

## Dothideales

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**Abstract** The type specimens or representative specimens of the potentially dothidealean genera *Bagnisiella*, *Botryochora*, *Coccostromella*, *Columnosphaeria*, *Delphinella*, *Dictyodothis*, *Discosphaerina*, *Dothidea*, *Dothiora*, *Endodothiora*, *Jaffuela*, *Mycoporis*, *Omphalospora*, *Pachysacca*, *Plowrightia*, *Sacchettoecium*, *Stylodothis*, *Sydowia* and *Yoshinagaia* were examined while, fresh specimens of *Aureobasidium pullulans*, *Dothidea insculpta*, *Plowrightia ribesia* and *Sacchettoecium sepincola* were made from Italy and Thailand. An introduction and the history of these genera, their family placement, morphology, and molecular phylogeny are provided. Morphology plus GenBank data are used to provide a systematic treatment of *Dothideales*. Phylogenetic analysis of LSU, SSU and ITS gene regions was

carried out and in the resulting phylogenetic tree the taxa cluster in two clades with high bootstrap support. Clade A comprises *Dothideaceae*, the family type of *Dothideales*. The family *Dothioraceae* is not recognized as a distinct family and is synonymized under *Dothideaceae*. *Neocylindroseptoria* is introduced to accommodate *Cylindroseptoria pistaciae* as it forms a well-supported distinct clade in *Dothideaceae*. Clade B comprises *Aureobasidium*, *Kabatiella*, *Pseudoseptoria*, *Sacchettoecium* and *Selenophoma* species and *Columnosphaeria fagi*, for which we propose a new family, *Aureobasidiaceae*. The recently introduced *Sydowia eucalypti* also clustered within Clade B and therefore based on morphology and molecular phylogeny a new genus *Pseudosydowia* is introduced for *Sydowia eucalypti*.

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*Celosporium laricicola* is separated in a distinct clade, and therefore it is placed in *Dothideales*, genera, *incertae sedis*. The genera *Bagnisiella*, *Botryochora*, *Coccostromella*, *Jaffuela*, *Lucidascocarpa*, *Mycoporis*, *Omphalospora*, *Pachysacca* and *Yoshinagaia* are excluded from *Dothideales* and their placements are discussed.

**Keywords** Ascomycota · *Aureobasidiaceae* · *Dothideaceae* · Dothideomycetes · *Dothioraceae* · Molecular phylogeny morphology taxonomy

## Introduction

The order *Dothideales* was introduced by Lindau (1897) to accommodate a single family *Dothideaceae*. During the next 100 years many families were included or removed from this order depending on the importance authors placed on different taxonomic features. This was a difficult time for researchers who attempted higher fungal classifications. Most fungi had few distinctive characters and therefore classifications became rather subjective as certain characters were chosen as important over others, without any real evidence for their importance. The researches such as M.E Barr, D.L Hawksworth, E.S. Luttrell, J. A. Von Arx and E. Müller however, produced significant classification schemes for their time, considering the vacuum they were working in (Luttrell 1973; Von Arx and Müller 1975; Barr 1987a; Hawksworth et al. 1995).

### Order-level classification based on morphology

Following the introduction of *Dothideales* with a single family, the order was first revised by Theissen and Sydow (1915) who included four heterogeneous families (*Dothideaceae*, *Montagnellaceae*, *Phyllachoraceae*, and *Polystomellaceae*) comprising unitunicate and bitunicate ascomycetes. Luttrell (1955, 1973) accepted the order for only bitunicate ascomycetes with loculi containing several asci and lacking paraphyses. Luttrell (1951) categorized five families in *Dothideales* (Table 1), while Luttrell (1955) synonymized *Pseudosphaeriales*, *Capnodiales* and *Dothiorales* under *Dothideales* and accepted four families in *Dothideales* in the subclass Loculoascomycetes. Luttrell (1973) included eight families in *Dothideales*, while Von Arx and Müller (1975) placed 34 families and synonymized *Dothioraceae* under *Dothideaceae*. (Barr 1979) treated *Dothideales* with five families and considered *Dothideaceae* and *Dothioraceae* as distinct families. Barr (1987a) accepted six families including a new family *Kriegeriellaceae* (Barr 1987b). Hawksworth et al. (1995) considered *Dothideales* to be the largest and most varied group of the *Ascomycota* including most

ascolocular ascomycetes with bitunicate asci and assigned 58 families to *Dothideales*. They synonymized *Asterinales*, *Capnodiales*, *Chaetothyriales*, *Dothiorales*, *Hysteriales*, *Melanommatales*, *Myriangiales*, *Perisporiales*, *Pleosporales* and *Pseudosphaeriales* under *Dothideales*. Barr (1996) introduced a new family *Planistromellaceae* in *Dothideales* including six genera. Kirk et al. (2001) included *Dothideales* with other bitunicate orders, *Capnodiales* and *Myriangiales*, in the subclass Dothideomycetidae which was characterized by lack of paraphyses, pseudoparaphyses and paraphysoids. Kirk et al. (2008) treated *Dothideales* with four families (*Dothideaceae*, *Dothioraceae*, *Coccoideaceae* and *Planistromellaceae*).

### Arrangement of dothideales with molecular data

Species identification based on morphology is not always adequate in classification schemes as it may be subjective or even wrong. Therefore, researchers have begun to rely on phylogenetic based identification (Liu et al. 2012; Chomnunti et al. 2014; Ariyawansa et al. 2014; Hongsanan et al. 2014; Hyde et al. 2014; Nilsson et al. 2014; Phookamsak et al. 2014; Wijayawardene et al. 2014). Phylogenetic analyses by Schoch et al. (2006, 2009) showed the *Dothideales* to be a well-supported order with nine other orders in the class Dothideomycetes and the order *Myriangiales* to be closely related to the *Dothideales*. They also validated the concept of Dothideomycetidae sensu Kirk et al. (2001) with several amendments. Schoch et al. (2006, 2009) used phylogenetic analysis to clearly show that the family *Botryosphaeriaceae* is distinct from the *Dothideales* and that was confirmed by Liu et al. (2012). Lumbsch and Huhndorf (2010) accepted the families, *Dothideaceae*, *Dothioraceae* and *Teratosphaeriaceae* in *Dothideales*, while Crous et al. (2007) and Hyde et al. (2013) moved *Teratosphaeriaceae* to *Capnodiales*.

In this study, we present new taxonomic and systematic treatment for *Dothideales* based on morphology and multigene phylogenetic analyses.

### History of *Dothideaceae*

The family *Dothideaceae* was introduced by Chevallier (1826) as ‘*Dothideae*’, and later Fuckel (1869) established this family with *Dothidea* as the type genus and *D. gibberulosa* as the type species, which were characterized by locules embedded in ascostromata without definite perithecia. This family however, has a rather varied past as can be seen from inclusion of genera by various authors (Table 2) and the follow up account.

From its introduction in 1896 to early 2000, the family *Dothideaceae* underwent numerous changes in concept and

**Table 1** Arrangement of families in *Dothideales* from 1955 to 2010

Luttrell 1951	Luttrell 1973	Von Arx and Müller 1975	Barr 1987a	Hawksworth et al. 1995	Lumbsch and Huhndorf 2010	Present study
<i>Capnodiaceae</i>	<i>Trichothyriaceae</i>	<i>Arthoniaceae</i>	<i>Dothideaceae</i>	<i>Antennulariaceae</i>	<i>Dothideaceae</i>	<i>Dothideaceae</i>
<i>Coryneliaceae</i>	<i>Chaetothyriaceae</i>	<i>Asterianaceae</i>	<i>Dothioraceae</i>	<i>Argynnaceae</i>	<i>Dothioraceae</i>	<i>Aureobasidiaceae</i>
<i>Dothideaceae</i>	<i>Parodiopsisaceae</i>	<i>Atichaceae</i>	<i>Kriegeriellaceae</i>	<i>Arthopyreniaceae</i>	<i>Teratosphaeriaceae</i>	
<i>Pseudosphaeriaceae</i>	<i>Englerulaceae</i>	<i>Botryosphaeriaceae</i>	<i>Lichenotheliaceae</i>	<i>Asterinaceae</i>		
	<i>Pseudosphaeriaceae</i>	<i>Brefeldiellaceae</i>	<i>Mycoporaceae</i>	<i>Autographaceae</i>		
	<i>Capnodiaceae</i>	<i>Capnodiaceae</i>	<i>Pseudosphaeriaceae</i>	<i>Botryosphaeriaceae</i>		
	<i>Dothideaceae</i>	<i>Chaetothyriaceae</i>		<i>Brefeldiellaceae</i>		
	<i>Dothioraceae</i>	<i>Dimeriaceae</i>		<i>Capnodiaceae</i>		
		<i>Dothideaceae</i>		<i>Chaetothyriaceae</i>		
		<i>Englerulaceae</i>		<i>Coccodiniaceae</i>		
		<i>Herpotrichiellaceae</i>		<i>Coccoideaceae</i>		
		<i>Hysteriaceae</i>		<i>Cookellaceae</i>		
		<i>Leptopeltidaceae</i>		<i>Cucurbitariaceae</i>		
		<i>Lophiaceae</i>		<i>Dacampiaceae</i>		
		<i>Lophiostomataceae</i>		<i>Diademaceae</i>		
		<i>Mesnieraceae</i>		<i>Didymosphaeriaceae</i>		
		<i>Micropeltidaceae</i>		<i>Dimeriaceae</i>		
		<i>Microthyriaceae</i>		<i>Dothideaceae</i>		
		<i>Mycoporaceae</i>		<i>Dothioraceae</i>		
		<i>Mycosphaerellaceae</i>		<i>Elsinoaceae</i>		
		<i>Myriangiaceae</i>		<i>Englerulaceae</i>		
		<i>Parmulariaceae</i>		<i>Eremomycetaceae</i>		
		<i>Parodiellimaceae</i>		<i>Euanthemiaceae</i>		
		<i>Patellariaceae</i>		<i>Fenestellaceae</i>		
		<i>Piedraiaceae</i>		<i>Herpotrichiellaceae</i>		
		<i>Pleosporaceae</i>		<i>Hypostromataceae</i>		
		<i>Pseudosphaeriaceae</i>		<i>Hysteriaceae</i>		
		<i>Saccardiaceae</i>		<i>Lautosporaceae</i>		
		<i>Schizothyriaceae</i>		<i>Leptosporaceae</i>		
		<i>Sporormiaceae</i>		<i>Leptopeltidaceae</i>		
		<i>Stigmataceae</i>		<i>Leptosphaeriaceae</i>		
		<i>Trichothyriaceae</i>		<i>Lichenotheliaceae</i>		
		<i>Vizellaceae</i>		<i>Lophiostomataceae</i>		
		<i>Zopfiaceae</i>		<i>Melanommataceae</i>		
				<i>Mesnieraceae</i>		
				<i>Metacapnodiaceae</i>		
				<i>Micropeltidaceae</i>		
				<i>Microtheliopsisaceae</i>		
				<i>Microthyriaceae</i>		
				<i>Mycoporaceae</i>		
				<i>Mycosphaerellaceae</i>		
				<i>Myriangiaceae</i>		
				<i>Mytiliniaceae</i>		
				<i>Parmulariaceae</i>		
				<i>Parodiellimaceae</i>		
				<i>Parodiopsisaceae</i>		

Table 1 (continued)

Luttrell 1951	Luttrell 1973	Von Arx and Müller 1975	Barr 1987a	Hawksworth et al. 1995	Lumbsch and Huhndorf 2010	Present study	
				<i>Phaeosphaeriaceae</i> <i>Phaeotrichaceae</i> <i>Piedriaceae</i> <i>Pleomassariaceae</i> <i>Pleosporaceae</i> <i>Polystomellaceae</i> <i>Pyrenothricaceae</i> <i>Schizothyriaceae</i> <i>Sporormiaceae</i> <i>Tubeufiaceae</i> <i>Venturiaceae</i> <i>Vizellaceae</i> <i>Zopfiaceae</i>			

inclusion of genera and was largely based on the understanding of morphological characters. Winter (1887) separated *Dothideaceae* from *Hypocreaceae* and *Sphaeriaceae* based on fleshy, black or blackish brown ascostromata with lack of perithecia and included nine genera with 38 species (Orton 1924). Theissen and Sydow (1915) placed this family in *Dothideales* and divided it into three subfamilies (*Coccoideae*, *Dothideae* and *Leveillelleae*). Gäumann (1952) included *Dothideaceae* in *Pseudosphaeriales* along with *Dothioraceae* and four other families. Luttrell (1973) categorized 22 genera under *Dothideaceae*, which is the highest number of genera included in the family. Arx and Müller (1975) synonymized *Dothioraceae* under *Dothideaceae* and included eleven genera. They accepted *Dothideaceae* for members having the following characters; ascomata developing as non-ostiolate loculi in stromata, opening by an apical fissure or dehiscence, eight- or many-spored asci borne at the base of the locules and one or many-septate, hyaline or brown, often guttulate ascospores. Sivanesan (1984) treated *Dothideaceae* with 14 genera and synonymized *Botryosphaeriaceae*, *Dothioraceae* and *Mycosphaerellaceae* under this family. Barr (1987a) treated *Dothideaceae* and *Dothioraceae* as two separate families and listed 16 genera under *Dothideaceae*. Hawksworth et al. (1995) removed 13 genera from those of Barr (1987a) and added ten other genera. Hawksworth et al. (1995) accepted 13 genera in *Dothideaceae* characterized by multiloculate ascostromata, saccate or clavate asci and transversely septate ascospores. In a first multigene molecular study, Schoch et al. (2009) confirmed the familial placement of *Dothideaceae* in the order *Dothideales* based on *Dothidea* species including the type *D. sambuci* and *Stylodothis puccinioides* (DC.) Arx & E. Müll. Lumbsch and Huhndorf (2010) listed 13 genera including *Dictyodothis* and *Lucidascocarpa* to the genera list of Hawksworth et al. (1995), while removing *Hyalocrea* and *Planistroma*. *Planistroma* was later included in *Planistromellaceae* in *Botryosphaeriales* based on molecular data (Hyde et al. 2013; Monkai et al. 2013). Wijayawardene et al. (2012) treated the family *Dothideaceae* with two asexual genera *Lecanosticta* and *Podoplaconema* based on the asexual states of *Scirrhia* and *Omphalospora* respectively, while Hyde et al. (2013) included *Endoconidioma*, *Kabatina* and *Podoplaconema*.

#### History of *Dothioraceae*

The family *Dothioraceae* was introduced by Theissen and Sydow (1917) in the order *Myriangiales* along with five other families (*Elsinoaceae*, *Plectodisceleae*, *Myxomyriangiaceae*, *Myriangiaceae* and *Saccardiaceae*) and included five genera *Bagnisiella*, *Dothiora*, *Pseudosphaeria*, *Wettsteinina*, and *Yoshinagaia*. This family has been referred to the *Dothiorales* by Müller and von Arx (1950). *Dothiorales* was introduced

**Table 2** Accepted genera according to various treatments of *Dothideaceae*

Luttrell 1973	Von Arx and Müller 1975	Sivanesan 1984	Barr 1987a	Hawksworth et al. 1995	Lumbsch and Huhndorf 2010	Present study
<i>Achorodothis</i>	<i>Delphinella</i>	<i>Anthracostroma</i>	<i>Coccodiella</i>	<i>Auerswaldia</i>	? <i>Auerswaldia</i>	<i>Coleophoma</i>
<i>Auerswaldia</i>	<i>Dothidea</i>	<i>Botryosphaeria</i>	<i>Cymadothea</i>	<i>Bagnisiella</i>	? <i>Bagnisiella</i>	<i>Cylindroseptoria</i>
<i>Coccodiella</i>	<i>Dothiora</i>	<i>Cymadothea</i>	<i>Dictyodothis</i>	<i>Coccostromella</i>	? <i>Coccostromella</i>	<i>Delphinella</i>
<i>Columnosphaeria</i>	<i>Jaffuela</i>	<i>Discosphaerina</i>	<i>Discosphaerina</i>	<i>Dothidea</i>	<i>Dictyodothis</i>	<i>Dictyodothis</i>
<i>Cerodothis</i>	<i>Leptoguignardia</i>	<i>Dothiora</i>	<i>Dothidea</i>	<i>Hyalocrea</i>	<i>Dothidea</i>	<i>Dothidea</i>
<i>Cymadothea</i>	<i>Omphalospora</i>	<i>Guignardia</i>	<i>Euryachora</i>	<i>Mycoporis</i>	<i>Lucidascocarpa</i>	<i>Dothiora</i>
<i>Delphinella</i>	<i>Plowrightia</i>	<i>Leptoguignardia</i>	<i>Lasiobotrys</i>	<i>Omphalospora</i>	<i>Mycoporis</i>	<i>Endoconidioma</i>
<i>Dothidea</i>	<i>Pringsheimia</i>	<i>Melanodothis</i>	<i>Melanodothis</i>	<i>Pachysacca</i>	<i>Omphalospora</i>	<i>Endodothiora</i>
<i>Euryachora</i>	<i>Scirrhia</i>	<i>Microcyclus</i>	<i>Microcyclus</i>	<i>Phyllachorella</i>	<i>Pachysacca</i>	<i>Kabatina</i>
<i>Guignardia</i>	<i>Stylodothis</i>	<i>Mycosphaerella</i>	<i>Mycosphaerella</i>	<i>Planistroma</i>	<i>Phyllachorella</i>	<i>Neoylindroseptoria</i>
<i>Lasiobotrys</i>	<i>Sydowia</i>	<i>Pringsheimia</i>	<i>Omphalospora</i>	<i>Scirrhia</i>	<i>Scirrhia</i>	<i>Phaeocryptopus</i>
<i>Microcyclus</i>		<i>Scirrhia</i>	<i>Plowrightia</i>	<i>Stylodothis</i>	<i>Stylodothis</i>	<i>Plowrightia</i>
<i>Mycosphaerella</i>		<i>Sphaerulina</i>	<i>Rhizogene</i>	<i>Vestergrenia</i>	<i>Vestergrenia</i>	? <i>Pringsheimia</i>
<i>Omphalospora</i>		<i>Sydowia</i>	<i>Scleroplella</i>			<i>Stylodothis</i>
<i>Phaeodothiora</i>			<i>Scirrhia</i>			? <i>Sydowia</i>
<i>Plowrightia</i>			<i>Sphaerulina</i>			
<i>Plurisperma</i>						
<i>Pringsheimia</i>						
<i>Rhizogene</i>						
<i>Scirrhia</i>						
<i>Sphaerulina</i>						
<i>Vestergrenia</i>						

for species having broad, nearly spherical or clavate asci, borne in non-ostiolate ascomata, opening at maturity by dehiscence or rupture, or in which the asci develop a naked hymenium (Müller and von Arx 1950). Luttrell (1951b) and Gäumann (1952) included *Dothioraceae* in *Pseudosphaeriales* and Gäumann (1952) mentioned that *Dothioraceae* included the more primitive representatives of the *Pseudosphaeriales*. Luttrell (1955) synonymized *Dothiorales* under *Dothideales* which was followed by some authors (Von Arx and Müller 1975; Sivanesan 1984), but not others (Froidevaux 1972; Luttrell 1973; Barr 1979a, b, 1987a; Hawksworth et al. 1995). Froidevaux (1972) accepted four genera in *Dothioraceae*, while Barr (1972) included eight. Luttrell (1973) listed seven genera in *Dothioraceae*. Von Arx and Müller (1975) and Sivanesan (1984) referred *Dothideaceae* and *Dothioraceae* as a single family in *Dothideales*, while (Barr 1979, 1987a) treated *Dothideaceae* and *Dothioraceae* as separate families. (Barr 1979) listed 13 genera in *Dothioraceae*, while Barr (1987a) included five. Hawksworth et al. (1995) listed eight genera characterized by uniloculate ascostromata, clavate asci with septate or muriform ascospores. Lumbsch and Huhndorf (2010) extended the genera in *Dothioraceae* to ten by adding *Phaeocryptopus* and *Yoshinagaia* to those of Hawksworth et al. (1995). Wijayawardene et al. (2012) treated the family *Dothioraceae* with inclusion of the asexual genera *Aureobasidium*, *Dothichiza*, *Hormonema*, *Japonia*, *Kabatina*, *Rhizosphaera* and *Sclerophoma*.

## Materials and methods

### Examination of herbarium material

The type specimens or representative specimens of *Bagnisiella*, *Botryochora*, *Coccostromella*, *Columnosphaeria*, *Delphinella*, *Dictyodothis*, *Discosphaerina*, *Dothidea*, *Dothiora*, *Endodothiora*, *Jaffuela*, *Mycoporis*, *Omphalospora*, *Pachysacca*, *Phaeocryptopus*, *Plowrightia*, *Sacothecium*, *Stylodothis*, *Sydowia* and *Yoshinagaia* were obtained from BPI, C, K, S, URM and W. Examination of the type specimens follow Chomnunti et al. (2011). Ascomata were rehydrated in 5 % KOH prior to examination and sectioning. Specimens were examined under a stereo microscope (Motic SMZ 168) and fine forceps were used to remove one or two ascomata and mounted in water. Hand sections were cut with a sharp razor blade. Observations and photomicrographs were made from material mounted in water or lactophenol with cotton blue dye using Nikon ECLIPSE 80i light microscope fitted with a Cannon 450D digital camera. India ink was added to water mounts to detect the presence of gelatinous sheaths or ascospore appendages. Measurements were made with Tarosoft (R) Image Frame Work.

### Sample collection, specimen examination and isolation

Fresh specimens were collected in Italy and Thailand. The specimens were observed and examined under Motic SMZ 168 stereomicroscope. Micromorphological characters of the

fungus were examined using a Nikon ECLIPSE 80i compound microscope and images captured using a Nikon ECLIPSE 80i compound microscope with a Canon EOS 550D digital camera. Measurements were made with the Tarosoft (R) Image Frame Work and images used for figures processed with Adobe Photoshop CS3 Extended version 10.0 software. Following the method of Chomnunti et al. (2014), a culture was derived from single spore isolation. Germinating spores were transferred to Potato Dextrose Agar (PAD) medium or Malt Extract Agar (MEA) and incubated at 25 °C in the dark. The cultural characteristics such as colour of the mycelium, and shape, texture and growth rate of colonies were recorded after 14 days.

#### DNA extraction, PCR amplification and sequencing

Fungal isolates were grown on PDA or MEA (Malt Dextrose Agar) at 25 °C for 2–4 weeks. Genomic DNA from mycelia was extracted as in Udayanga et al. (2012) while, Genomic DNA from fruiting bodies was extracted using Biospin Fungus Genomic DNA Extraction Kit (BioFlux®) following the instructions of the manufacturer. Polymerase chain reaction (PCR) was carried out using four partial gene portions in this study. NS1 and NS4 primers were used to amplify a region spanning the small subunit rDNA (White et al. 1990). LROR and LR5 primer pairs were used to amplify a segment of the large subunit rDNA (Vilgalys and Hester 1990) and internal transcribed spacers was amplified by primer pairs ITS1 and ITS4 (White et al. 1990). The amplifications were performed in 25 µL of PCR mixtures containing 9.5 µL ddH<sub>2</sub>O, 12.5 µL 2×PCR Master Mix (TIANGEN Co., China), 1 µL of DNA template, 1 µL of each primer (10 µM). The amplification conditions for SSU, LSU and ITS consisted of initial denaturation at 94 °C for 4 mins; followed by 35 cycles of 45 s at 94 °C, 45 s at 56 °C and 1 min at 72 °C, and a final extension period of 10 mins at 72 °C. The PCR products were observed on 1 % agarose electrophoresis gels stained with Ethidium bromide. Purification and sequencing of PCR products were carried at using the above-mentioned PCR primer at Invitrogen Biotechnology Co., Ltd, China.

ATCC American Type Culture Collection, Virginia, USA; CBS Centraalbureau voor Schimmelcultures, Utrecht, The Netherlands; CPC Collection of Pedro Crous housed at CBS; DAOM Plant Research Institute, Department of Agriculture (Mycology), Ottawa, Canada; MFLU Mae Fah Luang University Herbarium Collection; MFLUCC Mae Fah Luang University Culture Collection, Chiang Rai, Thailand; The University of Alberta Microfungus Collection and Herbarium.

#### Phylogenetic analysis

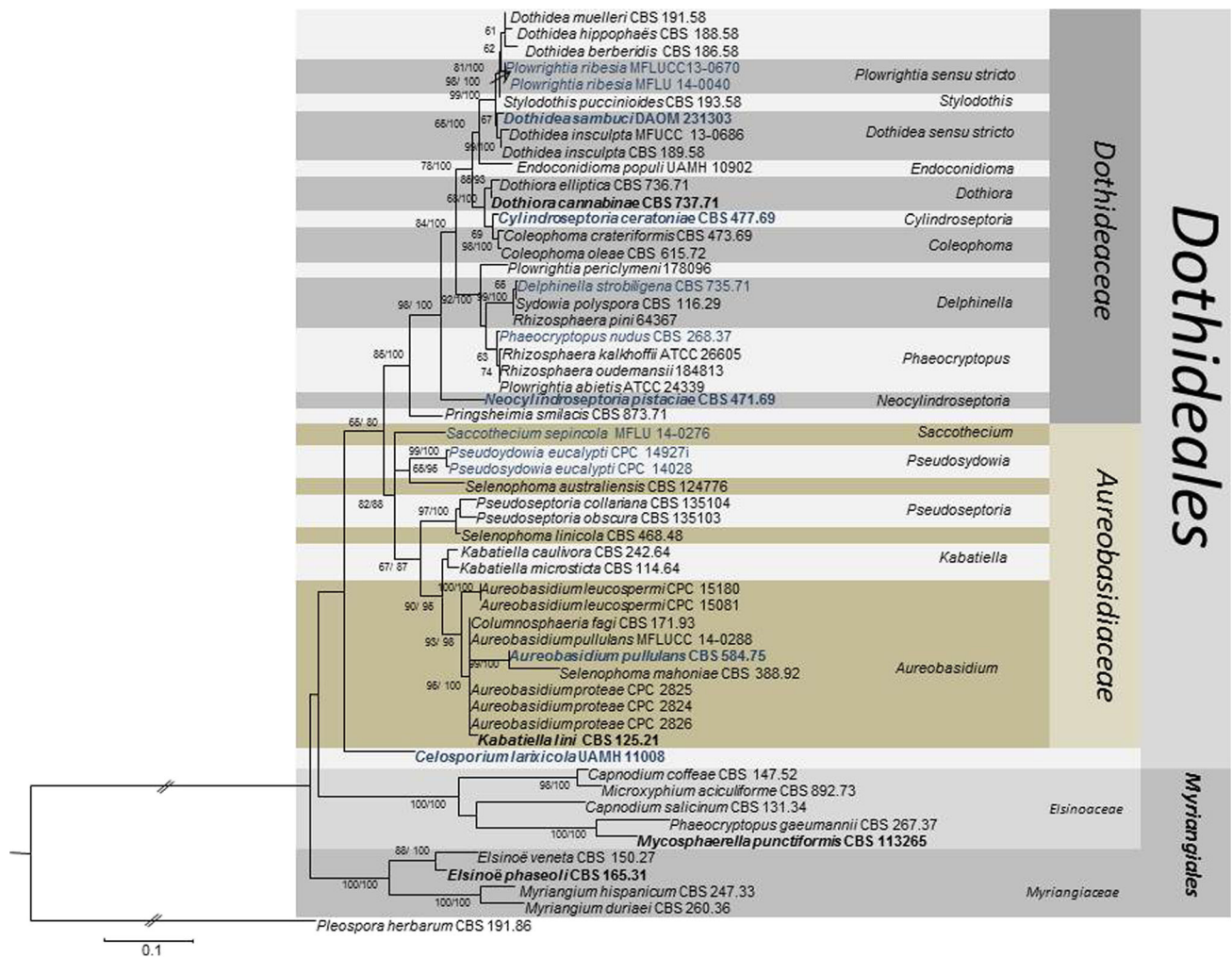
The phylogenetic analysis follows the methods used by Boonmee et al. (2014) with modifications as needed. The generated LSU, SSU and ITS sequences were analyzed using

the BLAST search engine of the National Center for Biotechnology Information (NCBI) for the rough identification of fresh isolates used in the analyses. Sequences of the available ex-type cultures and other taxa were obtained from GenBank are provided (Table 4). In addition, several other fungal taxa of the close families (*Capnodiaceae*, *Elsinoaceae*, *Mycosphaerellaceae* and *Myriangiaceae*) were also included in the analyses. The consensus sequences for each gene were initially aligned by ClustalX v. 1.8.3 and in Bioedit (Thompson et al. 1997). LSU, SSU and EF datasets were first analyzed separately and then the individual datasets were concatenated into a combined dataset. The model of evolution was performed by using MrModeltest 2.2 (Nylander 2004). A phylogenetic analysis of the concatenated alignment was performed on CIPRES webportal (Miller et al. 2010) using RAXML v. 7.2.7 (Stamatakis 2006; Stamatakis et al. 2008). The best scoring tree was selected with a final likelihood value of −21859.18898. One thousand non parametric bootstrap iterations were run with the GTR model and a discrete gamma distribution. The resulting replicates were plotted on to the best scoring tree obtained previously. Maximum Likelihood bootstrap values (MLBP) equal or greater than 50 % are given above each node (Fig. 1). Posterior probabilities (PP) (Rannala and Yang 1996; Zhaxybayeva and Gogarten 2002) were determined by Markov Chain Monte Carlo sampling (BMCMC) in MrBayes v. 3.0b4 (Huelsenbeck and Ronquist 2001). Six simultaneous Markov chains were run for 1000000 generations and trees were sampled every 100th generation and 10,000 trees were obtained. The first 2,000 trees, representing the burn-in phase of the analyses, were discarded while remaining 8,000 trees used for calculating posterior probabilities in the majority rule consensus tree (Cai et al. 2006). Bayesian Posterior Probabilities (BYPP) with those equal or greater than 0.80 given below each node (Fig. 1). General time reversible model (GTR) was applied with a discrete gamma distribution and four rate classes. Phylogenetic trees were drawn using Treeview v. 1.6.6 (Page 2001). The sequences of novel species and other sequenced taxa in this study are deposited in GenBank.

## Results

### Phylogenetic analysis

The combined 28S (LSU), 18S (SSU) and ITS gene data set consists of 55 taxa of which five are newly generated and 45 are from GenBank, including 45 dothidealean taxa and *Pleospora herbarum* as the outgroup taxon. All trees were similar in topology and not significantly different (data not shown). Forty-four taxa in *Dothideales* separated into two major clades with 65/80 % (RAXML / Bayesian posterior



**Fig. 1** RAxML tree based on a combined dataset of ITS, SSU and LSU gene regions. The first set of numbers above or below the nodes are bootstraps from 1000 repetitions, with values above 50 % shown. The second represent Bayesian posterior probabilities expressed as

percentages, with values above 80 % shown. *Pleospora herbarum* is the out-group taxon. The original isolate numbers are noted after the species names and ex-types are in bold

probabilities) bootstrap support, while *Celosporium laricicola* formed a separate clade but in the *Dothideales* clade. *Coleophoma*, *Cylindroseptoria*, *Delphinella*, *Dothidea*, *Dothiora*, *Endoconidioma*, *Phaeocryptopus*, *Plowrightia*, *Pringsheimia*, *Stylodothis* and *Rhizosphaera* species grouped in one major clade and we name this as *Dothideaceae* clade as it includes the type of *Dothidea* (*D. sambuci*). Other taxa belonging to *Aureobasidium*, *Discosphaerina*, *Kabatiella*, *Pseudoseptoria*, *Sacrothecium* and *Selenophoma* grouped in the second major clade. We called that clade *Aureobasidiaceae* as the type of *Aureobasidium* *A. pullulans* (neotypified by Hermanides-Nijhof 1977) clustered here.

Clade A comprises six sub clades with the epitype of *Dothidea sambuci* (Pers.) Fr. which represents the family *Dothideaceae* and order *Dothideales*. In the *Dothideaceae* clade taxa analyzed cluster in twelve resolved clades. Based on phylogeny, we refer the clade which comprises *Dothidea sambuci* and *D. insculpta* Wallr. as *Dothidea sensu stricto*. The

upper resolved clade comprises *D. muelleri* Loeffler, *D. hippophaës* (Pass.) Fuckel and *D. berberidis* De Not. are not *Dothidea* species in *Dothidea sensu stricto* and may later require a new genus. The type of *Plowrightia*, *P. ribesia* (Pers.) Sacc. clustered in another clade which refers as *Plowrightia sensu stricto*. *Stylodothis puccinioides* (the type of *Stylodothis*) grouped between *Dothidea sensu stricto* and *Plowrightia sensu stricto* as a distinct genus. Since the morphology indicates that *Dothiora* and *Sydowia* as a distinct genera and the tree is populated with few strains we prefer to maintain *Dothiora* and *Sydowia* as distinct genera, although there are no sequences of type strains are available for those genera. The clades *Coleophoma*, *Cylindroseptoria* and *Endoconidioma*, also separate as distinct genera in *Dothideaceae* with their type strains. *Cylindroseptoria pistaciae* Quaedvlieg, Verkley & Crous (CBS 471.69) clustered separately in a subclade with 98/100 % bootstrap supports and a new genus is required for this species. *Pringsheimia smilacis* E. Müll. nested separately

with 85/100 % bootstrap supports and it may represent *Pringsheimia*. However, the type of *Pringsheimia* should be recollected and epitypified in order to resolve the phylogenetic placement of *Pringsheimia* in *Dothideales*. The species grouped in *Phaeocryptopus* clade (*Rhizosphaera kalkhoffii* Bubák, *R. oudemansii* Maubl. and *Plowrightia abietis* M.E. Barr) along with *Phaeocryptopus nudus* might be considered to belong in the single genus *Phaeocryptopus* or could be two distinct genera. *Rhizosphaera pini* (Corda) Maubl. and *Sydowia polyspora* (Bref. & Tavel) E. Müll. clustered in the *Delphinella* clade along with the type of *Delphinella*, *D. strobiligena* (Desm.) Sacc. ex E. Müll. & Arx. The tree should be populated with more *Sydowia* species including the type in order to resolve the placement of *Sydowia*.

