Fungal Diversity (2014) 68:159–238
DOI 10.1007/s13225-014-0308-3

Revision of *Phaeosphaeriaceae*

Rungtiwa Phookamsak · Jian-Kui Liu · Eric H. C. McKenzie · Dimuthu S. Manamgoda · Hiran Ariyawansa · Kasun M. Thambugala · Dong-Qin Dai · Erio Camporesi · Ekachai Chukeatirote · Nalin N. Wijayawardene · Ali H. Bahkali · Peter E. Mortimer · Jian-Chu Xu · Kevin D. Hyde

Received: 19 August 2014 / Accepted: 11 September 2014 / Published online: 7 October 2014

Abstract *Phaeosphaeriaceae* is a large and important family in the order *Pleosporales* which includes economically important plant pathogens. Species may also be endophytes or saprobes on plant hosts, especially on monocotyledons (e.g., *Cannaceae*, *Cyperaceae*, *Juncaceae*, *Poaceae*); some species have also been reported on dicotyledons. The family previously accommodated 35 sexual and asexual genera and comprised more than 300 species with a range of morphological characters. The morphological characters of taxa in this family are often ambiguous and can be confused with other taxa in *Leptosphaeriaceae* and *Montagnulaceae*. Fourteen specimens of the type genera of *Phaeosphaeriaceae* were loaned from herbaria worldwide and were re-examined and illustrated. Fresh collections were obtained from Italy and Thailand, characterized, examined, isolated into pure culture and used to obtain molecular data. The asexual state was induced where possible on sterile bamboo pieces placed on water agar. Multigene phylogenetic analyses of ITS, LSU, SSU, *RPB2* and *TEF1* sequence datasets were carried out using maximum likelihood, maximum parsimony and Bayesian analysis. Molecular analyses shows that 21 genera (*Amarenomyces*, *Ampelomyces*, *Chaetosphaeronema*, *Dematiopleospora*, *Entodesmium*, *Loratospora*, *Neosetophoma*, *Neostagonospora*, *Nodulosphaeria*, *Ophiobolus*, *Ophiosphaerella*, *Paraphoma*, *Parastagonospora*, *Phaeosphaeria*, *Phaeosphaeriopsis*, *Sclerostagonospora*, *Setomelanomma*, *Setophoma*, *Vrystaatia*, *Wojnowicia* and *Xenoseptoria*) belong in *Phaeosphaeriaceae*, while seven

---

Electronic supplementary material The online version of this article (doi:10.1007/s13225-014-0308-3) contains supplementary material, which is available to authorized users.

R. Phookamsak · D.-Q. Dai · P. E. Mortimer · J.-C. Xu ·
K. D. Hyde (✉)
Key Laboratory for Plant Diversity and Biogeography of East Asia,
Kunming Institute of Botany, Chinese Academy of Sciences,
Kunming 650201, Yunnan, People's Republic of China
e-mail: kdhyde3@gmail.com

R. Phookamsak · D.-Q. Dai · P. E. Mortimer · J.-C. Xu · K. D. Hyde
World Agroforestry Centre, East and Central Asia,
Kunming 650201, Yunnan, People's Republic of China

R. Phookamsak · J.-K. Liu · D. S. Manamgoda · H. Ariyawansa ·
K. M. Thambugala · D.-Q. Dai · E. Chukeatirote ·
N. N. Wijayawardene · K. D. Hyde
School of Science, Mae Fah Luang University, Chiang Rai 57100,
Thailand

R. Phookamsak · J.-K. Liu · D. S. Manamgoda · H. Ariyawansa ·
K. M. Thambugala · D.-Q. Dai · E. Chukeatirote ·
N. N. Wijayawardene · K. D. Hyde
Institute of Excellence in Fungal Research, Mae Fah Luang
University, Chiang Rai 57100, Thailand

A. H. Bahkali · K. D. Hyde
College of Science, Botany and Microbiology Department, King
Saud University, Riyadh 1145, Saudi Arabia

E. Camporesi
A.M.B. Gruppo Micologico Forlivese "Antonio Cicognani", Via
Roma 18, Forlì, Italy

E. Camporesi
A.M.B. Circolo Micologico "Giovanni Carini", C.P. 314, Brescia,
Italy

E. Camporesi
Società per gli Studi Naturalistici della Romagna, C.P. 144,
Bagnacavallo, RA, Italy

E. H. C. McKenzie
Manaaki Whenua Landcare Research, Private Bag 92170, Auckland,
New Zealand

genera (*Amarenographium*, *Bricookea*, *Dothideopsella*, *Eudarluca*, *Phaeostagonospora*, *Scolecosporiella* and *Tiarospora*) are included based on morphological data. *Amarenomyces* is reinstated and *Nodulosphaeria* is confirmed in *Phaeosphaeriaceae. Eudarluca* is distinguished from *Sphaerellopsis* based on its morphological characters and is typical of *Phaeosphaeriaceae*. ITS gene phylogenetic analysis indicates that *Sphaerellopsis* belongs to *Leptosphaeriaceae. Ophiobolus* species form a clade within *Phaeosphaeriaceae* while *Ophiosphaerella* is shown to be polyphyletic. *Phaeosphaeria sensu stricto* is redefined. Two new species of *Phaeosphaeria* and one of *Phaeosphaeriopsis* are introduced while the asexual states of *Phaeosphaeria chiangraina* and *Phaeosphaeriopsis dracaenicola* are reported. *Scolicosporium minkeviciusii* forms a sister clade with *Neostagonospora* and *Parastagonospora* in *Phaeosphaeriaceae*. However, *Scolicosporium minkeviciusii* is not the type species. Thus, the placement of *Scolicosporium sensu stricto* in *Phaeosphaeriaceae* is questionable. Phylogenetic analysis of combined ITS and LSU genes, confirm the placement of *Septoriella oudemansii* in *Phaeosphaeriaceae*. However, it is not represented by the generic type, thus the placement of *Septoriella* is questionable. *Setophaeosphaeria* is excluded from *Phaeosphariaceae* as the type species, *Sp. hemerocallidis* forms a clade at the base of *Cucurbitariaceae. Wilmia* clusters in *Didymosphaeriaceae* and is synonymized under *Letendraea. Barria*, *Chaetoplea*, *Hadrospora*, *Lautitia*, *Metameris*, *Mixtura* and *Pleoseptum* are excluded from *Phaeosphaeriaceae* based on their morphological characters. The asexual genera *Mycopappus* and *Xenostigmina* are excluded from this family based on the phylogenetic evidence; these genera form a clade close to *Melanommataceae*.

Keywords Asexual state · *Didymosphaeriaceae* · *Montagnulaceae* · *Phaeosphaeria* · Phylogeny · *Pleosporales* · Taxonomy

Introduction

Phaeosphaeriaceae is a large and important family in *Pleosporales* and was previously reported to include more than 300 species in 35 genera (18 sexual and 17 asexual genera; Kirk et al. 2008; Zhang et al. 2009; Hyde et al. 2013; Wijayawardene et al. 2014b). Species of *Phaeosphaeriaceae*, especially the asexual taxa, are important plant pathogens, infecting major crops (Shoemaker and Babcock 1989b; Carson 2005; Stukenbrock et al. 2006; Zhang et al. 2009; Quaedvlieg et al. 2013; Hyde et al. 2014). For example, *Parastagonospora nodorum* (Berk.) Quaedvlieg et al. causes leaf and glume blotch of cereals crops, especially barley and wheat (Cunfer 2000; Stukenbrock et al. 2006; Vergnes et al. 2006; Quaedvlieg et al. 2013) while *Parastagonospora avenae* causes leaf blotch of barley and rye (f.sp. *tritici*) (Cunfer 2000; Quaedvlieg et al. 2013). Furthermore, many genera have also been reported as pathogens causing leaf spots on various hosts, such as *Neosetophoma*, *Phaeosphaeria*, *Phaeosphaeriopsis*, *Setophoma*, *Wojnowicia* and *Xenoseptoria* (Cason 2005; Arzanlou and Crous 2006; Quaedvlieg et al. 2013; Wijayawardene et al. 2013b; Crous et al. 2014; Phookamsak et al. 2014). Some species are also endophytes (Wang et al. 2005; Sánchez Márquez et al. 2007; Lawrey et al. 2012), *Lautitia danica* (Berl.) S. Schatz is obligate parasite on algae (Schatz 1984; Barr 1987b; Zhang et al. 2012) and many species are saprobic on monocotyledons, especially poaceous hosts, while others may be saprobes on herbaceous dicotyledonous hosts (Shoemaker 1984; Shoemaker and Babcock 1989b; Schoch et al. 2006; Zhang et al. 2009, 2012; De Gruyter et al. 2010; Hyde et al. 2013; Quaedvlieg et al. 2013).

History of *Phaeosphaeriaceae*

Introduction to the family

The family *Phaeosphaeriaceae* was introduced by Barr (1979) and typified by *Phaeosphaeria* with *Ph. oryzae* as the type species. The important family characters were described by Barr (1979) as “saprobic, pathogenic or hyperparasitic fungi typically on herbaceous stems or monocotyledonous leaves, culms, or flowers, but also on woody substrates. Ascomata were described as immersed, erumpent or superficial, globose or conical, short papillate, small to medium, asci as bitunicate, and ascospores as hyaline, yellowish or brown, narrowly or widely obovoid, aseptate or septate” Subsequent authors are in agreement with this description (Barr 1987b, 1992a, b; Zhang et al. 2012; Hyde et al. 2013). When Barr (1979) introduced the family *Phaeosphaeriaceae*, 15 genera were included (Table 1); i.e. *Comoclathris*, *Didymella*, *Eudarluca*, *Heptameria*, *Leptosphaeria*, *Loculohypoxylon*, *Metameris*, *Microthelia*, *Nodulosphaeria*, *Ophiobolus*, *Paraphaeosphaeria*, *Phaeosphaeria*, *Rhopographus*, *Scirrhodothis* and *Teichospora* (Barr 1979; Zhang et al. 2009, 2012).

Arrangement of genera in Phaeosphaeriaceae based on morphology (1979–1999)

Over the next 20 years the family was revised with additions and exclusions of genera and this is detailed below (Table 1). These revisions were based on morphological characters and were subjective with decisions made based on perceived importance of characters. During this period it was very difficult for researchers to develop higher classification

Table 1 Synopsis of *Phaeosphaeriaceae* from 1979 to 2014

Barr (1979)	Barr (1992a)	Eriksson and Hawksworth (1993)	Kirk et al. (2001)	Lumbsch and Huhndorf (2007)	Kirk et al. (2008)
Comoclathris	*Bricookea*	*Bricookea*	*Barria*	*Barria*	*Barria*
Didymella	*Chaetoplea*	*Carinispora*	*Bricookea*	*Bricookea*	*Bricookea*
Eudarluca	*Didymella*	*Eudarluca*	*Carinispora*	*Carinispora*	*Carinispora*
Heptameria	*Graphyllium*	*Hadrospora*	*Eudarluca*	*Chaetoplea*	*Eudarluca*
Leptosphaeria	*Hadrospora*	*Lautitia*	= *Cryptocrea*	*Eudarluca*	*Hadrospora*
Loculohypoxylon	*Kalmusia*	*Metameris*	= *Parabotryon*	*Hadrospora*	*Isthmosporella*
Metameris	*Lautitia*	*Mixtura*	= *Xenodimerium*	*Isthmosporella*	*Katumotoa*
Microthelia	*Metameris*	*Nodulosphaeria*	*Hadrospora*	*Katumotoa*	*Lautitia*
Nodulosphaeria	*Montagnula*	*Ophiosphaerella*	*Isthmosporella*	*Lautitia*	*Metameris*
Ophiobolus	*Nodulosphaeria*	*Paraphaeosphaeria*	*Lautitia*	*Leptosphaeria*	*Mixtura*
Paraphaeosphaeria	*Ophiosphaerella*	*Phaeosphaeria*	*Metameris*	*Metameris*	*Nodulosphaeria*
Phaeosphaeria	*Paraphaeosphaeria*	*Sulcispora*	= *Scirrhodothis*	*Mixtura*	*Ophiosphaerella*
Rhopographus	*Phaeosphaeria*	*Teratosphaeria*	= *Scirrhophragma*	*Neophaeosphaeria*	*Phaeosphaeria*
Scirrhodothis	*Rhopographus*		*Mixtura*	*Nodulosphaeria*	*Phaeosphaeriopsis*
Teichospora			*Nodulosphaeria*	*Ophiobolus*	*Setomelanomma*
			= *Pocosphaeria*	*Ophiosphaerella*	*Sulcospora*
			Ophiosphaerella	*Phaeosphaeria*	*Wilmia*
			Paraphaeosphaeria	*Phaeosphaeriopsis*	
			Phaeodothis	*Pleoseptum*	
			Phaeosphaeria	*Setomelanomma*	
			=*Leptosphaerella*	*Teratosphaeria*	
			=*Trematosphaerella*	*Wilmia*	
			Sulcispora		

