A. exilissimus* in *Agaricus* section *Xanthodermatei*. It can be easily recognized in the field by its small sized sporocarps with an ink odor, tiny brown fibrillose squamules on the pileus surface, and the slender stipe. *Agaricus exilissimus* is phylogenetically related to *A. bisporiticus* Nawaz et al., *A. murinocephalus* R.L. Zhao et al. and *A. fuscopunctatus* Thongklang et al. (Fig. 106). All these species have a pileus with brown, appressed squamules (Thongklang et al. 2014; Zhao et al. 2012). However, these three species have larger sporocarps than the new species with pileus diameters exceeding 50 mm when mature. Although such a criterion is not perfectly reliable, it could help to identify the new species. We note that the three species cited above plus *A. pseudopratensis* (Bohus) Wasser and *A. microvolvatulus* formed a clade in the tree of Fig. 106, although it was poorly supported. This agrees with the previous study of Thongklang et al. (2014). These authors showed that these five species shared two ITS XantII-specific markers: A and a deletion at positions 143 and 144, respectively (tcagc[A-]ybgyt) in the sequence alignment. The new species also possesses these two specific markers in agreement with them belonging in this group.

Amanitaceae R. Heim ex Pouzar

The family *Amanitaceae* is an important fungal family due to its ecological and economic importance (Yang 1997, 2005, 2015; Yang et al. 1999; Kernaghan 2005; Chen et al. 2013). The family probably comprises at least four genera: *Amanita*, *Aspidella*, *Catatrama* and *Limacella* (Moncalvo et al. 2002; Garnica et al. 2007; Justo et al. 2010; Vizzini et al. 2012; Wolfe et al. 2012), and *Amanita* is the most species-rich genus (Bas 2000; Tulloss 2005; Yang 2005).

Amanita Pers., Tent. disp. meth. fung. (Lipsiae): 65 (1797)

The genus *Amanita* (*Agaricales*, *Basidiomycota*) is a cosmopolitan genus, comprising about 500 described and accepted species worldwide (Bas 2000; Tulloss 2005; Yang 2005). This group of fungi can form ectomycorrhizal symbiosis with plants of more than ten families, such as *Fagaceae*, *Myrtaceae* and *Pinaceae* (Yang et al. 1999). Based on morphological and anatomical characters, *Amanita* could be divided into two subgenera, *Amanita* and *Lepidella* (E.J. Gilbert) Veselý (Corner and Bas 1962; Bas 1969), consisting of seven sections, *Amanita*, *Caesareae* Singer, *Vaginatae* (Fr.) Quél., *Amidella* (J.-E. Gilbert) Konrad & Maubl., *Lepidella*, *Phalloideae* (Fr.) Quél. and *Validae* (Fr.) Quél. (Yang 1997). Herein we described three new species of *A.* sect. *Amanita* supported by both morphological and molecular phylogenetic evidences. Sequence data used in this study are from previous studies (Weiβ et al. 1998; Zhang et al. 2004; Vargas et al. 2011; Wolfe et al. 2012; Sánchez-Ramírez et al. 2015) or are newly generated (Fig. 113).

212. ***Amanita melleialba*** Zhu L. Yang, Qing Cai & Yang Y. Cui, ***sp. nov.***

Index Fungorum number: IF551331; *Facesoffungi number*: FoF00898; Figs. 113, 114, 115, 116 and 117

Etymology: *melleialba*, referring to the honey-coloured center and whitish margin of the pileus.

Holotype: HKAS 83446

Basidiomata small. *Pileus* 2.8–5 cm in diam., plano-convex to plane, center often slightly depressed, honey-coloured, yellowish (4A3–4) to yellow (3B5–6), becoming yellowish to whitish (3A2) toward margin, viscid when moist; margin tuberculate-striate (0.4–0.6R), non-appendiculate; volval remnants as subconical to granular, small warts up to 2 mm high, dirty white (5B2), cream-coloured to yellowish (4A2–3), randomly arranged, or densely placed at center; trama white (1A1), unchanging. *Lamellae* free, white (1A1), crowded; lamellar edges finely fimbriate, white (1A1), dirty white (5B2, 4B1–2) to cream-coloured (4A2–3); lamellulae truncate, plentiful, evenly distributed. *Stipe* 4–8 × 0.4–0.8 cm, subcylindric or slightly tapering upward, with apex slightly expanded, white (1A1) to cream-coloured (1A2), covered with white (1A1) floccose squamules above annulus, with white (1A1) floccose squamules to granules under annulus; context white, loosely stuffed to hollow in center; basal bulb subglobose to napiform, 0.8–1.2 cm in diam., white (1A1); volval remnants as white to cream-coloured (1A1) floccose squamules to granules, or forming a short limb. *Annulus* present, pendant from attachment 1.5–3 cm below apex of stipe, white (1A1) to cream-coloured (1A2), with a yellow floccose edge. *Odor* indistinct.

Lamellar trama bilateral. Mediostratum 30–60 μm wide, composed of abundant ellipsoid inflated cells (35–60 × 16–37 μm); filamentous hyphae abundant, 2–8 μm wide; vascular hyphae rare. Lateral stratum composed of abundant fusiform to ellipsoid inflated cells (22–65 × 9–20 μm), diverging at an angle of ca. 30–45° to the mediostratum; filamentous hyphae abundant, 2–6 (−9) μm wide; septa without clamps. *Subhymenium* 30–60 μm thick, with 2–3 layers of subglobose to ovoid or irregularly shaped cells, 9–17 × 7–15 μm. *Basidia* 30–50 × 9–14 μm, clavate, 4-spored; sterigemata 3–5 μm long; basal septa without clamps. *Basidiospores* [60/3/2] 7.5–9.5(−10) × (5.5–)6–7 μm [*Q*=(1.21–)1.29–1.58(−1.63), Qm = 1.41 ± 0.10], ellipsoid, sometimes broadly ellipsoid, inamyloid, colourless, hyaline, thin-walled, smooth; apiculus small. *Lamellar edge* appearing as sterile strip, composed of globose, subglobose to ellipsoid inflated cells (12–32 × 10–25 μm), single and terminal or in terminal chains of 2–3, thin-walled, colourless, hyaline; filamentous hyphae abundant, 2–4 μm wide, irregularly arranged or ± running parallel to lamellar edge. *Pileipellis* 100–150 μm; upper layer (50–70 μm thick) strongly gelatinized, composed of subradically to somewhat interwoven, thin-walled, colourless to nearly colourless, filamentous hyphae 3–5 μm wide; lower layer (50–80 μm thick) composed of radically and compactly arranged, filamentous hyphae 3–8 μm wide; vascular hyphae rare. *Volval remnants* on pileus composed of vertically to subvertically arranged elements; inflated cells very abundant to nearly dominant, globose to subglobose or ellipsoid to subfusiform (20–65 × 10–35 μm), in chains of 2–4, thin-walled, colourless to subcolourless; filamentous hyphae rare to fairly abundant, 3–6 μm wide, thin-walled, colourless to nearly colourless; vascular hyphae rare. *Volval remnants* on the stipe base composed of two layers of intergrading into each other. Outer layer composed of longitudinally to irregularly arranged elements: inflated cells abundant to very abundant, fusiform to ellipsoid, 20–45 × 10–30 μm, colourless to yellow brownish, thin- to slightly thick-walled, terminal or in chains of 2–3 and then terminal, becoming rare toward inner layer; filamentous hyphae very abundant to abundant; vascular hyphae rare. Inner layer somewhat gelatinized, filamentous hyphae very abundant to nearly dominant, mixed with scattered, long ellipsoid to clavate inflated cells, 65–150 × 15–20 μm. *Stipe trama* composed of longitudinally arranged, long clavate, terminal cells, 150–350 × 27–50 μm; filamentous hyphae scattered to fairly abundant, 2–9(−14) μm; vascular hyphae rare. *Annulus* slightly gelatinized, composed of subradially arranged elements; inflated cells very abundant, ellipsoid to long ellipsoid, 15–65 × 10–28 μm, colourless, thin-walled, becoming elongated toward lower surface; filamentous hyphae abundant, 2–5(−8) μm, colourless, thin-walled. Clamps absent in all parts of basidioma.

Habitat and distribution: Solitary or gregarious in subtropical forests dominated by Fagaceae. Known from southwestern and central China.

Material examined: CHINA, Hunan Province, Changsha City, Yuelu Mountain, *Fagaceae* (altitude ca. 260 m), 18 July 2014, S.C. Li 1 (HKAS 83216). Yunnan Province, Puer City, Caiyanghe Nature Reserve, *Fagaceae* (altitude 1300 m), 11 July 2014, G. Wu 1339 (HKAS 83446, holotype!); the same location, *Fagaceae* (altitude 1326 m), 11 July 2014, Xiao B. Liu 439 (HKAS 87085).

Notes: *Amanita melleialba* is characterized by its small basidiomata, ellipsoid basidiospores (7.5–9.5 × 6–7 μm), volval remnants on the pileus dominantly composed of abundant inflated cells in chains of 2–4, and occurrence in subtropical forests dominated by plants of *Fagaceae*.

Amanita melleialba is very similar to *A. parvipantherina* Zhu L. Yang, M. Weiss & Oberw., however, the latter possesses a brownish pileus with shorter marginal striations, larger basidiospores (8.5–11.5 × 6.5–8.5 μm) and is distributed in the mixed forests with *Pinus yunnanensis* (Yang et al. 2004; Yang 2005, 2015). Our molecular phylogenetic analysis also suggested that *A. melleialba* is a separate species and is different from *A. parvipantherina* (Fig. 113).

Amanita melleialba may be confused with *A. elata* (Massee) Corner & Bas, a species originally described from Singapore. However, *A. elata* has volval remnants on the pileus as small, scattered, irregularly shaped, floccose-membranous, flat patches, which are easily washed off by rain, and globose to subglobose basidiospores (Corner and Bas 1962; Yang 2015).

213. ***Amanita pseudosychnopyramis*** Yang Y. Cui, Qing Cai & Zhu L. Yang, ***sp. nov.***

Index Fungorum number: IF551334; *Facesoffungi number*: FoF00897; Figs. 113, 117, 118 and 119

Etymology: *pseudosychnopyramis*, named due to its similarity to *A. sychnopyramis*.

Holotype: HKAS 87999

Basidiomata small to medium-sized. *Pileus* 4–7 cm in diam., plano-convex to plane, often slightly depressed at center, at first yellow (3A4–8) over disk, then yellowish brown (3B2–8) to brownish (3C4–7) at center, becoming yellowish (3A2–3, 3B2–4) to dirty white (3B1–2) toward margin, viscid when moist; margin tuberculate-striate (0.25–0.3R), non-appendiculate; volval remnants as conical, subconical to pyramid, dirty white to grayish (3B1–2) to brownish grey (3A2–4; 3B2–3), randomly arranged, small warts; trama white

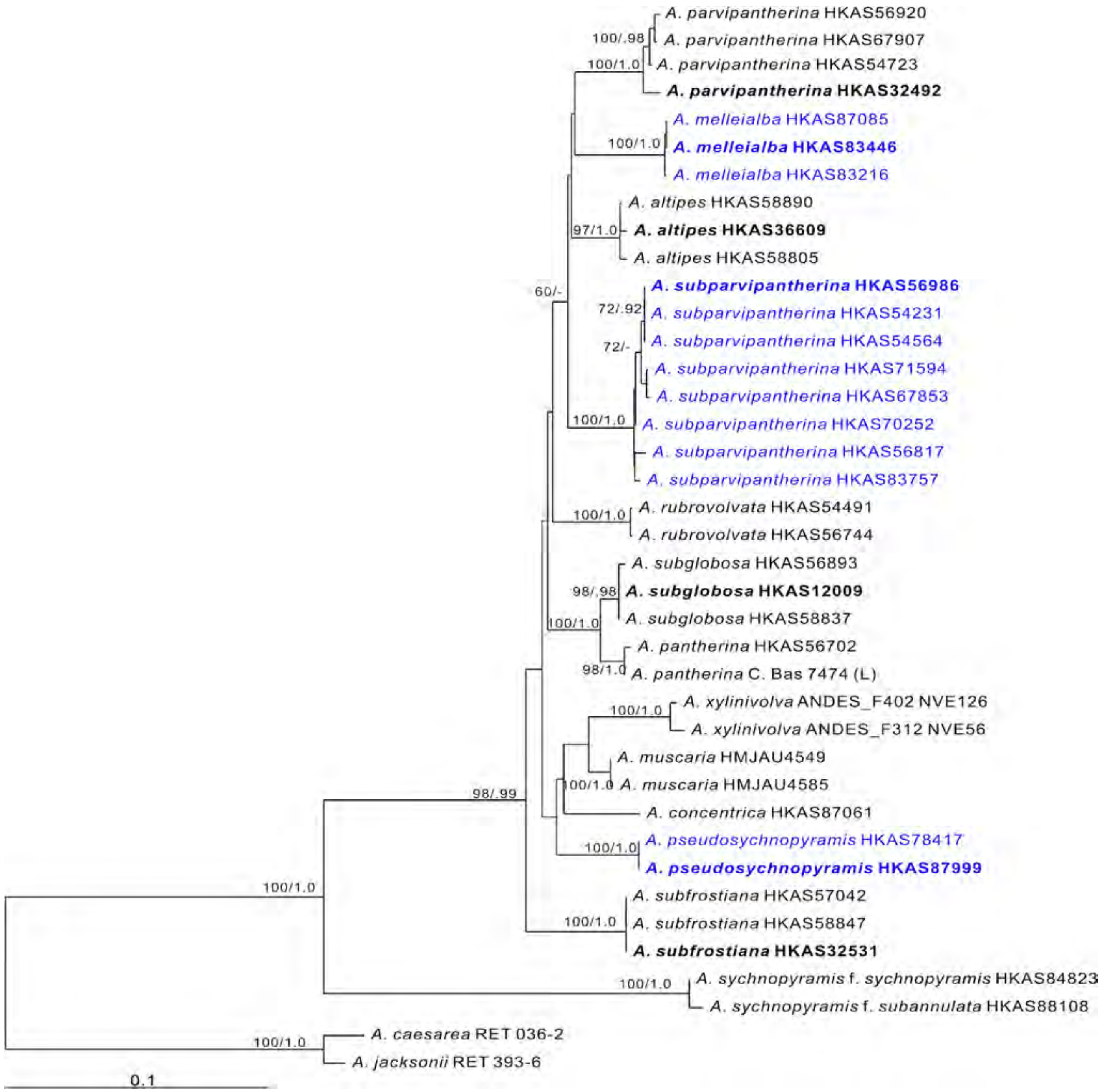


Fig. 113 Phylogram of *Amanita* sect. *Amanita* generated from Maximum likelihood (RAxML) analysis of LSU, *rpb2* and *tef1-α* sequence data. Maximum likelihood bootstrap values greater than 50 % and Bayesian posterior probabilities over 0.90 are indicated above or below the nodes. The new species are indicated in *blue*, and the type collections of the species are in *bold*. The tree is rooted with two species of *A.* sect. *Caesareae*, namely *A. caesarea* and *A. jacksonii*

(1A1), unchanging. *Lamellae* free, white (1A1), crowded; lamellulae truncate, plentiful, evenly distributed. *Stipe* 6–8.5 × 0.3–0.8 cm, subcylindric or slightly tapering upward, with apex slightly expanded, dirty white (3A1–3) to yellowish brown (4A2–3, much paler than 4B2–3), subglabrous or covered with white (1A1) floccose squamules; context white, hollow in center; basal bulb subglobose to long ellipsoid, 1–1.3 cm in diam., white (1A1) to dirty white (3A1–3), upper part covered with conical to subconical to granular grayish to brownish grey volval remnants arranged in several incomplete rings, usually forming a short limbate collar between the stipe and the bulb. *Annulus* present, superior, pendant from attachment 2–3 cm below apex of stipe, white (1A1), thin, membranous, fragile. *Odour* indistinct.

Fig. 114 Basidiomata of *Amanita melleialba* (holotype). Scale bars: **a**–**b**=1 cm

Lamellar trama bilateral. Mediostratum 40–75 µm wide, composed of abundant subglobose, ellipsoid to long ellipsoid inflated cells (35–110×25–50 µm); filamentous hyphae abundant, 2–8 µm wide; vascular hyphae rare. Lateral stratum composed of abundant ellipsoid to long ellipsoid inflated cells (25–70×7–17 µm), diverging at an angle of ca. 30–45° to the mediostratum; filamentous hyphae abundant, 3–5 µm wide; septa without clamps. *Subhymenium* 35–70 µm thick, with 2–3 layers of subglobose, ellipsoid or irregularly shaped cells, 7–30×12–25 µm. *Basidia* 36–47×10–13 µm, clavate, 4-spored, sometimes 2-spored; sterigemata 3–4 µm long; basal septa without clamps. *Basidiospores* [140/7/3] (7–)8–10(−11.5)×(6.5–)7–8.5(−10.5) µm [*Q*=1.06–1.20(1.39), Qm=1.13±0.05], subglobose to broadly ellipsoid, inamyloid, colourless, hyaline, thin-walled, smooth; apiculus small. *Lamellar edge* appearing as sterile strip, composed of subglobose to ellipsoid inflated cells (9–25×7–15 µm), single and terminal or two in chain and then terminal, thin-walled, colourless, hyaline; filamentous hyphae abundant, 2–4 µm wide, irregularly arranged or ± running parallel to lamellar edge. *Pileipellis* 150–200 µm; upper layer (60–80 µm thick) strongly gelatinized, composed of radically to subradically, thin-walled, colourless to nearly colourless, filamentous hyphae 2–7 µm wide; lower layer (80–125 µm thick) composed of compactly arranged, filamentous hyphae 3–8 µm wide; vascular hyphae rare. *Volval remnants* on pileus composed of more or less vertically arranged elements; inflated cells very abundant to nearly dominant, subglobose to ellipsoid (18–70×15–50 µm), in chains of 2–3 and then terminal, thin- to slightly thick-walled, yellowish to brownish vacuolarly pigmented, sometimes nearly colourless; filamentous hyphae abundant, 3–11 µm wide, thin-walled, yellowish to brownish vacuolarly pigmented or nearly colourless; vascular hyphae rare. Volval remnants on the stipe base (outer surface of the limbate collar) composed of somewhat irregularly arranged elements; inflated cells very abundant, subglobose to ellipsoid

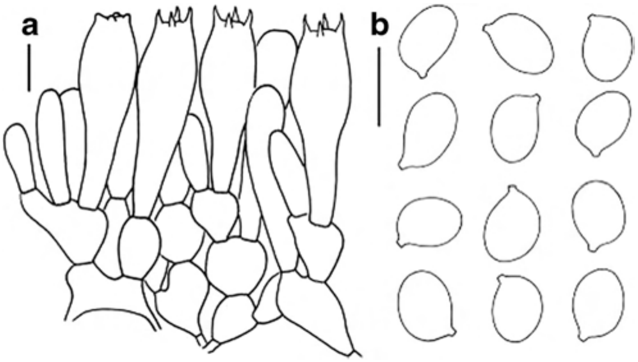


Fig. 115 Microscopic features of *Amanita melleialba* (holotype) **a** Hymenium and subhymenium **b** Basidiospores. Scale bars=10 µm

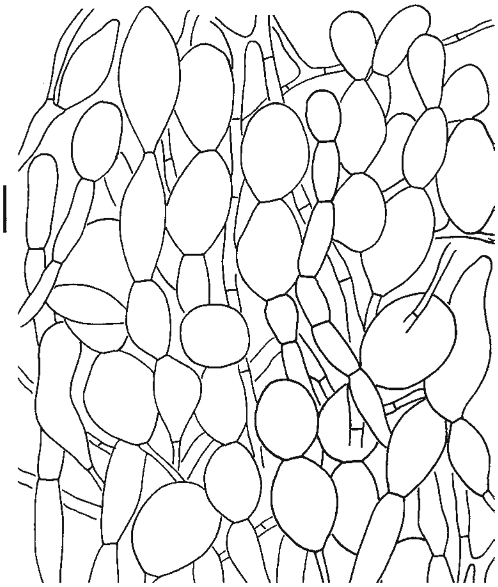


Fig. 116 Longitudinal section of a volval remnant on the pileus from ***Amanita melleialba*** (HKAS 83216). Scale bars=20 µm

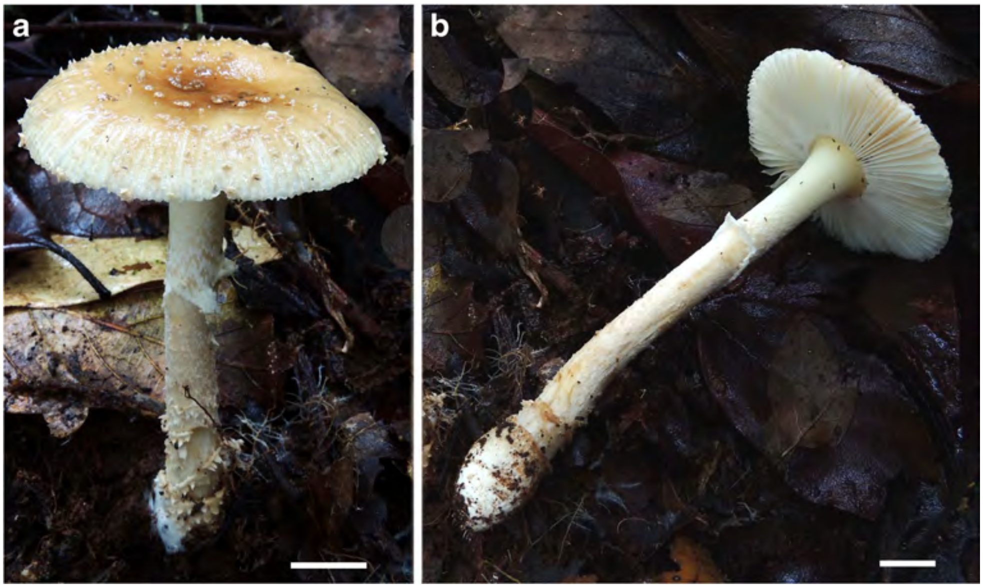


Fig. 117 Basidiomata of *Amanita pseudosychnopyramis* (HKAS 87999, holotype). Scale bars=1 cm

(22–100×15–45 µm), thin- to slightly thick-walled, in chains of 2; filamentous hyphae abundant, 3–8 µm wide, colourless to nearly colourless, thin-walled; vascular hyphae rare; interior of limbate collar on the stipe base composed of very abundant to nearly dominant filamentous hyphae 3–8 µm wide, mixed with scattered inflated cells; inner surface of limbate collar gelatinized, composed of filamentous hyphae 3–6 µm wide. *Stipe trama* composed of longitudinally arranged, long clavate, terminal cells, 200–450×25–50 µm; filamentous hyphae scattered (in interior) to fairly abundant (on stipe surface), 5–18 µm wide; vascular hyphae rare. *Annulus* composed of loosely and irregularly arranged elements; inflated cells abundant, ellipsoid to long ellipsoid to clavate (28–95×15–35 µm), colourless to nearly colourless, thin-walled, single and terminal or in chains of 2–3 and then terminal; filamentous hyphae abundant to very abundant, 3–7(−10) µm wide, colourless to nearly colourless, thin-walled; vascular hyphae rare. Clamps absent in all parts of basidioma.

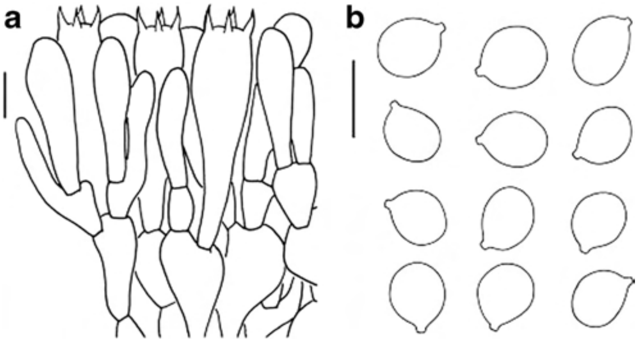


Fig. 118 Microscopic features of *Amanita pseudosychnopyramis* (HKAS 87999, holotype): **a** Hymenium and subhymenium; **b** Basidiospores. Scale bars=10 µm

Habitat and distribution: Solitary or gregarious in southern subtropical forests of *Fagaceae*. Distributed in southweatern and southern China.

Material examined: CHINA, Guangdong Province, Fengkai County, Heishiding, *Fagaceae* (altitude 500 m), 20 March 2012, F. Li 66 (HKAS 78417); the same location, *Fagaceae* (altitude 320 m), 16 March 2014, F. Li 1593 (HKAS 82293); Yunnan Province, Jinghong City, Dadugang Township, *Fagaceae* (altitude ca. 1000 m), 30 June 2014, K. Zhao 467 (HKAS 87999, holotype!).

Notes: *Amanita pseudosychnopyramis* is characterized by its conical to pyramid grey to brownish grey volval remnants

Fig. 119 Longitudinal section of a volval remnant on the pileus from *Amanita pseudosychnopyramis* (holotype). Scale bars=20 µm

on the pileus, a basal bulb with a short limbate collar and its subglobose to broadly ellipsoid basidiospores (8.5–10×7.5–8.5 μm). It is associated with subtropical forests dominated by *Fagaceae*.

Amanita pseudosychnopyramis resembles *A. sychnopyramis* f. *sychnopyramis* and f. *subannulata*, by its small to medium-sized basidiomata, characterized by a brownish to brown pileus with grey to brownish grey, conical to pyramid volval remnants. However, *A. sychnopyramis* f. *sychnopyramis* and f. *subannulata* has usually a bulb with conical to granular volval remnants arranged in incomplete rings, smaller basidia and smaller basidiospores (Corner and Bas 1962; Hongo 1971; Yang 1997). *Amanita pseudosychnopyramis* is also similar to *A. parvipantherina*, and *A. subparvipantherina* by its small to medium-sized basidiomata, characterized by a brownish to brown pileus with grey to brownish grey, conical to pyramid volval remnants. *Amanita parvipantherina* possesses a subglobose basal bulb, with floccose to granular volval remnants which usually do not form a limbate volva on the base of the stipe and broadly ellipsoid to ellipsoid basidiospores (8.5–11.5×6.5–8.5 μm) (Yang et al. 2004; Yang 2005, 2015). Furthermore, it occurs in mixed forests with pine trees. *Amanita subparvipantherina* has a short limbate collar volval remnants on the stipe base, broadly ellipsoid to ellipsoid basidiospores (9–11.5×6.5–8.5 μm), and volval remnants on the pileus with more abundant filamentous hyphae. In our molecular analyses, *A. pseudosychnopyramis* is supported to be a distinct species and is distantly related to *A. parvipantherina*, *A. subparvipantherina*, *A. sychnopyramis* f. *sychnopyramis* and f. *subannulata* (Fig. 113).

214. ***Amanita subparvipantherina*** Zhu L. Yang, Qing Cai & Yang Y. Cui, ***sp. nov.***

Index Fungorum number: IF551335; *Facesoffungi number*: FoF00899; Figs. 113, 120, 121, 122 and 123

Etymology: "*subparvipantherina*", named due to its similarity to *A. parvipantherina*.

Holotype: HKAS 56986

Basidiomata medium-sized. *Pileus* 5–7 cm in diam., at first hemispherical, then convex to plano-convex, center often slightly umbonate, yellowish brown (4A4–5, 4B4–7) to brown (4C5–8) or dark brown (4D6–8, 4E6–8), becoming yellowish (4A2–4) to brownish (4B3–4, 4C3–4) toward margin, viscid when moist; margin tuberculate-striate (0.2–0.3R), non-appendiculate; volval remnants as conical, subconical to granular, dirty white to grayish (3B1–2) to brownish (3A2–4; 3B2–3), randomly arranged, small warts; trama white (1A1), unchanging. *Lamellae* free, white (1A1), crowded; lamellulae truncate, plentiful, evenly distributed. *Stipe* 11–16.8×0.8–2 cm, subcylindric or slightly tapering upward, with apex slightly expanded, whitish (1A1), with yellowish brown (3B2–4) tinge, often glabrous to subglabrous, rarely covered with white (1A1) floccose squamules; context white, hollow in center; basal bulb subglobose to ovate to napiform, 2–3 cm in diam., white (1A1), upper part covered with subconical to granular greyish to brownish volval remnants, often forming a short limbate collar on the stipe base. *Annulus* present, superior to median, pendant from attachment 2–4 cm below apex of stipe, white (1A1), thin, membranous, fragile. *Odour* indistinct.

Fig. 120 Basidiomata of *Amanita subparvipantherina* (HKAS 83757). Scale bars=1 cm

Lamellar trama bilateral. Mediostratum 25–40 μm wide, composed of abundant fusiform, ellipsoid to long ellipsoid inflated cells (20–200×10–55 μm); filamentous hyphae abundant, 3–7 μm wide; vascular hyphae rare. Lateral stratum composed of abundant fusiform to ellipsoid inflated cells (20–45×10–20 μm), diverging at an angle of ca. 30–45° to the mediostratum; filamentous hyphae abundant, 2–6 μm wide; septa without clamps. *Subhymenium* 25–40 μm thick, with 2–3 layers of ellipsoid or irregularly shaped cells, 10–28×7–10 μm. *Basidia* 30–40×9–13 μm, clavate, 4-spored, rarely 2-spored; sterigemata 3–5 μm long; basal septa without clamps. *Basidiospores* [140/7/5] (8–)9–11.5(−13)×(5.5–)6.5–8(−9.5) μm [Q=(1.20–)1.28–1.5(−1.69), Qm=1.38±0.11], broadly ellipsoid to ellipsoid, rarely elongate, inamyloid, colourless, hyaline, thin-walled, smooth; apiculus small. *Lamellar edge* appearing as sterile strip, composed of inflated cells, mixed with abundant thin-walled, yellow brownish filamentous hyphae. *Pileipellis* 100–200 μm; upper layer (50–100 μm thick) strongly gelatinized, composed of radically to subradically, thin-walled, colourless to nearly colourless, filamentous hyphae 2–6 μm wide; lower layer (50–110 μm thick) composed of compactly arranged, filamentous hyphae 3–8 μm wide; vascular hyphae rare. *Volval remnants* on pileus composed of somewhat irregularly arranged elements; inflated cells fairly abundant to abundant, fusiform to ellipsoid to subglobose (25–50×15–40 μm), single and terminal or in

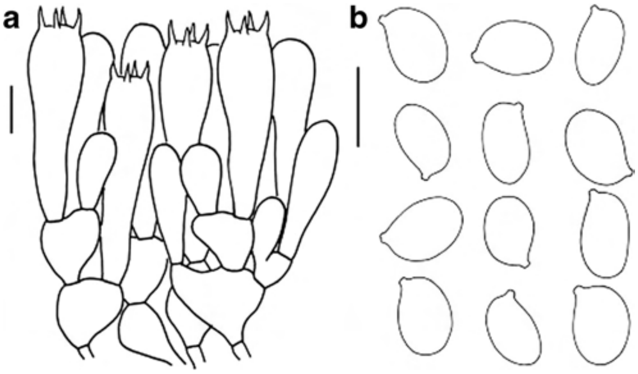


Fig. 121 Microscopic features of *Amanita subparvipantherina* (holotype) **a** Hymenium and subhymenium **b** Basidiospores. Scale bars=10 µm

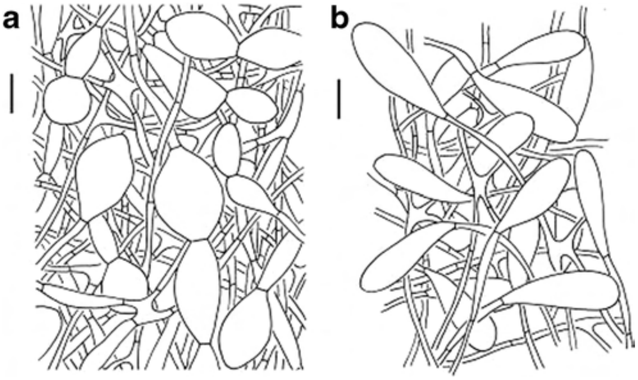


Fig. 122 Microscopic features of *Amanita subparvipantherina* (HKAS 54564) **a** Longitudinal section of a volval remnant on the pileus **b** Radially section of annulus. Scale bars: **a**–**b**=20 µm

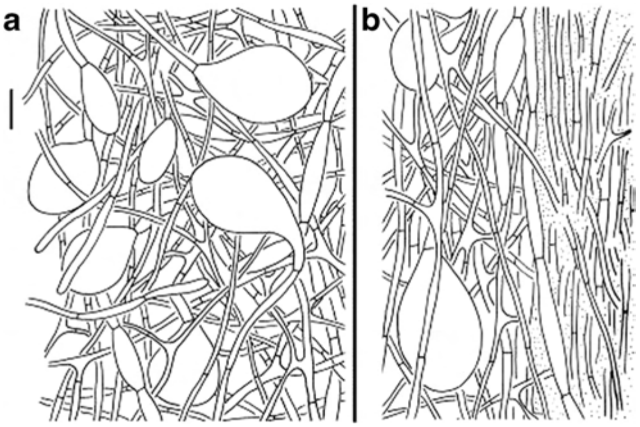


Fig. 123 Longitudinal section of the limbate collar on the stipe base from ***Amanita subparvipantherina* (holotype) a** Outer surface (*left edge*) and interior of the collar **b** Interior and inner surface (*right edge*) of the collar. Scale bars: a–b=20 µm

chains of 2–3 and then terminal, thin-walled, colourless to yellowish vacuolarly pigmented; filamentous hyphae very abundant, 2–10 µm wide, thin-walled, nearly colourless to yellowish vacuolarly pigmented; vascular hyphae rare. Interior of limbate collar on the stipe base composed of longitudinally to somewhat irregularly arranged elements; inflated cells fairly abundant, fusiform, ellipsoid, broadly clavate to pyriform (30–75×15–45 µm), becoming more abundant toward the outer surface of limbate collar, colourless to nearly colourless, thin-walled to slightly thick-walled, single, sometimes two in chains; filamentous hyphae abundant to very abundant, 2–10 µm wide, colourless to nearly colourless, thin-walled; vascular hyphae rare. Outer surface of limbate collar similar to the interior but with more abundant inflated cells; inner surface of limbate collar gelatinized, composed of 3–8 µm wide filamentous hyphae. *Stipe trama* composed of primarily of longitudinally arranged, long clavate, terminal cells 210–350×25–45 µm; filamentous hyphae scattered (in interior), to fairly abundant (on stipe surface), 6–16 µm wide; vascular hyphae rare. *Annulus* composed of loosely and subradially arranged elements; inflated cells fairly abundant, clavate, ellipsoid to long ellipsoid (35–65×15–25 µm), colourless to nearly colourless, thin-walled, single and terminal, rarely two in chains and then terminal; filamentous hyphae abundant to very abundant, 2.5–6 µm wide, colourless to nearly colourless, thin-walled; vascular hyphae rare. Clamps absent in all parts of basidioma.

Habitat and distribution: Solitary or gregarious in subtropical forests composed of *Pinus*, *Quercus*, *Keteleeria* and *Rhododendron*. Common in southwestern China.

Material examined: CHINA, Yunnan Province, Binchuan County, Jizu Mountain, *Pinus* mixed with *Quercus* and *Rhododendron* (altitude 2000–2100 m), 11 August 2011, Q. Cai 657 (HKAS 70252); the same location, 9 August 2014, Q. Cai 1288 (HKAS 83757); Chuxiong City, Zixi Mountain, *Pinus* and *Quercus* (altitude 2000 m), 17 June 2008, Z. W. Ge 2035 (HKAS 54231); Jingdong County, Ailao Mountain, *Pinus* and *Quercus* (altitude 2500 m), 15 July 2008, L. P. Tang 333 (HKAS 54564); Longyang District, Haitangwa Village, *Pinus* and *Quercus* (altitude 2400 m), 12 August 2011, Y.J. Hao 485 (HKAS 71594); Lushui County, Luzhang Town, Xiapianma Village, *Pinus* (altitude 2000 m), 7 August 2010, Q. Cai 291 (HKAS 67853); Tengchong County, Guanpojiao Village, *Pinus*, *Quercus*, *Keteleeria* and *Rhododendron* (altitude 1800 m), L. P. Tang 860 (HKAS 56817); Yongping County, Shangzhai Village, *Pinus* and *Quercus* (altitude 1991 m), 30 July 2009, L. P. Tang 1029 (HKAS 56986, holotype!).

Notes: *Amanita subparvipantherina* is distinguished by its slender basidioma with a long stipe, broadly ellipsoid to ellipsoid basidiospores (9–11.5×6.5–8 µm), volval remnants on the pileus and the limbate collar on the stipe base, composed of abundant to very abundant filamentous hyphae, mixed with fairly abundant inflated cells.

Amanita subparvipantherina is similar to *A. parvipantherina*. However, *A. parvipantherina* has floccose to granular volval remnants on the upper bulb, and volval remnants on the pileus with more abundant to nearly dominant inflated cells (Yang et al. 2004; Yang 2005, 2015).

Amanita subparvipantherina is also somewhat similar to *A. sychnopyramis* f. *subannulata*. However, the latter taxon has volval remnants on the pileus, with more abundant to nearly dominant inflated cells, and globose to subglobose basidiospores (6.5–8.5×6–8 μm) with Q=1.03–1.16 (Hongo 1971; Yang 1997, 2005, 2015).

Amanita subparvipantherina may be confused with *A. subglobosa* Zhu L. Yang, a species described from southwestern China, in their brownish pileus with white to yellow-brown conical volval remnants on the pileus. However, *A. subglobosa* has a larger basidioma, a distinctly globose to subglobose bulb on the base of the stipe, volval remnants on the pileus with more abundant inflated cells and a common presence of clamps (Yang 1997, 2005). Our molecular analyses also indicate that *A. subparvipantherina* is a distinct species and it is probably related to *A. parvipantherina*, *A. mellaialba* and *A. altipes*, but their relationships lack significant statistical supports (Fig. 113).

Entolomataceae Kotlaba & Pouzar

The family *Entolomataceae* is a family of *Agaricales* provided with spores that are pink in mass and have unique spore wall ornamentations, being formed by local thickenings in the spore wall, the epicorium (Clémençon et al. 2004). According to some recent phylogenetic studies (Moncalvo et al. 2002; Matheny et al. 2006) the family is monophyletic and sister to the *Lyophyllaceae* and includes the agaricoid genera *Clitopilus* (Fr. ex Rabenh.) P. Kumm. with spores showing longitudinal ribs, *Entoloma* Fr. ex P. Kumm. with angular spores and *Rhodocybe* Maire with bumpy spores, plus gasteroid genera like *Richoniella* Costantin & L.M. Dufour and *Rhodogaster* E. Horak. Other analyses (Baroni et al. 2011) did not confirm the monophyly of *Entolomataceae*. Based on a multigene analysis, Kluting et al. (2014) segregated from *Rhodocybe* the genera *Clitocella* Kluting et al., *Clitopilopsis* Maire and *Rhodophana* Kühner (Fig. 124).

Entoloma P. Kumm., Führ. Pilzk. (Zerbst): 97 (1871)

The genus *Entoloma* encompasses about 1000 taxa (Kirk et al. 2008a, b) distributed throughout the world, from (sub)arctic (Noordeloos and Morozova 2010) and temperate (e.g., Largent 1994; Noordeloos 1988b, 1992, 2004) to tropical regions (Baroni et al. 2008; Manimohan et al. 2006; Romagnesi 1941; Romagnesi and Gilles 1979).

Several authors recognized segregate genera within *Entoloma* (e.g., Horak 1976, 1978; Largent 1994; Aime et al. 2010), while others (Romagnesi 1941; Noordeloos 1992, 2004) treat it as a unique genus separable into different subgenera. The recent study by Co-David et al. (2009) showed that *Entoloma sensu lato* is monophyletic with the inclusion of *Rhodogaster* and *Richoniella*, the sequestrate taxa of the *Entolomataceae*. In his monograph on European *Entoloma* species Noordeloos (2004) reported about 380 taxa, but that number is likely to rise.

215. ***Entoloma calabrum*** Battistin, Marsico, Vizzini, Vila & Ercole, ***sp. nov.***

Index Fungorum number: IF551433; *Facesoffungi number*: FoF01046; Figs. 125 and 126

Etymology: the Latin epithet *calabrum* refers to the Italian region (Calabria) where the species has been first collected.

Holotype: MCVE 28566

Colour notations in the macroscopic descriptions refer to the Munsell Soil-Color Charts (1994).

Habit mycenoid. *Pileus* 19–30 mm broad, at first conical-campanulate to convex, then applanate with or without a prominent, obtuse umbo, yellow (Mu 10YR 8/6, 8/8), reddish yellow (Mu 7.5YR 6/8, 7/6, 7/8); surface dry, mat, fibrillose, tomentose or pubescent in some specimens, not or hardly hygrophanous; margin at first inflexed than straight, wavy, shortly translucently striate. *Lamellae* moderately crowded, adnexed to sinuate-emarginate, arcuate, up to 6–7 mm broad, very pale brown (Mu 10YR 8/3, 8/4) with many lamellulae. *Stipe* 50–60×2–3 mm, central, cylindrical or slightly compressed, equal or tapering at the apex, (sub)concolourous with the pileus, almost completely covered with white fibrils and a white tomentum. *Context* subconcolourous with pileus; odour not distinctive and taste mild. *Spores* 6.9–10.4×5.1–8.4 μm, on average 9×6.4 μm, Q=1.16–1.81 (Qm=1.41), almost exclusively heterodiametrical, 5–7 angled in side view. *Basidia* 35–47×11.7–15 μm, clavate, 4-spored, clamped. *Sclerobasidia* absent. *Hymenial cystidia* absent. There are some cylindroid, more or less flexuose, thin-walled, sterile hyaline elements scattered among basidia, which scarcely protrude beyond the hymenium. *Caulocystidia* up to 180 μm long, 5–11.7 μm wide, abundant, cylindrical, straight or curved, flexuose, some coralloid, septate, hyaline. *Hymenophoral trama* regular in the mediostratum, a bit less in the outer layer, made up of cylindroid or subfusiform hyphae 94–300×3.3–23 μm (n=22; mean: 172×12 μm). *Pileipellis* a cutis of cylindrical, radially arranged hyphae up to 16.7 μm wide. *Pigment* very finely encrusting and sometimes also parietal. *Clamp-connections* present.

Habitat and known distribution: Gregarious on grassy soil. So far known only from southern Italy.

Material examined: ITALY, Calabria, Cosenza, municipality of San Pietro in Guarano, locality Serra Vaccaro, about 39°20′ N 16°24′ E on acid soil in a grassy clearing of a *Fagus sylvatica* stand near *Cytisus scoparius* and *Astragalus calabrus*, 8 October 2010, leg. O. Marsico (MCVE 28566, **holotype**); same loc., 20 October 2010, leg. O. Marsico (TO AV201010a; same loc., 27 October 201 (TO AV271010a)).

Notes: Both Bayesian and Maximum likelihood analyses produced the same topology; therefore, only the Bayesian tree with both BPP (Bayesian Posterior Probabilities) and MLB (Maximum Likelihood Bootstrap) values is shown (Fig. 124). In the ITS sequence analysis the sequence of

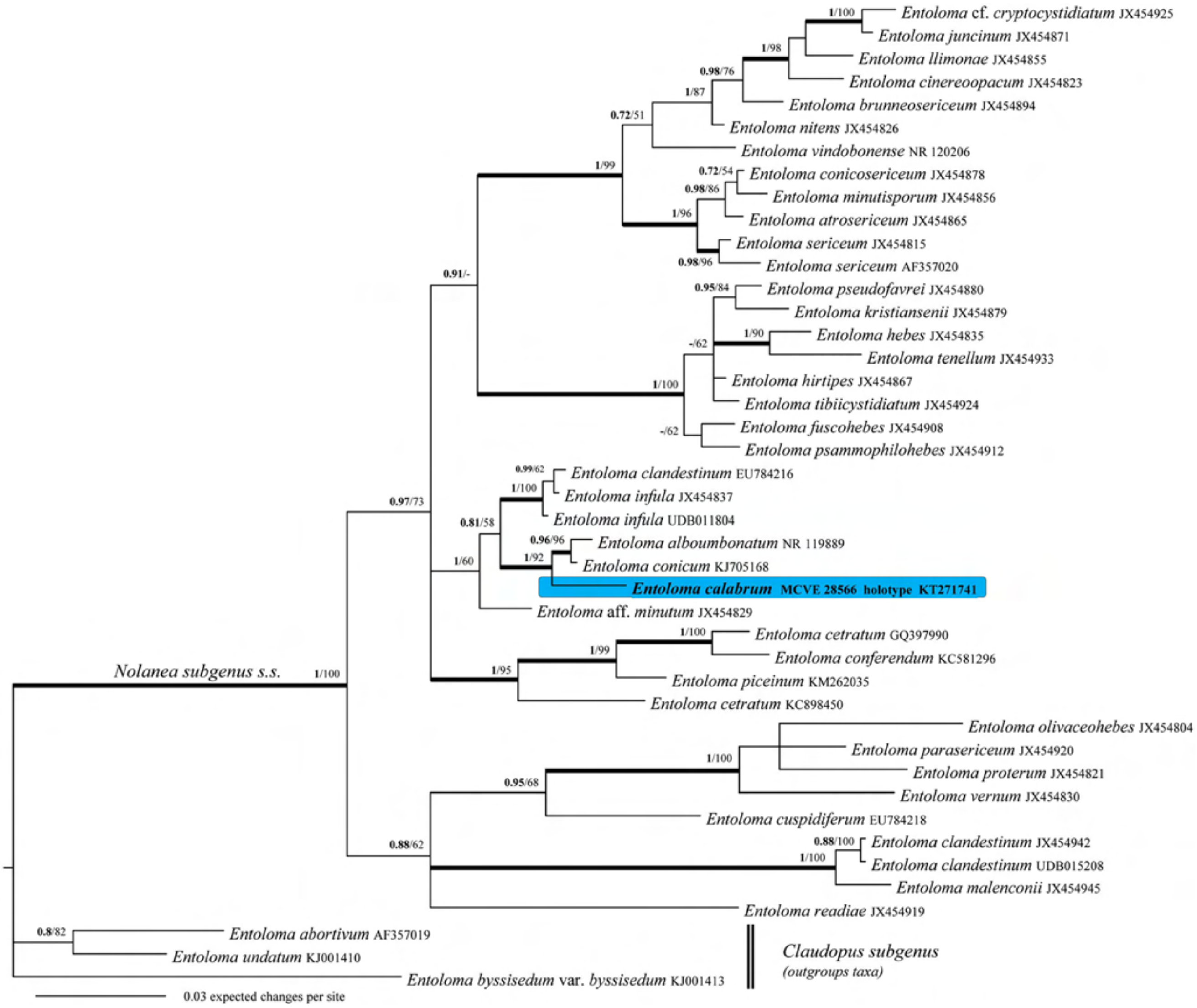


Fig. 124 Bayesian phylogram (MrBayes 3.2) of *Entoloma* subgen. *Nolanea* based on ITS sequences. Representative taxa from subgenus *Claudopus* were used as outgroups. Bayesian posterior probabilities (BPP) above 0.70 and RAxML bootstrap values (MLB) above 50 % are shown. *Thickened lines* indicate both BPP≥0.95 and MLB≥90 %

Entoloma calabrum clustered within the *Nolanea* major clade, in a clade consisting of *E. infula*, *E. clandestinum*, *E. conicum*, *E. alboumbonatum* and *E.* aff. *minutum*.