Clade B comprises five subclades with the neotype of *Aureobasidium pullulans* (de Bary) G. Arnaud which represents the new family *Aureobasidiaceae*. *Sydowia polyspora* (Bref. & Tavel) E. Müll. clustered in the *Dothideaceae* clade, while *S. eucalypti* (Verwoerd & du Plessis) Crous nested in the *Aureobasidiaceae* clade. Therefore, a new genus is required for *S. eucalypti* as it is distinct from the *Dothideaceae* clade. *Columnosphaeria fagi* (H.J. Huds.) M.E. Barr, *Kabatiella lini* and *Selenophoma mahoniae* grouped in the *Aureobasidium* clade and they might be considered to belong in *Aureobasidium*. However, the type sequences of *Columnosphaeria* and *Selenophoma* are needed in order to clarify their placement in *Aureobasidiaceae*. The *Kabatiella* clade represents *Kabatiella microsticta* Bubák, the type of *Kabatiella* and *K. caulivora* (Kirchn.) Karak. Although the sequences of type species are not available for *Pseudoseptoria* and *Selenophoma* they are considered as distinct genera in *Aureobasidiaceae* based on available sequence data and morphology.

#### Taxonomic treatment

**Dothideaceae** Chevall. [as ‘Dothideae’], Fl. gén. env. Paris (Paris) 1: 446 (1826), *Facesoffungi* number: FoF00066

*Biotrophic, necrotrophic or saprobic* on twigs and other parts of plants, rarely on leaves. **Sexual state:** *Ascstromata* dark brown to black, immersed to erumpent or superficial, solitary or scattered, usually pulvinate or crustose, globose to subglobose, uni or multiloculate, locules up to 13, non-ostiolate, opening by an apical, usually lysigenous pore or by dehiscence, interascal tissue lacking, ascstromata composed of several layers of light brown to dark brown cells of *textura angularis*. *Peridium* of locules generally of several layers of lightly pigmented, dark brown, thick-walled cells of *textura angularis*. *Hamathecium* generally lacking pseudoparaphyses, hyaline, when present septate. *Asci* eight- or poly-spored, bitunicate, fissitunicate, saccate or clavate, short-pedicellate, inner membrane apically thickened, apically rounded with an ocular chamber, asci borne at the base of the locules. *Ascospores* uni-seriate or bi-seriate, partially overlapping,

hyaline or brown, transversely septate, constricted at the primary septum, sometimes muriform, small, wall smooth to verrucose, with or without a sheath. **Asexual states:** mostly coelomycetous or hyphomycetous species of *Coleophoma*, *Cylindroseptoria*, *Hormonema*, *Endoconidioma* and *Kabatina*. *Conidiomata* pycnidial, stromatic, epidermal to subepidermal, solitary or aggregated, immersed to erumpent, globose to subglobose or flask-shaped or irregular, dark brown to black, uni or multi loculate or convoluted with or without central ostioles. *Conidiomata wall* composed of several layers of hyaline, brown to dark brown cells of *textura angularis*. *Conidiophores* present or reduced to conidiogenous cells, hyaline to pale brown at the base, branched, septate, smooth when present. *Conidiogenous cells* enteroblastic, phialidic, integrated or discrete, determinate, cylindrical to doliiform, hyaline to brown, smooth-walled, lining the inner cavity. *Conidia* hyaline, aseptate or one-septate, cylindrical or ellipsoid, smooth-walled, granular or not, guttulate.

*Type:* **Dothidea** Fr.

*Notes:* In this study, we synonymize *Dothioraceae* under *Dothideaceae* and accept fifteen genera in *Dothideaceae*. Recollection, epitypification and multigene molecular analyses are needed for the type and other species of *Dictyodothis*, *Dothiora*, *Endodothiora*, *Kabatina*, *Phaeocryptopus* and *Pringsheimia* in order to confirm the familial status in *Dothideaceae* as no type species sequences are available.

#### Key to sexual genera of *Dothideaceae*

1. Ascstromata superficial, gregarious, globose to globose-depressed, black, developing on conifer needles..... **Phaeocryptopus**
1. Ascstromata immersed, becoming erumpent, clustered, gregarious, or scattered, pulvinate or crustose, locules subglobose to globose, dark brown to black, developing on twigs, woody branches or leaves..... 2
2. Ascstromata uni-loculate, loculi usually broad..... 3
2. Ascstromata usually multiloculate, loculi often sphaerical..... 4
3. Asci with many ascospores..... **Sydowia**
3. Asci with 8, multiseptate ascospores, constricted at the primary septum..... **Pringsheimia**
4. Asci with many, 1-septate, hyaline ascospores constricted at the septum..... **Delphinella**
4. Asci with 8 or many, 1-septate or multiseptate or muriform, hyaline or pigmented ascospores constricted at the primary septum..... 5
5. Ascospores hyaline to brown, 1-many septate or muriform..... 6
5. Ascospores hyaline, 1-septate, strongly constricted at the septum..... **Plowrightia**
6. Asci with 4–8, ellipsoid to fusiform, brown, 1-septate ascospores..... **Stylodothis**



6. Asci with 8 or more, brown or hyaline, 1-many septate or muriform ascospores..... 7
7. Asci with 8, 1-many septate or muriform ascospores..... 8
7. Asci with 8 or more, 1-septate or muriform ascospores..... 9
8. Ascospores brown, muriform, with longitudinal and transverse septa..... *Dictyodopsis*
8. Ascospores hyaline to brown, 1-septate constricted at the septum..... *Dothidea*
9. Asci with many, hyaline, ascospores with 5–7 transverse septa..... *Endodochia*
9. Asci usually with 8, hyaline, one to many septate or muriform, ascospores..... *Dothiora*

#### Key to asexual genera of *Dothideaceae*

1. Two types of conidia, endoconidia hyaline, unicellular, blastoconidia mostly two-celled, light to dark brown..... *Endoconidioma*
1. Only one type of conidia, conidia hyaline, smooth-walled, aseptate..... 2
2. Conidiophores absent, conidiophores reduced to conidiogenous cells..... 3
2. Conidiophores present..... 4
3. Conidia solitary, hyaline, smooth-walled, granular or not, cylindrical with obtuse apex, tapering at base to truncate scar..... *Cylindroseptoria*
3. Conidia mostly straight, rarely slightly curved, apex subobtusate, base truncate, guttulate
- Neocylindroseptoria*
4. Conidiogenous cells enteroblastic, phialidic or percurrent, determinate, brown to pale brown, channel and collarete, periclinal thickening present or absent..... *Kabatina*
4. Conidiogenous cells discrete or integrated, determinate, hyaline, phialidic..... *Coleophoma*

*Dothidea* Fr., *Observ. mycol. (Havniae)* 2: 347 (1818), *Facesoffungi* number: FoF00066

#### Synonyms

*Phragmodopsis* Theiss. & Syd., *Annls mycol.* 12(2): 179 (1914)

*Systemma* Theiss. & Syd., *Annls mycol.* 13(3/4): 330 (1915)

*Saprobic* on dead wood, stems and twigs. **Sexual state:** *Ascostromata* dark brown to black, erumpent through the outer layer of the host tissue, to superficial, solitary or scattered, pulvinate, globose to subglobose, coriaceous, multiloculate, with 3–15 locules, cells of *ascostromata* composed of several layers of dark brown cells of *textura angularis*. *Locules* globose to subglobose, broadly or narrowly conical, thick-walled, with or without ostioles. *Peridium* of locules comprising 1–2 layers of thick-walled, lightly

pigmented, dark brown to black cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* eight-spored, bitunicate, fissitunicate, clavate to sub-cylindrical, with a short broad pedicel, thickened and rounded at apex, with a clear ocular chamber. *Ascospores* uniseriate to biseriate, partially overlapping, hyaline, sometimes brown, 1-septate, constricted at the septum, ellipsoidal or oblong to obovoid with broadly rounded ends, smooth-walled, thick-walled, with or without a sheath. **Asexual state:** See notes.

*Notes:* *Dothidea* was introduced by Fries (1818) and later Fuckel (1869) assigned *Dothidea* as the type genus of *Dothideaceae* with *D. gibberulosa* (Ach.) Fr. as the type species. Theissen and Sydow (1915) introduced *Systemma* to accommodate *Dothidea* typified by *D. sambuci* Pers., while *D. ribesia* and *D. berberidis* were transferred to *Dothidella* (Shear 1936) which was in the subfamily *Dothideae*. Theissen and Sydow (1915) chose the oldest species, *Sphaeria natans* Tode, as the basionym and cited the later *Dothidea sambuci* as a synonym (Shoemaker and Hambleton 2005). Clements and Shear (1931) changed the type genus and assigned *D. sambuci* as the type species, in accordance with the recommendation of the Cambridge revision of the International Code (Blain 1927; Orton 1924; Shear 1936). Shoemaker et al. (2003) proposed that the type for *Dothidea* be formally conserved as *Sphaeria sambuci* Pers. (*Dothidea sambuci* (Pers.) Fr.:Fr.) and an epitype specimen was established by Shoemaker and Hambleton (2005). *D. sambuci*, *D. hippophaës* and *D. insculpta* Wallr., form a highly supported monophyletic group, and cluster with high support with other genera classified in *Dothideaceae* and *Dothioraceae* in one of the three lineages of dothideomycetous taxa (Hambleton et al. 2003; Lutzoni et al. 2004; Shoemaker and Hambleton 2005). *Dothidea* presently comprises 499 epithets in Index Fungorum (2014).

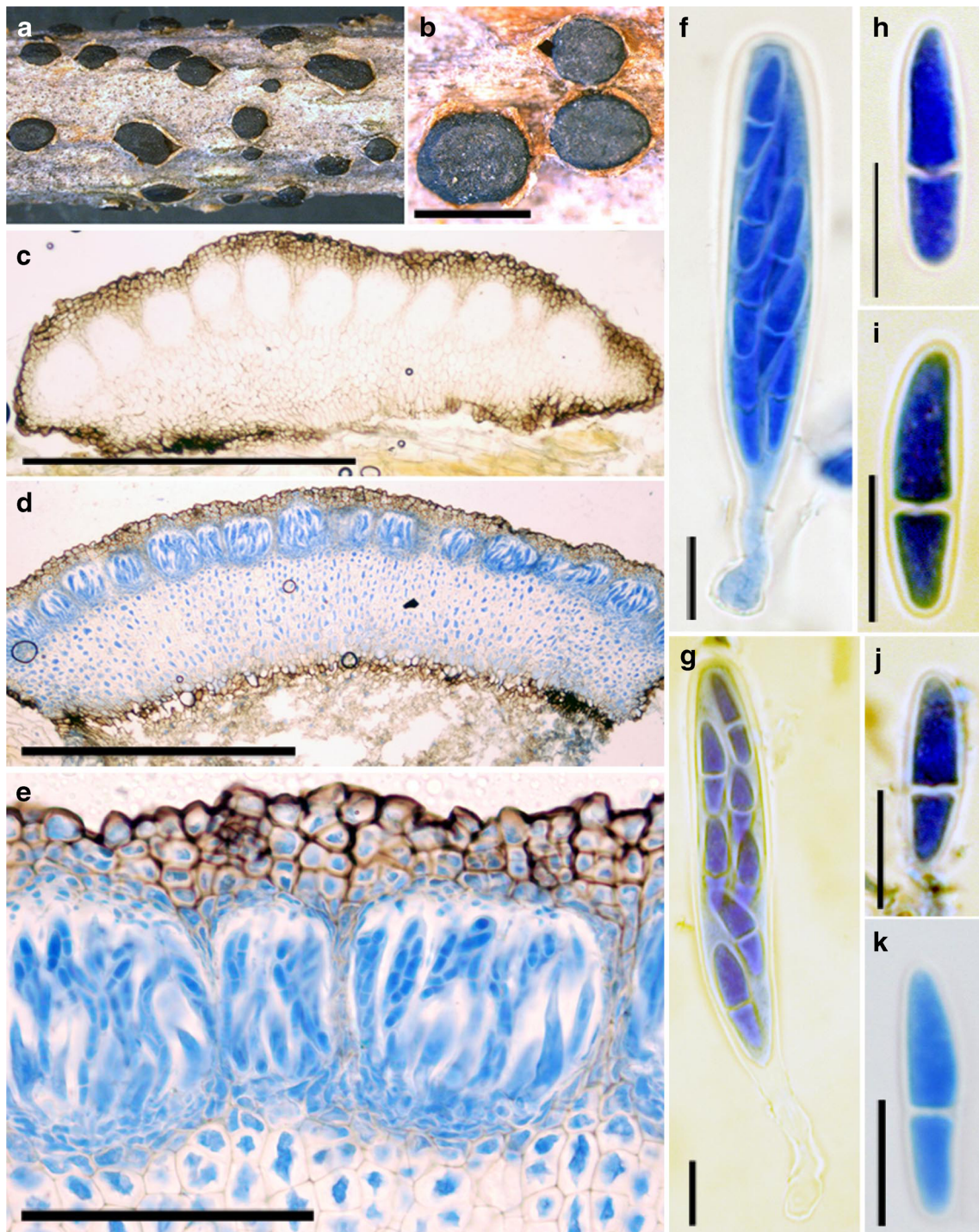
In our phylogenetic tree, the epitype of *Dothidea sambuci* (Pers.) Fr. clustered in the *Dothideaceae* clade with 99/100 % bootstrap support along with *D. insculpta* and we refer this clade as *Dothidea* sensu stricto. *D. muelleri*, *D. hippophaës* and *D. berberidis* are not *Dothidea* species in *Dothidea* sensu stricto and may later require a new genus.

*Type species: Dothidea sambuci* (Pers.) Fr., *Syst. mycol. (Lundae)* 2(2): 551 (1823), (Fig. 2), *Facesoffungi* number: FoF00067

≡ *Sphaeria sambuci* Pers., *Syn. meth. fung. (Göttingen)* 1: 14 (1801)

For other synonyms see Index Fungorum

*Saprobic* on dead stems. **Sexual state:** *Ascostromata* 700–1000 × 200–310 μm ( $\bar{x}$  = 900 × 260 μm,  $n$  = 5), black, erumpent through the outer layer of the host tissue, to near superficial, solitary or scattered, globose to subglobose, coriaceous, multiloculate, with 8–15 locules, cells of *ascostromata* composed of several layers of dark brown cells



**Fig. 2** *Dothidea sambuci* (GZU 78–2002, epitype). **a, b** Ascostromata on the host substrate. **c, d** Section through ascostroma showing the arrangement of locules. **e** Close up of the locules. **f, g** Asci in cotton blue

reagent. Bearing eight ascospores. **h–k** Ascospores in cotton blue reagent. Scale bars: **b**=1000  $\mu\text{m}$ , **c, d**=500  $\mu\text{m}$ , **e**=100  $\mu\text{m}$ , **f–k**=10  $\mu\text{m}$

of *textura angularis*. Locules 80–120  $\times$  65–90  $\mu\text{m}$  ( $\bar{x}$ = 95  $\times$  70  $\mu\text{m}$ ,  $n$  = 20), globose to subglobose, broadly or narrowly conical, with individual ostioles. Ostiole usually widely porate, with well-developed neck, ostiolar canal filled with a tissue of hyaline cells. Peridium of locules 28–41  $\mu\text{m}$  ( $\bar{x}$ = 35  $\mu\text{m}$ ,  $n$  = 15) comprising 1–2 layers of

thick-walled, lightly pigmented, small cells of *textura angularis*. Hamathecium lacking pseudoparaphyses. Asci 70–80  $\times$  12–15  $\mu\text{m}$  ( $\bar{x}$ = 73.5  $\times$  13.5  $\mu\text{m}$ ,  $n$  = 10), eight-spored, bitunicate, fissitunicate, clavate to sub-cylindrical, thickened with a short broad pedicel and rounded at apex, with a clear ocular chamber.

*Ascospores* 17–20 × 5–6.5 μm ( $\bar{x}$  = 17.5 × 5.5 μm,  $n$  = 20) uniseriate, partially overlapping, hyaline to light brown when immature, becoming brown to chestnut brown when mature, 1-septate, constricted at the septum, ellipsoidal with broadly rounded ends, smooth-walled, thick-walled, lacking a sheath.

**Asexual state:** Unknown.

**Material examined:** AUSTRIA, Steiermark (Styria) Grazer Bergland, on *Sambucus nigra* L. (*Adoxaceae*), leg D. Baloch 4 October 2002 det. C. Scheuer (GZU 78–2002, **epitype**).

**Notes:** Shoemaker and Hambleton (2005) established an epitype specimen from Austria on *Sambucus nigra* (*Adoxaceae*). There is no evidence of formation of an asexual state in the culture of the epitype.

*Dothidea insculpta* Wallr., Fl. crypt. Germ. (Norimbergae) 2: 864 (1833), (Fig. 3), MycoBank: MB 173197; *Facesoffungi* number: FoF00068

≡ *Plowrightia insculpta* (Wallr.) Sacc., Syll. fung. (Abellini) 2: 636 (1883)



**Fig. 3** *Dothidea insculpta* (MFLU 14–0156) **a** Appearance of ascostromata on host. **b** Vertical section through ascostroma with asci. **c** Section of peridium. **d** Immature ascus. **e–h** Mature asci. **i** Immature

ascospore. **j–n** Mature ascospores. **o** Colony on PDA medium. (*upper*) **q** Colony on PDA medium. (*lower*) **r** Germinating ascospore. *Scale bars:* a, b=200 μm, c–h=20 μm. i–n=10 μm

≡ *Plowrightia insculpta* (Wallr.) Sacc., Syll. fung. (Abellini) 2: 636 (1883)

≡ *Scirrhia insculpta* (Wallr.) M.E. Barr, Contr. Univ. Mich. Herb. 9(8): 565 (1972)

*Saprobic* on a dead branch of *Clematis vitalba*. **Sexual state:** *Ascstromata* 92–192 μm high × 63–198 μm diam ( $\bar{x}$  = 144 × 134 μm,  $n$  = 7), dark brown to black, superficial on host tissue, solitary, scattered, globose to subglobose, coriaceous, multiloculate, with 2–4 locules, cells of ascstromata composed of dark brown-walled cells of *textura angularis*. *Locules* 91–125 × 109–144 μm ( $\bar{x}$  = 87 × 114 μm,  $n$  = 10), globose to subglobose, non-ostiolate. *Peridium* of locules 27–63 μm, comprising few layers of brown to dark brown cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 53–79 × 8–14 μm ( $\bar{x}$  = 65 × 11 μm,  $n$  = 10), eight-spored, bitunicate, fissitunicate, cylindrical to oblong, with a short pedicel, rounded at the apex with an ocular chamber. *Ascospores* 11–23 × 5–7 μm ( $\bar{x}$  = 16 × 6 μm,  $n$  = 20), overlapping uni to biseriate, broadly ovoid or ellipsoid, hyaline, 1-septate, constricted at the septum, upper cell broader than the lower cell, smooth. **Asexual state:** See notes.

**Cultural characteristics:** Ascospores germinating on MEA or PDA within 36–48 h. Colonies growing on MEA or PAD, reaching 3–5 cm in 5 days at 18–20 °C, rhizoid colonies, flat, rough surface, rhizoid edge, opaque opacity, dull green mycelium, dark green around the colonies, produce some odor and clearing effect on media.

**Material examined:** ITALY, Poggio alla Portacce-Pratomagno (Province of Arezzo [AR]), on a dead branch of *Clematis vitalba* L. (*Ranunculaceae*), 30 June 2013, Erio Camporesi (MFLU 14–0156), living culture MFUCC 13–0686.

**Notes:** We could not locate the type specimen of *Dothidea insculpta* and our specimen can be considered as an authentic specimen. Hess and Müller (1951) introduced a monotypic genus *Asteromellopsis* and described *Asteromellopsis insculpta* H.E. Hess & E. Müll. as the asexual state found in young ascomata of *Dothidea insculpta* found in nature. Luttrell (1951a) found a microconidial state in young stromata of *Dothidea collecta* (Eriksson 1981; Shoemaker and Hambleton 2005). We did not observe formation of an asexual state in the culture.

***Coleophoma*** Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 116: 637 (1907), *Facesoffungi* number: FoF00069

**Type species:** *Coleophoma crateriformis* (Durieu & Mont.) Höhn., Mitt. bot. Inst. tech. Hochsch. Wien 2(3): 77 (1925)

≡ *Ascospora crateriformis* Durieu & Mont., Flora Algéricae 1: 590 (1849) [1846–49]

≡ *Macrophoma crateriformis* (Durieu & Mont.) Berl. & Voglino, Atti Soc. Veneto-Trent. Sci. Nat. 10(1): 194 (1886)

≡ *Macrophoma crateriformis* (Durieu & Mont.) Berl. & Voglino, Atti Soc. Veneto-Trent. Sci. Nat. 10(1): 194 (1886) f. *crateriformis*

≡ *Macrophoma crateriformis* f. *macrospora* D. Sacc.

≡ *Phoma crateriformis* (Durieu & Mont.) Sacc., *Michelia* 2(no. 6): 90 (1880)

≡ *Septoria crateriformis* (Durieu & Mont.) Sacc., Syll. fung. (Abellini) 3: 496 (1884)

**Notes:** *Coleophoma* was introduced by Höhnelt (1907) and species of *Coleophoma* are parasitic, saprobic or endophytic on plants in terrestrial habitats. This genus is characterized by pycnidial conidiomata with well-developed lower and usually poorly developed upper walls; hyaline, septate, collapsed paraphyses among the conidiophores; discrete or integrated, determinate, phialidic conidiogenous cells and hyaline, aseptate, smooth-walled, cylindrical or ellipsoid conidia (Wu et al. 1996; Sutton 1980; Duan et al. 2007). Wijayawardene et al. (2012) placed *Coleophoma* in Ascomycota, genera *incertae sedis*. In the phylogenetic analysis of Gruyter et al. (2009), a putative strain of *Coleophoma crateriformis* clustered in *Dothideales*, while *C. maculans* grouped in *Helotiales*. *C. crateriformis* is closely related with *C. oleae* and Duan et al. (2007) reassigned *C. oleae* to the genus *Coleonaema* based on conidiomatal development. In our phylogenetic study, *C. crateriformis* the type of *Coleophoma* clustered with *Coleophoma oleae* in one of the subclades in the *Dothideaceae* clade. Therefore, we accept *Coleophoma* as an asexual genus in *Dothideaceae*.

***Cylindroseptoria*** Quaedvlieg et al., Stud. Mycol. 75: 358 (2013)

**Type species:** *Cylindroseptoria ceratoniae* Quaedvlieg et al., Stud. Mycol. 75: 358 (2013)

**Notes:** *Cylindroseptoria* was introduced by Quaedvlieg et al. (2013) and typified with *C. ceratoniae*. *Cylindroseptoria ceratoniae* is characterized by separate, brown, cupulate, short-stipitate conidiomata; a rim with elongated brown, thick-walled cells with obtuse ends, 3–4 wall layers of medium brown cells of *textura angularis*, becoming hyaline towards inner region, hyaline, smooth, ampulliform conidiogenous cells with prominent periclinal thickening and solitary, hyaline, smooth, granular or not, aseptate, cylindrical conidia with obtuse apex. Quaedvlieg et al. (2013) tentatively placed a new species *C. pistaciae* in *Cylindroseptoria*, as it has pycnidial rather than cupulate conidiomata. Multigene phylogenetic analysis of Quaedvlieg et al. (2013) showed that *Cylindroseptoria* belongs to *Dothideaceae*. However, the two species clustered in separate clades in the family *Dothideaceae* in our phylogenetic study. *Cylindroseptoria ceratoniae* grouped as sister clade to the *Coleophoma* while, *C. pistaciae* clustered separately with 98/100 % bootstrap support in *Dothideaceae*. Therefore, we introduce a new genus, *Neocylindroseptoria* below, for *C. pistaciae*.

**Delphinella** (Sacc.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 74 (1898), *Facesoffungi* number: FoF00074

Synonyms

*Diplosphaerella* Grove, J. Bot., Lond. 50: 91 (1912)

*Glonium* subgen. *Delphinella* Sacc., Syll. fung. (Abellini) 9: 1103 (1891)

*Hariotia* P. Karst., J. Bot., Paris 3: 206 (1889)

*Pleoglonis* Clem., Gen. fung. (Minneapolis): 56, 173 (1909)

*Rehmiellopsis* Bubák & Kabát, in Bubák, Naturwiss. Z. Forst–Landw. 8: 320 (1910)

*Saprobic* or parasitic on twigs, wood, leaves and cone scales of gymnosperms and woody dicotyledons (Barr 1972). **Sexual state:** *Ascostromata* dark brown to black, immersed and becoming erumpent, solitary or gregarious, globose to subglobose, multiloculate, thick-walled. *Locules* globose to subglobose, lacking ostioles. *Peridium* of locules relatively thick, comprising 1–2-layers, lightly pigmented of cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* polysporous, bitunicate, fissitunicate, oblong, clavate or cylindrical, with a short pedicel, apically rounded, ocular chamber absent, asci borne at the base of the loculus. *Ascospores* overlapping 2–3-seriate to crowded, transversely 1-septate, hyaline or yellowish, with rounded apex, obtuse or pointed at the base, constricted at the septum, smooth-walled. **Asexual state:** See notes.

**Notes:** *Delphinella* was introduced by Kuntze (1898) based on *Sphaeria strobiligena*. Müller and von Arx (1962) assigned *Delphinella strobiligena* as the type species, and transferred *D. abietis* (O. Rostr.) E. Müll., *D. balsameae* (Waterman) E. Müll., *D. cookie* (Linds.) E. Müll., *D. deviata* (Petr.) E. Müll. and *D. polyspora* (Johanson) E. Müll. Barr (1972) introduced *D. tsugae* (House) M.E. Barr, while Barr et al. (1986) added *D. peckii* (Lindau) M.E. Barr which had been previously been referred to *Sphaerella* and *Mycosphaerella*. The locules of *D. polyspora* are smaller and more conic than the other species of the genus (Barr 1972). Von Arx and Müller (1975) included the genus *Delphinella* under *Dothideaceae*. Hawksworth (1979) synonymized *D. cookei* under *Muellerella lichenicola* (Sommerf.) D. Hawksw. and placed it in *Verrucariaceae* based on its polysporous asci. However, the genus *Delphinella* should be placed under *Dothideaceae*, *Dothideomycetes* (Barr 2001; Hyde et al. 2013).

Barr (1972) described the asexual state of *Delphinella abietis* as *Dothiorella* (*Phoma bohémica* Bubák and Kabát) which is characterized by thick-walled pycnidia with aspects similar to that of *ascostromata* and hyaline, fusoid, one-celled conidia. However, modern taxonomic and molecular data has shown the *Dothiorella* belongs in *Botryosphaeriaceae* (Liu et al. 2012).

In the phylogeny (Fig. 1) a putative strain of *Delphinella strobiligena* (CBS 735.71) clustered in *Dothideaceae* clade close to a putative strain of *Sydowia polyspora* (CBS

116.29). Considering the close relationship of the two strains it may be that one of these two strains is wrongly identified or these two species should be in one genus. However, we named this clade as *Delphinella* which comprises *D. strobiligena*, *Rhizosphaera pini* and *S. polyspora* pending on more fresh collections of *Delphinella* and *Sydowia* species.

**Type species:** *Delphinella strobiligena* (Desm.) Sacc. ex E. Müll. & Arx, in Müller & von Arx, Beitr. Kryptfl. Schweiz 11(no. 2): 25 (1962), (Fig. 4), *Facesoffungi* number: FoF00075

≡ *Didymella strobiligena* (Desm.) Sacc., Syll. fung. (Abellini) 1: 552 (1882)

≡ *Glonium strobiligenum* (Desm.) Mouton, Bull. Soc. R. Bot. Belg. 28(C.R.): 79 (1889)

≡ *Hariotia strobiligena* (Desm.) P. Karst., J. Bot., Paris 3: 206 (1889)

≡ *Pleoglonis strobiligena* (Desm.) Clem., Gen. fung. (Minneapolis): 1–227 (1909)

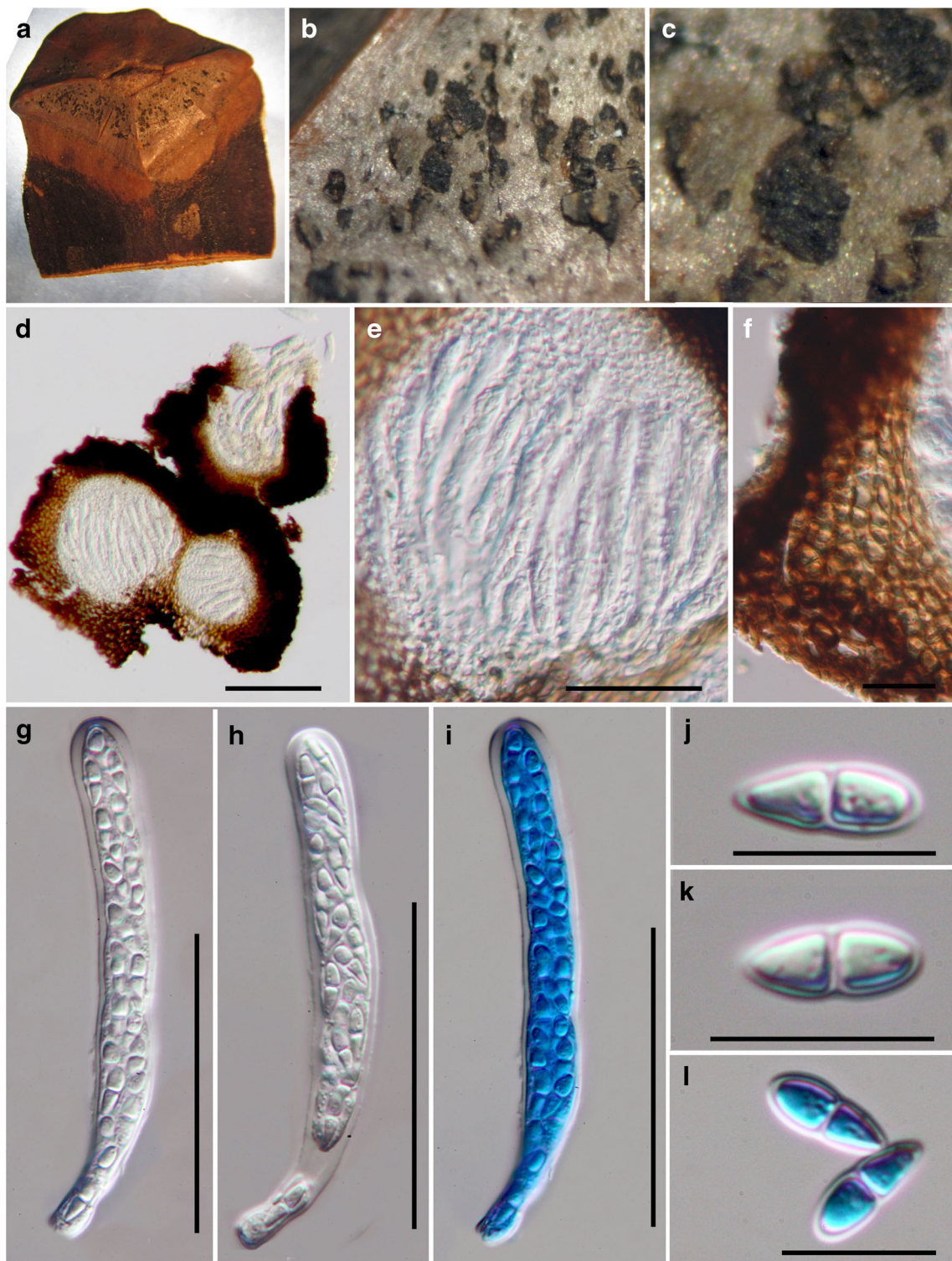
≡ *Sphaeria strobiligena* Desm., Anns Sci. Nat., Bot., sér. 3 6: 75 (1846)

*Parasitic* on twigs, wood, needles and cone scales of conifer plants. **Sexual state:** *Ascostromata* 220–310  $\mu\text{m}$  high  $\times$  290–330  $\mu\text{m}$  diam ( $\bar{x}$  = 295  $\times$  320  $\mu\text{m}$ ,  $n$  = 5), black, initially immersed and becoming erumpent at maturity on host surface, scattered, subglobose, carbonaceous, 2–3-loculate, cells of *ascostromata* of brown-walled *textura angularis*. *Locules* 140–209  $\mu\text{m}$  high  $\times$  162–191  $\mu\text{m}$  diam ( $\bar{x}$  = 180  $\times$  170  $\mu\text{m}$ ,  $n$  = 5), globose to subglobose, lacking ostioles. *Peridium* of locules 22–80  $\mu\text{m}$  ( $\bar{x}$  = 46  $\mu\text{m}$ ,  $n$  = 10), thin-walled, composed of a single layer of light brown to hyaline cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 79–87  $\times$  9–11  $\mu\text{m}$  ( $\bar{x}$  = 82  $\times$  10  $\mu\text{m}$ ,  $n$  = 7), poly-sporous, bitunicate, fissitunicate, oblong, clavate or cylindric-clavate with a short pedicel, rounded at the apex. *Ascospores* 8–10  $\times$  3–5  $\mu\text{m}$  ( $\bar{x}$  = 9  $\times$  4  $\mu\text{m}$ ,  $n$  = 15), overlapping 1–3-seriate, hyaline, 1-septate, ellipsoid to fusiform, upper cell rounded and wider than lower cell, slightly constricted at the septum, smooth-walled, surrounded by a thin sheath. **Asexual state:** Unknown.