Lumbsch and Huhndorf (2010)	Hyde et al. (2011) (Asexual state reported)	Zhang et al. (2012)	Hyde et al. (2013)	Wijayawardene et al. (2014b) and in this study
Barria	*Amarenographium*	*Barria*	*Ampelomyces*	*Amarenographium*
Bricookea	(Sexual=*Amarenomyces*)	*Bricookea*	*Barria*	*Amarenomyces*
Carinispora	*Ampelomyces*	*Chaetoplea*	*Bricookea*	*Ampelomyces*
Chaetoplea	*Chaetosphaeronema*	*Eudarluca*	*Chaetoplea*	*Bricookea*
Entodesmium	*Coniothyrium*	*Entodesmium*	*Chaetosphaeronema*	*Chaetosphaeronema*
Eudarluca	(Sexual=*Ophiobolus*)	*Hadrospora*	*Entodesmium*	*Dematiopleospora*
Hadrospora	*Hendersonia*-like	*Lautitia*	*Eudarluca*	*Dothideopsella*
Isthmosporella	(Sexual=*Austropleospora* and *Phaeosphaeria*)	*Loratospora*	*Hadrospora*	*Entodesmium*
Lautitia	*Neosetophoma*	*Metameris*	*Lautitia*	*Eudarluca*
Metameris	*Parahendersonia*	*Mixtura*	*Loratospora*	*Loratospora*
Mixtura	(Sexual=*Chaetoplea*)	*Nodulosphaeria*	*Metameris*	*Neosetophoma*
Nodulosphaeria	*Paraphoma*	*Ophiobolus*	*Mixtura*	*Neostagonospora*
Ocala	*Phaeoseptoria*	*Ophiosphaerella*	*Neosetophoma*	*Nodulosphaeria*
Ophiobolus	(Sexual=*Phaeosphaeria*)	*Phaeosphaeria*	*Nodulosphaeria*	*Ophiobolus*
Ophiosphaerella	*Phaeostagonospora*	*Phaeosphaeriopsis*	*Ophiobolus*	*Ophiosphaerella*
Phaeosphaeria	(Sexual=*Phaeosphaeriopsis*)	*Pleoseptum*	*Ophiosphaerella*	*Paraphoma*
= *Amarenomyces*	*Phoma*	*Setomelanomma*	*Parahendersonia*	*Parastagonospora*
Phaeosphaeriopsis	(Sexual=*Ophiobolus*)	*Wilmia*	*Paraphoma*	*Phaeosphaeria*
Pleoseptum	*Rhabdospora*		*Phaeoseptoria*	= *Phaeoseptoria*
Setomelanomma	(Sexual=*Ophiobolus*)		*Phaeosphaeria*	*Phaeosphaeriopsis*
Wilmia	*Scolecosporiella*		*Phaeosphaeriopsis*	*Phaeostagonospora*
	(Sexual=*Ophiosphaerella* and *Phaeosphaeria*)		*Pleoseptum*	*Sclerostagonospora*
	Setophoma		*Setomelanomma*	*Scolecosporiella*
	Sphaerellopsis		*Setophoma*	?? *Scolicosporium*
	(Sexual=*Eudarluca*)		*Tiarospora*	??*Septoriella*
	Stagonospora		*Wilmia*	*Setomelanomma*
	(Sexual=*Phaeosphaeria*)		*Wojnowicia*	*Setophoma*
	Tiarospora			*Tiarospora*
				Vrystaatia
				Wojnowicia.
				Xenoseptoria

schemes as it was not possible to confirm the importance of characters (K.D. Hyde, personal experience). Therefore, the researchers did their work to the best of their ability and have often been proven correct.

Barr (1982) included the monotypic genus *Bricookea* in *Phaeosphaeriaceae*, while Schatz (1984) introduced *Lautitia*, a parasite on red algae, and accommodated it in the family. Barr (1987a) transferred *Leptosphaeria* as the type to establish the new family *Leptosphaeriaceae*, because of its large scleroplectenchymatous, thick-walled peridium cells and host preference on dicotyledons (Barr 1987a, b; Khashnobish and Shearer 1996; Câmara et al. 2002). Barr (1987b) also transferred *Ophiobolus* and *Heptameria* to *Leptosphaeriaceae* and followed by Tanaka and Harada (2005). *Eudarluca*, *Loculohypoxylon* and *Teichospora* were placed in *Dacampiaceae*, while some species of *Microthelia* were regarded as synonyms of *Kirschsteiniothelia*, and subsequently placed in *Pleosporaceae* (Hawksworth 1985; Barr 1987b). *Montagnula* was considered as a part of *Pleospora* (Barr 1987b), however, the genus was re-established by Crivelli (1983). Barr (1987b) added *Bricookea*, *Chaetoplea*, *Kalmusia*, *Lautitia* and *Ophiosphaerella* and suggested that *Amarenomyces* and *Entodesmium* could also be accommodated in *Phaeosphaeriaceae*. Boise (1989) introduced *Hadrospora* as a new genus in *Phaeosphaeriaceae* and additionally, *Sulcispora* was established in *Phaeosphaeriaceae* by Shoemaker and Babcock (1989b). More recently, *Mixtura* (Syd.) Eriksson and Yue (1990) was placed, with some uncertainty in *Phaeosphaeriaceae*.

Eriksson and Hawksworth (1991) included *Entodesmium* and *Peridiothelia* in the family but this was disputed by Barr (1992a). It was suggested that *Entodesmium* should be placed in *Lophiostomataceae* because of its abrupt, beak-like apex and the periphysate ostioles which were illustrated by Shoemaker (1984) and *Peridiothelia* could be accommodated in *Pleomassariaceae*. Thus, Barr (1992a) accepted only 14 genera in *Phaeosphaeriaceae*: *Bricookea*, *Chaetoplea*, *Didymella*, *Graphyllium*, *Hadrospora*, *Kalmusia*, *Lautitia*, *Metameris*, *Montagnula*, *Nodulosphaeria*, *Ophiosphaerella*, *Phaeosphaeria*, *Paraphaeosphaeria* and *Rhopographus* (Table 1).

Shoemaker and Babcock (1992) revised the taxonomy of the *Pleosporales* and transferred *Comoclathris* to *Diademaceae* and *Graphyllium* was moved to *Hysteriaceae* based on its hysterothecia with a slit-like opening (Zhang et al. 2011; Ariyawansa et al. 2014a). The marine fungus, *Carinispora* K.D. Hyde (Hyde 1992), a saprobe on the intertidal *Nypa* palm was placed in *Phaeosphaeriaceae*, and it was noted that the genus was closely related to *Phaeosphaeria*, although differed in several important aspects. The genus was tentatively placed in *Phaeosphaeriaceae* due to lack of molecular data (Hyde 1992, 1994; Jones et al. 2009; Lumbsch and Huhndorf 2007, 2010).

Eriksson and Hawksworth (1993) listed 13 genera in *Phaeosphaeriaceae*: *Bricookea*, *Carinispora*, *Eudarluca*, *Hadrospora*, *Lautitia*, *Metameris*, *Mixtura*, *Nodulosphaeria*, *Ophiosphaerella*, *Paraphaeosphaeria*, *Phaeosphaeria*, *Sulcispora* and *Teratosphaeria* (Table 1). *Scirrhodothis* was synonymised under *Metameris*, while *Didymella* was excluded from the family. Sivanesan (1984) proposed placing *Didymella* in *Pleosporaceae*, while Reddy et al. (1998) treated it in *Venturiaceae* (Dianese et al. 2001; Zhang et al. 2012). Yuan (1994) established *Barria* as a monotypic genus from *Picea* within *Phaeosphaeriaceae*. The peridium in this genus is composed of thin-walled pseudoparenchymatous cells and it has narrow cellular pseudoparaphyses. Ramaley and Barr (1995) introduced the monotypic genus *Pleoseptum* from *Yucca baccata* and reported *Camarosporium yuccaesedum* Fairm. as the asexual state of the genus. *Pleoseptum* shares morphological characters with several Dothideomycetes genera (Ramaley and Barr 1995). However there is a lack of molecular phylogenetic evidence to place this genus in *Phaeosphaeriaceae* (Zhang et al. 2012; Hyde et al. 2013).

Wilmia, a monotypic genus, was introduced as a pathogen of *Memora peduncULATA*

Dothideopsella was characterized by broadly pseudoparenchymatous cells, and phragmosporous, brown ascospores. The genus was introduced by von Höhnel (1915) to accommodate non-congeneric species of *Leptosphaeria* (Barr and Rogerson 1999). However, the genus was reinstated under *Leptosphaeria* by von Arx and Müller (1975) and this was followed in Kirk et al. (2001, 2008). Barr and Rogerson (1999) treated *Dothideopsella* in *Botryosphaeriaceae*, while Lumbsch and Huhndorf (2010) placed the genus in Dothideomycetes, genera *incertae sedis*. Recently, *Dothideopsella* was reported as a genus in *Leptosphaeriaceae* which contained four epithet species. However, Ariyawansa et al. (2013) observed the type species and found that the genus was typical in *Phaeosphaeriaceae* rather than *Leptosphaeriaceae*. Thus the genus was transferred to *Phaeosphaeriaceae* and is followed by Wijayawardene et al. (2014b).

Various other genera included in *Phaeosphaeriaceae* by Barr (1979, 1987a, b, 1990a, 1992a), have been transferred to other families based on morphology. *Comoclathris* is currently accommodated in the *Diademaceae* (Shoemaker and Babcock 1992; Zhang et al. 2012; Hyde et al. 2013; Ariyawansa et al. 2014a), *Heptameria* and *Rhopographus* are treated in Dothideomycetes, genera *incertae sedis* (Lumbsch and Huhndorf 2007, 2010; Zhang et al. 2012; Hyde et al. 2013), *Loculohypoxylon* and *Teichospora* in the family *Teichosporaceae* (Barr 2002; Lumbsch and Huhndorf 2007, 2010; Zhang et al. 2012; Hyde et al. 2013; Wijayawardene et al. 2014b).

Initial phylogenetics for resolving Phaeosphaeriaceae

In 1995 the first phylogenetic evidence for placement of genera in *Phaeosphaeriaceae* started to emerge. Morales et al. (1995) attempted to determine the relationships between *Leptosphaeria* and *Phaeosphaeria* species using rRNA gene sequences. The separation of *Leptosphaeria* and *Phaeosphaeria* was not strongly supported and the asexual states were phylogenetically uninformative in their analysis. Phylogenetic analysis indicated that *Phaeosphaeria* was part of *Leptosphaeriaceae* due to the fact that *Ph. nodorum* and *Ph. microscopica* formed a clade close to *L. doliolum*, the type species of *Leptosphaeria* (Morales et al. 1995; Câmara et al. 2002.). Khashnobish and Shearer (1996) found that *Phaeosphaeria* formed a distinct group separate from *Leptosphaeria* based on a cladistic analysis of morphological and sequence data. Câmara et al. (2002) concluded that peridial characters, asexual state and host preferences are taxonomically and phylogenetically significant at the generic level, with *Leptosphaeria sensu stricto* and *Phaeosphaeria* sharing a more recent common ancestor in their analysis.