Macroscopically *Entoloma calabrum* is a distinct taxon on account of its sometimes zonate, umbonate, strongly fibrillose, almost villose pileus, the brown stipe covered with abundant white fibrils and a white tomentum, the cream or cream-brownish lamellae, and the odourless and mild context.

Microscopically it is characterised by the presence of clamp-connections, heterodiametrical spores, pigment mainly finely encrusting but also parietal, absence of hymenial cystidia, and presence of caulocystidia.

A combination of morphological features such as size, habit, overall colours and the structure of the hymenophoral trama and pileipellis placed it in the subgenus *Nolanea* (Fr.: Fr.) Noordel. (typified by *Agaricus hirtipes* Schumach.) as circumscribed by Noordeloos (1980, 1992, 2004). This placement is supported by the ITS phylogenetic analysis (Fig. 124) and by the fact that LSU query sequence produced the following matches: 99 % max. identity with *Nolanea sericea* (accessions GQ289191, AF223171, AY207197 and AF223170) and *N. conica* (accession AF2613170).

According to Noordeloos' taxonomic arrangement (1992, 2004) and with regard to the five sections included in *Nolanea*, i.e., *Mammosa* (Romagn.) Noordel., *Cosmeoexonema* (Largent & Thiers) Noordel., *Endochromonema* (Largent & Thiers) Noordel., *Fernandae* Noordel. and *Canosericei* Noordel., we think that on a strictly morphological basis *E. calabrum* should be placed within section *Endochromonema* subsection *Endochromonema*

Fig. 125 *Entoloma calabrum* (holotype) **a** Basidiomes **b** Pileus **c** Stipe. Scale bars: 1 cm

(Largent & Thiers) Noordel., especially on account of the heterodiametrical spores and the presence of an intraparietal pigment.

Consulting the iconography of Noordeloos' monograph (1992, 2004), *Entoloma calabrum* looks vaguely like *E. pallescens* (P. Karst.) Noordel., *E. lanuginosipes* Noordel. and *E. cetratum* (Fr.) M.M. Moser, which belong to section *Endochromonema* subsection *Endochromonema*, but the former differs especially by the presence of a subzonate and strongly fibrillose, almost villose pileus and 4-spored basidia.

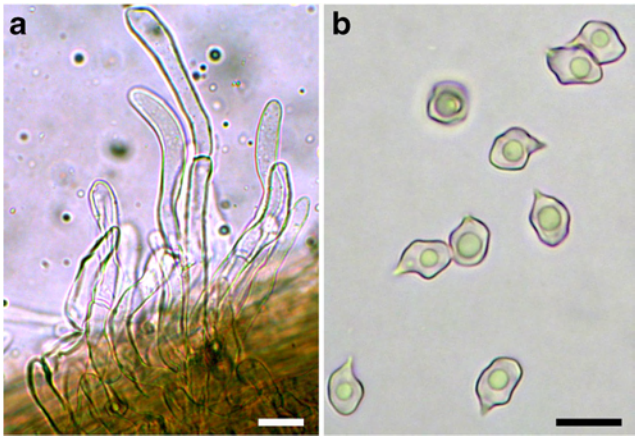


Fig. 126 *Entoloma calabrum* (holotype) **a** Caulocystidia **b** Spores. Scale bars: 10 μm

The species gravitating around *Entoloma sericeum* Quél., some of them recently described (Vila et al. 2013), such as *E. minutisporum* (Vila & Llimona) J. Carbó et al., *E. conicosericeum* Vila et al., *E. atrosericeum* (Kühner) Noordel., *E. cinereoopacum* (Noordel.) Vila et al., *E. vindobonense* Noordel. & Hauskn., *E. nitens* (Velen.) Noordel., *E. juncinum* (Kühner & Romagn.) Noordel., *E. brunneosericeum* Noordel. et al., *E. llimonae* Vila et al., differ from *E. calabrum* especially in the iso- or subisodiametrical spores and the abundant encrusting epiparietal pigment.

Entoloma hebes (Romagn.) Trimbach and closely related taxa like *E. hirtipes* (Schumach.) M.M. Moser, *E. fuscohebes* Vila et al., *E. psammophilohebes* Vila & J. Fernández, *E. tenellum* (J. Favre) Noordel., *E. kristiansenii* Noordel., *E. tibiicystidiatum* Arnolds & Noordel. and *E. pseudofavrei* Noordel. & Vila can be distinguished from *E. calabrum* on the basis of the occurrence of distinct cheilocystidia (Noordeloos 2004; Vila et al. 2013).

No extra-European known species fits our new taxon (Hesler 1967; Horak 1973, 1976, 1978, 1980, 1982, 2008; Romagnesi and Gilles 1979; Pegler 1983, 1997; Noordeloos 1988a, 2008; Largent 1994; Wölfel and Noordeloos 2001; Manimohan et al. 2006; Gates and Noordeloos 2007; Noordeloos and Gates 2009, 2012; Noordeloos and Hausknecht 2007; Noordeloos and Morozova 2010; Henkel et al. 2014). According to the ITS sequence data analysis (Fig. 1), the most closely related species are *Entoloma conicum* (Sacc.) Hesler and *E. infula* (Fr.) Noordel. two taxa sometimes with subzonate pileus. *E. conicum* (Peck) Hesler, described from North America (= *E. alboumbonatum* Hesler;= *E. subquadratum* Hesler fide Noordeloos (1988b, 2008), who studied type collections, Horak (1976) and Largent (1994), differs from *E. calabrum* mainly in having a subfarinaceous odour and taste, isodiametrical, and quadrate to 5-angled spores, Qm=1.2 (Hesler 1967; Noordeloos 1988b).

E. infula is distinguished by its subglabrous pileus and stipe surfaces, presence of intracellular and encrusting pigment in the pileipellis and its smaller spores (Noordeloos 1987, 1988a, 1992, 2004, 2012; Noordeloos and Hausknecht 1993).

Finally, *E. minutum* (P. Karst.) Noordel. is characterised by a strongly translucently striate pileus, often with a slight depression in the centre, subisodiametrical spores, and growth in moist grasslands, on damp places with *Alnus*, *Fraxinus*, *Betula* and *Salix* (Noordeloos 1992, 2004).

Hygrophoraceae Lotsy

The importance of the *Hygrophoraceae* for lichenization in the Basidiomycota was only recently recognized, with the inclusion of *Dictyonema* and relatives in this family (Lawrey et al. 2009). Until about ten years ago, *Dictyonema* was considered to contain only five, widespread species in a single genus (Parmasto 1978), but the clade is now known to comprise five genera (*Acantholichen*, *Cora*, *Corella*, *Cyphellostereum*, *Dictyonema*) and several hundred species (Dal-Forno et al. 2013; Lücking et al. 2013, 2014). In particular, the genus *Cora* is hyperdiverse, with 114 species recognized based on molecular phylogeny and over 400 species predicted (Lücking et al. 2014). While *Cora* is essentially neotropical, *Dictyonema sensu stricto* is found in all tropical areas and hence should have a similarly high number of species. Based on recent phylogenetic studies, further two species in the clade are here described as new (Fig. 127).

216. *Cora barbulata* Lücking, Dal-Forno & Lawrey, *sp. nov.*

Index Fungorum number: IF551501; *Facesoffungi number*: FoF01049; Fig. 128a–c

Etymology: Referring to the beard-like concentric rings of irregular tomentum on the upper lobe surface.

Holotype: R. Lücking R18 (CR).

Diagnosis: Differing from the morphologically similar *Cora aspera* in the crenulate, undulate lobe margins and the large, broad hymenophore patches.

Thallus epiphytic on stems and branches of shrubs, foliose, up to 15 cm across, composed of 1–5(−10) semicircular lobes per thallus; lobes 2–7 cm wide and 1–5 cm long, often branched and with short radial branching sutures, marginally distinctly crenulate (with short secondary branches) and undulate, light bluish to greenish or brownish grey with slight concentric colour zonation when fresh, with thin but distinct, involute, white to light grey margins, becoming white to grey in the herbarium. Upper surface smooth, glabrous except for a few concentric lines of short, irregular, white trichomes; trichomes 0.2–0.3 mm long and 7–15 µm thick at the base, composed of agglutinated hyphae; involute margin glabrous; lower surface ecorticate, finely felty-arachnoid (representing the exposed medulla), light grey when fresh and becoming white in the herbarium. Thallus in section 200–300 µm thick, with upper cortex, photobiont layer, and medulla; upper cortex formed by a 20–50 µm thick layer of rather loosely packed, irregularly arranged to nearly periclinal, 4–5 µm thick hyphae supported by an indistinct, 20–30 µm high 'medullary' layer of spaced groups of densely packed, anticlinal, 3–5 µm thick hyphae; photobiont layer 50–120 µm thick, composed of clusters of short, coiled cyanobacterial filaments wrapped in a dense, paraplectenchymatous hyphal sheath formed by jigsaw puzzle-shaped cells, clusters 20–30 µm diam., individual photobiont cells 11–13 µm broad and 5–8 µm long, dark blue-green to lighter green in upper portions, penetrated by tubular fungal hyphae; heterocytes sparse, hyaline to pale yellow, 9–11 µm wide and 5–6 µm long; cells of hyphal sheath wavy in lateral outline, 3–4 µm thick; medulla 50–100 µm thick, composed of loosely woven, irregularly arranged to

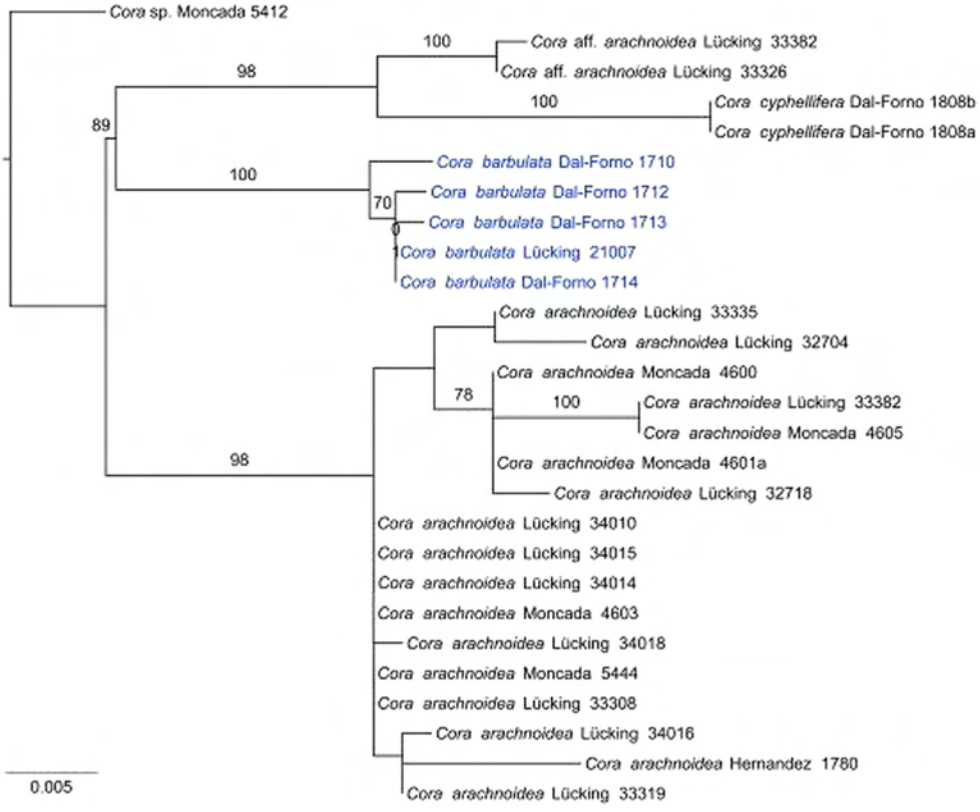


Fig. 127 Best-scoring maximum likelihood tree with bootstrap support values computed with RAxML 8.2.0 of selected species of *Cora* (*Hygrophoraceae*), including the new species *C. barbulata*. GenBank numbers and voucher information are indicated in the tree (see Lücking et al. 2014 for full tree)

Fig. 128 *Cora barbatula* (paratypes) **a**, **b** Thallus in situ. *Cora barbatula* (holotype) **c** Thallus underside with hymenophore. *Dictyonema gomezianum* (holotype) **d**–**f** Thallus surface view with appressed cyanobacterial filaments. Scale bars: **a**–**c**= 10 mm, **d**–**f**=1 mm

more or less periclinal hyphae 4–5 μm thick; clamp connections not observed. Hymenophore developed as angular-rounded, resupinate patches irregularly dispersed on the underside, patches 5–15 mm diam., with pale orange-yellow, smooth surface and felty, involute margins; hymenophore in section 50–100 μm thick, composed of a paraplectenchymatous layer resting on loose, 4–6 μm thick, generative medullary hyphae and supporting the hymenium; hymenium composed of numerous, palisade-like basidioles and scattered basidia; basidioles 25–35×5–6 μm; basidia 25–40×6–7 μm, 4-sterigmate; basidiospores not observed. *Chemistry*: No substances detected by TLC.

Material examined: COSTA RICA, San José, Los Santos Forest Reserve, km 90 on road (ruta 2) from Cartago to San Isidro, access road to towers on summit; 83° 45′ W, 09° 34′ N, 3400–3450 m; upper montane cloud forest and subalpine paramo zone, disturbed low paramo shrub with *Chusquea*, on stems and twigs of unidentified shrubs; 12 September 2007, R. Lücking 21007 (CR **holotype**; F **isotype**); same locality; 21 May 2012, M. Dal-Forno 1710, 1712 (GMUF **paratypes**); COSTA RICA, Cartago: Tapantí-Cerro de la Muerte National Park, km 90 on road (ruta 2) from Cartago to San Isidro, roadside forest remnants; 83° 45′ W, 09° 34′ N, 3350–3400 m; upper montane cloud forest zone, disturbed low oak forest, on stems and twigs of unidentified shrubs; 21 May 2012, M. Dal-Forno 1713, 1714 (GMUF **paratypes**).

Distribution and ecology: Known from several collections as shrub epiphyte in the upper montane cloud forest and paramo zone in the Cordillera de Talamanca in Costa Rica.

Notes: *Cora barbulata* is morphologically similar to *C. aspera* Wilk et al. (Lücking et al. 2013) in the epiphytic growth habit, the rather large thallus composed of several lobes, and the concentric lines of irregular tomentum. The two species are, however, only distantly related, each falling into one of the two major *Cora* clades (Lücking et al. 2014). A closer relative of *C. barbulata* is the terrestrial *C. arachnoidea* J. E. Hern. & Lücking (Fig. 128a–c), which is grey-brown when fresh and uniformly thinly tomentose on the upper surface (Lücking et al. 2013). *Cora barbulata* can be distinguished from *C. aspera* mainly by the coarsely crenulate, undulate lobe margins and the different hymenophore, forming large, irregularly dispersed patches on the underside.

217. ***Dictyonema gomezianum*** Lücking, Dal-Forno & Lawrey, ***sp. nov.***

Index Fungorum number: IF551502; *Facesoffungi number*: FoF01050; Fig. 131d–f

Etymology: Dedicated to the late Dr. Luis Diego Gómez, prominent Costa Rican botanist, naturalist, and conservationist and long-time director of Las Cruces Biological Station.

Holotype: R. Lücking 18053 (CR).

Diagnosis: Differing from the morphologically similar and related *Dictyonema metallicum* in the narrower cyanobacterial filaments with more or less paraplectenchymatous hyphal sheath and the very narrow associated hyphae.

Thallus epiphytic on tree trunks and overgrowing nearby bryophytes, appressed filamentous, continuous, up to 5 cm across, forming a strongly compressed mat of horizontal, densely interwoven, dark aeruginous fibrils almost completely embedded in a gelatinous matrix with metallic shimmer, except for a broad, white, opaque, byssoid prothallus; thallus in section 50–100 μm thick, composed of an irregular photobiont layer and an irregular medulla or hypothallus. Photobiont *Rhizonema*, in a layer composed of numerous cyanobacterial filaments wrapped in a closed hyphal sheath formed by small, paraplectenchymatous or indistinctly jigsaw puzzle-shaped cells; cyanobacterial filaments composed of 7–9 μm wide and 3–5 μm high, dark aeruginous cells penetrated by tubular fungal hyphae; heterocytes sparse, yellowish, 6–10 μm wide and 2–4 μm high; cells of hyphal sheath angular to slightly wavy in lateral outline, 1.5–2 μm thick; hyphae associated with hyphal sheath straight, 2–3 μm thick, lacking clamp connections; compacted prothallus mostly formed by densely arranged empty hyphal sheaths admixed with straight hyphae. *Hymenophore* not observed. *Secondary chemistry*: no substances detected by TLC.

Material examined: COSTA RICA, Puntarenas, Las Cruces Biological Station near San Vito de Coto Brus; 82° 58′ W, 08° 47′ N, 1200 m; lower montane rain forest zone, on ridge beyond Río Java, on trunk of tree in disturbed primary forest; October 2004, R. Lücking 18053 (CR **holotype**; F **isotype**).

Distribution and ecology: Known from lower montane rain forest in southern Costa Rica in the broader southern Central American Choco region.

Notes: *Dictyonema gomezianum* is similar and closely related to the recently described *D. metallicum* Lücking et al. (2013). Both share the strongly appressed, filamentous thallus in which the horizontally oriented fibrils are embedded in a gelatinous matrix that gives the thallus a strong metallic shimmer. While the phylogenetic distance between *D. metallicum* and its sister species, *D. gomezianum*, is considerable (Dal-Forno et al., in prep.), the morphological differences are minor: *D. metallicum* has a thinner thallus with indistinct medulla, the cyanobacterial filaments are broader (likely influenced by the fungus which produces a sheath with more distinctly puzzle-shaped cells), and particularly the associated fungal hyphae are thicker (4–6 μm).

Inocybaceae Jülich

The family *Inocybaceae* is a monophyletic lineage within *Agaricales*. It is species rich and has a worldwide distribution. The species are small to medium sized with a brown spore deposit, and most species form ectomycorrhiza with a broad range of host trees and shrubs. Besides *Inocybe* the family today include *Tubariomyces* (Alvarado et al. 2010) and Auritella (Matheny and Bougher 2006).

Inocybe (Fr.) Fr. Monogr. Hymenomyc. Suec. (Upsaliae) 2(2): 346 (1863)

As currently circumscribed, *Inocybe* is a morphologically and genetically diverse genus. Molecular phylogenetic analyses suggest the genus can be divided in the four major lineages, Inocybe s.s, Pseudosperma, Inosperma and Mallocybe (Larsson et al. 2009; Ryberg et al. 2010), and the family *Inocybaceae* to be composed of at least seven evolutionary lineages (Matheny 2009; Matheny et al. 2009). However, the proposed taxonomical rearrangements have not yet been fully implemented.

The species in subgenus *Mallocybe* are frequently encountered in arctic/alpine, subalpine and boreal habitats (Cripps et al. 2010; Jacobsson and Larsson 2012). Many of the species are associated and forming ectomycorrhiza with dwarf and shrub *Salix* species. Morphology, ecology and comparison of sequence data, including ITS sequences of type specimens, support the recognition of a new species in subgenus *Mallocybe* from the northern boreal and subalpine regions of Scandinavia, associated with *Salix phyllicifolia* on more calcareous ground (Fig. 129).

218. ***Inocybe granulosa*** Jacobsson & E. Larss., ***sp. nov.***

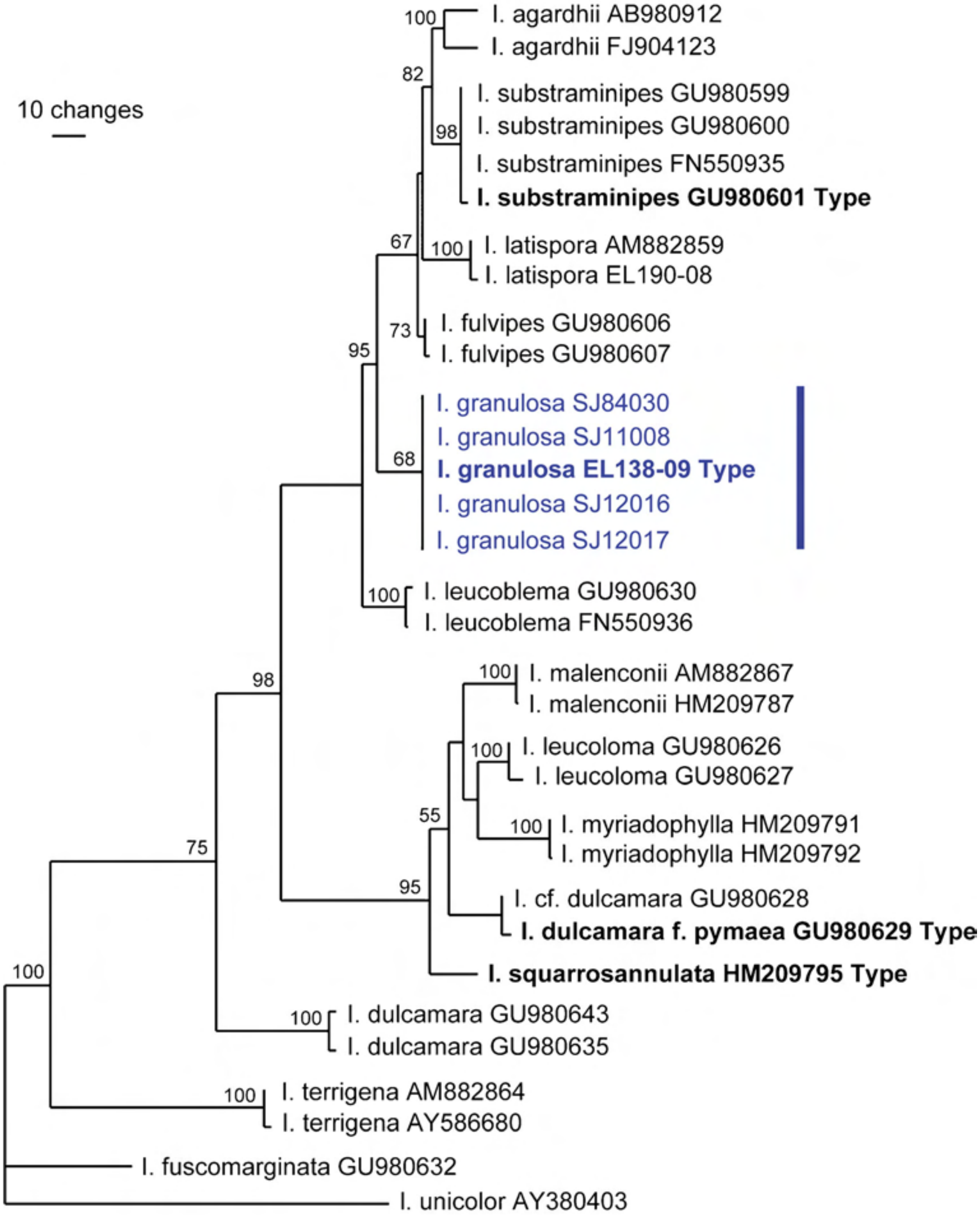
MycoBank number: MB 812048; *Facesoffungi number*: FoF00989; Figs. 130 and 131.

Etymology: Refers to the granular small scaly appearance of the stipe and pileus.

Holotype: SWEDEN, Jämtland, Berg, close to Lake Storsjön, 4 km N Svenstavik, 1 September 2009, E. Larsson 138-09 (Herbarium GB).

Pileus 10–32 mm diam., at first convex with an incurved margin, then expanded, when mature flat or frequently with

Fig. 129 Phylogram from the analysis of ITS and LSU rDNA sequence data (PAUP*, Version 4) showing the position of *Inocybe granulosa* in relation to closely related species in the subgenus *Mallocybe*. Bootstrap values are indicated on branches. Sequences of type specimens are in *bold*



somewhat depressed centre, not umbonate, at first pale yellowish, later becoming yellowish brown at least in the centre, covered by numerous small, floccose scales. The scales are often pointed and upraised at least in the centre, at first yellowish brown, sometimes but not always becoming dark brown with age. The scales often loosen and disappear at least partly in mature basidiomata. *Lamellae* normally distant, at first pale beige to yellowish, gradually rather dark greyish brown with a paler edge. *Stipe* 15–35 mm long, 2–4 (5) mm wide, equal or somewhat thicker towards the base, pale yellowish brown with a white base, with granular to floccose brownish scales similar to those on the cap. *Veil* beige sometimes forming a thin and evanescent annulus. *Flesh* pale, whitish without distinct smell, taste mild. *Basidia* clavate, 35–45 × 8–11 μm, 4-spored, sometimes with brownish necropigments. *Spores* (8–)9–12 × 5–7(−7.5) μm, *Q*=1.4–1.8, mostly ellipsoid and slightly phaseoliform in profile. *Cheilocystidia* numerous, more or less septate with a broadly clavate to almost globose end cells, 12–24 μm broad, thin walled, some with brownish necropigments, Fig. 3. *Pleurocystidia* absent. *Clamp-connections* present.

Habitat: On sandy roadsides or gravelly ground, often near mines or industrial sites, likely associated with *Salix phyllicifolia* but probably also with other *Salix* species. Likely favoured by calcareous ground.

Distribution: Found in upper boreal and subalpine zones in the western part of the provinces of Jämtland and Härjedalen, central Sweden and in adjacent parts of central Norway.

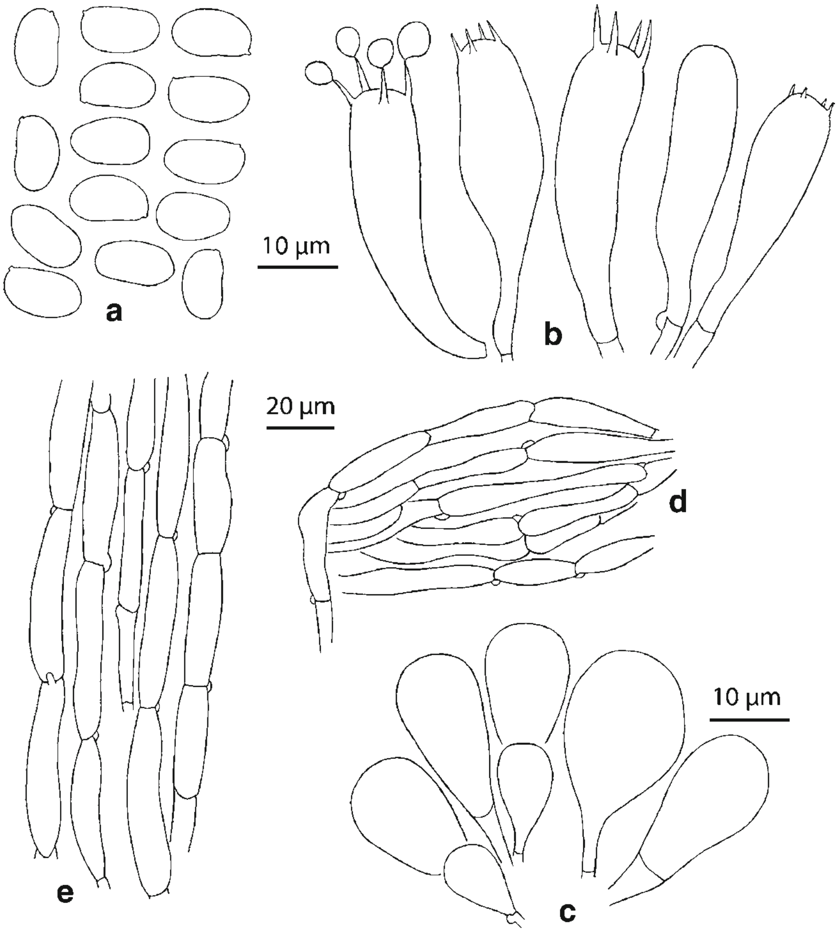
Fig. 130 Basidiomata of *Inocybe granulosa* (holotype)

Rather common and often abundant in its special habitat in central Scandinavia but so far not known outside this area.

Material examined: SWEDEN, Jämtland, Åre, Handöl, sandy road-side with *Salix*, 10 August 1984, S. Jacobsson 84030 (GB); Jämtland, Berg, N Svenstavik, resting-place, among *Salix phyllicifolia*, 1 September 2009, E. Larsson 138-09 (GB, **holotype**) (**Isotypus** TUR-A); the same locality 26 August 2011, S. Jacobsson 11007 (GB); Jämtland, Åre, Undersåker, Nulltjärnsgården, road-side with *Salix*, 27 August 2011, S. Jacobsson 11008 (GB); Härjedalen, Tännäs, Bruksvallarna, roadside with *Salix phyllicifolia* 2 July 2012, S. Jacobsson 12002 (GB). NORWAY, Hedmark, Folldal, on clinkers close to the mine, 23 August 2012, S. Jacobsson 12016 (GB); Oppdal, Dovre, Hjerkinn, roadside with *Salix phyllicifolia*, 20 August 2012, S. Jacobsson 12017 (GB).

Notes: Members of subgenus *Mallocybe* frequently occur in boreal, subalpine and arctic/alpine regions (Kühner 1988; Cripps et al. 2010). Several of these species may have more or less distinct scales on the pileus surface and some of them may possibly be mistaken for *Inocybe granulosa*. The most similar species in the literature is *I. squarrosoannulata* (originally described as *I. dulcamara* f. *squamosoannulata* by Favre 1955) encountered in alpine environments growing with dwarf *Salix*. It is depicted with distinct scales both on the pileus surface and the stipe (Bon 1997; Ferrari 2006), but the scales are coarser than in *I. granulosa* and arranged in garlands, somewhat similar to *I. terrigena* (Fr.) Kuyper. Comparison of ITS sequence data of the holotype (Fig. 1)

Fig. 131 Micro-morphological characters of *Inocybe granulosa* (holotype) **a** spores **b** basidia **c** cheilocystidia **d** hyphae of pileipellis **e** stipe surface hyphae



show that *I, squarrosoannulata* and *I. granulosa* are distinct species.

Another species about the same size and colour as *I. granulosa* and with similar habitats and ecology is *I. malenconii* Heim. However, the pileus is more finely scaly and the scales are absent or rare on the stipe. In micromorphology *I. malenconii* is easily separated from *I. granulosa* by having a narrowly cylindrical spore shape, more reminiscent of those of *I. lacera* (Fr.) P. Kumm. *Inocybe malenconii* was described from France (Heim 1931) and is widely distributed. It has been recorded several times in central Sweden and the Nordic countries, often found along roadsides (Jacobsson and Larsson 2012).

Inocybe granulosa is readily identified in the field and commonly encountered in a restricted part of central Scandinavia, but so far not known outside this region. Despite similarity in macro-morphology with *I. malenconii* and *I. squarrosoannulata* the phylogenetic analysis (Fig. 1) indicate *I. granulosa* to be more closely related to *I. agardhii* (Lund) P.D. Orton, *I. substraminipes* Kűhn. and *I. fulvipes* Kűhn., all growing associated with *Salix*.

Boletales

Boletaceae Chevall.

The family *Boletaceae* is characterized by species developing their spores in a tubular hymenophore on the underside of the pileus, although some species (e.g., those in the genus *Phylloporus* Quél.) show highly anastomosed lamellae and others exhibit a hypogeous behavior. *Boletaceae* species produce fleshy basidiomes, sometimes quite large, with a central stipe. The spore print colours vary from olivaceous-tobacco-brown to yellow, yellowish or vinaceous. In many species, flesh after wound or cut turns blue, as a result of the oxidation of pulvinic acid derivatives.

Singer (1986) included 26 genera in this family. Molecular phylogenetic studies of the 2000s have revised the concept of the family: Binder and Hibbett (2006) recognized 38 genera. Some changes in classification have moved some genera out of the *Boletaceae*; nevertheless, it remains a large family with many genera. According to the Kirk et al. 2008a, b, 35 genera are recognized; in the overall work of Wu et al. (2014), seven major clades at subfamily level and 59 generic lineages were uncovered, including 4 new subfamilies and 22 new potential generic clades (Fig. 132).

Xerocomellus Šutara, Czech Mycol. 60(1): 44 (2008)

The genus *Xerocomellus* was described by J. Šutara (2008) with *X. chrysenteron* (Bull.) Šutara as the type species. This genus, segregated from *Xerocomus*, included species characterized by a pileipellis arranged from the early stage in a characteristic palisadoderm of incrusted hyphae, and a spore surface which is never bacillate, but smooth or with specialized apex ("truncature") and/or longitudinally striate. As originally circumscribed, the genus included *X. armeniacus* (Quel.) Šutara, *X. engelii* (Hlavaček) Šutara (= *Xerocomus communis* (Bull.) Bon s. auct), *X. fennicus* (Harmaja) Šutara, *X. marekii* (Šutara & Skala) Šutara, *X. porosporus* (Imler ex Moreno & Bon) Šutara, *X. pruinatus* (Fr.) Šutara, *X. ripariellus* (Redeuilh) Šutara and *X. rubellus* (Krombh.) Šutara. *Xerocomus cisalpinus* (Simonini et al.) Klofac was included in the genus by Klofac (2011). In 2014, *Xerocomus dryophilus* was also included in this genus as *X. dryophilus* (Thiers) N. Siegel et al. (Frank 2014). Vizzini (2015) established for *Boletus rubellus* Krombh. (= *X. rubellus* (Krombh.) Šutara) the new genus *Hortiboletus* Simonini et al. and for *Xerocomus armeniacus*, as well as for the close *Xerocomus persicolor* H. Engel et al., the new genus *Rheubarbariboletus* Vizzini et al..

219. ***Xerocomellus sarnarii*** Simonini, Vizzini & Eberhardt, ***sp. nov.***

Index Fungorum number: IF551434; *Facesoffungi number*: FoF01047; Figs. 133 and 134

Etymology: dedicated to our friend Mauro Sarnari, who found this bolete at Monte Argentario.

Holotype: MCVE 28577

Colour terminology and alphanumeric codes are those of Kornerup and Wanscher (1978) and Seguy (1936).

Pileus 35–90 mm broad, fleshy, convex to pulvinate, rarely almost plane, also slightly depressed at the centre but conserving pulvinate shape; surface dry, tomentose-velutinous, soon cracking into scabs independently on weather conditions, with a subpellis very weakly and not always pink-reddish coloured, being this colour rarely visible in the fissures, sometimes only in the bites of the snails; surface variable in colour: in very young basidiomes with uncracked pileus dark brown with olive shade (6–7/F6–F4, 6/F8–F7), with fading patches (5/D5–D3), cracking into scabs and discolouring to ochre-beige with olive shade (4–5/D6–D3), passing through transition colours (5–6/D7–F4). Dull cream-whitish (3/4A2) cracks appear beneath the pileipellis layer in dry weather.

Tubes up to 5–10 mm long, separable, depressed to sinuate around the stipe, sometimes slightly decurrent, as high as the context of the pileus or even more; initially bright yellow with olive shades (1/2A7/8, 3A/B7/8), later dull greenish yellow (2C/D7/8, 3/4C/D6), bluing then darkening to blackish when bruised. *Pores* angular, uneven, in mature basidiomes 0.7–2 mm diam., concolourous to the tubes, slowly bluing (S351, 352, 366, 367) then darkening to blackish when bruised. *Stipe* 30–90 × 5–25 mm, cylindrical, slender, curved, somewhat tapering towards the base or also slightly widened. Surface dry, smooth to ingrown fibrillose, chrome yellow in the upper part, in the lower part and towards the base or partially or completely, sometimes abruptly, red, dark purple red or even blackish-red coloured (11–12/D8–F4). *Context* soft in

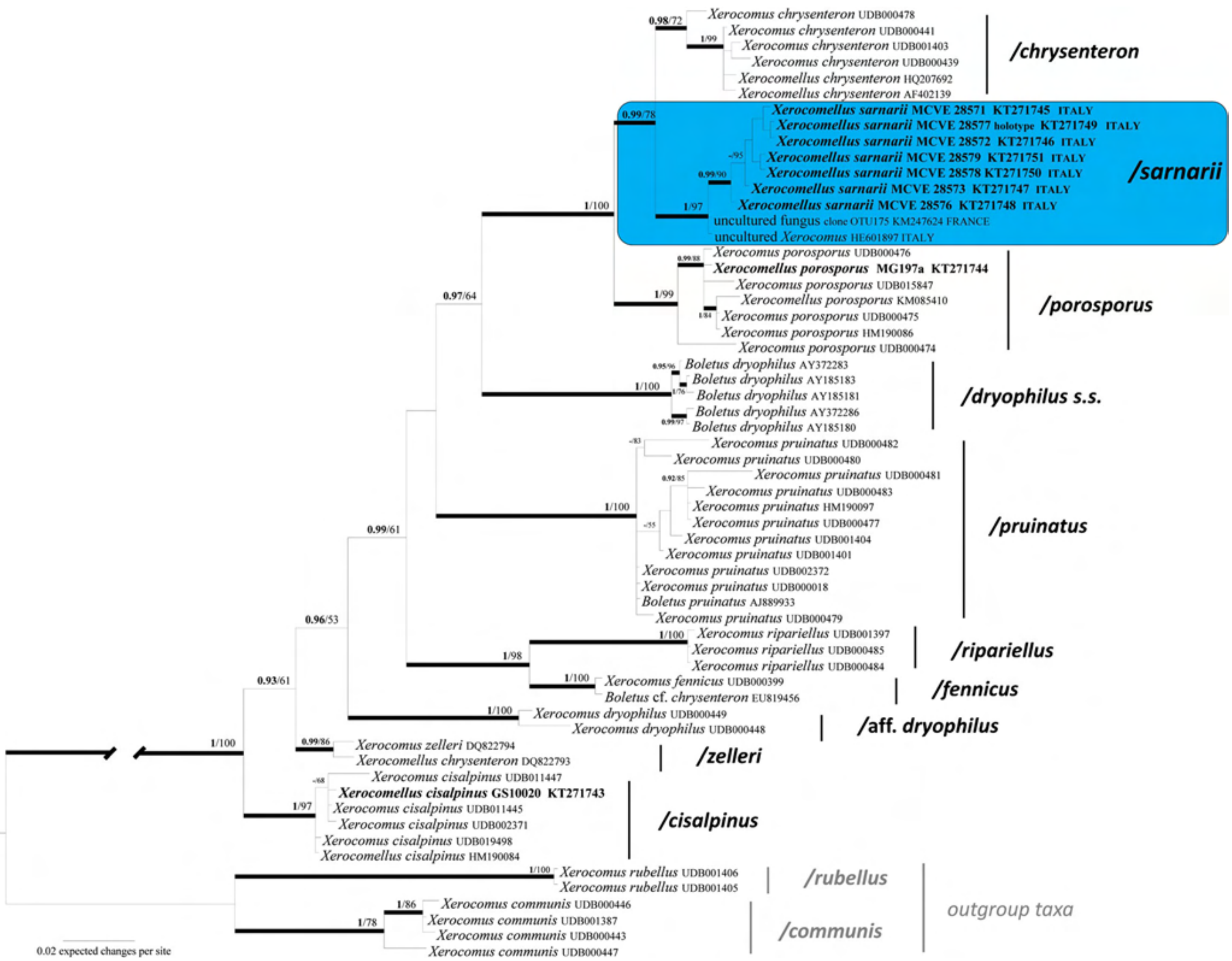


Fig. 132 Bayesian phylogram (MrBayes 3.2) of *Xerocomellus* species based on ITS sequence data. *Xerocomellus rubellus* and *X. communis* were used as outgroups. Bayesian posterior probabilities (BPP) above 0.90 and RAxML bootstrap values (MLB) above 50 % are shown. *Thickened lines* indicate both BPP≥0.95 and MLB≥70 %. Newly sequenced collections are in *bold*

the pileus, fibrillose and brittle in the stipe; in the pileus pale yellow (3A3) soon fading to dirty whitish when exposed (29/30A2), below the pileipellis sometimes showing a fine red line, often inconspicuous or really absent; in the stipe vivid yellow (3A4/5) or yellow with dull reddish tinges that are concolourous to the cortex (8 to 11C/D7/8), bluing (S446 to 448) in the whole pileus and in the stipe upper part when cut, with the dark purple red areas in the stipe base darkening, the stipe context at the extreme base dull ochre-brownish (S336 to 339); *smell* not distinctive, typical of the *Xerocomellus*, somewhat like wet iron; *taste* not distinctive, slightly sour. *Spore-print*: brownish with some olive tinges. *Macrochemical reactions*: weak fleeting-amyloid reaction in stipe context and hymenophoral trama of dry specimens. *Spores* (13.5) 13.8–15.1 (15.7)×(5.5) 5.5–6.1 (6.6) μm, Q=2.51±0.08, V=256±41 μm^3 (n=330/10/10), subfusiform, slender, with a weakly developed but distinct supra-apicular depression, spore wall up to 0.5 μm thick, intensely honey-coloured and with one or two guttules when mature, with a specialized spore apex ("truncature" faint and not always visible under the optical MS). *Basidia* 25–36×10–14 μm, inconspicuous, clavate, hyaline to yellowish, mainly 4-spored, not rarely 2-spored. *Pleurocystidia* scarce, 35–52×6–11 μm, fusiform or ventricose-fusiform, sometimes with a obtuse-rounded apex, resembling those of *Psathyrella barlae* (Bres.) A.H. Sm., with hyaline to slightly yellowish content. *Cheilocystidia* similar, but smaller, 22–32×4–10. In some of the specimens collected it was observed an abundance of *pseudocystidia* with a yellowish, refringent, oily content, reacting to dark blue with Cresyl blue. *Pileipellis* a palisadoderm strongly reminiscent of the pileipellis of *X. chrysenteron*, with long parallel chains of elements, terminal elements rarely wider than the basal ones, mostly cylindrical and somewhat tapering towards the apex, obtusely triangular, mitriform, also acorn-shaped to exceptionally subsphaerical, rarely papillate, (36.5) 36.2–38.2 (39.2)×(13.1) 13.3–15.9 (16.1) μm, Q=2.62±0.22 (n=99/3/

Fig. 133 *Xerocomellus sarnarii*. Basidiomes. **a** to **h** Coll. MCVE 28572, MCVE 28579, MCVE 28574, MCVE 28576, MCVE 28573, MCVE 28571, MCVE 28577 (holotype), MCVE 28578, respectively, from Sardinia, Calangianus (OT), basidiomes in all stages of development, under *Quercus suber*, in granitic acid soil **i** Coll. MCVE 18361, from M. Argentario (GR), Tuscany, Centre Italy, mature basidiome under *Quercus ilex*, in calcareous soil **j** Coll. MCVE 17797, from Sardinia, Cala Gonone (NU), mature basidiome under *Quercus ilex*, in calcareous soil. Scale bars: 10 mm

3), terminal and subterminal elements moderately to heavily incrusted, only exceptionally smooth. *Stipitipellis* consisting of loosely interwoven, 3–6 μm broad hyphae with hyaline to yellowish content. In the upper part of the stipe is present a well-developed *caulohymenium* with spore-forming caulobasidia and caulocystidia. *Stipe texture* formed of parallel running, hyaline, 2.5–5 μm broad hyphae; no "pruinatus-hyphae" in the lower part of the stipe are present (Ladurner and Pöder 2000). No clamp-connections observed.

Microchemical reactions: with the exception of the amyloid reacting hyphae in the stipe, no particular reproducible macrochemical reactions were observed.

Habitat and known distribution: *X. sarnarii* is a rare species, so far known only from Italy (Sardinia and Tuscany) and France (see notes), in Mediterranean areas under *Quercus suber* and *Quercus ilex*. This taxon seems to prefer climatically moderate zones and undisturbed habitats. The main fruiting period is late autumn (November).

Material examined: ITALY, Sardinia, Province of Olbia-Tempio Pausania, Common of Calangianus, along road SP 38 "Via S. Antonio", loc. Monti di La Jescia, "Cava Merzari", 40°56′21″N, 9°12′35″E, 425 m a.s.l., on granitic soil, under *Quercus suber*, mixed with *Xerocomus cisalpinus*, 10 November 2011, leg. G. Simonini (MCVE 28577, **holotype**), (GS

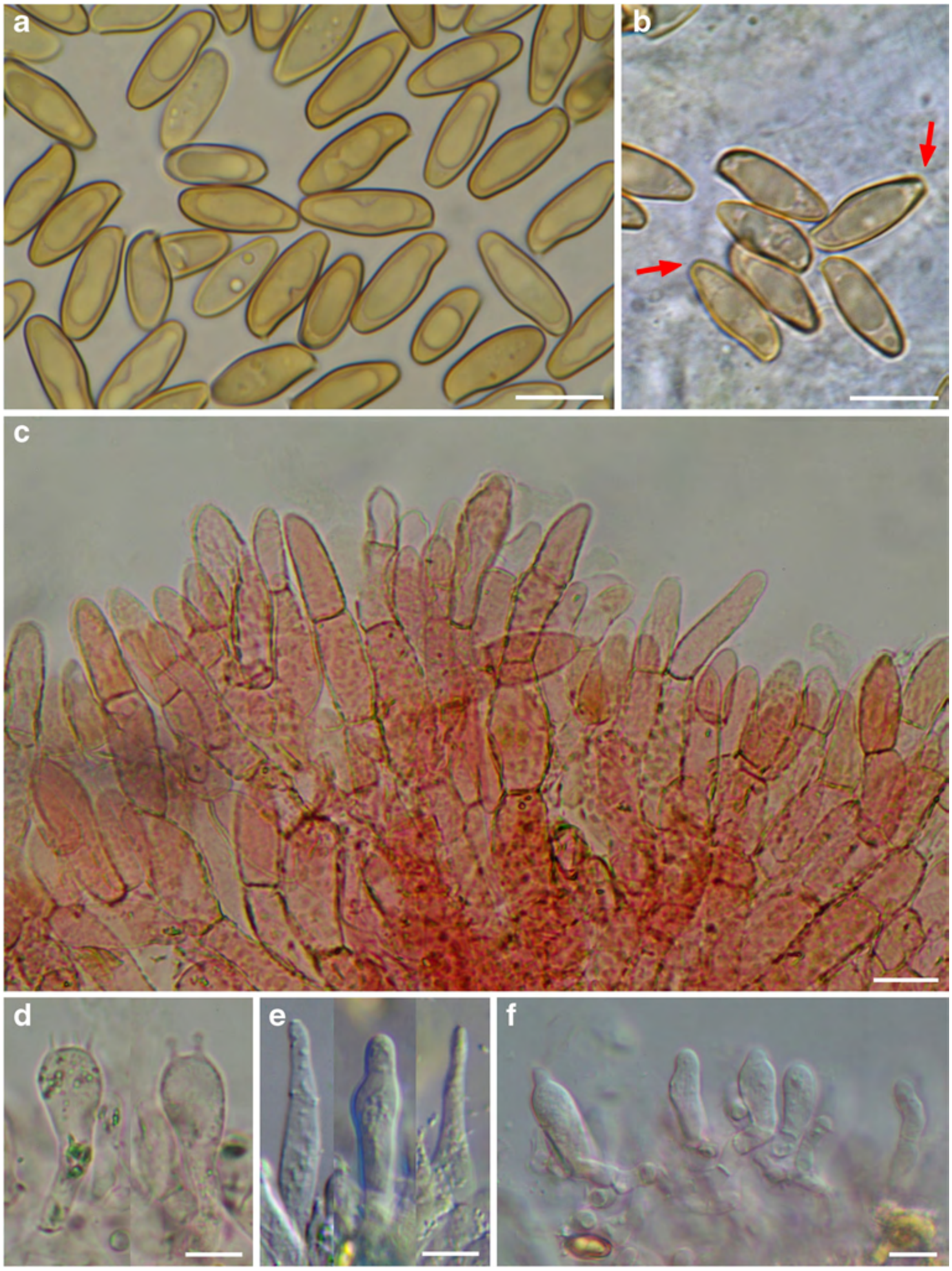


Fig. 134 *Xerocomellus sarnarii* Microscopic features **a** Spores, in L4, coll MCVE 28572 **b** Spores, in L4, coll. MCVE 28576, the *arrows* indicate the specialized apex (small "truncature") **c** Pileipellis, in L4 + ammoniacal Congo red, coll. MCVE 28572 **d** Basidia, in L4, coll. MCVE 28572 **e** Pleurocystidia, in L4, in interferential phase contrast, coll. MCVE 28572 **f** Cheilocystidia, in L4, with interferential phase contrast, coll. GS 10151. Scale bars: = 10 μm

10025, **isotype**); same locality and date of the typus, MCVE 28571, MCVE 28572, MCVE 28573, MCVE 28576, MCVE 28578, MCVE 28579; Sardinia, NU, Dorgali, Cala Gonone, "Via dei Lecci", 40°16′25″ N, 9°36′37″ E, 230 m a.s.l., on calcareous soil, under *Quercus ilex*, 7 November 1994, leg. G. Redeuilh (MCVE 17797); Tuscany, GR, Monte Argentario, "Via Acquedotto Leopoldino", 42°24′53″N, 11°10′1″E, 185 m a.s.l., on calcareous soil, under *Quercus ilex*, 1 November 1998, leg. M. Sarnari (MCVE 18361).