**Material examined:** FRANCE, on strobili of *Pinus* sp., Desmaziere (PC 0084688, **holotype**).

*Dictyodothis* Theiss. & Syd., Anns mycol. 13(3/4): 346 (1915), *Facesoffungi* number: FoF00076

*Saprobic* on dead twigs, stems and branches of land plants. **Sexual state:** *Ascostromata* black, immersed, erumpent at maturity, aggregated or in clusters, scattered, discoid to pulvinate, globose to subglobose, coriaceous, multiloculate, with 8–10 locules, cells of *ascostromata* composed of several layers of dark brown to black cells of *textura prismatica* and *textura angularis*. *Locules* globose to subglobose, ostiolate. *Hamathecium* lacking pseudoparaphyses. *Peridium* of locules comprising light brown to brown cells of *textura angularis*.



**Fig. 4** *Delphinella strobiligena* (PC 0084688, holotype). **a–c** Ascostromata on host surface. **d** Section through ascostromata showing locules. **e** Ascus arrangement in locules. **f** Cells of ascostroma and

peridium of locule. **c–h** Asci. **i** Ascus stained in cotton blue reagent. **j–k** Ascospores. **l** Ascospores stained in cotton blue reagent. Scale bars: **d**=100  $\mu\text{m}$ , **e**, **g–i**=50  $\mu\text{m}$ , **f**=20  $\mu\text{m}$ , **j–l**=10  $\mu\text{m}$

*Hamathecium* lacking pseudoparaphyses. *Asci* eight-spored, bitunicate, clavate to sub-clavate or cylindrical, pedicellate, thickened with a short broad pedicel and rounded at apex, with a clear ocular chamber. *Ascospores* overlapping uniseriate to

biseriate, yellowish brown to dark brown, muriform, with 3–6 transverse septa and 1–5 longitudinal septa, constricted at the primary septum, oblong, ovoid to fusoid, part above the central septum wider. **Asexual state:** Unknown.

*Notes:* *Dictyodothis* was introduced by Theissen and Sydow (1915) to accommodate *Dictyodothis berberidis* (Rehm) Theiss. & Syd. and *Dictyodothis excavata* (Cooke & Ellis) Theiss. & Syd. under the family *Dothideaceae*. As the type genus they assigned *Dictyodothis berberidis* which has been referred to *Curreya*. Tilak and Kale (1969) introduced two species with paraphyses, *Dictyodothis acaciae* Tilak, S.B. Kale & S.V.S. Kale and *D. grewiae* Tilak, S.B. Kale & S.V.S. Kale. Later Von Arx and Müller (1975) included this genus in the family *Pleosporaceae* based on “paraphysoids” in the locules. Barr (1981) showed that “paraphysoids” are the walls and strands of cytoplasmic remnants of discharged asci and ascospores are similar with those of *Dothidea sambuci*. Therefore, Barr (1981) included *Dictyodothis* again in the *Dothideaceae*. Barr (1987a), Lumbsch and Huhndorf (2010) also listed *Dictyodothis* under the *Dothideaceae*. No asexual states have been reported for this genus. Currently there are around eight species epithets listed in Index Fungorum (2014).

Because of the erumpent, multiloculate ascostromata this genus should be included in *Dothideaceae*. However, *Dictyodothis* is distinct in having yellowish-brown, muriform ascospores. No sequence data is available for this species.

*Type species: Dictyodothis berberidis* (Rehm) Theiss. & Syd., *Annls mycol.* 13(3/4): 346 (1915), (Fig. 5), *Facesoffungi number:* FoF00077

≡ *Curreya berberidis* Rehm, *Bih. K. svenska Vetensk Akad. Handl., Afd. 3* 25(no. 6): 4 (1899)

*Saprobic* on branches of *Berberis buxifolia*. **Sexual state:** *Ascostromata* 1000–1500 × 150–180 μm ( $\bar{x}$  = 1100 × 150 μm,  $n$  = 20), black, superficial, semi-immersed to erumpent, solitary or scattered, subglobose to broadly ellipsoid, coriaceous, multiloculate, with 8–10 locules, cells of ascostromata dark brown to black cells of *textura angularis*, sometimes ostiolate. *Peridium* of locules 20–40 ( $\bar{x}$  = 35 μm,  $n$  = 20) comprising lightly pigmented to light brown cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 50–60 × 14–20 μm ( $\bar{x}$  = 55 × 17 μm,  $n$  = 20) eight-spored, bitunicate, fissionate, clavate to broadly-clavate, with a short, broad pedicel, thickened and rounded at apex with an ocular chamber. *Ascospores* 15–20 × 6–10 μm ( $\bar{x}$  = 16 × 8 μm,  $n$  = 40), uniseriate or discontinuously arranged, partially overlapping, reddish brown to dark yellowish brown, muriform with three transverse septa and 1–2 vertical septum in the central cells when mature, constricted at the septa, oblong, smooth to verruculose, without a sheath. **Asexual state:** Unknown.

*Material examined:* SOUTH AMERICA, Pantagonia, Rio Argopardo, on dead wood of *Berberis buxifolia* Lam. (*Berberidaceae*), 4 March 1896, Dunsen (W, **holotype**).

*Dothiora* Fr., *Summa veg. Scand., Section Post.* (Stockholm): 418 (1849), *Facesoffungi number:* FoF00078

Synonyms

*Dothiora subgen. Metadothis* Sacc., *Syll. fung.* (Abellini) 8: 766 (1889)

*Jaapia* Kirschst., *Krypt.-Fl. Brandenburg* (Leipzig) 7(3): 444 (1938)

*Keisslerina* Petr., *Annls mycol.* 17(2/6): 74 (1920) [1919]

*Leptodothiora* Höhn., *Ber. dt. bot. Ges.* 36: 311 (1918)

*Metadothis* (Sacc.) Sacc., *Syll. fung.* (Abellini) 10: 857 (1892)

*Stigmaea* Bonord., *Abh. naturforsch. Ges. Halle* 8: 79 (1864)

*Saprobic* or *parasitic* on leaves, branches or twigs in terrestrial habitats. **Sexual state:** *Ascostromata* black, immersed to erumpent, pulvinate to depressed globose, multiloculate, thick-walled, cells of ascostromata composed of lightly pigmented or dark brown cells of *textura angularis*. *Locules* globose to subglobose, broadly rounded to short papillate, apex opening by an irregular, small pore. *Peridium* of locules composed of several layers of thick-walled dark brown cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 8 or more spored, bitunicate, fissionate, oblong to clavate, pedicellate, with a small ocular chamber. *Ascospores* overlapping biseriate to crowded, one to many septate, usually constricted at the primary median septum, sometimes with a vertical septum in one or several of the central cells and rarely in the end cells, hyaline, rarely yellow to pale brown, obovate to elliptic or fusoid, often inequilateral or slightly curved, smooth, occasionally surrounded by a thin mucilaginous sheath. **Asexual states:** *Dothichiza* sp.: *Pycnidia* frequently found on host and produced in culture conidial stroma similar to ascostromata. *Conidiogenous cells* lining the cavity of the pycnidium. *Conidia* aoid to oblong, hyaline, one celled formed singly on phialidic, obpyriform, simple, smooth-walled. (asexual morph description follows *D. europaea*) (Eriksson 1981; Sivanesan 1984).

*Notes:* *Dothiora* was introduced by Fries (1849) with *D. pyrenophora* (Fr.) Fr. as the type species. Saccardo (1889) and Lindau (1897) included the genus in the *Discomycetes*, while Theissen and Sydow (1915) placed it in *Dothideales*. Theissen and Sydow (1917) moved the genus to the new family *Dothioraceae* under the order *Myringiales*. Clements and Shear (1931) placed it both in the *Phacidiaceae* and *Myriangiaceae* (Miller and Burton 1943). Froidevaux (1972) placed *Dothiora* in *Dothioraceae* along with four other genera (Table 3) and assigned *D. sorbi* (*Dothiora pyrenophora* synonymized with *D. sorbi*) as the type species. Barr (1972) listed eleven species with, *D. pyrenophora* as type species, while Froidevaux (1972) accepted 14 species. Von Arx and Müller (1975) and Sivanesan (1984) treated *Dothiora* under the family *Dothideaceae* as they synonymized



**Fig. 5** *Dictyodothis berberidis* (holotype). **a**. Ascostromata on host surface. **b**. Close up of ascostroma **c**. Section through ascostroma. **d**. Close up of the cells of ascostroma. **e–g**. Asci with short, broad pedicel

bearing eight ascospores. **h–k** Reddish brown to dark yellowish brown, muriform ascospores. Scale bars: **c**=500 µm, **d**=100 µm, **e–g**=20 µm, **h–k**=5 µm

*Dothideaceae* and *Dothioraceae*. Barr (1987a), Hawksworth et al. (1995) and Lumbsch and Huhndorf (2010) however, categorized *Dothiora* under *Dothioraceae* as they treated *Dothideaceae* and *Dothioraceae* as separate two families in *Dothideales*.

The asexual state of *Dothiora pyrenophora* has been reported as *Dothichiza sorbi* Lib. by Sivanesan (1984) as

pycnidia formed in culture and abundantly on the host. The type species of *Dothichiza* is *D. populea* Sacc. & Briard, which causes cankers of *Populus* sp. (Hedgcock and Hunt 1916; Waterman 1957). *Dothiora populea* forms multiloculate pustules on the surface of *Populus* sp., but have not been linked to a sexual state. Although some species of *Dothichiza* have been linked to *Dothideales* via molecular



**Table 3** Accepted genera according to various treatments of *Dothioraceae*

Froidevaux 1972	Luttrell 1973	Barr 1972	Barr 1979	Barr 1987a	Hawksworth et al. 1995	Lumbsch and Huhndorf 2010
<i>Delphinella</i>	<i>Bagnisiella</i>	<i>Bagnisiella</i>	<i>Auerswaldia</i>	<i>Bagnisiella</i>	<i>Botryochora</i>	<i>Botryochora</i>
<i>Dothiora</i>	<i>Hypnotheca</i>	<i>Botryosphaeria</i>	<i>Bagnisiella</i>	<i>Delphinella</i>	<i>Delphinella</i>	<i>Delphinella</i>
<i>Pringsheimia</i>	<i>Leptodothiora</i>	<i>Cocodiella</i>	<i>Botryosphaeria</i>	<i>Dothiora</i>	<i>Dothiora</i>	<i>Dothiora</i>
<i>Sydowia</i>	<i>Dothiora</i>	<i>Delphinella</i>	<i>Cocodiella</i>	<i>Sacothecium</i>	<i>Endodothiora</i>	<i>Endodothiora</i>
	<i>Sydowia</i>	<i>Dothiora</i>	<i>Delphinella</i>	<i>Sydowia</i>	<i>Jaffuela</i>	<i>Jaffuela</i>
	<i>Keisslerina</i>	<i>Sacothecium</i>	<i>Dothiora</i>		<i>Plowrightia</i>	<i>Phaeocryptopus</i>
	<i>Endodothiora</i>	<i>Scirrhia</i>	<i>Jaffuela</i>		<i>Sacothecium</i>	<i>Plowrightia</i>
		<i>Sydowia</i>	<i>Leptoguignardia</i>		<i>Sydowia</i>	<i>Sacothecium</i>
			<i>Lichenopeltella</i>			<i>Sydowia</i>
			<i>Phyllachorella</i>			<i>Yoshinagaia</i>
			<i>Pringsheimia</i>			
			<i>Scirrhia</i>			
			<i>Sydowia</i>			

data (Bills et al. 2004; Zalar et al. 2008), it has not been established that *Dothiora pyrenophora* and *Dothichiza populea* are related.

**Type species:** *Dothiora pyrenophora* (Fr.) Fr., Summa veg. Scand., Section Post. (Stockholm): 418 (1849), (Fig. 6), *Facesoffungi* number: FoF00079

**Saprobic** on branches of *Sorbus* sp. **Sexual state:** *Ascstromata* (639–) 650–756.5  $\mu\text{m}$  diam, black, immersed to erumpent, breaking through the host surface through angular splits, multiloculate, cells of ascstromata composed dark brown to black cells of *textura angularis*. *Locules* 140–172  $\mu\text{m}$  high  $\times$  152–180  $\mu\text{m}$  diam., subglobose or obpyriform, arranged at periphery of stroma in a single layer, widest at the base, short papillate, with small ostiole pores. *Peridium* of locules 78–88  $\mu\text{m}$  thick, composed cell layers of *textura prismatica* and *textura angularis*, thick-walled and black at the outer wall. *Hamathecium* lacking pseudoparaphyses. *Asci* (85–)93–108(–112)  $\times$  (13–)16–20(–23)  $\mu\text{m}$  ( $\bar{x}$  = 99  $\times$  18  $\mu\text{m}$ ,  $n$  = 15), eight-spored, bitunicate, fissitunicate, oblong to subclavate, saccate, short-pedicellate, with a distinct ocular chamber, ca. 2(–3)  $\mu\text{m}$  wide. *Ascospores* (28–)29–36(–40)  $\times$  8–10(–11)  $\mu\text{m}$  ( $\bar{x}$  = 32  $\times$  10  $\mu\text{m}$ ,  $n$  = 10), 2–3-seritate overlapping in the ascus, sometime irregularly arranged, hyaline or pale grayish, muriform, 7–transverse septate, with 1–longitudinal septum in upper part, deeply constricted at middle septum, cylindrical to fusiform, pointed at both ends, smooth. **Asexual states:** Unknown.

**Material examined:** SWITZERLAND, Graubuenden, Davos, Dischmatal, on *Sorbus aucuparia* L. (*Rosaceae*), May 26 1964, E. Müller (BPI 674269).

**Notes:** Conidiomata with numerous, cylindrical, hyaline conidia were found at the base of the ascstromata (Fig. 6). It is not clear if these are the asexual state, another associated taxon or a fungicolous taxon. We could not loan the type so illustrate a specimen from BPI.

**Endoconidioma** Tsuneda et al., Mycologia 96(5): 1129 (2004), *Facesoffungi* number: FoF00080

**Type species:** *Endoconidioma populi* Tsuneda et al., Mycologia 96(5): 1129 (2004)

**Notes:** *Endoconidioma* was introduced by Tsuneda et al. (2004) as a monotypic genus in order to accommodate *E. populi* in *Dothideaceae*. Endoconidiogenesis in *E. populi* is similar to the endoconidial hyphomycete *Phaeotheca* and no coelomycetous taxa have been reported to produce endoconidia. Morphological characters and DNA sequence data showed that *Endoconidioma* is distinct from the previously established endoconidial genera (Tsuneda et al. 2004). This genus is characterized by subglobose to flask-shaped, entirely closed conidiomata, forming on a black subiculum, a darkly pigmented peridium and locules filled with conidiogenous cells. Endoconidia are formed endogenously and hyaline, unicellular and released by dissolution of the conidiogenous and the peridial cells of the conidioma. Blastic conidia, light to dark brown, mostly two-celled, produced holoblastically from pigmented, undifferentiated hyphae (Tsuneda et al. 2004). In our phylogenetic analysis (Fig. 1) *E. populi* is clustered in *Dothideaceae* with 65/100 % bootstrap support.

**Endodothiora** Petr., *Annls mycol.* 27(5/6): 345 (1929), *Facesoffungi* number: FoF00082

**Parasitic** on *Dothidea puccinioides*. **Sexual state:** *Ascstromata* black, immersed, becoming erumpent, solitary or gregarious, subglobose to broadly ellipsoid, coriaceous, multiloculate, with 2–5 locules, cells of ascstromata composed of dark brown to black cells of *textura angularis*. *Locules* globose to subglobose, without ostioles. *Peridium* of locules thin-walled, composed of light brown to hyaline cells of *textura angularis*. *Asci* 20–26-spored, bitunicate, cylindrical to broadly cylindrical with a short pedicel, rounded at the apex. *Ascospores* overlapping, crowded, hyaline, oblong, 5–7 septate, constricted at the primary septum, smooth-walled. **Asexual state:** Unknown.

**Table 4** Taxa used in the phylogenetic analysis and their corresponding GenBank accession numbers. Newly deposited sequences are shown in bold

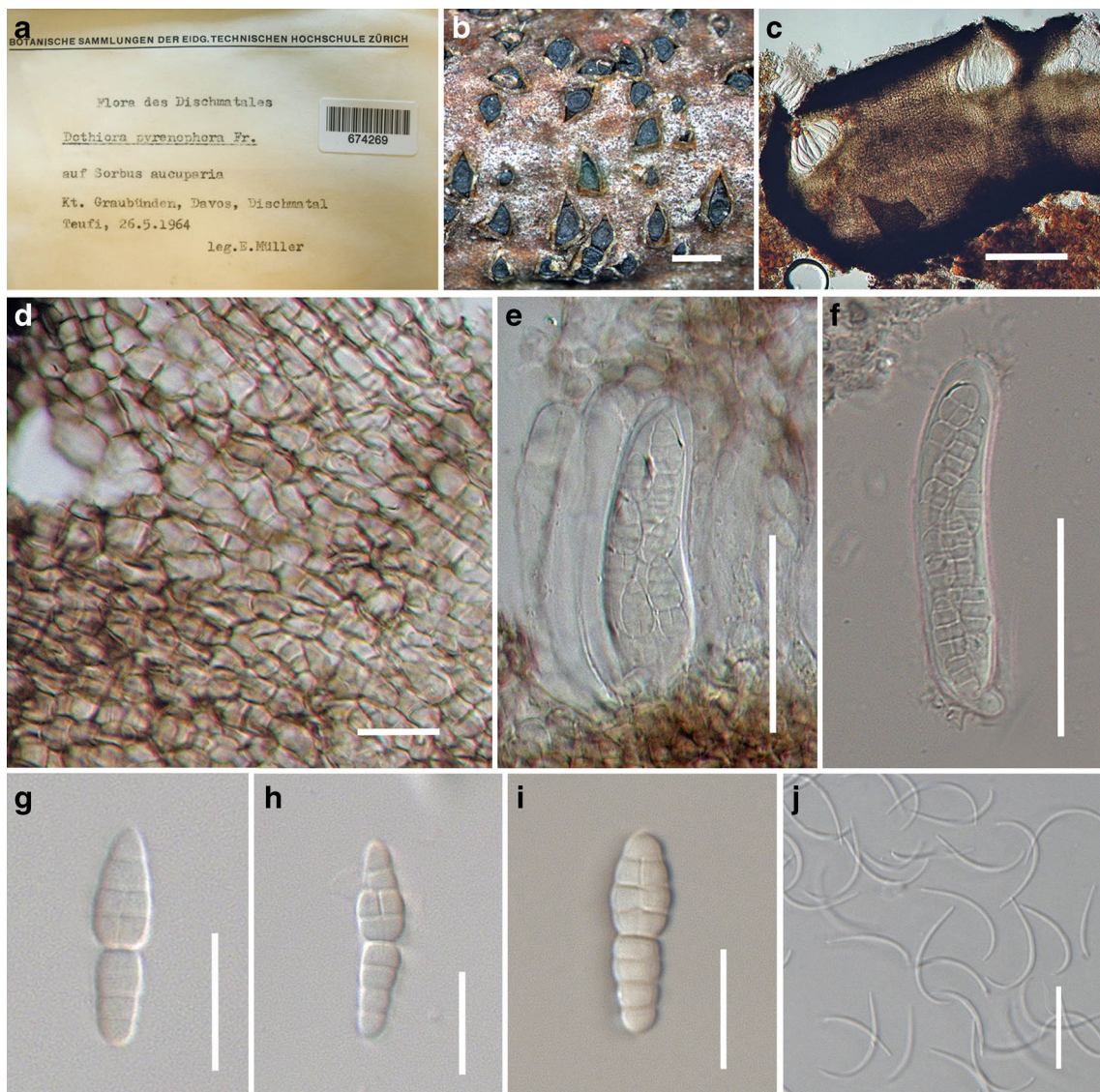
Taxon	Culture/ voucher No.	ITS	SSU	LSU
<i>Aureobasidium leucospermi</i>	CPC 15180	JN712489	–	JN712555
<i>Aureobasidium leucospermi</i>	CPC 15081	JN712487	–	JN712553
<i>Aureobasidium proteae</i>	CPC 2826	JN712493	–	JN712559
<i>Aureobasidium proteae</i>	CPC 2824	JN712491	–	JN712557
<i>Aureobasidium proteae</i>	CPC 2825	JN712492	–	JN712558
<i>Aureobasidium pullulans</i>	CBS 584.75	FJ150906	DQ471004	DQ470956
<b><i>Aureobasidium pullulans</i></b>	<b>MFLUCC 14–0288</b>	KM388542	KM388547	KM461701
<i>Capnodium coffeae</i>	CBS 147.52	AJ244239	DQ247808	DQ247800
<i>Capnodium salicinum</i>	CBS 131.34	AJ244240	DQ67799	DQ678050
<i>Celosporium larixicola</i>	UAMH 11008	FJ997287	–	FJ997288
<i>Coleophoma crateriformis</i>	CBS 473.69	–	EU754047	EU754146
<i>Coleophoma oleae</i>	CBS 615.72	–	EU754049	EU754148
<i>Cylindroseptoria ceratoniae</i>	CBS 477.69	KF251151	–	KF251655
<i>Cylindroseptoria pistaciae</i>	CBS 471.69	KF251152	–	KF251656
<i>Delphinella strobiligena</i>	CBS 735.71	–	DQ471029	DQ470977
<i>Discosphaerina fagi</i>	CBS 171.93	–	AY016342	AY016359
<i>Dothidea berberidis</i>	CBS 186.58	EU167601	EU167601	EU167601
<i>Dothidea hippophaeos</i>	CBS 188.58	–	U42475	DQ678048
<i>Dothidea insculpta</i>	CBS 189.58	AF027764	DQ247810	DQ247802
<b><i>Dothidea insculpta</i></b>	<b>MFUCC 13–0686</b>	KM388543	KM388548	KM388551
<i>Dothidea muelleri</i>	CBS 191.58	EU167593	EU167593	EU167593
<i>Dothidea sambuci</i>	DAOM 231303	AY883094	AY544722	AY544681
<i>Dothiora cannabinae</i>	CBS 737.71	AJ244243	DQ479933	DQ470984
<i>Dothiora elliptica</i>	CBS 736.71	–	–	GU301811
<i>Elsinoe phaseoli</i>	CBS 165.31	–	DQ678042	DQ678095
<i>Elsinoe veneta</i>	CBS 150.27	–	DQ767651	DQ767658
<i>Endoconidioma populi</i>	UAMH 10902	HM185487	–	HM185488
<i>Kabatiella caulivora</i>	CBS 242.64	EU167576	EU167576	EU167576
<i>Kabatiella lini</i>	CBS 125.21	FJ150897	EU707925	FJ150946
<i>Kabatiella microsticta</i>	CBS 114.64	FJ150873	–	FJ150940
<i>Microxyphium aciculiforme</i>	CBS 892.73	–	GU296176	GU301847
<i>Mycosphaerella punctiformis</i>	CBS 113265	–	DQ471017	DQ470968
<i>Myriangium duriae</i>	CBS 260.36	–	AY016347	DQ678059
<i>Myriangium hispanicum</i>	CBS 247.33	–	GU296180	GU301854
<i>Phaeocryptopus gaeumannii</i>	CBS 267.37	EF114685	EF114722	EF114698
<i>Phaeocryptopus nudus</i>	CBS 268.37	EU700371	GU296182	GU301856
<i>Pleospora herbarum</i>	CBS 191.86	KC584239	DQ247812	DQ247804
<i>Plowrightia abietis</i>	ATCC 24339	–	EF114727	EF114703
<i>Plowrightia perichlymeni</i>	178096	–	FJ215709	FJ215702
<b><i>Plowrightia ribesia</i></b>	<b>MFLUCC 13–0670</b>	KM388545	KM388550	KM388553
<b><i>Plowrightia ribesia</i></b>	<b>MFLU 14–0040</b>	KM388544	KM388549	KM388552
<i>Pringsheimia smilacis</i>	CBS 873.71	AJ244257	–	FJ150970
<i>Pseudoseptoria collariana</i>	CBS 135104	KF251218	–	KF251721
<i>Pseudoseptoria obscura</i>	CBS 135103	KF251219	–	KF251722
<i>Rhizosphaera kalkhoffii</i>	ATCC 26605	–	EF114731	EF114706
<i>Rhizosphaera oudemansii</i>	184813	–	EF114732	EF114707
<i>Rhizosphaera pini</i>	64367	–	EF114733	EF114708
<b><i>Sacothecium sepincola</i></b>	<b>MFLU 14–0276</b>	KM388546	–	KM388554
<i>Selenophoma australiensis</i>	CBS:124776	GQ303293	–	GQ303324

**Table 4** (continued)

Taxon	Culture/ voucher No.	ITS	SSU	LSU
<i>Selenophoma linicola</i>	CBS 468.48	–	EU754113	EU754212
<i>Selenophoma mahoniae</i>	CBS 388.92	FJ150872	EU754114	EU754213
<i>Stylodothis puccinioides</i>	CBS 193.58	–	–	AY004342
<i>Sydowia eucalypti</i>	CPC:14028	GQ303296	–	GQ303327
<i>Sydowia eucalypti</i>	CPC:14927	GQ303297	–	GQ303328
<i>Sydowia polyspora</i>	CBS 116.29	–	DQ678005	DQ678058

*Notes:* *Endodothiora* was introduced by Petrak (1929) to accommodate a single species *E. sydowiana* Petr., which is immersed in ascostromata of *Dothidea puccinioides* (DC.) Fr.,

Syst. (Barr 1972). Polyspored asci, multiseptate hyaline ascospores of *Endodothiora* share similar characteristics with those of *Sydowia*, but immersed parasitic habitat excludes it

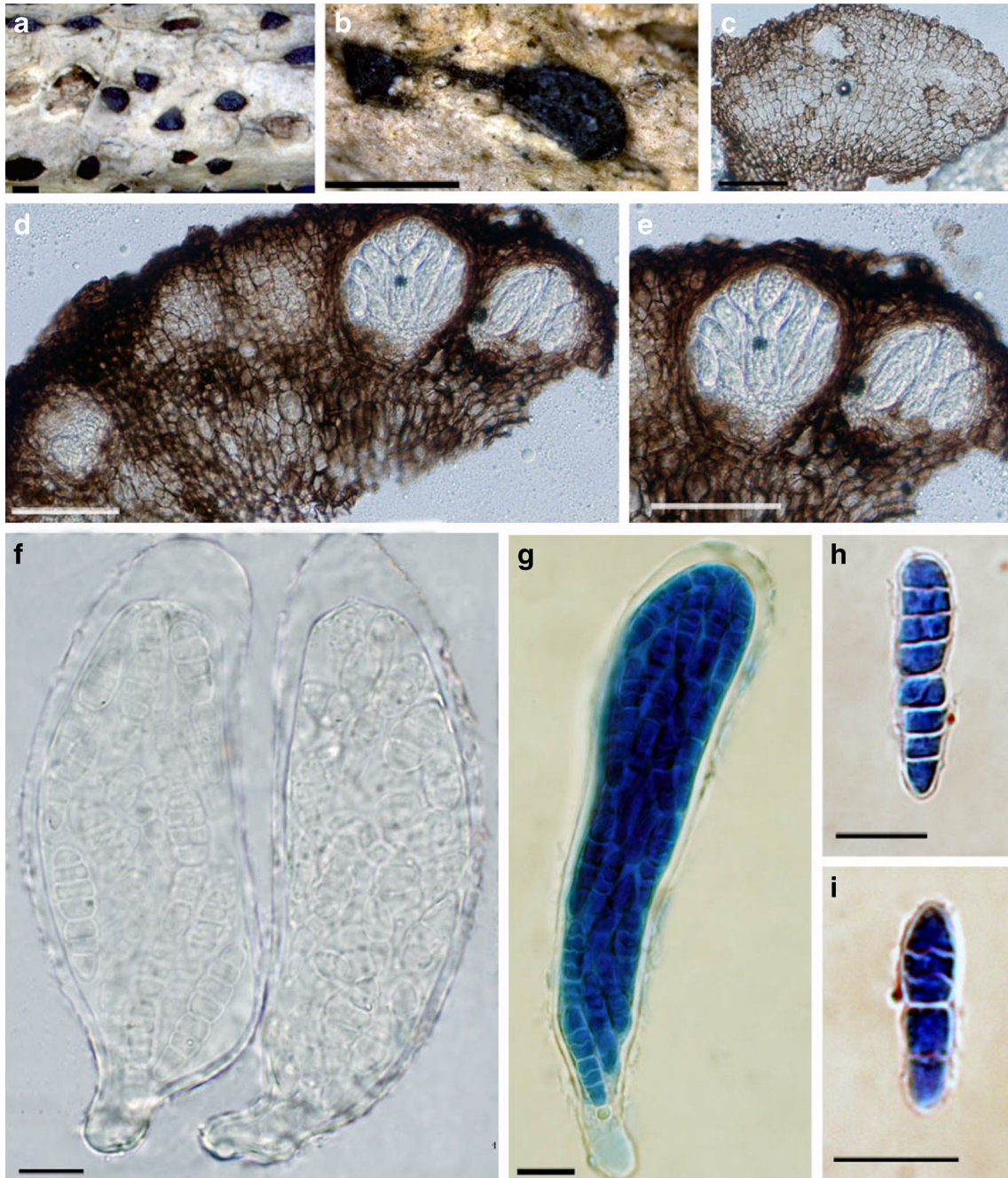


**Fig. 6** *Dothiora pyrenophora* (BPI 674269). **a** Material label. **b** Ascostromata on host surface. **c** Cross section through ascostroma and peridium. **d** Peridial wall. **e**, **f** Immature and mature asci. **g–i** Muriform ascospores. **j** Conidia associated with base of ascostromata. Scale bars: **b**, **c**=200  $\mu\text{m}$ , **d**, **g–j**=20  $\mu\text{m}$ , **e**, **f**=50  $\mu\text{m}$

from *Sydowia* (Barr 1972, 2001). Luttrell (1973) placed this genus in *Dothioraceae* based on it being parasitic on *Dothidea collecta* (Schwein.) Ellis & Everh., and immersed in the stroma of the host fungus. We re-examined the type and we found different asci with brown ascospores (*Dothidea puccinioides*) which share the same ascromata that is good proof for *E. sydowiana* being parasitic on the *Dothidea puccinioides*. No sequence data is available for this monotypic genus.

*Type species: Endodothiora sydowiana* Petr., *Annlis mycol.* 27(5/6): 345 (1929), (Fig. 7), *Facesoffungi* number: FoF00083

*Parasitic on Dothidea puccinioides. Sexual state: Ascstromata* 250–310  $\mu\text{m}$  high  $\times$  200–600  $\mu\text{m}$  diam., gregarious, black, immersed, becoming erumpent solitary or scattered, subglobose to broadly ellipsoid, coriaceous, multiloculate, with 2–5 locules, cells of ascstromata dark brown to black cells of *textura angularis*. *Locules* 120–



**Fig. 7** *Endodothiora sydowiana* (W 12058, holotype). **a, b** Ascstromata of *E. sydowiana*. **c, d** Vertical section through ascstromata illustrating the structure. **e** Vertical section of ascstromata showing the

loculi bearing the asci inside. **f** Asci. **g** Asci in cotton blue reagent. **h, i** Ascospores in cotton blue reagent. Scale bar: b=500  $\mu\text{m}$ . c–e=100  $\mu\text{m}$ . f–i=10  $\mu\text{m}$

140  $\mu\text{m}$   $\times$  110–120  $\mu\text{m}$  ( $\bar{x}$  = 137  $\times$  114  $\mu\text{m}$ ,  $n$  = 5) globose to subglobose, without ostioles. *Peridium* of locules 20–28  $\mu\text{m}$  ( $\bar{x}$  = 23  $\mu\text{m}$ ,  $n$  = 5), thin-walled, composed of light brown to hyaline cells of *textura angularis*. *Asci* 90–115  $\mu\text{m}$   $\times$  21–35  $\mu\text{m}$  ( $\bar{x}$  = 96  $\times$  32  $\mu\text{m}$ ,  $n$  = 10), 20–26-spored, bitunicate, cylindrical to broadly cylindrical with a short pedicel, rounded at the apex. *Ascospores* 16–30  $\times$  6–9  $\mu\text{m}$  ( $\bar{x}$  = 19  $\times$  7  $\mu\text{m}$ ,  $n$  = 20), overlapping, crowded, hyaline, oblong, hyaline, 5–7 septate, constricted at the primary septum, smooth-walled. **Asexual state:** Unknown.

*Material examined:* ABKHAZIA, on dead stem of *Buxus sempervirens* L. (*Buxaceae*), 27 March 1912, G. Woronow (W 12058, **holotype**).

**Kabatina** R. Schneid. & Arx, *Phytopath. Z.* 57: 179 (1966), *Facesoffungi* number: FoF00084

*Type species:* **Kabatina thujae** R. Schneid. & Arx, *Phytopath. Z.* 57: 180 (1966)

*Parasitic* on branches of *Abies*, *Juniperus*, *Mahonia*, *Populus* and *Thuja*. **Sexual state:** Unknown. **Asexual state:** *Mycelium* immersed, branched, septate, hyaline to pale brown or black. *Conidiomata* dark brown to black, sporodochial or acervular, epidermal to subepidermal, pulvinate, pale to dark brown, partially immersed inside the host, composed of branched, septate hyphae, amphigenous or hypophyllous, thick-walled *textura angularis*. Dehiscence by irregular rupture of the cuticle and epidermis. *Conidiophores* stromatic or branched, clustered together resembling a synnema, septate, hyaline to pale brown, smooth. *Conidiogenous cells* enteroblastic, phialidic or percurrent, determinate, cylindrical to doliform or subclavate, brown to pale brown, channel and collarete minute, periclinal thickening present or absent, borne terminally and intercalary. *Conidia* hyaline, aseptate, cylindrical to ellipsoid, terminal in basipetal chains or singly, conidial secession schizolytic, smooth (Sutton 1980; Butin and Pehl 1993; Seifert et al. 2011).