Kruys et al. (2006) investigated the relationships of families in *Pleosporales* and observed that *Phaeosphaeriaceae* is closely related to *Leptosphaeriaceae* and formed an unresolved monophyletic group. The main features distinguishing the two families are the ascomata wall characters. In *Leptosphaeriaceae* taxa have scleroplectenchymatous ascomata walls and in *Phaeosphaeriaceae* taxa have thin-walled, pseudoparenchymatous ascomata walls (Câmara et al. 2002; Cheng et al. 2004; Schoch et al. 2006). *Shiraia*, an uncertain genus grouped with *Leptosphaeriaceae* and *Phaeosphaeriaceae* in the phylogenetic analysis of Kruys et al. (2006). Cheng et al. (2004) suggested that *Shiraia* should be treated as a member of *Phaeosphaeriaceae*. The genus was unofficially placed in *Shiraiaceae*, by Ogawa et al. (2003) (see GenBank AB105798), but was not validly published (Kruys et al. 2006; Liu et al. 2013). Liu et al. (2013) illustrated and epitypified the type species, *Shiraia bambusicola* from fresh collection in Zhejiang Province, China. Based on their phylogenetic investigation, *Shiraia* formed a distinct clade separate from *Phaeosphaeriaceae*. Therefore, Liu et al. (2013) introduced a new valid family *Shiraiaceae* to accommodate a monotypic genus *Shiraia* in *Pleosporales* and illustrated a coelomycetous asexual state.

Zhang et al. (2009) incorporated multigene phylogenetic analysis and included 15 families in *Pleosporales*. They included four families in the suborder *Pleosporineae viz. Didymellaceae*, *Leptosphaeriaceae*, *Phaeosphaeriaceae* and *Pleosporaceae*. In addition, they introduced two new families, *Amniculicolaceae* and *Lentitheciaceae* to accommodate some freshwater fungi (Zhang et al. 2009, 2012). Zhang et al. (2009) re-accommodated *Ophiobolus* in *Phaeosphaeriaceae* due to its morphological characters and because *Ophiobolus* is often associated with the asexual genus *Chaetosphaeronema* on the host (Petrak 1944). However, this link has not been confirmed (Zhang et al. 2009).

Zhang et al. (2012) re-circumscribed the families *Phaeosphaeriaceae* in *Pleosporales*. These authors treated 18 sexual genera base on morphology in *Phaeosphaeriaceae* and accepted *Entodesmium*, *Ophiosphaerella*, *Phaeosphaeria* and *Setomelanomma* based on phylogenetic analysis (Table 1). The freshwater genera *Isthmosporella* Shearer and Crane (1999) and *Ocala* Raja et al. (2009) were also accommodated in *Phaeosphaeriaceae*. Zhang et al. (2012), however, removed these genera from *Phaeosphaeriaceae* based on morphological characters and phylogenetic analysis; *Ocala* formed a unique clade basal to *Jahnulales* (Shearer et al. 2009) and *Isthmosporella* was treated in *Pleosporales*, genera *incertae sedis*. Hyde et al. (2013) listed 27 sexual and asexual genera in *Phaeosphaeriaceae* and later, Wanasinghe et al. (2014) introduced the monotypic genus, *Dematiopleospora* typified by *D. mariae* in *Phaeosphaeriaceae* based on molecular data. Furthermore, Crous et al. (2014) included *Setophaeosphaeria* Crous & Y. Zhang ter with *Sp. badalingensis* Crous & Y. Zhang ter, *Sp. hemerocallidis* Crous & Y. Zhang ter and *Sp. setosa* (Leuchtm.) Crous in *Phaeosphaeriaceae. Setophaeosphaeria* is morphologically and phylogenetically distinct from *Phaeosphaeria oryzae*, the type species of *Phaeosphaeriaceae*, but is similar to *Ph. setosa*. Thus the genus was established to accommodate phaeosphaeria-like species.

Recent molecular studies place *Kirschsteiniothelia* in a new family *Kirschsteiniotheliaceae* based on molecular data (Boonmee et al. 2012) and *Microthelia* species are treated in synonymy of various genera of Dothideomycetes (Hyde et al. 2013). *Kalmusia*, *Montagnula* and *Paraphaeosphaeria* are accommodated in *Montagnulaceae* (Boonmee et al. 2012; Hyde et al. 2013; Lumbsch and Huhndorf 2010; Zhang et al. 2009, 2012; Ariyawansa et al. 2014b). Several genera in *Phaeosphaeriaceae*, such as *Barria*, *Bricookea*, *Chaetoplea*, *Eudarluca*, *Hadrospora*, *Lautitia*, *Metameris*, *Mixtura*, *Nodulosphaeria*, *Ophiobolus*, *Pleoseptum*, and *Wilmia* lack molecular data.

History of genera

Amarenomyces Eriksson was introduced as a new genus based on its multi-layered endotunica and large, thick-walled and sheathed ascospores (Eriksson 1981). Eriksson (1982) reported *Amarenographium* to be the asexual state of *Amarenomyces. Amarenomyces* was synonymized under *Phaeosphaeria* by Zhang et al. (2009) based on phylogenetic evidence from *Amarenomyces ammophilae* (Lasch) O.E. Erikss. which formed a related clade with other *Phaeosphaeria* species.

Didymella was treated as a member of *Phaeosphaeriaceae* by Barr (1979) when she introduced the new family *Phaeosphaeriaceae*. However, Silva-Hanlin and Hanlin (1999) suggested that *Didymella* belongs in *Pleosporaceae* rather than *Phaeosphaeriaceae* based on phylogenetic relationships, while Lumbsch and Huhndorf (2007) treated *Didymella* in *Pleosporales*, genera *incertae sedis*. Later, De Gruyter et al. (2009) introduced a new family *Didymellaceae* based on a multigene phylogenetic analysis with *Didymella* as the type genus.

Entodesmium was introduced by Reiss (1854) as typified by *E. rude* Riess associated with legumes (Zhang et al. 2009). The genus was previously placed in *Lophiostomataceae* based on its periphysate papilla (Eriksson and Hawksworth 1990; Barr 1992b; Zhang et al. 2009). Liew et al. (2000) sequenced a strain of *E. rude* and their phylogenetic analysis indicated that *Entodesmium* belongs to *Phaeosphariaceae* which has been upheld by subsequent authors (Schoch et al. 2009; Zhang et al. 2009, 2012; Hyde et al. 2013, 2014). However, there is only one putative strain of *Entodesmium rude* (CBS 650.86) available in GenBank (Liew et al. 2000), and this is not apparently linked to any herbarium material.

Eudarluca was introduced by Spegazzini (1908) as a hyperparasite in the uredinia of rust fungi from *Canna* (Zhang et al. 2012). *Sphaerellopsis* was reported to be the asexual state of this genus (Yuan et al. 1998; Nischwitz et al. 2005; Zhang et al. 2012). Many strains of *Eudarluca caricis* (Fr.) O.E. Erikss. are available in GenBank. Nischwitz et al. (2005) investigated host specialization and relationships of *Eudarluca caricis* with *Ampelomyces*. Based on the phylogenetic analysis, their results have shown that *Eudarluca caricis* formed a clade with other pleosporalean taxa and appeared to be host-specific (Nischwitz et al. 2005). The phylogenetic investigation was limited to variation between differentiated isolates and could not resolve the current placement of *Eudarluca* in *Phaeosphaeriaceae* (Bayon et al. 2006; Zhang et al. 2012).

Katumotoa was introduced as a monotypic genus in *Phaeosphaeriaceae* and was tentatively placed in *Phaeosphaeriaceae* (Tanaka and Harada 2005). Later, Tanaka et al. (2009) removed *Katumotoa* from *Phaeosphaeriaceae* and accommodated this genus in the family *Lentitheciaceae* (Zhang et al. 2009), based on morphological and phylogenetic evidence.

Loratospora was introduced by Kohlmeyer and Volkmann-Kohlmeyer (1993) as a monotypic genus. The type species, *Loratospora aestuarii* Kohlm. & Volkm.-Kohlm. is an obligate and facultative marine taxon (Kohlmeyer and Volkmann-Kohlmeyer 1993; Monkai et al. 2013). Suetrong et al. (2009) transferred *Loratospora* to *Phaeosphaeriaceae* based on phylogenetic data, whereas based on morphology it had previously been placed in *Planistromellaceae* (Barr 1996).

Ophiosphaerella was introduced by Spegazzini (1909) with *Op. graminicola* Speg. as the type species. Barr (1987b) placed *Ophiosphaerella* in *Phaeosphaeriaceae*, due to its morphological characters (Shoemaker and Babcock 1989b; Dong et al. 1998). The placement in *Phaeosphaeriaceae* was confirmed by Zhang et al. (2009, 2012) and Hyde et al. (2013) based on molecular phylogeny.

Phaeosphaeriopsis was introduced to accommodate *Paraphaeosphaeria* species that were not congeneric based on morphological characters and phylogenetic investigation and that had a *Phaeostagonospora* asexual state (Câmara et al. 2003; Zhang et al. 2012). The placement of the genus in *Phaeosphaeriaceae* was confirmed by multi-gene analysis (Quaedvlieg et al. 2013; Thambugala et al. 2014).

Setomelanomma was introduced by Morelet (1980) as a pathogen on blue and white spruce (Morelet 1980; Rossman et al. 2002). The genus was considered morphologically similar to *Phaeosphaeriaceae* (Rossman et al. 2002; Zhang et al. 2012). Rossman et al. (2002) confirmed the genus belongs in *Phaeosphaeriaceae* based on a phylogenetic analysis and this was verified with multi-gene analyses (Schoch et al. 2009; Zhang et al. 2009, 2012; De Gruyter et al. 2012; Hyde et al. 2013; Wijayawardene et al. 2014b).

Placement of asexual genera in Phaeosphaeriaceae

Before the era of molecular phylogeny it was difficult to establish if asexual genera belonged in *Phaeosphaeriaceae* unless single ascospore cultures produced the asexual morph or where the asexual morph was associated with the sexual state on the host (Eriksson 1982; Ramaley 1995; Ramaley and Barr 1995; Yuan et al. 1998; Câmara et al. 2003; Nischwitz et al. 2005). Previous to the compilation by Hyde et al. (2011) there were few attempts to incorporate asexual genera in sexually defined families. Perhaps the first report of an asexual state of *Phaeosphaeriaceae* is that of Eriksson (1982) who reported *Amarenographium* to be the asexual state of *Amarenomyces*. Barr (1987b) listed nine coelomycetous genera, *Ascochyta*, *Chaetodiplodia*, *Coniothyrium*, *Microdiplodia*, *Microsphaeropsis*, *Phoma*, *Scolecosporiella*, *Stagonospora* and *Sphaerellopsis* in *Phaeosphaeriaceae* based on their holoblastic or enteroblastic conidiogenesis and aseptate or septate conidia.

Camarosporium yuccaesedum Fairm formed conidiomata on leaves of *Yucca baccata* that were associated with ascomata of *Pleoseptum yuccaesedum*, the type species of *Pleoseptum*, (Ramaley and Barr 1995; Zhang et al. 2012). Based on its structurally similar and close association, Ramaley and Barr (1995) linked *Camarosporium yuccaesedum* as an asexual state of *Pleoseptum*. *Camarosporium* species had been reported as asexual morphs in various genera of *Botryosphaeriales* and *Cucurbitariaceae* with doubtful polyphyletic support (Crous et al. 2006; Kirk et al. 2008; Liu et al. 2012; Zhang et al. 2012; Doilom et al. 2013). However, Wijayawardene et al. (2014a, c, d) recognized *Camarosporium sensu stricto* as a distinct phylogenetic linage in *Pleosporineae*, *Pleosporales* hence introduced *Camarosporiaceae*, (Wijayawardene et al. 2014a, d)

Hyde et al. (2011) and Wijayawardene et al. (2012) also listed *Hendersonia* as an asexual state of *Phaeosphaeriaceae*. However, the genus was synonymized under *Stagonospora* and is currently placed in *Massarinaceae* (Swart and Walker 1988; Quaedvlieg et al. 2013).