Additional material examined. Xerocomellus cisalpinus: ITALY, Sardinia, Province of Olbia-Tempio Pausania, Common of Calangianus, along road SP 38 "Via S. Antonio", loc. Monti di La Jescia, "Cava Merzari", 40°56′21″N, 9°12′35″E, 425 m a.s.l., on granitic soil, under *Quercus suber*, mixed with *Xerocomellus sarnarii*, 10 November 2011, leg. G. Simonini (GS10020). *Xerocomellus porosporus*: ITALY, Latium, Manziana (RM), 320 m a.s.l., under *Quercus cerris* in acid soil, 20 June 2009, legit. M. Gelardi and V. Migliozzi (MG197a).

Notes: Both Bayesian and Maximum likelihood analyses produced the same topology; therefore, only the Bayesian tree with both BPP and MLB values is shown (Fig. 132). In the ITS sequence analysis the 7 sequenced collections of *X. sarnarii* form a well-supported clade / *sarnarii*, (BPP=1, MLB=97 %), together with two environmental sequences (uncultured fungus clone OTU175 KM247624 from ectomycorhiza of *Quercus ilex*, Pézilla-de-Conflent, southern France, and uncultured *Xerocomus* HE601897 from ectomycorrhizal mantle of *Quercus ilex*, Sardinia, Italy). As the sequences of this clade show a high ITS sequence homology (pairwise % identity value=99.4), *X. sarnarii* seems present also in France. The *X. sarnarii* clade is sister (BPP=99, MLB=78 %) to *X. chrysenteron*.

As with the other *Xerocomellus* species, *X. sarnarii* is difficult to be recognized in the field based only on its macromorphological features.

At a first glance, the brownish cracked pileus with the pallid context showing through, recalls *X. porosporus*, but the vivid purple-red stipe base is disconcerting. In young specimens, or specimens in which the pileus surface does not crack clearly, the confusion with *X. redeuilhii* nom. prov. (Taylor et al. 2012 = *X. dryophilus sensu* Simonini 1994, and indicated in Fig. 1 as *X.* aff. *dryophilus*) is possible, due to the two-coloured stipe cortex, chrome yellow in the upper part and abruptly dark red in the lower part, very close to that of *X. redeuilhii*. (Fig. 1a–j); moreover, some collections of *X. redeuilhii* may also have occasionally a brown pileus. The spores of the two boletes are however, clearly different mainly in Q ratio: *Q*=2.1–2.4 for *X. redeuilhii* and *Q*=2.4–2.6 for *X. sarnarii*. In its most typical appearance, because of its obvious cracked pileus surface, *X. sarnarii* is somewhat similar to *X. chrysenteron* (Bull.) Šutara, *X. cisalpinus* (Simonini et al.) Klofac, and *X. porosporus* (Imler ex Bon & G. Moreno) Šutara (= *Boletus marekii* Šutara et Skála, unpublished data); moreover, all these boletes have a similar pileipellis structure, with long chains of parallel, incrusted elements (Ladurner and Simonini 2003). Nevertheless, *X. sarnarii* can easily be distinguished from these species based on its spore features: the smooth spores with the characteristic specialized apex, showing a hardly detectable, small "truncation" are typical for *X. sarnarii*, and are different from both those of *X. chrysenteron* (without any truncation), *X. cisalpinus* (with no truncation and faintly but clearly longitudinally striate) and *X. porosporus* (smooth, but with a much more evident truncation) (Ladurner and Simonini 2003; Šutara 2008). In addition, the spores of *X. sarnarii* are significantly broader (5.5–6.1 μm) than those of both *X. chrysenteron* (4.7–5.4 μm) and *X. cisalpinus* (4.6–5 μm). However, *X. porosporus* has spores as broad (5.6–6.4 μm) as *X. sarnarii* (Supplementary Table 4).

Xerocomellus truncatus (Singer et al.) Klofac (2011), based on *Xerocomus truncatus* Singer et al. (1960), is a North American taxon that shares with *X. sarnarii* the general appearance, with the tendency of the pileus surface to crack and the stipe having also red areas. It differs for "*the* (pileus) *cracks pinkish-purple or rarely with the pallid flesh showing through*", while the context among pileus cracks of *X. sarnarii* is, oppositely, whitish pallid and very rarely pinkish; the context "*in the central portion of the stipe red*", while in *X. sarnarii* the red colour is concentrated in the lower half or the bottom; the spores "*with a truncate-applanate apex which is thicker-walled at the two apical angles and often with markedly thinned wall between these angles*, *there also frequently depressed to umbilicate-depressed*, *a minority with the apex merely rounded*", while in *X. sarnarii* the spores apex is only faintly truncate, and in the most of the cases the truncation is not clearly perceptible at the optical MS. In the later illustration by Snell and Dick (1970, pl. 79 Fig. 5), the truncature is really wide and sharply angled in the spore adaxial profile, with an estimable width on the drawing=3 μm; the spores profile of *X. sarnarii*, is quite different, with a truncation that is hardly perceptible, having an estimable width=1 μm.

Cantharellales

Cantharellus Adans. ex Fr., Syst. mycol. (Lundae) 1: 316 (1821)

Madagascar is extremely rich in chanterelles (Buyck 2008, 2012, 2014, Buyck et al. 2014, 2015; Buyck and Randrianjohany 2013; Liu et al. 2015) with many species showing very close relationships to mainland African taxa. In the following section we describe four new chanterelles that are associated with imported eucalypts in Madagascar, but are clearly sister-species to other African or Malagasy chanterelles (Fig. 135).

220. ***Cantharellus eucalyptorum*** Buyck, Randrianjohany & V. Hofstetter, ***sp. nov.***

MycoBank: MB 813239; *Facesoffungi number*: FoF00990; Figs. 136 and 140

Etymology: refers to its association with *Eucalyptus robusta*.

Diagnosis: Differs from the Malagasy *C. tricolor* principally by the much paler gill folds, and genetically by its closer relationship to *C. tanzanicus*.

Holotype: MADAGASCAR, Central Highlands, 25 km before reaching Antananarivo when returning from Andasibe, collected under *E. robusta* in hills along the RN2 before reaching the village of Ambanitsena, 6 February 2006, Buyck & V. Hofstetter 06.159 (PC0085037).

Cap mostly 25-45(−60) mm diam., regular or with uneven, waving or undulating lobes, when young with strongly incurved margin becoming even or uplifted when old with a sunken center to strongly infundibiliformous; surface when young tomentose-granulose to pubescent, with age usually fragmenting in larger, appressed and concentrically arranged squamules, when wet smooth to velvety, colours varying from cream or ochre (3A2 to 4A3-5) to pale grayish brown (5C4) or even dull gray in the center. *Hymenophore* decurrent and not abruptly delimited from the sterile stipe surface, formed of

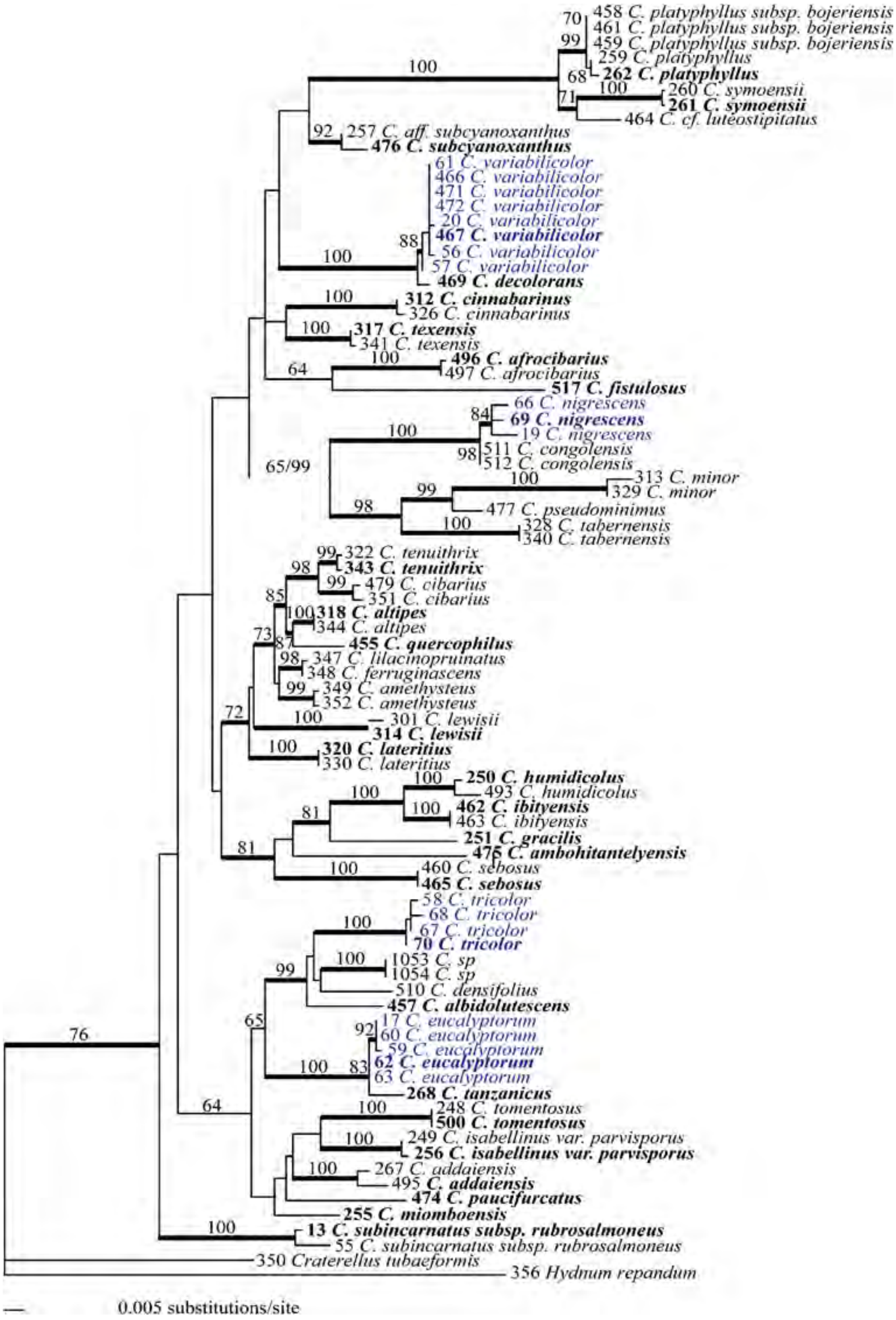


Fig. 135 Phylogram generated from maximum likelihood analysis based on tef-1 locus for 85 taxa. Branches that received bootstrap support ≥70 and BPP ≥95 % are in *bold* (ML/BPP). Only BS values are reported along the branches except for the branch in *bold grey* which is supported only by Bayesian analysis. The type strains are in bold and the new species are in *blue*. Sequence data used in this study have been taken from (Buyck et al. 2015)

well-developed gill folds, 2-4(6) mm high, starting out as very pale cream or off-white (at the most 3-4A2), but then developing pale yellowish tints (3-4A4) with age, forkings not abundant except closer to the cap margin, either completely smooth or frequently anastomosed in between gill folds. *Stipe* mostly distinctly shorter than the cap diam., more rarely quite slender and exceeding the cap diam., (3-)5-10 mm diam., and mostly (15)20-30(45) mm long, subcylindrical or slightly narrowing downwards, mostly off-white to creamish yellow and somewhat paler than the hymenophore, in the upper half often developing appressed squamae deposited in circular girdings, solid. **Flesh** firm and thick beneath the cap center, whitish, but showing distinct yellowing when cut or handled, particularly in the lower stipe half. *Taste* mild. *Smell* faint and

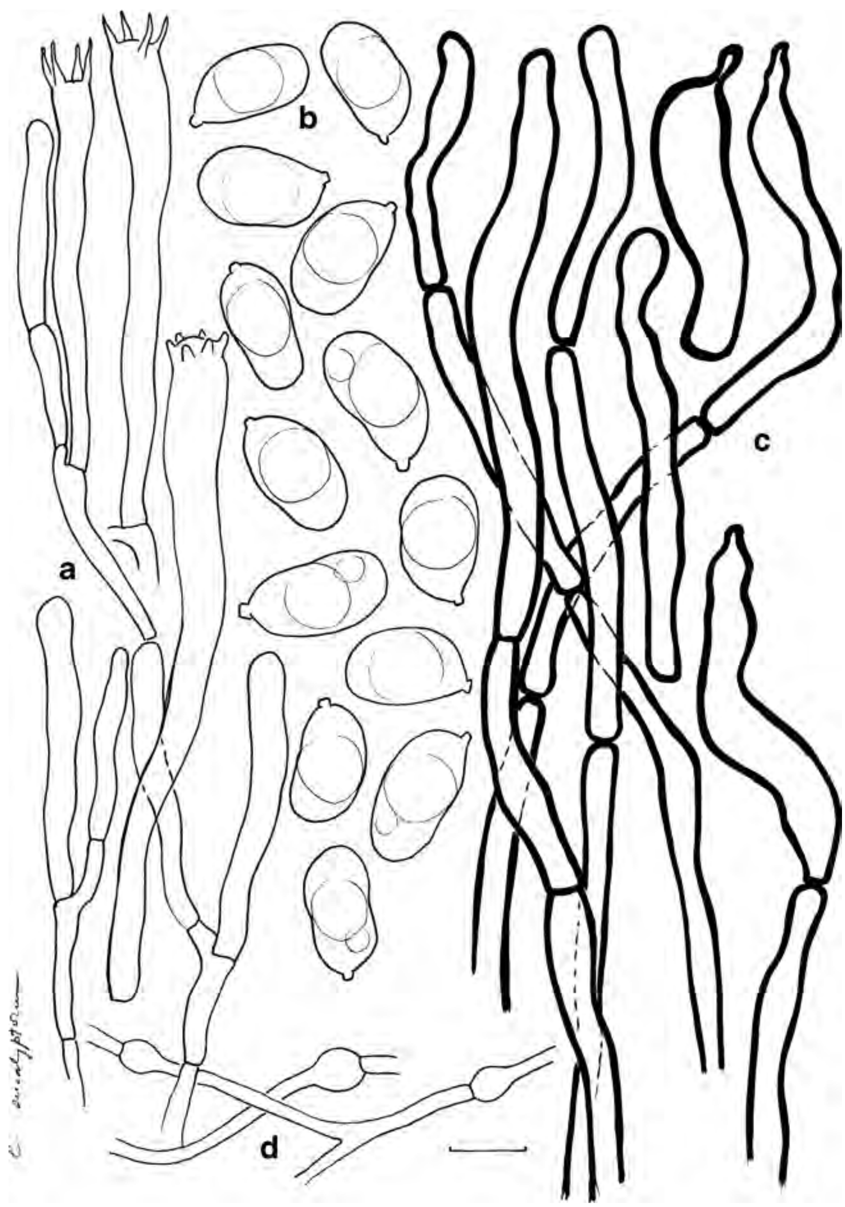


Fig. 136 *Cantharellus eucalyptorum* (holotype) **a** Spores. **b** Basidia, basidiola and subhymenial cells **c** Hyphal extremities of the pileipellis. Scale bars=10 µm, but only 5 µm for spores. Drawings B. Buyck

not very typical. *Spore print* probably pale yellowish, insufficient for a good appreciation.

Spores ellipsoid to narrowly ellipsoid, often slightly constricted in the central part and reniformous, measuring (7.5)7.8-8.33-8.8(9.4)×(4.2)4.5-4.91-5.3(5.4) µm, *Q*=(1.5)1.6-1.71-1.8(1.9), neither amyloid nor cyanophilous, smooth, containing mostly a distinct, large oil drop. *Basidia* quite long and slender, mostly 50-70(−85)×5–7 µm, clavate, (2)4-5-spored. *Cystidia* absent. *Subhymenial cells* often long and slender, but often also wider than the basal part of the basidia. *Lamellar trama* comprised of predominantly narrow and slender elements, sometimes as thin as 1 µm diam., some being inflated towards the septa on one side. *Pileipellis* with thick-walled (up to 1 µm), flexuous hyphal extremities, ca 4–9 µm wide, that often adhere together forming tufts or short, coiled, rhizoid-like structures, falling easily apart into smaller fragments when squashed, very frequently giving the impression that cells narrow abruptly near the septa and only stick together in the more central part of the septum; most cells slender and narrowly cylindrical; the terminal cell mostly 30–60 µm long, more often slightly inflated, clavate, fusoid or irregularly undulate in outline, near the tip obtuse-rounded or frequently constricted and papillate to subcapitate. *Clamp connections* absent from all tissues.

Material examined: MADAGASCAR, Central Highlands, Arivonimamo, under eucalypts, on lateritic soil at 1400 m alt., 30 January 1997, Buyck, Eyssartier & Moreau leg., in Buyck 97.078 (PC0084828), ibid., 30 January 1996, Buyck 96.543 (PC0084830); near Andasibe, under *Eucalyptus*, 12 February 1997, Buyck, Eyssartier & Moreau leg., in Buyck 97.406

(PC0084829); 25 km before reaching Antananarivo when returning from Andasibe, bought from vendors along the RN2 before reaching the village of Ambanitsena, 28 February 2000, Buyck 00.1828 (PC0085036); ibid. 4 February 2006, Buyck & V. Hofstetter V. 06.148 (PC0084127), 06.149 (PC0084128); ibid., collected under eucalypts, 6 February 2006, Buyck & V. Hofstetter 06.153 (PC0084112), 06.159 (PC0085037), 06.165 (PC0084789).

Notes: *Cantharellus eucalyptorum* is very closely related to the mainland African *C. tanzanicus* and we hesitated at first to describe it as a different species since our phylogeny (Fig. 135) shows no support to distinguish the two taxa, mainly due to the fact that *C. tanzanicus* is still known from a single collection. When taking a closer look at the sequences, the Malagasy specimens represent without any doubt a clearly different species. The 92 % BS that supports the distinction between a subclade formed by three specimens of *C. eucalyptorum* versus the grouping of the remaining two specimens together with *C. tanzanicus*, is based on a single mutation (Fig. 135). However, the latter species differs from all six Malagasy specimens by four apomorphies in the coding part of the tef-1 sequences, and two additional mutations in the introns, which is far more than the number of apomorphies that support for example in subgenus *Cantharellus* the distinction between the North American *C. tenuithrix*, *C. flavus* and *C. phasmatis* (Foltz et al. 2013).

Morphological characters that may help to distinguish *C. eucalyptorum* from *C. tanzanicus* are the slightly more voluminous spores, more pronounced filamentous subhymenium and somewhat longer basidia of the Malagasy species. Such differences, however, would need to be confirmed by comparing more collections. Judging from their general appearance, the specimens depicted and described in Härkönen et al. (2003, as *C. isabellinus*), most likely correspond to our *C. tanzanicus* and they share superposable spore sizes with the holotype of the latter [7.5–9 × 3.5–4.5 versus (7.3)7.9–*8.4*–8.9(9.2) × (3.7)3.8–*4.1*–4.4(4.6) µm], which suggests that the smaller and more cylindrical spores of *C. tanzanicus* might represent a reliable distinction. Spore measurements of other collections for *C. eucalyptorum* confirm those obtained for the holotype:

97.078/ (6.75)7-7.71-8.5(9) × (4.25)4.5-4.94-5.5(6) µm Q=(1.3)1.4-1.57-1.7(1.8)
96.543/ 7–7.37-7.7(8) × (4.5)4.8-5.17-5.5(6) Q=(1.3)1.5-1.67-1.7
96.550/ (6.5)7.3-83-8.7(9.5) × (4)4.5-5.00-5.5(6) Q=(1.1)1.4-1.62-1.8(2.1)
Holotype/ (7.5)7.8-8.33-8.8(9.4) × (4.2)4.5-4.91-5.3(5.4) µm, Q=(1.5)1.6-1.71-1.8(1.9)

This fleshy and very variable chanterelle is locally abundant under *E. robusta* plantations on the Central Plateau of Madagascar and is frequently offered for sale along roads and in market places. It is often sold as 'girolle', the common name in France for *C. cibarius* Fr.:Fr., of which it has the general habit, but not the yellow colour. It differs from this European species most markedly in the white, but distinctly yellowing flesh, particularly so in the stipe and, of course, in the grayish brown, fibrillose to cottony surface of the cap and to a lesser degree, also of the stipe. This type of surface is typical for many species in subgenus *Rubrinus* sect. *Isabellinus* (see Buyck et al. 2014), but can be quite variable in its appearance and development. This variability contributes a lot to the sometimes important differences in general aspect of these species. Typically smooth and continuous when young, at least in the cap center, this type of surface tissue frequently breaks up at maturity into concentric rings or into appressed to sometimes even dressed squamules that are more or less concentrically arranged. A similar pattern may be observed on the stipe surface with darker squamules in more or less horizontal arrangements circling the stipe, although the squamae are usually much less pronounced compared to the cap.

The cap colour can vary from pale yellowish to quite dark brown or locally almost blackish gray when fresh and humid, but turns to an isabelline or dirty white or creamish colour when dry. The hymenophore is typically composed of gill-like folds that can be mixed with smaller lamellulae or forked to varying degrees; in some cases more strongly anastomosing, veined types of hymenophore can be observed. The colour of the hymenophore is typically very pale, sometimes nearly white when young, but then develops pale yellowish tinges with age, which distinguishes this species from *C. albidolutescens*, another very similar, usually somewhat paler chanterelle with intensively yellowing context.

221. ***Cantharellus nigrescens*** Buyck, Randrianjohany & V. Hofstetter, ***sp. nov.***

MycoBank: MB 813240; *Facesoffungi number*: FoF00991; Figs. 137 and 140

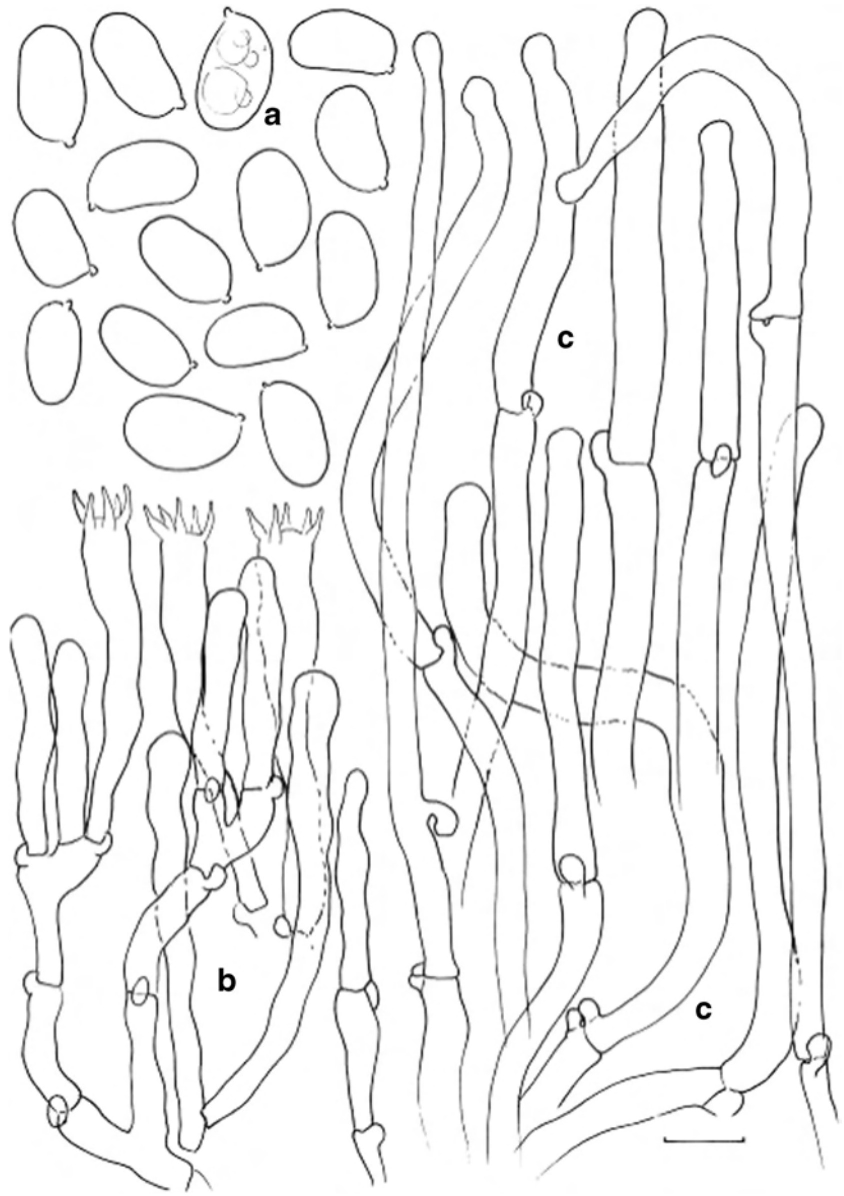
Etymology: the name refers to the rapidly blackening basidiomata

Diagnosis: Can be distinguished from *C. congolensis* by its more robust stature and frequently fasciculate growth, as well as by its association with *Eucalyptus robusta*.

Holotype: MADAGASCAR, Talatanivolonondry, in *E. robusta* plantations along the road to Anzojorobe, 10 February 2006, Buyck & V. Hofstetter 06.197 (PC0084076).

Cap up to 15 cm or more, when young very pale, cream to pale yellowish brown or even whitish when remaining covered by dead leaves or other detritus, with appressed, grayish-brownish squamules which become less visible when the cap is expanding, rapidly turning to reddish brown or blackish brown, and finally black. *Hymenophore* strongly decurrent

Fig. 137 *Cantharellus nigrescens* (holotype) **a** Spores **b** Basidia, basidiola and subhymenial cells **c** Hyphal extremities of the pileipellis. Scale bars=10 µm, but only 5 µm for spores. Drawings B. Buyck



and well delimited, irregularly and strongly veined-sinuate as well as anastomosing as to almost forming pores, up to 3 mm high, with obtuse edges, pale grayish or isabelline, then turning mouse gray and finally blackish gray to black in an unregular pattern. *Stipe* short and robust, mostly 20–30×10–20 mm, subcylindrical or slightly narrowing upwards or even ventricose when young, dirty cream or even pure white when young, quickly staining brown or gray and finally blackening with handling or age, smooth, compact and firm. *Flesh* very firm and thick beneath the cap center, white to whitish with almost some greenish tinges toward the stipe base, rapidly turning to a dirty brownish gray and finally black when cut. *Taste* mild to even slightly bitter. *Smell* weak but typical, of apricot. *Spore print* with distinct yellowish tinges.

Spores ellipsoid, (6)6.5-6.98-7.5(8.1)×(3.7)4-4.35-4.7(4.8) µm, *Q*=(1.4)1.5-1.61-1.8(1.9), smooth, filled with one to numerous oily inclusions. *Basidia* mostly 50-65(74)×7-8(−9) µm, subcylindrical to weakly clavulate, often sinuate, (3-)5-6-spored; basidiola slender, subcylindrical, sinuate, becoming tardily clavate. *Subhymenium* filamentous, of slender, strongly septate, hyphal cells, 2-3(4) µm wide like the basidium base. *Cystidia* none. *Pileipellis* a loose cutis of ramifying, thin-walled hyphal extremities, measuring mostly 5-8(12) µm diam., terminal cells subcylindrical and hardly differentiated from the subapical ones, but often slightly constricted subterminally and subcapitate, all containing a brown diffuse pigment; no incrusting pigments observed at the surface but present in lower tissues. *Clamp connections* present everywhere.

Material examined: MADAGASCAR, Central Highlands, Andasibe, along road side with planted eucalypts, 17 February 1997, Buyck, Eyssartier & Moreau 97.547 (PC0084821), near Antananarivo, from *E. robusta* plantations, 6 February 2006, Buyck & V. Hofstetter 06.166 (PC0084979), 06.176 (PC0084078), Talatanivolonondry, in *E. robusta* plantations along the road to Anzojorobe, 10 February 2006, Buyck & V. Hofstetter 06.197 (PC0084076 holotype), 06.203 (PC0084980).

Notes: This chanterelle is one of the more common and abundantly fruiting species found in the *E. robusta* plantations of Madagascar's Central Highlands. On some occasions, it can literally cover the soil but it is not easily noticed because the pale to dirty or grayish brown cap colour is so similar to the fallen, dry eucalypt leaves lying around it. It is often found in important clusters, frequently more or less aggregated or in very tight groups sitting on mycelial mats. Microscopic examination of specimens collected from different places on the Central Plateau show a remarkable homogeneity among these specimens.

During the first years of our fungal inventory of Madagascar, we never saw it for sale, but more recently it is commonly found for sale around and in the capital Antananarivo, perhaps as a result of our collecting trips where people observed us filling baskets of this species. There appears to be no particular reason why local people did not eat this species other than the unappealing aspect and almost instant blackening tissues when cooked. In mainland Africa, the similar *C. congolensis* is a considered a mediocre edible (Beeli 1928; Buyck 1994; Härkönen et al. 2003). We have prepared and consumed it on several occasions without any further complications. Nevertheless, these blackening species appear to be chemically somewhat different from most other chanterelles as they exhibit remarkable macrochemical reactions: first greenish, then brick red and finally dirty brown with potassium, dark gray with silver nitrate, slowly dark olive green with iron sulfate and green with Guaiac (Eyssartier 2001).

Our phylogeny shows it to be very closely related to mainland African collections from miombo woodland that are traditionally identified as *C. congolensis* Beeli (e.g., Buyck et al. 2000), which is a species originally described from equatorial rain forest. Preliminary sequence data reveal that the blackening chanterelles represent more than just a single species with a large distribution in the whole of tropical Africa, and *C. nigrescens* is not conspecific with the Central African species of the original description (Buyck & Hofstetter unpubl.).

Cantharellus avellaneus Pat. is another Malagasy chanterelle possessing a mouse gray hymenophore, but is definitely a different taxon because of the very elongated spores (see discussion in Buyck et al. 2015). Additional spore measurements for other collections of *C. nigrescens* give very similar results compared to those made for the holotype:

06.203/ 7–7.65-8.25(9)×(4)4.5-4.75-5 µm Q=1.44-1.62-2
06.166/ (6.2)6.6-7.15-7.7(8.1)×(3.7)3.8-4.16-4.5(5) µm, Q=(1.5)1.6-1.72-1.8(2)
97.547/ (6)6.5-7.01-7.5(8)×4–4.31-4.75(5) µm Q=1.4-1.63-1.88
Holotype/ (6)6.5-6.98-7.5(8.1)×(3.7)4-4.35-4.7(4.8) µm, Q=(1.4)1.5-1.61-1.8(1.9)

222. ***Cantharellus tricolor*** Buyck, Randrianjohany & V. Hofstetter, ***sp. nov.***

MycoBank: MB 813241; *Facesoffungi number*: FoF00992; Figs. 138 and 140

Etymology: the name refers to the three contrasting colours resulting from the brown cap, white stipe and bright yellow hymenophore.

Diagnosis: Differs from *C. eucalyptorum* in its more bright yellow colour of the hymenophore, particularly when young, and its closer genetic relationship to *C. densifolius*.

Holotype: MADAGASCAR, Central Highlands, near Ranomafana, collected under *E. robusta* along the road, 18 February 2006, Buyck & V. Hofstetter 06.247 (PC0085151).

Cap mostly 25-45(−60) mm diam., regular or with uneven, waving or undulating lobes, when young with strongly incurved margin becoming even or uplifted when old with a sunken center to strongly infundibiliformous; surface when young mostly entirely cottony-tomentose to pubescent, with age usually disrupting in larger, appressed and concentrically arranged squamules, when wet smooth and sometimes almost velvety, colours varying from coffee-with-milk or the colour of milk chocolate, to more reddish or grayish hazelnut or cinnamon brown (5C3-4, 5B3, 4B2-3). *Hymenophore* decurrent, of well-developed, gill folds, 2-4(6) mm high, quite thin and often fissured over their entire height, a bright chrome to yellowish orange when young (more intensely yellow than 2-3A7), forkings not abundant and mostly close to the cap margin, varying from completely smooth to heavily anastomosed in between gills. *Stipe* mostly and sometimes distinctly shorter than the cap diam., more rarely quite slender and exceeding the cap diam., 8–17 mm diam., up to 30 (04) mm long, subcylindrical or slightly narrowing downwards, mostly white, but sometimes also tinged with chrome yellow or a diluted yellowish to cream over part or all of its surface, except for the extreme base which remains generally pure white, often developing similar squamae as the cap, but lower and solid. *Flesh* firm and thick beneath the cap center, white but yellowing near the surface or when handled. *Taste* mild. *Smell* faint and untypical. *Spore print* distinctly yellowish.

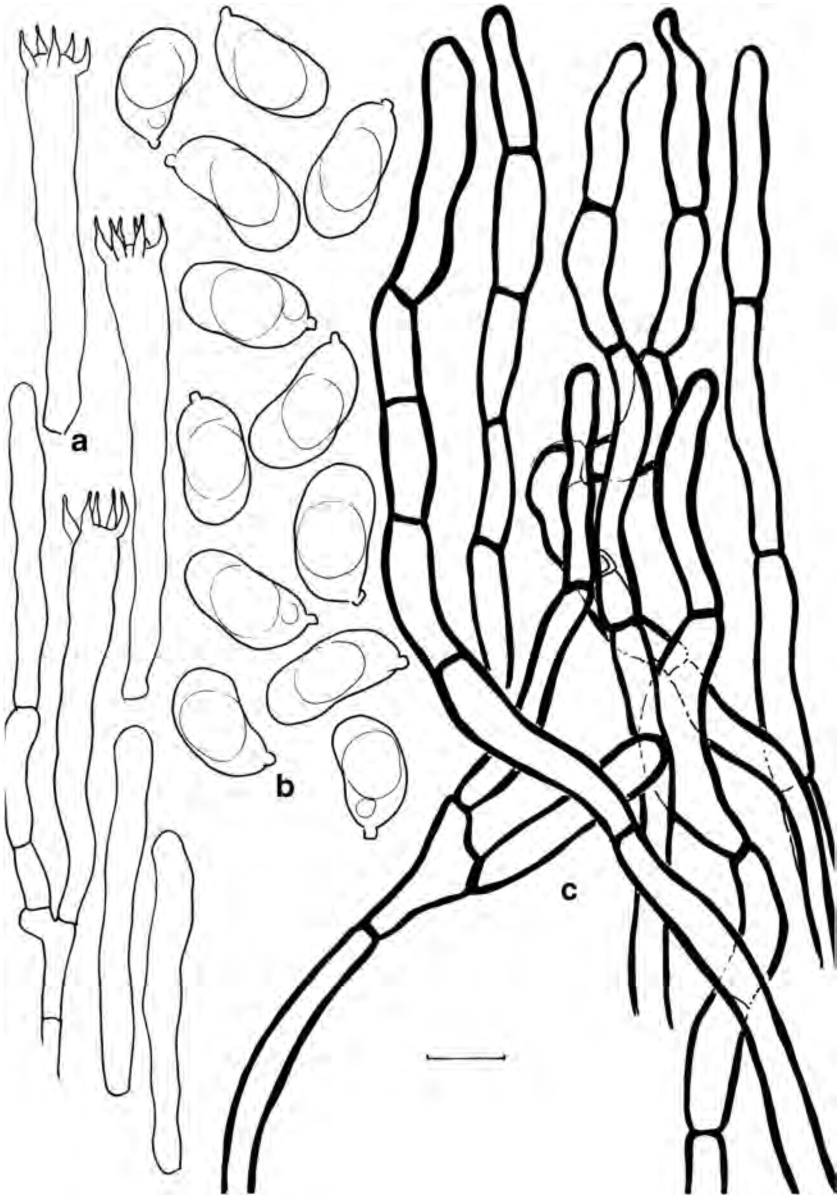


Fig. 138 *Cantharellus tricolor* (holotype) **a** Spores **b** Basidia, basidiola and subhymenial cells **c** Hyphal extremities of the pileipellis. Scale bars=10 µm, but only 5 µm for spores. Drawings B. Buyck

Spores ellipsoid, reniform to almost oblong or even cylindrical, l(7.3)8-8.31-8.7×(4.2)4.5-4.90-5.3(5.4) µm, *Q*=(1.3)1.5-1.71-1.9(2.1), smooth, filled with one large, oily inclusion. *Basidia* 50-60(65)×7–9 µm, subcylindrical to weakly clavulate, (4)5-6-spored and with 5–8 µm long sterigmata (longer for 2–3 spored basidia and also rather frequently deformed); basidiola not particularly irregular in form. *Subhymenium* filamentous, with cells of similar diam. as the basidium base. *Cystidia* none, however some specimens are completely sterile forming aborted basidia, resembling very irregular, cystidia-like cells in the hymenium. *Pileipellis* a loose (tricho)cutis of ramifying, thick-walled hyphal extremities, densely septate with up to 10 consecutive cells, sparsely branching, measuring mostly 4-6(9) µm diam. toward the cap margin often somewhat wider, terminal cells generally subcylindrical and regular, sometimes locally inflated or subapically constricted; pigment inclusions very apparent inside cells, strongly refringent. *Clamp connections* absent from all tissues.

Material examined: MADAGASCAR, Central Highlands, 24 km before reaching Antananarivo when returning from Andasibe, bought from vendors along the RN2 before reaching the village of Ambanitsena, 28 February 2000, Buyck 00.1827 (PC0085149); ibid., collected in Eucalypt plantations on lateritic soil, 4 February 2006, Buyck & V. Hofstetter 06.147 (PC0084110), *ibid.*, 7 February 2000, Buyck & V. Hofstetter 06.179 (PC0084129), 06.180 (PC0084130), 06.219 (PC0084827); near Ranomafana, collected under *E. robusta* 18 February 2006, Buyck & V. Hofstetter 06.247 (PC0085151); near Antananarivo, along RN7 direction Antsirabe, bought from vendors, 25 January 2008, Buyck & V. Hofstetter 08.159 (PC0085148), 08.163 (PC0085150); near Ambila Lemaitso, in littoral forest with *Uapaca littoralis*, *Sarcolaena* and *Leptolaena* spp. and *Asteropeia multiflora* on deep sandy soil, 29 June 2011, Buyck & V. Hofstetter 11.041(PC0085572).

Notes: This chanterelle is clearly a cryptic species that cannot be unequivocally distinguished from its twin *C. eucalyptorum* with morphological features unless specimens with very typical colour are compared. Under the microscope, *C. tricolor* has usually somewhat more densely septate hyphal extremities, as well as overall shorter basidia compared to *C. eucalyptorum*, but with more collections such differences may not hold up. Notwithstanding the morphological similarities, our phylogeny (Fig. 135) reveals that both species are not sister to each other, and that each one is more closely related to a different African mainland chanterelle: viz. the African *C. tanzanicus* is sister to *C. eucalyptorum*, whereas *C. tricolor* is closer to the African *C. densifolius* and the Malagasy *C. albidolutescens* as well as to another, still undescribed Malagasy chanterelle, both of which have a much paler, practically white hymenophore.

The two chanterelles grow side by side in exactly the same localities and are sold in mixtures, often after having been washed, which makes both species even more alike. On several occasions, we have tried without success to sort all specimens to the correct species when buying mixtures from merchants. We have observed this species also once in endemic vegetation, growing in the deep sandy soils of the littoral forest where we noted *Uapaca littoralis*, various *Sarcolaena* and *Leptolaena* spp. as well as *Asteropeia multiflora* as possible host trees. Nevertheless, we would not dare, in retrospect, to confirm with absolute certainty the complete absence of any *Eucalyptus* specimen in the surroundings. This east coast collection had a much paler cap than usual, also a more slender stipe, but shared the intensely yellow gill folds. Spore measurements of other collections of this species revealed a greater variability than for the other species here described:

00.1827/ (8.1)8.5-9.14-9.8 (10.4)×(4.2)4.5-4.86-5.2(5.4) µm, Q=(1.6)1.7-1.89-2.1(2.3)
Holotype/ 06.246 (7.3)8-8.31-8.7×(4.2)4.5-4.90-5.3(5.4) µm, Q=(1.3)1.5-1.71-1.9(2.1)
06.180/ (6.9)7.4-7.85-8.3(8.5)×(4.2)4.6-4.98-5.4(5.6) µm, Q=(1.3)1.4-1.59-1.7(2)

223. ***Cantharellus variabilicolor*** Buyck, Randrianjohany & V. Hofstetter, ***sp. nov.***

MycoBank: MB 813242; *Facesoffungi number*: FoF00993; Figs. 139 and 140

Diagnosis: Differs from the endemic *Cantharellus decolorans* and from the other reddish species in subgenus *Cinnabarinus* in its much more variable colour and its association with *E. robusta* in Madagascar.

Holotype: MADAGASCAR, Central Highlands, along the road 15 km before reaching Ranomafana, 31 January 2008, under *Eucalyptus robusta*, Buyck & V. Hofstetter 08.290 (PC0084806).

Cap small. 10–20 mm diam., thin, rapidly depressed in the center and finally often strongly infundibuliformous, mostly irregularly undulate, flexuous or even lobed but not striate near the margin; the surface dull, smooth, either pale pinkish red to light lilac pink or orange to almost deep yellowish in colour, hygrophanous and much paler when dry. *Hymenophore* strongly decurrent, composed of well differentiated gill folds, relatively thick, up to 2 mm high, forking and anastomosing in different degrees, concolourous or slightly paler than the cap. *Stipe* 10–20×1.5–2 mm, subcylindrical or slightly narrowing downwards, smooth or nearly so and concolourous with the cap, solid then narrowly fistulose. *Flesh* relatively thick in the cap center, but rapidly narrowing outward, concolourous and hygrophanous. *Taste* mild. *Smell* typical. *Spore print* very pale cream to off-white, insufficient for a correct appreciation of the colour, but a priori not yellowish.

Spores shortly ellipsoid to ellipsoid or slightly reniformous, measuring (7.1)7.6-8.08-8.6(9.2)×(4.2)4.5-4.81-5.2(5.4) µm, *Q*=(1.5)1.6-1.68-1.8(2), smooth, uni- to pluriguttulate. *Basidia* slender, poorly to distinctly clavate, (50)60-75(80)×(8.5)9-12 µm, (3)4-5(6)-spored; basidiola longtime subcylindrical. *Cystidia* none. *Subhymenium* filamentous but strongly septate, composed of rather short, inflated cells that are hardly wider than the basidium base. *Pileipellis* a thin and loose cutis of thin- to slightly thick-walled, fragile and easily collapsing hyphae measuring (5)7-14(17) µm diam., terminal cells subcylindrical to slightly fusiformous or clavulate. *Clamp connections* everywhere.

1826: (7)7.5-8.14-9×5–5.59-6(6.5) Q=1.33-1.46-1.56(1.75)
1825: (7.1)7.3-7.70-8(8.3)×(5)5.1-5.39-5.7(5.8) Q=1.3-1.43-1.5(1.6)
holotype: (7.1)7.6-8.08-8.6(9.2)×(4.2)4.5-4.81-5.2(5.4) µm, Q=(1.5)1.6-1.68-1.8(2)

Material examined: MADAGASCAR, Central Highlands, 25 km southeast of Antananarivo, along RN2 to Antsirabe, bought from road stall before reaching the village of Ambanitsena, 28 February 2000, Buyck & Randrianjohany 00.1826 (PC 0085152), 00.1825 (PC 0085153); along RN2 bought from road stall and said to have been collected under *E. robusta*, 4 February

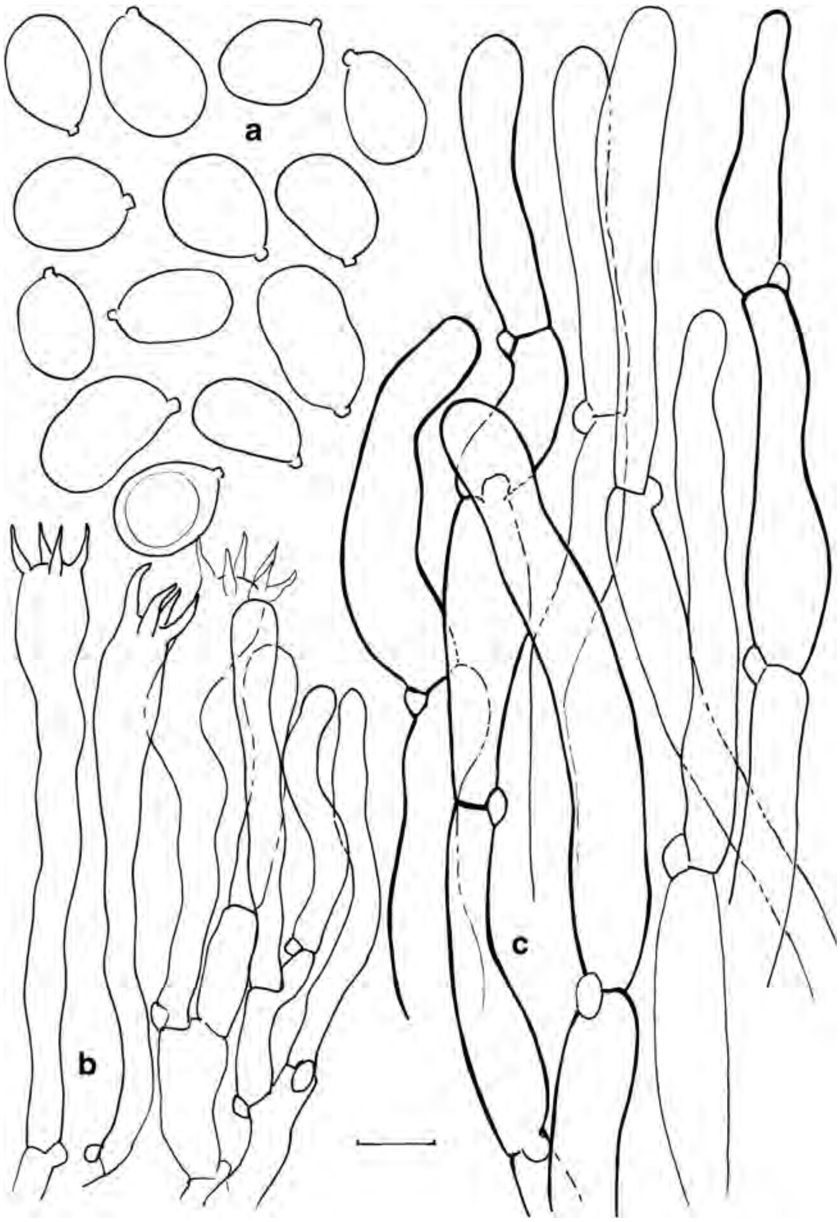


Fig. 139 *Cantharellus variabilicolor* (holotype) **a** Spores **b** Basidia, basidiola and subhymenial cells **c** Hyphal extremities of the pileipellis. Scale bars=10 μm, but only 5 μm for spores. Drawings B. Buyck

2006, Buyck & V. Hofstetter 06.145 (PC0084111), 06.146 (PC0084757); *ibid*., collected in young *E. robusta* plantation, 6 February 2006, Buyck & V. Hofstetter 06.151 (PC0124634), 06.168 (PC0124633); close to Ambohimasoa along the RN7 from Ambositra to Fianarantsoa, 1420 m alt., 29 January 2008, under *E. robusta*, Buyck & V. Hofstetter 08.243 (PC0084733), 08.260 (PC0084808), 08.261 (PC0085154); along the road 15 km before reaching Ranomafana, 31 January 2008, under *Eucalyptus robusta*, Buyck & V. Hofstetter 08.290 (PC0084806), 08.291 (PC0084807).