*Notes:* *Kabatina* was introduced by Schneider and von Arx (1966) to accommodate *K. juniperi* R. Schneid. & Arx, and *K. thujae* R. Schneid. & Arx., Butin and Schneider (1976), Ramaley (1992) and Butin and Pehl (1993) added *K. populi* Butin & R. Schneid., *K. mahoniae* A.W. Ramaley and *K. abietis* Butin & Pehl, respectively. This genus was shown to group as a sister clade with *Dothidea hippophaës* and *D. insculpta* Wallr. by Tsuneda et al. (2004). Bills et al. (2004) also showed that the phylogenetic placement of *K. thujae* and *K. juniperi* (CBS 239.66, CBS 466.66) in *Dothideales* with *Hormonea* species based on the phylogenetic analysis of ITS1-5.8S-ITS2 rDNA (ITS) data. Wijayawardene et al. (2012) placed this genus under *Dothioraceae*, while Hyde et al. (2013) categorized *Kabatina* as an asexual genus in the family *Dothideaceae*. We also accept *Kabatina* as an asexual genus in *Dothideaceae* considering above facts. Although, *Kabatina* presently comprises nine epithets (Index Fungorum 2014), only ITS sequence data

are available in GenBank therefore, we did not include the *Kabatina* species in to our phylogenetic tree. Species of *Kabatina* need to be sequenced for protein-coding genes and nuclear ribosomal genes in order to obtain a better resolution.

*Kabatina* species cause several disease known as “Evergreen Disease, Needle Cast of Firs” and economic losses in *Abies*, *Juniperus*, *Mahonia* and *Populus* and is associated with needle diebacks in conifers (Sutton 1980; Tisserat and Pair 1997; Bills et al. 2004; Cech et al. 2009).

**Neocylandroseptoria** K. M. Thambugala & K. D. Hyde, gen. nov., Index Fungorum number: IF 550730

*Etymology:* The generic epithet, neo (Lat., new), refers to the similarity to *Cylindroseptoria*.

*Type species:* **Neocylandroseptoria pistaciae** (Quaedvlieg, Verkley & Crous) K. M. Thambugala & K. D. Hyde, com. nov., Index Fungorum number: IF 550731  $\equiv$  *Cylindroseptoria pistaciae* Quaedvlieg, Verkley & Crous, *Stud. Mycol.* 75: 359 (2013)

#### Generic description

**Asexual state:** *Conidiomata* pycnidial, globose, black, erumpent, separate, with black crusty outer layer of cells, with central ostiole; wall of 3–6 layers of brown cells of *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic (mostly monophialidic, but a few observed to also be polyphialidic), lining the inner cavity, hyaline, smooth, ampulliform, proliferating percurrently (inconspicuous) or with periclinal thickening at apex (also occurring as solitary loci on superficial hyphae surrounding pycnidia). *Conidia* cylindrical, mostly straight, rarely slightly curved, hyaline, smooth-walled, apex subobtuse, base truncate, guttulate, aseptate (Quaedvlieg et al. 2013). **Sexual state:** Unknown.

*Notes:* *Cylindroseptoria pistaciae* was introduced by Quaedvlieg et al. (2013) and tentatively placed in *Cylindroseptoria* as it has pycnidial rather than cupulate conidiomata. *Cylindroseptoria pistaciae* separates from *C. ceratoniae* and formed a strong clade in *Dothideaceae* with 98/100 % bootstrap support. Therefore, we introduce *Neocylandroseptoria* to accommodate *C. pistaciae*.

**Phaeocryptopus** Naumov, *Bull. Soc. mycol. Fr.* 30(1): 424 (1915), *Facesoffungi* number: FoF00086

#### Synonyms

*Adelopus* Theiss., in Theissen & Sydow, *Annl. mycol.* 15(6): 482 (1918) [1917]

*Cryptopus* Theiss., *Annl. mycol.* 12(1): 72 (1914)

*Growing* on conifer needles. **Sexual state:** *Ascostromata* black, globose to globose-depressed, erumpent or superficial, uniloculate, irregularly ostiolate, base embedded in the matrix, fused to erumpent hypostroma. *Hamathecium* lacking pseudoparaphyses. *Asci* eight-spored, cylindrical to cylindrical clavate, sessile and rounded at apex with a small ocular

chamber. *Ascospores* uniseriate to triseriate, partially overlapping, hyaline, 1-septate, constricted at the septum, clavate or oblong with rounded ends, smooth-walled (Saccardo 1925; Von Arx and Müller 1954). **Asexual state:** See notes.

**Notes:** *Phaeocryptopus* was introduced by Naumov (1914) as a monotypic genus and *Phaeocryptopus abietis* Naumov. was assigned as the type. Petra (1938) included another three species *Phaeocryptopus gaeumannii* (T. Rohde), *Phaeocryptopus nudus* (Peck) Petr. and *Phaeocryptopus pinastri* (Sacc. & Ellis) Petr. while Petrak (1962) added *P. podocarpi* (Syd. & P. Syd.) Petr., Butin (1970) included *P. araucariae* Butin, and *P. australis* Butin, while Farr (1984) added *P. saxegothae* (Henn.) M.L. Farr, which has been referred to *Dimerosporium*. Müller and Von Arx (1950) included *Phaeocryptopus* in *Venturiaceae*. Barr (1987a) also classified *Phaeocryptopus* under *Venturiaceae*. *Rhizosphaera* species are generally accepted as asexual states of *Phaeocryptopus*, however the relationship has never been conclusively established (Winton et al. 2007). Presently *P. nudus* (*Asterina nuda* Peck), is considered as the type of *Phaeocryptopus* as the earliest introduced one. Phylogenetic analysis of Winton et al. (2007) and Schoch et al. (2009) showed that *Phaeocryptopus gaeumannii* clustered in *Mycosphaerellaceae*, *Capnodiales* while *P. nudus* nested in *Dothioraceae*, *Dothideales*. In our phylogenetic analysis *Rhizosphaera kalkhoffii*, *R. oudemansii* and *Plowrightia*

*abietis* along with *Phaeocryptopus nudus* clustered in a subclade which might be considered to belong in a single genus *Phaeocryptopus* or could be two distinct genera. We name this subclade as *Phaeocryptopus* since *Rhizosphaera abietis* L. Mangin & Har. the type of *Rhizosphaera*, has no molecular data.

**Type species:** *Phaeocryptopus nudus* (Peck) Petr., *Annls mycol.* 36(1): 15 (1938), (Fig. 8), *Facesoffungi* number: FoF00087

**Parasitic** on conifer needles. **Sexual state:** *Mycelium* superficial, extensive, brown. *Ascstromata* 13–21  $\mu\text{m}$  diam, black, superficial, gregarious, solitary or scattered, globose to subglobose, coriaceous, forming linear spots parallel along the middle vein. *Hamathecium* lacking pseudoparaphyses. *Asci* 41–48  $\times$  11–19  $\mu\text{m}$  ( $\bar{x}$  = 45  $\times$  17  $\mu\text{m}$ ,  $n$  = 5), eight-spored, bitunicate, fissitunicate, clavate, widely oblong, lacking a pedicel, ocular chamber not observed. *Ascospores* 11–18  $\times$  3–9  $\mu\text{m}$  ( $\bar{x}$  = 14  $\times$  6  $\mu\text{m}$ ,  $n$  = 5), uniseriate to triseriate, partially overlapping, hyaline, 1-septate, strongly constricted at the septum, upper cell slightly larger than lower cell, clavate, widely oblong, guttulate. **Asexual state:** Unknown.

**Material examined:** USA, Adirondack mountains, on dead needles of *Abies balsamea* (S- F67760 **holotype**?).

**Plowrightia** Sacc., *Syll. fung.* (Abellini) 2: 635 (1883), *Facesoffungi* number: FoF00088

Synonyms



**Fig. 8** *Phaeocryptopus nudus* (F67760, holotype). **a, b** Herbarium material. **c, d** Ascromata on the host surface. **e, f** Asci. **g** Ascospores. Scale bars: **d** = 1000  $\mu\text{m}$ , **e, f** = 20  $\mu\text{m}$ , **g** = 10  $\mu\text{m}$

*Elmerococcum* Theiss. & Syd., *Annl. mycol.* 13(3/4): 282 (1915)

*Parasitic* or *saprobic* on leaves, twigs and wood in terrestrial habitats. **Sexual state:** *Ascostromata* dark brown to black, immersed, becoming erumpent through the epidermis, solitary or scattered, pulvinate, subglobose to globose, coriaceous, multiloculate, with 2 to many locules, cells of *ascostromata* composed of several layers of dark brown cells of *textura angularis*. *Locules* subglobose to globose, thick-walled. *Peridium* of *locules* comprising several layers of dark brown cells of *textura angularis* or *prismatica*, vertical to the host surface. *Hamathecium* lacking pseudoparaphyses. *Asci* eight-spored, bitunicate, fissitunicate, cylindrical, elongate to ellipsoid, pedicellate, rounded at the apex. *Ascospores* overlapping, biseriata, hyaline, 1-septate, slightly constricted at septum, fusiform, subglobose to globose, tapering towards both ends, smooth-walled. **Asexual state:** See notes.

*Notes:* *Plowrightia* was introduced by Saccardo (1883) in the family *Dothideaceae* to accommodate *P. berberidis* (De Not.) Sacc., *P. bullata* Sacc., *P. hippophaës*, *P. insculpta* (Wallr.) Sacc., *P. martianoffiana* (Niessl & Thüm.) Sacc., *P. mezerei* (Schleich. ex Fr.) Sacc., *P. morbosa* Sacc., *P. periclymeni* (Fuckel) Sacc., *P. ribesia*, *P. tuberculiformis* (Ellis) Sacc., and *P. virgultorum* (Fr.) Sacc., and *P. ribesia* assigned as the type species. Barr (1972) synonymised *Plowrightia* with *Dothiora*, but Von Arx and Müller (1975) and Barr (1987a) reinstated it in *Dothideaceae* and separated it from *Dothiora* based on the pulvinate, erumpent *ascostromata* of *Plowrightia* with small *locules* often higher than broad. Barr (1987a) transferred *Plowrightia* to *Dothideaceae*, while Hawksworth et al. (1995) and Lumbsch and Huhndorf (2010) included it in the family *Dothioraceae*. Recent molecular and phylogenetic studies carried out by Winton et al. (2007) also confirmed the position of *Plowrightia* in the family *Dothioraceae*. Based on their phylogenetic analysis, Winton et al. (2007) showed that *Plowrightia abietis* is similar to *Phaeocryptopus nudus* and identical to *Rhizosphaera oudemansii* Maubl. However, in this study we observed the type specimen of *P. nudus* and *P. abietis* and it is clear that they are not similar. In our phylogenetic tree, *Phaeocryptopus nudus* and *R. oudemansii* are clustered separately in two sister clades in *Dothideaceae* while, *Plowrightia abietis* clustered with *R. oudemansii* in the same clade. Therefore, we can conclude that *Plowrightia abietis* and *R. oudemansii* are identical with the latter as the asexual state of *P. abietis*. However, *Rhizosphaera abietis* L. Mangin & Har. the type of *Rhizosphaera*, has no molecular data and needs to be re-collected and sequenced in order to resolve the affinities of *Rhizosphaera* with *Plowrightia* in *Dothideaceae*. *Plowrightia* shares a common morphology with *Dothidea*. We collected *P. ribesia*, the type species of *Plowrightia* and it clustered in *Dothideaceae* along with other *Dothidea* species. Other *Plowrightia* species *P. abietis* and *P. periclymeni* grouped with

*P. nudus* and *Rhizosphaera* species. *Rhizosphaera* species are also known as the asexual states of *Phaeocryptopus*. Conidia are unicellular but occasionally two-celled (Orton 1915). *Plowrightia* also produces *Hormonema* asexual states in culture and classified in *Venturiaceae*, but grouping with *Capnodiales* (Winton et al. 2007). Petrak (1923b) proposed a new genus *Systemmopsis* with *Systemmopsis ribesia* as the asexual morph of *Dothidea (Plowrightia) ribesia* found in *stromata* in nature with hyaline conidia without conidiophores. *Systemmopsis ribesia* needs re-collecting and sequencing to establish the relationship between *Plowrightia ribesia* and *Systemmopsis ribesia*.

*Type species:* ***Plowrightia ribesia*** (Pers.) Sacc., *Syll. fung.* (Abellini) 2: 635 (1883), (Figs. 9, 10), *Facesoffungi* number: FoF00089

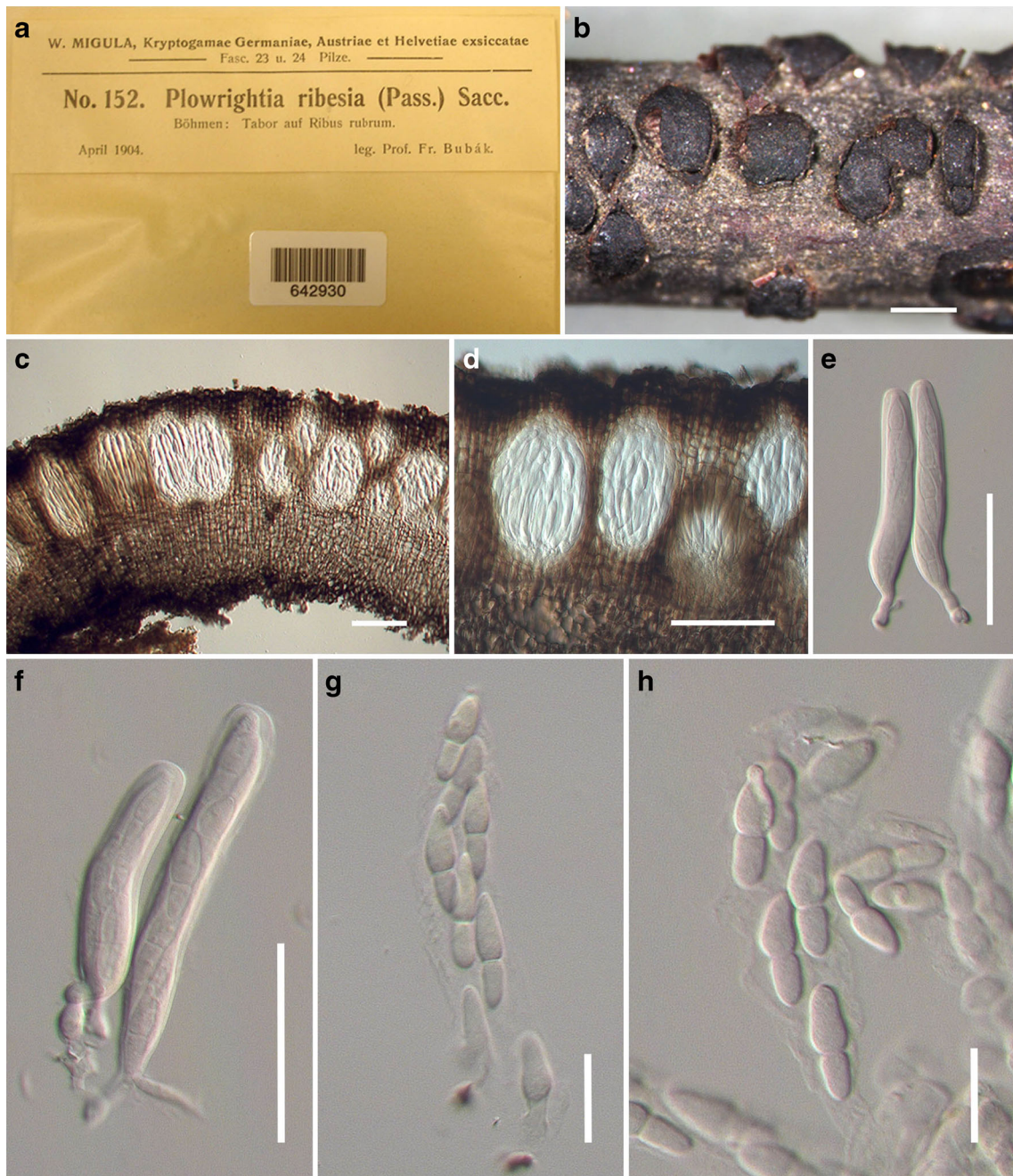
≡ *Sphaeria ribesia* Pers., *Ann. Bot. (Usteri)* 11: 24 (1794)

*Parasitic* or *saprobic* on wood and twigs in terrestrial habitats. **Sexual state:** *Ascostromata* (683–)955 × 1257(–1297) μm, black, immersed, becoming erumpent through bark at maturity, solitary or scattered, globose to subglobose, coriaceous, multiloculate, with many *locules*, cells of *ascostromata* composed of several layers of dark brown to black cells of *textura angularis*. *Locules* 408–413 μm high × (76–)84–115(–122) μm diam. ( $\bar{x}$  = 410.5 × 93 μm,  $n$  = 10), subglobose to obpyriform, arranged at the periphery 1 to 2 layers of *locules*, evidently ostioles at the surface. *Peridium* of *locules* thick, cell layers with *ca.* 11 μm thick, composed of dark brown to lightly pigmented cells of *textura prismatica* and *angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* (108.5–) 111–123 (–125) × 13–16 (–18) μm ( $\bar{x}$  = 116 × 15 μm,  $n$  = 15), eight-spored, bitunicate, oblong, cylindrical to subclavate, pedicellate, and rounded at the apex with a flattened ocular chamber *ca.* 2.5 μm wide, stalks *ca.* 16 μm long. *Ascospores* (20–)23–30.5(–32) × 7–9.5(–10) μm ( $\bar{x}$  = 26 × 8.5 μm,  $n$  = 25), overlapping, uni to biseriata, hyaline, broadly fusiform, rounded at both ends, with upper broad cell, 1-septate, with a median septum, constricted at the septum, smooth. **Asexual state:** Unknown.

*Material examined:* CZECH REPUBLIC, Böhmen, Tabor, on *Ribes rubrum* L. (*Grossulariaceae*), April 1904, Fr. Bubák (BPI 642930).

Description of *Plowrightia ribesia* (MFLU 14–0040)

*Saprobic* on woody plants. **Sexual state:** *Ascostromata* 1–1.3 mm high × 0.45–0.53 mm diam ( $\bar{x}$  = 1.23 × 0.48 mm,  $n$  = 10), black, superficial or semi-immersed to erumpent, solitary, scattered, or sometimes gregarious, globose to subglobose, coriaceous, multiloculate, with 10–13 *locules*, cells of *ascostromata* composed of dark brown-walled of *textura angularis*. *Locules* ( $\bar{x}$  = 131 × 98 μm,  $n$  = 10), globose to subglobose, non-ostiolate. *Peridium* of *locules* 15–31 μm ( $\bar{x}$  = 21 μm,  $n$  = 7), comprising few layers of lightly pigmented to brown cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses.



**Fig. 9** *Plowrightia ribesia* (BPI 642930). **a** Herbarium material. **b** Ascostromata on the host surface. **c** Partial section through ascostromata. **d** Close up of the locules. **e, f** Asci. **g, h** Ascospores. Scale bars: **b**=1000  $\mu\text{m}$ , **c, d**=100  $\mu\text{m}$ , **e, f**=50  $\mu\text{m}$ , **g, h**=20  $\mu\text{m}$

*Asci* 81–122  $\times$  11–17  $\mu\text{m}$  ( $\bar{x}$  = 98  $\times$  14  $\mu\text{m}$ ,  $n$  = 10), eight-spored, bitunicate, fissionitic, clavate, with a short pedicel, thick-walled, rounded at the apex. *Ascospores* 18–28  $\times$  5–11  $\mu\text{m}$  ( $\bar{x}$  = 23  $\times$  8  $\mu\text{m}$ ,  $n$  = 10), uniseriate, partially overlapping, hyaline, 1-septate, constricted at the septum, upper cell often broader than the lower cell, fusiform to ellipsoid, gradually tapering towards the apex, smooth-walled. **Asexual state:** Unknown.

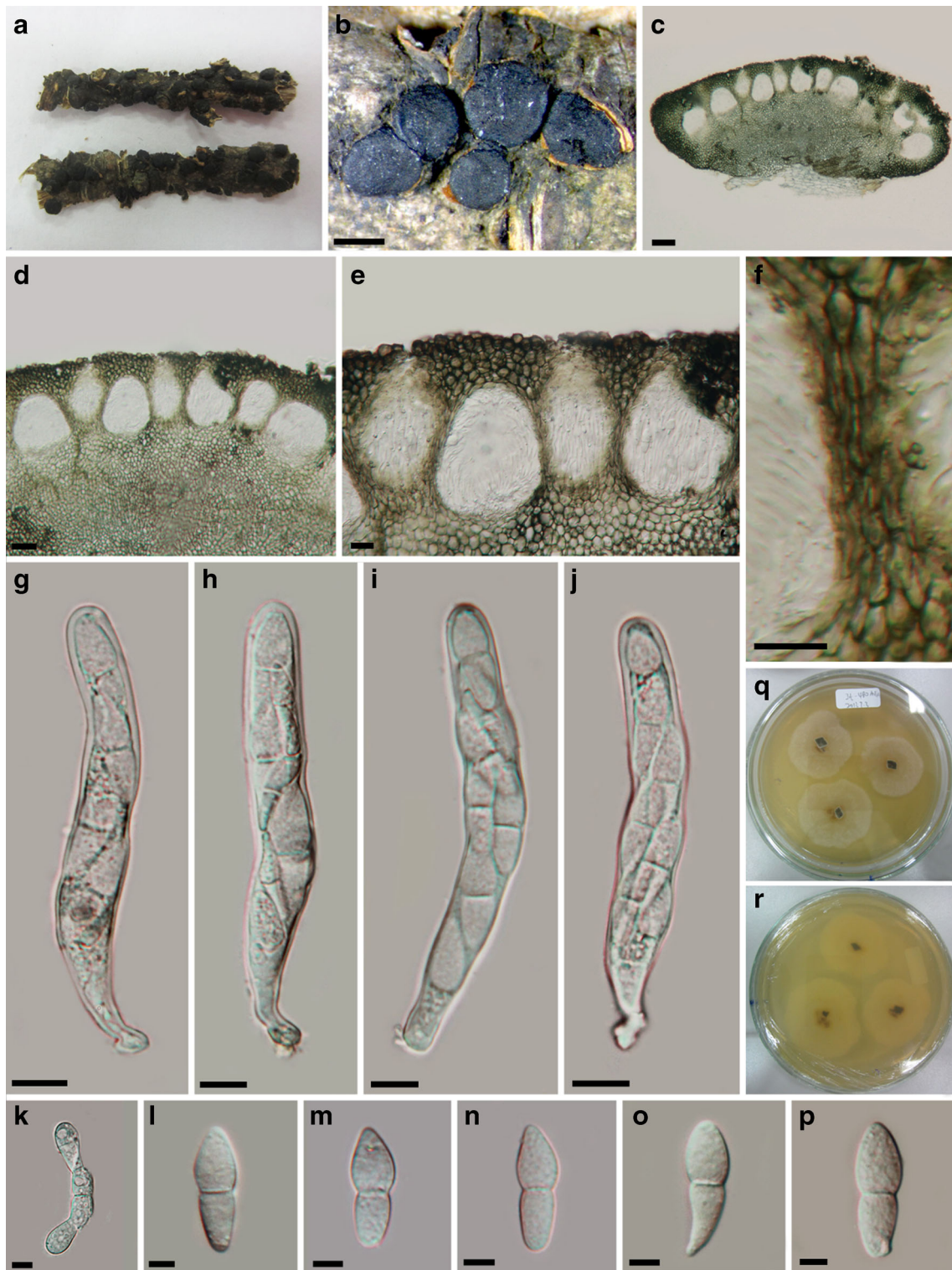
**Culture characteristics:** Ascospores germinating on PDA within 12 h and germ tubes arise from both end cells.

Colonies growing fast on PDA, reaching a diam. of 3 cm after 5 days at 29  $^{\circ}\text{C}$ , velvety, radiating towards the edge. Mycelium initially hyaline and light pink at the margin.

**Material examined:** ITALY, Fonte al Fringuello - Pratomagno (Province of Arezzo [AR]), on dead and not land branch of *Daphne* sp. (*Thymelaeaceae*), 10 May 2013, Camporesi Erio (MFLU14–0040), living culture MFLUCC 13–0670.

**Notes:** *Plowrightia ribesia* (*Sphaeria ribesia* Pers.) was introduced by Saccardo (1883) as the type specimen of





**Fig. 10** *Plowrightia ribesia* (MFLU 14–0040). **a, b.** Ascostromata on the host surface. **c–e.** Vertical section through ascostromata. **f.** Close up of the peridium of locus. **g–j.** Asci with ascospores. **k.** Germination of

ascospore. **l–p.** Ascospores. **q.** Colonies on PDA from above and **r** blow. Scale bars: **b**=1000  $\mu\text{m}$ , **c**=100  $\mu\text{m}$ , **d**=50  $\mu\text{m}$ , **e, f**=20  $\mu\text{m}$ , **g–k**=10  $\mu\text{m}$ , **l–p**=5  $\mu\text{m}$

*Plowrightia*. We could not loan the holotype of *Plowrightia ribesia* (Pers.) Sacc., but observed a specimen from BPI (BPI 642930) from the Czech Republic. This was compared with

our recent collection from Italy from dead branches of *Daphne* sp. and is indistinguishable. *Plowrightia ribesia* is widely distributed in Europe and is parasitic on *Ribes rubrum*

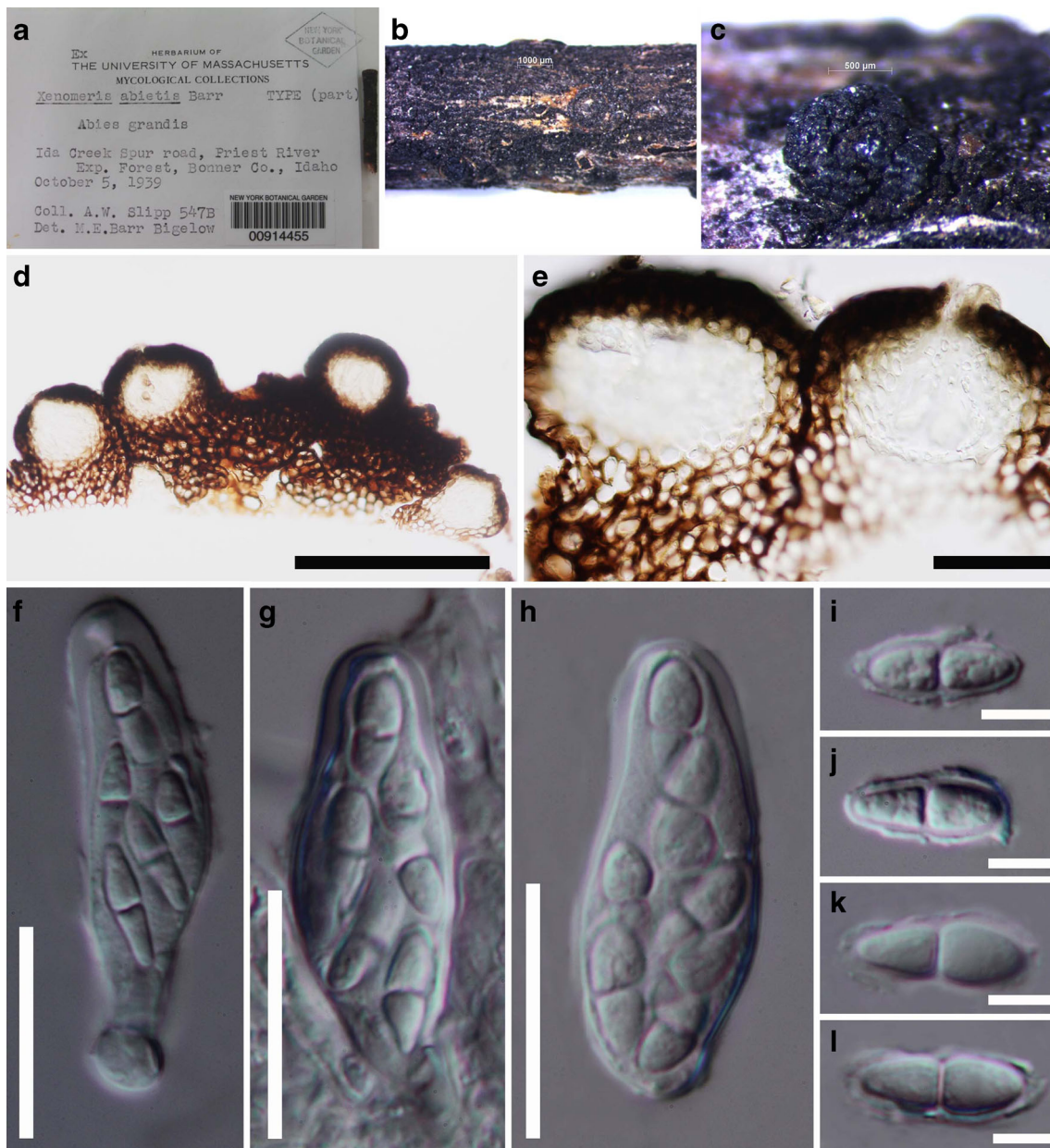
(*Grossulariaceae*) (Saccardo 1883; Hoggan 1927). Since the host of the MFLU specimen from Italy is from *Daphne* sp. (*Thymelaeaceae*) and not *Ribes* we have not designated this as an epitype. However, this strain can be considered as an authentic until proven otherwise.

***Plowrightia abietis*** (M.E. Barr) M.E. Barr [as 'Plowrightia'], *Sydowia* 41: 32 (1989), (Fig. 11), *Facesoffungi* number: FoF00090

≡ *Xenomeris abietis* M.E. Barr, *Can. J. Bot.* 46: 842 (1968)

*Saprobic* on twigs in terrestrial habitats. **Sexual state:** *Ascstromata* 400–800  $\mu\text{m}$  wide black, superficial, solitary, globose to subglobose, multiloculate, cells of ascstromata

composed of several layers of dark brown cells of *textura angularis*. *Locules* 40–50  $\mu\text{m}$   $\times$  32–40  $\mu\text{m}$  ( $\bar{x}$  = 44  $\times$  37  $\mu\text{m}$ ,  $n$  = 5), globose to subglobose, non-ostiolate. *Peridium* of locules 8–12  $\mu\text{m}$  wide, comprising dark brown to lightly pigmented cells of *textura angularis*. *Pseudoparaphyses* not observed. *Asci* 35–45  $\mu\text{m}$   $\times$  11.7–13  $\mu\text{m}$  ( $\bar{x}$  = 39  $\times$  12.4  $\mu\text{m}$ ,  $n$  = 15), eight-spored, bitunicate, broadly cylindrical, obovoid, short pedicellate and rounded at the apex with an ocular chamber. *Ascospores* 10–13.5  $\mu\text{m}$   $\times$  3.5–5.5  $\mu\text{m}$  ( $\bar{x}$  = 11.8  $\times$  4.3  $\mu\text{m}$ ,  $n$  = 20), uni to biserial, partially overlapping, hyaline, 1-septate, with the upper cell slightly broader than the lower one, rounded end at both apices, constricted at the



**Fig. 11** *Plowrightia abietis* (NY00914455, holotype) **a** Herbarium material **b, c** Ascstromata on the host surface. **d** Section through ascstroma. **e** Close up of locules. **f–h** Bitunicate asci. **i–l** Ascospores. Scale bars: **d** = 200  $\mu\text{m}$ , **e** = 50  $\mu\text{m}$ , **f–h** = 20  $\mu\text{m}$ , **i–l** = 5  $\mu\text{m}$

septa, oblong to obovoid, smooth-walled. **Asexual state:** Unknown.

*Material examined:* USA, Idaho, Ida Creek Spur Road, on twigs of *Abies grandis* (Douglas ex D. Don) Lindley (*Pinaceae*), 5 October 1939, A.W. Slipp (NY00914455, **holotype**).

*Notes:* Sequence data of a putative strain of *Plowrightia abietis* (ATCC 24339) clustered in the *Phaeocryptopus* clade with *Rhizosphaera* species (*R. kalkhoffii* and *R. oudemansii*). This species should therefore probably be synonymised under *Rhizosphaera* or *Phaeocryptopus*, but we refrain from doing so until a sequence can be linked with morphology.

**Stylodothis** Arx & E. Müll., *Stud. Mycol.* 9: 11 (1975), *Facesoffungi* number: FoF00091

*Saprobic* on bark and stems. **Sexual state:** *Ascstromata* black, immersed, erumpent to superficial, solitary or scattered, gregarious, coriaceous, multiloculate, with four to numerous locules, cells of ascstromata composed of several layers of dark brown cells of *textura angularis*. *Locules* globose to subglobose, non-ostiolate. *Peridium* of locules a single layer heavily or lightly pigmented cells of *textura angularis*. *Hamathecium* comprising hyaline, septate, anastomosing pseudoparaphyses, embedded in a gelatinous matrix. *Asci* 4–8-spored, bitunicate, clavate to cylindrical, pedicellate, rounded at the apex. *Ascospores* uni or biserial, sometimes partially overlapping, yellowish-brown to dark brown, 1-septate, rarely 2 or 3-septate, constricted at the primary septum, upper cell wider, ellipsoid to fusiform, lower cell narrow and tapering to rounded base, smooth-walled, sometimes guttulate. **Asexual state:** Unknown.

*Notes:* *Stylodothis* was introduced by Von Arx and Müller (1975) to accommodate *Stylodothis puccinioides* and *Stylodothis indica* (Loeffler & S.K. Bose) Arx & E. Müll. Morphologically these two species are similar to *Dothidea*. *S. puccinioides* has four ascospores in ascus and develops on *Buxus sempervirens* while *S. indica* bear eight ascospores sometimes with 2 or 3-septate and grows on *Berberidis lycii*. Recent phylogenetic analyses by Schoch et al. (2006) show that *S. puccinioides* is closely related to *Dothidea*. In the present study *Stylodothis* is well-supported genus in *Dothideaceae* with 81/100 % bootstrap support.