Parahendersonia Ramaley (1995) was classified by its ampulliform conidiogenous cells producing thick-walled, brown, (1–)3-septate conidia. This monotypic genus is represented by *P. dasylirionis*. The sexual state was reported as *Chaetoplea dasylirionis* on *Dasylirion* (*Agavaceae*) in *Leptosphaeriaceae* (Ramaley 1995; Calatayud and Etayo 2001). However, Barr (1987b) accommodated *Chaetoplea* in *Phaeosphaeriaceae* and reported a microdiplodia-like asexual state for *Chaetoplea* (Barr 1990b; Zhang et al. 2012). Recently, *Parahendersonia* was treated in *Leptosphaeriaceae* (Index Fungorum 2014).

Rhabdospora was originally established to accommodate septoria-like species associated with stems of *Nerium oleander* L. (Priest 2006; Quaedvlieg et al. 2013). The genus was treated in the taxonomic studies of Sutton (1980) which 11 *Rhabdospora* species currently classified under *Septoria* in *Mycosphaerellaceae* (Quaedvlieg et al. 2013). Hyde et al. (2011) listed *Rhabdospora* as the asexual state of *Phaeosphaeriaceae*, while Zhang et al. (2012) treated the genus as an asexual state of *Ophiobolus*. Wijayawardene et al. (2014b) treated the genus in Dothideomycetes, genera *incertae sedis*. There are 648 epithets listed in Index Fungorum (2014) for *Rhabdospora* and it was accommodated in *Mycosphaerellaceae*. However, *Rhabdospora* is a poorly understood genus and is in need of modern taxonomic and molecular treatment (Quaedvlieg et al. 2013).

The type species of *Scolecosporiella*, *Sc. typhae* (Oudemans) Petr. was reported as the asexual state of *Phaeosphaeria typharum* (Desm.) L. Holm (Nag Raj 1989). The genus has been re-described taxonomic revision by Sutton (1968, 1980) and Nag Raj (1989). Various sexual genera, such as *Ophiobolus*, *Ophiosphaerella*, and *Phaeosphaeria* have been reported as *Scolecosporiella* sexual states (Farr et al. 1989; Nag Raj 1989; Shoemaker and Babcock 1989b; Hyde et al. 2011; Zhang et al. 2012).

Tiarospora was reported as an asexual member of *Phaeosphaeriaceae* by Kirk et al. (2008). However, there are no molecular data to prove that this genus belongs in *Phaeosphaeriaceae. Tiarospora* has four epithets in Index Fungorum (2014) with *T. perforans* (Sacc.) Höhn being listed as a synonym of *Montagnula perforans* (Aptroot 2006).

Molecular data has allowed linkage of asexual genera in Phaeosphaeriaceae

Ascochyta, *Chaetodiplodia*, *Microdiplodia* and *Microsphaeropsis* have been reported as asexual states of *Phaeosphaeriaceae* (Barr 1987b); however, using phylogenetic evidence Crous et al. (2006) treated *Microdiplodia* as the asexual state of *Karstenula* in *Montagnulaceae* (Ariyawansa et al. 2014b). Liu et al. (2012) and Hyde et al. (2013) reported *Microdiplodia* as an asexual state in *Botryosphaeriaceae. Ascochyta* and *Microsphaeropsis* were treated in *Didymellaceae* based on phylogenetic evidence with the sexual morph of these genera described as *Didymella* (De Gruyter et al. 2009; Aveskamp et al. 2010). *Ascochyta* was shown to be polyphyletic in *Pleosporales* by subsequent researchers (De Gruyter et al. 2009, 2012; Aveskamp et al. 2010). Furthermore, allied *Ascochyta* species were determined to belong in *Pleosporaceae* by De Gruyter et al. (2012). A *Chaetodiplodia* strain formed a clade within *Leptosphaeriaceae*; however, the genus is polyphyletic in *Pleosporaceae* (De Gruyter et al. 2009, 2012).

Based on phylogenetic evidence, Câmara et al. (2003) introduced the new genus *Phaeosphaeriopsis* in *Phaeosphaeriaceae* and transferred *Paraphaeosphaeria nolinae* A.W. Ramaley to *Phaeosphaeriopsis*. *Phaeostagonospora* was reported as the asexual state based on its morphology (Ramaley 1997). Sexual and asexual morph connections were studied by Quaedvlieg et al. (2013) and Thambugala et al. (2014).

De Gruyter et al. (2009) included *Wojnowicia hirta* (J. Schröt.) Sacc., the type species in their phylogenetic analysis and concluded that *Wojnowicia hirta* has an asexual state in *Phaeosphaeriaceae* and this phylogenetic placement was supported by Wijayawardene et al. (2013b, 2014b).

Zhang et al. (2009) listed *Ampelomyces*, *Chaetosphaeronema*, *Coniothyrium*, *Phoma*, *Plenodomus*, *Stagonospora* and *Wojnowicia* (asexual genera) in *Phaeosphaeriaceae*. Based on phylogenetic evidence, *Chaetosphaeronema* was placed in *Phaeosphaeriaceae* and often formed a sister clade with the sexual genus *Entodesmium* (Zhang et al. 2009, 2012; Hyde et al. 2013; Wijayawardene et al. 2014b). *Phoma radicina* (McAlpine) Boerema, the type species of *Phoma* section *Paraphoma* formed a sister clade with the sexual genus *Setomelanomma holmii* M. Morelet as basal *Phaeosphaeriaceae* (Zhang et al. 2009, 2012; Hyde et al. 2013; Wijayawardene et al. 2014b).

De Gruyter et al. (2010) introduced two new genera, *Neosetophoma* and *Setophoma* in *Phaeosphaeriaceae* and also re-introduced *Paraphoma* in *Phaeosphaeriaceae* based on phylogenetic evidence. Four *Phoma* species from Aveskamp et al. (2010) which clustered in *Phaeosphaeriaceae* were accommodated in these genera (De Gruyter et al. 2010). Hyde et al. (2011) reported 17 asexual genera in *Phaeosphaeriaceae* (Table 1). Later, Wijayawardene et al. (2012) updated the checklist of asexual states of *Phaeosphaeriaceae* and included the hyphomyceteous genera *Harpophora* and *Mauginiella*. In their compilation of families in *Pleosporales*, Zhang et al. (2012) accepted 17 asexual genera in *Phaeosphaeriaceae*. They excluded the hyphomycetous genera, based on a broad familial concept and phylogenetic support.

Hyde et al. (2013) excluded *Amarenographium* which formed a clade outside *Phaeosphaeriaceae* and this is supported by Hodhod et al. (2012). Wijayawardene et al. (2013a) accommodated *Scolicosporium minkeviciusii* Treigienė in *Phaeosphaeriaceae* as this species formed a clade with other well-established asexual genera. Furthermore, Crous et al. (2013) revealed that *Xenostigmina* and *Mycopappus* grouped in *Phaeosphaeriaceae* in their phylogenetic analysis.

Quaedvlieg et al. (2013) re-circumscribed the pathogenic fungi genera *Septoria*, and *Stagonospora* and related genera such as *Phaeosphaeria* and *Phaeoseptoria*. Based on their phylogenetic study, they introduced 14 new genera, 36 new species, and 19 new combinations. The new genera *Neostagonospora*, *Parastagonospora*, *Xenoseptoria* and *Vrystaatia* were placed in *Phaeosphaeriaceae*. Furthermore, they epitypified *Phaeosphaeria oryzae* I. Miyake and *Phaeoseptoria papayae* Speg. and confirmed sexual asexual connections. *Phaeoseptoria* was confirmed as the asexual morph of *Phaeosphaeria* based on the sequenced strain of *P. papayae* which formed a well-supported clade with *Ph. oryzae*.

Crous et al. (2014) included *Septoriella oudemansii* Oudem. in *Phaeosphaeriaceae. Septoriella* was compared with species of *Phaeosphaeriaceae* and a megablast search of NCBI showed that *Septoriella* is similar to *Phaeosphaeria caricis*, *Ph. ammophilae* and *Ophiosphaerella herpotricha* with high percentage similarities (Crous et al. 2014).

In a new outline of the Dothideomycetes, Wijayawardene et al. (2014b) proposed synonymies and suggested names for 34 genera while incorporating asexual genera into a natural classification. This publication resulted from the new ruling in article 59.1 of International Code of Nomenclature for Algae, Fungi, and Plants (ICN; Melbourne Code) that a species or genus can only have one name. They listed 29 genera (17 only known as asexual genera) in *Phaeosphaeriaceae*.

According to phylogenetic evidence, *Ampelomyces* species grouped in *Didymellaceae* and *Phaeosphaeriaceae* (De Gruyter et al. 2009; Aveskamp et al. 2010; Hyde et al. 2013; Wijayawardene et al. 2013a, 2014b). The type species of *Ampelomyces*, *A. quisqualis* Ces. formed a clade within *Phaeosphaeriaceae* (De Gruyter et al. 2009; Aveskamp et al. 2010; Wijayawardene et al. 2013a), while *A. quercinus* (Syd.) Rudakov grouped in *Didymellaceae* (De Gruyter et al. 2009). Therefore, Aveskamp et al. (2010) transferred all *Ampelomyces* species belonging in *Didymellaceae*, to *Phoma* based on phylogenetic relationships.

Coniothyrium Corda (1840) is characterized by pycnidial conidiomata, reduced conidiophores, annellidic conidiogenous cells, with brown, aseptate or septate, verrucose conidia (De Gruyter et al. 2012). Based on the phylogenetic analyses, *Coniothyrium* was revealed as polyphyletic in *Pleosporales* (Verkley et al. 2004, 2014). The type species of *Coniothyrium*, *C. palmarum* Corda clustered in *Leptosphaeriaceae* (De Gruyter et al. 2009). In De Gruyter et al. (2012), *C. palmarum* formed a distinct clade with other *Phoma* species in the reinstated *Coniothyriaceae* based on phylogenetic analysis. De Gruyter et al. (2012) indicated that *Coniothyrium* had convergent evolution with similar characters found in other families in *Pleosporales* such as *Cucurbitariaceae*, *Didymellaceae*, *Phaeosphaeriaceae*, *Leptosphaeriaceae*, *Montagnulaceae* and *Sporormiaceae*. However, *Coniothyrium concentricum* (Desm.) Sacc. is related to *Phaeosphaeriaceae*. A new genus should be designated to accommodate this coniothyrium-like species (Hyde et al. 2013).

Harpophora was introduced by Gams (2000) to accommodate phialophora-like species characterized by fast-growing, thin colonies and sickle-shaped phialoconidia (Gams 2000; Saleh and Leslie 2004). The genus contains the asexual state of *Gaeumannomyces* and *Magnaporthe* in *Magnaporthaceae* (Gams 2000; Saleh and Leslie 2004; Kirk et al. 2008; Yuan et al. 2010).

Based on a homologous test using ITS sequence data, Abdullah et al. (2005) indicated that *Mauginiella scaettae* Cavara was closely related to species of *Phaeosphaeria* which formed a clade with *Phaeosphaeria* associated with non-grass hosts. It was concluded that *Mauginiella* may represent the asexual state of *Phaeosphaeria* following the suggestion of Câmara et al. (2002). Câmara et al. (2002) mentioned that the morphological characters, asexual state and host preferences are important to clarify *Phaeosphaeria* species. It has been suggested that a great deal of convergent evolution had occurred in species of *Leptosphaeria* and *Phaeosphaeria* (Câmara et al. 2002; Abdullah et al. 2005).