Notes: The most remarkable feature of this species is the variation in its overall colour which is frequently not pink but more lilac or sometimes even entirely yellowish orange (Fig. 140). The different colour forms of this species grow mixed in the same localities. The pinkish red colour forms are undistinguishable from another Malagasy species, *C. decolorans* Eyssart. & Buyck and our phylogeny (Fig. 135) resolves and supports it as the sister species of *C. variabilicolor*. (BS=88 %).

Our species differs from *C. decolorans* principally in its ecology, as it is found exclusively under introduced *Eucalyptus robusta* on the Central Plateau, whereas the latter chanterelle is only found growing with endemic species of the genus *Uapaca* (*U. densifolia* or *U. ferruginea*), mostly near mountain crests. Contrary to *C. decolorans*, which is too rare to be of any commercial value, *C. variabilicolor* is one of the

Fig. 140 General habit of the species **a**, **b** *Cantharellus eucalyptorum*, different aspects of the holotype collection, **c**, **e**, **g** *Cantharellus variabilicolor* aspects of colour variation: orange form (BB 06.174), yellow form (BB 06.175), pink form (BB 08.291), **d**, **f** *Cantharellus tricolor*, field aspect of east coast form (**d**, BB 11.041); field aspect of highland form (**f**, holotype); **h** *Cantharellus nigrescens* (BB 06.166). (photos B. Buyck)

chanterelles that is frequently offered for sale in road stalls and on market places during the rainy season It belongs in *Cantharellus* subg. *Cinnabarinus* Buyck & V. Hofstetter.

Athough *C. variabilicolor* is similar in the field to other small pinkish red species, such as the North American *C. cinnabarinus* and *C. texensis*, or the European *C. friesii*, there is no doubt that the Australian *C. concinnus* is quite its closest match outside Madagascar and both species are near identical in their overall morphology. Yet, on the basis of RPB2 sequences (Buyck & V. Hofstetter unpubl.), *C. concinnus* is genetically more distant, being closely related to the New Caledonian *C. garnieri* Ducousso & Eyssart. and *C. wellingtonensis* McNabb described from New Zealand. We were unfortunately unable to obtain *tef*-1 sequences for these species.

Corticiales

The order *Corticiales* contains a group of corticioid basidiomycetes with diverse ecology and trophic modes. Ghobad-Nejhad et al. (2010) made a first family arrangement for the order, and recognized three monophyletic families in *Corticiales*, viz., *Corticiaceae*, *Punctulariaceae*, and *Vuilleminiaceae*. In the recent study by Ghobad-Nejhad and Duhem (2014), a new genus *Dendrominia* Ghobad-Nejhad & Duhem was introduced in *Corticiales*. *Dendrominia* takes a basal position in *Corticiales* and is sister to the other three families mentioned above. A new family *Dendrominiaceae* is described to settle this genus (Fig. 141).

Cortinariaceae R. Heim

The limits of the family *Cortinariaceae* remain unknown, although most of the species are currently included in the genus *Cortinarius*. Many genera formerly placed in *Cortinariaceae* e.g., *Phaeocollybia*, *Hebeloma*, *Galerina*, and others have been moved to other families in the *Agaricales*. However, the sequestrate genera, *Thaxterogaster*, *Quadrispora*, *Protoglossum* and *Hymenogaster p.p.*, as well as *Cuphocybe*, *Rapacea* and *Rozites*, once thought to be genera in the *Cortinariaceae*, are currently included in the genus *Cortinarius* (Peintner et al. 2001, 2002). Species in this family range from agaricoid to sequestrate, many have well-developed veils, and they typically have brown, ornamented basidiospores.

Cortinarius (Pers.) Gray, Nat. Arr. Brit. Pl. (London) 1: 627 (1821)

Cortinarius is the largest genus of *Agaricales* with a cosmopolitan distribution and over 2000 described species. The species are important ectomycorrhizal fungi and are associated with different trees and shrubs, belonging to the families *Fagaceae*, *Salicaceae*, *Caesalpiniaceae*, *Cistaceae*, *Dipterocarpaceae*, *Myrtaceae*, *Rhamnaceae*, *Rosaceae* and *Pinaceae*, as well as some herbaceous plants in the *Cyperaceae* and *Polygonaceae*. Revealing the true diversity of species using only morphological and ecological characteristics has proven to be a difficult if not impossible task. The use of DNA sequence data has made it possible to elucidate phylogenetic relationships within the genus, show patterns of speciation, and uncover convergent and cryptic species. None the less there are many species still that remain to be undescribed.

224. ***Cortinarius alboamarescens*** Kytöv., Niskanen & Liimat. ***sp. nov.***

Index Fungorum number: IF551436; *Facesoffungi number*: FoF00996; Figs. 143a and 144a

Etymology: The name refers to the white colour of the basidiomata and the bitter taste.

Holotype: T. Niskanen 04-850, H6031311 (H).

Pileus 10–30 mm, conical to hemispherical, then low conical to low convex, white to very pale ochraceous white, viscid to somewhat glutinous, with hygrophanous streaks. *Lamellae* almost crowded, adnexed, very pale brown. *Stipe* 35–60 mm long, 3–5 mm thick at apex, 4–7 mm at base, somewhat clavate, often slightly rooting at base, white, viscid. *Universal veil* viscid. *Context* very pale yellow, marbled hygrophanous. *Odor* of flesh sweetish. *Taste* bitter at least of the pileus

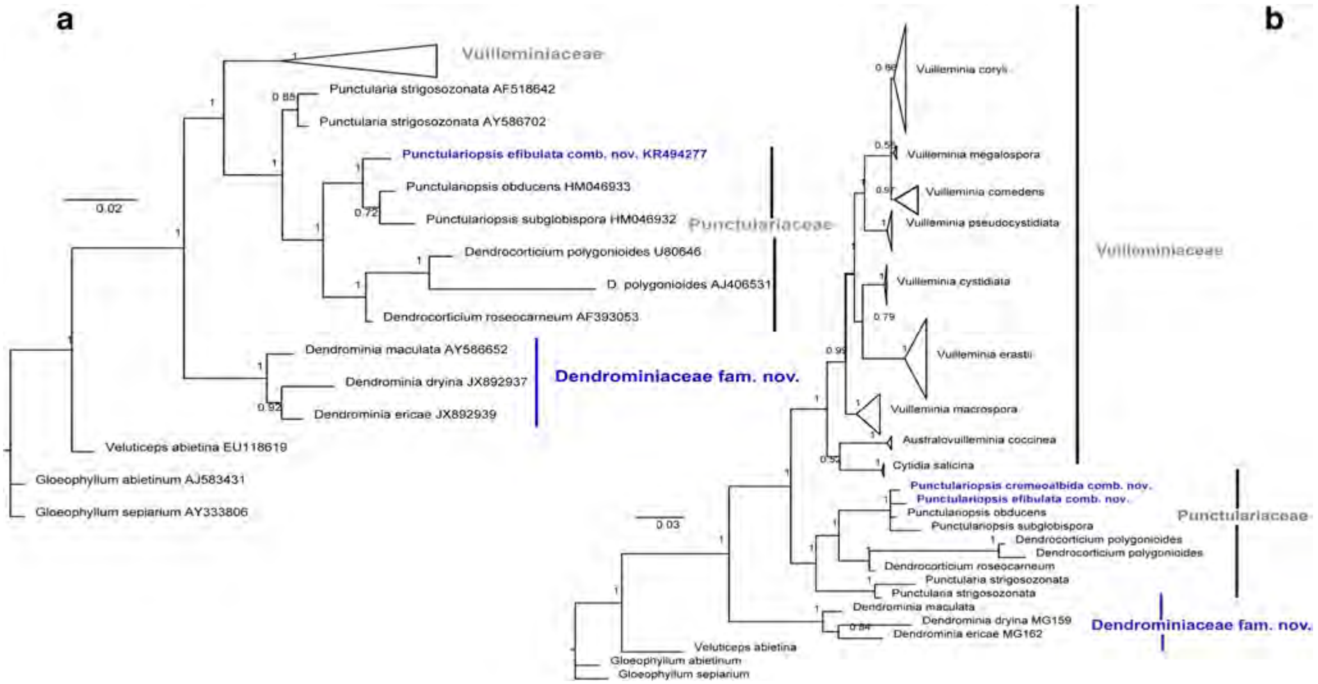


Fig. 141 Phylograms generated from Bayesian analyses **a** Tree from LSU dataset **b** Tree from combined ITS-LSU dataset. Phylograms show the position of *Dendrominiaceae* fam. nov., *Punctulariopsis cremeoalbida* comb. nov., and *P. efibulata* comb. nov. (*in blue*). Bayesian Posterior Probabilities are indicated above or below the nodes. Both trees are rooted with *Gloeophyllum sepiarium*. Details of *Vuilleminiaceae* clade follow (Ghobad-Nejhad & Duhem 2014); the clade is collapsed here for conciseness

surface. *Basidia* 4-spored. *Basidiospores* 5.2–6.3×4.1–5 μm (av. = 5.8×4.5 μm, 160 spores, 7 specimens), *Q*=1.17–1.40 (av. = 1.29), ovoidly subglobose, finely to fairly finely verrucose, somewhat dextrinoid. *Lamellar trama hyphae* smooth, sometimes finely granulose, pale yellowish to yellowish in Melzer's reagent. *Pileipellis* hyphae in the surface layer narrow, 2–4 μm wide, hyaline, embedded in mucus. Hyphae under the surface layer 5–15 μm wide, pale yellow in Melzer's reagent, not encrusted. *ITS sequence* (GenBank KR011136, holotype) distinct from the other known members of the section *Vibratiles*, and differs from them in the ITS region by more than 10 substitutions and indel positions.

Ecology and distribution. In coniferous forests, mostly in low-herb depressions of *Picea* forests, more seldom in pure *Pinus* heaths, one collection from *Fagus* forest, sometimes on calcareous ground. Often solitary or only a few basidiomata in each location. Producing basidiomata in late summer and autumn. Fairly rare to occasional, known from Northern and Central Europe.

Material examined: DENMARK, Nordjylland, Sindal, Tolne, small *Fagussylvatica* forest, 12 September 1998, *leg*. I. Kytövuori 98-1889 (H). GenBank ITS: KR011134. FINLAND, Varsinais-Suomi, Lohja, Esker of Lohja, outdoor recreation area by the road 36, dry pine (*Pinus sylvestris*) heath forest on sandy soil with lime dust effect, 19 September 2004, *leg*. I. Kytövuori & T. Niskanen 04-867, H6029887 (H). GenBank ITS: KR011137. Varsinais-Suomi, Vihti, Vihtijärvi, dryish pine forest with some *Picea* and *Betula*, 12 October 2003, *leg*. H. Tuovila 03-227 (H). Uusimaa, Helsinki, Herttoniemi, Kivinokka, mesic to grass-herb *Picea* forest, a shallow depression, 17 August 1994, *leg*. I. Kytövuori 94-061 (H); Malminkartano, 15 August 1979, J. Issakainen (H); Oulunkylän urheilupuisto, mesic to grass-herb *Picea* forest, 22 September 2000, *leg*. I. Kytövuori (H). Uusimaa, Inkoo, Kalasatama, mesic to grass-herb *Picea* forest, 3 September 2004, *leg*. I. Kytövuori (H). Uusimaa, Porvoo, W side of the lake Venjärvi, mesic to damp, mossy, grass-herb spruce forest (*Picea abies*) with some *Populus tremula*, *Betula* and *Pinus sylvestris*, 17 September 2004, *leg*. K. Liimatainen & T. Niskanen 04-850, H6031311 (**holotype**, H), (**isotype**, NY); Stensböle, Natura area, *Picea abies* dominated mesic grass-herb forest with *Betula*, old wooded pasture land, 24 September 2012, *leg*. T. von Bonsdorff (H). Etelä-Savo, Leivonmäki, Selänpohja, Syysniemi, slightly paludified spruce forest with some hardwood trees and bushes, 22 August 1993, *leg*. I. Kytövuori 93-454 (H). Etelä-Häme, Lahti, Pesäkallio, spruce forest, 30 September 2002, *leg*. T. von Bonsdorff & I. Kytövuori (H). Etelä-Häme, Valkeakoski, Mälkiäinen, Kariniemi, on mossy ground in rich, mixed forest, 8 September 1990, K. Syrjänen (OULU). Etelä-Häme, Virrat, Pohjaslahti, Monoskylä, Hennilä, moist spruce forest, swampy depression, 19 October 1996, *leg*. I. Kytövuori 96-1338 (H). Laatokan Karjala, Parikkala, Saari, congregation camp center at the lake, below the church, dry pine heath forest on fine sand, some *Betula*, 18 September 2009, *leg*. I. Kytövuori 09-1290 (H). Laatokan Karjala, Uukuniemi, Tarnala, mesic conifer forest, on the sawdust track, 11 September 2006, *leg*. I. Kytövuori 06-716 (H). Pohjois-Häme, Jyväskylä, Vesanka, Sivulanmäki NW, nature reserve, old *Picea* forest, 31 August 2014, *leg*. T. Jaakkonen (H). Pohjois-Häme, Konginkangas, Kivetty, mesic *Picea* forest, 9 September 2002, *leg*. H. Tuovila 02-026 (H). FRANCE, Haute-Savoie, pessière de Quintal, 24 October 1990, *leg*. P. Moënne-Loccoz 1761 (PC). SWEDEN, Medelpad, Ånge, Alby church yard, conifer dominated forest (*Pinus*, *Picea*) on calcareous soil, 28 August 2003, *leg*. I. Kytövuori, K. Liimatainen & T. Niskanen 03-823, H7018118 (H). GenBank ITS: KR011135. Medelpad, Liden, Sundsjöåsen Nature Reserve, mesic to grass-herb *Picea* forest, 13 September 2014, *leg*. I. Kytövuori (H). Härjedalen, Tännäs, Ramundberget, half-open pasture with thickets of *Betula*, *Alnusincana* and *Populustremula*, 18 August 2006, *leg*. M. Toivonen & I. Kytövuori 06-189 (H). Jämtland, Bräcke, Bodtjärnbäcken, spruce forest with some hardwood trees and bushes, 4 September 1997, I. Kytövuori 97-735 (H). Pite Lappmark, Arvidsjaur, Grundsel, dryish conifer forest with *Picea*, *Pinus* and some *Betula*, some moist depressions, 8 September 1997, *leg*. I. Kytövuori 97-970 (H).

Notes: *Cortinarius alboamarescens* is a small, white species with very small, almost subglobose spores. The viscid pileus and stipe, and the bitter taste place it in the /Vibratiles and the placement is confirmed in the phylogenetic analysis (Fig. 142). Thus far, *C. alboamarescens* is the only known white species of the section that occurs in coniferous forests. *Cortinarius leucophanes* P. Karst. and *C. lustratus* Fr. *Sensu* Jeppesen et al. of the /Leucophanes are also white and occur in coniferous forests, but their basidiomata are somewhat larger, the taste is mild or farinaceous, and the spores are somewhat larger and ellipsoid.

225. ***Cortinarius brunneoalbus*** Ammirati, Liimat. & Niskanen, ***sp. nov.***

syn. *C. collinitus* var. *olympianus* A.H. Sm., Lloydia 7(3): 175 (1944).

Index Fungorum number: IF551437; *Facesoffungi number*: FoF00997; Figs. 143c and 144c

Etymology: The name refers to the colours of the basidiomata.

Holotype: T. Niskanen 09-075 (H).

Pileus 30–65 mm, at first hemispherical, then low convex to plane, margin somewhat plicate-striate, ochraceous brown to dull yellowish brown, strongly glutinous, hygrophanous. *Lamellae* medium spaced, emarginated, at first very pale brown, later pale brown. *Stipe* 50–100 mm long, 7–13 mm thick at apex, 8–15 mm at base, cylindrical or

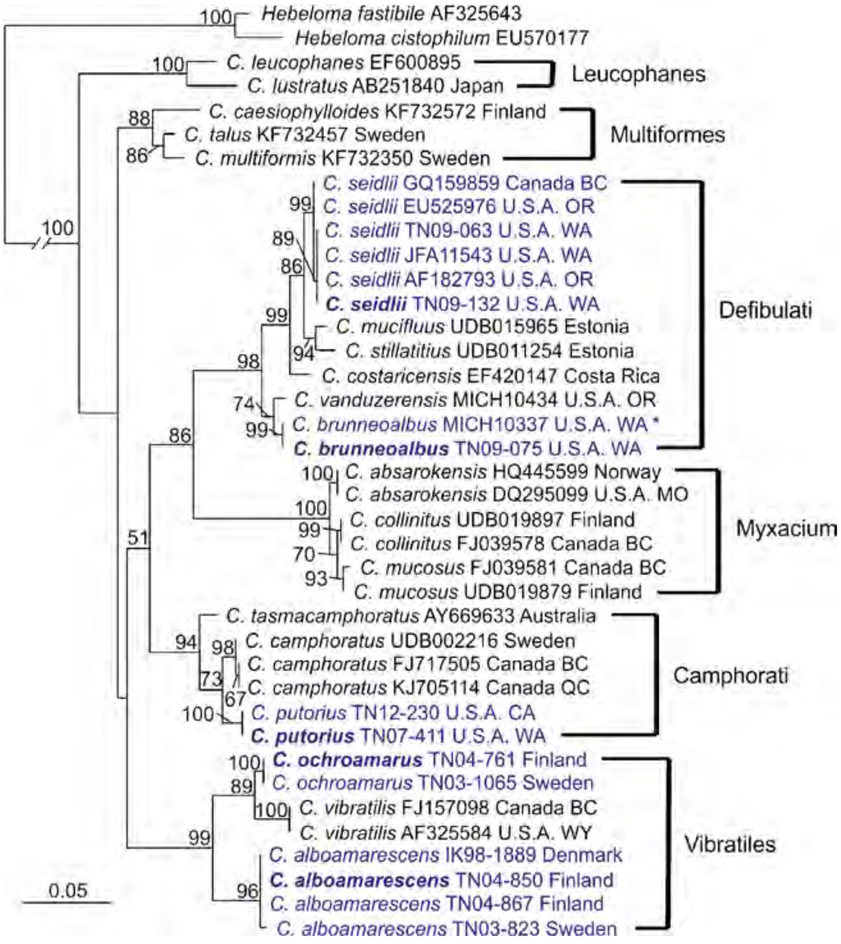


Fig. 142 Phylogram generated from Maximum likelihood (RAxML) analysis based on ITS sequence data. Maximum likelihood bootstrap support values greater than 50 % are indicated above or below the nodes, new species are in *blue* and species for which obtained sequences are based on type material have names in *bold*. The tree is rooted with *Hebeloma* spp. *Asterisk* = the holotype of *C. collinitus* var. *olympianus*

very slightly and evenly enlarged downward, white, glutinous. *Universal veil* glutinous, colourless. *Context* white to very pale yellow. *Odour* in the context at the base of the stipe very faintly honey-like. *Basidia* 4-spored. *Basidiospores* 13–15(−16)×7.5–8.5(−9) μm (av. = 14.2×8.5 μm, 40 spores, 2 specimens), *Q*=1.65–1.8(−1.9) (av. = 1.75), citriform, finely to moderately, densely verrucose, somewhat dextrinoid. *Lamellar trama hyphae* smooth, somewhat yellow in Melzer's reagent. *Pileipellis*. Hyphae in the surface layer 2.5–7 μm wide, hyaline, without clamp connections, embedded in mucus. Hyphae under the surface layer 3–15 μm wide, pigmented, brownish yellow in Melzer's reagent, somewhat spot-like encrusted. *ITS sequence* (GenBank KR011128, holotype) distinct from the other known members of the section *Defibulati* and differs from them it in the ITS region by more than 10 substitutions and indel positions.

Ecology and distribution. In mossy, mesic coniferous forests (*Abies*, *Tsuga*). Producing basidiomata in autumn. To date only known from U.S.A., Washington.

Material examined: USA, Washington, Clallam, Olympic Hot Springs, Olympic National Park, gregarious under fir, 30 September 1941, *leg*. A.H. Smith 17437, MICH10337 (MICH, holotype of *C. collinitus* var. *olympianus*). GenBank ITS: KR011129. Snohomish County, Barlow Pass, Mount Baker-Snoqualmie national forest, mixed coniferous forest with *Tsuga heterophylla* and *Abies amabilis*, 10 October 2009, *leg*. J.F. Ammirati, K. Liimatainen & T. Niskanen 09-075, (**holotype**, H), (**isotype**, NY).

Notes: In our phylogenetic analysis *Cortinarius brunneoalbus* is placed in the /Defibulati, a sister group of/ Myxacium (Fig. 1). Its placement in the /Defibulati is supported by a combination of morphological characteristics: medium to large basidiomata, glutinous pileus and stipe, large, amygdaloid to citriform spores, and the absence of clamp connections. *Cortinarius brunneoalbus* is most reminiscent of *C. mucifluus* Fr., which belongs to the same section and also has a white stipe. *Cortinarius mucifluus*, however, does not occur in the Pacific North West and has relatively narrower spores (12–16(−17)×7–8.5(−9) μm). Western North American *C. vanduzerensis* A.H. Sm. & Trappe and *C. seidlii* Ammirati, Niskanen & Liimat. differ in having a purplish stipe. Sometimes the stipe of *C. seidlii* is almost white but then it can be distinguished from *C. brunneoalbus* by its broader spores, Qav. = 1.58.

Fig. 143 *Cortinarius* species **a** *Cortinarius alboamarescens* 04-850, H6031311 (holotype, H) **b** *Cortinarius ochroamarus* 04-761, H6030006 (holotype, H) **c** *Cortinarius brunneoalbus* 09-075 (holotype, H) **d** *Cortinarius seidlii* 09-132 (holotype, H) **e** *Cortinarius putorius* 07-411 (holotype, H). Scale bars: **a**–**e**=10 mm. Photographs by K. Liimatainen

226. ***Cortinarius ochroamarus*** Niskanen, Kytöv. & Liimat., ***sp. nov.***

Index Fungorum number: IF551438; *Facesoffungi number*: FoF00998; Figs. 143b and 144b

Etymology: The name refers to the ochraceous colour of the pileus and the bitter taste.

Holotype: T. Niskanen 04-761, H6030006 (H).

Pileus 20–60 mm, hemispherical, then low convex, ochraceous yellow to yellow, sometime more yellowish red brown when moist, viscid, with hygrophanous streaks. *Lamellae* almost crowded, adnexed to emarginated, very pale brown, later pale brown. *Stipe* 40–80 mm long, 4–8 mm thick at apex, 6–13 mm at base, somewhat clavate, white, almost dry. *Universal veil* viscid. *Context* in pileus and upper part of the stipe pale yellow, white to pale yellow at the base of the stipe marbled hygrophanous. *Odor* of flesh sweetish, pleasant. *Taste* very bitter at least of the pileus surface. *Basidia* 4-spored. *Basidiospores* 7–8.4×4.5–5.4 µm (av. = 7.7×5 µm, 120 spores, 3 specimens), *Q*=1.44–1.67 (av. = 1.54), amygdaloid-ellipsoid, finely to fairly strongly verrucose, most strongly at apex, fairly weakly dextrinoid. *Lamellar trama hyphae* smooth, often somewhat granulose, yellow in Melzer's reagent. *Pileipellis*. Hyphae in the surface layer narrow, 2–4 µm wide, hyaline, embedded in mucus. Hyphae under the surface layer 5–15 µm wide, pale yellow in Melzer's reagent, not encrusted. *ITS sequence* (GenBank KR011132,

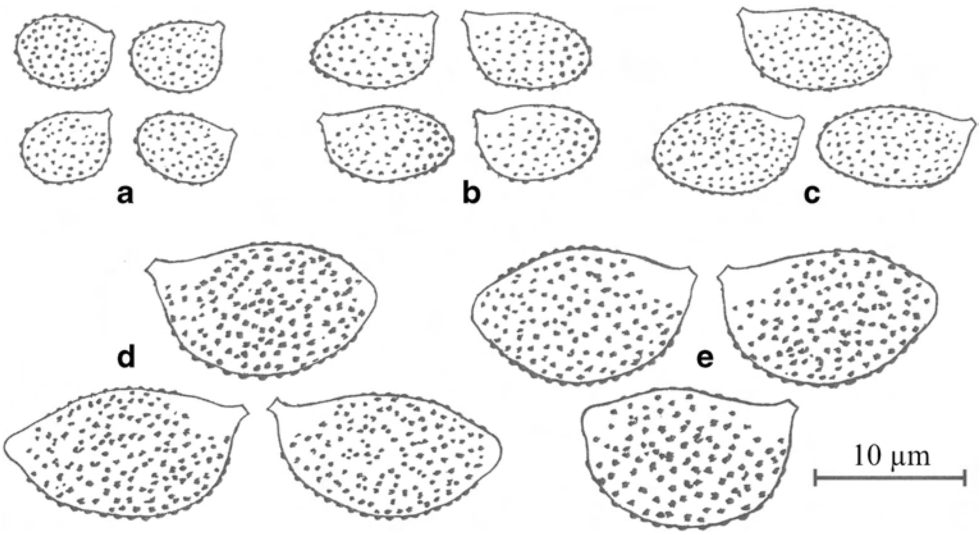


Fig. 144 *Cortinarius* species **a** Spores of a *Cortinarius alboamarescens* 04-850, H6031311 (holotype, H) **b** *Cortinarius ochroamarus* 04-761, H6030006 (holotype, H) **c** *Cortinarius putorius* 07-411 (holotype, H) **d** *Cortinarius brunneoalbus* 09-075 (holotype, H) **e** *Cortinarius seidlii* 09-132 (holotype, H), in Melzer's reagent. Scale bars: **a**–**e**=10 µm. Drawings by T. Niskanen and I. Kytövuori

holotype) distinct from the other known members of the section *Vibratiles*, and differing from them it in the ITS region by more than 10 substitutions and indel positions.

Ecology and distribution. In herb-rich, mossy *Picea abies*-dominated forests on calcareous ground. Producing basidiomata in late summer and autumn. Rare to occasional, known from Northern Europe.

Material examined: FINLAND, Uusimaa, Espoo, Luukkaa outdoor recreation area, N of Hauklampi, nature reserve area, mesic, partly grass-herb spruce forest (*Picea abies*) with some *Populus tremula*, *Betula* and *Pinus sylvestris*, 9 September 2004, *leg*. K. Liimatainen & T. Niskanen 04-761, H6030006 (**holotype**, H), (**isotype**, NY). Varsinais-Suomi, Karjaa, Mustio, Kohagen, herb-rich *Picea abies* forest with some *Corylus avellana*, *Quercus robur*, *Betula* and *Populus tremula*, or under *Populus tremula*, 2 September 2008, *leg*. K. Liimatainen & T. Niskanen 08-045, H6001939 (H). SWEDEN, Jämtland, Östersund, Böle, Fillstabäcken, damp to submesic coniferous forest (*Picea*, *Pinus*) on calcareous ground, 2 September 2003, *leg*. I. Kytövuori, K. Liimatainen & T. Niskanen 03-1065, H7018099 (H).

Notes: *Cortinarius ochroamarus* belongs to /Vibratiles (Fig. 142). Typical for the species of this clade are viscid to glutinous pileus, almost dry to glutinous stipe, and bitter taste. *Cortinarius ochroamarus* is best recognized by the combination of ochraceous yellow pileus, almost dry stipe, amygdaloid-ellipsoid spores, and habitat on calcareous soils. The species is most similar to *C. vibratilis* (Fr.: Fr.) Fr. *sensu* Moser and of Kytövuori & Niskanen, but *C. vibratilis* has a saturated apricot yellow to yellowish red brown pileus, somewhat narrower spores, 7–8×4.3–4.8 µm, and it occurs on more acid soils. Large basidiomata of *C. ochroamarus* can even resemble species of /Multiformes, but those have a clavate to bulbous stipe base, mild taste, and larger spores, over 8 µm long.

227. ***Cortinarius putorius*** Niskanen, Liimat. & Ammirati **sp. nov**.

Index Fungorum number: IF551439; *Facesoffungi number*: FoF00999; Figs. 143e and 144e

Etymology: The name refers to the unpleasant smell of the basidiomata.

Holotype: T. Niskanen 07-411 (H).

Pileus 30–90 mm, hemispherical, then low convex to plane, purple when young, later very pale purple to almost whitish, viscid. *Lamellae* medium spaced, adnexed to emarginated, at first purple, later strong brown. *Stipe* 50–130 mm long, 6–10 mm thick at apex, 6–13 mm at base, cylindrical to somewhat clavate, pale purple when young, later very pale brown to whitish silky fibrillose. *Universal veil* white, thin, forming some complete and/or incomplete girdles on the stipe. *Basal mycelium* white. *Context* at first purple later strong yellowish brown. *Odor* of lamellae unpleasant. *Basidia* 4-spored. *Basidiospores* 8.8–9.5(−10)×5–5.7 µm (av. = 9.2×5.4 µm, 40 spores, 2 specimens), *Q*=(1.55–)1.6–1.8(−1.85) (av. = 1.71), amygdaloid to somewhat ellipsoid, finely and densely verrucose, almost indextrinoid to somewhat dextrinoid. *Lamellar trama hyphae* smooth, somewhat yellow in Melzer's reagent. *Cheilocystidia* 35–45×7–13 µm, cylindrical to weakly lageniform. *Pileipellis*. Hyphae in the surface layer 3–7 µm wide, in gelatinous substance, hyaline, with granulose contents. Hyphae under the surface layer 5–10 µm wide, hyaline, not encrusted. *ITS sequence* (GenBankKR011124, holotype) distinct from the other members of /Camphorati, and differing from them in the ITS region by more than 10 substitutions and indel positions.

Ecology and distribution. In mesic coniferous forests (*Tsuga*, *Abies*, *Pseudotsuga*, *Picea*). Producing basidiomata in autumn. Rare, to date known from Washington and California in western North America.

Material examined: USA, California, Humboldt Co., Redwood National Park, coniferous forest, *leg*. J. Olsson & K. Liimatainen, T. Niskanen 12-230 (H). Washington, Olympic peninsula, Olympic National Park, surroundings of Sol Duc camp ground, coniferous forest (at least *Tsuga heterophylla*), 6 October 2007, *leg*. K. Liimatainen & T. Niskanen 07-411 (**holotype**, H), (**isotype**, NY).

Notes: *Cortinarius putorius* belongs to /Camphorati (Fig. 142). The group is characterized by the purple to almost white basidiomata, unpleasant smell, and distinct cheilocystidia. The closely related *C. camphoratus* (Fr.) Fr., which also occurs in the coniferous forests of the Pacific North West, has less purple basidiomata, the universal veil is at first pale bluish violet, and the spores are larger (9–)9.5–10.5×(5.5–)6–6.5 μm.

228. ***Cortinarius seidlii*** Ammirati, Niskanen & Liimat., ***sp. nov***.

Index Fungorum number: IF551440; *Facesoffungi number*: FoF01002; Figs. 143d and 144d

Etymology: Named after Michelle T. Seidl.

Holotype: T. Niskanen 09-132 (H).

Pileus 40–80 mm, at first hemispherical, then low convex to plane with a low and broad umbo and with margin plane to uplifted, strongly radially wrinkled, dirty ochraceous olive brown to brown, center dark brown but ochraceous when dried, edge at least at first whitish or pale, strongly glutinous, hygrophanous. *Lamellae* medium spaced, emarginated, at first very pale brown, later pale brown, sometimes with a purple tinge. *Stipe* 80–150 mm long, 7–15 mm thick at apex, 10–21 mm at the broadest portion, cylindrical to narrowly ventricose, base tapered to rounded, white, and glutinous. *Universal veil* glutinous, very pale purple to pale purple, sometimes almost white. *Context* in pileus brown, in stipe apex whitish to very pale brown, in base of the stipe pale yellow brown. *Odor* in the context of the stipe base indistinct, faintly iodoform-like or sweet. Lamellar trama hyphae smooth, somewhat yellow in Melzer's reagent. *Basidia* 4-spored. *Basidiospores* (12–)12.5–14.5(−15)×(7.5–)8–9 μm ($\bar{x}$ = 13.5×8.5 μm, *Q*=1.5–1.7(−1.8), *n*=40), broadly citriform, moderately, densely verrucose, almost indextrinoid to somewhat dextrinoid. *Pileipellis*. Hyphae in the surface layer 3–6 μm wide, hyaline, without clamp connections, embedded in mucus. Hyphae under the surface layer 5–17 μm wide, pigmented, brownish yellow in Melzer's reagent, finely to coarsely encrusted. *ITS sequence* (GenBank KR011125, holotype) distinct from the other known members of the section *Defibulati* and differs from them it in the ITS region by more than 10 substitutions and indel positions.

Habitat and distribution: In mesic, mossy coniferous forests (*Pseudotsuga*, *Tsuga*, *Abies*). Producing basidiomata from late summer to late autumn. Common in Pacific North West of North America, known from USA. Oregon to Canada British Columbia.

Material examined: USA, Oregon, Clackamas Co., Bull Run Watershed, fairly mesic, mixed coniferous forest (*Tsuga*, *Pseudotsuga*, *Abies*), 8 September 1995, L. Norvell, M.T. Seidl 4166 (WTU) (as *C. vanduzerensis*). Washington, Olympic Peninsula, Sol Duc camp ground, coniferous forest (*Tsuga heterophylla*, *Pseudotsuga*), 25 October 2009, K. Liimatainen & T. Niskanen 09-132 ((**holotype**, H), isotype, NY). Snohomish Co., Boardman Lake Trail, coniferous forest (mostly *Tsuga heterophylla*), 5 October 2009, J.F. Ammirati & T. Niskanen 09-063 (H); Mount Rainier National Park, Cougar Rock Campground, *Tsuga*, *Abies*, *Pseudotsuga*, 18 October 1995, J.F. Ammirati 11591 (WTU) (as *C. mucifluus*). Olympic Peninsula, Big Quilcene Trail, *Abies*, *Tsuga*, *Pseudotsuga*, deep humus, 11 October 1995, J.F. Ammirati 11543 (WTU). CANADA, British Columbia, *Tsuga heterophylla* ectomycorrhizal root tip, GenBank ITS: FJ152500 (as *C.* sp.). Mt. Washington, Trail to Divers Lake, 12 September 2001, O. Ceska OC44, F17116 (UBC) (as *C.* cf. *pseudosalor*). Port Renfrew, near the 2nd Bridge on Way to Fairy Lake, 24 August 2003, O. Ceska OC131, F17203 (UBC) (as *C. stillatitius*). Queen Charlotte Islands, Moresby Island, West side of Rose Inlet, Boschniakia Point, 5 September 2005, O. Ceska et al., F15962 (UBC), (as *C.* cf. *vanduzerensis*). Roberts Creek, Mt. Elphinstone Provincial Park, Upper Area #1, 22 August 2000, P. Kroeger, PK5331, F16402 (UBC), (as *C. vanduzerensis*); 3 September 2000, P. Kroeger, PK5336, F16403, (as *C. vanduzerensis*); area #2, in old growth *Pseudotsuga*, 4 September 2000, K. Goodwin & P. Kroeger, PK3374, F15805 (UBC), (as *C.* cf. *vanduzerensis*); area #3, 5 November 2000, K. Goodwin & P. Kroeger, PK3396, F15827 (UBC), (as *C.* cf. *vanduzerensis*). USA, Oregon, HJ Andrews Experimental Forest, *Pseudotsuga menziesii*, OSC 1064174 (OSC), (as *C.* sp.).

Notes: *Cortinarius seidlii* is a typical member of /Defibulati (Fig. 142). Members in this clade are characterized by the medium to large basidiomata, glutinous pileus and stipe, large, amygdaloid to citriform spores, and the absence of clamp connections. *Cortinarius seidlii* is characterized by the dirty ochraceous olive brown to brown pileus with dark brown center, very pale purple to pale purple, glutinous universal veil, and broadly citriform spores. Originally the species was identified as *C. vanduzerensis* A.H. Sm. & Trappe, but the study of the type specimen of *C. vanduzerensis* (MICH10434, GenBank ITS: KR011130, holotype) revealed that it is a different species. The pileus of *C. vanduzerensis* is chestnut black with chestnut brown margin and the spores are narrower 7–8(−9) μm wide. The species is currently only known for sure from the type locality, Tillamook Co, Oregon. *Cortinarius stillatitius* Fr. is also very similar to *C. vanduzerensis*, but it has a strong honey-like smell in the context of the base of the stipe and it does not occur in Pacific North West. *Cortinarius brunneoalbus*, which occurs in the same area, can be distinguished from *C. seidlii* by the narrower spores, *Q*=1.75, and the white stipe. *ITS sequence* (GenBank KR011125, holotype) distinct from the other known members of the section *Defibulati* and differing from them in the ITS region by more than 10 substitutions and indel positions.

229. ***Dendrominiaceae*** Ghobad-Nejhad, ***fam. nov***.

MycoBank number: MB812413; *Facesoffungi number*: FoF01003

Etymology: In reference to the type genus *Dendrominia*.

Type genus: *Dendrominia* Ghobad-Nejhad & Duhem, Mycol. Progr.: 10.1007/s11557-012-0881-3 [7] (2013)

Saprobic on decorticated or barked wood. *Basidiome* effused, resupinate, ceraceous to crustaceous. *Hyphal system* monomitic, hyphae with or without clamps, encrusted with fine crystals. *Basidia* large cylindrical to clavate, flexuose, arising from inflated basidioles (probasidia). *Dendrohyphidia* present. *Basidiospores* lunate to allantoid, walls smooth.

The family *Dendrominiaceae* currently contains the genus *Dendrominia* with three species: *D. dryina* (Pers.) Ghobad-Nejhad & Duhem, *D. ericae* (Duhem) Ghobad-Nejhad & Duhem, and *D. maculata* (H.S. Jacks. & P.A. Lemke) Ghobad-Nejhad & Duhem.

Punctulariaceae Donk, Persoonia 3(2): 287 (1964)

Punctulariaceae is a small family in *Corticiales* and accounts for corticioid taxa with simple resupinate basidiomes growing on angiosperm wood. All species possess dendrohyphidia and have ellipsoid spores negative in Melzer's reagent. The family contains the three genera *Dendrocorticium* M.J. Larsen & Gilb., *Punctularia* Pat., and *Punctulariopsis*.

Punctulariopsis Ghobad-Nejhad, Taxon 59(5): 1529 (2010)

The genus *Punctulariopsis* was established by Ghobad-Nejhad et al. (2010) to accommodate *P. obducens* (Hjortstam & Ryvarden) Ghobad-Nejhad, and *P. subglobispora* (Hallenb. & Hjortstam) Ghobad-Nejhad (both species were first described in the genus *Vuilleminia*, but shown to represent an independent genus based on morphology and DNA sequence data). During our survey on *Corticiales* taxa, the phylogenetic affinity of two *Corticium* species namely *C. cremeoalbidum* and *C. efibulatum* (Fig. 141) was examined for the first time. Phylogenetic analyses of ITS and LSU sequences (Fig. 141), show that both *C. cremeoalbidum* and *C. efibulatum* well reside in the genus *Punctulariopsis*, and their morphological characters also match the concept of the genus (see below). Therefore, two new combinations are proposed in the following.

230. ***Punctulariopsis cremeoalbida*** (M.J. Larsen & Nakasone) Ghobad-Nejhad, ***comb. nov***.

MycoBank number: MB812414; Fig. 145

≡ *Laeticorticium cremeoalbidum* M.J. Larsen & Nakasone, Mycologia 76(3): 528 (1984).

= *Corticium cremeoalbidum* (M.J. Larsen & Nakasone) M.J. Larsen, in Nakasone, Mycol. Mem. 15: 59 (1990).

231. ***Punctulariopsis efibulata*** (M.J. Larsen & Nakasone) Ghobad-Nejhad, ***comb. nov***.

MycoBank number: MB812415; Fig. 145

≡ *Laeticorticium efibulatum* M.J. Larsen & Nakasone, Mycologia 76(3): 530 (1984).

= *Corticium efibulatum* (M.J. Larsen & Nakasone) M.J. Larsen, in Nakasone, Mycol. Mem. 15: 60 (1990).

Notes: *Punctulariopsis cremeoalbida* and *P. efibulata* were originally described by Larsen and Nakasone (1984) for two corticioid species with effused basidiomes growing on *Vitis* (the former), and on *Vaccinium* (the latter) in North America. The light-coloured, thin, adnate basidiomes of both species, their little-branched dendrohyphidia, large and broadly ellipsoid spores with blunt apiculus, and their growth on hardwood match well with the concept of *Punctulariopsis* (see Ghobad-Nejhad et al. 2010). Both species are apparently known only from their type locality in the USA. With the two species combined here in *Punctulariopsis*, the number of species in this genus grows to four. *Punctulariopsis efibulata* is currently the only species in the genus lacking clamps on its hyphae.

Material examined: *Laeticorticium cremeoalbidum*: USA, Florida, Gannet Pond Quelet, Tall Timbers-Leon County, on *Vitis*, 29 July 1977, Burdsall 9616 (CFMR, **holotype**). *Laeticorticium efibulatum*: USA, Mississippi, Harison Expt. Forest, Rd. H2, Desoto National Forest, Harrison County, on *Vaccinium*, 26 February 1976, Burdsall 8824 (CFMR, **holotype**).

Order *Hymenochaetales*

Hymenochaetaceae Donk

The family *Hymenochaetaceae* is one of the most important families in Basidiomycota because it accommodates species with medicinal properties (Dai et al. 2009; Dai 2010). Around 480 species have been recorded in the family.

Hymenochaete Lév., Annls Sci. Nat., Bot., sér. 3 5: 150 (1846)

Hymenochaete is a large wood-inhabiting genus with more than 120 species He and Dai (2012). This genus was charactered by its corticioid hymenophore within the *Hymenochaetaceae*, until Wagner and Fischer (2002)

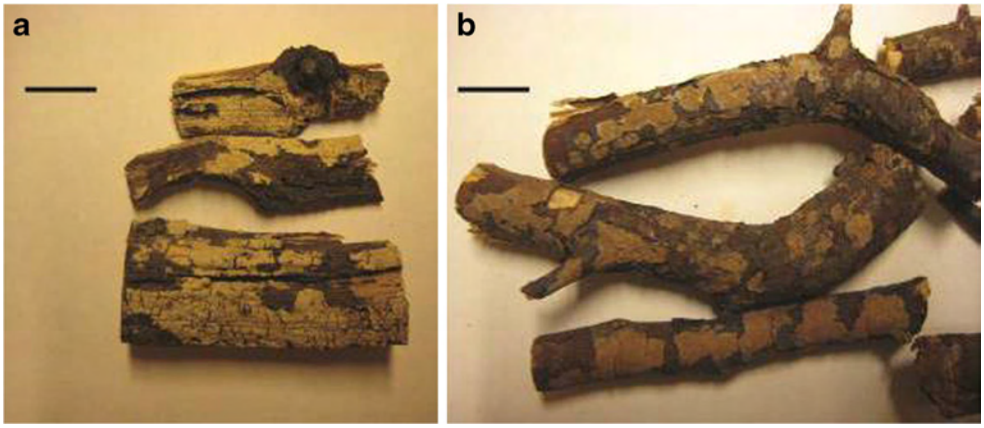


Fig. 145 *Punctulariopsis* basidiomes **a** *Punctulariopsis cremeoalbida* (holotype, CFMR) **b** *Punctulariopsis efibulata* (holotype, CFMR). Scale bars= 1 cm. Permission to publish type material photos kindly issued by CFMR herbarium

combined lamellate and poroid species from *Cyclomyces* Kunze ex Fr. Later, three more poroid species of *Cyclomyces* were addressed in *Hymenochaete* (He and Dai 2012; Gomes-Silva et al. 2012). Two new poroid species of *Hymenochaete* are described in this study (Fig. 146).

232. ***Hymenochaete micropora*** L.W. Zhou & Y.C. Dai, ***sp. nov.***

Index Fungorum number: IF551490; *Facesoffungi number*: FoF01004; Fig. 147

Etymology: referring to small pores distinguishing from other species of *Hymenochaete*.