*Type species:* **Stylodothis puccinioides** (DC.) Arx & E. Müll., *Stud. Mycol.* 9: 11 (1975), (Fig. 12), *Facesoffungi* number: FoF00092

≡ *Sphaeria puccinioides* DC., in de Candolle & Lamarck, *Fl. franç.*, Edn 3 (Paris) 5/6: 118 (1815)

*Saprobic* on twigs or wood. **Sexual state:** *Ascstromata* 197–374  $\mu\text{m}$  high  $\times$  495–713  $\mu\text{m}$  diam ( $\bar{x}$  = 345  $\times$  570  $\mu\text{m}$ ,  $n$  = 5), black, formed on erumpent basal stroma, gregarious, thick at the basal of ascstromata, coriaceous, multiloculate, with 4–5 locules, cells of ascstromata composed of several layers of dark brown cells of *textura angularis*. *Locules* 69–134  $\mu\text{m}$  high  $\times$  83–116  $\mu\text{m}$  diam ( $\bar{x}$  = 88  $\times$  110  $\mu\text{m}$ ,  $n$  = 10), globose to sub-

globose, without an ostiole. *Peridium* of locules 31–40  $\mu\text{m}$  ( $\bar{x}$  = 34  $\mu\text{m}$ ,  $n$  = 10), comprising 1-layer, with heavily pigmented, brown to dark brown cells of *textura angularis*. *Hamathecium* of 5  $\mu\text{m}$  wide, septate, anastomosing, pseudoparaphyses embedded in a gelatinous matrix. *Asci* 135–147  $\times$  21–24  $\mu\text{m}$  ( $\bar{x}$  = 138  $\times$  23  $\mu\text{m}$ ,  $n$  = 10), 2–4-spored, bitunicate, clavate to cylindrical, short and rounded pedicellate, rounded at the apex without an ocular chamber. *Ascospores* 36–40  $\times$  17–20  $\mu\text{m}$  ( $\bar{x}$  = 39  $\times$  19  $\mu\text{m}$ ,  $n$  = 10), uniseriate, yellowish when immature, brown to dark brown at maturity, 1-septate, constricted and dark at septum, upper cell wider than lower cell, ellipsoid to fusiform, smooth-walled, sometimes guttulate. **Asexual state:** Unknown.

*Material examined:* GERMANY, near Aix, on bark and stem of *Buxus sempervirens* L. (*Buxaceae*), Mont du Chat (PC 0084648, **holotype**)

**Sydowia** Bres., *Hedwigia* 34(Beibl.): 66 (1895), *Facesoffungi* number: FoF00093

Synonyms

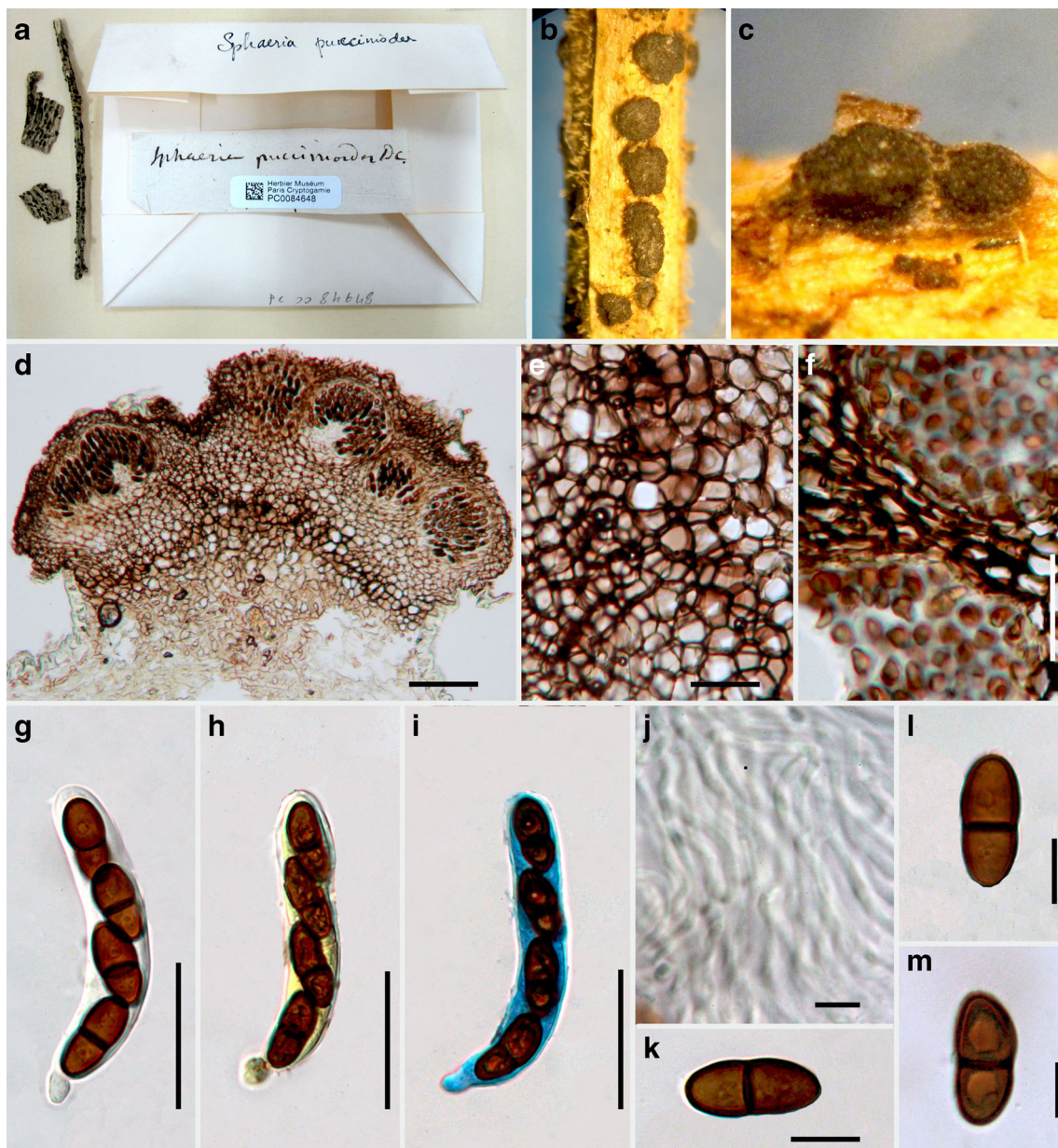
*Pleodothis* Clem., *Gen. fung.* (Minneapolis): 49, 173 (1909)

*Plowrightia* sect. *Plowrightiella* Sacc., *Syll. fung.* (Abellini) 11: 376 (1895)

*Plowrightiella* (Sacc.) Trotter, in Saccardo, *Syll. fung.* (Abellini) 24(1): 542 (1926)

*Parasitic* or *saprobic* on conifer plants or branches and wood. **Sexual state:** *Ascstromata* black, immersed to erumpent, solitary or gregarious, globose to subglobose, coriaceous, uniloculate, ostiolate. *Peridium* several layers thick, composed of dark brown cells of *textura angularis* or sometimes *prismatica*, more darkened on the outside, hyaline to lightly pigmented towards the interior. *Hamathecium* lacking pseudoparaphyses. *Asci* 8-poly-spored, bitunicate, fissitunicate, clavate to oblong with a short pedicel, apically rounded. *Ascospores* crowded to overlapping, hyaline, transversely multiseptate, constricted at the primary septum, sometimes with a vertical septum in the mid cells or rarely in the end cells, straight to inequilateral, guttulate, upper part usually wider and shorter than the lower part, elliptic, obovate, smooth. **Asexual state:** *Hormonema* and *Sclerophoma* (Wijayawardene et al. 2012; Hyde et al. 2013). *Pycnidia* stromatic, immersed at first, later erumpent, globose to irregular, solitary or aggregated, uni or multi locular or convoluted. The wall is thick and dehisces by breaking down the overlying wall tissue. *Conidiogenous cells* phialidic, enteroblastic, determinate, discrete, hyaline to pale brown, doliiform to ampulliform, with a wide channel and minute collarette, formed from the inner cells of the wall lining the locule. *Conidia* hyaline, aseptate, ellipsoid, and rarely tapered at the base smooth-walled, sometimes guttulate (Sivanesan 1984).

*Notes:* *Sydowia* was formally established by Bresadola (1895) based on its gregarious ascomata in the host surface and remained monotypic until Saccardo (1899) added



**Fig. 12** *Stylothis puccinioides* (PC 0084648, holotype). **a** Herbarium material. **b, c** Ascostromata on host substrate. **d** Section through ascostroma. **e** Cells of ascostroma. **f** Peridium of locules. **g** Ascus. **h** Ascus stained in Melzer's reagent. **i** Ascus stained in cotton blue reagent. **j**

Pseudoparaphyses. **k** Ascospore in 70 % lactic acid. **l** Ascospore stained in Melzer's reagent. **m** Ascospore stained in cotton blue reagent. Scale Bar: d=100  $\mu$ m, e–i, k–m=20  $\mu$ m, j=10  $\mu$ m

*S. carestiae*. Later, Luttrell (1973) transferred this genus into *Dothioraceae* based on its phragmosporous ascospores. Arx and Müller (1975) re-evaluated the bitunicate ascomycetes and placed this genus in *Dothideaceae* based on its broad unilocular stromata and ascospores with only transverse septa. Barr (1972) and Sivanesan (1984) accepted only polysporous species in this genus. Barr (1972) accepted five species in *Sydowia* while Sivanesan (1984) included two. Barr (2001) accepted phragmosporous species in both eight-spored and poly-spored asci. She introduced three new phragmosporous species (*S. slippii*, *S. taxicola* and *S. wolfii*)

which have been referred to *Dothiora* and *S. ceanothi*. Recent phylogenetic studies by Schoch et al. (2006) also proved that the placement of *Sydowia* in the *Dothioraceae*. The type species of *Hormonema*, *Hormonema dematioides* Lundberg and Melin has been suggested as the asexual state of *Sydowia polyspora* (Butin 1964; Cheewangkoon et al. 2009). In phylogeny analysis in Bills et al. (2004) *Sydowia polyspora* and *H. dematioides* clustered in the same clade. *H. dematioides* do not have the sequences of ex-type strain and also no authentic specimen has been described. We did not include this *H. dematioides* in our phylogenetic analysis as lack of LSU

sequence data. Sequences dat of LSU and other protein coding genes and culture based analysis are required in order to confirm this relationship. Hence, we do not synonymize *Hormonema* under *Sydowia* and further investigations are suggested. Crous (in Crous et al. 2003) introduced *Sydowia eucalypti* (*Sphaerulina eucalypti*) and accommodated it in this genus based on having *Sclerophoma* and *Hormonema* synanamorphs in culture and the thick-walled ascostromata. In present phylogenetic study *Sydowia eucalypti* separates from the *Dothideaceae* clade and clusters in the *Aureobasidiaceae* clade with other *Selenophoma* species. Therefore, we exclude *S. eucalypti* from *Sydowia* and accommodate it in a new genus, *Pseudosydowia*. In our phylogeny analysis (Fig. 1) a putative strain of *Sydowia polyspora* (CBS 116.29) clustered in *Dothideaceae* close to a putative strain of *Delphinella strobiligena* (CBS 735.71). Considering the close relationship of the two strains it may be that one of these two strains is wrongly identified or these two species should be in one genus as both of them are polysporous. However, we named this clade as *Delphinella* which comprises *D. strobiligena*, *Rhizosphaera pini* and *S. polyspora* pending fresh collections of *Delphinella* and *Sydowia* species. *Sydowia* differs from other genera of *Dothideaceae* in having uniloculate ascostromata. However, we accommodate *Sydowia* in *Dothideaceae* pending molecular data of the type species.

**Type species:** *Sydowia gregaria* Bres., *Hedwigia* 34(Beibl.): 66 (1895), (Fig. 13), *Facesoffungi* number: FoF00094

**Parasitic or saprobic** on branches of conifer trees. **Sexual state:** *Ascostromata* 190–255  $\mu\text{m}$  wide, black, immersed, becoming erumpent, gregarious, scattered, globose to subglobose, coriaceous, uniloculate, with a papillate to rounded short ostiole. *Peridium* up to 32–65  $\mu\text{m}$  thick several layers thick, composed of dark brown cells of *textura angularis*, more darkened on the outside. *Hamathecium* lacking *pseudoparaphyses*. *Asci* 78–105  $\times$  12–17  $\mu\text{m}$  ( $\bar{x}$  = 95.5  $\times$  13.3  $\mu\text{m}$ ,  $n$  = 15), polyspored, bitunicate, clavate to oblong, with a short pedicel, apically rounded. *Ascospores* 10–14  $\times$  3–4.2  $\mu\text{m}$  ( $\bar{x}$  = 12.3  $\times$  3.6  $\mu\text{m}$ ,  $n$  = 30), crowded to overlapping, hyaline, transversely 2–3-septate, constricted at the primary septum, elliptic, obovate, smooth-walled. **Asexual state:** Unknown.

**Material examined:** GERMANY, Berlin, Steglitz bei Berlin, on branches of *Picea abies* (L.) H. Karst (*Pinaceae*), October 1894, P. Sydow (S-F6473, **holotype**).

Genera not studied

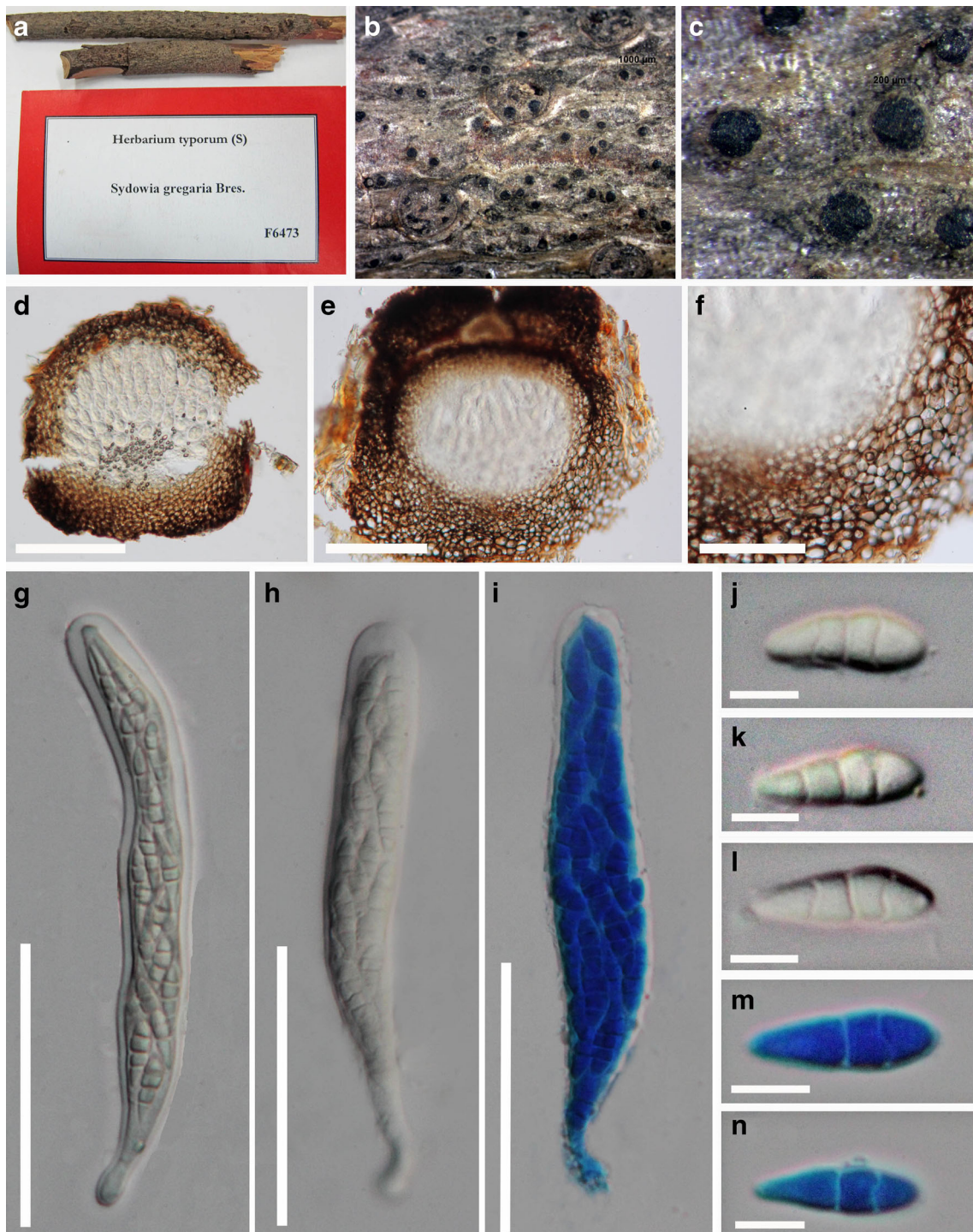
**Pringsheimia** Schulzer, Verh. zool.-bot. Ges. Wien 16: 57 (1866)

**Type species:** *Pringsheimia rosarum* Schulzer, Verh. zool.-bot. Ges. Wien 16: 57 (1866)

**Notes:** *Pringsheimia* was introduced by Schulzer (in Schulzer et al. 1866) to accommodate *P. rosarum* and currently comprises 17 epithets (Index Fungorum 2014). We could not locate the type of this genus. A sequence from a putative strain of *Pringsheimia smilacis* is available in GenBank and clustered in *Dothideaceae* as a separate clade in our phylogenetic tree. The sequences of the type and other species are not available and they need recollecting, molecular analysis and epitypifying in order to resolve the family placement of this genus.

**Aureobasidiaceae** K. M. Thambugala & K. D. Hyde, fam. nov., Index Fungorum number: IF 550732; *Facesoffungi* number: FoF00097

**Parasitic or saprobic** on twigs, wood and leaves or human skin. **Sexual state:** *Ascomata* black, subglobose, immersed to erumpent, uniloculate, sometimes ostiolate. *Peridium* composed of several layers of brown to dark brown cells of *textura angularis*. *Hamathecium* lacking *pseudoparaphyses*. *Asci* eight-spored, bitunicate, saccate to broadly clavate with a short bifurcate pedicel or apedicellate, apex broadly rounded with a distinct ocular chamber. *Ascospores* biseriolate to triseriate, partially overlapping, hyaline, 3 to many septate or aseptate, muriform to phragmosporous, obovoid or elliptic with broad to narrow rounded ends. **Asexual state:** Coelomycetous or hyphomycetous. **Hyphomycetous asexual state:** *Stromata* present or absent, visible in substomatal cavity, hyaline or lightly pigmented, dark brown with globose to broadly ellipsoidal, round or elongated pseudoparenchymatous cells when present. *Colonies* spreading, smooth, often covered with slimy masses of conidia, usually with sparse aerial mycelium; light brown, yellow, pink or black. Hyphae with cells commonly wider than long, hyaline, frequently soon becoming brown and thick-walled sometimes thin, smooth, transversely septate. *Conidiogenous cells* on hyaline hyphae, lateral, terminal or intercalary, cylindrical, clavate or globose, integrated, terminal, with holoblastic, polyblastic conidiogenesis, with numerous synchronously produced conidia. *Conidia* blastic, hyaline to dark brown, smooth, aseptate, straight, ellipsoidal to spherical, reniform to sickle-shaped, oblong to cylindrical, sometimes cylindrical with obtuse ends and occasionally with a slightly truncate base. *Secondary conidia* common; endoconidia often present. **Coelomycetous asexual state:** *Conidiomata* dark brown, pycnidial or acervular, separate or aggregated, scattered, immersed or superficial, globose, unilocular, thin-walled; walls 2–3 layers thick, composed of lightly pigmented to brown, thick-walled cells of *textura angularis*, with or without an ostiole. *Conidiophores* reduced to conidiogenous cells or hyaline, irregularly branched at the base and above, 1 to 3-septate, smooth when present. *Conidiogenous cells* enteroblastic, phialidic, discrete, determinate or ampulliform, hyaline to pale brown, smooth, subglobose, obpyriform or obovoid, collarette and



**Fig. 13** *Sydowia gregaria* (S-F6473, holotype). **a** Herbarium material. **b, c** Ascostromata on host surface. **d, e** Section of ascostromata. **f** Close up of the peridium. **g–i** Bitunicate asci. **j–m** Ascospores. Scale bars: **d, e** = 100  $\mu$ m, **f** = 50  $\mu$ m, **g–i** = 50  $\mu$ m, **j–m** = 5  $\mu$ m

channel minute, with apical periclinal thickening, guttulate, formed from the inner cell of the pycnidial wall, slightly tapered toward the apex. *Conidia* holoblastic, aseptate, falcate, fusiform, ellipsoidal to obovoid, eguttulate or irregularly guttulate, smooth, at first thin-walled, hyaline or pale brown, later pale brown with thicker walls, smooth-walled or verruculose.

*Type: Aureobasidium* Viala & G. Boyer

*Notes:* The *Aureobasidiaceae* clade comprises *Aureobasidium*, *Kabatiella*, *Pseudoseptoria*, *Sacothecium* and *Selenophoma* species and *Columnsphaeria fagi*, for which we propose a new family, *Aureobasidiaceae*. The CBS 584.75 ex-neotype strain of *Aureobasidium pullulans* clustered here. *Aureobasidiaceae* separates from

*Dothideaceae* with 65/80 % bootstrap support. Morphologically, *Aureobasidiaceae* can be distinguished from *Dothideaceae* usually by having only immersed to erumpent, uniloculate ascostromata and aseptate to many-septate, hyaline ascospores. The recently introduced *Sydowia eucalypti* also clustered within *Aureobasidiaceae* and we propose a new genus, *Pseudosydowia* for *Sydowia eucalypti*. The asexual states of *Aureobasidiaceae* *Aureobasidium*, *Kabatiella*, *Pseudoseptoria* and *Selenophoma* species cluster here, while *Columnosphaeria*, *Pseudosydowia* and *Sacchettoecium* nested as sexual genera. *Columnosphaeria fagi*, *Pseudosydowia eucalypti* and *Sacchettoecium sepincola* are the only sexual species cluster in the *Aureobasidiaceae* clade. The sexual species *Discosphaerina (Columnosphaeria) fagi* is closely related with *Aureobasidium pullulans* (Schoch et al. 2006; Zalar et al. 2008). Our phylogenetic tree also shows the close relationship of these two species which form a single clade. We accept three sexual genera and four asexual genera in *Aureobasidiaceae*.

#### Key to sexual genera of *Aureobasidiaceae*

1. Ascospores septate, obovoid to ellipsoid..... 2
1. Ascospores aseptate, ellipsoidal-fusiform, or fusiform..... ***Columnosphaeria***
2. Asci broadly ellipsoid to clavate, straight to slightly curved, sessile, ascospores bi- to multiseriate, overlapping, hyaline, (1–)3(–4)-septate at maturity, constricted at the median septum, obovoid to ellipsoid with obtuse ends, tapering towards both ends, but more prominently towards the lower end..... ***Pseudosydowia***
2. Asci saccate to broad-clavate with a short bifurcate pedicel or apedicellate, ascospores biserial to triserial, partially overlapping, hyaline, 3 to many septate, muriform to phragmosporous, obovoid or elliptic with broad to narrowly rounded ends..... ***Sacchettoecium***

#### Key to asexual genera of *Aureobasidiaceae*

1. Coelomycetous asexual states..... 2
1. Hyphomycetous asexual states..... 3
2. Conidia falcate, fusiform, ellipsoidal to obovoid, aseptate, eguttulate or irregularly guttulate, smooth, at first thin-walled, hyaline or pale brown, later pale brown with thicker walls and verruculose..... ***Selenophoma***
2. Conidia fusiform, lunate or irregular, curved, aseptate, colourless, smooth-walled with or without an excentric basal appendage, continuous with conidium body, plectronoid to podiform, or with a blunt or spatulate distal end..... ***Pseudoseptoria***

3. Conidia blastic, produced simultaneously in dense groups, hyaline to dark brown, smooth, aseptate, straight, ellipsoidal to spherical, reniform to sickle-shaped..... ***Aureobasidium***
3. *Conidia* clustered on swollen apex, borne on tiny sterigmata, aseptate, hyaline, oblong to cylindrical..... ***Kabatiella***  
***Aureobasidium*** Viala & G. Boyer, Rev. gén. Bot. 3: 371 (1891), *Facesoffungi* number: FoF00098  
Synonyms:  
*Aureobasis* Clem. & Shear, Gen. fung., Edn 2 (Minneapolis): 343, 381 (1931)  
*Dematoidium* Stautz, Phytopath. Z. 3: 204 (1931)  
*Pachybasidiella* Bubák & Syd., Anns mycol. 13(1): 9 (1915)  
*Polyspora* Laff., Scientific Proc. R. Dublin Soc., N.S. 16: 258 (1921) [1920–22]  
*Protocoronis* Clem. & Shear, Gen. fung., Edn 2 (Minneapolis): 197, 344 (1931)  
*Protocoronospora* G.F. Atk. & Edgerton, J. Mycol. 13(5): 185 (1907)  
*Pullularia* Berkhout, De Schimmelgeslachten Monilia: 55, 64 (1923)  
*Parasitic* or *saprobic* on plants, fruits and causes human skin diseases. Some plant pathogens form *Kabatiella* synanamorphs which cause leaf spots. They form sub circular irregular, amphigenous, necrotic, sunken, pale to medium brown leaf spots with a raised, dark brown margin. Stromata present or absent, visible in sub-stomatal cavity, hyaline or lightly pigmented, dark brown with globose to broadly ellipsoidal, round or elongated pseudo-parenchymatous cells when present. *Colonies* spreading, smooth, often covered with slimy masses of conidia, usually with sparse aerial mycelium; light brown, yellow, pink or black. *Hyphae* with cells commonly wider than long, hyaline, frequently soon becoming brown and thick-walled sometimes thin, smooth, transversely septate. **Asexual state:** *Conidiomata* acervular to sporodochial, amphigenous, substomatal, subepidermal, pulvinate, dry or crystalline in appearance, pale brown, discrete. *Conidiogenous cells* on hyaline hyphae, lateral, terminal or intercalary, cylindrical, clavate or globose, integrated, terminal, with holoblastic, polyblastic conidiogenesis, with numerous synchronously produced conidia. *Conidia* blastic, hyaline to dark brown, smooth-walled, aseptate, straight, ellipsoidal to spherical, reniform to sickle-shaped, sometimes cylindrical with obtuse ends and occasionally with a slightly truncate base, rather variable in shape and size. *Secondary conidia* common; endoconidia often present. Occasionally dark, one or two-celled arthroconidia are formed. *Hyaline conidia* one-celled, smooth, ellipsoidal, very variable in shape and size often with an indistinct hilum. *Dark brown conidia* 1–2 celled, two celled slightly constricted at septum. (Hermanides-Nijhof 1977; Zalar et al. 2008). **Sexual state:** See notes.

*Notes:* *Aureobasidium* was introduced by Viala and Boyer (1891) and *Aureobasidium vitis* assigned as the type specimen. Thereafter a number of species were introduced by various authors and several *Kabatiella* species were also transferred to *Aureobasidium* considering morphological characters and ability to form leaf spots on a restricted host range (Hermanides-Nijhof 1977). The type specimen *Aureobasidium vitis* has not been preserved. De Bary (1884) introduced *Dematium pullulans* and Arnaud (1910) suggested that *Dematium pullulans* and *Aureobasidium vitis* are the same. Then Hermanides-Nijhof (1977) described *A. pullulans* as the oldest name for the type species of *Aureobasidium* designating CBS 584.75 as a ex-neotype strain (Zalar et al. 2008). In this paper, we introduce a new family *Aureobasidiaceae* in order to accommodate species in the second major clade (*Aureobasidiaceae*) of our phylogenetic

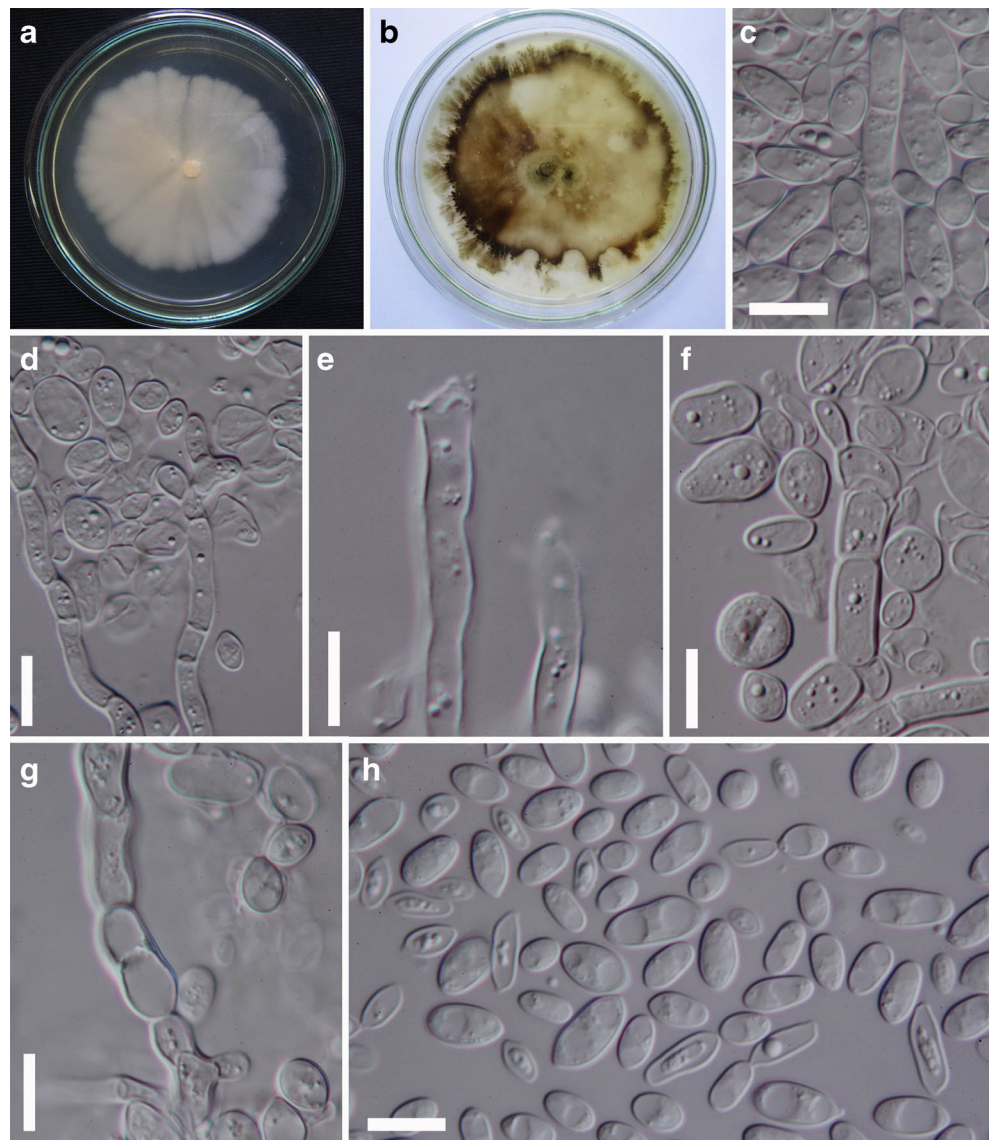
tree. The *Aureobasidium* clade consist of two putative strains of *Discosphaerina* (*Columnosphaeria*) *fagi* (CBS 171.93), *Selenophoma mahoniae* (CBS 388.92) and the ex-type strain of *Kabatiella lini* (CBS 125.21) in addition to *Aureobasidium* species. They might be considered to belong in *Aureobasidium*, but we retain *Columnosphaeria fagi* and *Selenophoma mahoniae* in related genera until the type specimens of *Columnosphaeria* and *Selenophoma* are collect and sequenced.

*Type species:* *Aureobasidium pullulans* (de Bary) G. Arnaud var. *pullulans* – Annales École Nat. Agric. Montpellier 16: 39, 1918, (Fig. 14), *Facesoffungi* number: FoF00099

For other synonyms see *Index Fungorum*

*Cultural characteristics:* Colonies on PDA at 25 °C attaining about 70–80 mm diam after 14 days, appearing smooth and slimy due to abundant

**Fig. 14** *Aureobasidium pullulans* (MFLUCC 14-0288). **a** Culture on PDA incubated for a. 2 weeks b. 7 weeks at 25 °C. **c–g** Conidiophores and conidiogenesis. **h** Conidia. Scale bars: c–h=10 μm





sporulation, pinkish white. Within first 6 weeks colonies filamentous and there after develop white, setae-like mycelia then turning to brown first and then black at the irregular margin.

*Vegetative hyphae* hyaline, transversely septate, smooth, sometimes becoming brown to dark brown when getting older, smooth, thin-walled, 2–9  $\mu\text{m}$  wide, transversely septate. *Conidiogenous cells* undifferentiated, intercalary or terminal on hyaline hyphae or arising as short lateral branches. *Conidia* 5.5–16  $\times$  3–6  $\mu\text{m}$  ( $\bar{x}$  = 9.2  $\times$  4.2  $\mu\text{m}$ ,  $n$  = 60), produced synchronously in dense groups from small denticles, and also formed percurrently on short lateral denticles, hyaline sometimes becoming brown, ellipsoidal, aseptate, smooth. *Endoconidia* are produced by an intercalary cells.

*Material examined*: THAILAND, Chiang Rai, on PDA, 12 April 2013 (MFLUCC 14–0288, ICMP 20350).