Phoma species have been described as the asexual state of various genera of Dothideomycetes i.e. *Didymella*, *Mycosphaerella*, *Leptosphaeria* and *Pleospora* (Boerema 1997; De Gruyter et al. 2009). De Gruyter et al. (2009) carried out a re-classification of the *Phoma* complex based on molecular phylogeny. Their results showed that *Phoma* was polyphyletic and was subsequently classified in nine sections: *Phoma*, *Heterospora*, *Paraphoma*, *Peyronellaea*, *Phyllostictoides*, *Sclerophomella*, *Plenodomus*, *Macrospora*, and *Pilosa* (Boerema 1997; Boerema et al. 2004; De Gruyter et al. 2009). Based on phylogenetic evidence, they concluded that *Phoma* section *Paraphoma*, as typified by *Ph. radicina* (McAlpine) Boerema can be assigned in *Phaeosphaeriaceae*, while *Ph. heteromorphospora*, the type species of *Phoma* section *Heterospora* should be treated in *Leptosphaeriaceae*. Additionally, the family *Didymellaceae* was proposed to accommodate others *Phoma* sections *viz. Macrospora*, *Peyronellaea*, *Phoma*, *Phyllostictoides* and *Sclerophomella* (De Gruyter et al. 2009). Aveskamp et al. (2010) indicated that the current Boeremaean subdivision was incorrect as *Phoma* is polyphyletic comprising six distinct clades in *Pleosporales* and appeared to be common in different families (Aveskamp et al. 2010). Therefore, De Gruyter et al. (2012) concluded that *Phoma* should be restricted only to *Didymellaceae*, while other *Phoma* sections were transferred to related families. However, Lawrey et al. (2012) treated lichenicolous *Phoma* species in *Phaeosphaeriaceae* based on their multigene phylogenetic analysis. Therefore, a new genus should be introduced to accommodate all lichenicolous *Phoma* species in *Phaeosphaeriaceae* (Hyde et al. 2013).

Plenodomus Preuss is typified by *Pl. rabenhorstii* Preuss to accommodate the phoma-like species which Boerema (1982) synonymized under *Phoma* section *Plenodomus* (Boerema et al. 2004; Torres et al. 2005). Torres et al. (2005) mentioned that Reddy et al. (1998) treated phoma-like species with the sexual state known as *Leptosphaeria* in *Plenodomus* in *Leptosphaeriaceae* and concluded that *Phoma* should be restricted to the species relating to *Didymella* in *Phaeosphaeriaceae*. Zhang et al. (2009) listed *Plenodomus* in *Phaeosphaeriaceae*; however based on phylogenetic evidence, De Gruyter et al. (2012) reinstated the genus *Plenodomus* to accommodate *Phoma* section *Plenodomus* within *Leptosphaeriaceae*.

Sclerostagonospora was typified by *S. heraclei* (Sacc.) Höhn. (1917) and characterized with pycnidial conidiomata with holoblastic, determinate, discrete, ampulliform to irregular conidiogenous cells, and subcylindrical, 3-septate, pale brown, verruculose conidia (Sutton 1980; Quaedvlieg et al. 2013). *Sclerostagonospora* differs from *Stagonospora* in its pigmented conidia (Quaedvlieg et al. 2013). Crous and Palm (1999) reported *Sclerostagonospora leucadendri* Crous & M.E. Palm as the asexual state of *Leptosphaeria leucadendri* Crous & M.E. Palm which occurs on leaves of *Leucadendron*. Based on phylogenetic analysis, *Sclerostagonospora opuntiae* (Ellis & Everh.) Huhndorf (CBS 118224) formed a clade with *Phaeosphaeria* and *Phaeosphaeriopsis* (Crous et al. 2008). Thus, Kirk et al. (2008) treated *Sclerostagonospora* as an asexual state in the *Pleosporale*s. In Quaedvlieg et al. (2013), multigene phylogenetic analysis has shown that *Sclerostagonospora phragmiticola* Quaedvlieg et al. (CBS 338.86) is related to *Phaeosphaeriaceae*.

Stagonospora is characterized by holoblastic or annellidic conidiogenesis and produces phragmoconidia (Schoch et al. 2006; Quaedvlieg et al. 2013). The genus was reported as an asexual genus in *Phaeosphaeriaceae*, which often clusters with *Phaeosphaeria* and *Phoma* in phylogenetic analyses (Cunfer and Ueng 1999; Câmara et al. 2002; Solomon et al. 2006; Zhang et al. 2009, 2012; Hyde et al. 2013). *Stagonospora* has often been confused with *Septoria*; however, the genus was clarified by Cunfer and Ueng (1999) and Solomon et al. (2006). Based on phylogenetic evidence, *Stagonospora* is more closely related to other genera in *Pleosporales*, while *Septoria* clustered in *Mycosphaerellaceae*, *Capnodiales* (Quaedvlieg et al. 2013). Quaedvlieg et al. (2013) re-collected the type species of *Stagonospora*, *St. paludosa* (Sacc. & Speg.) Sacc. and their phylogenetic analysis showed that this species formed a separate clade with other *Stagonospora* species which occurred on *Poaceae* (*i.e. St. avenae* (A.B.. Frank) Bissett and *St. nodorum* (Berk.) E. Castell. & Germano). Therefore, Quaedvlieg et al. (2013) concluded that stagonospora-like species belonged in different genera and introduced the new genera, *Neostagonospora* and *Parastagonospora* to accommodate the stagonospora-like species in *Phaeosphaeriaceae*. The type species of *Stagonospora*, *St. paludosa* and other *Stagonospora* species grouped in *Massarinaceae* (Quaedvlieg et al. 2013).

The aim of this study is to revisit all genera of *Phaeosphaeriaceae* and provide revised descriptions of the sexual and asexual morphs of the genera. Available generic type specimens were examined, described and illustrated. We have also collected fresh specimens from Thailand and Italy. Phylogenetic investigation of available sequence data reveals the current placement of genera in *Phaeosphaeriaceae*.

Material and methods

Herbarium examination, fungal isolation, morphology and asexual state study

Type specimens of each genus in *Phaeosphaeriaceae* were obtained from BPI, BR, NY, S, and UB herbaria. Morphology of generic types were examined and re-described. Generic descriptions were provided based on the original descriptions and non type herbarium specimens if generic type specimens could not be located or loaned. Some types were redrawn from iconotype. Ascomata on herbarium material were rehydrated by adding 5 % KOH. Free hand sections and squash mounts were prepared and morphological characters were observed under stereo microscope and compound microscope.

Collections of *Phaeosphaeriaceae* were made from Italy and Thailand and returned to the laboratory for examination. If the specimens were dry, they were incubated in a moist chamber for 2–3 days at 25 °C. Ascomata were sectioned by hand and examined under an Olympus SZH10 stereomicroscope. Macro-morphological characters were photographed using a Sony DSC-T110 digital camera. The micro-morphological characters were captured by a Cannon 550D digital camera, using a Nikon ECLIPSE 80i compound microscope with DIC objectives. Indian ink was added to show mucilaginous sheaths surrounding ascospores. Cotton blue and congo red reagents were used as stains for checking ascospore septation and internal elements of the hamathecium. Permanent slides were prepared by mounting material on lactoglycerol and sealing with clear nail polish. Measurements were obtained using a Tarosoft (R) Image Frame Work version 0.9.7. Photographic plates were prepared in Adobe Photoshop version CS3 (Adobe Systems Inc., The United States).

Pure cultures were obtained from single spores following the methods described in Chomnunti et al. (2014) and Phookamsak et al. (2013). Ascomata were cut at the apex and sides walls by a razor blade. The contents inside ascoma was picked and soaked in sterile water and broken up further mechanically with the sterile needle until a spore suspension was obtained. The ascospore suspension was dropped on water agar (WA; 15.0 g/L sterile distilled water) and incubated at room temperature overnight. The germinating spores were transferred to malt extract agar (MEA; 33.6 g/L sterile distilled water, Difco malt extract) and cultivated in corn meal agar (CMA, 17 g/l sterile distilled water, Difco corn meal agar) and potato dextrose agar (PDA; 39 g/L distilled water, Difco potato dextrose) for recording growth rates and culture characters. Sterile bamboo pieces on water agar (WA; 15 g/l sterile distilled water) were used to encourage production of asexual morphs. Cultures are deposited in Mae Fah Luang University Culture Collection (MFLUCC), and duplicated in the International Collection of Microorganisms from Plants (ICMP), Landcare Research, New Zealand. Herbarium specimens were prepared by drying the specimens with silica gel at room temperature for 7–10 days depending on the humidity and kept in envelopes or small boxes. The herbarium specimens are deposited in the herbarium of Mae Fah Luang University (MFLU), Chiang Rai, Thailand and duplicates in the New Zealand Fungal Herbarium (PDD), Landcare Research, New Zealand or Université Catholique de Louvain, Belgium (MUCL).

Molecular and phylogenetic analysis

Fungal DNA extraction, PCR amplification and sequencing

The fungal colonies were grown on MEA/PDA at 25–30 °C for 2–4 weeks. After 4 weeks, the fungal mycelium was scraped and transferred to micro centrifuge tube. The fungal genomic DNA was extracted by Biospin Fungus Genomic DNA Extraction Kit (BioFlux®, China) following the manufacturer's instructions (Hangzhou, P.R. China).

DNA amplifications were performed by Polymerase Chain Reaction (PCR). The internal transcribed spacer (ITS) was amplified by using primers ITS4 and ITS5 as defined by White et al. (1990). The partial small subunit nuclear rDNA (SSU) was amplified by using primers NS1 and NS4 (White et al. 1990). The partial large subunit nuclear rDNA (LSU) was amplified by using primers LROR and LR5 (Vilgalys and Hester 1990). The partial RNA polymerase second largest subunit (*RPB2*) was amplified by using primers fRPB2-5F and fRPB2-7cR (Liu et al. 1999). The translation elongation factor 1-alpha gene (*TEF1*) was amplified by using primers EF1-983F and EF1-2218R (Rehner 2001). The amplification reaction were carried out following protocol: The final volume of the PCR reaction was 50 μl which contained 2.0 μl of DNA template, 1.5 μl of each forward and reverse primers, 25 μl of 2× Easy Taq PCR SuperMix (mixture of *EasyTaq*TM DNA Polymerase, dNTPs, and optimized buffer, Beijing TransGen Biotech Co., Ltd., Chaoyang District, Beijing, PR China) and 20 μl sterilized water (Phookamsak et al. 2013).

The PCR thermal cycle program of ITS, nuSSU, nuLSU and *TEF1* genes amplification were provided as: initially 94 °C for 3 min, followed by 40 cycles of denaturation at 94 °C for 30 s, annealing at 55 °C for 50 s, elongation at 72 °C for 1 min, and final extension at 72 °C for 10 min. The PCR thermal cycle program for the partial RNA polymerase second largest subunit (RPB2) was obtained by step as initially 95 °C for 5 min, followed by 40 cycles of denaturation at 95 °C for 1 min, annealing at 52 °C for 2 min, elongation at 72 °C for 90 s, and final extension at 72 °C for 10 min. The quality of PCR products were checked on 1 % agarose gel electrophoresis strained with ethidium bromide. The PCR products were send for sequencing at Shanghai Sangon Biological Engineering Technology & Services Co., Ltd (Shanghai, P.R. China) (Phookamsak et al. 2013).

Phylogenetic analyses

Combined ITS, LSU, SSU, *RPB2* and *TEF1* sequence data were used for phylogenetic analysis in this study. The reference nucleotide sequences of *Phaeosphaeriaceae* and other selected families in Dothideomycetes were obtained from the GenBank database and included in the analysis (see Supplementary table). The fungal sequence strains were combined and aligned in MEGA6 (Tamura et al. 2013) and improved manually where necessary in BioEdit v. 7.2 (Hall 1999). The combined sequences alignment was analyzed by Bayesian, maximum likelihood and maximum parsimony methods.