Holotype: BJFC006546

Basidiocarps annual, pileate, sometimes attached by a lateral tapering base, imbricate, corky and without odour or taste when fresh, hard corky and brittle when dry. *Pilei* dimidiate to usually fan-shaped, projecting up to 3 cm, 4 cm wide and 2 mm thick at base. *Pileal surface* yellowish brown to reddish brown, narrowly concentrically zoned in different shades, tomentose to velutinate; *margin* acute, convex when dry. *Pore surface* rust-brown to greyish brown; *sterile margin* distinct, yellowish brown, up to 1 mm wide; *pores* circular to angular, 9–11 per mm; *dissepiments* thin, entire. *Context* reddish brown, up to 1 mm thick, duplex, towards the tomentum separated by one black line, lower part hard corky, upper tomentum soft corky. *Tubes* honey-yellow, paler than pores, up to 1 mm long. *Hyphal system* monomitic; generative hyphae with simple septa; tissue darkening and slightly swelling in KOH. *Contextual hyphae* in the lower dense context yellowish, thick-walled with a wide lumen, unbranched, interwoven, 2.5–4 μm in diam; hyphae in the black line dark brown, distinctly thick-walled with a narrow lumen, strongly agglutinated; hyphae in the upper tomentum yellow to brown, thick-walled with a wide to narrow lumen, unbranched, regularly arranged, 3–4.5 μm diam. *Tramal hyphae* varying from pale yellowish and slightly thick-walled to brown and thick-walled with a wide lumen, occasionally branched close to a septum, frequently simple septate, straight, parallel along the tubes, 2–3.5 μm diam. *Setae* frequent, distinctly subulate, arising from trama, most part embedded in hymenium, slightly curved at base, dark brown, thick-walled, 10–28 × 4–8 μm; *cystidia* and *cystidioles* absent; *basidia* more or less barrel-shaped, with four sterigmata and a simple septum at the base, 7–12 × 4–6 μm; *basidioles* in shape similar to basidia, distinctly smaller. *Basidiospores* ellipsoid, hyaline, thin-walled, smooth, IKI–, CB–, (2.5–)2.6–3(−3.1)×(1.5–)1.6–2(−2.1) μm, *L*=2.81 μm, *W*=1.8 μm, *Q*=1.56 (*n*=30/1).

Material examined: CHINA, Yunnan Province, Tengchong County, Gaoligong Mountain, on fallen angiosperm trunk, 24 October 2009, Cui 8057 (BJFC006546, **holotype**; IFP019137, **isotype**).

Notes: *Hymenochaete micropora* has similar basidiospores to *H. porioides* T. Wagner & M. Fisch. (2.5–3.5 × 1.5–2 μm, Ryvarden 2004; 2.5–3.1 × 1.5–1.9 μm, measured from LWZ 20140719–11). However, the small pores make *H. micropora* distinguished from all other known species of *Hymenochaete*. In addition, the duplex context of *H. micropora* is separated by one black line, while *H. porioides* has two black lines in context. In ITS-based phylogeny (Fig. 146), the clade formed by two *H. micropora* was also distinct from that of *H. porioides*.

233. ***Hymenochaete subporioides*** L.W. Zhou & Y.C. Dai, ***sp. nov.***

Index Fungorum number: IF551491; *Facesoffungi number*: FoF01005; Fig. 148

Etymology: referring to the similarity to *Hymenochaete porioides*.

Holotype: BJFC011058

Basidiocarps annual, pileate, sometimes attached by a lateral tapering base, imbricate, corky and without odour or taste when fresh, hard corky and brittle when dry. *Pilei* dimidiate to usually fan-shaped, projecting up to 2.5 cm, 3 cm wide and 4 mm thick at base. *Pileal surface* cinnamon-buff, yellowish

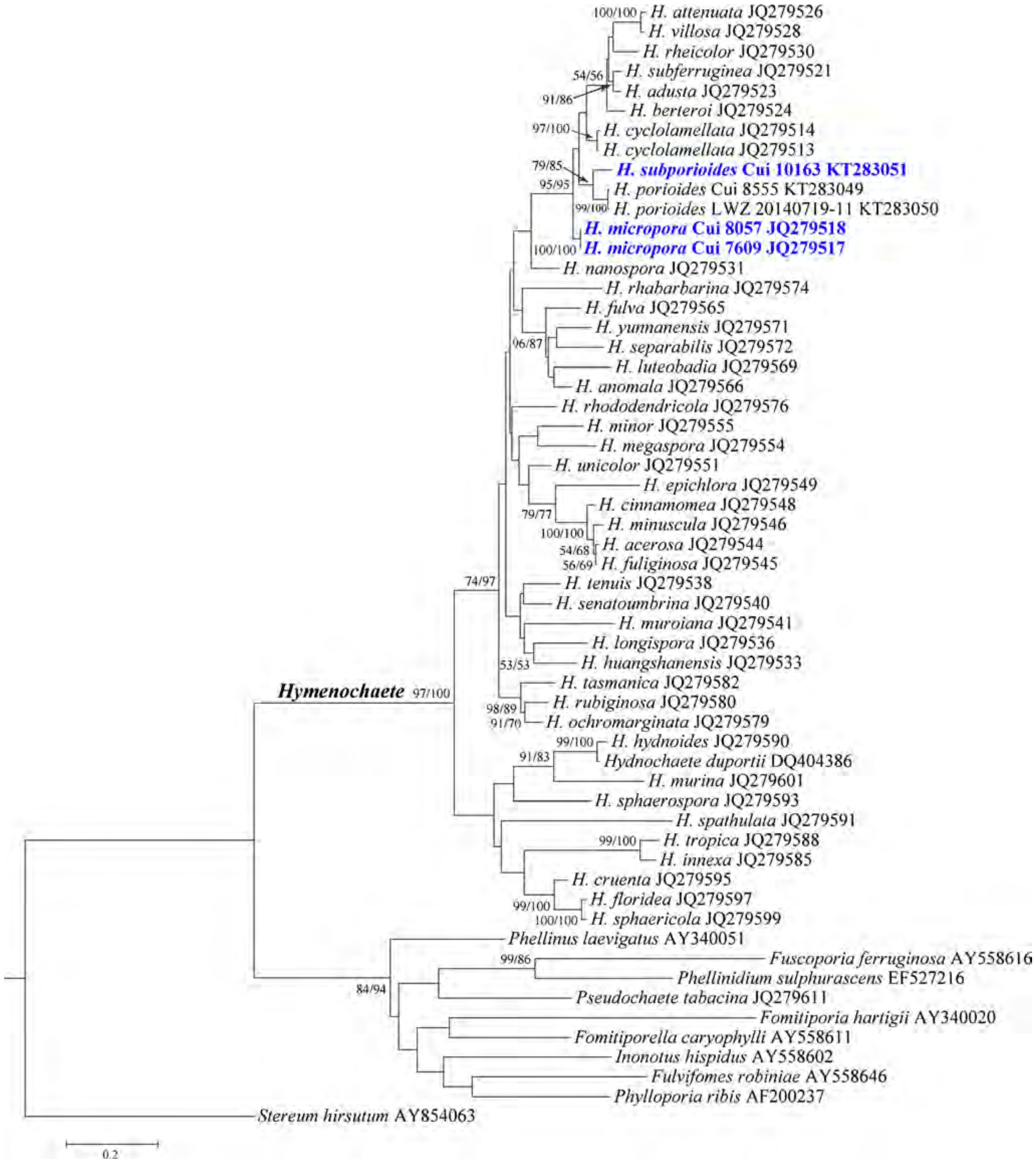


Fig. 146 Phylogenetic position of *Hymenochaete micropora* and *H. subporioides* (in *bold-face*) inferred from ITS sequences. Topology is from maximum likelihood analysis; statistical values from maximum likelihood and maximum parsimony (simultaneously above 50 %) for each node are indicated at the branches

brown to brown, narrowly concentrically zoned in different shades, tomentose to velutinate; *margin* acute, convex when dry. *Pore surface* yellowish brown to dark brown; *sterile margin* distinct, yellowish brown, up to 1 mm wide; *pores* circular to angular, 6–8 per mm; *dissepiments* thin, entire. *Context* orange-brown, up to 3 mm thick, duplex, towards

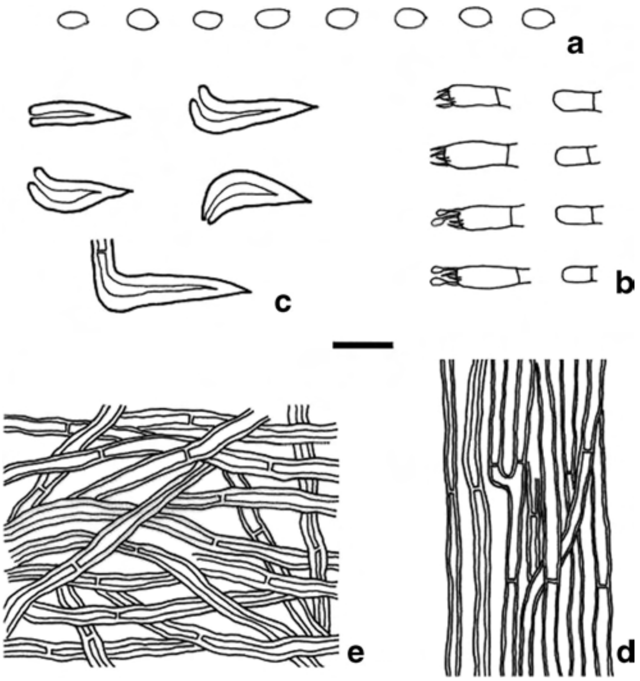


Fig. 147 *Hymenochaete micropora* microscopic structures (BJFC006546, holotype) **a** Basidiospores **b** Basidia and basidioles **c** Hymenial setae **d** Hyphae in trama **e** Hyphae in lower context. Scale bars: **a**=5 *μm*, **b**–**e**=10 *μm*

the tomentum separated by two black lines, lower and medium parts hard corky, upper tomentum soft corky. *Tubes* honey-yellow, paler than pores, up to 1 mm long. *Hyphal system* monomitic; generative hyphae with simple septa; tissue darkening and slightly swelling in KOH. *Contextual hyphae* in the lower dense context yellow, thick-walled with a wide lumen, unbranched, loosely interwoven, 3–5 μm in diam; hyphae in the two black lines dark brown, distinctly thick-walled with a narrow lumen, strongly agglutinated; hyphae between the two black lines yellow to brown, unbranched, parallel along the black lines, 3–4.5 μm in diam; hyphae in the upper tomentum brown, thick-walled with a wide lumen, unbranched, regularly arranged, 3–4.5 μm diam. *Tramal hyphae* varying from pale yellowish and slightly thick-walled to brown and thick-walled with a wide lumen, rarely branched, straight, parallel along the tubes, 2.5–4 μm diam. *Setae* frequent, distinctly subulate, arising from trama, most part embedded in hymenium, slightly curved at base, dark brown, thick-walled, 22–43×4–8 μm; *cystidia* and *cystidioles* absent; *basidia* more or less barrel-shaped, with four sterigmata and a simple septum at the base, 9–15×4–6 μm; *basidioles* in shape similar to basidia, distinctly smaller. *Basidiospores* oblong-ellipsoid to ellipsoid, hyaline, thin-walled, smooth, IKI–, CB–, (3.4–)3.7–4.3(−4.4)×(1.8–)1.9–2.4(−2.5) μm, *L*=3.92 μm, *W*=2.18 μm, *Q*=1.8 (*n*=30/1).

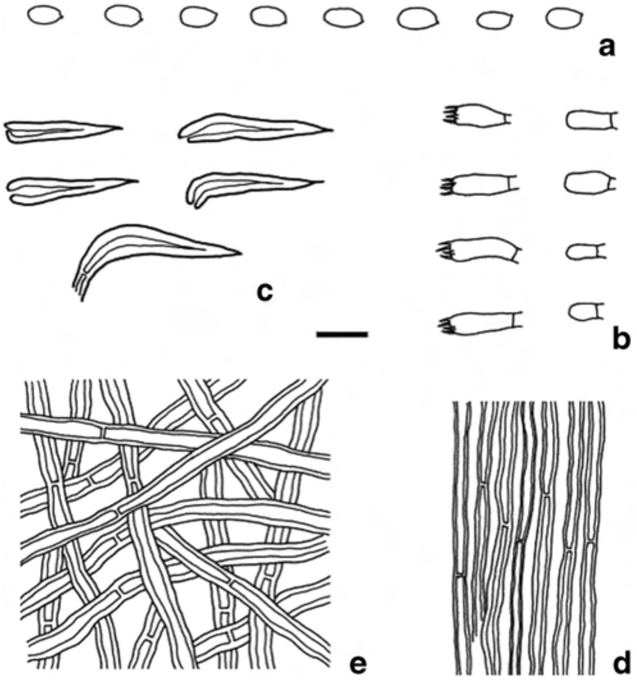


Fig. 148 *Hymenochaete subporioides* microscopic structures (BJFC011058, holotype) **a** Basidiospores **b** Basidia and basidioles **c** Hymenial setae **d** Hyphae in trama **e** Hyphae in lower context Scale bars: **a**=5 μm, **b**–**e**=10 μm

Material examined: CHINA, Zhejiang Province, Yongjia County, Longwantan Forest Park, on angiosperm stump, 21 August 2011, Cui 10163 (BJFC011058, **holotype**), (IFP019138, **isotype**).

Notes: *Hymenochaete subporioides* resembles *H. porioides* by its pore size (*H. porioides*: 7–9 per mm, Ryvarden 2004; 6–8 per mm, measured from LWZ 20140719-11) and duplex context separated by two black lines, but microscopically

H. subporioides could be easily differentiated by its larger basidiospores (*H. porioides*: 2.5–3.5 × 1.5–2 µm, Ryvarden 2004; 2.5–3.1 × 1.5–1.9 µm, measured from LWZ 20140719-11). The ITS-based phylogeny (Fig. 146) also supports *H. subporioides* was separated from *H. porioides*.

234. ***Neoantrodiellaceae*** Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan, ***fam. nov.***

Index Fungorum number: IF551497; *Facesoffungi number*: FoF01011

Habitat: grows on gymnosperm wood, including dead trees, fallen trunks and rotten wood, causes a white rot.

Basidiocarps annual to perennial, resupinate, effused-reflexed or pileate with smooth to poroid hymenophores, soft corky to hard corky, white, cream or pink. *Hyphal system* monomitic to dimitic; *generative hyphae* bearing clamp connections; *skeletal hyphae* thick-walled, cyanophilous; *cystidia* present in most species; *basidiospores* cylindrical, allantoid or ellipsoid, thin-walled, hyaline, smooth, indextrinoid, acyanophilous.

Type genus: **Neoantrodiella** Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan

Notes: The family *Neoantrodiellaceae* is established to accommodate the genera *Neoantrodiella* Y.C. Dai et al., *Cyanotrama* Ghob.-Nejh. & Y.C. Dai, *Poriodontia* Parmasto and *Fibricium* J. Erikss, in the order *Hymenochaetales*, *Agaricomycetes* based on its distinct lineage in the phylogenetic analysis (Figs. 149 & 150). The combined phylogeny of ITS, nLSU, RPB2 and mtSSU gene data demonstrate that *Neoantrodiella* show no affinity to the other orders of *Agaricomycetes* (Fig. 149). The sampled specimens of *Neoantrodiella* clustered in the Hymenochaetales clade and formed a well-supported lineage. According to the ITS and nLSU rDNA-based phylogeny (Fig. 150), *Neoantrodiellaceae* (including *Neoantrodiella*, *Cyanotrama*, *Poriodontia* and *Fibricium*) grouped close to *Hyphodontia* in the *Kneiffella* family, but formed a distinct clade with moderate support (73% MP and 0.93 BPPs) within the order *Hymenochaetales*. Previously, *Neoantrodiella* (including *Antrodiella gypsea* and *A. thujae*) was included in *Phanerochaetaceae*, *Polyporales* (Hattori and Ryvarden 1994; Kirk et al. 2008; Dai and Yuan 2007; Dai 2012); *Cyanotrama* was included in Hymenochaetales without existed family (Ghobad-Nejhad and Dai 2010), *Fibricium* was included in *Corticiaceae*, *Corticiales* (Jülich 1974); and *Poriodontia* was included in *Schizoporaceae*, *Hymenochaetales* (Kirk et al. 2008). However, recent studies (Ghobad-Nejhad and Dai 2010; Miettinen and Larsson 2011; Yuan 2014) and our current phylogenetic analyses showed these four genera are included in an unknown family. Thus, the new family *Neoantrodiellaceae* is established. *Cyanotrama* is similar to *Neoantrodiella* in morphology, so *Neoantrodiella gypsea* and *N. thujae* were combined as *Cyanotrama gypsea* (Yasuda) Miettinen and *C. thujae* (Y.C. Dai & H.S. Yuan) Miettinen & Y.C. Dai (Miettinen 2011). However, these two genera formed two well-supported lineages in the ITS and nLSU rDNA-based phylogeny, respectively (Fig. 150). *Antrodiella* Ryvarden & I. Johans. was described by Ryvarden and Johansen (1980) to comprise the so-called *Polyporus semisupinus* Berk. & M.A. Curtis complex (Ryvarden 1991). At present there are about 50 species in *Antrodiella*, either transferred from other genera or described as new species in the genus (Dai 2012; Miettinen et al. 2012; Ryvarden and Melo 2014; Yuan 2014). However, molecular studies showed that species of *Antrodiella* are polyphyletic and most species in the genus, including the type species belong to Polyporales (Miettinen et al. 2012; Yuan 2014). But in our study, *Antrodiella gypsea* and *A. thujae* phylogenetically are distinctly distant from species in the *Polyporales* (Fig. 150), and both species belong to *Hymenochaetales*. It is necessary to set up the new genus and family to accommodate them. So the above new genus, family and combinations are proposed.

In the current study, we resolve the placement of *Fibricium*, *Neoantrodiella*, *Cyanotrama* and *Poriodontia*. The combined ITS, nLSU, RPB2 and mtSSU sequence dataset was used for order placement (see note for order). The combined ITS and nLSU sequence dataset was used for family placement (see note for family). The new sequences were generated for this study (Table 1), and other reference sequences were obtained from GenBank (Ghobad-Nejhad and Dai 2010; Miettinen and Larsson 2011).

235. ***Neoantrodiella*** Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan, ***gen. nov.***

Index Fungorum number: IF551498; *Facesoffungi number*: FoF01012

Etymology: *Neoantrodiella* (Lat.): referring to resembling *Antrodiella*.

Basidiocarps annual to perennial, resupinate, effused-reflexed or pileate with poroid hymenophores, corky to hard corky, white to cream. *Hyphal system* dimitic; *generative hyphae* bearing clamp connections; *skeletal hyphae* thick-walled, cyanophilous; *cystidia* present or absent; *basidiospores* allantoid or ellipsoid, thin-walled, hyaline, smooth, indextrinoid, acyanophilous.

Type species: ***Neoantrodiella gypsea*** (Yasuda) Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan

236. ***Neoantrodiella gypsea*** (Yasuda) Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan, ***comb. nov.***

Index Fungorum number: IF551499; *Facesoffungi number*: FoF01013

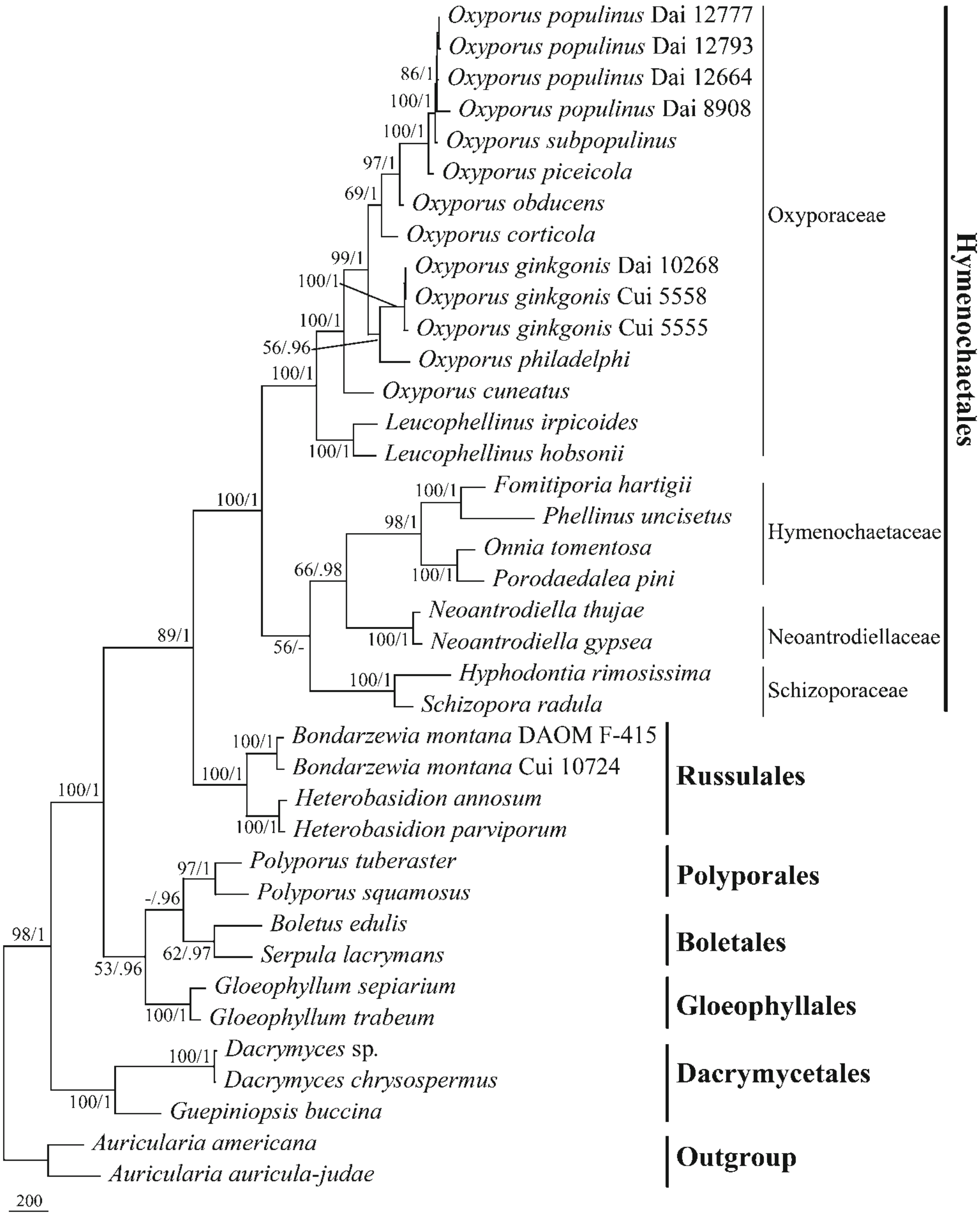


Fig. 149 Maximum Parsimony strict consensus tree illustrating the phylogeny of *Neoantridieelaceae*, and related species in *Agaricomycetes* based on ITS + nLSU + RPB2 + mtSSU sequence data. Branches are labelled with parsimony bootstrap proportions (before *slanting line*) higher than 50 % and Bayesian posterior probabilities (after *slanting line*) more than 0.95

Basionym: *Polystictus gypseus* Yasuda, Bot. Mag., Tokyo 32: 249 (1918).

= *Antrodiella gypsea* (Yasuda) T. Hatt. & Ryvarden, Mycotaxon 50: 35 (1994).

237. ***Neoantrodiella thujae*** (Y.C. Dai & H.S. Yuan) Y.C. Dai, B.K. Cui, Jia J. Chen & H.S. Yuan, ***comb. nov.***

Index Fungorum number: IF551500; *Facesoffungi number*: FoF01014

Basionym: *Antrodiella thujae* Y.C. Dai & H.S. Yuan, Cryptog. Mycol. 28: 179 (2007).

Basidiocarps perennial, resupinate, effused-reflexed or pileate with poroid hymenophores, corky, white, cream. *Hyphal system* dimitic; *generative hyphae* bearing clamp connections; *skeletal hyphae* thick-walled, cyanophilous; *cystidia* present; *basidiospores* allantoid or ellipsoid, thin-walled, hyaline, smooth, indextrinoid, acyanophilous (Fig. 151).

Schizoporaceae

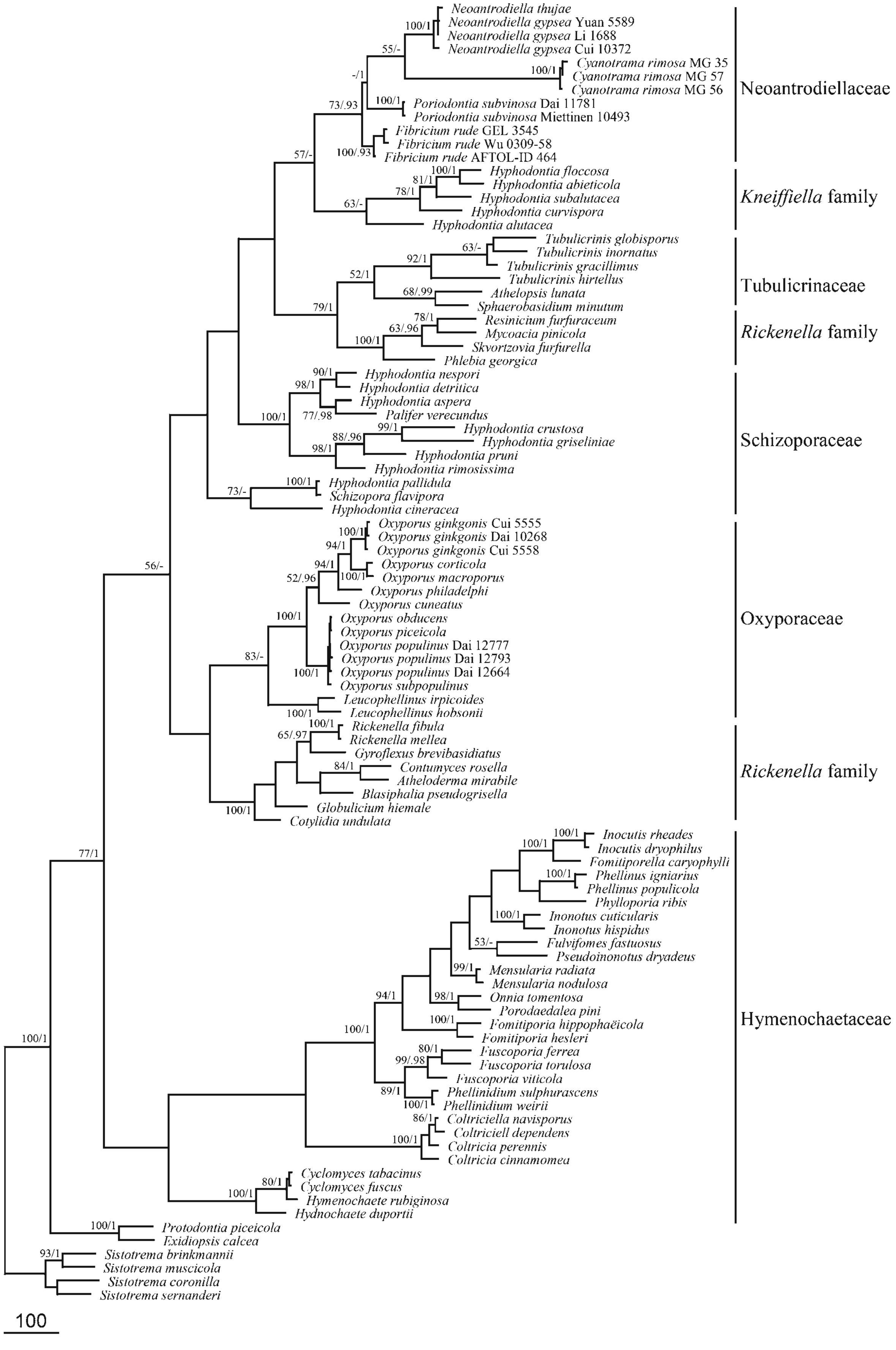
238. ***Xylodon ramicida*** Spirin & Miettinen, ***sp. nov.***

MycoBank number: MB 813990; *Facesoffungi number*: FoF01006; Fig. 152

Holotype: Spirin 7664

Etymology: Branch killer, derived from *ramus* (Lat.), branch

Basidiocarps annual, resupinate, arid, covering several cm. Sterile margin first white, floccose, up to 1 mm wide, absent in


100/1
Neoantrodiella thujae
Neoantrodiella gypsea Yuan 5589
Neoantrodiella gypsea Li 1688
Neoantrodiella gypsea Cui 10372
55/-
100/1
Cyanotrama rimosa MG 35
Cyanotrama rimosa MG 57
Cyanotrama rimosa MG 56
-/1
Neoantrodiellaceae
73/.93
100/1
Poriodontia subvinosa Dai 11781
Poriodontia subvinosa Miettinen 10493
Fibricium rude GEL 3545
Fibricium rude Wu 0309-58
100/.93
Fibricium rude AFTOL-ID 464
57/-
100/1
Hyphodontia floccosa
81/1
Hyphodontia abieticola
78/1
Hyphodontia subalutacea
Kneiffiella family
63/-
Hyphodontia curvispora
Hyphodontia alutacea
Tubulicrinis globisporus
63/-
Tubulicrinis inornatus
92/1
Tubulicrinis gracillimus
52/1
Tubulicrinis hirtellus
Tubulicrinaceae
68/.99
Athelopsis lunata
Sphaerobasidium minutum
79/1
78/1
Resinicium furfuraceum
63/.96
Mycoacia pinicola
Rickenella family
100/1
Skvortzovia furfurella
Phlebia georgica
90/1
Hyphodontia nespori
98/1
Hyphodontia detritica
Hyphodontia aspera
100/1
77/.98
Palifer verecundus
99/1
Hyphodontia crustosa
88/.96
Hyphodontia griseliniae
Schizoporaceae
98/1
Hyphodontia pruni
Hyphodontia rimosissima
100/1
Hyphodontia pallidula
73/-
Schizopora flavipora
Hyphodontia cineracea
56/-
Oxyporus ginkgonis Cui 5555
100/1
Oxyporus ginkgonis Dai 10268
94/1
Oxyporus ginkgonis Cui 5558
94/1
Oxyporus corticola
100/1
Oxyporus macroporus
52/.96
Oxyporus philadelphi
Oxyporus cuneatus
100/1
Oxyporus obducens
Oxyporus piceicola
Oxyporaceae
Oxyporus populinus Dai 12777
Oxyporus populinus Dai 12793
100/1
Oxyporus populinus Dai 12664
83/-
Oxyporus subpopulinus
Leucophellinus irpicoides
100/1
Leucophellinus hobsonii
100/1
Rickenella fibula
65/.97
Rickenella mellea
Gyroflexus brevibasidiatus
84/1
Contumyces rosella
Rickenella family
Atheloderma mirabile
Blasiphalia pseudogrisella
Globulicium hiemale
100/1
Cotylidia undulata
100/1
Inocutis rheades
100/1
Inocutis dryophilus
Fomitiporella caryophylli
77/1
100/1
Phellinus igniarius
Phellinus populicola
Phylloporia ribis
100/1
Inonotus cuticularis
Inonotus hispidus
53/-
Fulvifomes fastuosus
Pseudoinonotus dryadeus
99/1
Mensularia radiata
Mensularia nodulosa
94/1
98/1
Onnia tomentosa
Porodaedalea pini
Hymenochaetaceae
100/1
Fomitiporia hippophaëicola
100/1
Fomitiporia hesleri
100/1
80/1
Fuscoporia ferrea
99/.98
Fuscoporia torulosa
Fuscoporia viticola
89/1
Phellinidium sulphurascens
100/1
Phellinidium weirii
86/1
Coltriciella navisporus
Coltriciell dependens
100/1
Coltricia perennis
Coltricia cinnamomea
80/1
Cyclomyces tabacinus
Cyclomyces fuscus
100/1
Hymenochaete rubiginosa
Hydnochaete duportii
100/1
Protodontia piceicola
Exidiopsis calcea
93/1
Sistotrema brinkmannii
Sistotrema muscicola
Sistotrema coronilla
Sistotrema sernanderi
100

◀ **Fig. 150** Maximum Parsimony strict consensus tree illustrating the phylogeny of the new family *Neoantridieelaceae*, and more representative available families in *Hymenochaetales*, based on the combined ITS + nLSU sequence datasets. Branches are labelled with parsimony bootstrap proportions (before slanting line) higher than 50 % and Bayesian posterior probabilities (after slanting line) more than 0.95

older basidiocarps. Hymenial surface pale ochraceous, odontoid; spines solitary or fused together, rather regularly arranged, up to 0.6 mm long, (3)4–5 per mm, with sharpened fimbriate apices. *Hyphal structure* monomitic, hyphae clamped, faintly cyanophilous. Subicular hyphae densely and mostly irregularly arranged, some in parallel bundles, with thickened walls, (2.8)3.1–3.8(4.3) µm (n=40/2). Tramal hyphae subparallel, thin- to slightly thick-walled, in subhymenium short-celled, (2)2.4–3(3.4) µm (n=40/2). *Cystidia* of hymenial origin, variable in shape and size, moniliform or capitate to bottle-shaped, (13)19.2–31.3(34.8)×(3)3.1–4(4.7) µm (n=20/2), accidentally encrusted by small crystalline aggregations. *Basidia* suburniform, 4-spored, 18–23.6×3.6–4.6 µm, with thickened wall at basal part. *Basidiospores* thin-walled, cylindrical, often tapering to distal end, (6)6.1–7.8(8.1)×(2.4)2.5–3(3.1) µm, L=6.66, W=2.74, Q=2.41–2.48 (n=90/3), ventral side flat or indistinctly convex, very rarely slightly concave, occasionally with several oil drops. Oily matter scanty or absent.

Notes: Morphology and DNA data place *X. ramicida* in the vicinity of *X. quercinus* (Pers.) Gray, the type species of *Xylodon* (Fig. 1). ITS sequence difference is only 5–7 bp. They have similar macroscopic characters and hyphal structure, but basidiospores of *X. quercinus* are wider, thick cylindrical, and often with a depressed ventral side (Fig. 2), (5.6)5.7–7.5(7.6)×(2.7)2.8–3.3(3.4) µm, L=6.53, W=3.07, Q=2.06–2.18 (n=90/3). Moreover, tissues of *X. quercinus* exude abundant oily matter in Cotton Blue. Ecology and distribution areas of these species are different as well. *Xylodon quercinus* is found in Europe and Siberia, and it inhabits thick, dead and usually fallen branches of angiosperm trees, mostly of *Quercus* spp. It has not been reported from China, Japan, or Russian Far East (Langer 1994; Dai 2011). *Xylodon ramicida* is an East Asian species. It attacks living or dying but still attached branches of gymnosperms (mostly *Picea ajanensis*). A few records of *X. ramicida* come from living stems of *Pinus pumila*, the shrub-like pine species, thus indicating its possible pathogenic facilities. *Xylodon quercinus* has been reported from North America, but these data should be rechecked (Langer 1994).

Material examined: *Xylodon quercinus*: FINLAND, Uusimaa: Vantaa, Tammisto Nat Res., *Quercus robur*, 1 June 2013 Niemelä 9040 (H). Uusimaa, Helsinki, Patola, *Salix caprea* (?), 2 November 2011 Miettinen 15050.1 (H), INSD KT361632. RUSSIA, Krasnoyarsk Reg.: Turukhansk Dist. Mirnoe, *Alnus sibirica*, 19 August 2013 Kotiranta 26316 (H). Nizhny Novgorod Reg.: Lukoyanov Dist., Razino, *Q. robur*, 8 September 2011 Spirin 4482 (H). *Xylodon ramicida*. RUSSIA. Khabarovsk Reg.: Solnechnyi Dist., Igdomi, *Abies nephrolepis* (fallen log), 6 August 2011 Spirin 3851 (H); Verkhnebureinskii Dist., Kyvyty, *Picea ajanensis* (attached branches), 17 August 2014 Spirin 7390,7469 (H), Hegdy, *P. ajanensis* (attached branches), 18 August 2014 Spirin 7482, 7505, 7518 (H), 22 August 2014 Spirin 7797 (H), *A. nephrolepis* (attached branch), 18 August 2014 Spirin 7536 (H), *Pinus pumila* (living stem), 22 August 2014 Spirin 7856 (H), Dublikan Nat Res., *P. ajanensis* (attached branches), 19–21 August 2014 Spirin 7583, 7635, 7664 (H, **holotype**, INSD KT361634), 7715, 7724, 7753 (H), 23 August 2014 Spirin 7904 (H), *P. pumila* (living stem), 21 August 2014 Spirin 7764 (H), Sidorka, *Picea obovata* (attached branch), 24. VIII.2014 Spirin 7961 (H).

Polyporales

Polyporaceae Fr. ex Corda

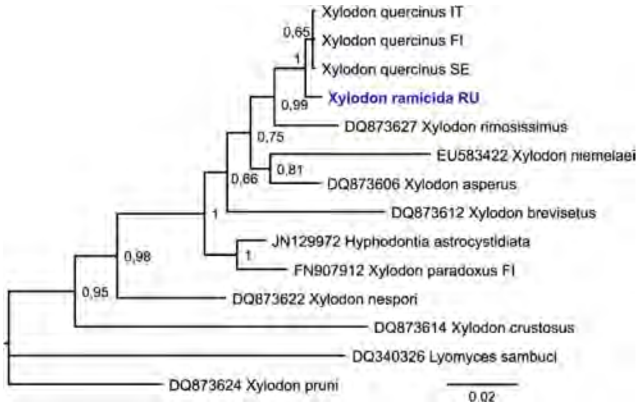


Fig. 151 *Xylodon ramicida* within the *Coltricia* clade of *Hymenochaetales* (Basidiomycota) *sensu* Larsson et al. (2006). Consensus phylogram of the 4503 trees retained in the Bayesian analysis of nrDNA ITS and LSU. *Numbers* represent Bayesian posterior probabilities

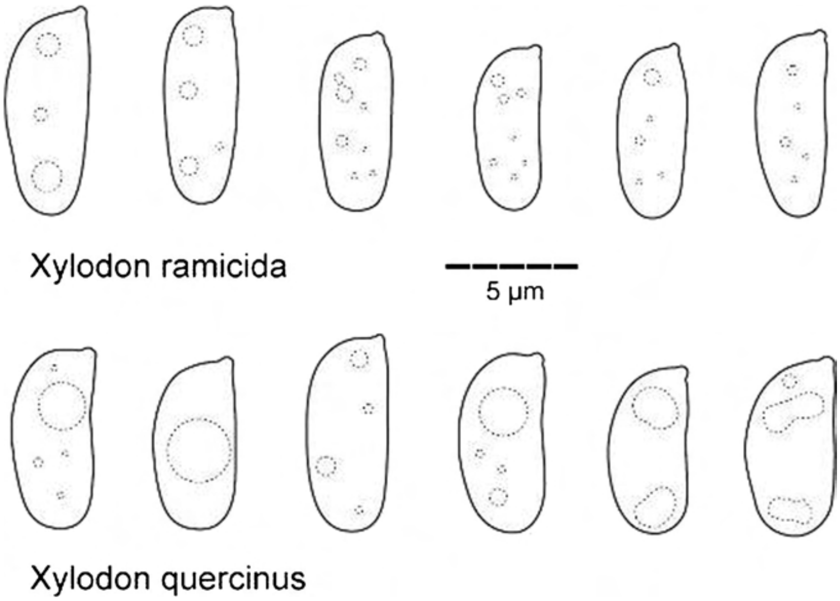


Fig. 152 Basidiospores of *Xylodon ramicida* (holotype) and *Xylodon quercinus* (Niemelä 9040)

239. *Colospora* Miettinen & Spirin, *gen. nov.*

MycoBank number: MB813992; *Facesoffungi number*: FoF00994

Etymology: *Colus* (Lat.), distaff, refers to the shape of spores.

Basidiocarps resupinate, minutely odontioid, corticioid on dead wood. *Hyphal system* dimitic throughout, clamps present, short-branched dendrohyphidia common, spines sterile towards the tip. *Basidiospores* large, thin-walled, biapiculate.

Type species: *Colospora andalasii* Miettinen & Spirin

Other species: *Colospora citrispora* (Boidin & Lanquetin) Miettinen *comb. nov.*; Basionym *Epithele citrispora* Boidin & Lanquetin, Mycotaxon 16: 467, (1983); MycoBank number MB 813996.

Notes: This genus contains two *Epithele*-like fungi with a dimitic hyphal structure and biapiculate spores. The type species of *Epithele* (*E. typhae*) and *Skeletohydnum* (*S. nikau*), the two existing genus names for *Epithele*-like fungi, are not particularly closely related (Fig. 1). *Epithele typhae* (Pers.) Pat. is a monomitic species with smooth, fusiform spores. *Skeletohydnum nikau* (G. Cunn.) Jülich also has smooth, fusiform spores, which are thick-walled, and skeletal hyphae are restricted in its spines making the basidiocarps more fragile than in *Colospora* (Boidin and Lanquetin 1983; Nakasone 2013). *Colospora* belongs to the core polyporoid clade (*Polyporaceae*) of the *Polyporales* (Binder et al. 2013). Closest relatives are found among the polypore genera *Porogramme*, *Tinctoporellus*, *Theleporus* and the corticioid genus *Erythromyces* (Fig. 2). Those genera contain species with smaller, thin-walled spores. Of these, the light-coloured *Theleporus* spp. are most similar morphologically, but their spores and hymenial cells are of much smaller dimensions. Also *Diplomitoporus venezuelicus* Ryvarden & Iturraga is closely related to *Colospora*. The species is morphologically similar to *Theleporus* spp. (Ryvarden and Johansen 1980; Zhou and Dai 2012). Ryvarden and Iturriaga (2003) did not report dendrohyphidia or branching skeletal hyphae in the type of *D. venezuelicus*, but we confirm that these characters are present.

The best placement of *D. venezuelicus* is for the time being in *Theleporus venezuelicus* (Ryvarden & Iturraga) Miettinen, *comb. nov.*; basionym *Diplomitoporus venezuelicus* Ryvarden & Iturraga, Mycologia 95:1069, 2003; MycoBank number: MB 813995 (Fig. 153).

240. *Colospora andalasii* Miettinen & Spirin, *sp. nov.*

MycoBank number: MB 813994; *Facesoffungi number*: FoF00995; Figs. 154 and 155

Etymology: After Andalas University, the leading botanical research institution in Sumatra.

Holotype: Miettinen 13096

Basidiocarps annual, resupinate, leathery, up to 15 cm in widest dimension, up to 0.3 mm thick. *Margin* compact, sterile. *Hymenial surface* pale cream coloured, odontoid, in older parts with vinaceous stains; spines (sterile hyphal pegs) solitary, regularly arranged, up to 200–300×40–60 µm, 5–7 per mm, with sharp apices. *Subiculum* (thickness excluding the spines) 150–250 µm. *Hyphal structure* dimitic (amphimitic), generative hyphae clamped. *Skeletal hyphae* dominating in all parts of basidiocarps, irregularly arranged in subiculum, (1.8)2–2.8(3.4) µm (n=34/1), subparallel in spine trama,

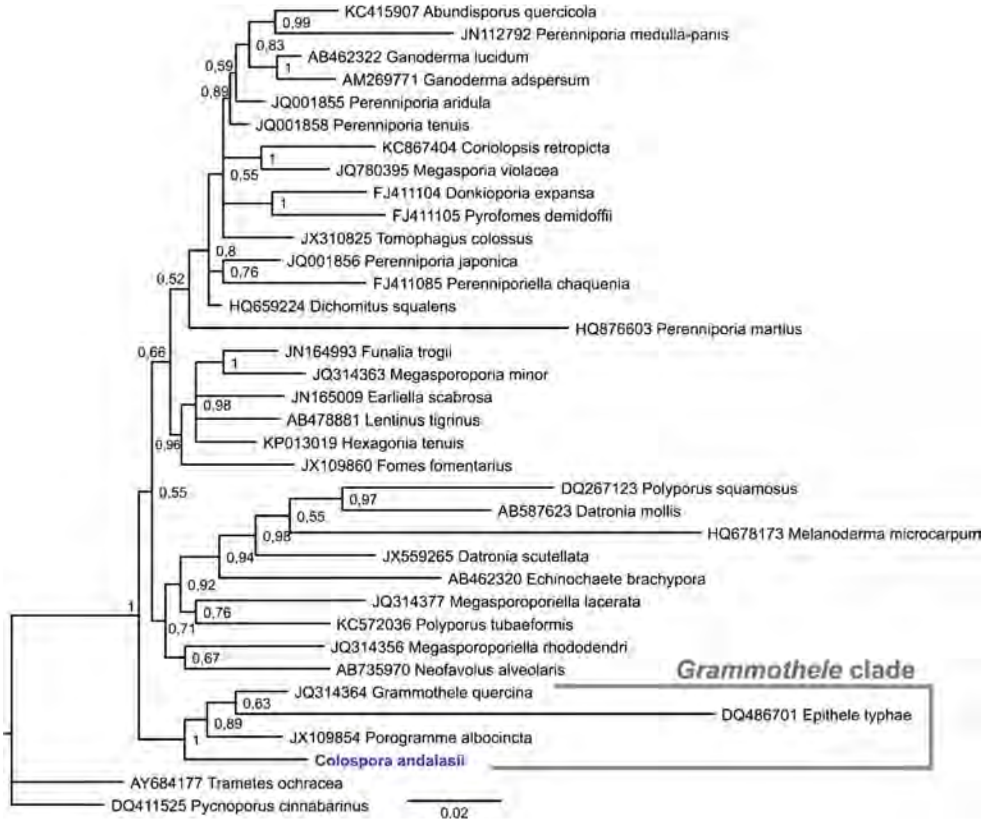


Fig. 153 Position of *Colospora* within the core polyporoid clade (*Polyporales*, Basidiomycota). Consensus phylogram of the 4503 trees retained in the Bayesian analysis of nrDNA ITS and LSU. *Numbers* represent Bayesian posterior probabilities

(2)2.6–2.9(3.2) µm (n=20/1), branched and tapering but sparingly, thick-walled, with a capillary, rather indistinct lumen (one sixth of hyphal diam. or less), acyanophilous, faintly yellowish or hyaline in Melzer's reagent. *Generative hyphae* thin-walled, 1.8–2.8 µm. Coarse crystals abundant in subiculum, up to 20 µm in widest dimension, mostly of square or rhomboidal shape; also fine sand-like encrustation. *Hymenium* covers spines only close to their base and does not extend close to the tip. *Dendrohyphidia* present in hymenium, usually not projecting, 2.5–4 µm in diam., with short blunt branches, collapsing easily. *Basidia* utriform, 4-spored, 30–40×9–10 µm, with oil drops inside, sterigmata subulate, up to 12×2 µm. *Basidiospores* slightly thick-walled, finely ornamented (covered by minute warts), biapiculate, apical parts distinctly tapering and refractive, with numerous oil drops inside, faintly cyanophilous, showing small amyloid patches in apices, 14.7–18.8×(5.7)6–7.3(7.8), L=16.99 µm, W=6.65 µm, Q=2.56 (n=32/1).

Material examined: *Colospora andalasii*: INDONESIA, Sumatera Barat, Padang, Limau Manis, dry fallen angiosperm branch, 15 July 2008 Miettinen 13096 (ANDA **holotype**, H), INSD KT361629. *Epithele alba*: BRAZIL, São Paulo, Campinas, Moji-Guaçu, 29 January 1987 Ryvarden 24517 (H ex O). *Epithele subfusispora*: BRAZIL, São Paulo, Campinas, Moji-Guaçu, 23 January 1987 Ryvarden 24554 (H ex O). *Epithele typhae*: ESTONIA, Valgamaa, Otepää, Valkjärva, *Carex acutiformis*, 10 September 2012 Kotiranta 25248 (H). *Erythromyces*

Fig. 154 Photographs of *Colospora andalasii* (holotype) in the field

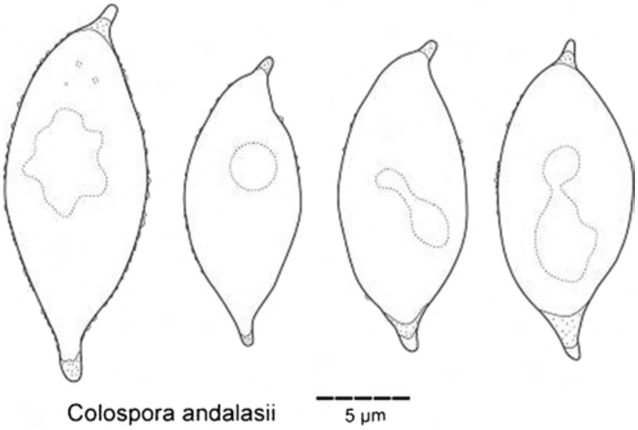


Fig. 155 Basidiospores of *Colospora andalasii* (isotype) drawn in Cotton Blue

crocicreas; INDONESIA, Sumatera Barat, Padang, Limau Manis, dicot log, 16 July 2008 Miettinen 13157 (ANDA, H), INSD KT361630. *Skeletohydnum nikau*: NEW ZEALAND, Auckland, Waitakere Ranges, *Rhopalostylis sapida* (fallen twig), 24 February 1984 Buchanan 84/016 (H ex O). *Theleporus venezuelicus*: VENEZUELA, Estado Bolivar, Sifontes, Tumeremo, 17 November 1994 Ryvarden 35205 (O, **holotype**), INSD KT361631.