***Columnnosphaeria*** Munk, Dansk bot. Ark. 15(no. 2): 103 (1953), *Facesoffungi* number: FoF00100

For other synonyms see *Index Fungorum*

*Saprobic* or parasitic on dead wood or leaves in terrestrial habitats **Sexual state**: *Ascostromata* black to dark brown, immersed under the host tissue or erumpent, solitary or gregarious or scattered, globose to subglobose, unilocular, ostiolate at maturity usually by dehiscence of the thin wall apex. *Peridium* of several layers, dark brown wall cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* eight-spored, bitunicate, clavate to cylindro-clavate, short pedicellate, apically rounded. *Ascospores* uni-seriate or irregularly bi-seriate, partially overlapping, hyaline to brown, aseptate, ellipsoidal-fusiform, or fusiform, smooth-walled, sometimes with a thin mucilaginous sheath. **Asexual state**: See under *C. fagi*.

*Notes*: *Columnnosphaeria* was introduced by Munk (1953) as a monotypic genus and typified by *Columnnosphaeria sarothamni*. Von Arx and Müller (1954, 1975) and Munk (1957) considered *Columnnosphaeria* as a synonym of *Guignardia* (Luttrell 1973) while Sivanesan (1984) synonymized the genus under *Discosphaerina* and *C. sarothamni* under *D. cytisi*. Luttrell (1973) accommodated this genus in *Dothideaceae*. Barr (2001) included new five species which have been referred to *Guignardia* and *Physalospora* and placed *Columnnosphaeria* in *Dothioraceae*. However, in our phylogenetic tree *Columnnosphaeria* (*Discosphaerina*) *fagi* nests in the family *Dothideaceae*. Barr (2001) transferred *Discosphaerina fagi* (H.J. Huds.) M.E. Barr, to *Columnnosphaeria fagi* based on its morphology. *Phyllosticta* Pers., is considered as the current name of *Columnnosphaeria* (*Index Fungorum* 2014). However, *Columnnosphaeria sarothamni*, the type of *Columnnosphaeria* does not share morphological features with *Phyllosticta* (Wikee et al. 2013). *Hormonema*, *Sarcophoma* and *Aureobasidium* are reported as the asexual morphs in culture (Barr 2001) and these asexual morphs are usually reported in *Dothideales*. We examined the

type material of *Columnnosphaeria* (*C. sarothamni*) and *C. fagi*, which grouped in *Aureobasidiaceae*. Based on the dothidealean asexual morphs of *Columnnosphaeria* species and the similarity between *C. sarothamni* and *C. fagi* tentatively we accept *Columnnosphaeria* in *Aureobasidiaceae*, *Dothideales* although the type has morphological characters like *Botryosphaeriaceae*.

*Type species*: ***Columnnosphaeria sarothamni*** Munk, Dansk bot. Ark. 15(no. 2): 103 (1953), (Fig. 15), *Facesoffungi* number: FoF00101

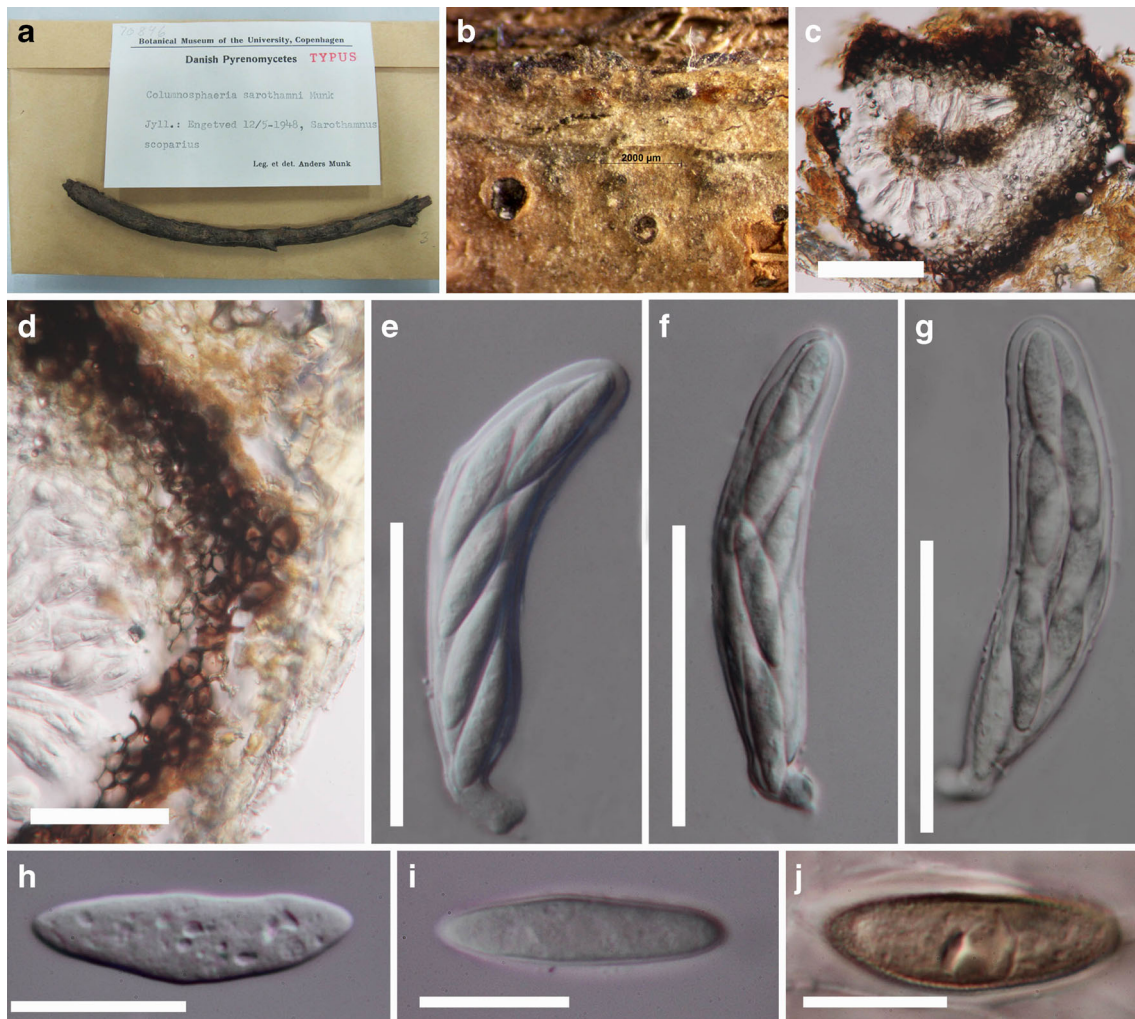
*Saprobic* on twigs of *Sarothamnus* sp. **Sexual state**: *Ascostromata* 235–300  $\mu\text{m}$  high, 260–295  $\mu\text{m}$  wide ( $\bar{x}$  = 267  $\times$  282  $\mu\text{m}$ ,  $n$  = 10) solitary or scattered, black, immersed under the host tissue, globose to subglobose, uniloculate, ostiolate at maturity usually by dehiscence of the thin wall at the apex. *Peridium* 30–50  $\mu\text{m}$  ( $\bar{x}$  = 42  $\mu\text{m}$ ,  $n$  = 15) wide, comprising several layers of dark brown cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 80–90  $\times$  15–18  $\mu\text{m}$  ( $\bar{x}$  = 86  $\times$  16.5  $\mu\text{m}$ ,  $n$  = 20) eight-spored, bitunicate, clavate to cylindro-clavate, short pedicellate, apically rounded. *Ascospores* 22–31  $\times$  5.5–9  $\mu\text{m}$  ( $\bar{x}$  = 27  $\times$  7  $\mu\text{m}$ ,  $n$  = 20) uni-seriate or irregularly bi-seriate, partially overlapping, hyaline when young, brown at maturity, aseptate, ellipsoidal-fusiform, or fusiform, smooth-walled. **Asexual state**: Unknown.

*Material examined*: DENMARK, on *Cytisus scoparius* (L.) Link (*Fabaceae*), 12 May 1948, Anders Munk (C-F70846, **holotype**)

***Columnnosphaeria fagi*** (H.J. Huds.) M.E. Barr, Harvard Pap. Bot. 6(1): 28 (2001), (Fig. 16), *Facesoffungi* number: FoF00102

≡ *Guignardia fagi* H.J. Huds., Nova Hedwigia 10(3/4): 323 (1966) [1965]

*Parasitic* on leaves of a deciduous tree. **Sexual state**: *Ascomata* 65–100  $\mu\text{m}$  high, 70–115  $\mu\text{m}$  wide ( $\bar{x}$  = 76  $\times$  93  $\mu\text{m}$ ,  $n$  = 5), epiphyllous, subcuticular, black, immersed to erumpent, scattered, uniloculate without a distinct ostiole. *Peridium* 9–20  $\mu\text{m}$  ( $\bar{x}$  = 14  $\mu\text{m}$ ,  $n$  = 15) wide, comprising several layers, dark brown to hyaline cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 35–45  $\times$  9–14  $\mu\text{m}$  ( $\bar{x}$  = 40.5  $\times$  11.5  $\mu\text{m}$ ,  $n$  = 20), eight-spored, sometimes less than eight, bitunicate, broadly cylindrical, ellipsoidal, short pedicellate or sessile, apically rounded with an ocular chamber. *Ascospores* 11–19  $\times$  3–6  $\mu\text{m}$  ( $\bar{x}$  = 13.6  $\times$  4.4  $\mu\text{m}$ ,  $n$  = 20), overlapping bi-triseriate, hyaline, aseptate, ellipsoidal to fusiform, sometimes with a thin mucilaginous sheath. **Asexual state**: aureobasidium-like; Colonies white to black. *Conidiogenous cells* intercalary or terminal, forming blastic conidia, denticulate or with minute scar. *Conidia* aseptate, rarely 1-septate, hyaline, smooth, elliptic-oblong. *Secondary conidia* and *endoconidia* are sometimes produced (asexual morph description follows Sivanesan 1984).



**Fig. 15** *Columnnosphaeria sarothamni* (C-F70846, holotype). **a** Herbarium material. **b** Ascostromata on the host surface. **c** Section through ascostroma. **d** Peridium. **e–g** Bitunicate asci. **h–j** Ascospores. Scale bars: c=100  $\mu$ m, d–g=50  $\mu$ m, h–j=15  $\mu$ m

*Material examined*: UK, Cambridgeshire: Cambridge, Gogmagog Hills, on *Fagus sylvatica* (Fagaceae), 18 May 1964, H.J. Hudson (IMI 110819, holotype).

*Kabatiella* Bubák, Hedwigia 46: 297 (1907), *Facesoffungi* number: FoF00103

Synonymy:

*Exobasidiopsis* Karak., Notul. syst. Inst. cryptog. Horti bot. petropol. 1: 81 (1922)

*Subepidermal* on leaves. **Sexual state**: Unknown. **Asexual state**: *Conidiomata* sporodochia or acervuli, stromata, pale or pale brown. *Conidiophores* stromatic, unbranched, or branched, hyaline. *Conidiogenous cells* polyblastic synchronous, inconspicuous scars or dendrites, vesiculate, hyaline. *Conidia* clustered on swollen apex, borne on tiny sterigmata, aseptate, hyaline, oblong to cylindrical, conidial secession schizolytic (Bubák and Kabát 1907; Seifert et al. 2011).

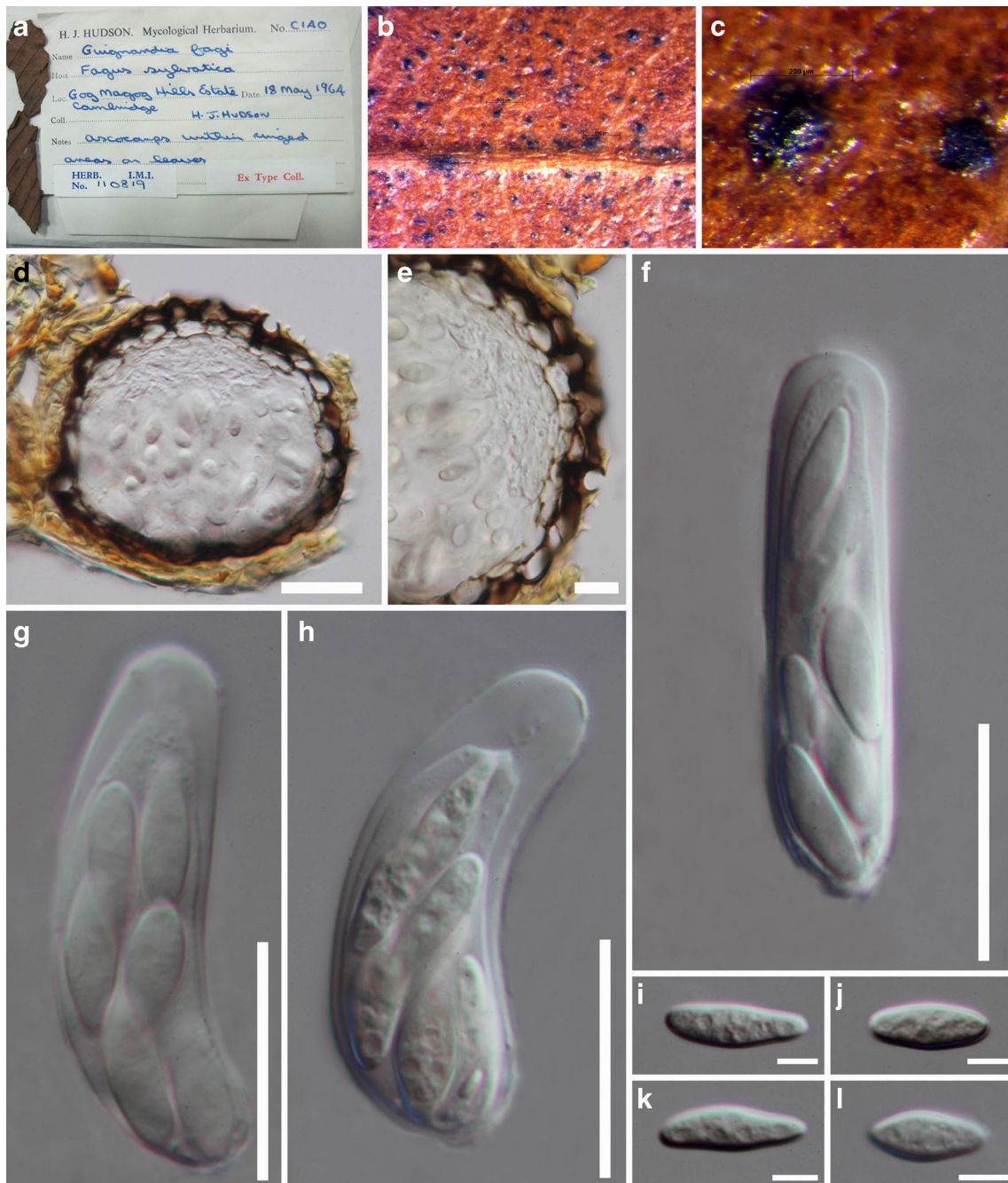
*Type species*: *Kabatiella microsticta* Bubák, Hedwigia 46: 297 (1907)

*Notes*: *Kabatiella* was introduced by Bubák (in Bubák and Kabát 1907) in order to accommodate *Kabatiella microsticta*. Several authors have been synonymized *Kabatiella* under *Aureobasidium* (Hermanides-Nijhof 1977; Sivanesan 1984) but Seifert et al. 2011 treated these two genera as separate. In our phylogenetic analysis, *Kabatiella* forms a separate clade with 90/ 95 % bootstrap support. *Kabatiella microsticta*, the type species of *Kabatiella* and *K. caulivora* clustered in the *Kabatiella* clade. However, the ex-type strain of *K. lini* clustered with *Aureobasidium* species in our phylogenetic tree. Therefore, *K. lini* may belong to *Aureobasidium*.

*Pseudoseptoria* Speg., Anal. Mus. nac. B. Aires, Ser. 3 13: 388 (1910), *Facesoffungi* number: FoF00134

$\equiv$  *Lunospora* Frandsen, Meddr. Plantepatol. Afd. Kgl. Veterin. Landb., (København) 26: 70 (1943)

$\equiv$  *Aphanofalx* B. Sutton, Trans. Br. mycol. Soc. 86(1): 21 (1986)



**Fig. 16** *Columnosphaeria fagi* (IMI 110819, holotype). **a** Herbarium material **b, c** Ascostromata on the host surface. **d** Section through ascostroma. **e** Peridium. **f–h** Bitunicate asci **i–l** Ascospores. Scale bars: **d**=25  $\mu$ m, **f–h**=20  $\mu$ m, **i–l**=5  $\mu$ m

*Type species: Pseudoseptoria donacicola* Speg., Anal. Mus. nac. B. Aires, Ser. 3 13: 388 (1911), *Facesoffungi* number: FoF00135

*Notes:* *Pseudoseptoria* was introduced by Spegazzini (1910) as an asexual genus in order to accommodate *Pseudoseptoria donacicola* (*P. donacis*). This genus is characterized by immersed, branched, septate, pale brown mycelium, pycnidial, solitary or linearly aggregated, immersed, brown, globose, unilocular, thin-walled conidiomata of pale brown cells of *textura angularis* with a distinct, central,

circular ostiole. Conidiogenous cells are discrete, determinate or indeterminate, hyaline, smooth, ampulliform with a prominent cylindrical papilla and falcate. Conidia are fusoid, hyaline, aseptate, guttulate, smooth, thin-walled, and acutely rounded at each end (Sutton 1980; Quaedvlieg et al. 2013). Wijayawardene et al. (2012) placed this genus in Ascomycota, genera *incertae sedis*. Quaedvlieg et al. (2013) introduced two new species, *P. collariana* and *P. obscura* and placed them in *Dothioraceae*, based on molecular phylogeny and stated

that *P. donacis* (CBS 291.69, 313.68 and 417.51), the type species of *Pseudoseptoria* formed a monophyletic lineage with *P. collariana* and *P. obscura*. In this study *P. collariana* and *P. obscura* clustered in *Aureobasidiaceae* as a sister clade to *Selenophoma linicola* (CBS 468.48). Considering these facts we accept *Pseudoseptoria* in *Aureobasidiaceae* as a distinct genus.

***Pseudosydowia*** K. M. Thambugala & K. D. Hyde gen. nov., Index Fungorum number: IF 550733, *Facesoffungi* number: FoF00105 Etymology: Referring to its similarity with *Sydowia*

*Type species: Pseudosydowia eucalypti* (Verwoerd and du Plessis) K. M. Thambugala & K. D. Hyde sp. comb. Nov., Index Fungorum number: IF 550734; *Facesoffungi* number: FoF00106

≡ *Sydowia eucalypti* (Verwoerd & du Plessis) Crous, in Crous et al., *Sydowia* 55(2): 143 (2003)

≡ *Selenophoma eucalypti* Crous, C.L. Lennox & B. Sutton, *Mycol. Res.* 99(6): 648 (1995)

≡ *Sphaerulina eucalypti* Verwoerd & du Plessis, *S. Afr. J. Sci.* 28: 296 (1931)

**Leaf spots** amphigenous, sub circular, becoming confluent, covering large areas of the leaf, pale brown, surrounded by a narrow, raised, dark brown margin. Mycelium internal, medium brown, consisting of septate, branched, smooth hyphae. **Sexual state:** *Ascostromata* amphigenous, black, subepidermal, becoming erumpent, separate or aggregated in clusters of up to 8, globose, apical ostiole wall consisting of several layers of dark brown *textura angularis*. *Asci* eight-spored, bitunicate, fasciculate, broadly ellipsoid to clavate, straight to slightly curved, sub sessile with a well-developed ocular chamber. *Ascospores* overlapping, bi- to multiseriate, hyaline, (1-)3(-4)-septate at maturity, constricted at the median septum, aguttulate, thin-walled, straight to slightly curved, obovoid to ellipsoid with obtuse ends, tapering towards both ends, but more prominently towards the lower end (Crous et al. 2003). **Asexual state:** *Conidiomata* pycnidial to avervular, amphigenous, subepidermal, dark brown, dehiscence by irregular rupture of the upper wall. *Conidiomata* wall comprising 3 to 6 layers of dark brown to black cells of *textura angularis*. *Conidiophores* reduced to conidiogenous or hyaline, smooth, branched, 1 to 7-septate, constricted at the septa after incubation in moist chambers. *Conidiogenous cells* annellidic, integrated, indeterminate, formed from the inner cells of the conidiomatal wall, hyaline to pale brown, smooth-walled, slightly thick-walled, ampulliform to cylindrical, slightly tapered toward the apex. *Conidia* aseptate, medium brown to olivaceous-brown, ellipsoid to ovoid, aguttulate, thin-walled (Crous et al. 2003; Cheewangkoon et al. 2009).

**Notes:** *Sydowia eucalypti* was originally described by Verwoerd and du Plessis (1931) as *Sphaerulina eucalypti*. Crous et al. (2003) accommodated this species in *Sydowia*

based on its *Sclerophoma* and *Hormonema* asexual states and the thick-walled ascostromata. His phylogenetic analysis also showed that of *Sydowia eucalypti* clustered in *Dothioraceae*, *Dothideales*. *Sydowia eucalypti* is linked to the sexual morph of *Selenophoma eucalypti*, which clustered with other *Aureobasidium* and *Hormonema* species (Crous et al. 2003; Cheewangkoon et al. 2009). In our study *Sydowia eucalypti* clustered in *Aureobasidiaceae* with species of *Aureobasidium*, *Selenophoma* and *Kabatiella*. Therefore, we propose a new monotypic genus *Pseudosydowia* for *Sydowia eucalypti*.

***Saccolthecium*** Fr., *Fl. Scan.*: 349 (1836), *Facesoffungi* number: FoF00107

Synonyms

*Metasphaeria* Sacc., *Syll. fung.* (Abellini) 2: 156 (1883)

*Phaeodothiora* Petr., *Sydowia* 2(1–6): 82 (1948)

*Pleosphaerulina* Pass., *Atti R. Acad. Lincei, Rendiconti Cl. Sci. Fis., sér. 5* 7(2): 46 (1891)

*Schizostegae* Theiss., *Annl. mycol.* 14(6): 415 (1917) [1916]

**Parasitic** or **saprobic** on woody branches and rarely on leaves in terrestrial habitats. **Sexual state:** *Ascomata* black, immersed to erumpent, solitary or gregarious, globose to subglobose, usually uniloculate, thick-walled, sometimes ostiolate. *Peridium* composed of several layers of brown to dark brown pseudoparenchymatous cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* eight-spored, bitunicate, fissitunicate, saccate to broad-clavate, becoming cylindrical-clavate just before rupture, with a short bifurcate pedicel or apedicellate, apex broadly rounded with a distinct ocular chamber. *Ascospores* biseriate to triseriate, partially overlapping, hyaline, 3 to many septate, muriform to phragmosporous, obovoid or elliptic with broadly to narrowly rounded ends. **Asexual state:** aureobasidium-like; conidia hyaline or brownish, ovate, aseptate (Barr 1972).

**Notes:** *Saccolthecium* was introduced by Fries (1836) and Kirschstein (1938, 1939) introduced several species which had been assigned to *Metasphaeria*, *Sphaerulina*, *Leptosphaeria* and *Sphaeria*. Kirschstein (1939, 1941) added two new species to *Saccolthecium*, while Vasilyeva and Mel'nik (2006) introduced *Saccolthecium cornicola* Lar. N. Vassiljeva, Pande (2008) placed several species in *Saccolthecium*, which had been classified under *Pringsheimia* or *Metasphaeria*, but most are invalid (Mycobank 2014). Wehmeyer (1957) and Holm (1957) proposed to lectotypify the genus with *Saccolthecium sepincola*. Froidevaux (1972) and Sivanesan (1984) synonymized *Saccolthecium sepincola* under *Pringsheimia sepincola* and they considered *P. sepincola* as the type species of *Pringsheimia*. *Saccolthecium* has been assigned to *Dothioraceae*, *Dothideales* (Barr 1972; 1987a and 2001; Kirk et al. 2008; Lumbsch and Huhndorf 2010) based on similar

morphological characters of peridium, asci and ascospores (Barr 1972), while *Pringsheimia* is considered to be distinct from *Sacchettoecium* (Barr 1987a; 2001). Molecular phylogenetic analysis, Schoch *et al.* (2009) shows that *Sacchettoecium sepincola* (CBS 278.32) clustered within *Didymellaceae* and Zhang *et al.* (2012) included *Sacchettoecium* in *Pleosporales* genera *incertae sedis*. As there are no morphology-molecular link between the strain CBS 278.32 and *S. sepincola* it is difficult to show the affinities of *Sacchettoecium* in

*Pleosporales*. However, we collected *S. sepincola* from Italy and directly isolated DNA from ascostromata. Our collection of *S. sepincola* from Italy clustered in *Aureobasidiaceae* in our phylogenetic analysis. Therefore, we assign *Sacchettoecium* in *Aureobasidiaceae*.

*Type species: Sacchettoecium sepincola* (Fr.) Fr. [as ‘saepincola’], Summa veg. Scand., Section Post. (Stockholm): 398 (1849), (Fig. 17), *Facesoffungi* number: FoF00108



**Fig. 17** *Sacchettoecium sepincola* (MFLU 14-0276). **a, b** Appearance of immersed ascostromata on the host surface. **c, d** Section through ascostromata. **e** Bitunicate asci. **f–i** Released ascospores. **j–m**. Released ascospores. Scale bars: c–e=50µm, f–i=25µm, j–m=10µm

≡ *Sphaeria sepincola* Fr. [as ‘saepincola’], *Observ. mycol. (Havniae)* 1: 181 (1815)

*Saprobia* on twigs, and branches of *Rosa* and *Crataegus* sp. **Sexual state:** *Ascomata* 105–135  $\mu\text{m}$  high, 80–105  $\mu\text{m}$  wide ( $\bar{x}$  = 121  $\times$  95  $\mu\text{m}$ ,  $n$  = 10), black, immersed to erumpent, solitary or scattered, globose to subglobose, usually uniloculate, rarely biloculate without a distinct ostiole. *Peridium* 14–36  $\mu\text{m}$  ( $\bar{x}$  = 22  $\mu\text{m}$ ,  $n$  = 15) wide, a single layer, composed of brown to lightly pigmented cells of *textura angularis*, near the base connected to the host tissue. *Hamathecium* lacking pseudoparaphyses. *Asci* 38–64  $\times$  11–16  $\mu\text{m}$  ( $\bar{x}$  = 50  $\times$  14  $\mu\text{m}$ ,  $n$  = 20), eight-spored, bitunicate, saccate to broadly clavate or cylindrical, with a short bifurcate pedicel and a distinct ocular chamber. *Ascospores* 14–20  $\times$  4–6  $\mu\text{m}$  ( $\bar{x}$  = 16.9  $\times$  5  $\mu\text{m}$ ,  $n$  = 25), overlapping biseriate, hyaline, 3–6-septate, sometimes 1 vertical septate, asymmetric, obovoid, fusiform to clavate, with broadly to narrowly rounded ends, with broad upper cells, smooth-walled. **Asexual state:** Unknown.

*Material examined:* ITALY, Collinaccia - Castrocaro e Terra del Sole (province of Forlì-Cesena [FC]), on the twigs of *Cornus sanguinea* (*Cornaceae*), 3 March 2013, Erio Camporesi (MFLU 14–0276).

***Selenophoma*** Maire, *Bull. Soc. bot. Fr.* 53: clxxxvii (1907), *Facesoffungi number:* FoF00109

Synonyms

*Falcispora* Bubák & Serebrian., *Hedwigia* 52: 269 (1912)

*Ludwigiella* Petr., *Annl. mycol.* 20(5/6): 319 (1922)

*Neopatella* Sacc., in Sydow & Sydow, *Annl. mycol.* 6(6): 530 (1908)

*Pseudosarcophoma* Urries, *An. Jard. bot. Madr.* 10: 227 (1952)

*Selenophomopsis* Petr., *Annl. mycol.* 22(1/2): 182 (1924)

*Mycelium* immersed, branched, septate, pale brown. **Sexual state:** Unknown. **Asexual state:** *Conidiomata* pycnidial or avicular, separate or aggregated, scattered, immersed or superficial, globose, dark brown, uniloculate, thin-walled; walls 2 to 3 layers thick, composed of brown, thick-walled, large-celled, *textura angularis*, lacking ostioles, dehiscence by circular or irregular rupture of upper wall. *Conidiophores* reduced to conidiogenous cells or hyaline, irregularly branched at the base and above, 1 to 3-septate, smooth. *Conidiogenous cells* enteroblastic, phialidic, discrete, determinate, hyaline to pale brown, smooth, subglobose, obpyriform or obovoid, collarete and channel minute, with apical periclinal thickening, guttulate, formed from the inner cell of the pycnidial wall, slightly tapered toward the apex. *Conidia* holoblastic, aseptate, falcate, fusiform, ellipsoidal to obovoid, eguttulate or irregularly guttulate, smooth-walled, at first thin-walled, hyaline or pale brown, later pale brown with thicker walls and verruculose.

*Type species:* ***Selenophoma catananches*** Maire [as ‘catanaches’], *Bull. Soc. bot. Fr.* 53: clxxxvii (1906) MB 182152; *Facesoffungi number:* FoF00110

*Notes:* *Selenophoma* was introduced by Selenophoma (1907) with *Selenophoma catananches* Maire as the type species. Sutton (1980) accepted five species in *Selenophoma* and the graminicolous *Selenophoma* species have been accommodated in *Pseudoseptoria* which is the earliest available generic name for them. The type species differs from those subsequently included in the genus *Selenophoma* inasmuch as that a proportion of the conidia become pale brown with thicker walls and develop verruculose ornamentation (Sutton 1980). Crous et al. (2003) introduced *Sydowia eucalypti* with its *Selenophoma* asexual state and coniothyrium-like and hormonema-like synanamorphs. Sutton (1996) introduced *S. anniae* and recently Cheewangkoon et al. (2009) introduced *S. australiensis* with *Hormonema* as a synanamorph. In our phylogenetic analysis three *Selenophoma* species clustered in three different clades. *Selenophoma australiensis* has been shown to be a sister group to *Pseudosydowia*, while *S. linicola* to *Pseudoseptoria*.

#### ***Dothideales*, genera *incertae sedis***

***Celosporium*** Tsuneda & M.L. Davey, *Botany* 88: 472 (2010), *Facesoffungi number:* FoF00111

*Type species:* ***Celosporium laricicola*** Tsuneda & M.L. Davey [as ‘larixicolum’], *Botany* 88(5): 473 (2010), *Facesoffungi number:* FoF00112

*Notes:* *Celosporium* was introduced by Tsuneda et al. (2010) to accommodate a single species *C. laricicola*. This is characterized by dematiaceous hyphae forming terminal or intercalary, black, irregular shaped cellular clumps, conidiomata with aggregated cellular clumps and 1 to 3 celled, hyaline endoconidia, variable size and shape released by cell-wall dissolution of the conidiogenous cells. Phylogenetic analyses (LSU and ITS) of Tsuneda et al. (2010) shows that *C. laricicola* clustered in *Dothideales*. In their ITS analyses *C. laricicola* nested with endophytes of spruce and slow growing dematiaceous endolithic fungi by forming a strongly supported clade. Although *C. laricicola* clustered among endophytes and slow growing dematiaceous endolithic fungi, it separates from the other endoconidial dothidealean taxa. Our phylogenetic analysis also confirmed the placement of *C. laricicola* in *Dothideales* but it separates from both clades A and B. Therefore, we remain *Celosporium* in *Dothideales*, genera *incertae sedis*.

#### Genera excluded from *Dothideales*

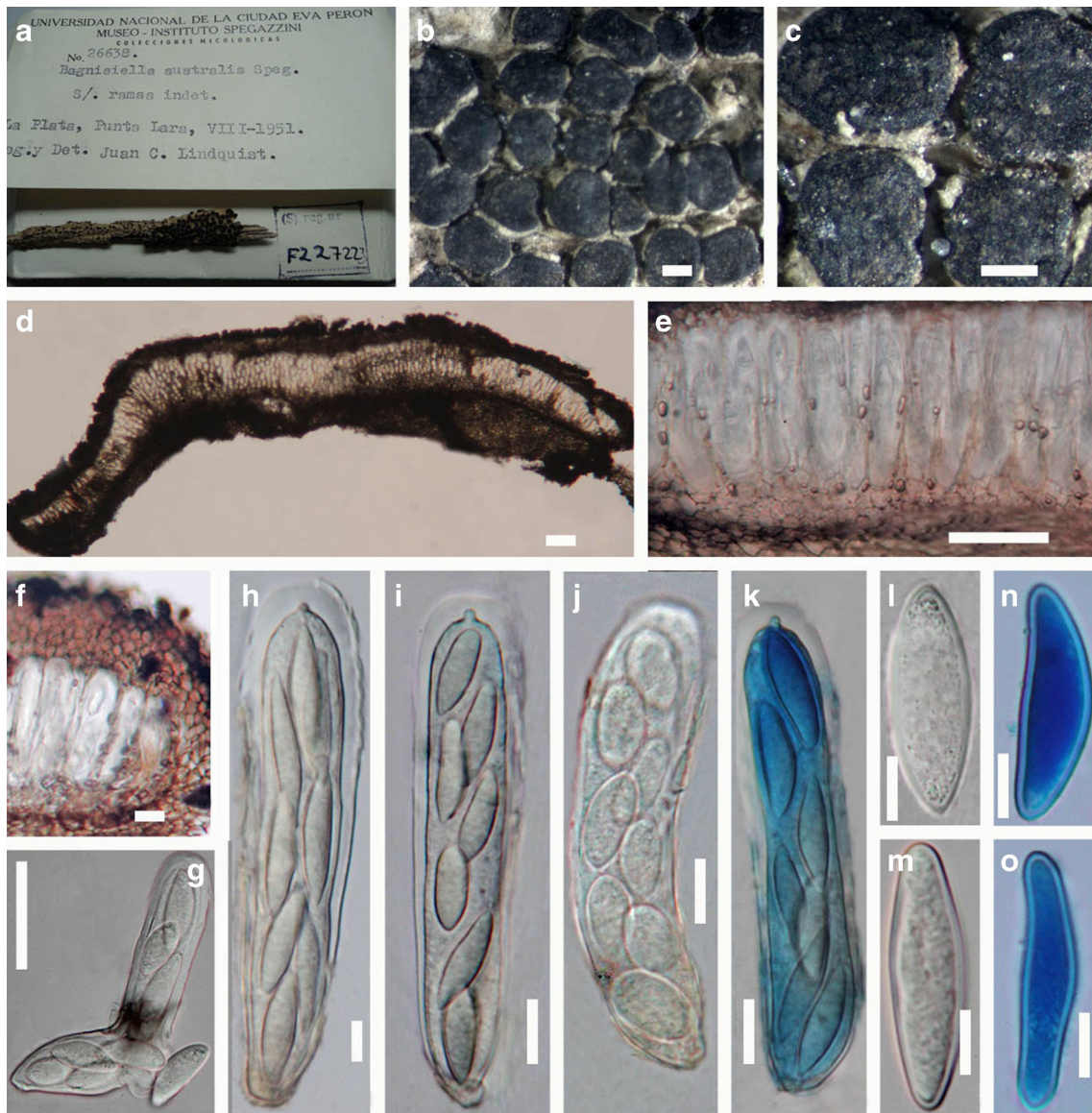
Genus and type species descriptions are given unless the genus is monotypic when only the species description is given.