Bayesian analyses was carried out using MrBayes v. 3.0b4 (Ronquist and Huelsenbeck 2003). The best-fit model of sequences evolution was estimated by using MrModeltest 2.2 (Nylander 2004). Markov Chain Monte Carlo sampling (BMCMC) in MrBayes v. 3.0b4 (Huelsenbeck and Ronquist

2001) were used to determine the Posterior probabilities (PP) (Rannala and Yang 1996; Zhaxybayeva and Gogarten 2002). Phylogenetic trees were sampled every 100th generation (resulting in 10,000 total trees) in 1,000,000 generations from the running of six simultaneous Markov chains. The first 2,000 trees which contained the burn-in phase of the analyses were discarded. The remaining 8,000 trees were used to calculate the posterior probabilities (PP) in the majority rule consensus tree (Liu et al. 2011).

A maximum likelihood analysis (ML) was performed in RaxmlGUI v.1.0 (Silvestro and Michalak 2011). Alignments in PHYLIP format were loaded and automatically checked their compatibility in raxmlGUI. The available substitution models consisting of a generalized time reversible (GTR) was applied with four rate classes and a discrete gamma distribution (Yang 1994) for nucleotides, symmetric, Markovian, and ordered models for morphological characters (Liu et al. 2011; Silvestro and Michalak 2011). The best scoring tree from a separate randomized tree under the same model was selected. Rapid bootstrap with nonparametric bootstrap iterations (Stamatakis et al. 2008) was run in 1,000 replicates with the GTR model and a discrete gamma distribution (Liu et al. 2011).

A maximum parsimony (MP) analysis was conducted by using PAUP v. 4.0b10 (Swofford 2002). The heuristic search option with 1,000 random sequences addition and tree-bisection reconnection (TBR) of branch-swapping algorithm were performed. Maxtrees were setup at 1,000 and a zero of maximum branch length was collapsed. Gaps were treated as missing data and all characters were unordered and of equal weight. All multiple, equally parsimonious trees were saved. Descriptive tree statistics for parsimony consistency index (CI), retention index (RI), rescaled consistency index (RC) and homoplasy index (HI) was calculated. The robustness of the best parsimonious tree was estimated by a bootstrap (BT) value with 1,000 replicates, each with 10 replicates of random stepwise addition of taxa (Liu et al. 2011; Phookamsak et al. 2013). The best scoring phylogram from Bayesian analysis was selected for representing phylogenetic relationships and drawn in Treeview (Page 1996) with bootstrap values above and below the branches. All the sequences generated in this study have been deposited in GenBank (Liu et al. 2011; Phookamsak et al. 2013).

Results and discussion

Three phylogenetic reconstructions were generated to clarify the phylogenetic relationships of genera and species that have been accommodated in *Phaeosphaeriaceae*. Figure 1 deals with the genus and family level placement within the *Phaeosphaeriaceae* and *Pleosporales*. The dataset includes LSU, SSU, *RPB2*, and *TEF1* sequences and were analyzed using maximum likelihood (ML), maximum parsimony (MP) and Bayesian analyses. The dataset comprised 85 taxa, with *Massaria inquinans* (M 19) selected as the outgroup taxon. Twenty-nine *Phaeosphaeriaceae* taxa formed a well-supported clade (74 % ML/ 1.00 PP) within the suborder *Pleosporinae*, while *Mycopappus* and *Xenostigmina* form a single clade close to *Melanommataceae*. Therefore, we exclude these later genera from *Phaeosphaeriaceae* in this study. *Wilmia* was synonymized under *Letendraea* by Ariyawansa et al. (2014b). Phylogenetic evidence shows *Letendraea cordylinicola* is related with *Didymosphaeriaceae* which form a strongly-supported clade (75 % ML/ 1.00 PP) with *Paraphaeosphaeria michotii* (CBS 652.86), *Deniquelata barringtoniae* (MFLUCC 11-0422) and *Kalmusia brevispora* (KT 2313) in *Didymosphaeriaceae*. Thus, *Letendraea* is excluded from *Phaeospthariaceae* in this study and transferred to *Didymosphaeriaceae*. *Phaeosphaeriopsis*, *Parastagonospora*, *Ophiosphaerella*, *Phaeosphaeria* and *Setophoma* are well-resolved genera and formed distinct clades, while the other clades comprised groups of genera without clear combining features or comprising more than one genus (Fig. 2).

Figure 2 focuses on the phylogenetic relationships of genera in *Phaeosphaeriaceae*. The multigene combined dataset (ITS, LSU, SSU and *RPB2*) were obtained from maximum likelihood (ML), maximum parsimony (MP) and Bayesian analysis. *Didymella exigua* (CBS 183.55) was selected as the outgroup taxon. The dataset consists of 58 taxa, with 57 taxa belonging to the *Phaeosphaeriaceae*. Eleven clades (A–K) can be recognized in Fig. 2. Clade A comprises the genera *Chaetosphaeronema*, *Dermatiopleospora*, *Entodesmium*, *Loratospora*. *Nodulosphaeria* and *Ophiobolus*. *Dermatiopleospora*, *Entodesmium* and *Loratospora* are represented by their ex-type strains and type species. This clade needs better populating with many more species from the respective genera as it is presently not well-resolved. *Ophiobolus cirsii* (MFLUCC 13-0218) formed a robust clade (99 % ML/ 97 % MP/ 1.00 PP) with the asexual genus *Chaetosphaeronema*, while *O. erythrosporus* (MFLU 12-2225) forms a weakly supported clade with *Entodesmium rude*. However, *Ophiobolus* is not represented by its type species and the strains used have not been morphologically clearly defined (see Ariyawansa et al. 2014c). Clade B represents the genus *Phaeosphaeriopsis* and is well resolved in *Phaeosphaeriaceae* (97 % ML/ 93 % MP/ 1.00 PP). It is represented by the type species *Ps. glaucopunctata* (ex-type strain), plus other strains and a new species *Ps. dracaenicola* is also introduced here (see details in "Taxonomy" section). Clade C represents *Phaeosphaeria sensu stricto* with five species, including the type species and two new species; detailed phylogenetic relationships among these species are shown in Fig. 3. Clade D represents two isolates of the genus

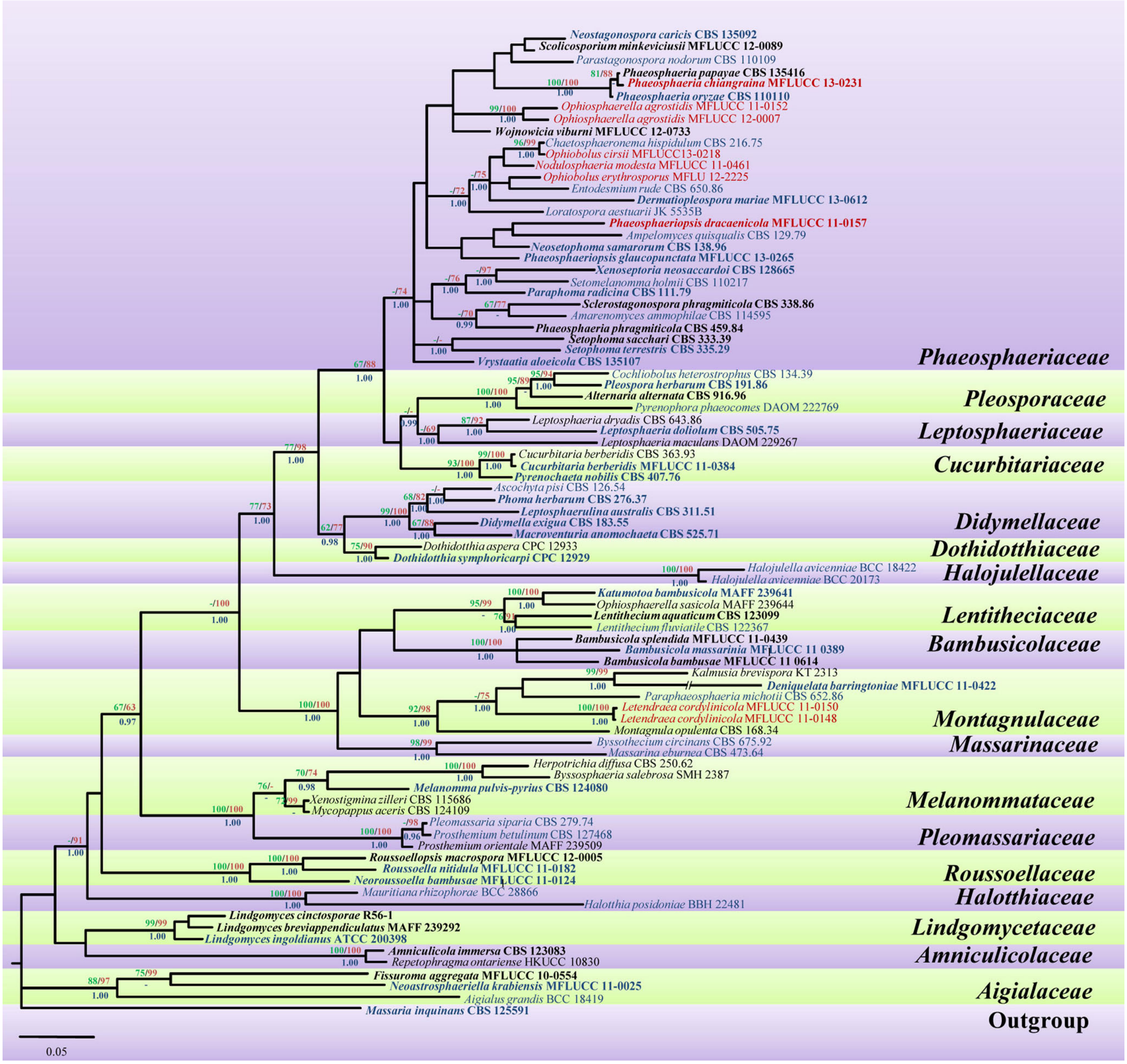


Fig. 1 A Bayesian 50 % majority rule consensus tree based on combined dataset of LSU, SSU, *TEF1* and *RPB2* alignment. Bootstrap support values for maximum likelihood (ML, red) and maximum parsimony (MP, green) equal or greater than 60 % are given above the nodes. Bayesian posterior probabilities (BYPP, blue) equal or higher than 0.95 are given below the nodes. *Massaria inquinans* (M 19). Ex-type and ex-epitype strains are in bold. Newly generated sequences are in red and the type species are indicated in blue

Ophiosphaerella, which form a strongly supported clade (100 % ML/ 100 % MP/ 1.00 PP) separate from *Ophiosphaerella herpotricha*. The two strains of *Ophiosphaerella agrostidis* are clearly defined based on morphology (see under *Ophiosphaerella agrostidis*). However, the genus *Ophiosphaerella* is not represented by its type species. Further isolates and type strains from *Ophiobolus* and *Ophiosphaerella* are required to better resolve and naturally place these genera. Clade E comprises the genera *Amarenomyces*, *Sclerostagonospora*, and *Wojnowicia* plus a putative strain of *Ophiosphaerella herpotricha* and four strains of *Phaeosphaeria*. *Phaeosphaeria ammophilae* is not closely related to *Phaeosphaeria sensu stricto*, the species is reinstated as *Amarenomyces*, while other *Phaeosphaeria* taxa in this clade may need removing from *Phaeosphaeria*. However, the tree needs to be better populated with strains that are morphologically well-defined before adjustments can be made. Clade F comprises two strains, *Phaeosphaeria alpina* and *Ph. typharum* which are also unrelated to *Phaeosphaeria sensu stricto* and need further study. Clade G comprises the type species and ex-type strains of *Ampelomyces* and *Neosetophoma*, these genera also need to