Notes: *Colospora andalasii* is very similar morphologically to *Epithele citrispora* described from Gabon. The main separating character is the ornamentation of spores–clearly visible in *C. andalasii*, but not reported for *E. citrispora*. Boidin and Gilles (1998) produced an ITS sequence of a paratype of *E. citripora*. Even if we do not have control over the quality of the *E. citrispora* sequence, the ITS difference between the two seems convincingly large (>10 %) to exclude conspecificity.

A few *Epithele* species have ornamented spores: *E. alba* (Viegas) Boidin et al., *E. interrupta* Bres. and *E. subfusispora* (Burds. & Nakasone) Hjortstam & Ryvarden (Hjortstam and Ryvarden 2005). Their hyphal structure is different from that one of *Colospora*, considered as monomitic (Hjortstam and Ryvarden 2005) or dimitic with 'microbinding hyphae' (Nakasone 2013).

Russulales

Russula Pers., Observ. mycol. (Lipsiae) 1: 100 (1796) (Fig. 156)

Russula subsection *Roseinae* Singer ex Sarnari is a member of subgenus *Incrustatula* Romagn., together with subsections *Amethystinae* (Romagn.) Bon, *Chamaeleontinae* Singer, and *Lilaceinae* (Melzer & Zvára) Jul. Schaeff., all of which have primordial hyphae in pileipellis (Romagnesi 1985, 1996). Members of *Roseinae* can be distinguished from those of the other subsections of subgenus of *Incrustatula* by brightly orange, pink to reddish tinged pileus, a whitish spore print, and a persistent bright reddening in dried fruit bodies. The concept of subsection *Roseinae* was established by Singer based on *Russula*, then corresponded by Romagnesi, and emended by Sarnari (Singer 1986; Romagnesi 1967, 1985; Sarnari 1998). North American mycologists also made contributions in recognizing the species diversity of *Roseinae* (Adamčík and Buyck 2012). Although 21 species and 3 varieties of *Russula* have been described from China, only one variety *R. minulula* var. *minor* Z.S. Bi can be placed in subsection *Roseinae* (Singer 1935; Chiu 1945; Ying 1983; Bi and Li 1986; Zang and Yuan 1999; Wen and Ying 2001; Song et al. 2007; Wang et al. 2009; Li et al. 2011, 2012, 2013a, b, 2015a, b).

Southern China is a region characterized by subtropical to tropical climates, rather diverse rainforests and evergreen broad-leaved forests. *Russula* species form associations with diverse higher plants in these forests as ectomycorrhizal symbionts. Fruit bodies of some edible *Russula* species such as *R.* cf. *griseocarnosa* X.H. Wang et al. are often collected, sold and consumed as precious food of highly nutritious values for parturients in this area. However, not all of the *Russula* taxa are gathered, because some of them are regarded as "poisonous mushrooms" by indigenous people. After some fungus forays in southern China, newly collected specimens were examined, and two "suspected poisonous" *Russula* taxa unknown to science were found. These new species are described and illustrated using morphological and phylogenetic evidence. Comparisons with the other closely related and similar *Russula* taxa are also made.

241. ***Russula guangxiensis*** G.J. Li, H.A. Wen & R.L. Zhao, ***sp. nov.***

Index Fungorum number: IF551492; *Facesoffungi number*: FoF01007; Fig. 157

Etymology: refers to the type locality.

Holotype: CHINA. Guangxi Zhuang Autonomous Region, Wuzhou City, Tengxian County, Xiangqi Township, Xiangqi Village, 21 August 2013, Xin-Hua Chen 35 (HMAS 267867).

Basidiomata small to medium sized. *Pileus* 30–65 mm diam., first hemispheric to plano-convex, then expanding to applanate, finally slightly depressed in center to concave, smooth, viscid when wet, slightly glabrous when young, peeling 1/3–1/2 from the edge, sometimes desquamated in small patches, margin sometimes undulate, not striate, rarely cracked; pale pinkish red tinged with Begonia Rose (I1b) to Geranium Pink (I3d), intermixed with Strawberry Pink (I5d) in center, Hermosa Pink (I1f), Shrimp Pink (I5f), or even White (LIII) towards the margin. *Lamellae* adnate, equal to sub equal, 2–4 mm in height, 15–21 pieces per cm at the edge, rarely forked near the stipe and pileal edge, often intervened, White when fresh, slowly turning Orange Cinnamon (XXIX13″) to Mikado Brown (XXIX13″i) when injured, lamellulae absent. *Stipe* central, 6–9 × 0.8–1.5 cm,

Fig. 156 Phylogram generated from Maximum Parsimony (MP) analysis based on sequence data of ITS for 58 *Russula* and two outgroup sequences (*Albatrellus flettii* and *Gloeocystidiellum aculeatum*). Sequences used in this study have been sampled from a previous study (Miller and Buyck 2002; Eberhardt 2002; Li et al. 2015b) or newly generated for *R. guangxiensis* and *R. hakkae*. Significant supported bootstrap values (≥70 %) are shown above the branches. *Thickened clades* represent posterior probabilities (PP≥0.95) from Bayesian inference

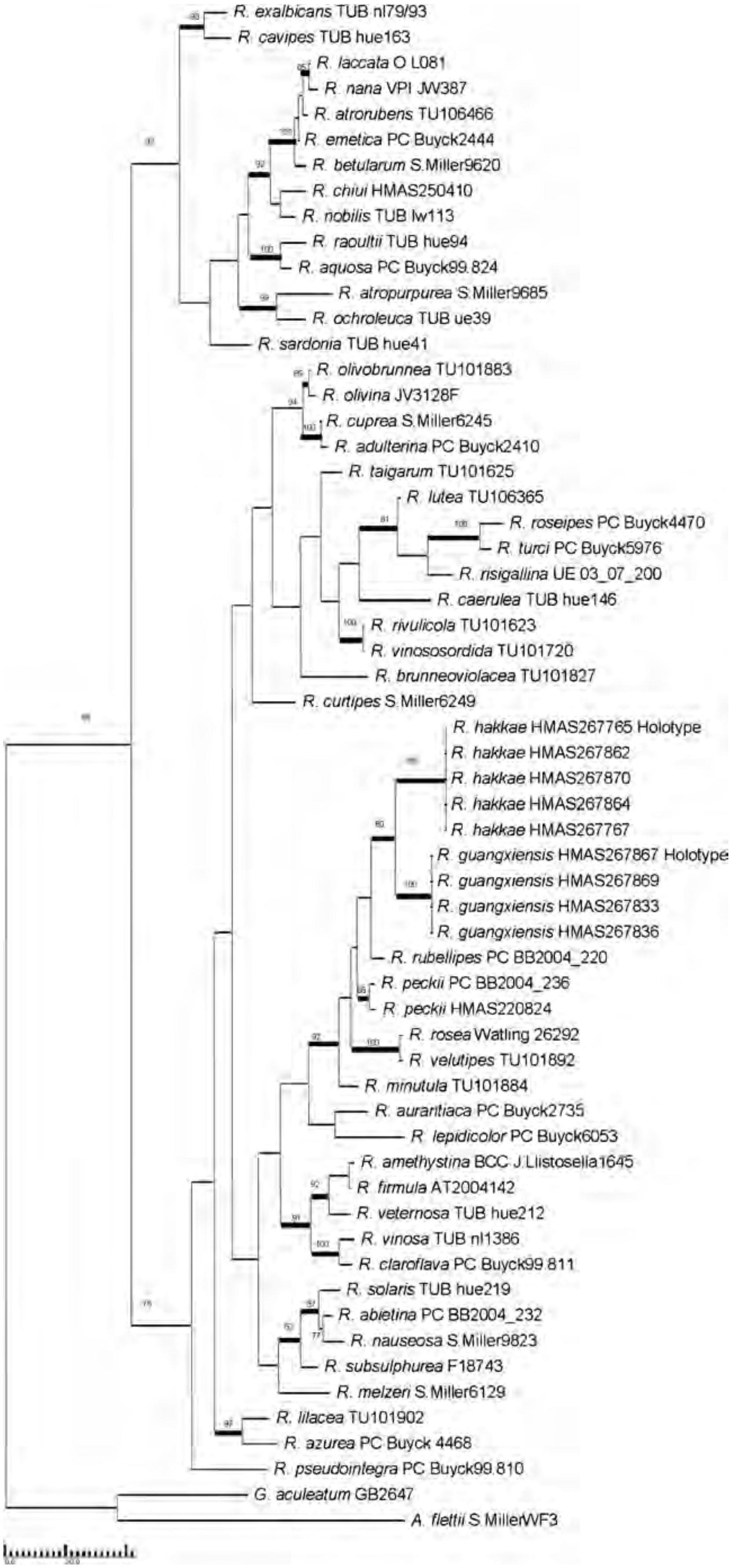
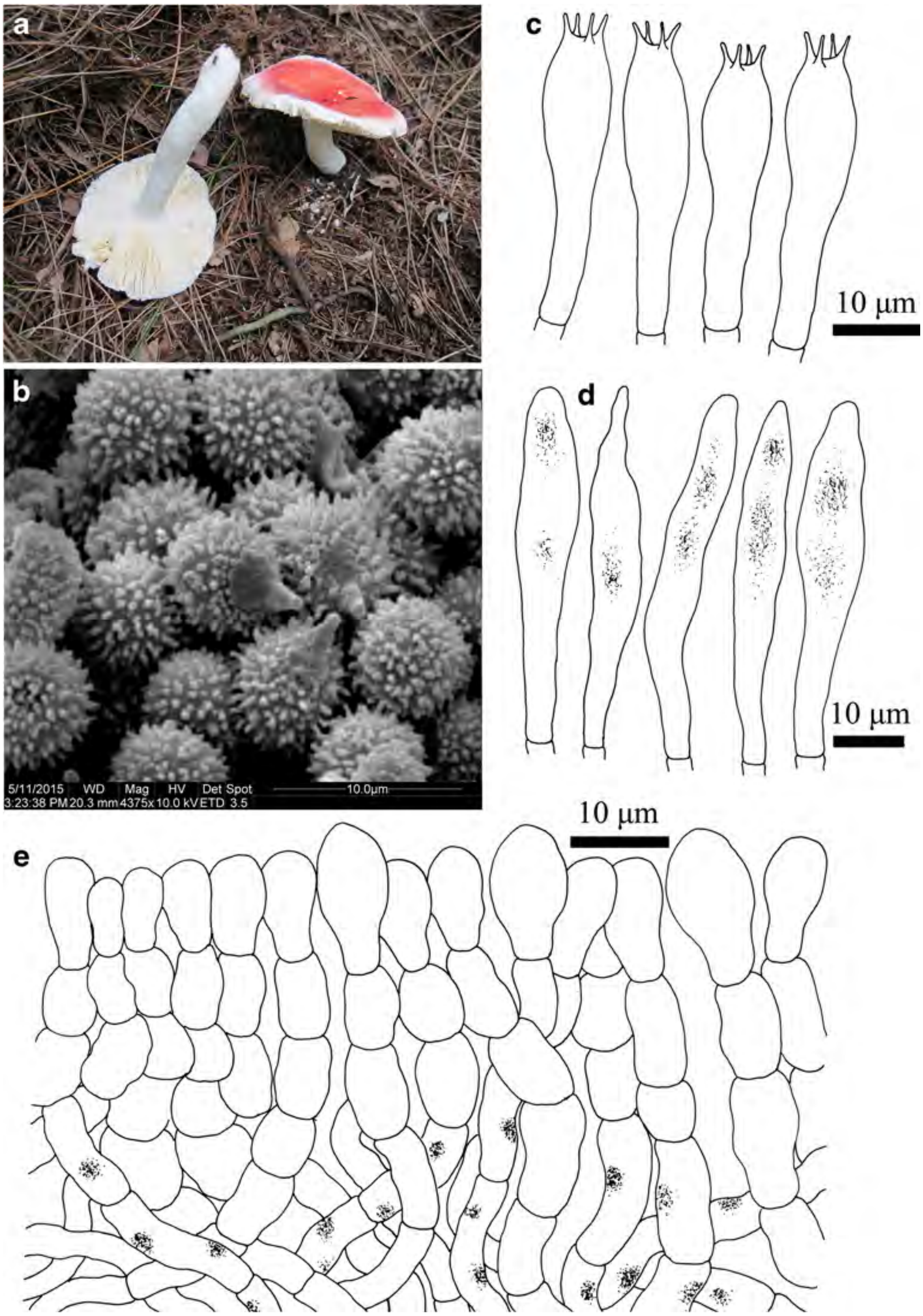


Fig. 157 *Russula guangxiensis* (holotype) **a** Basidiocarps **b** Basidiospores **c** Basidia **d** Pleurocystidia **e** Pileipellis



subcylindrical, surface dry, smooth, rarely rugulose longitudinally, dull, sometimes slightly attenuate upwards or downwards, white, a tinge of when injured and dry, first stuffed, becoming hollow at last. *Context* 2–4 mm at the center of the pileus, white, fragile, odour indistinct, taste mild. *Spore print* White (RomagnesiIa).

Basidiospores(Fig.) [200/10/10] 5.9–6.9 (−7.2)×4.9–6.1 μm, *Q*=(1.05–) 1.08–1.23 (−1.26), (*Q*=1.16±0.05), hyaline, subglobose to broadly ellipsoid; ornamentation composed of amyloid conical warts that are mostly isolated or rarely linked, not forming network, warts 0.7–1 μm in height; suprahilar are distinct and amyloid. *Basidia* 38–47×7–10 μm, mostly with four sterigmata 3–5 μm long, hyaline, sometimes yellowish in KOH, subclavate to clavate, rarely subcylindrical. *Pleuroystidia* scattered, 55–63×7–12 μm, projecting 10–20 μm beyond the basidia, subfusoid to subcylindrical, sometimes clavate to subclavate, apices round to subacute, often appendiculate to subcapitate, thin–walled, contents granular, crystal, refractive, weakly grey in SV. *Cheilocystidia* same as pleurocystidia. *Subhymenium* a cellular layer 15–30 μm thick composed of inflated cells 6–17 μm diam., hyaline, sometimes pale yellowish in KOH. *Pileipellis* orthochromatic in cresyl blue, composed of epipellis and subpellis; epipellis a dense, hymeniderm 50–60 μm thick, composed of thin-walled, cylindrical hyaline hyphae 3–6 μm wide; terminal cells 15–30×5–10 μm, septate, clavate, apex mostly obviously inflated; subpellis less dense, a pseudoparenchymatic region, 40–60 μm thick, composed of irregular inflated sphaerocysts 20–30 μm diam., interweaved hyaline hyphae 2–6 μm wide; primordial hyphae cylindrical, septate, 3–6 μm diam., with heteromorphous-opalescent inclusions and acid-resistant incrustations, apex obtuse; pileocystidia not observed. *Stipitipellis* a cutis, composed of filamentous hyphae 3–6 μm diam., interweaved with inflated cells 10–15 μm diam., hyaline, some hyphae yellowish to pale ochre in KOH; caulocystidia absent. *Trama* composed of sphaerocytes 30–90 μm diam. *Clamp connections and lacticiferous hyphae* absent from all tissues.

Habitat and distribution: Single or scattered in broad-leaved forests (dominated by *Lithocarpus* spp.).

Additional specimens examined: CHINA, Guangxi Zhuang Autonomous Region, Wuzhou City, Tengxian County, Xiangqi Township, Xiangqi Village, 21 August 2013, Xin-Hua Chen 57 (HMAS267863); *ibid*., Xin-Hua Chen 29 (HMAS267831); *ibid*., Xin-Hua Chen 19 (HMAS267869); *ibid*., Xin-Hua Chen 24 (HMAS267829); *ibid*., Xin-Hua Chen 41 (HMAS267833); *ibid*., Xin-Hua Chen 25 (HMAS267868); *ibid*., Xin-Hua Chen 28 (HMAS267832); *ibid*., Xin-Hua Chen 7 (HMAS267866); *ibid*., Xin-Hua Chen 14 (HMAS267836).

Notes: The combination of white spore print, mild taste, bright red pileus, pileipellis with primordial hyphae but without pileocystidia, pseudoparenchymatic subpellis, and the topology of phylogenetic analysis of ITS sequences clearly place *R. guangxiensis* within subgenus *Incrustatula* Romagn. Subsection *Roseinae* Singer ex Sarnari. Two new taxa, *R. guangxiensis* and *R. hakkae*, clustered together with strong support (BS 92 %, PP 1.00) with most members of subsection between the two new taxa through a fairly good support (BS 80 %, PP 1.00). The two *Roseinae* involved in this study. Our phylogenetic analysis also indicated a close relationship new taxa have context without distinctive odour, amyloid and distinct basidiospores uprahilar area, and habitat of *Lithocarpus* forest. However, *R. hakkae* has an acrid tasted context, larger basidiospores with dense ornamentation up to 1.2 μm in height, and a palisade epipellis.

Other species of subsection *Roseinae* originally described from Europe can be distinguished from *R. guangxiensis* as follows. *Russula lepidicolor* Romagn. has a low basidiospore ornamentation composed of hemispherical warts up to 0.4 μm high which is often linked by fine lines as short to long ridges, and wider basidia (9–12 μm) (Romagnesi 1967; Sarnari 2005). *Russula minutula* Velen. has a small, velutinous pileus 17–30 mm, a context with a strong but short-lived odour of rosemary, and a quite rarely little amyloid basidiospores uprahilar area (Romagnesi 1967; Sarnari 2005). *Russula velutipes* Velen. has a pileus with copper brown or apricot orange shade, a bulbous stipe, and a low basidiospore ornamentation composed of hemispherical warts up to 0.4 μm high are which often linked by fine lines as short to long ridges.

Type specimens of several members of subsection *Roseinae* which were described from America has been studied recently (Adamčík and Buyck 2012). Among good members of subsection *Roseinae*, *R. albida* Peck can be distinguished from *R. guangxiensis* by a white to slightly yellow tinged pileus which has a narrowly tuberculose-striatepileus margin, and a basidiospore ornamentation composed of spines which form an almost complete reticulum, connected by frequent line connections; *R. nigrescentipes* Peck differs in a stipe becoming blackish by handling or bruising, basidiospore ornamentation composed of warts connected by frequent line connections, and short basidia (22–30 μm); *R. rimosa* Murrill can be distinguished by shortly ellipsoid to ellipsoid basidispores which have dense, low ornamentations (0.2–0.5 μm) with numerous line connections, and pileipellis with pileocystidia SV-insensitive contents (Adamčík and Buyck 2012).

242. ***Russula hakkae*** G.J. Li, H. A. Wen & R.L. Zhao, ***sp. nov.***

Index Fungorum number: IF551493; Facesoffungi number: FoF01048; Fig. 158.

Etymology: refers to the hakka people living in the type locality.

Holotype: CHINA. Guangdong Province, Meizhou City, Meixian County, Longwen Township, 9 August 2013, Xin-Hua Chen 34 (HMAS 267765).

Basidiomata small to large sized. *Pileus* 40–100 mm diam., first hemispheric, then flat hemispheric to applanate, plano-convex to convex when mature, smooth, viscid when wet, slightly glabrous when young, peeling 1/4–1/2 from the edge, sometimes desquamated in small patches; brightly tinged with Spectrum Red (I1), Peach Red (I5b) to Scarlet (I5), intermixed with pink tinge of Rose Doree (I3b) to Strawberry Pink (I5d) in center, Eosine Pink (I1d), Hermosa Pink (I1f) to Hydrangea Pink (XXVII5″f) towards margin. *Lamellae* adnate, equal, 2–6 mm high, 17–22 pieces per cm at the edge, rarely forked near the stipe and pileal edge, often interveined, white when fresh, lamellulae absent. *Stipe* central to subcentral, 5–7×0.8–2 cm, subcylindrical, slightly tapering towards the apex and base, smooth, sometimes rugulose longitudinally, mostly pinkish tinged with Eosine Pink (I1d) to La France Pink

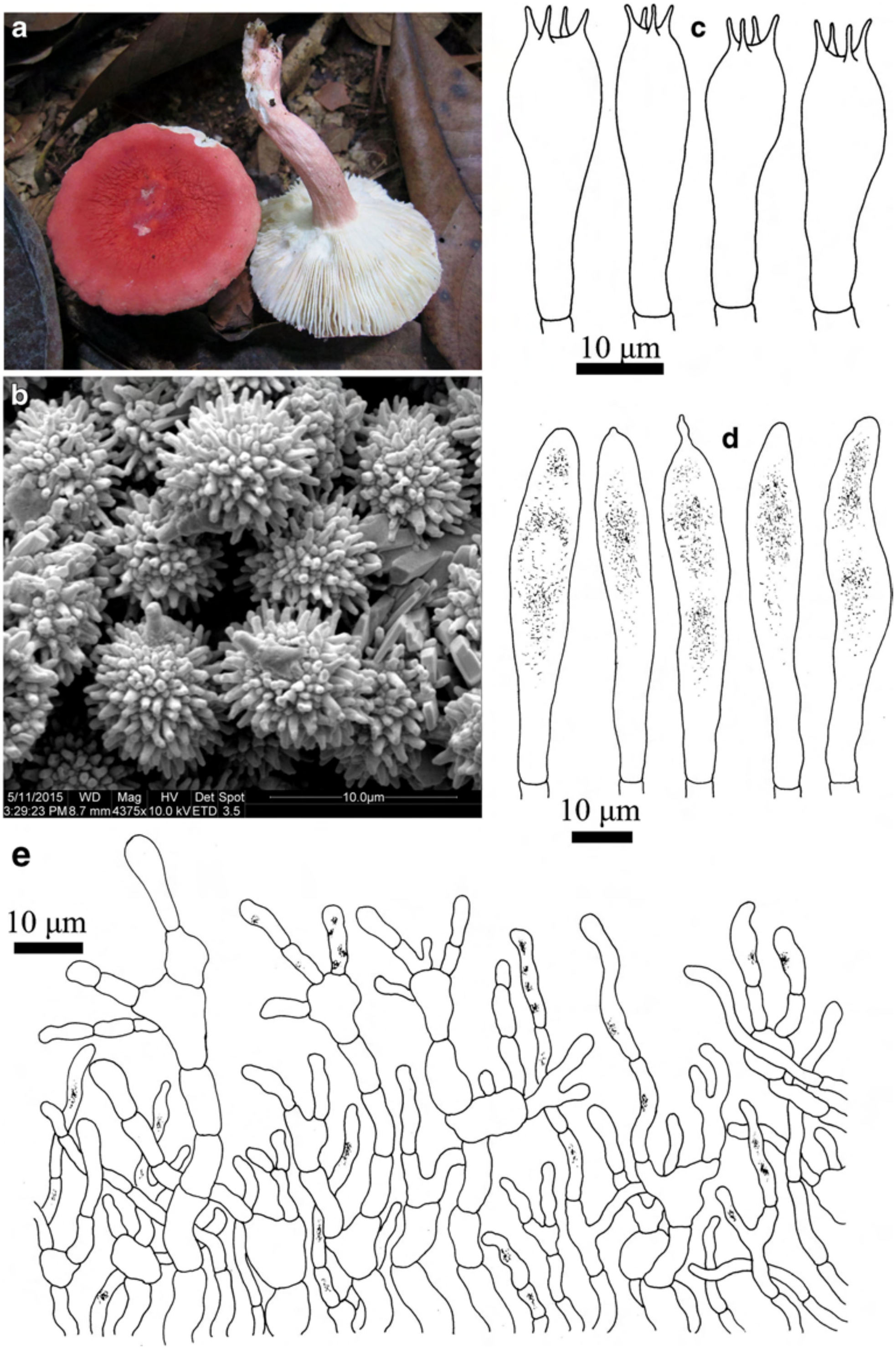


Fig. 158 *Russula hakkae* (holotype) **a** Basidiocarps **b** Basidiospores **c** Basidia **d** Pleurocystidia **e** Pileipellis

(I3f), partly longitudinally fade to White (LIII), a tinge of Pale Yellow–Orange (III15f) when injured, old and dry, first unchanging, spongy to hollow when mature. *Context* 2–5 mm thick from the lamellae attachment to the stipe, White, unchanging or becoming Sanford's Brown (II11k) when injured, fragile, odour indistinct, taste acrid. *Spore print* White (Romagnesi Ia).

Basidiospores [200/10/10] (6–) 6.7–8.1 (−8.8) × (5.5–) 5.8–6.9 (−7.5) µm, Q=(1.06–) 1.13–1.27 (−1.31), (Q=1.17± 0.06), hyaline, subglobose to broadly ellipsoid, rarely ellipsoid; ornamentation composed of dense, amyloid warts that are 0.9–1.2 µm high; suprahilar are distinct and amyloid. *Basidia* 40–50 × 10–15 µm, mostly with four sterigmata3–7 µm long, hyaline, sometimes yellowish in KOH, subclavate to clavate, rarely cylindrical. *Pleuroystidia* scattered, 55–77×8–12 μm, distinctly projecting 15–25 μm beyond the basidia, subfusoid to subcylindrical, sometimes clavate to subclavate, apices round to subacute, often appendiculate to subcapitate, thin–walled, contents granular to crystal, weakly grey in SV. *Cheilocystidia* same as pleurocystidia. *Subhymenium* a cellular layer 20–30 μm thick composed of inflated cells 10–25 μm diam., hyaline, sometimes pale yellowish in KOH. *Pileipellis* orthochromatic in cresyl blue, composed of epipellis and subpellis; epipellis a palisade 25–50 μm thick, composed of thin-walled, dense, ascending to erect, cylindrical hyaline hyphae 3–8 μm wide arising from a gelatinous matrix; terminal cells 6–10 μm wide, septate, clavate to cylindrical, apex obtuse; subapical cells often irregular, inflated, branched, up to 30 μm diam., subpellis composed of inflated cells same as the subapical cells, forming a pseudoparenchymatic region, interweaved hyaline hyphae 2–6 μm wide; primordial hyphae septate, protruding, with heteromorphous-opalescent inclusions and acid-resistant incrustations, 3–7 μm wide, apex obtuse; pileocystidia not observed. *Stipitipellis* a cutis, composed of filamentous hyphae 3–6 μm diam., interweaved with inflated cells 10–25 μm diam., hyaline, some hyphae yellowish to pale ochre in KOH; caulocystidia absent. *Trama* composed of sphaerocytes 35–100 μm diam. *Clamp connections and lacticiferous hyphae* absent from all tissues.

Habitat and distribution: Solitary to scattered in broad leaved forest dominated by *Lithocarpus* spp.

Additional specimens examined: CHINA, Guangdong Province, Meizhou City, Meixian County, Longwen Township, 9 August 2013, Xin-Hua Chen 9 (HMAS 267862); *ibid*., Xin-Hua Chen 4 (HMAS 267870); *ibid*., Xin-Hua Chen 45 (HMAS 267767); *ibid*., Xin-Hua Chen 9 (HMAS 267862); *ibid*., Xin-Hua Chen 2 (HMAS 267865); *ibid*., Xin-Hua Chen 34 (HMAS 267765); *ibid*., Xin-Hua Chen 37 (HMAS 267768); *ibid*., Xin-Hua Chen 6 (HMAS 267861); *ibid*., Xin-Hua Chen 15 (HMAS267864); *ibid*., Xin-Hua Chen 25 (HMAS 267769).

Notes: *Russula hakkae* can be easily distinguished from most of the other taxa of subsection *Roseinae* by its stabile pinkish tinge of stipe, acrid context taste, and very dense basidiospore ornamentation up to 1.2 μm. There are only a few members of subsection *Roseinae* which have pinkish tinged stipe. These taxa can be distinguished from *R. guangxiensis* as follows. *Russula peckii* Singer [as "undescribed species" in subsection *Roseinae* in Adamčík and Buyck (2012)] has a crenulate lamellar edge, a mild context taste, an ixotrichoderm pileus epicutis, and a habitat of coniferous forest (Peck 1907; Singer 1935). *Russula pseudopeckii* Fatto has a pileus edge with a few long lamellulae, a fruity to nondescript context odour, a cream spore print, and a basidiospore ornamentation composed of low warts (0.4–0.6 μm). *Russula rubellipes* Fatto has a mild context taste, a cream spore print, and some warts of basidiospore ornamentations forming a variable number of connectives (Fatto 1998).

Tremellomycetes*–*Tremellales

The class *Tremellomycetes* currently includes the orders *Cystofilobasidiales*, *Filobasidiales*, *Holtermanniales* and *Tremellales* (Boekhout et al. 2011; Wuczkowski et al. 2011; Millanes et al. 2011). The circumscription of these orders and the families within the Tremellomycetes is very much based on morphology and culture characteristics, and few molecular based investigations have tested these concepts. *Tremella* itself is highly paraphyletic, and the taxonomy and classification of filamentous and yeast-forming groups have developed in parallel (Chen 1998; Fell et al. 2000; Scorzetti et al. 2002). We expect the classification of the *Tremellales* to change rather drastically in the future. Some filamentous tremellalean groups were distinguished by Chen (1998), and Millanes et al. (2011) identified several groups of mainly lichenicolous species. A phylogenetic tree of *Tremellales* is presented in Fig. 159, to place the three newly described lichenicolous *Tremella* species in a phylogenetic context.

243. ***Tremella dirinariae*** Diederich, Millanes & Wedin, ***sp. nov.***

Index Fungorum number: IF551494; *Facesoffungi number*: FoF01008; Fig. 160.

Etymology: In reference to the host *Dirinaria*.

Holotype: Harris 37673 (NY).

Lichenicolous on the thallus of *Dirinaria aegialita*, not gall-inducing, not causing any visible damage to the host. Known only from the type locality in Florida. **Sexual morph**: *Basidiomata* initially as black swellings on the host thallus, breaking through the cortex, then black, pulvinate, often slightly taller than broad, strongly gelatinous, not gall-inducing, surface smooth to rugose, roundish to sometimes irregular in form, mainly 0.25–0.35(−1) mm diam., up to 0.3 mm tall. *Context hyphae* thick-walled, 2.2–3.5 μm diam., clamp connections not observed; haustorial branches present, mother cells subsphaerical, 3.5–4.5 μm long, 2.5–4 μm wide, haustorial filament 0.5–1 μm diam. *Hymenium* hyaline, containing numerous probasidia; *hyphidia* absent; *probasidial initials* clavate, proliferations occurring through the basal clamp. *Basidia*, when mature, 2-celled, with one transverse or oblique, exceptionally longitudinal septum, slightly constricted at the septum, (15–)17–24×6.5–10(−12) μm (excl. epibasidia), Q=(1.5–)2–3.5, often with an attenuated stalk-like base of variable length (explaining the rather large variability of basidial size); *epibasidia* subcylindrical, up to 50 μm long (only old collapsed epibasidia measured), 2.5–4 μm diam. *Basidiospores* ellipsoid to subsphaerical, with a distinct apiculus, 6–8×5.5–6.5 μm, Q=1–1.3. **Asexual morph**: Undetermined.

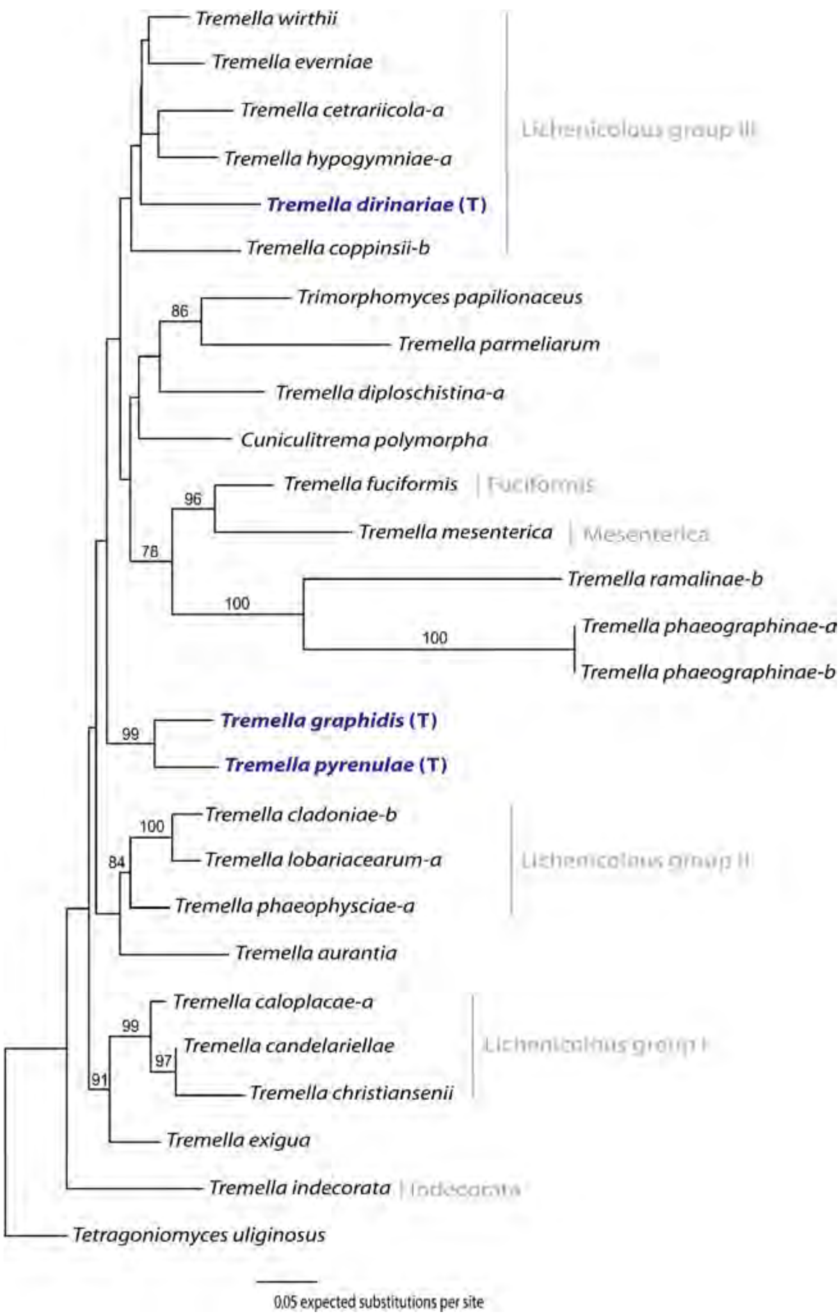


Fig. 159 Phylogram generated from maximum likelihood analysis (implemented in RAxMLGUI 1.3) based on combined LSU and ITS sequence data. Maximum likelihood bootstrap values≥70 % are indicated over the branches. Newly described species are in *blue*, and are represented by the type specimen (T). The tree is rooted with *Tetragoniomyces uliginosus* (Millanes et al. 2011)

Material examined: USA, Florida, Seminole Co., Little Big Econlockhatchee State Forest, along Florida Trail from entrance on Co. Rd. 426, 3.3 mi NE of Co. Rd. 419 in Oviedo, 28°41′ N, 81°10′ W, Sabal-*Quercus virginiana*-hardwood swamp, on *Liquidambar*, on *Dirinaria aegialita*, 10 January 1996, R. C. Harris 37673 (NY, **holotype**), (herb. Diederich, **isotype**).

Notes: Amongst the lichenicolous *Tremella* species with basidiomata developing on the host thallus and with 1-septate basidia, the new species is distinguished from most by the frequently stalked basidia and by the black basidiomata that are often slightly taller than broad. An undescribed species on *Leptogium* s. lat. studied by Diederich (1996, as '*Tremella* sp. 6') has much shorter basidia, 11–15 × 8.5–10 μm, and pale brown basidiomata. Another yet undescribed species on *Anaptychia* ('*Tremella* sp. 5') is distinguished by larger blackish basidiomata and slightly shorter and distinctly broader basidia, 15–19 × 10–15 μm. Within the species with not or rarely stalked basidia with mainly transverse or rarely oblique septa and distinct, not gall-inducing basidiomata, *Tremella santessonii* Diederich on *Usnea* is distinguished by dark reddish brown and flatter basidiomata, *T. phaeographidis*

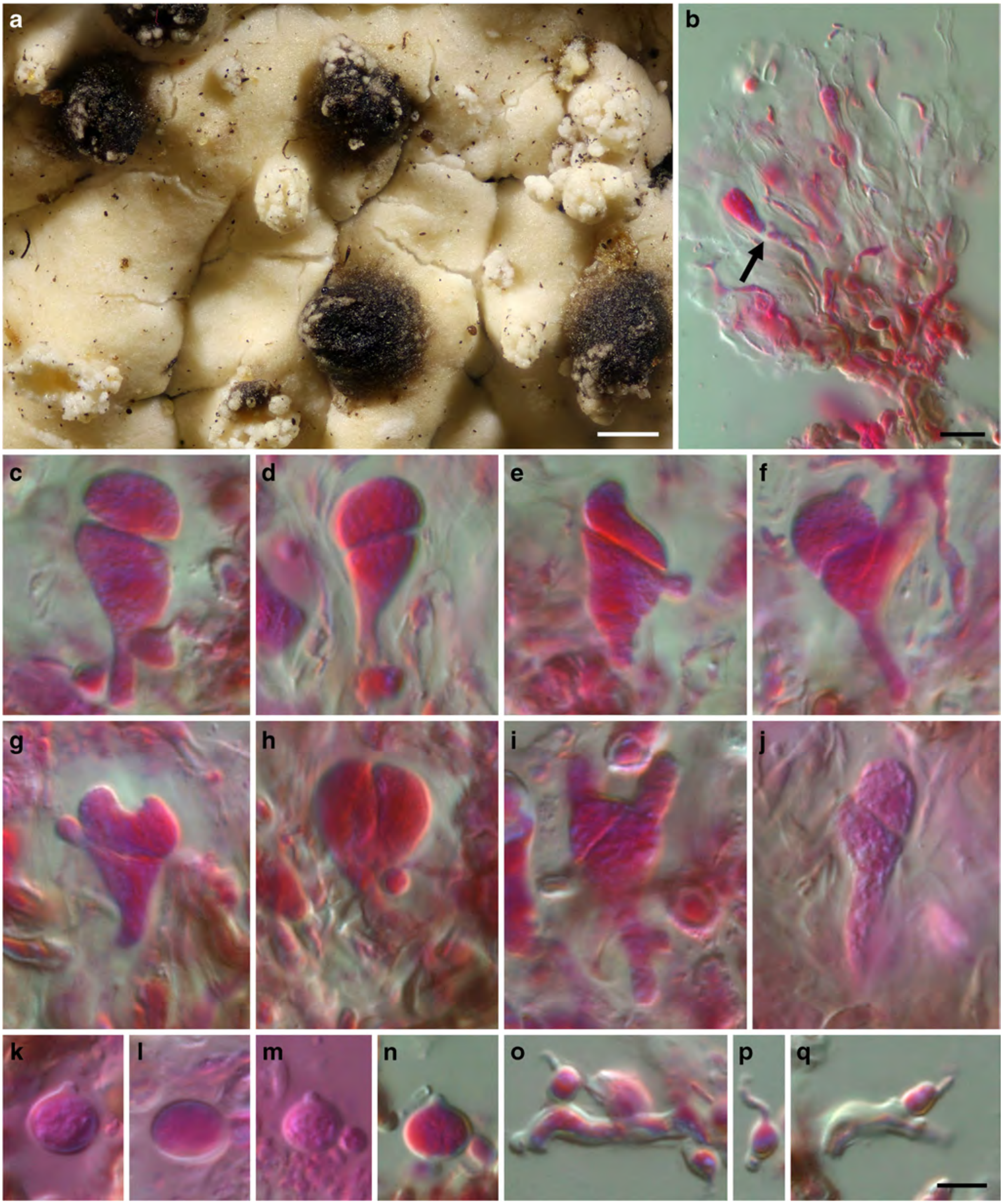


Fig. 160 *Tremella dirinariae* (NY, holotype) **a** Black basidiomata on thallus of *Dirinaria aegialita* **b** Hymenium with probasidium (*arrow* shows basal clamp), and old basidia and epibasidia (not stained) **c**–**j** Mature 1-septate basidia **k**–**n** Basidiospores **o**–**q** Haustoria. All microscopical photos in Phloxin B using DIC optics. Scale bars: **a**= 200 μm, **b**=20 μm, **c**–**q**=5 μm (scale bar in **q**). Photographs by P. Diederich

Diederich et al. on *Phaeographis* by larger basidiomata, 0.4–0.7 mm diam., and *T. psoromicola* Diederich on *Psoroma* by a hymenium composed of a dense layer of cylindrical, septate, little ramified hyphidia intermixed with basidia (Diederich 1996). The species is not closely related to other lichenicolous *Tremella* species growing on *Caliciales* (e.g., *Tremella christiansenii* and *T. phaeophysciae*), but rather groups with species growing on *Parmeliaceae*, within a clade designated as clade III by Millanes et al. (2011). This relationship is not recovered with support, however, in our phylogenetic analyses. *Dirinaria* belongs to *Caliciaceae* (Wedin et al. 2002; Helms et al. 2003; Miadlikowska et al. 2014) and the hosts of *T. christiansenii* and *T. phaeophysciae* belong to the *Physciaceae*.

244. *Tremella graphidis* Diederich, Millanes, Wedin & Common, *sp. nov.*

Index Fungorum number: IF551495; *Facesoffungi number*: FoF01009; Fig. 161

Etymology: In reference to the host *Graphis*.

Holotype: Common 9434B (BR).

Lichenicolous in the hymenium of *Graphis* species, incl. *G. assimilis*, *G. caesiella*, *G. cupei* and *G.* cf. *desquamescens*, not gall-inducing, distinctly enlarging the width of the host ascomata and gradually replacing the host hymenium by the basidiomata. Known only from Florida. **Sexual morph**: *Basidiomata* developing within the host hymenium, strongly enlarging the width of the initially narrowly lirelliform host apothecia, pale pinkish to brown, strongly gelatinous, surface rather smooth, elongate, up to 2(−3)×0.25 mm (i.e., the same form and size as the broadened disk of the host apothecia). *Context hyphae* thin-walled, 1.5–2.5 μm diam., clamp connections not observed; haustorial branches present, mother cells subsphaerical, 2.5–3.5 μm long, 1.5–2.5 μm wide, haustorial filament 1.5–4 μm long, 0.5–1 μm thick. *Hymenium* hyaline, containing numerous probasidia; *hyphidia* absent; *probasidial initials* narrowly clavate cylindrical, proliferations occurring through the basal clamp. *Basidia*, when mature, narrowly and elongate cylindrical, 2-celled, with one transverse septum in the upper third or quarter, not or slightly constricted at the septum, 30–38×4–5(−5.5) μm (excl. epibasidia), *Q*=6–8.5, without a stalk-like base; *epibasidia* subcylindrical, reaching at least 40 μm in length, probably 2–3 μm diam. (only old collapsed epibasidia observed). *Basidiospores* broadly ellipsoid, with a distinct apiculus, 6.3–6.8×5.3–5.8 μm, *Q*=1.1–1.2. **Asexual morph**: Undetermined.

Material examined: USA, Florida, Collier Co., Fakahatchee Strand State Preserve, trail north of Boardwalk, 25°56.51′ N, 81°28.16′ W, on *Graphis assimilis* and *G. caesiella*, 11 November 2011, R. Common 9434B (BR, **holotype**), (S, herb. Diederich, **isotypes**); *ibid*., on *G.* cf. *desquamescens*, R. Common 9443F (herb. Diederich); ibid., trail from Gate 7, 25°58.78′ N, 81°24.61′ W, on *Graphis* sp., R. Common 9370F (herb. Diederich); *ibid*., on *G. caesiella*, R. Common 9370H (herb. Diederich); near lake by Ranger Station, 25°57.25′ N, 81°21.80′ W, on *G. caesiella*, R. Common 9393H (herb. Diederich); *ibid*., Janes Scenic Drive, 25°58.74′ N, 81°22.26′ W, on *G. cupei*, 2014, R. Common 9736D, 9755J, 9763B, 9788C (herb. Diederich).

Notes: *Tremella graphidis* is a very distinct species, distinguished from all hitherto known lichenicolous *Tremella* species by the particularly long and narrow basidia, with a single transverse septum in the upper third or quarter. It mostly resembles *Biatoropsis usnearum* Räsänen s. lat., an assemblage of closely related species belonging to the non-monophyletic genus *Tremella* s. lat. (Millanes et al. 2014), and which has 1–3-septate, clavate to subcylindrical basidia, 20–44×3–6.5 μm, with usually missing basal clamps, and basidiospores 4.5–8×4–7.5 μm. All intrahymenial *Tremella* species described by Diederich (1996) have broader basidia.

Tremella graphidis is rather common in the hymenium of *Graphis* species in Fakahatchee Strand State Preserve in Florida, and resembles macroscopically *Tremella phaeographinae* Diederich & Aptroot, a species probably confined to *Phaeographis* s. lat., which is also common in Florida. The original material of *T. phaeographinae* was described from specimens of *Phaeographina*, a genus no longer recognized. The host of the holotype (Aptroot 26229, B) may belong in *Platygramme*, whilst the host of a paratype (Buck 22971, NY) is *Platygramme pachnodes* (det. Lendemer & Tripp). The host of a further specimen (Harris 36016, NY) is *Leiorreuma explicans* (det. Lendemer & Tripp). Both *Leiorreuma* and *Platygramme* belong to the *Phaeographis* clade, which might represent a single large genus *Phaeographis* (Rivas Plata et al. 2013), but none of the known host species has yet been included in a phylogenetic analysis. R. Harris and H. Sipman are acknowledged for information on the hosts identity. *Tremella phaeographinae* is macroscopically rather similar to *T. graphidis*, with basidiomata occurring on the host thallus and hymenium, but differs microscopically by very different, usually 3-celled basidia, often with a mixture of transverse and longitudinal septa. *Tremella phaeographinae* is here for the first time included in a phylogenetic analysis. Our results show that the *Tremella* species on *Graphidaceae* for which DNA sequences are available (i.e., *T. diploschistina*, *T. graphidis* and *T. phaeographinae*), do not group together. *Tremella phaeographinae* forms a well-supported clade with *T. ramalinae*, another *Tremella* species that combine both transverse and longitudinal septa within the same basidium (Diederich 1996).