***Aplosporellaceae*** Slippers, Boissin & Crous, *Studies in Mycology* 76: 41 (2013)

The family *Aplosporellaceae* was introduced by Slippers et al. (2013) and includes *Aplosporella* and *Bagnisiella* in the order *Botryosphaeriales*. *Aplosporellaceae* is characterized by multiloculate ascomata, bitunicate, stalked or sessile asci with a well-developed apical chamber and hyaline to pigmented, septate or aseptate ascospores, without a mucoid appendage or sheath. The asexual states of *Aplosporellaceae* are characterized by uni-multilocular pycnidial conidiomata, hyaline, phialidic conidiogenous cells, proliferating percurrently or with periclinal thickening at apex, hyaline, smooth-walled, septate, hyphae-like, branched or unbranched paraphyses and ellipsoid to sub cylindrical, aseptate conidia initially hyaline becoming pigmented (Slippers et al. 2013).

*Bagnisiella* Spag., Anal. Soc. cient. argent. 10(5–6): 146 (1880), (Fig. 18), *Facesoffungi* number: FoF00114

*Saprobic* on branches, wood. **Sexual state:** *Ascostromata* black, immersed to erumpent or superficial, pulvinate, scattered or aggregated, apex plane or depressed, coriaceous, multiloculate, with 4 to numerous locules, opening widely and irregularly at maturity, cells of ascostromata arranged in upright rows, blackened externally, dark brown to hyaline cells of *textura angularis*. *Locules* globose to subglobose, thickened-walled. *Peridium* of locules thin-walled, lightly pigmented or dark brown cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* eight-spored, bitunicate, clavate to cylindro-clavate, with a short pedicel, apically rounded, with



**Fig. 18** *Bagnisiella australis* (S-F227223) **a–c** Ascostromata on host substrate, **d** Section of ascostroma. **e** Asci arrangement within hamathecium **f** Close up of the peridium. **g** Dehiscence of asus **h–j** Asci with short pedicel bearing discontinuously arranged partially overlapping

**6–8** ascospores. **k** Ascus stained with *cotton blue* reagent. **l–m** Smooth, hyaline ascospores. **n–o** Ascospore stained with *cotton blue* reagent. *Scale bars*: **d**=20  $\mu$ m, **e**, **f**=500  $\mu$ m, **g**=15  $\mu$ m, **h–k**=5  $\mu$ m, **l–o**=10  $\mu$ m

a small ocular chamber. *Ascospores* overlapping uni-triseriate, hyaline to dark brown, aseptate, tapered to pointed ends, elliptic, oblong to ovate, straight to inequilateral, minutely guttulate, smooth-walled without a sheath. **Asexual state:** Unknown.

*Notes:* *Bagnisiella* was introduced by Spegazzini (1880) and *Bagnisiella australis* Speg. assigned as the type species. Saccardo (1883) placed this genus in *Dothideaceae*. Theissen (1916) established family *Dothioraceae* of the *Myriangiales* and included *Bagnisiella* in *Dothioraceae*. Previously (1915) this genus was included in an “Anhang” to their arrangement of the *Dothideales*. The placement of *Bagnisiella* in *Dothioraceae* was followed by Theissen and Sydow (1917), Petrak (1923a); (Barr 1979, 1987a); Hawksworth et al. (1995) and Kirk et al. (2001, 2008). Luttrell (1955) suggested that *Bagnisiella* may be representing a link between *Myriangiales* and *Dothioraceae*. Lumbsch and Huhndorf (2007, 2010) categorized *Bagnisiella* in *Dothideaceae*. We examined *B. australis*, the type of *Bagnisiella* and its morphology suggests *Bagnisiella* should be excluded from *Dothideales* and placed in *Botryosphaeriales*. Slippers et al. (2013) showed that there is a consistent connection between *Aplosporella* and *Bagnisiella* and placed it in family *Aplosporellaceae* and *Bagnisiella* reduced to synonymy with *Aplosporella*. Therefore, we transfer *Bagnisiella* from *Dothideales* to *Aplosporellaceae* based on molecular phylogeny and morphology.

*Type species:* ***Bagnisiella australis*** Speg., Anal. Soc. cient. argent. 10(1): 22 (1880), *Facesoffungi* number: FoF00115

*Parasitic* on woody branches. **Sexual state:** *Ascostromata* 900–1200×1000–1400 μm ( $\bar{x}$ = 1100 × 1200 μm, *n* = 10) , black, outwardly grey, flattened at the upper surface, erumpent, solitary or scattered, globose to sub globose, coriaceous, multiloculate, with 5 to numerous locules, cells of *ascostromata* composed of several layers of dark brown cells of *textura angularis*. *Locules* 12.3–19.1×2.3–4.2 μm ( $\bar{x}$ = 13 × 2.9 μm, *n* = 24) rectangular. *Peridium* comprising several layers of thick-walled, pale brown cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 29–49×6–9 μm ( $\bar{x}$ = 39 × 9 μm, *n* = 10) 6–8 spored, bitunicate, fissitunicate, clavate to sub-cylindrical, aggregated, short pedicellate, apically rounded with a small ocular chamber. *Ascospores* 25–40×5–9 μm ( $\bar{x}$ = 29.5 × 8.23 μm, *n* = 2) discontinuously arranged partially overlapping, hyaline, aseptate, oblong or ovate, smooth-walled, without a sheath. **Asexual state:** Unknown.

*Material examined:* ARGENTINA, La Plata, Punta Lara, on *Acacia bonariensis* Hook. & Arn (*Fabaceae*), August 1951, J.C. Lindquist (S-F227223).

*Notes:* Liu et al. (2012) has observed and illustrated the holotype of *Bagnisiella australis* in LPS which is

immature, but does not appear to be botryosphaeriaceous based on the characters of the sunken *ascostromata* and cylindrical *asci*. Therefore, we examined an authentic specimen from S in order to clarify its familial placement.

***Botryosphaeriaceae*** Theiss. & Syd. [as ‘Botryosphaeriaceae’], Anns mycol. 16(1/2): 16 (1918)

*Botryosphaeriaceae* was introduced by Theissen and Sydow (1918) and previously this family had been referred to various orders including *Myriangiales*, *Dothideales*, and *Pseudosphaeriales/Pleosporales*. Schoch et al. (2006) included *Botryosphaeriaceae* in *Botryosphaeriales* and the family is characterized by uni- to multilocular *ascostromata*, hyphae-like, branched or unbranched, septate, pseudoparaphyses, bitunicate, fissitunicate *asci* with apically rounded with an ocular chamber and hyaline to brown, aseptate to septate smooth to verrucose *ascospores*. Asexual morphs of *Botryosphaeriaceae* with uni to multilocular pycnidial conidiomata, with hyaline, phialidic conidiogenous cells and hyaline to pigmented, thin to thick-walled conidia which sometimes have mucoid appendages or sheaths, striations, verrucose walls and germ slits (Liu et al. 2012; Hyde et al. 2013). Kirk et al. (2008) estimated that there are 26 genera and 1517 species in the family, while Liu et al. (2012) accepted 29 genera and approximately 1485 species.

***Coccostromella*** Petr., Sydowia 21: 267 (1968) [1967], *Facesoffungi* number: FoF00117

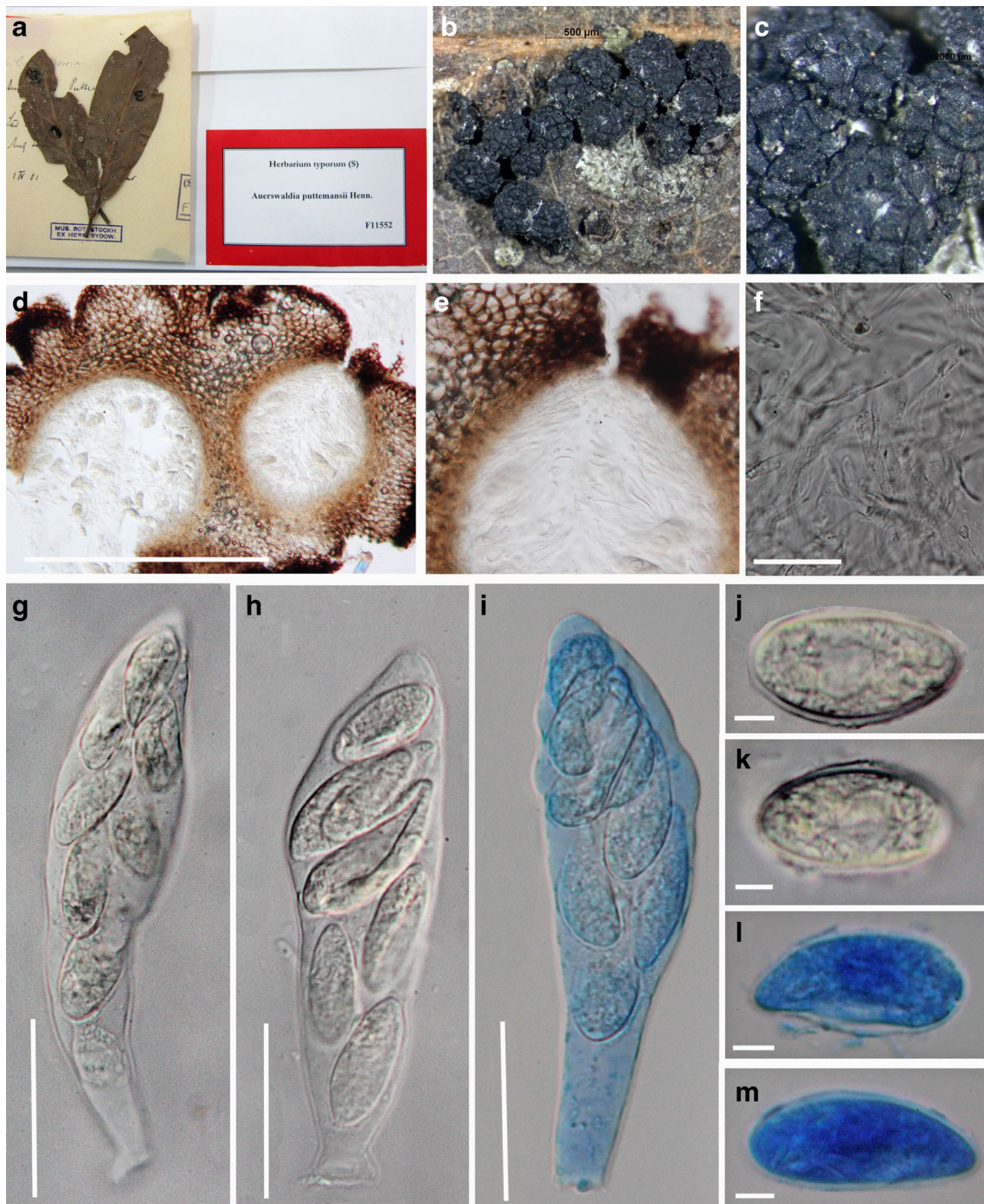
*Notes:* *Coccostromella* was introduced by Petrak (1967) to accommodate a single species *Coccostromella puttemansii* which has been referred to *Auerswaldia*. Lumbsch and Huhndorf (2010) grouped the genera *Auerswaldia* and *Coccostromella* within *Dothideaceae*, while Liu et al. (2012) included *Auerswaldia* into *Botryosphaeriaceae* based on molecular and phylogenetic data. Although Lumbsch and Huhndorf (2010) placed *Coccostromella* in *Dothideaceae*, presence of filiform pseudoparaphyses and clavate to cylindro-clavate *asci* and aseptate *ascospores* exclude it from *Dothideaceae*. Therefore, we refer *Coccostromella* to *Botryosphaeriaceae*.

*Type species:* ***Coccostromella puttemansii*** (Henn.) Petr., Sydowia 21: 267 (1968) [1967], (Fig. 19), *Facesoffungi* number: FoF00118

≡ *Auerswaldia puttemansii* Henn., Hedwigia 41: 111 (1902)

*Parasitic* on leaves. **Sexual state:** *Ascostromata* up to 1000 μm diam, black, gregarious, superficial, epiphyllous, sometimes hypophyllous, globose to subglobose, gregarious, globose to subglobose, coriaceous, multiloculate, with 3–4 locules, cells of *ascostromata* thick-walled, brown *textura angularis*. *Locules* 180–350×200–360 μm ( $\bar{x}$ = 265 × 280 μm, *n* = 15) , globose to subglobose,





**Fig. 19** *Coccostromella puttemansii* (S-F11552, **isotype**) **a** Herbarium packet and material. **b, c** Ascostromata on leaf surface. **d** Section of ascostroma showing locules. **e** Close up of cells of ascostromata **f**

Pseudoparaphyses. **g–h** Asci with 8 ascospores **j–m** Ascospores. Scale bars: **d**=700  $\mu\text{m}$ , **e–f**=100  $\mu\text{m}$ , **g–i**=50  $\mu\text{m}$ , **j–m**=5  $\mu\text{m}$

without individual ostiole, opening by dehiscence. *Peridium* of locules composed of thin-walled, light brown to hyaline cells of *textura angularis*. *Hamathecium* composed of 2.5–4  $\mu\text{m}$  wide, filiform, hyphae-like, aseptate, hyaline pseudoparaphyses. *Asci* 100–125  $\times$  20–34  $\mu\text{m}$  ( $\bar{x}$  = 113  $\times$  27.5  $\mu\text{m}$ ,  $n$  = 15), eight-spored, bitunicate, fissitunicate, clavate to cylindro-clavate, with a

short pedicel, apically rounded. *Ascospores* 24–32  $\times$  8.5–15  $\mu\text{m}$  ( $\bar{x}$  = 27  $\times$  10.8  $\mu\text{m}$ ,  $n$  = 30) overlapping uniseriate to biseriata, hyaline, aseptate, ellipsoidal to obovoid, rough-walled. **Asexual state**: Unknown.

*Material examined*: BRAZIL, São Paulo, on leaves of *Lauracearum* (*Lauraceae*), 01 April 1901, Puttemans (S-F11552, **isotype**).

*Mycosphaerellaceae* Lindau, in Engler and Prantl, Nat. Pflanzenfam., Teil. I (Leipzig) 1(1): 421 (1897)

Synonym:

*Sphaerellaceae* Nitschke, Verh. naturh. Ver. preuss. Rheinl. 26: 74 (1869)

The family *Mycosphaerellaceae* was introduced by Lindau (1897) with the family type *Mycosphaerella* Johanson. Hawksworth et al. (1995) placed *Mycosphaerellaceae* in *Dothideales*. Kirk et al. (2001) assigned *Mycosphaerellaceae* to the new order *Mycosphaerellales*, while Kirk et al. (2008) placed the family in *Capnodiales*. *Mycosphaerellaceae* is characterized by uni to multiloculate ascostromata with a central ostiole, bitunicate cylindrical to cylindrical-clavate asci and hyaline to pale yellowish, aseptate or septate ascospores

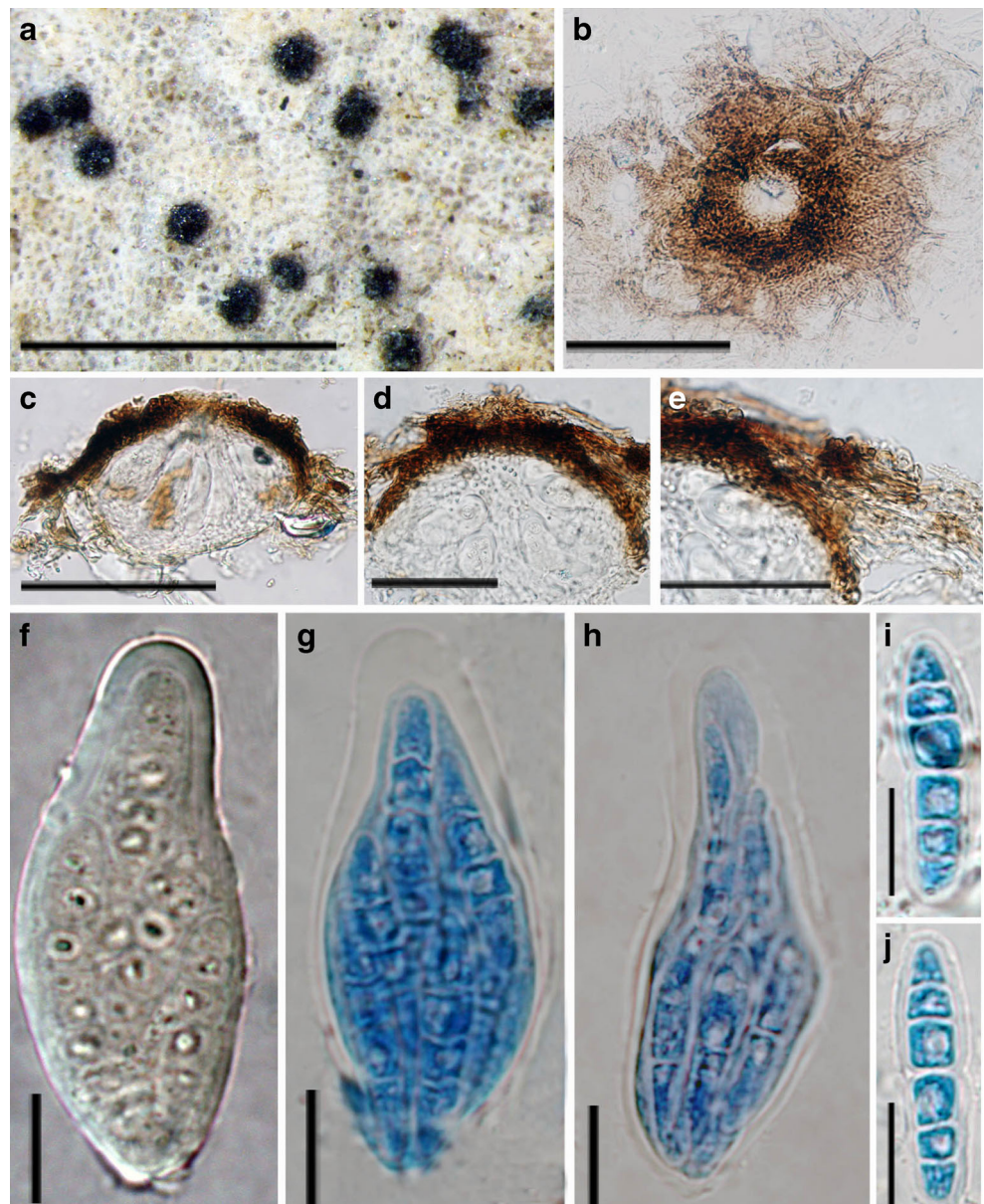
often constricted at the septum. Asexual morphs of *Mycosphaerellaceae* include mucedinaceous and dematiaceous hyphomycetes (conidiophores solitary, fasciculate, sporodochial or synnematosus), or acervular to pycnidial coelomycetes with hyaline to pigmented conidiophores and conidia. Hyde et al. (2013) accepted *Mycosphaerellaceae* in *Capnodiales* with 12 sexual and 32 asexual genera.

*Mycoporis* Clem., Gen. fung. (Minneapolis): 50, 173 (1909), *Facesoffungi* number: FoF00120

Type species: *Mycoporis perexigua* (Müll. Arg.) Clem., Gen. fung. (Minneapolis): 1–227 (1909), (Fig. 20), *Facesoffungi* number: FoF00121

≡ *Mycoporellum perexiguum* Müll. Arg., Nuovo G. bot. ital. 23: 399 (1891)

**Fig. 20** *Mycoporis perexigua* (G 00110864, holotype). **a** Ascomata on the host surface. **b** Squash mount of ascomata **c, d** Sections of the ascomata **e** Peridium. **f** Ascus in water **g–h** Asci in lactophenol **cotton blue** **i–j** Ascospores stained in **cotton blue** reagent. Scale bars: **a**=1000  $\mu$ m, **b, c**=100  $\mu$ m, **d, e**=50  $\mu$ m, **f–j**=10  $\mu$ m



*Parasitic* on leaves. **Sexual state:** *Ascomata* 120–180  $\mu\text{m}$ , appearing as black spots on the host surface, gregarious, scattered, superficial, very easily removed from the host surface, globose, uniloculate, ostiolate. *Peridium* 11–18  $\mu\text{m}$ , one-layered, composed of dark to brown cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 48–57  $\times$  11–22  $\mu\text{m}$  ( $\bar{x}$  = 50  $\times$  20  $\mu\text{m}$ ,  $n$  = 15), eight-spored, bitunicate, broadly cylindrical to fusiform, sessile, with a large ocular chamber, up to 5–9  $\mu\text{m}$ . *Ascospores* 22–27  $\times$  4–8  $\mu\text{m}$  ( $\bar{x}$  = 24  $\times$  7  $\mu\text{m}$ ,  $n$  = 15), overlapping, uniseriate at the apex to tri-seriate near the base, hyaline, 5-septate, strongly constricted at the primary septum, broadly fusiform to cylindrical with broadly rounded ends. **Asexual state:** Unknown.

*Notes:* *Mycoporis* was introduced by Clements (1909) as a monotypic genus in order to accommodate *Mycoporellum perexiguum* Müller Arg. (*Mycoporis perexigua*). Zahlbruckner (1922) categorized *Mycoporis* under *Mycoporaceae*, while Hawksworth et al. (1995) and Lumbsch and Huhndorf (2010) included this genus in *Dothideaceae*. We examined *M. perexiguum* which did not match the taxonomic concepts of *Dothideaceae* or *Dothideales* as ascomatal characters mainly differ from other dothidealean species but similar with *Mycosphaerellaceae*. Therefore, we exclude *Mycoporis* from *Dothideales* and transfer it to *Mycosphaerellaceae*.

*Material examined:* AUSTRALIA, Brisbane, Bailey (G 00110864, **holotype**).

***Pseudoperisporiaceae*** Toro, in Seaver & Palacios Chardon, Scient. Surv. P. Rico 8(1): 0 (1926)

Synonym:

*Epipolaeaceae* Theiss. & P. Syd., Anns mycol. 16(1/2): 7(1918)

The family *Pseudoperisporiaceae* was introduced by Toro in Seaver and Chardón (1926) and is characterized by superficial ascomata surrounded by brown mycelium at the base, brown to red brown, thin-walled, peridium composed of cells of *textura angularis*, bitunicate, sessile, or short pedicellate asci with small ocular chamber and 1-septate, hyaline to brown ascospores constricted at the septum (Hyde et al. 2013). *Chaetosticta* is reported as the asexual state of this family (Hyde et al. 2013). Lumbsch and Huhndorf (2010) and Hyde et al. (2013) listed 22 genera in *Pseudoperisporiaceae* in *Dothideomycetes incertae sedis*.

***Jaffuela*** Speg., Boln Acad. nac. Cienc. Córdoba 25: 39 (1921), *Facesoffungi* number: FoF00123

*Type species:* ***Jaffuela chilensis*** Speg., Boletín de la Academia Nacional de Ciencias de Córdoba 25: 39 (1921), (Fig. 21), *Facesoffungi* number: FoF00124

Growing on leaves of *Puya chilensis*. **Sexual state:** *Mycelium* up to 8–13  $\mu\text{m}$  long spreading below host surface

which easily removed from the host tissue, composed of dark-brown moniliform shape cells. *Ascostromata* 100–130  $\mu\text{m}$  high  $\times$  90–130  $\mu\text{m}$  diam., black, immersed to erumpent, gregarious, scattered, globose to subglobose, coriaceous, unilocular, composed of one layer of brown cells of *textura angularis* fused to the host. *Hamathecium* lacking pseudoparaphyses *Asci* 40–60  $\times$  20–30  $\mu\text{m}$  ( $\bar{x}$  = 48  $\times$  25  $\mu\text{m}$ ,  $n$  = 15), eight-spored, bitunicate, elliptic-obovate, sessile or short pedicellate, apically rounded with a small ocular chamber. *Ascospores* 25–30  $\times$  7–9  $\mu\text{m}$  ( $\bar{x}$  = 27  $\times$  8.5  $\mu\text{m}$ ,  $n$  = 15), irregularly arranged, overlapping, 2 to 3 seriate, brown, 1-septate, constricted at the septum, with broadly to narrowly rounded ends, smooth-walled. **Asexual state:** Unknown.

*Notes:* *Jaffuela* was introduced by Spegazzini (1921) based on *J. chilensis* and has remained monotypic until now. Luttrell (1973) placed this genus in *Parodiopsidaceae* which is characterized by intact pseudothecia opening by a broad pore or crumbling at the apex. Arx and Müller (1975) accommodated *Jaffuela* in *Dothideaceae*, while Lumbsch and Huhndorf (2010) included it in *Dothioraceae*.

We examined the type specimen of *Jaffuela* and it does not share common morphology with those genera of *Dothideales*. However, *Jaffuela* shows similarities with *Pseudoperisporiaceae*, such as superficial ascomata surrounded by brown mycelium, brown to red brown, thin-walled, peridium composed of cells of *textura angularis*, bitunicate, short pedicellate asci with a small ocular chamber and 1-septate, brown ascospores, constricted at the septum. Therefore, we tentatively assign *Jaffuela* to *Pseudoperisporiaceae* based on the morphology. The type needs recollecting, sequencing and epitypifying in order to confirm its familial status.

*Material examined:* CHILE, on *Puya chilensis* Molina (*Bromeliaceae*), 1918, Spegazzini (LPS 667, **holotype**).

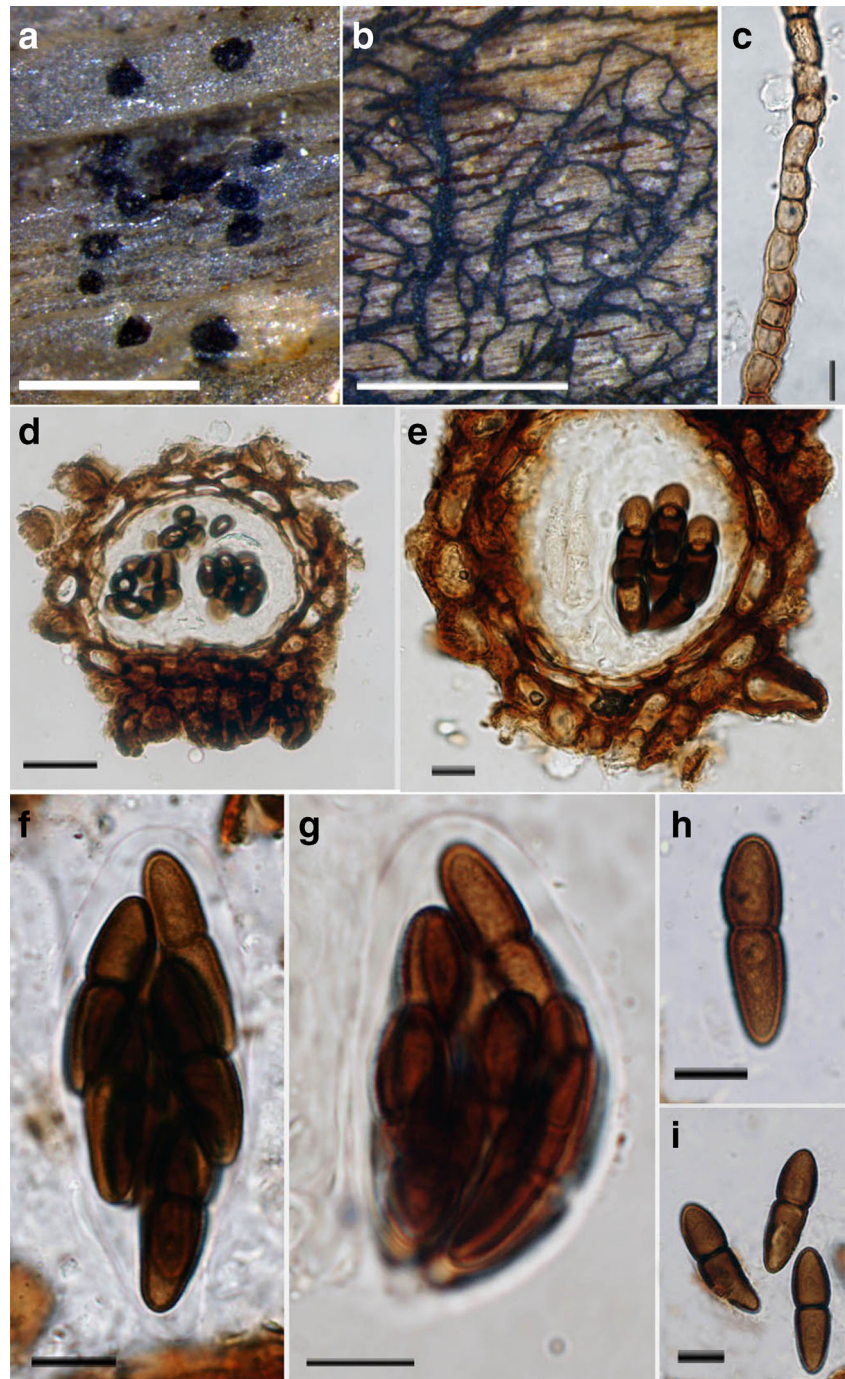
***Teratosphaeriaceae*** Crous & U. Braun, Stud. Mycol. 58: 8 (2007)

*Teratosphaeriaceae* was introduced by Crous et al. (2007) with its phylogenetic position within *Capnodiales*. This family is characterized by pseudothecial, immersed to superficial ascomata with papillate ostioles, branched, septate, anastomosing pseudoparaphyses, bitunicate, obclavate to globose or saccate asci and 1-septate, hyaline ascospores. Crous et al. (2009) accepted *Baudoinia*, *Capnobotryella*, *Catenulostroma*, *Devriesia*, *Penidiella*, *Phaeothecoidea*, *Readeriella*, *Staninwardia* and *Teratosphaeria* in *Teratosphaeriaceae* based on DNA sequence data derived from the LSU gene. Hyde et al. (2013) accepted 24 sexual and asexual genera in this family.

***Pachysacca*** Syd., Anns mycol. 28(5/6): 435 (1930), *Facesoffungi* number: FoF00126

*Type species:* ***Pachysacca eucalypti*** Syd., Anns mycol. 28(5/6): 435 (1930), (Fig. 22), *Facesoffungi* number: FoF00127

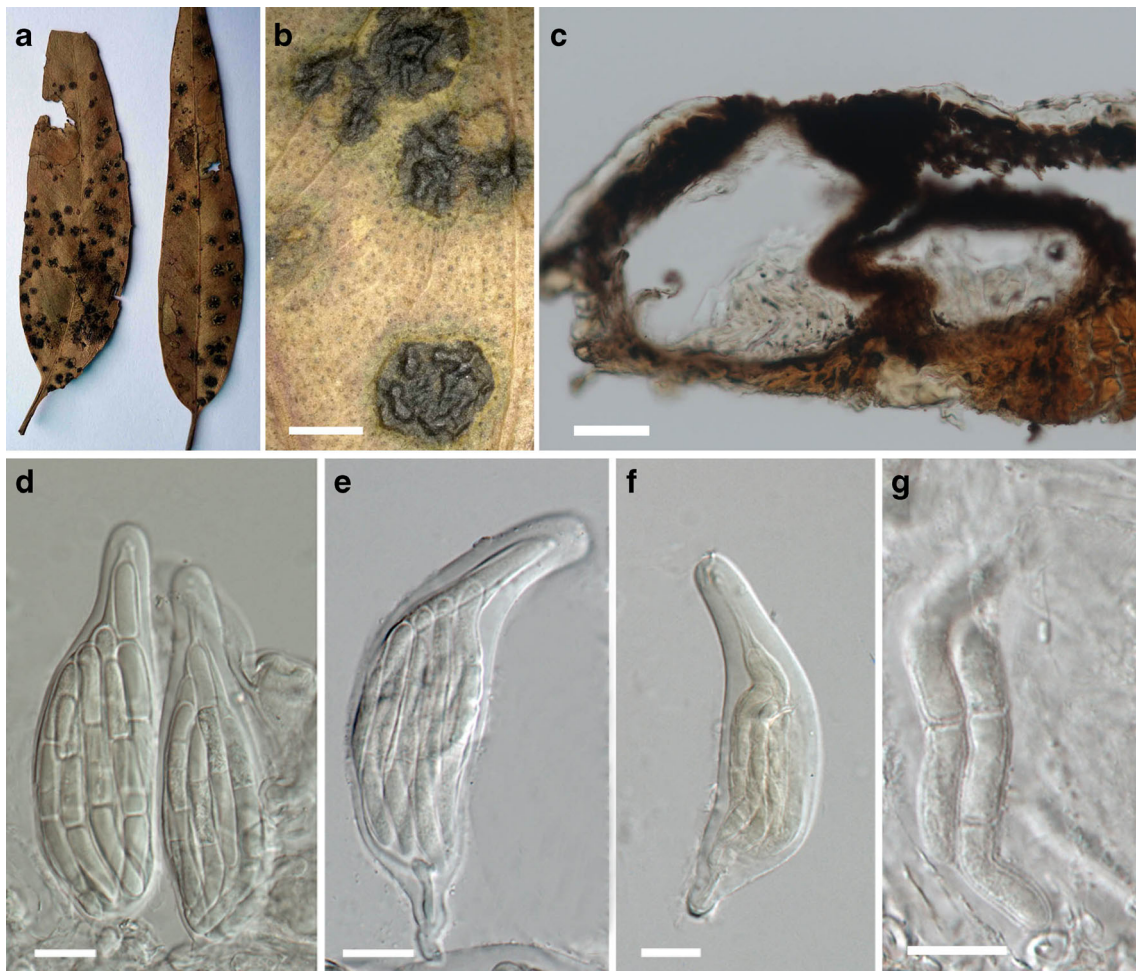
**Fig. 21** *Jaffuela chilensis* (LPS 667, holotype). **a** Appearance of ascomata on the host surface. **b** Mycelium on the host surface. **c** Mycelium. **d, e** Sections through ascomata. **f, g** Asci. **h, i** Ascospores. Scale bars: a, b=500  $\mu\text{m}$ , c=10  $\mu\text{m}$ , d=25  $\mu\text{m}$ , e–i=10  $\mu\text{m}$



*Saprobic* on *Eucalyptus* leaves. **Sexual state:** *Ascostromata* up to 900–1200  $\mu\text{m}$  diam ( $\bar{x}$  = 1150  $\mu\text{m}$ ), black, immersed at the base, fused with host surface, nearly flattened at the top, solitary or scattered, multiloculate, with 2–4 locules. *Peridium* of locules composed of pale brown to brown cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 120–150  $\times$  36–43  $\mu\text{m}$  ( $\bar{x}$  = 135  $\times$  41  $\mu\text{m}$ ,  $n$  = 5), eight-spored, bitunicate, fissionate, narrowly cylindrical at the upper and broadly oblong at the end, with a short pedicel. *Ascospores* 59–65  $\times$  8–10  $\mu\text{m}$  ( $\bar{x}$  = 63  $\times$  9  $\mu\text{m}$ ,

$n$  = 10), over-lapping, uniseriate to multiseriate, hyaline, 1–2-septate, narrowly cylindrical, with broadly rounded ends, smooth-walled. **Asexual state:** Unknown.