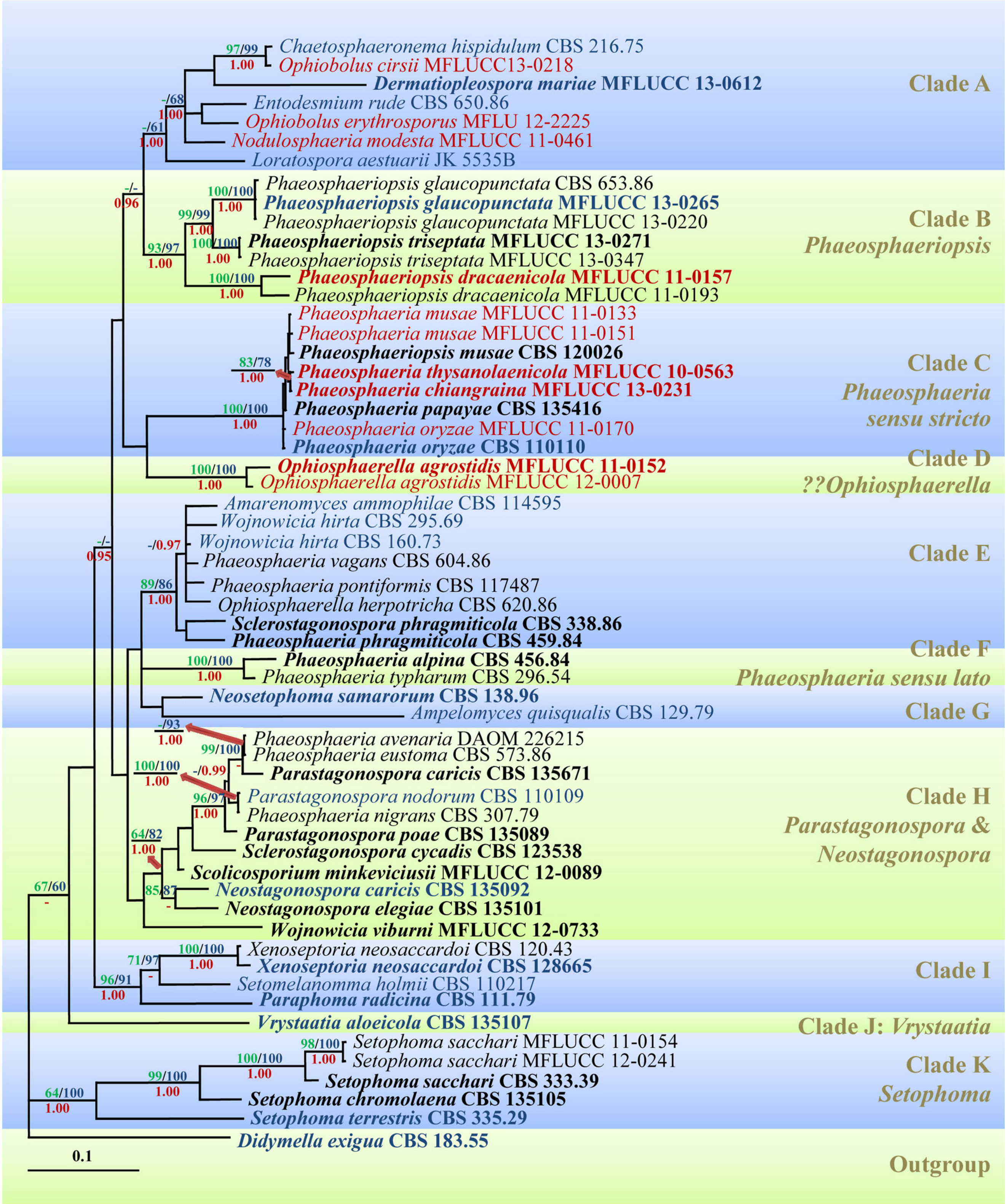


Fig. 2 A Bayesian 50 % majority rule consensus tree based on combined dataset of ITS, LSU, SSU and *RPB2* alignment. Bootstrap support values for maximum likelihood (ML, blue) and maximum parsimony (MP, green) equal to or greater than 60 % are given above the nodes. Bayesian posterior probabilities (BYPP, red) equal or higher than 0.95 are given below the nodes. The tree is rooted to *Didymella exigua*. Ex-type and ex-epitype strains are in bold. Newly generated sequences are in red and the type species are indicated in blue

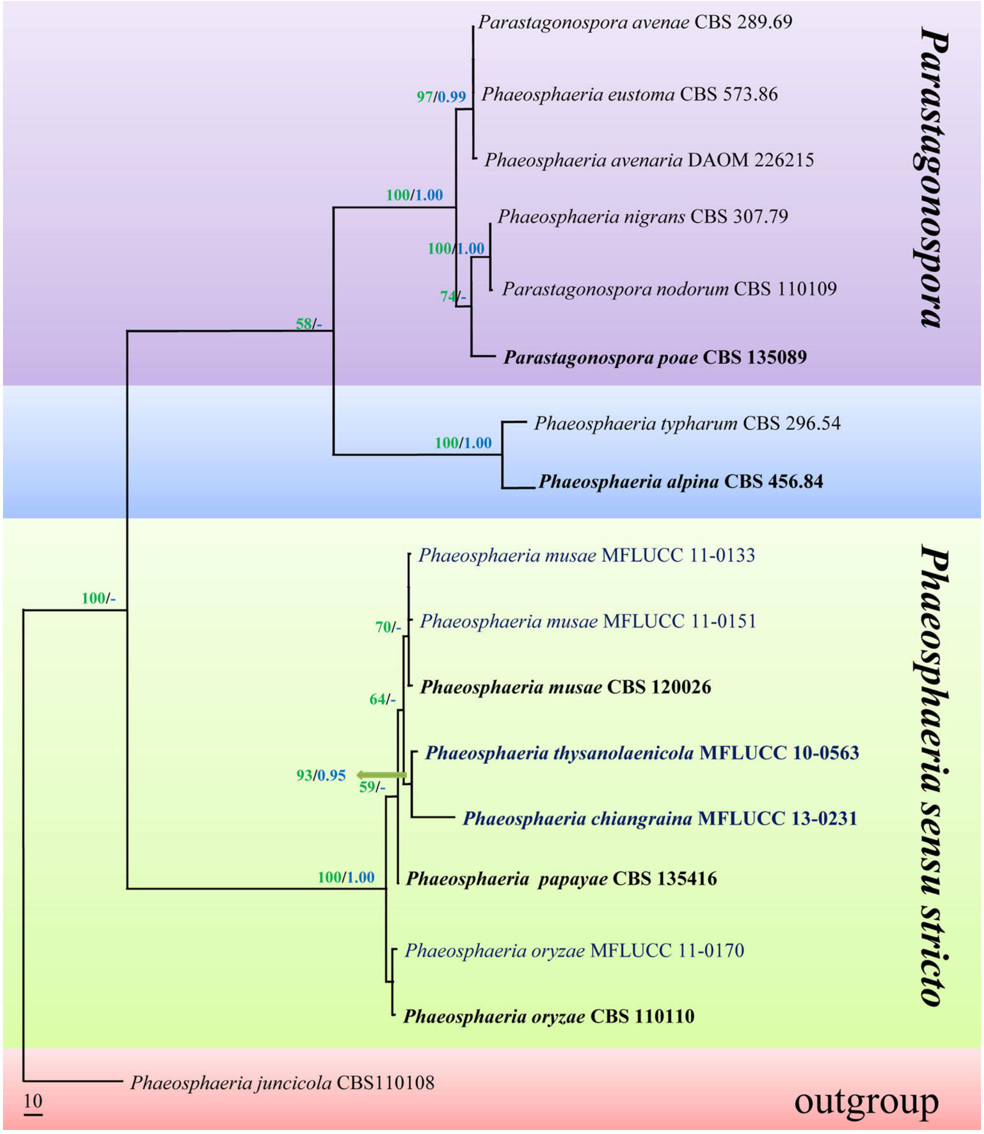


Fig. 3 Maximum parsimony tree based on a combined dataset of ITS, LSU, *RPB2* and *TEF1*. Bootstrap support values for maximum parsimony (MP, green) (equal to or greater than 50 %) and the values of the Bayesian posterior probabilities (BYPP, blue) from MCMC analyses provided significant (equal or higher than 95 %) are given above the nodes. The tree was rooted to *Phaeosphaeria juncicola*. Ex-type and ex-epitype strains are in bold. Newly generated sequences are in blue

be better populated with strains that are morphologically well-defined. Clade H comprises the ex-types strains and type species of *Parastagonospora* and, *Neostagonospora*, and ex-type strains *Sclerostagonospora cycadis*, *Scolicosporium minkeviciusii* and *Wojnowicia viburni* (the latter three species are not generic types). Three *Phaeosphaeria sensu lato* strains also cluster here indicating the polyphyletic nature of the genus. Clade I comprises *Xenoseptoria*, *Setomelanomma* and *Paraphoma*, with *Xenoseptoria* and *Paraphoma* represented by ex-type strains of their type species. *Setomelanomma* is closely related to *Xenoseptoria* which formed a robust clade (97 % ML/ 71 % MP) in our multigene phylogenetic analyses. Clade J represents *Vrystaatia* with single species, *V. aloeicola*. Clade K represents the asexual genus *Setophoma* with five strains, including the type species, *S. terrestris*. The genus is well-resolved in our phylogenetic analyses which form a strongly supported clade (100 % ML/ 64 % MP/ 1.00 PP) at the basal of *Phaeosphariaceae*.

Figure 3 deals with the species complex of *Phaeosphaeria sensu stricto* and *Parastagonospora*. *Phaeosphaeria juncicola* (CBS 110108) was selected as the outgroup taxon. The newly generated strains which were collected from Thailand form a robust clade with the ex-type species, *Phaeosphaeria oryzae* and with *Ph. papayae* and *Ph. musae* in the *Phaeosphaeria sensu stricto* clade. *Phaeosphaeria sensu stricto* is distinguished from *Parastagonospora*, the