Sequenced specimens of Tremella phaeographinae examined: USA, Florida, Hillsborough Co., Hillsborough River State Park, Florida Trail, 28°08.94′ N, 82°14.10′ W, on *Phaeographis*, 15 September 2011, R. Common 9481B

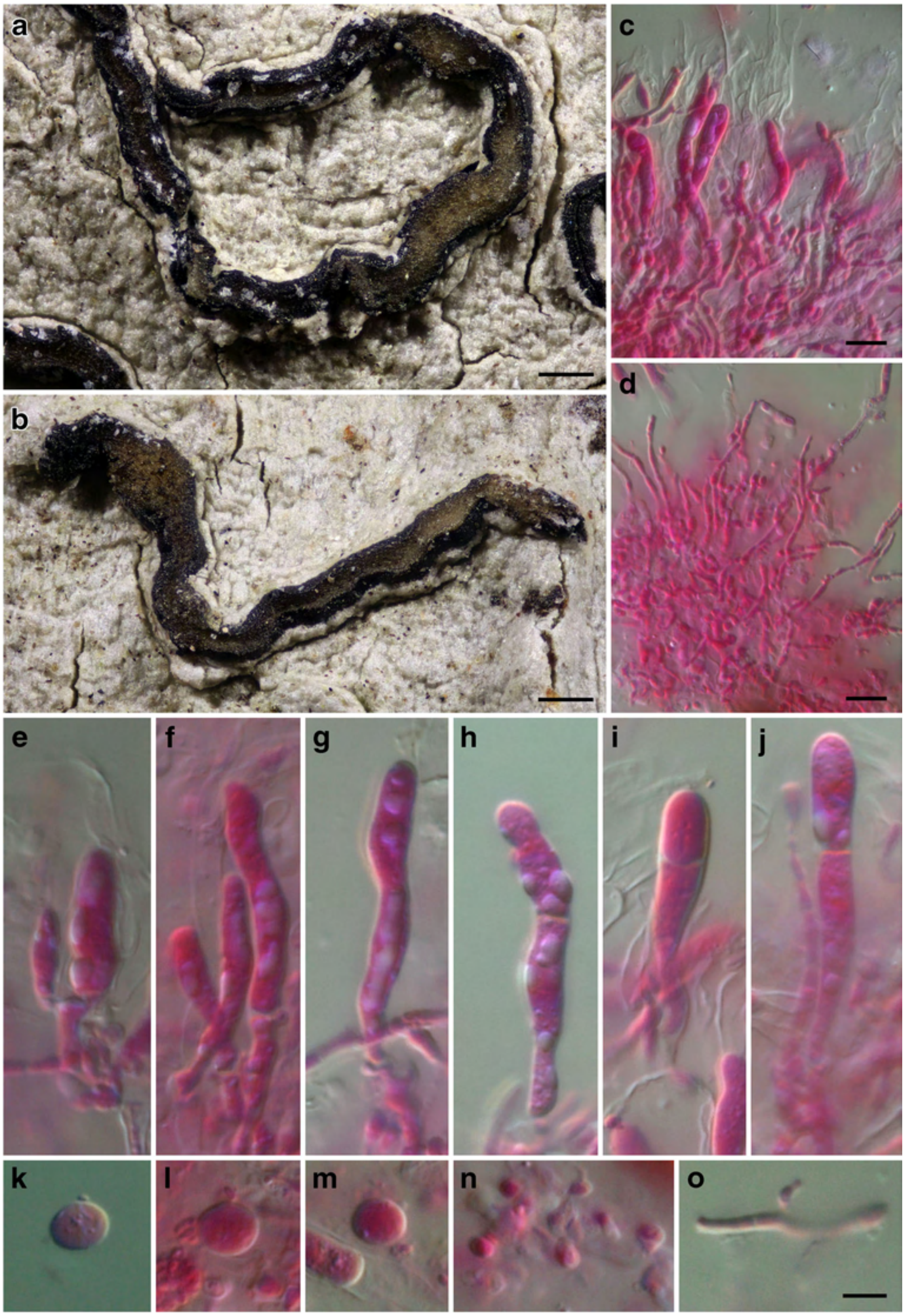


Fig. 161 *Tremella graphidis* (BR, holotype) **a**, **b** Brownish basidiomata parasitizing the hymenium of *Graphis assimilis* (*top left* of **a** visibly non-infected part of host apothecia). **c** Hymenium with basidia **d** Context hyphae **e**, **f** Probasidia (basal clamp visible in **d**) **g**–**j** Mature 1-septate basidia **k**–**m** Basidiospores **n**–**o** Haustoria. All microscopical photos in Phloxin B using DIC optics. Scale bars: **a**–**b**=200 μm, **c**–**d**=10 μm, **e**–**o**= 5 μm (scale bar in **o**). Photographs by P. Diederich

(S, herb. Diederich); sequence 'a' in Fig. 159; ibid., 28°08.90′ N, 82°14.01′ W, on *Phaeographis*, 26 October 2011, R. Common 9249C (S, herb. Diederich); sequence 'b' in Fig. 159.

245. ***Tremella pyrenulae*** Diederich, Millanes, Wedin & Common, ***sp. nov.***

Index Fungorum number: IF551496; *Facesoffungi number*: FoF01010; Fig. 162.

Etymology: In reference to the host *Pyrenula*.

Holotype: Common 9170B (BR).

Lichenicolous on the thallus of *Pyrenula ochraceoflavens*, not gall-inducing, not causing any visible damage to the host. Known only from Florida. **Sexual morph**: *Basidiomata* pink to pale brown, pulvinate, strongly gelatinous, surface rather smooth, roundish to slightly elongate, up to 0.5×0.4 mm, up to 0.3 mm tall, when mature with a constricted base. *Context hyphae* thin-walled, 2–

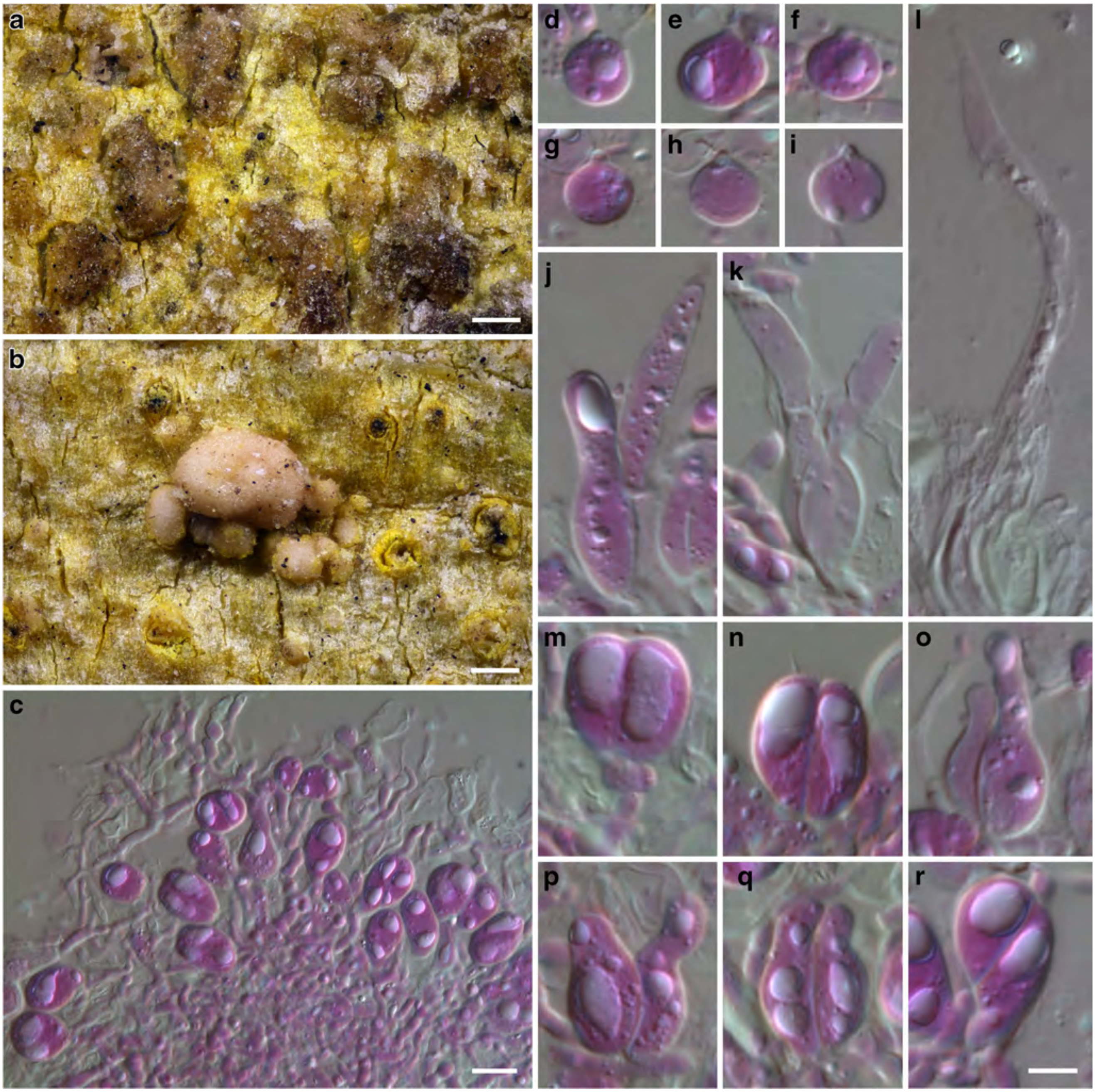


Fig. 162 *Tremella pyrenulae* (BR, holotype) **a**, **b** Brown to pinkish basidiomata on thallus of *Pyrenula ochraceoflavens* **c** Hymenium with numerous basidia **d**–**i**, Basidiospores **j**–**l** Mature 1-septate basidia with epibasidia **m**–**r** Basidia. All microscopical photos in Phloxin B using DIC optics. Scale bars: **a**–**b**=200 µm, **c**=10 µm, **d**–**r**=5 µm (scale bar in **r**). Photographs by P. Diederich

3 µm diam., clamp connections not observed; *haustorial branches* not observed. *Hymenium* hyaline, containing numerous probasidia; *hyphidia* absent; *probasidial initials* ellipsoid to rarely clavate, proliferations occurring through the basal clamp. *Basidia*, when mature, 2-celled, with one longitudinal septum, slightly constricted at the septum, 13–17(−19)×9.5–13 µm (excl. epibasidia), *Q*=1–1.6(−2), generally without attenuated stalk-like base; *epibasidia* subcylindrical, at least 45 µm long, 3–6 µm diam. *Basidiospores* ellipsoid to subsphaerical, with a distinct apiculus, 7–8×6.5–7.5 µm, *Q*=1–1.1. **Asexual morph**: Undetermined.

Material examined (all on *Pyrenula ochraceoflavens*): USA, Florida: Hernando Co., Baypoint Park at end of CR 50/550, 28°32.166′ N, 82°39.04′ W, 25 August 2011, R. Common 9170B (BR, **holotype**), (S, herb. Diederich, **isotypes**); *ibid*., R. Common 9165B (BR, herb. Diederich); Collier Co., Fakahatchee Strand State Park, Janes Scenic Drive, 25°58′45″ N, 81°22′15″ W, 2014, R. Common 9870Q (herb. Diederich); *ibid*., picnic area off US 41, 25°55′53″ N, 81°26′39″ W, 2014, R. Common 9705 K (herb. Diederich); Pinellas Co., Caladasi Island State Park, shrubs near beach, 28°02′ N, 82°49′ W, 2013, R. Common 9616A (herb. Diederich).

Notes: This species is distinguished from many lichenicolous *Tremella* species by the pale non-gall-inducing basidiomata developing over the host thallus, and by the non-stalked basidia with one longitudinal septum. *Tremella phaeographidis* Diederich et al. has smaller basidiospores, 5.5–7.5×5–6 μm, longer and narrower basidia (*Q*=c. 2) and larger basidiomata, 0.4–0.7 mm. *Tremella microcarpa* Diederich and *T. coccocarpiae* Diederich have smaller basidiomata, rarely exceeding 0.2 mm diam., the former smaller basidia, 9.5–12.5×7–11 μm, the latter smaller basidiospores, 5.5×4–4.5 μm. *Tremella macroceratis* Diederich & Hafellner and *T. papuana* Diederich have narrower basidiospores, 3.5–5.5 μm broad. *Tremella montis-wilhelmii* Diederich and the very similar *T. normandinae* Diederich are both distinguished by basidia with a larger l/w ratio (*Q*=1.5–2) (12–17×7–9 μm in *T. montis-wilhelmii*, and 14.5–21×8.5–11.5 μm in *T. normandinae*), and *T. montis-wilhelmii* furthermore by slightly smaller basidiospores, 6–7×5–6 μm. In our phylogeny, *Tremella pyrenulae* and *T. graphidis* form a monophyletic group. Neither the morphology, nor the host preference, however, explain this relationship. This is not surprising since previous studies have shown that morphological characters in *Tremella* are highly variable in closely related species, and that host switches have probably been frequent in the evolution of the group (Millanes et al. 2011, 2014).

Contributions to Zygomycota

Mucorales

Basal lineages of terrestrial fungi are traditionally summarized to the Zygomycota in a colloquial sense (Voigt 2012). The conquest of land as earliest fungi facilitated the invention of aplanosporic mitospores which do not rely on water for dispersal. Based on the potential to form zygospores during conjugation of two yoke-shaped gametangia it is referred to a phylogenetically coherent group named the Zygomycota for zygosporic fungi, even though these basal fungal clades lack phylogenetic resolution at the molecular level (James et al. 2006). Molecular phylogenetic analyses revealed the dispersal of this phylum into four subphyla (Hibbett et al. 2007; Hoffmann et al. 2011) and one phylum (Humber 2012).

Absidia proposed by (Van Tieghem 1876), classifies in the subphylum Mucoromycotina, order *Mucorales*, family *Cunninghamellaceae* (Voigt 2012). It includes mesophilic species morphologically characterized by producing sporangiophores arising from stolons and apophysate sporangia with deliquescent walls. A septum is frequently observed below the sporangium (Benny 2009). Zygospores enveloped by appendages are produced by sexual reproduction after conjugation of heterothallic gametangia (Hoffmann et al. 2007).

Species of *Absidia* are commonly isolated from soil and animal dung (Richardson 2009) and the last species proposed to this genus was *A. idahoensis* Hesselt., M.K. Mahoney & S.W. Peterson, isolated from honey bees in the state of Idaho, USA (Hesseltine et al. 1990). In 2001, *A. graminea* L.S. Loh was described in Malaysian (Loh et al. 2001), but it was considered invalid for not having a holotype deposited in a Culture Collection (http://www.indexfungorum.org; accessed 25 June 2015).

During a study on the *Mucorales* from semi-arid regions in Brazil, an *Absidia* specimen that differs morphologically and genetically from the other species of the genus was isolated and is being described as new to science. Another *Absidia* specimen was isolated from soil of Dokdo Island in Korea, which differs morphologically and phylogenetically from any other species within the genus. Furthermore, a new species of *Gongronella* was described from forest soil in the Jeonnam Province in Korea. At the generic level *Gongronella* is related to *Absidia* within the Cunninghamellaceae (Voigt 2012) (Fig. 163).

246. ***Absidia caatinguensis*** D.X. Lima & A.L. Santiago, ***sp. nov.***

Index Fungorum number: IF551223; *Facesoffungi number*: FoF01015; Fig. 164

Etymology: caatinguensis. Referring to biome where the species was first isolated.

Holotype: URM 7156

Colony initially white and becoming brownish gray (MP 15C2), covering the Petri dish (9 cm diam.) for four days and reaching the plate lid (1.5 cm height) in some points in MEA; colony reverse wavy zonate, initially cream to buff (MP 12H3) then becoming blackish brown in older cultures due to pigment production in the culture medium. *Odour* none; rhizoids branched and stolons 5–12 μm diam., smooth-walled, hyaline to light gray and irregularly septate. *Sporangiophores* 40–150(−210)×2.5–5 μm, erect, smooth and hyaline, growing along the stolons and terminally, showing occasionally swellings; solitary to 2–6 (−7) in a whorl and these often branched again (up to five times, mostly after 6 days of incubation), often with a septum below the sporangium, rarely showing two septa. *Sporangia* pyriform (15–)17.5–27.5 μm diam., multi-spored and smooth-walled, apophysate, sometimes with a bell shaped apophysis. *Columellae* hemispheric, sometimes subglobose, 10–20 μm

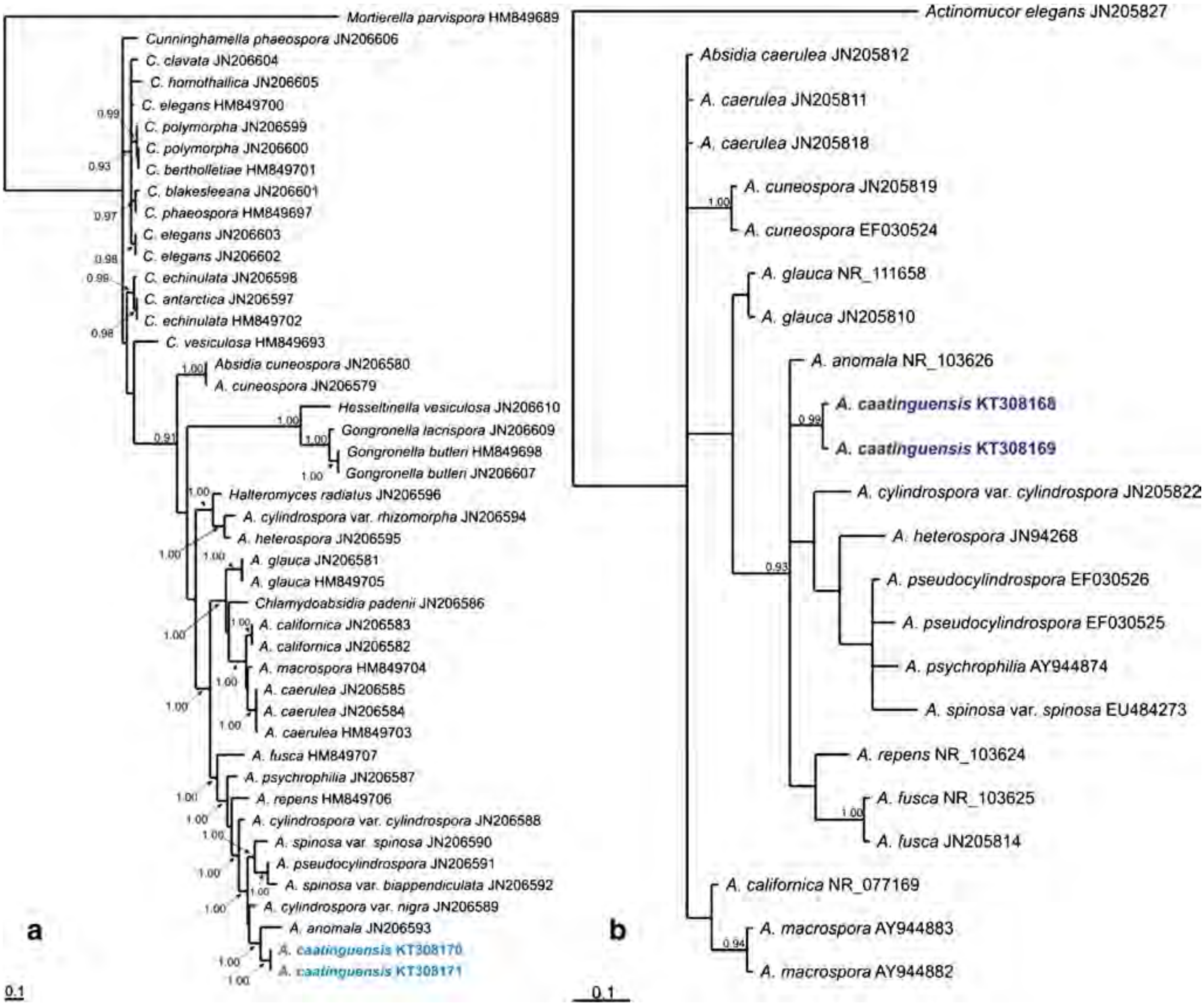


Fig. 163 **a** Phylogram generated from Bayesian analysis based on LSU sequence data. Bayesian posterior probabilities (PP) greater than 0.90 are indicated above or below the nodes. The new isolates are in *blue*. The tree is rooted with *Mortierella parvispora*. **b** Phylogram generated from Bayesian analysis based on 5.8S rDNA sequence data. Bayesian posterior probabilities (PP) greater than 0.90 are indicated above or below the nodes. The new isolates are in *blue*. The tree is rooted with *Actinomucor elegans*

diam., smooth-walled; collar present sometimes. One projection is usually present on upper surface of columellae up to 5.75 μm in length, some are bulbous at distal end up to 2.5 μm in width. *Sporangiospores* 5–7.5×2.5–3.7 μm, smooth, regular in size and shape, cylindrical, slightly constricted at the central portion. *Chlamydospores* absent. *Zygospores* not observed. Probably heterothallic.

Media, *temperature tests and mating experiments*: On MEA. At 15 °C–slow growth (7 cm in 192 h). At 20 °C–Good growth (9 cm in 96 h) and good sporulation. At 25 °C–Good growth with better sporulation than at 20 °C (9 cm in 96 h). A brown pigment is produced in media. At 31 °C–slower growth than at 25 °C (9 cm in 120 h) and good sporulation. At 35 °C–Lack of growth and sporulation. The growth of *A. caatinguensis* on PDA was similar to the growth on MEA at 25 °C, but the brown pigment was not produced. At 31 °C–the growth was slower in PDA than in MEA (9 cm in 120 h) with low sporulation. Influence of light: not detected.

Material examined: BRAZIL, Pernambuco, Buíque, Catimbau National Park (8°31′55.8″S, 37°15′34.2″W), Soil. 2013, D.X. Lima. Holotype (URM 7156); living culture deposited at Jena Microbial Resource Collection (University of Jena and Leibniz Institute for Natural Product Research and Infection Biology, Jena, Germany) (JMRC: SF:012107).

Habitat: soil

Notes: *Absidia caatinguens* is morphologically similar to *A. fusca*, but differs primarily in its pattern of sporangiophores branching, by the size of sporangiospores and the pigment production in the culture medium (Fig. 164). As *A. fusca*, some strains of *A. caatinguensis* produce branched

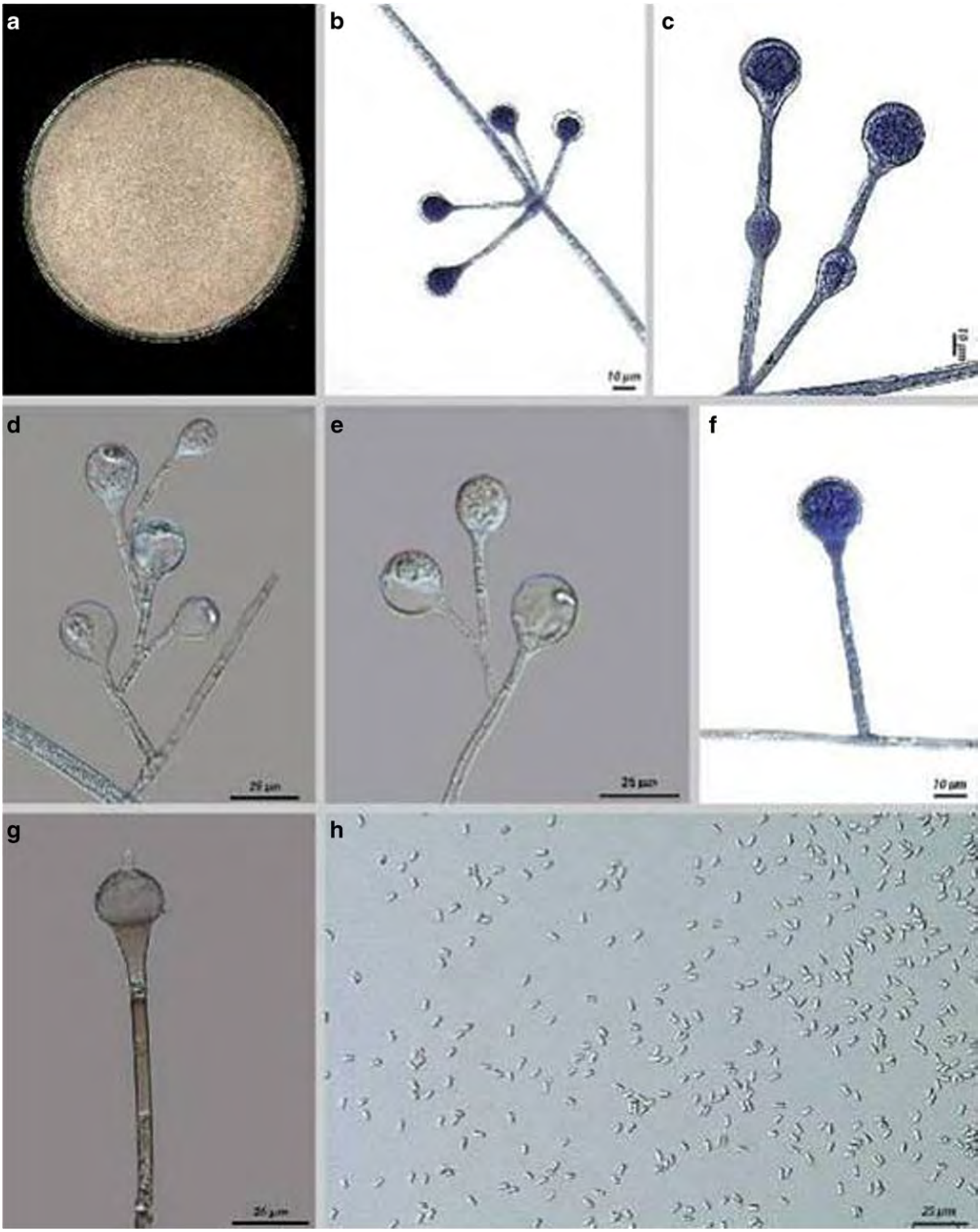


Fig. 164 *Absidia caatinguensis* (holotype) **a** Colony surface **b** Four sporangiophores in a whorl **c** Two sporangiophores in a whorl with occasional swellings **d**, **e** Branched sporangiophores **f** Simple sporangiophore with a bell-shaped apophysis under the sporangium **g** Simple sporangiophore with columella and a single projection **h** Sporangiospores

sporangiophores and a brown pigment that begins to appear by 20th day. However, sporangiophores of *A. caatinguensis* are much more branched than those of *A. fusca*, and the pigment is produced at temperatures higher than 15 °C d. *Absidia caatiguensis* sporangiospores are greater than those of *A. fusca* (3.3–4.5 × 1.8–3.5) (Hesseltine and Ellis 1964). Additionally, *A. fusca* colonies show a smooth colony reverse, different from the wavy zonate reverse observed in the new species. Our molecular analyzes (LSU rDNA and 5.8S rDNA) showed that *A. caatinguensis* is genetically different from the other species of the genus (Fig. 163a, b).

247. ***Absidia koreana*** H.B. Lee, H.W. Lee & T.T.T. Nguyen, ***sp. nov.***

MycoBank number: MB 813805; *Faces of fungi number*: FoF 01015; Fig. 166

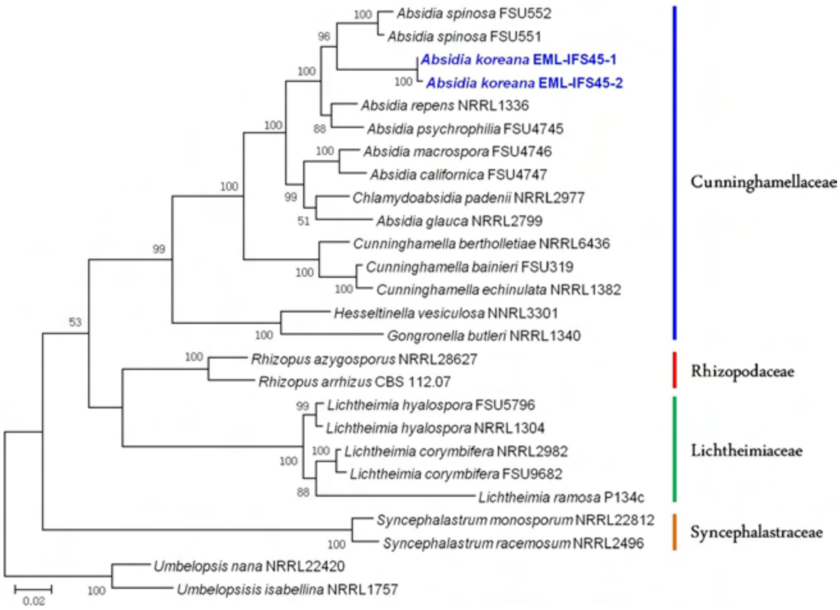
Etymology: koreana. Referring to the country which from the species was first isolated (Korea, Dokdo island).

Holotype: CNUFC-EML-IFS45-1, deposited at the Environmental Microbiology Laboratory Herbarium, Chonnam National University, Gwangju, Korea.

Colony exhibits rapid growth on SMA, attaining a diameter of 62–65 mm after 4 days at 25 °C. The initial color of the colonies is white, which later changed to grayish white or smoky gray, and the colonies cover almost the entire surface of the agar in the petri dishes within 5 days. The colony reverse is white and irregularly zonate. Although the mycelial growth on SMA is sparse, the sporulation is excellent. *Sporangia* 19.33–23.64 μm × 21.06–26.35 μm in diam., and are globose to slightly elliptical, having sporangial net wall. *Sporangiophores* are 3.84–4.60 μm wide and arise as 1–6 sporangiophores (average 2–4) per whorl from a single point in the stolons. They show occasional branching, with the presence of a septum approximately 17.71–23.53 μm in length below the apophysis. *Collar* appears around the base of each columella. *Sporangiospores* are short-cylindrical or cylindrical, and measure 2.15–2.35 μm wide × 3.54–4.48 long. *Columellae* are 10.90–16.96 μm × 11.46–18.89 μm diam., and typically globose with a collarette. *Zygospores* are not observed in this medium. *Colonies* exhibit slower growth on PDA than on SMA, attaining 39.5–41 mm in diam. after 4 days at 25 °C, which is about 15 mm higher than that attained in 3 days. The colonies exhibit slower growth on PDA than on SMA, attaining 39.5–41 mm in diam., and 1.5 mm in height after 4 days at 25 °C. At 25 °C, the colonies appear dark brown in the center, with a lighter margin. The colony reverse is white, with the wavy zonation much more pronounced than that shown by colonies grown on the SMA medium. *Sporangiophores* are 3.69–4.68 μm wide, erect, and arise as a single sporangiophore or in groups of 2–3 from the same location on the stolon. They exhibit occasional branching with a septum consistently present 14.38–19.80 μm below the apophysis. *Sporangia* measure 18.78–27.59 μm × 19.80–29.57 μm in diam., and are globose to slightly elliptical. *Sporangiospores* measure 1.73–1.98 μm wide × 2.07–4.28 μm long, and are cylindrical. *Columellae* measure 10.64–12.98 μm × 15.60–16.83 μm, and appear globose, with a small collarette. Chlamydospores and vesiculate sporangiophores were observed at 32 °C.

On SDA, *Colonies* grow more rapidly than on SMA and PDA, attaining 73–75 mm in diam. after 4 days at 25 °C. The initial color of the colonies at 25 °C is grayish white, which

Fig. 165 Phylogenetic tree for *Absidia koreana* EML-IFS45-1 and EML-IFS45-2 and related species based on Maximum likelihood (ML) analysis of multigenes including 18S and 28S rDNA, elongation factor (EF-1α), and actin (Actin-1). Sequences of *Umbelopsis nana* and *U. isabellina* were used as outgroups. Bootstrap support values >50 % are indicated at the nodes. The *bar indicates* the number of substitutions per position



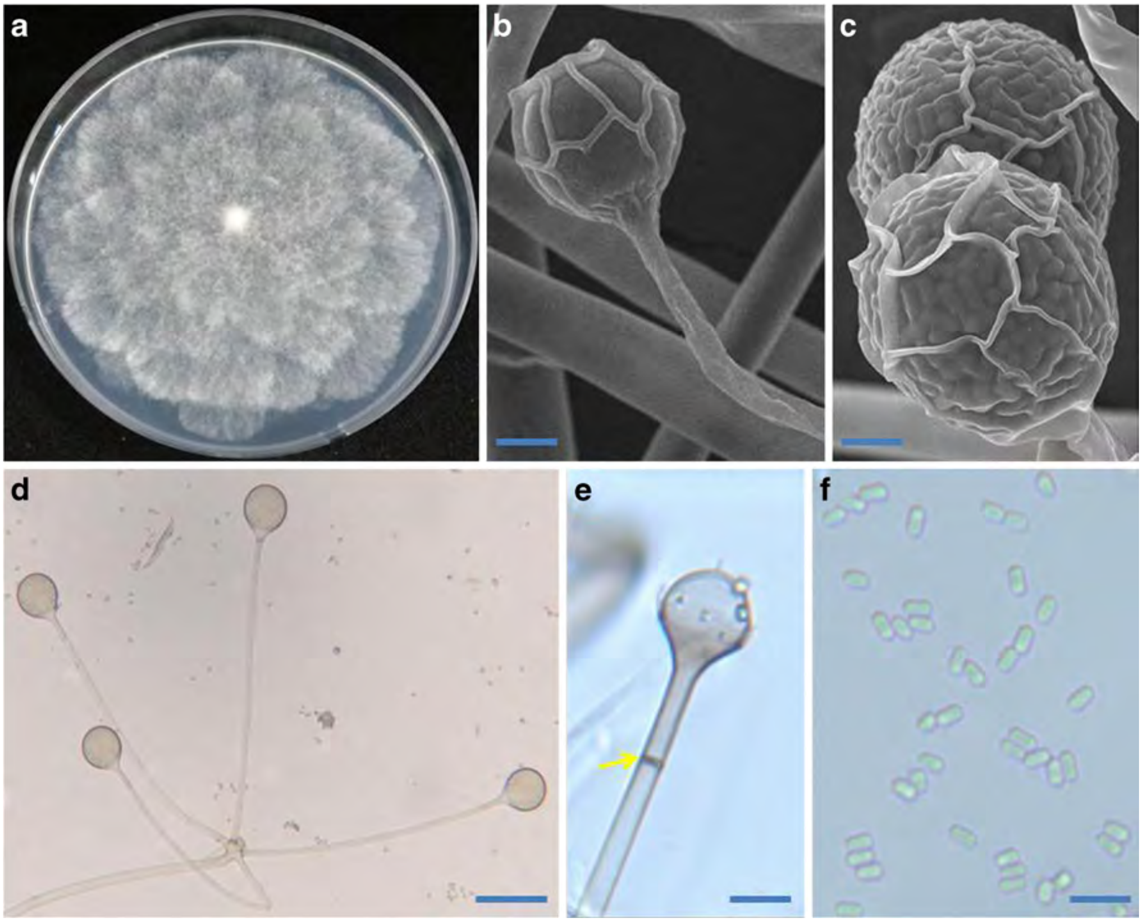


Fig. 166 Morphology of *Absidia koreana* (EML-IFS45-1, holotype). **a** colony in synthetic mucor agar. **b** simple sporangiophore with young sporangium. **c** mature sporangia with sporangial net wall and sporangiospores. **d** attachment of sporangiophores. **e** columella with collarette and septum (*yellow arrow*). **f** sporangiospores. Scale bars: **b**, **c**, **f**=10 μm, **d**=50 μm, **e**=20 μm

later changed to grayish brown. The colony reverse is grayish white, with wavy zonation. *Sporangiophores* are 2.17–4.28 μm wide, erect, and arise either singly or in groups of 2–4 sporangiophores from the same location on the stolon. They exhibit occasional branching, and always have a septum under the sporangium. *Sporangia* measure 24.97–42.21 μm× 23.24–35.94 μm in diam., and are globose to slightly elliptical in appearance. *Sporangiospores* are cylindrical and measure 2.0–2.57 μm wide×3.25–4.15 μm long. No chlamydospores or zygospores are detected in this medium. Although the SDA medium exhibit good mycelial growth, a small number of sporangia are produced. A temperature from 27 °C to 32 °C is found to be optimal for the growth of *Absidia*, as shown in the colonies observed on PDA, SMA, and SDA. The fungus shows restricted growth at 37 °C.

Material examined: REPUBLIC OF KOREA, Division of Food Technology, Biotechnology & Agrochemistry, College of Agriculture & Life Sciences, Chonnam National University, Gwangju 61186, Korea, from soil in Dokdo island in the East Sea of Korea; KOSPFGC 1143 (ex-type) at Culture Collection of National Institute of Biological Resources (NIBR), Incheon, Korea, and isotype EML-IFS45-2 preserved as glycerol stock at −80 °C in the CNUFC.

The isolate was observed to grow over a wide range of temperatures with varying growth rates on PDA, SMA, and SDA. The average growth rates of EML-IFS45-1 on PDA, SMA, and SDA were 13 mm, 21 mm, and 27 mm per day, respectively. Optimal growth was observed at 27 °C, slow growth was observed at 18 °C, and extremely slow growth at 37 °C (Fig. 168).

248. ***Gongronella koreana*** H.B. Lee & T.T.T. Nguyen, ***sp. nov.***

MycoBank number: MB 811445; *Faces of fungi number*: FoF 01015; Fig. 169

Etymology: koreana. Referring to the country which from the species was first isolated (Korea, Jeonnam Province).

Holotype: EML-TS2Bp was maintained permanently in a metabolically inactive state at the Environmental Microbiology Laboratory Herbarium, Chonnam National University,

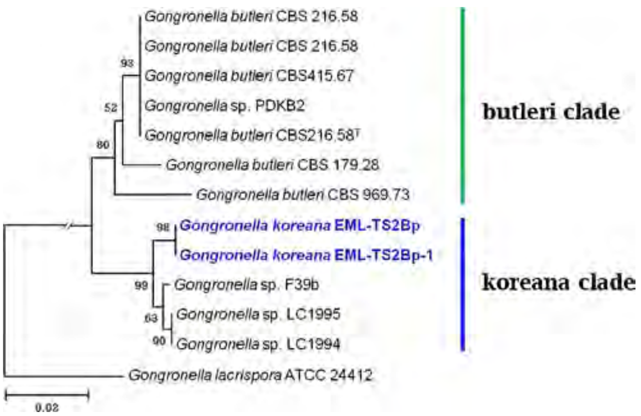


Fig. 167 NJ phylogenetic tree inferred from the individual datasets of rDNA ITS sequences from *Gongronella koreana* sp. nov. EML-TS2Bp and EML-TS2Bp-1 and related species. Sequences of *Gongronella lacrispora* was used as outgroups. *Numbers* at the nodes indicate the bootstrap values (>50 %) from 1000 replications. The *bar* indicates the number of substitutions per position

Gwangju, Korea. CNUFC- EML-TS2Bp, as dried fungal mass from culture (PDA), August 2013, by H. B. Lee, in the Chonnam National University Fungal Collection (CNUFC), Gwangju, Korea.

Colonies exhibit slow growth on SMA, attaining 21–25 mm in diam. after 7 days at 25 °C. All colonies are cotton white in color. The colony reverse is also white with an irregular margin. Although the growth of mycelia on SMA is

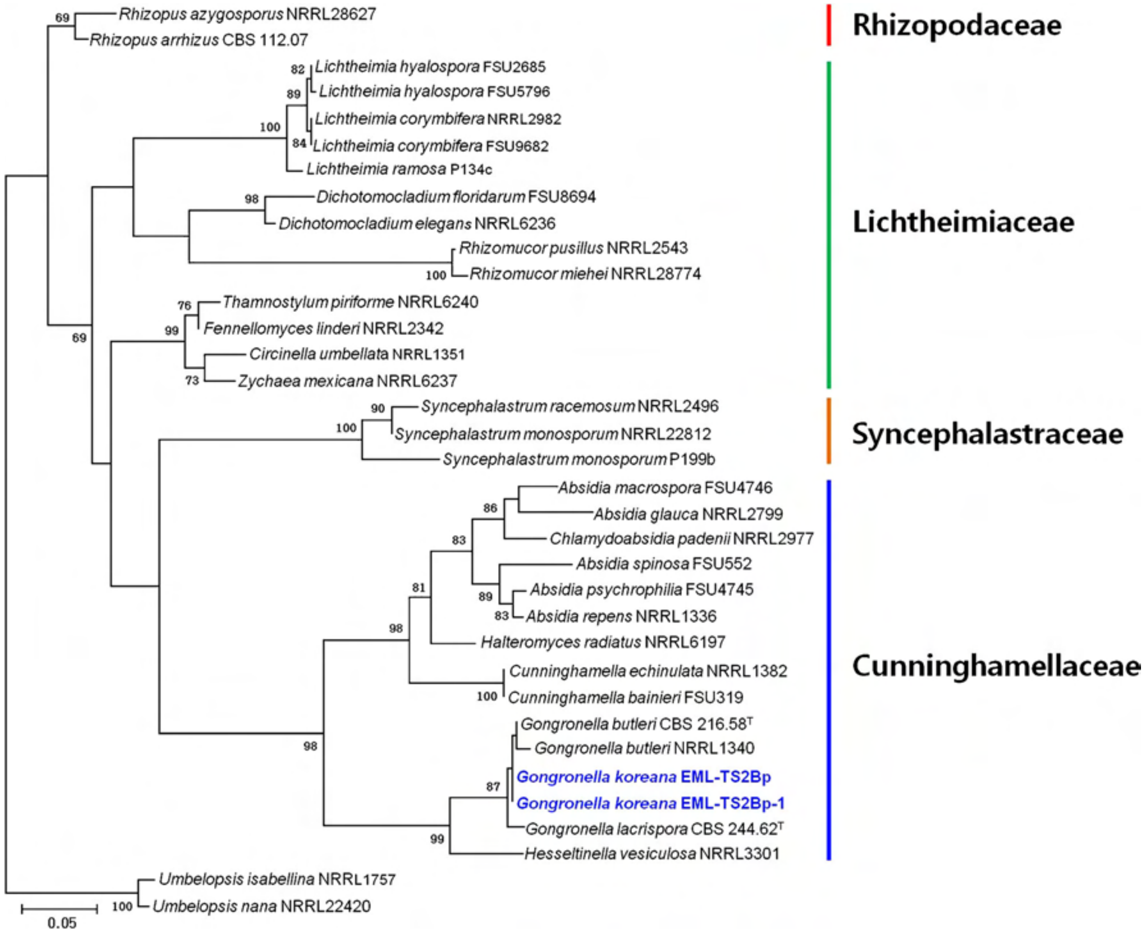


Fig. 168 Maximum likelihood phylogenetic tree inferred from the combined dataset of 18S rDNA, 28S rDNA, elongation factor (EF-1α), and actin (Actin-1) gene sequences from *Gongronella koreana* sp. nov. EML-TS2Bp and EML-TS2Bp-1 and related species. Sequences of *Umbelopsis nana* and *U. isabellina* were used as outgroups. *Numbers* at the nodes indicate the bootstrap values (>50 %) from 1000 replications. The bar indicates the number of substitutions per position

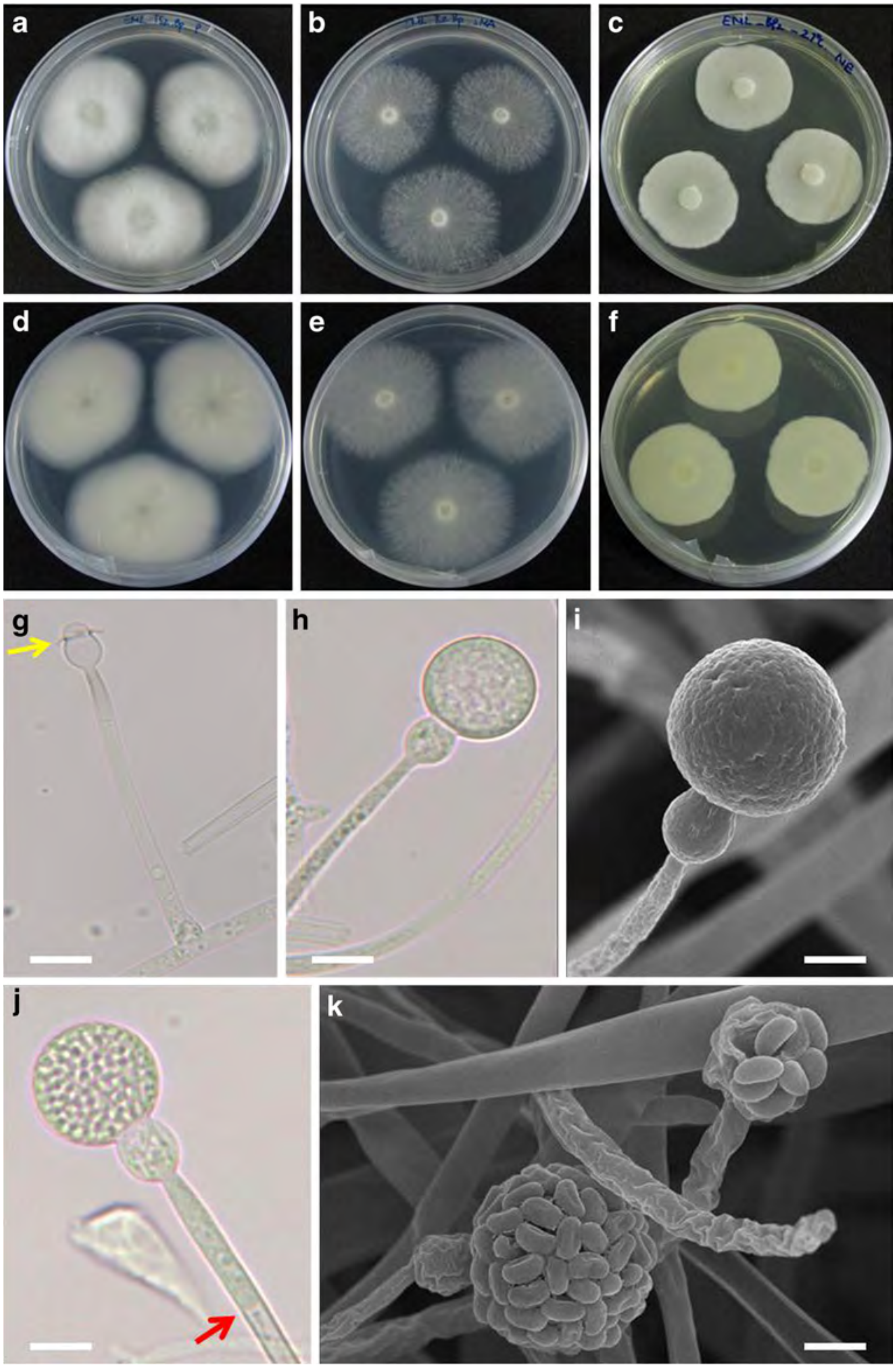


Fig. 169 Morphology of *Gongronella koreana*. **a**, **d** colony in potato dextrose agar. **b**, **e** colony in synthetic mucor agar **c**, **f** colony in malt extract agar after 7 days at 25 °C. **a-c** colony representing the obverse plate view. **d-f** colony representing the reverse plate view. **g** sporangiophore with short columella, apophysis, and collarette (*yellow arrow*). **h**, **i** simple sporangiophore with young sporangium. **j** development of sporangia and sporangial septum (*red arrow*). **k** mature sporangia and sporangiospores. Scale bars: **g**–**j**= 20 μm, **k**=10 μm

sparse, the sporulation observed is extensive. *Sporangiophores* grow to a width of 2.5–2.8 μm and a variable length surfacing directly from the aerial mycelia, erect, many-branched, and always displaying a septum clearly below the apophysis, separating the sporangium from the sporangiophore (Fig. 169g). *Sporangia* measure 12.3–15.5× 12.4–15.6 μm in diam., and are globose, light yellow to chestnut yellow, and are multispored. The sporangial wall is thin and purple. *Sporangiospores* are released after the sporangial wall is deliquesced at maturity. The sporangiospores measure

1.7–2.1 × 2.1–2.8 μm, and are mostly bean-shaped. *Columellae* 1.2–2.3 × 2.6–3.3 μm in size, hemispherical with a collarette. *Apophyses* are 5.4–6.5 × 5.9–7.1 μm in size, and typically pyriform (Fig. 169g). *Chlamydospores* are present on the aerial mycelia. *Zygospores* are not observed. *Rhizoids* are not well developed.