*Notes:* *Pachysacca* was introduced by Sydow (1930) in order to accommodate *P. eucalypti*. Later, Swart (1982) introduced another two new species *P. pusilla* H.J. Swart and *P. samuelii* (Hansf.) H.J. Swart. Hawksworth et al. (1995) and Lumbsch and Huhndorf (2010) placed this genus in *Dothideaceae*. We examined and illustrated the type specimen of *Pachysacca* and it should be excluded from *Dothideales* as



**Fig. 22** *Pachysacca eucalypti* (K(M) 176511, **holotype**). **a, b** Appearance of ascostromata on the host surface. **c** Section through ascostroma. **d–f** Asci. **g** Ascospores. Scale bars: **b**=800  $\mu\text{m}$ , **c**=50  $\mu\text{m}$ , **d, e**=20  $\mu\text{m}$

morphology of *Pachysacca* differs from other members of *Dothideales* that we accept here. *Pachysacca* shares morphologically similar characteristics with *Teratosphaeriaceae*. Therefore, we tentatively refer *Pachysacca* in *Teratosphaeriaceae*.

**Material examined:** AUSTRALIA, Noorlunga, on *Eucalyptus rostrata* Schlecht. (*Myrtaceae*), May 1924, G. Samuel (K(M)176511, **holotype**).

#### Dothideomycetes, genera *incertae sedis*

Dothideomycetes is the largest class in the division Ascomycota and is characterized by bitunicate (fissitunicate) asci. Lumbsch and Huhndorf (2010) included 34 families and over 150 genera in *Dothideomycetes incertae sedis* in the Outline of Ascomycota—2009, while Hyde *et al.* (2013) included 26 families. We exclude the following genera from *Dothideales* and include them in *Dothideomycetes, genera incertae sedis* pending fresh collections and phylogenetic investigations.

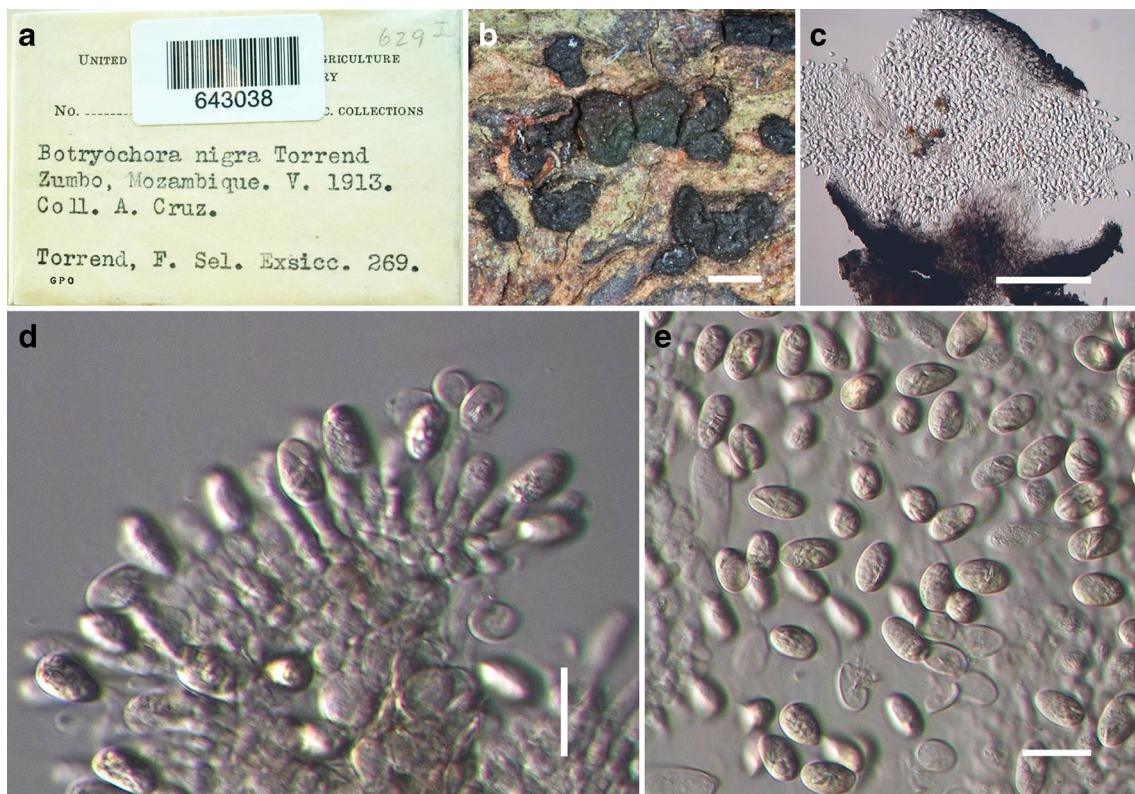
***Botryochora*** Torrend, Brotéria, sér. bot. 12: 65 (1914), *Facesoffungi* number: FoF00128

**Type species:** *Botryochora nigra* (Torrend) Torrend, Brotéria, sér. bot. (1914), (Fig. 23),

*Facesoffungi* number: FoF00129

**Saprobic** on bark. **Sexual state:** not observed. **Asexual state:** *Conidiomata* 1272–1704 (–1941)  $\mu\text{m}$  diam ( $\bar{x}$ = 1673  $\mu\text{m}$ ,  $n$  = 5), black, solitary or scattered, immersed at base, superficial, globose to subglobose, multiloculate with 3–5 locules. *Peridium* composed of pale to brown cells of *textura angularis*. *Conidiophores* (10–)13–16(–20)  $\times$  5–5.5  $\mu\text{m}$  long ( $\bar{x}$ = 16  $\times$  5  $\mu\text{m}$ ,  $n$  = 20), hyaline, unbranched. *Conidiogenous cells* integrated, phallic. *Conidia* 15.5–19 (–20)  $\times$  9.5–11  $\mu\text{m}$  ( $\bar{x}$ = 18  $\times$  10  $\mu\text{m}$ ,  $n$  = 30), hyaline, aseptate, oval-ellipsoid, rounded to narrow ends, smooth-walled.

**Notes:** *Botryochora* was introduced by Torrend (1914) in order to accommodate *Megalonectria nigra* Torrend which was classified in *Nectriaceae*, Sordariomycetes. Hawksworth *et al.* (1995) and Lumbsch and Huhndorf (2010) placed this genus in *Dothioraceae*. Although the sexual morph could not be found on this specimen, we observed the asexual state



**Fig. 23** *Botryochora nigra* (BPI 643038). **a.** Herbarium packet **b** Conidiomata on the host surface. **c** Section through conidioma **d** Conidiophores and developing conidia. **e** Conidia. Scale bars: b=1000µm, c=200µm, d–e=20µm

associated with in same herbarium material. The sexual state is characterized by black, erumpent to superficial, multiloculate ascostromata, eight-spored asci and brown ascospores (Saccardo 1925–1928). We could not observe the sexual state in the herbarium material and the morphology of its asexual state does not justify placement in *Dothideales*. Therefore, we transfer *Botryochora* to *Dothideales*, genera *incertae sedis*. Recollection, epitypification and molecular analysis are required to confirm the placement of *Botryochora*.

*Material examined:* MOZAMBIQUE, Zumbo, May 1913, A. Cruz (BPI 643038); CONGO, Kisantu, leg. by H. Vanderyst (URM 9415, 9416).

*Lucidascoarpha* A. Ferrer, et al., *Mycologia* 100(4): 642 (2008)

*Type species: Lucidascoarpha pulchella* A. Ferrer et al. *Mycologia* 100(5): 644 (2008)

*Notes:* *Lucidascoarpha* was introduced by Ferrer et al. (2008) in order to accommodate *Lucidascoarpha pulchella*. Based on ascostromatic ascomata, fissitunicate asci and lack of pseudoparaphyses, they placed *Lucidascoarpha* in *Dothideaceae*. *Lucidascoarpha* is distinct from other species of *Dothideaceae* as it does not share common morphologies. In *L. pulchella*, ascomata are white, with long periphysate necks, peridium comprises hyaline *textura angularis* cells and ascospores have seven septate and surrounded by a large

gelatinous sheath. Therefore, we exclude *Lucidascoarpha* from *Dothideaceae* and transfer in to *Dothideomycetes* genera *incertae sedis*. *Lucidascoarpha* shares some morphological affinities with *Tubeufiaceae* such as superficial, unilocular, globose-subglobose, papillate ascomata, eight-spored, clavate, pedicellate asci and multiseptate, hyaline ascospores. *Lucidascoarpha* differs from other species of *Tubeufiaceae* in having hyaline ascomata with a long cylindrical neck, a hamathecium lacking pseudoparaphyses, and verruculose ascospores with a large gelatinous sheath.

*Omphalospora* Theiss. & Syd., *Annls mycol.* 13(3/4): 361 (1915), *Facesoffungi number:* FoF00132

Synonyms

*Plectosphaerella* Kirschst., *Krypt.-Fl. Brandenburg (Leipzig)* 7(3): 310 (1938)

*Plectosphaerina* Kirschst., *Annls mycol.* 36(5/6): 368 (1938)

*On leaves and stalks of dicotyledons. Sexual state:* *Ascostromata* forming shiny black erumpent bands on both leaf surfaces between the cuticle and epidermis, gregarious, superficial to immersed, crustose, multiloculate, locules globose to subglobose, without a distinct ostiole. *Peridium* consists of two layers of cells; inner layer vertically arranged dark-brown cells of *textura angularis*, outer layer; consist with cells of *textura epidermoidea*. *Hamathecium* lacking pseudoparaphyses. *Asci* eight-spored, bitunicate, broadly

cylindrical to subglobose or ovoid, rounded at the apex, sessile or very short pedicellate. *Ascospores* overlapping, uniseriate to biseriata, hyaline, 1-septate, septate near the base, not constricted at the septum, ovoid to oblong with broadly rounded ends, tapered to a pointed base, smooth-walled (Theissen and Sydow 1915; Barr 1972). **Asexual state:** *Podoplaconema* (Wijayawardene et al. 2012).

**Notes:** *Omphalospora* was introduced by Theissen and Sydow (1915) to accommodate *Omphalospora ambiens* (Lib.) Theiss. & Syd. and *O. stellariae* (Lib.) Theiss. & Syd. which have been referred to *Dothidea*. It is a very poorly studied genus. Höhnelt (1919) introduced three new species *O. himantia* (Pers.) Höhn., *O. melaena* (Fr.) Höhn. and *O. silenes* (Niessl) Höhn. which were classified in *Sphaeria* and *Asteroma*, but later *O. himantia* (Pers.) Höhn. and *O. silenes* (Niessl) Höhn. has been excluded from *Omphalospora*. *Omphalospora stellerae* Murashk., *O. tragacanthae* (Lév.) Petr. and *O. acanthaceifolii* Bat. et al. have been introduced recently. No molecular data are available for this genus in GenBank. *Omphalospora* is considered as a genus of *Dothideaceae* (Von Arx and Müller 1975; Barr 1987a; Hawksworth et al. 1995; Lumbsch and Huhndorf 2010), but we believe *Omphalospora* belongs to

neither *Dothideaceae* nor *Dothideales* and tentatively we refer this genus in to *Dothideomycetes*, genera *incertae sedis*. *Podoplaconema* is considered as the asexual state of *Omphalospora* (Wijayawardene et al. 2012). More molecular and morphology studies are needed to resolve these affinities.

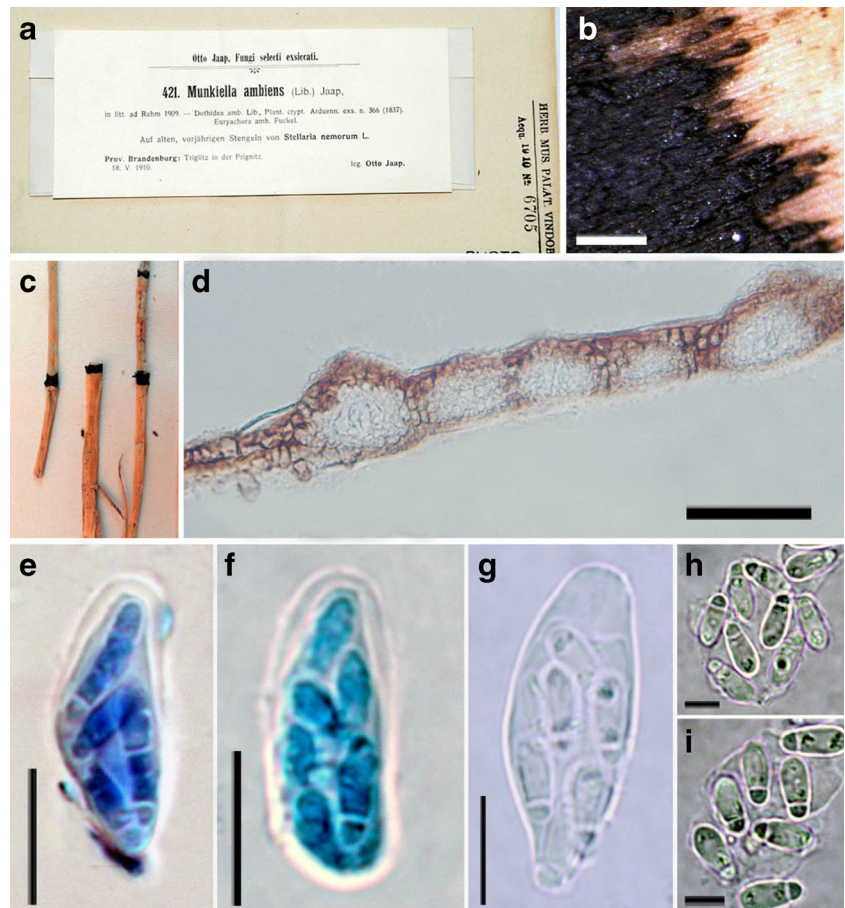
**Type species:** *Omphalospora stellariae* (Lib.) Theiss. & Syd., *Annls mycol.* 13(3/4): 361 (1915), (Fig. 24), *Facesoffungi* number: FoF00133

≡ *Dothidea stellariae* Lib., *Pl. crypt. Arduenna*, fasc. (Liège) 2(nos 101–200): no. 172 (1832).

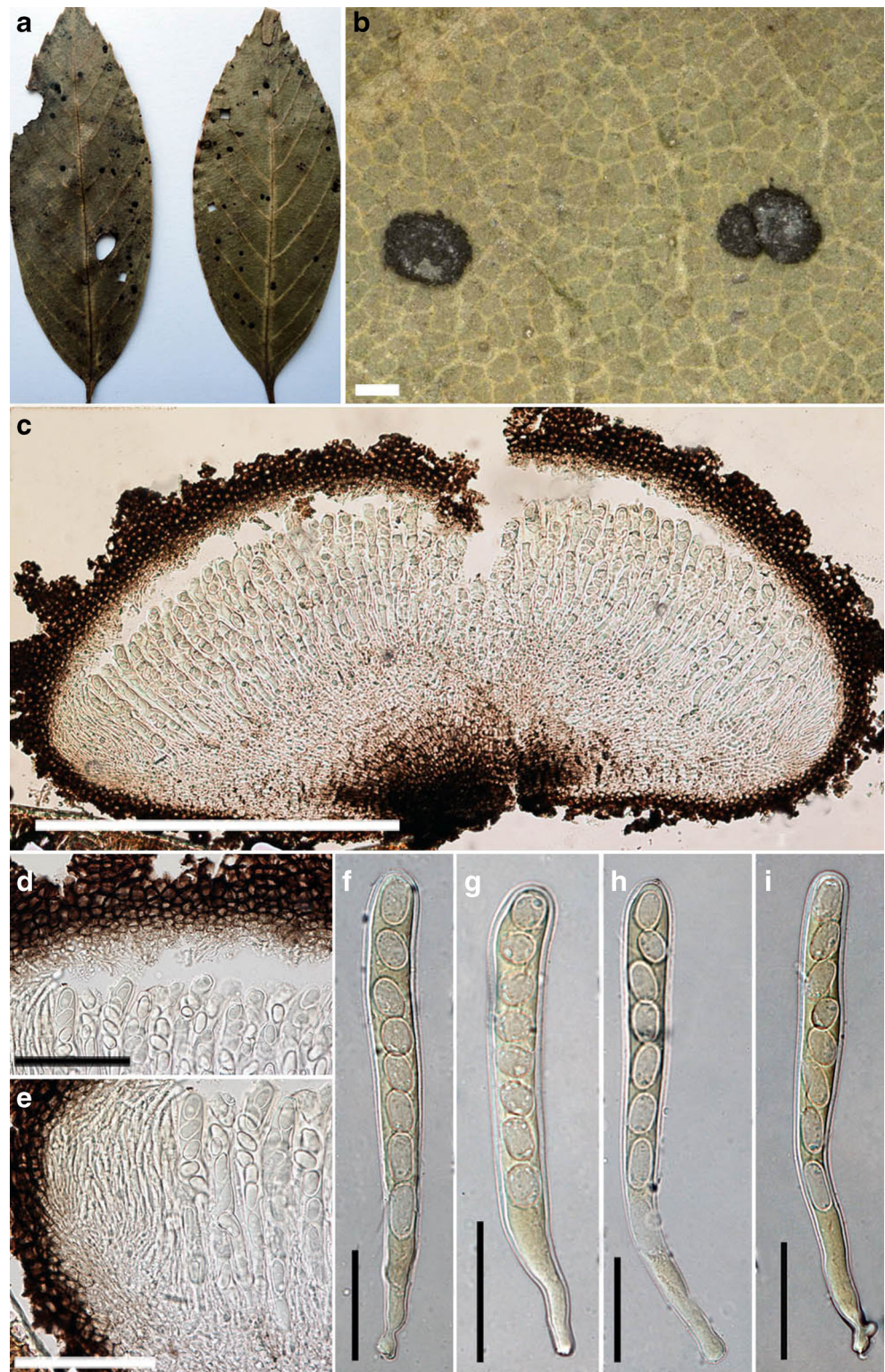
For other synonyms see Index Fungorum

**On leaves and stems of *Stellaria nemorum*** in terrestrial habitats. **Sexual state:** *Ascstromata* forming black areas on the host, superficial, gregarious, scattered, elongate, multiloculate, with 5–6 locules, cells of ascstromata composed of few layers of brown cells of *textura angularis*. *Locules* globose to subglobose, non-ostiolate. *Peridium* of locules one-layered, composed of brown to lightly pigmented cells of *textura angularis*. *Hamathecium* lacking pseudoparaphyses. *Asci* 18–25×7–12 μm ( $\bar{x}$  = 21 × 10 μm,  $n$  = 15), eight-spored, bitunicate, broadly cylindrical to clavate, sessile, apex narrowly rounded. *Ascospores* 6–9×4–5.6 μm ( $\bar{x}$  = 8 × 5 μm,  $n$  = 15), overlapping, uniseriate to

**Fig. 24** *Omphalospora stellariae* (W 421). **a** Herbarium material. **b, c** Ascstromata on the host surface. **d** Section through ascostroma. **e, f** Asci in lactophenol cotton blue reagent. **g** Ascus in water. **h, i** Ascospores. Scale bars: **b** = 100 μm, **d** = 50 μm, **e–g** = 10 μm, **h–i** = 5 μm



**Fig. 25** *Yoshinagaia quercus* (IMI 348745, holotype). **a, b** Appearance of ascostromata on the host surface. **c** Vertical section through ascostroma. **d, e** Close up of the peridium. **f–i** Asci. Scale bars: **c**=500  $\mu$ m. **d, e**=100  $\mu$ m. **f–i**=50  $\mu$ m



triseriate, hyaline, 1-septate, apiosporous, slightly constricted at the septum, ovoid to oblong with broadly rounded ends, smooth-walled. **Asexual state:** Unknown.

**Material examined:** GERMANY, Brandenburg Province, on *Stellaria nemorum* L. (*Caryophyllaceae*), 18 May 1910, identified by Otto Jaap. (W421).

*Yoshinagaia* Henn., Hedwigia 43: 143 (1904), *Facesoffungi* number: FoF00136

**Type species:** *Yoshinagaia quercus* Henn., Hedwigia 43: 143 (1904), (Fig. 25), *Facesoffungi* number: FoF00137

≡ *Japonia quercus* Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 118: 880 [69 repr.] (1909)



*Parasitic* on living leaves of *Cyclobalanopsis morii*. **Sexual state:** *Ascostromata* scattered, erumpent on both sides of the leaf surface, with irregular pore at the surface, globose, black. *Peridium* uniloculate, with a foot-like hypostroma at the base connected to the host surface, surrounded by the brown to black pseudoparenchymatous cells. *Hamathecium* lacking pseudoparaphyses. *Asci* 190–220 × 19–27 μm ( $\bar{x}$  = 210 × 23 μm,  $n$  = 10), eight-spored, bitunicate, fissitunicate, cylindrical, rounded at the apex, with a pedicel up to 30 μm. *Ascospores* 19–25 × 11–15 μm ( $\bar{x}$  = 22 × 13 μm,  $n$  = 10), uniseriate, sometimes overlapping, hyaline, aseptate oval to oblong, with broadly rounded ends. **Asexual state:** *Japonia quercus*, develops in the same stromatic locule; *conidiogenous cells* are holoblastic; hyaline, *conidia* are 2-septate, long fusoid to navicular, and bear an apical branched appendage (asexual morph description follows Barr 2001).

*Notes:* *Yoshinagaia* was established by Hennings (1904) as a monotypic genus and has remained monotypic until now. Eriksson and Hawksworth (1993) placed *Yoshinagaia* in *Seuratiaceae* based on its ascostromatic character. Sivanesan and Hsieh (1995) re-appraised the systematic status of *Yoshinagaia*, discussed the similarity in the morphology between *Bagnisiella* and *Yoshinagaia* and placed this genus under the family *Dothioraceae* based on ascomatic, hamathecial, ascus and ascospore characters. Lumbsch and Huhndorf (2010) in outline of Ascomycota, also included *Yoshinagaia* in the family *Dothioraceae*, but in this study we exclude this genus from *Dothideales* to *Dothideomycetes* genera *incertae sedis* as it is not typical of any existing family of *Dothideomycetes*.

*Material examined:* TAIWAN, on the leaves of *Cyclobalanopsis morii* (Hayata) Schottky (*Fagaceae*), 29 May 1991, W.H. Hsieh (IMI 348745, **holotype**).

Sordariomycetes

***Hyponectriaceae*** Petr., *Annl. mycol.* 21(3/4): 305 (1923)

*Hyponectriaceae* was introduced by Petrak (1923b) which is typified by *Hyponectria buxi* and accommodates the genera *Hyponectria* and *Anisostomula*. Barr (1994) placed *Hyponectriaceae* in *Xylariales*, Wang and Hyde (1999) refer eleven genera to the *Hyponectriaceae*, while Lumbsch and Huhndorf (2010) treated *Hyponectriaceae* in *Xylariales* with 16 genera. The family *Hyponectriaceae* is characterized by immersed, erumpent or nearly superficial ascomata, septate paraphyses, unitunicate, eight-spored asci and one-celled or one to several septate ascospores, surrounded by mucilaginous sheath (Barr 1990; Wang and Hyde 1999).

***Discosphaerina*** Höhn., *Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1* 126(4–5): 353 (1917), (Fig. 26), *Facesoffungi number:* FoF00138

*Saprobic* on leaves and twigs in terrestrial habitats. **Sexual state:** *Ascomata* black, depressed, globose to tympaniform, scattered to aggregated, immersed to superficial, visible as minute black dots on host tissue, uniloculate, ostiolate at maturity usually by dehiscence of the thin wall at the apex. *Peridium* 2-layered: outer layer comprising several layers, dark brown to black cells of *textura angularis*, inner layer of fattened cells, 2–3 layers of hyaline to light brown cells of *textura angularis*. *Paraphyses* not observed. *Asci* eight-spored, ?unitunicate, oblong to ovoid, sessile to sub-sessile, apically rounded with an ocular chamber. *Ascospores* overlapping biseriate to triseriate, hyaline, elliptic, obovate, oblong to fusoid, aseptate, smooth-walled. **Asexual state:** Unknown.

*Notes:* *Discosphaerina* was introduced by Höhnel (1917) and typified by *D. discophora* Höhn. The placement of this genus is still confused as the unitunicate nature of *D. discophora* is unclear and some members of this genus have bitunicate asci. Barr (1972) treated *Discosphaerina* in *Dothideaceae*, *Dothideales* and accepted five species in this genus. Sivanesan (1984) also placed this genus in *Dothideaceae* with nine species. Lumbsch and Huhndorf (2010) placed *Discosphaerina* in *Hyponectriaceae*. The phylogenetic placement of *Discosphaerina* (= *Columnosphaeria*) *fagi* was confirmed in *Dothideaceae*, *Dothideales* (Schoch et al. 2006; 2009; Zalar et al. 2008) and some *Discosphaerina* species produce *Aureobasidium*, *Kabatia*, *Sarcophoma* and *Selenophoma* asexual morphs in culture (Sivanesan 1984; Barr 1972). We examined the type of *Discosphaerina* and *D. fagi* in order to obtain a better morphological understanding of this problem. We believe that *D. discophora* should not be placed in *Dothideales* because of the apparently unitunicate nature of its asci (Fig. 26 f, h). Our phylogenetic analysis shows a close relationship between *Discosphaerina* (*Columnosphaeria*) *fagi* and the *Aureobasidium pullulans* group which cluster in the same clade in the family *Aureobasidiaceae*. *Discosphaerina fagi* has been classified under *Columnosphaeria* (Barr 2001) and we discuss this further in *Columnosphaeria* section. Fresh collections of *D. discophora* are needed to establish a natural classification.

*Type species:* ***Discosphaerina discophora*** Höhn., *Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1* 126(4–5): 353 (1917), *Facesoffungi number:* FoF00139

≡ *Guignardia discophora* (Höhn.) Petr., *Annl. mycol.* 19(1/2): 111 (1921)

*Saprobic* on leaves and twigs in terrestrial habitats. **Sexual state:** *Ascomata* 68–122 μm high 90–130 μm wide, black, depressed, globose to tympaniform, scattered to aggregated, immersed to superficial, visible as minute black dots on host tissue, uniloculate, ostiolate at maturity usually by dehiscence of the thin wall at the apex. *Peridium* 15–30 μm thick, 2-layered: outer layer thick, comprising several layers of dark brown to black cells of *textura angularis*, inner layer thin, of fattened cells, 2–3 layers of hyaline to light brown cells



**Fig. 26** *Discosphaerina discophora* (S-F10728, holotype). **a** Herbarium material. **b, c** Ascomata on host surface. **d** Section through ascoma. **e** Peridium. **f–h** Apparently unitunicate asci. **i** Ascospores. Scale bars: **d**=50  $\mu$ m, **e–g**=25  $\mu$ m, **h**=15  $\mu$ m, **i**=10  $\mu$ m

of *textura angularis*. Paraphyses not observed. Asci 28–45  $\times$  6–8.5  $\mu$ m ( $\bar{x}$  = 37  $\times$  7.5  $\mu$ m,  $n$  = 15), eight-spored, ?unitunicate, oblong to ovoid, sessile to sub-sessile, apically rounded with an ocular chamber. Ascospores 8–12  $\times$  2.4–3.8  $\mu$ m ( $\bar{x}$  = 9.5  $\times$  3  $\mu$ m,  $n$  = 15), overlapping biseriate to

triseriate, hyaline, elliptic, obovate, oblong to fusoid, aseptate, smooth-walled. **Asexual state:** Unknown.

**Material examined:** CZECH REPUBLIC, Theusing in Böhmen, Bernklau, on *Solidago virgaurea* L. (Asteraceae), June 1917, R. Steppan (S-F10728, holotype).

## Discussion

In this paper we re-examined the types or representative specimens of dothidealean genera including the genera which were previously referred to *Dothideales* by various authors. Based on the molecular phylogeny and modern taxonomic concepts, we accept two families in *Dothideales* including the *Dothideaceae* and new family *Aureobasidiaceae*. *Dothioraceae* is not recognized as a distinct family and is synonymized under *Dothideaceae*. However, several genera *Columnosphaeria*, *Dictyodothis*, *Dothiora*, *Endodothiora*, *Kabatina*, *Pringsheimia*, *Selenophoma* and *Sydowia* which do not have ex-type sequences need to be re-collected and sequenced in order to confirm their familial placements. We exclude several genera from *Dothideales* to appropriate families or Dothideomycetes, genera *incertae sedis* or Sordariomycetes genera *incertae sedis* based on morphology and modern taxonomic concepts.

In this study, we re-collected and described *P. ribesia* and it forms a separate subclade in *Dothideaceae* while, other *Plowrightia* species (*P. abietis* and *P. periclymeni*) grouped in another separate clade along with *Delphinella strobiligena*, *Sydowia polyspora*, *Phaeocryptopus nudus* and *Rhizosphaera* species. This clade may represent a new genus, but needs more sequenced strains especially *Hormonema* and *Kabatina* in order to resolve their phylogenetic placement in *Dothideaceae*.

*Dothideaceae* is characterized by immersed to erumpent or superficial, uni or multiloculate ascostromata, 8- or polyspored, bitunicate asci and hyaline or brown, transversely septate, sometimes muriform ascospores while *Aureobasidiaceae* consists of immersed to erumpent, uniloculate ascostromata, eight-spored, bitunicate asci with a short bifurcate pedicel or apedicellate and hyaline, 3 to many septate or aseptate, muriform to phragmosporous, obovoid or elliptic ascospores with broad to narrow rounded ends. The asexual morphs of *Dothideales* are coelomycetous or hyphomycetous with a wide host range. The asexual genera which we accept in *Dothideaceae* include only coelomycetous species (*Coleophoma*, *Cylindroseptoria*, *Endoconidioma*, *Kabatina*, *Neocylindroseptoria*) while *Aureobasidiaceae* consist with both coelomycetous and hyphomycetous species (*Aureobasidium*, *Kabatiella*, *Pseudoseptoria* and *Selenophoma*). However, there are hyphomycetous species that have been reported as the asexual morphs of *Dothideaceae*. *Rhizosphaera* species are known as the asexual states of *Phaeocryptopus* (Orton 1915), while the type of *Hormonema*, *H. dematioides* Lundberg and Melin has been suggested as the asexual state of *Sydowia polyspora* (Butin 1970; Cheewangkoon et al. 2009). We do not refer *Hormonema* and *Rhizosphaera* as separate genus in *Dothideaceae* and further morphology and phylogeny studies are needed. Wijayawardene et al. (2012) and Hyde

et al. (2013) listed *Podoplaconema* under *Dothideaceae* as an asexual genus. In this study, we transfer *Omphalospora* to Dothideomycetes, genera *incertae sedis*. Therefore, the placement of *Podoplaconema* which is known as the asexual state of *Podoplaconema* still confused, as no molecular data are available in GenBank.

*Aureobasidiaceae* has 65/80 % bootstrap support in the phylogenetic tree (Fig. 1) we propose as a new family based on both morphology and phylogeny. Previous phylogenetic studies (Lumbsch and Lindemuth 2001; Schoch et al. 2006, 2009; Boonmee et al. 2012; Hyde et al. 2013) also showed that the separation of *A. pullulans* and other associated species which we accommodate in *Aureobasidiaceae* with high bootstrap support in *Dothideales*. In this study we used only ITS, SSU and LSU in our phylogenetic analysis due to the unavailability of other genes in GenBank. We suggest to include protein-coding genes (EF, RBP2 or BTUB) in future phylogenetic analysis of this order as it is evident that *Aureobasidium* species form a species complex (Zalar et al. 2008).

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