On PDA, *colonies* grow more rapidly than on SMA, reaching 31.5–33 mm in diam. after 7 days at 25 °C. The initial color of the colonies at 25 °C is light white, which later turned to cotton white. The color of the colony reverse is light-colored to white. The *center* of the *colony* appeared moist. *Sporangiophores* are 2.8–3.0 μm wide, erect, but slightly curved inwardly, and arising from the aerial mycelia, either singly or with up to six branches. *Sporangia* measure 17.5–20.6 × 17.0–21.0 μm in diam., and are mostly globose and multispored. *Sporangiospores* are subglobose to ellipsoidal or bean-shaped, became hollow inwardly and measure 1.3–1.6 × 2.7–3.2 μm. *Apophyses* measure 8.7–10.0 × 5.7–8.2 μm, and display a subglobose to pyriform shape. *Columellae* are hemispherical and globose and measure 2.7–3.3 × 3.9–5 μm, and a large collarette is usually present. Mycelial development and chlamydospore formation is well defined on PDA medium. *Zygospores* are not observed on this medium.

Colonies on MEA attain a diameter of 27.0–28.5 mm. after 7 days at 25 °C. The color of the colonies is creamy-white. The colony reverse color is milky-white. *Sporangiophores* are 2.4–2.7 μm wide, erect, displaying either a single branch or 2–4 branches. *Sporangia* measure 13.2–15.6 × 13.7–16.0 μmindiam., and are typically globose. *Sporangiospores* measure 1.4–1.6 × 2.6–3.2 μm, and are subglobose to ellipsoidal, or bean-shaped. *Apophyses* are pyriform, and measure 4.4–7.5 × 5.4–8.1 μm. *Zygospores* are not observed on this medium. Mycelial development is notably better than that on SMA medium; however, a smaller number of sporangia are produced on MEA medium.

Material examined: REPUBLIC OF KOREA, Division of Food Technology, Biotechnology & Agrochemistry, College of Agriculture and Life Sciences, Chonnam National University, Gwangju 500–757, Korea, from forest soil in the Jeonnam Province in Korea; KOSPFGC 1268 (ex-type) at the Culture Collection of National Institute of Biological Resources (NIBR), Incheon,, Korea, and also additional ex-types EML-TS2Bp-1 to −3 preserved as glycerol stock at −80 °C in the CNUFC.

The isolate was observed to grow in a wide range of temperatures with varying growth rates on PDA, SMA, and MEA media. The average growth rates of the EML-TS2Bp isolate on PDA, SMA, and MEA were 5.5 mm, 3.5 mm, and 4.5 mm per day, respectively. The optimal growth temperature was found to be 27 °C, and slow growth was observed at 18 °C. No growth was observed at 37 °C.

Mortierellales

Mortierella is currently a member of the family *Mortierellaceae*, order *Mortierellales*, subphylum Mortierellomycotina (Hibbett et al. 2007; Hoffmann et al. 2011), now approximately 85 species (Kirk et al. 2008a, b).

They are ubiquitously saprotrophic or parasitic microfungi, usually can be isolated from soil, leaf letter or animal dung (Gams 1977; Hoffmann et al. 2011). Their colonies appear zonate and rosette-like, some species produce garlic-like odor. Young mycelia are coenocytic and produce irregular septa when age. Sporangiophores are simple or with various branches terminating with sporangia and swelling at the base. Sporangia are spherical, multi-, few- or uni–spored, forming only a rudimentary columella or lacking it altogether. Some species produce chlamydospores or stylospores. Zygospores are naked, or surrounded by a hyphal sheat and with unequal suspensors (Zycha et al. 1969; Gams 1977; Degawa and Seiji 1997; Weber and Webster 2007; Wagner et al. 2013). Identification is usually based on morphological characters. In a survey of Zygomycetes in Taiwan, soil and leaf letter specimens were collected form forests, national parks, roadsides and school campus. Among the *Mortierella* species collected, two undescribed species of *Mortierella* were isolated. Because they do not correspond to any described species, thus, are proposed here as two new species (Fig. 170).

249. ***Mortierella pisiformis*** H.M. Ho, S.F. Wei & K. Voigt, ***sp. nov.***

MycoBank: MB 811959; *Facesoffungi number*: FoF01016; Figs. 171 and 172

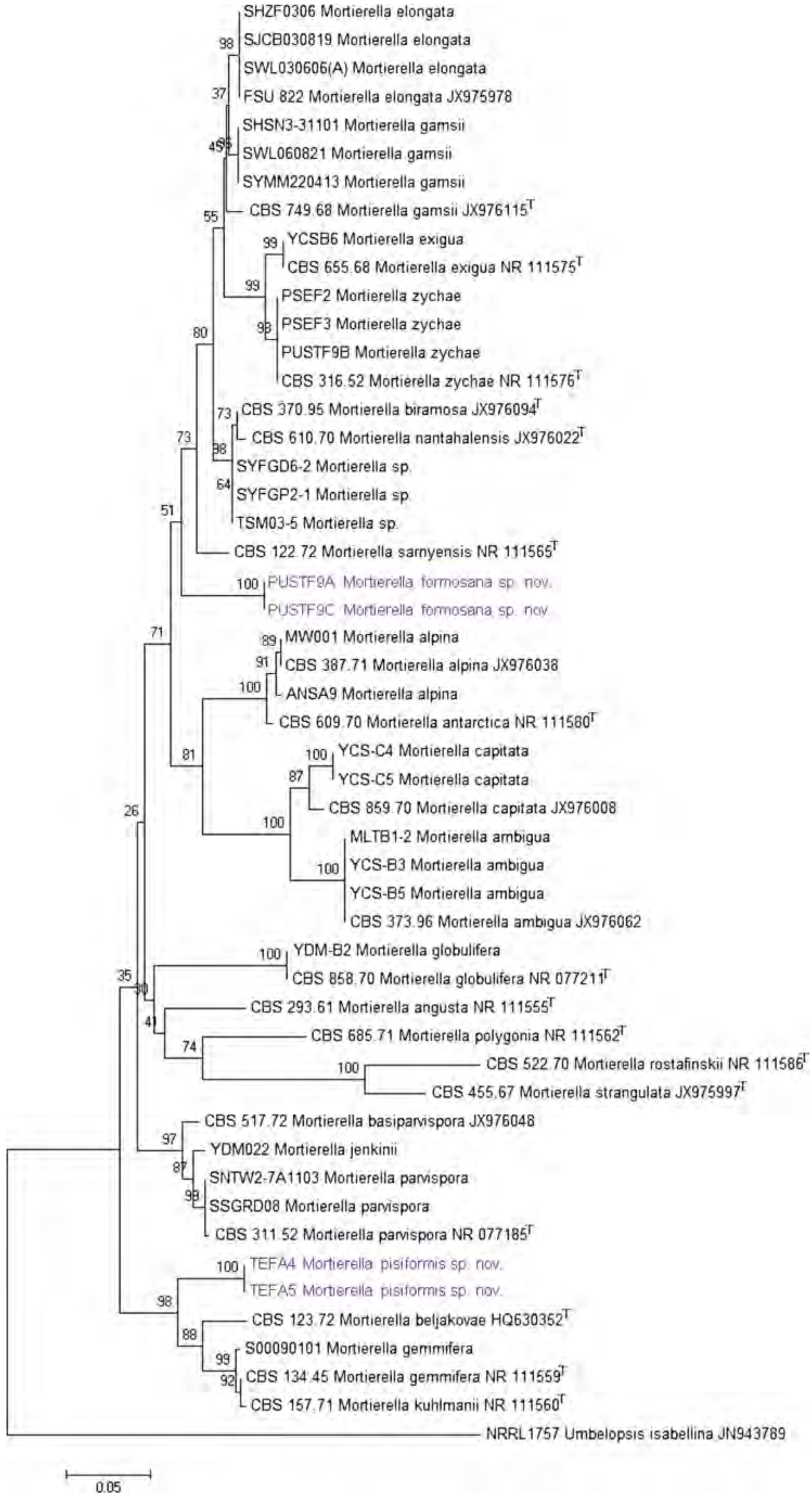
Etymology: From the Latin *pisiformis*, meaning pea-shaped, in reference to the shape of spores.

Holotype: TNMF 28604

Colonies grown on PDA at 25 °C for 7 days, reaching 9 cm in diameter, white, with abundant aerial hyphae, turf cottony. On CMA, aerial hyphae dispersed, creeping on the agar surface. *Sporangiophores* developing from creeping aerial hyphae, simple or with 1–2 branches arising from the lower portion near base, 643–874.5 μm long, 10–12.5 μm wide near base, tapering upward, becoming 2.5–5 μm wide near sporangium, basal rhizoid absent or with one simple rhizoid. *Sporangia* globose, multisporous, hyaline, 25.5–33 μm in diam., wall smooth, after deliquescence leaving indistinct columellae and trace of collar. *Spores* ellipsoid, pea-shaped, hyaline, surface smooth, 7.5–10 × 12.5–15 μm. *Chlamydospores* globose, 15–23 μm in diam., submerged in agar medium or on the agar surface, usually on short hyphae terminal, sometimes in chains. *Zygospores* not observed. *Odour* faint.

Material examined: TAIWAN, Taichung City, Dongshi Forest Garden, from leaf litter, December 2013, by S.F. Wei, TEFA4 (TNMF 28604, **holotype**), BCRC FU30283, living

Fig. 170 NJ phylogenetic tree based on a MEGA 5.0 analysis (Tamura et al. 2011) using ITS rDNA sequences of *Mortierella* species with *Umbelopsis isabellina* as the out group taxon. The bootstrap values are based on 1500 replicates



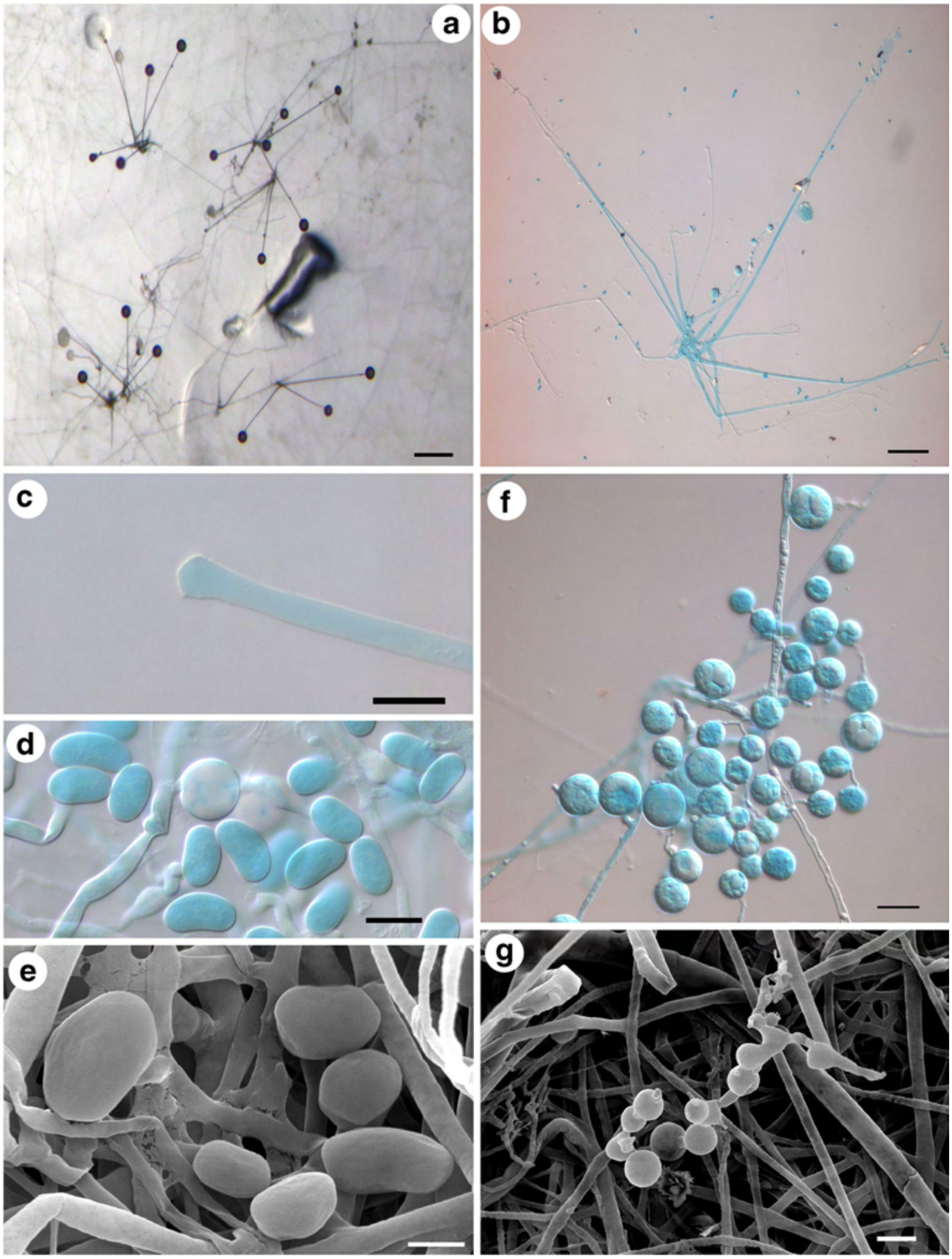


Fig. 171 *Mortierella pisiformis* (TEFA5) **a** Photograph of fresh culture taken with a stereomicroscope; **b**–**d**, **f**, **l**, **m**; **e**, **g**, SEM. **a** Habit on CMA **b** Sporangiophore with branch **c** Columellae (*arrow*) and collar (*arrow head*) Spores **e** Spores **f** Chlamydospores **g** Chlamydospores. Scales bars: **a**= 300 μm, **b**=100 μm, **c**, **f**=20 μm, **d**, **g**=10 μm, **e**=5 μm

culture deposited at Jena Microbial Resource Collection (University of Jena and Leibniz Institute for Natural Product Research and Infection Biology, Jena, Germany) (JMRC: SF:012101).

Other specimen: Taichung City, Dongshi Dist., from leaf litter, Decembe 2013, S-F Wei. TEFA5 = BCRC FU30284

Notes: According to Gams (1977), this fungus belongs to Section Hygrophila, and is similar to *M. Beljakovae* Mil'ko, *M. parazychae* W. Gams and *M. zychae* Linnem. by having the following characters in common: multisporous sporangia; sporangiophores longer than 120 μm, basitonous ramification and with chlamydospores aggregated in rows or clusters. However, this fungus can be differentiated from the other three by spore shape, which is pea-shaped, ellipsoid in the former and is more or less globose in *M. beljokovae*, ellipsoid to cylindrical in the other two species. Molecular data revealed that our two isolates are clustered in on clade and can be separated from the other species of *Mortierella* in phylogenetic tree of ITS region. We thus identified this fungus as a new species.

250. ***Mortierella formosana*** S.F. Wei, H.M. Ho & K. Voigt, ***sp. nov.***

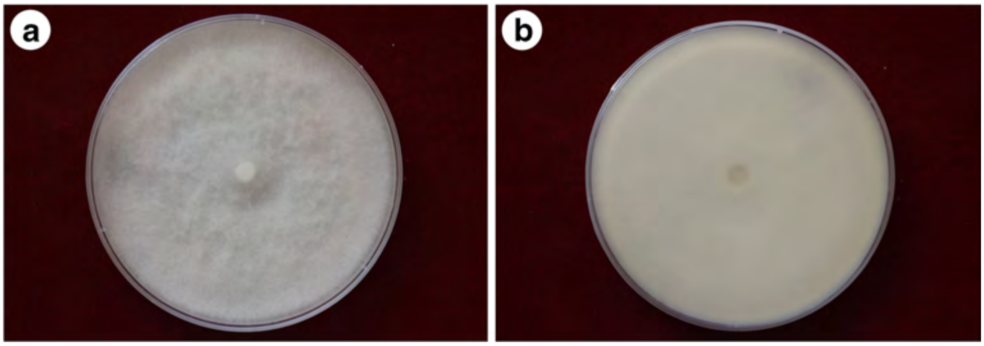


Fig. 172 Cultures of *M. pisiformis* (TEFA5). *Left*: top view, *Right*: bottom view

MycoBank: MB812482; *Facesoffungi number*: FoF01017; Figs. 173 and 174

Etymology: Referring to Taiwan where the fungus was collected.

Holotype: TNMF 28605

Colonies growing on PDA at 25 °C for 7 days reaching 9 cm in diam., white, zonnate, rosette, with abundant aerial hyphae. *Sporangiophores* on CMA, vertically arising from aerial hyphae, numerously along the sporangiophores, usually simple, sometimes producing a branch from the upper portion of sporangiophore near the middle, (57-)106-116(−227.5) μm long, 4–5 μm wide near base, tapering upward reaching 2.5–4 μm wide near sporangium, basal rhizoid indistinct. *Sporangia* globose, multisporous, hyaline, 11.5–25.5 μm in diam., wall smooth, after deliquescence, leaving collar and in distinct columella. *Spores* globose, wall smooth, hyaline, 6.5–7.5 μm in diam. *Chlamydospores* and *zygospores* not observed. *Odour* faint.

Material examined: TAIWAN, Pingtung County, Pingtung University of Science and Technology, from soil, July 2014, by S.F. Wei, PUSTF9A (TNMF 28605, **holotype**), BCRC FU30355, living culture deposited at Jena Microbial Resource Collection (University of Jena and Leibniz Institute for Natural Product Research and Infection Biology, Jena, Germany) (JMRC:SF:012102).

Other specimen: National Pingtung University of Science and Technology, PingtungCounty, from soil, July 2014, by S-F Wei, PUSTF9C.

Notes: According to Gams (1977), this fungus belongs to Section Mortierella, and similar to *M. polycephala* Coemans by having the following characters in common: multisporous sporangia; sporangiophores having branches arising above the middle of the sporangiophore and with smooth walled spores. However, they can be differentiated by the spore characters which are globose and 6.5–7.5 μm in diam. in our isolates and globose or oval and 10–12 μm in the latter. Molecular data revealed that our two isolates are clustered in one clad and can be separated from the other species of *Mortierella* in phylogenetic tree based on ITS sequenced data. We thus identified this fungus as a new species.

Contributions to Neocallimastigomycota

Neocallimastigales

Anaerobic fungi were formerly classified among the chytridiomycete fungi (Li et al. 1990), later designated to their own phylum Neocallimastigomycota (Hibbett et al. 2007) and subsequently summarized as Chytridiomycota for flagellate fungi (Voigt 2012). Since their recognition as Fungi by Orpin (1974), eight genera of obligately anaerobic fungi, currently classified in the class Neocallimastigomycetes are described (Barr et al. 1989; Breton et al. 1990; Callaghan et al. 2015; Dagar et al. 2015; Gold et al. 1988; Griffith et al. 2010; Gruninger et al. 2014; Orpin 1975; Ozkose et al. 2001).

The first of these was the genus *Neocallimastix*, originally named as a flagellate protozoan *Callimastix frontalis* by Braune (1913), renamed by Vavra and Joyon (1966) as *Neocallimastix frontalis*, and eventually recongised as a fungus by Orpin (1975). It was formally named by Heath et al. (1983) as *Neocallimastix frontalis*, within the new family *Neocallimastigaceae* within the chytrid order *Spizellomycetales* (Fig. 175).

Within genus *Neocallimastix*, three other species have since been named: *N. patriciarum* (Orpin and Munn 1986), *N. hurleyensis* (Webb and Theodorou 1991) and *N. variabilis* (Ho et al. 1993). However, Wubah et al. (1991) undertook a direct comparison of the type cultures of *N. frontalis* and *N. patriciarum* and found them to be morphologically and culturally indistinguishable. Ho and Barr (1995) later synonymised these two species and also *N. variabilis* as *N. frontalis*, and also cast doubt on the distinctiveness of *N. hurleyensis*. The morphological variability of these fungi in culture and the paucity of morphological traits (Gruninger et al. 2014) makes it difficult to assess the validity of this decision. Type material exists only for Orpin's *N. particiarum* (IMI 295997 at RBG Kew) and also for *N. hurleyensis* (IMI 344175 at RGB Kew) and isolate CX, Orpin's original culture from which the *N. patriciarum* type material was derived also remains viable, having been cryopreserved in liquid nitrogen at the Rowett Institute (Aberdeen, Scotland).

The genus *Piromyces* was first observed as flagellate zoospores in rumen fluid by Liebetanz in (1910) and can probably

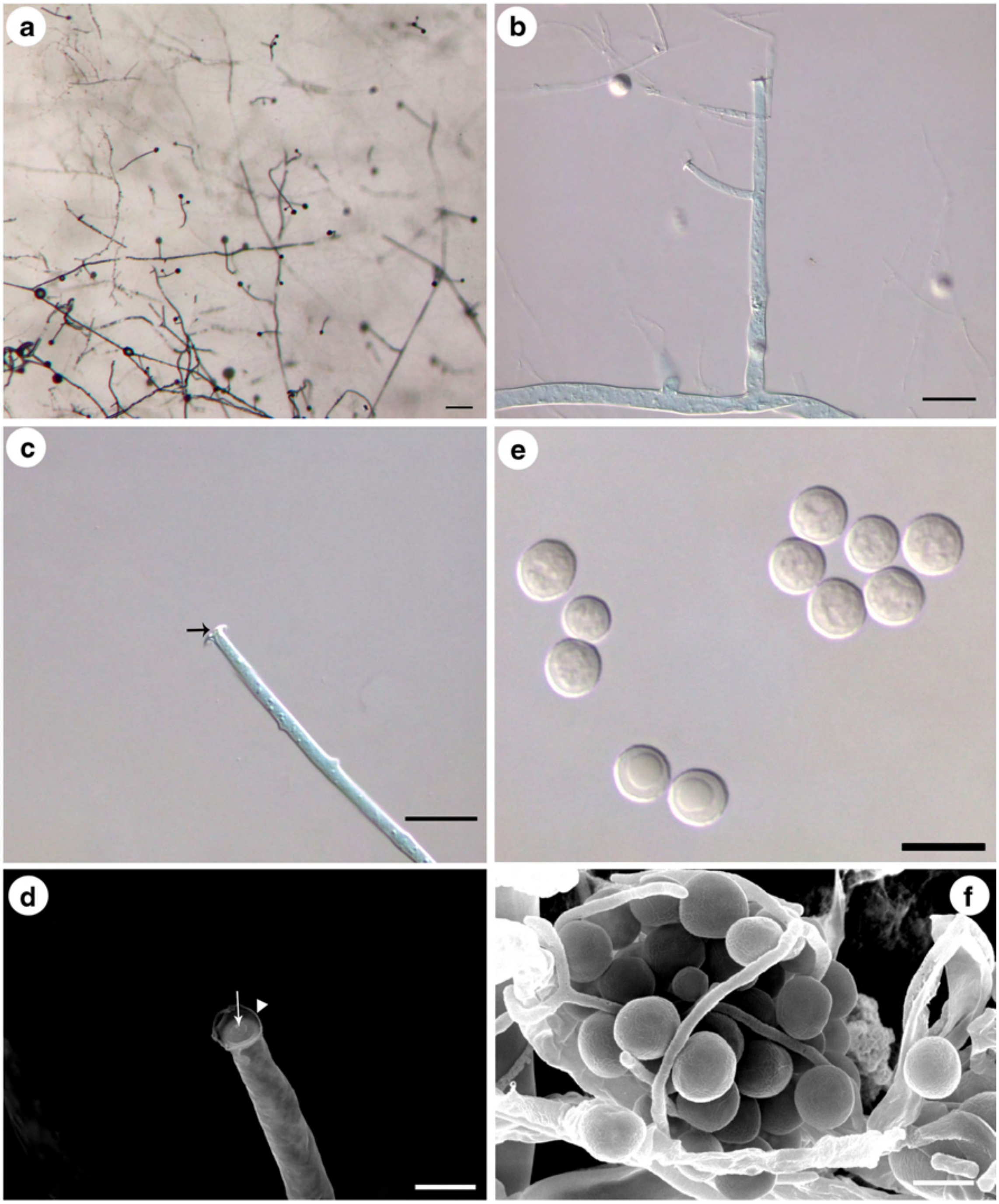


Fig. 173 *Mortierella formosana* (PUSTF9A) **a** Photograph of fresh culture taken with a stereomicroscope; **b**, **c**, **e**, LM; **d**, **f**, SEM **a** Habit on CMA **b** Sporangiophore with branch **c** Rudimentary columella (*arrow*) **d** Columella (*arrow*) and collar (*arrow head*) **e** spores **f** spores. Scales bars: **b**, **c**=20 μm, **e**=10 μm, **d**, **f**=5 μm

be assumed as 'the oldest' known genus of anaerobic fungi, even if at that time it was described as a protozoan: *Piromonas communis*. Orpin (1977) much later adopted this name for his isolate correctly characterized as a fungus, which was the reason to rename this organism as *Piromyces* (Gold et al. 1988). The emended description of *Piromyces communis* was published by Barr et al. (1989) and currently seven other species have been described in the genus including *P. mae* (Li et al. 1990), *P. dumbonica* (Li et al. 1990), *P. rhizinflata* (Breton et al. 1991), *P. spiralis* (Ho et al. 1993c), *P. minutus* (Ho et al. 1993b), *P. citronii* (Gaillard-Martinie et al. 1995), *P. polycephalus* (Chen and Hseu 2002) and *P. cryptodigmaticus* (Kirk 2012). This genus thus covers the highest number of species and represents also the most studied

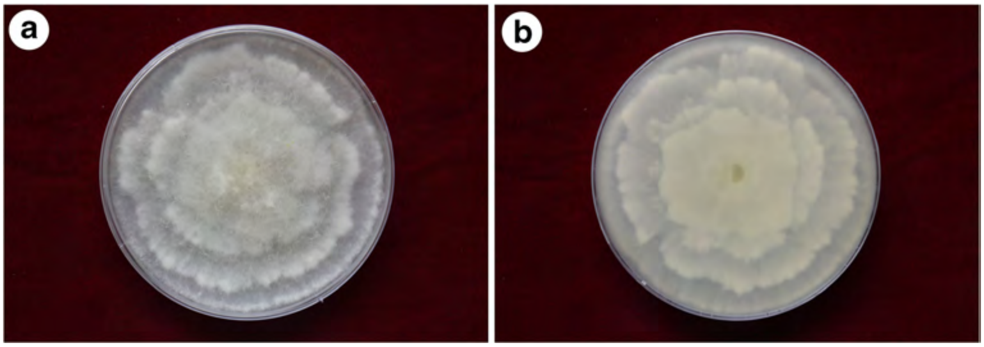


Fig. 174 Cultures of *M. formosana* (PUSTF9A). *Left*: tope view, *Right*: bottom view

anaerobic fungus, especially from the enzymological point of view (Harhangi et al. 2002, 2003a, b, c; Steenbakkers et al. 2001, 2002a, b, 2003, 2008). The recent pyrosequencing analysis of feces samples from 30 animal species has moreover revealed the *Piromyces* as the most abundant genus being encountered in 28 different animals and representing 36 % of all obtained sequences (Liggenstoffer et al. 2010). Comparing with other anaerobic fungi this genus is also the most heterogenous with some of its member grouping close to *Neocallimastix* strains and next to *Orpinomyces* strains (Hausner et al. 2000; Fliegerová et al. 2004) and therefore sometimes wrongly classified (Fliegerová et al. 2010). This heterogenity however can indicate the presence of new hidden *Piromyces* species.

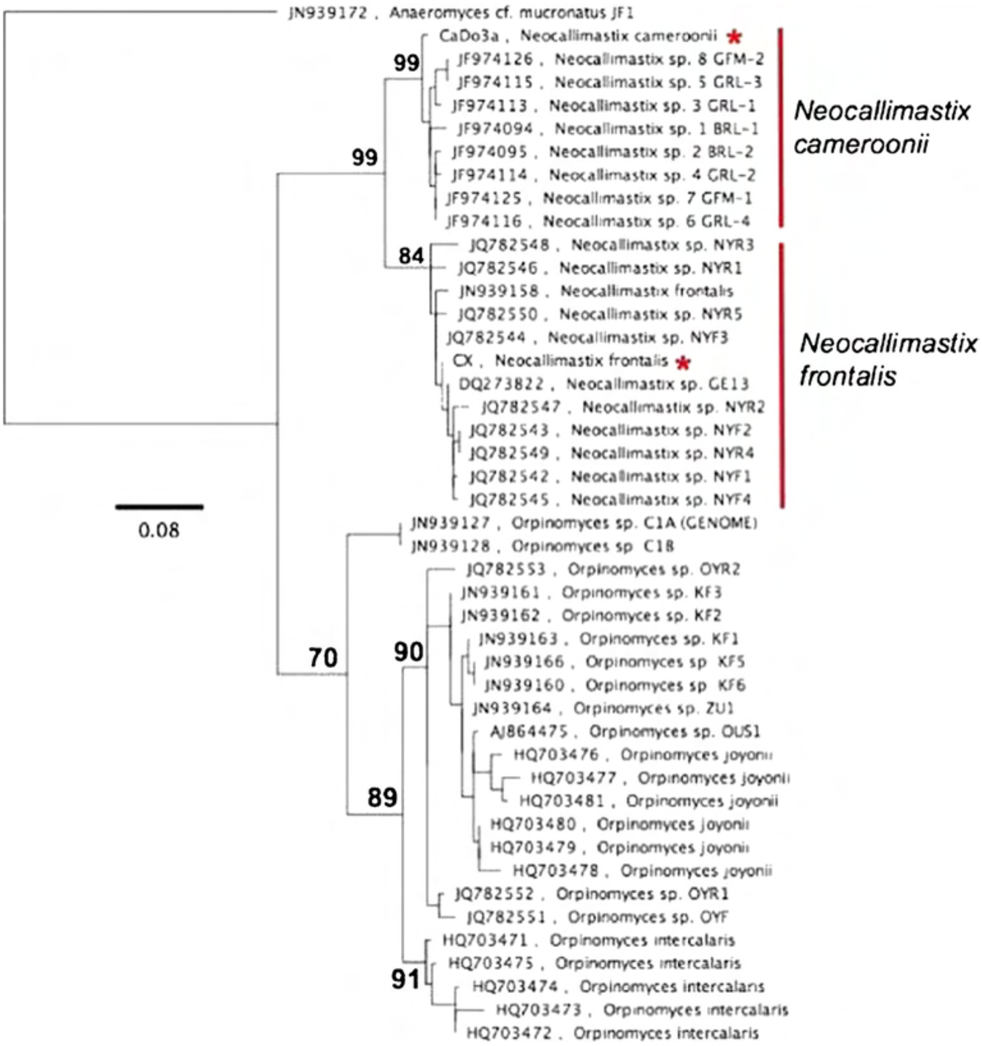


Fig. 175 Maximum likelihood (PhyML) tree based on alignment of the D1/D2 region of the Large Ribosomal Subunit (758 bp alignment; 45 sequences; 96 phylogenetically informative sites; HKY model). Salient bootstrap values are shown (as %; 1000 replicates). *Scale bar* indicates number of substitutions per site

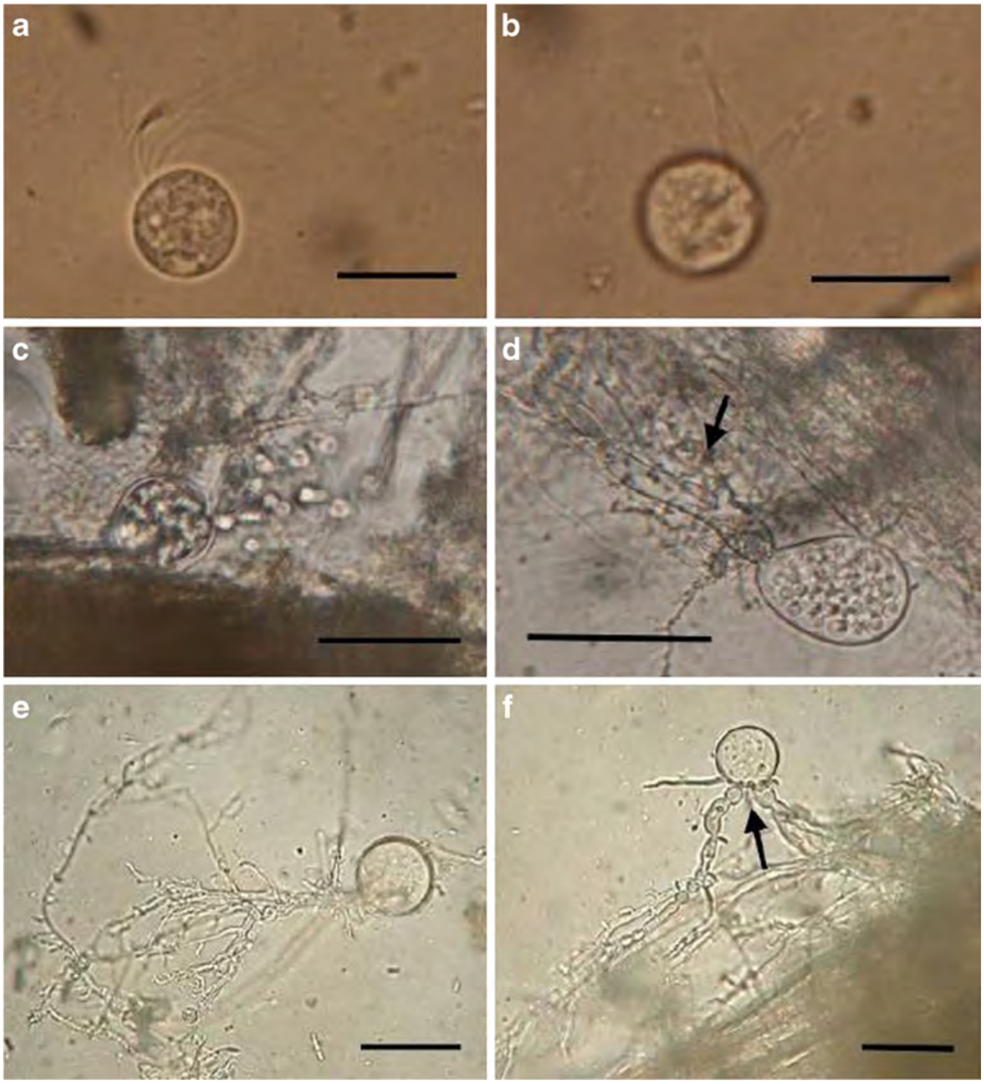


Fig. 176 Morphology of *Neocallimastix cameroonii* (holotype) **a**, **b** Muiltiflagellate zoospores **c** Zoospore formed readily in culture **e**–**f** Thalli consistently monocentric and often with bifurcation of main rhizoid at the base of the sporangium (*arrowed* in **d** and **f**). Scale bars **a**, **b**=10 μm, **c**–**f**= 50 μm

As part of collaborative, to achieve a stable taxonomy and to name the novel clades that exist within this phylum, we and others (Griffith et al. 2010) are in the process of collecting and distributing reference materials and cultures to diverse laboratories engaged in research on these fungi. Here we provide DNA barcode data for Orpin's isolate CX (GenBank ID: KR920744) and also provide a description for a second species, *Neocallimastix cameroonii*, which forms a distinct clade within the genus *Neocallimastix* based on morphological examination (Fig. 176) and phylogenetic analysis of 28S rRNA gene sequence (Fig. 175). No ITS sequence data is provided since within anaerobic fungi there is substantial (up to 13 %) intragenomic variation (Callaghan et al. 2015), which complicates direct sequencing of PCR products and the unambiguous assignment of reference sequences.

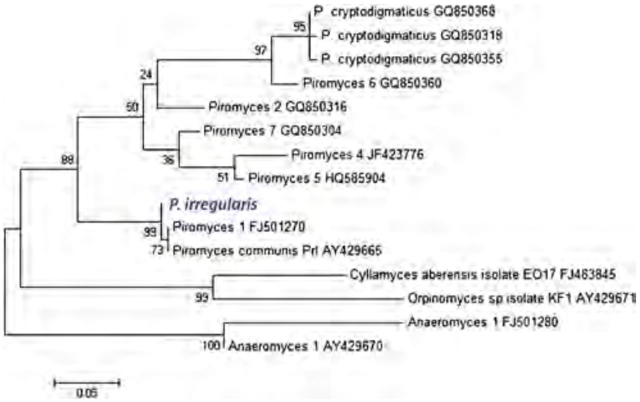


Fig. 177 Phylogenetic analyses based on maximum likelihood statistics, Tamura-Nei substitution model and nearest–neighbor Interchange (NNI) ML heuristic method using MEGA 5.2 (Tamura et al. 2011). The bootstrap values are based on 1000 replicates

Anaerobic fungi were isolated from the faeces of Cameroon sheep (a rare breed of domesticated sheep originally from West Africa), which are kept at Wildpark Poing, Munich, Germany (48.17 N, 11.83 W) and fed on a mixture of grass forage and silage. Faeces were collected on 15th September 2013 and stored frozen during transfer to Aberystwyth, where isolation was undertaken using the methods described by Callaghan et al. (2015). Individual thalli were excised from roll tubes. Three cultures (CaDo3a, CaDo3b, CaDo3d) were isolated into axenic culture with wheat straw as carbon source, and later cryopreserved in liquid nitrogen.

Thalli of CaDo3a were consistently monocentric (Fig. 176c, f), with rhizoids radiating from a single sporangium. Mature sporangia were mostly ovoid to spherical (30–50 μm diameter). Zoospores (6–9 μm diameter) were observed in most cultures after 3d growth on wheatstraw at 39 °C (Fig. 176c) and these consistently bore multiple (9–15) flagella (Fig. 176a, b) 15–25 μm long. The rhizoidal system emanating from the base of the sporangium was often observed to be distinctly bifurcated (Fig. 176d, f).

251. ***Neocallimastix cameroonii*** G.W. Griff., Dollhofer, Veronika & T. Callaghan ***sp. nov.***

Index Fungorum number: IF551212; *Facesoffungi number*: FoF01018; Fig. 176

Etymology: In reference to the breed of sheep from which it was isolated.

Holotype: ABS CaDo3a

An obligately anaerobic fungus isolated from the faeces of Cameroon sheep (*Ovis aries*) kept at Wildpark Poing (Germany). The fungus forms a determinate monocentric thallus and spherical to ovoid sporangia. The rhizoidal system emanating from the base of the sporangium is often bifurcated at base of sporangium. *Sporangia* ovoid to spherical (30–50 μm), non-papillate. Zoospores formed abundantly, spherical (6–9 μm diam.) with multiple (9–15) flagella 15–25 μm long.

Material examined: The reference culture is lodged in biorepositories at: Aberystwyth University (ABS CaDo3a, holotype); Royal Botanic Gardens, Kew, London (K(M), **isotype**); and University of Jena and Leibniz Institute for Natural Product Research and Infection Biology, Jena, Germany (Jena Microbial Resource Collection JMRC:SF:012157, **isotype**).

The D1/D2 region of the 28S large ribosomal subunit (LSU) was amplified using the primers NL1

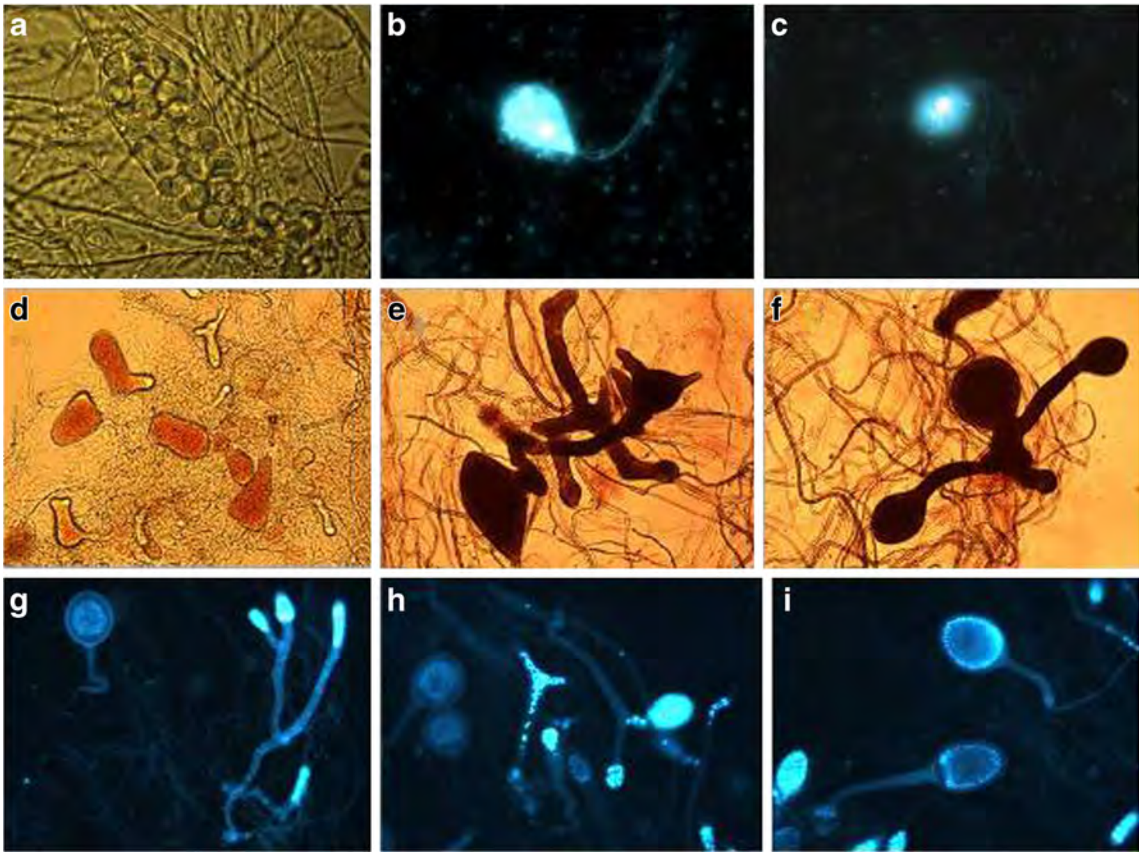


Fig. 178 Morphology of *Piromyces irregularis* (KF9) **a** Globose zoospores released from matured sporangium (lugol stained culture, 1000×) **b** Biflagellate lamp-bulb zoospore (DAPI stained culture, 1000×) **c** Multiflagellate ovoid zoospore (DAPI stained culture, 1000×) **d** Sporangia of variable shapes (lugol stained culture, 200×) **e** Irregular horned sporangium (lugol stained culture, 400×) **f** Irregular branched sporangium (lugol stained culture, 400×) **g** Nuclei in sporangium (*left*) and in apex of branched sporangial stalk (*right*) (DAPI stained culture, 400×) **h** Nuclei present in sporangium and sporangiophore (DAPI stained culture, 400×) **i** Nuclei in sporangium separated by septum from sporangiophore (DAPI stained culture, 400×)

(GCATATCAATAAGCGGAGGAAAAG) and NL4 (GGTCCGTGTTTCAAGACGG; ca. 750 bp amplicon), as described by Dagar et al. (2011). The sequences for all three isolates was identical and that for isolate CaDo3a is deposited at GenBank (ID: KR920745). Phylogenetic reconstruction of the two genera of anaerobic fungi with multiflagellate zoospores (*Neocallimastix* and *Orpinomyces*) with the reference isolate for the genus *Anaeromyces* as outgroup recovered CaDo3a and several unpublished sequences from India in a distinct clade with high bootstrap support (Fig. 177).

252. ***Piromyces irregularis*** Fliegerová, K. Voigt & P.M. Kirk, ***sp. nov*.**

Index Fungorum number: IF550065; *Facesoffungi number*: FoF01019; Fig. 178

Etymology: Referring to irregularly shaped sporangia.

Holotype: JMRC SF:011205

Colonies tiny (Ø 3 mm) with irregular edges on agar plates and fragile mycelium in liquid M10 medium (Caldwell and Bryant 1966) enriched by 25 % (*V*/*V*) rumen fluid with either glucose or cellobiose (both 4 g/l) as carbon source. Thallus with highly branched rhizoidal system without evidence of a subsporangial swelling formed by fine rhizoids with a multitude of tiny lateral stolons. *Sporangiophores* of varying length and shape, from short to long, narrow to very wide, simple, as well as flexuous or branched. . *Sporangia* consistently produced, highly variable in both shape and size, globose, ellipsoidal, elongated, pestle-shaped, triangular, pyriform or rounded rectangular, often also bifurcated, horned and with irregular shape, both open to the sporangiophore or with a basal septum, nuclei present both in the sporangium and the sporangiophore. *Zoospores* when freshly released from sporangium globose, free floating zoospores ovoid to somewhat lamp-bulb shaped, mononucleate, with variable flagellation, ranging from uniflagellate to quadriflagellate or multiflagellate*Material examined*: CZECH REPUBLIC, Institute of Animal Physiology and Genetics, Czech Academy of Sciences, v.v.i., Videnska 1083, 14220 Prague, Czech Republic, from rumen fluid of slaughtered cow, July 2009, by K. Fliegerova, *KF 9* (**holotype** Jena Microbial Resource Collection (University of Jena and Leibniz Institute for Natural Product Research and Infection Biology, Jena, Germany) JMRC SF:011205).

Nuclei may remain in the zoospore cyst, which has developed into single sporangium and sporangiophore; rhizoids are anucleate. The accompanying illustrations display also a more complex development when some sporangiophores are not terminated by sporangia, they do, however, contain nuclei. Both types of development occurs together in one culture. Barr et al. (1989) described this as two types of thallus development, type I as endogenous and monocentric, type II as exogenous and monocentric. However, the rhizoid system is always in both cases anucleate and in our opinion, therefore, it represents only the endogenous and monocentric development.

Notes: The species thus exhibits all types of morphological variations described by Barr et al. (1989) for *P. communis*, however analysis of ITS1-5.8S-ITS2 rDNA revealed sequence divergence sufficient to justify the description of a new species of *Piromyces* (Fig. 177). The new species introduces a new character: zoospores of all previously described species of *Piromyces* are uni- or bi-flagellate, and when polyflagellate, there are no more then 4 flagella.

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