Fig. 4 ITS pair wise comparison of *Phaeosphaeria oryzae* (CBS 110110), *P. oryzae* (RP0086; MFLUCC 11-0170), *P. papayae* (CBS 135416), *P. thysanolaenicola* (RP0036; MFLUCC 10-0563), *P. chiangraina* (RP0131; MFLUCC 13-0231), *P. musae* (CBS 120026) and *P. musae* (RP0049; MFLUCC 11-0133 and RP0067; MFLUCC 11-0151) ▶

```
                ....|....| ....|....| ....|....| ....|....| ....|....|
                        60         70         80         90        100
CBS 110110      TTGTTTACAC CCTTGTTTTT TTGCGTACCT ATCGTTTCCT CGGCGGGCTT
RP0086          TTGTTTACAC CCTTGTTTTT TTGCGTACCT ATCGTTTCCT CGGCGGGCTT
CBS 135416      TTGTTTACAC CCTTGTTTTT TTGCGTACCT ATCGTTTCCT CGGCGGGCTT
RP0036          TTGTTTACAC CCTTGTTTTT TTGCGTACTT ATCGTTTCCT CGGCGGGCTT
RP0131          TTGTTTACAC CCTTGTTTTT TTGCGTACTT ATCGTTTCCT CGGCGGGCTT
CBS 120026      TTGTTTACAC CCTTGTCTTT TTGCGTACTT ATCGTTTCCT CGGCGGGCTT
RP0049          TTGTTTACAC CCTTGTCTTT TTGCGTACTT ATCGTTTCCT CGGCGGGCTT
RP0067          TTGTTTACAC CCTTGTCTTT TTGCGTACTT ATCGTTTCCT CGGCGGGCTT
Clustal Co      ********** ****** *** ******** * ********** **********


                ....|....| ....|....| ....|....| ....|....| ....|....|
                       110        120        130        140        150
CBS 110110      GCCTGCCGGT TGGACAACTT TATAACC--- TTTTTAAATC TTCAATCAGC
RP0086          GCCTGCCGGT TGGACAACTT TATAACC--- TTTTTAAATC TTCAATCAGC
CBS 135416      GCCTGCCGGT TGGACAACTT TATAACC-TT TTTTTAAATC TTCAATCAGC
RP0036          GCCTGCCGGT TGGACAACTT TATAACC--T TTTTTAAATC TTCAATCAGC
RP0131          GCCTGCCGGT TGGACAACTT TATAACC--T TTTTTAAATC TTCAATCAGC
CBS 120026      GCCTGCCGGT TGGACAACTT TATAACC--- TTTTTAAATC TTCAATCAGC
RP0049          GCCTGCCGGT TGGACAACTT TATAACC--- TTTTTAAATC TTCAATCAGC
RP0067          GCCTGCCGGT TGGACAACTT TATAACCTTT TTTTTAAATC TTCAATCAGC
Clustal Co      ********** ********** *******    ********** **********


                ....|....| ....|....| ....|....| ....|....| ....|....|
                       160        170        180        190        200
CBS 110110      GTCTGAACAA TATACAATAA TTACAACTTT CAACAACGGA TCTCTTGGTT
RP0086          GTCTGAATAA TATACAATAA TTACAACTTT CAACAACGGA TCTCTTGGTT
CBS 135416      GTCTGAATAA TATACAATAA TTACAACTTT CAACAACGGA TCTCTTGGTT
RP0036          GTCTGAATAA TATACAATAA TTACAACTTT CAACAACGGA TCTCTTGGTT
RP0131          GTCTGAATAA TATACAATAA TTACAACTTT CAACAACGGA TCTCTTGGTT
CBS 120026      GTCTGAATAA TATACAATAA TTACAACTTT CAACAACGGA TCTCTTGGTT
RP0049          GTCTGAATAA TATACAAAAA TTACAACTTT CAACAACGGA TCTCTTGGTT
RP0067          GTCTGAATAA TATACAATAA TTACAACTTT CAACAACGGA TCTCTTGGTT
Clustal Co      ******* ** ******* ** ********** ********** **********

                ....|....| ....|....| ....|....| ....|....| ....|....|
                       410        420        430        440        450
CBS 110110      GCCAGTGTTT TGGTAGTAAG CGCAGCACAT TTTGCGTCTT GGTCCCTCAA
RP0086          GCCAGTGTTT TGGTAGTAAG CGCAGCACAT TTTGCGTCTT GGTCCCTCAA
CBS 135416      GCCAGTGTTT TGGTAGTAAG CGCAGCACAT TTTGCGTCTT GGTCCCTCAA
RP0036          GCCAGTGTTT TGGTAGTAAG CGCAGCACAT TTTGCGTCTT GGTCCCTCAA
RP0131          GCCAGTGTTT TGGTAGTAAG CGCAGCACAT TTTGCGTCTT GGTCCCTCAA
CBS 120026      GCCAGTGTTT TGGTATTAAG CGCAGCACAT TTTGCGTCTT GGTCCCTTAA
RP0049          GCCAGTGTTT TGGTAGTAAG CGCAGCACAT TTTGCGTCTT GGTCCCTTAA
RP0067          GCCAGTGTTT TGGTAGTAAG CGCAGCACAT TTTGCGTCTT GGTCCCTTAA
Clustal Co      ********** ***** **** ********** ********** ******* **


                ....|....| ....|....| ....|....| ....|....
                       460        470        480
CBS 110110      CAGCGGCATC CATCAAGCCA TTTTCTCACT TTTGACCTC
RP0086          CAGCGGCATC CATCAAGCTA TTTTCTCACT TTTGACCTC
CBS 135416      CAGCGGCATC CATCAAGCCA TTTTCTCACT TTTGACCTC
RP0036          CAGCAGCTTC CATCAAGCCA -TTTCTCAC- TTTGACCTC
RP0131          CAGCAGCTTC CATCAAGCCA TTTTCTCAC- TTTGACCTC
CBS 120026      CAGCAGCATC CATCAAGCCA TTTTCTCAC- TTTGACCTC
RP0049          CAGCAGCATC CATCAAGCCA TTTTCTCACT TTTGACCTC
RP0067          CAGCAGCATC CATCAAGCCA TTTTCTCACT TTTGACCTC
Clustal Co      **** ** ** ******** *  ********  *********
```

species having been accommodated in *Phaeosphaeria* and *Phaeosphaeria sensu lato* (*Phaeosphaeria alpina* and *Ph. typharum*).

Phaeosphaeria sensu stricto taxa (MFLUCC 11-0133; MFLUCC 11-0151) cluster with *Ph. musae* (CBS 120026), a pathogen of banana. An ITS pair wise comparison shows that these three isolates differ in seven base positions (Fig. 4) while there are only one to two base differentiated in *TEF1* gene comparisons. Isolate MFLUCC 11-0133 is slightly morphologically different from the other two isolates (MFLUCC 11-0151 and CBS 120026) in its ascus and ascospore sizes. However, these three isolates are generally similar in morphology and phylogeny. Therefore, we treat the isolates causing leaf spot disease on *Calathea* sp. and *Cordyline* sp. from Thailand as conspecific with *Phaeosphaeria musae*. *Phaeosphaeria thysanolaenicola* (MFLUCC 10-0563), a pathogen on *Thysanolaena maxima*, forms a clade with. *Ph. chiangraina*, which is saprobic on rice. These two species form strongly-supported clades which are well-resolved from the ex-type species of *Phaeosphaeria oryzae*.

Phaeosphaeria avenaria, *Ph. eustoma* and *Ph. nigrans* form a clade with *Parastagonospora* species. *Phaeosphaeria avenaria* was synonymized under *Parastagonospora avenae* by Quaedvlieg et al. (2013), and the other two species may need to be synonymized under *Parastagonospora* based on the phylogenetic relationships. However, it was not possible to observe the types of these species or confirm if they are correctly identified.

Phaeosphaeria alpina and *Ph. typharum* form a distinct clade from the *Phaeosphaeria sensu stricto* species which is separate with other *Phaeosphaeria sensu lato* taxa. The type species need to re-visited and a new genus may need to be introduced to accommodate these species.

Taxonomy

Phaeosphaeriaceae M.E. Barr Mycologia 71(5): 948 (1979).

Faces of Fungi number: FoF00232

Endophytic, *hyperparasitic*, *pathogenic*, or *saprobic* on monocotyledonous and some dicotyledonous hosts. **Sexual state:** *Ascomata* scattered, clustered, solitary or gregarious, immersed to semi-immersed or erumpent through host tissue, small to large, uniloculate, globose to subglobose, glabrous or setose, brown to dark brown or black, ostiolate, with short to long papilla. *Peridium* with thin to thick walls, composed of brown to dark brown or black, pseudoparenchymatous cells, mostly arranged in a *textura angularis* to *textura prismatica*. *Hamathecium* composed of sparse to numerous, filamentous, septate, rarely anastomosing, mostly cellular pseudoparaphyses, or pseudoparaphyses occasionally lacking. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, or clavate, sessile to subsessile, or usually with short pedicels, apically rounded with typically well-developed ocular chamber. *Ascospores* overlapping muriform, phragmosporous, or scolecosporous, varying in shape from ellipsoidal, fusiform to broadly fusiform, clavate, and cylindrical to filiform, mostly brown to dark brown or reddish-brown, sometimes hyaline, 1- to multi-septate, constricted or not constricted at the septum, walls smooth or rough, echinulate, punctuate or verrucose, some with appendage or mucilaginous sheath. **Asexual state:** *Coelomycetous. Conidiomata* pycnidial, scattered, solitary or gregarious, immersed to superficial, uni- to multi-loculate, globose to subglobose, glabrous or setose, light brown to dark brown or black, ostiole central, papillate. *Conidiomata walls* thin, composed of pseudoparenchymatous cells, arranged in a *textura angularis* to *textura prismatica*. *Conidiophores* lining inner cavity of the conidioma, typically reduced to conidiogenous cells, hyaline to brown, aseptate or septate. *Conidiogenous cells* enteroblastic or holoblastic, annellidic or phialidic, discrete, oblong to ampulliform, hyaline to brown. *Conidia* varied in shape, hyaline to brown, aseptate or septate, walls smooth or rough, echinulate, punctuate or verrucose, some with appendage or mucilaginous sheath.

Notes: *Phaeosphaeriaceae* is one of the largest families in *Pleosporales*, and demonstrates variability in morphological characters. Previously, many genera with brown spores, associated with monocotyledonous hosts, having a thin-walled peridium and producing coelomycetous asexual states were accommodated in *Phaeosphaeriaceae* (Barr 1979, 1987b, 1990a, 1992a; Crivelli 1983; Schatz 1984; Shoemaker 1984; Shoemaker and Babcock 1989b; Yuan 1994; Ramaley and Barr 1995; Dianese et al. 2001; Zhang et al. 2009, 2012). Most of genera in *Phaeosphaeriaceae* lack molecular data or only limited sequence data is available in some genera such as *Entodesmium* and *Phaeosphaeria*. Several genera in *Phaeosphaeriaceae* share morphological characters with genera in other families (e.g. *Didymosphaeriaceae*, *Leptosphaeriaceae* and *Pleosporaceae*) and thus their placement is confused. Therefore, re-visiting all type genera of *Phaeosphaeriaceae* to establish their morphology and to obtain molecular sequence data from fresh collections are essential to provide modern descriptions and to determine the placement of genera in this family.

Type: ***Phaeosphaeria*** I. Miyake, Bot. Mag., Tokyo 23: 93 (1909).

Notes: The following genera are placed in *Phaeosphaeriaceae*. Genera are listed in alphabetical order and provided with genus description and notes, descriptions of type or authentic species, notes on species, material examined and illustrations. If the genus is monotypic, only a single description which also represents the genus is provided.

Key to genera of *Phaeosphaeriaceae*

1. Sexual state 2
1. Asexual state 14
2. Ascospores phragmosporous or scolecosporous 3
2. Ascospores dictyosporous, muriform, on *Ononis spinosa* (dicotyledon) .... ***Dematiopleospora***
3. Ascospores phragmosporous 4
3. Ascospores scolecosporous 12
4. Ascospores 2–3-septate 5
4. Ascospores mostly more than 3-septate 10
5. Ascospores mostly 2-septate, associated with rust fungi .... ***Eudarluca***
5. Ascospores 3-septate, saprobic or pathogenic on monocots or dicots 6
6. Ascomata in groups or rows with slit-like ostioles; ascospores hyaline .... ***Bricookea***
6. Ascomata solitary, scattered, opening ostiolate to papillate; ascospores pale brown, yellowish brown to brown 7
7. Asci ovoid to ampulliform, aparaphysate, on *Juncus roemerianus* .... ***Loratospora***
7. Asci broadly cylindrical, cellular pseudoparaphyses 8
8. Ascomata typically glabrous 9
8. Ascomata typically setose .... ***Setomelanomma***
9. Ascomata typically immersed, ostioles with minute papilla, asexual state: *Phaeoseptoria* .... ***Phaeosphaeria***
9. Ascomata semi-immersed to erumpent, near superficial, ostiole with conical, knob-like, asexual: unknown .... ***Dothideopsella***
10. Ascospores cylindrical, with typically one enlarged cell 11
10. Ascospores broadly fusiform, widest at the middle cell, saprobic on *Ammophila* .... ***Amarenomyces***
11. Papilla, with numerous long, large setae in the ostiole, ascospores with one enlarged cell near apex .... ***Nodulosphaeria***
11. Papilla absent, opening ostiolate, ascospores typically enlarged cell near the base .... ***Phaeosphaeriopsis***
12. Ascospores with enlarged cells ....***Ophiobolus***
12. Ascospores lacking enlarged cells 13
13. Ascospores constricted at the septa, breaking into part spores, saprobic or parasitic on legumes .... ***Entodesmium***
13. Ascospores non-constricted at the septum, not separating into part spores, saprobic on various monocots .... ***Ophiosphaerella***
14. Conidia amerosporous, didymosporous phragmosporous or scolecosporous 15
14. Conidia dictyosporous (muriform) ... ***Amarenographium***
15. Conidia aseptate 16
15. Conidia septate 18
16. Saprobic or pathogenic, conidiomata setose 17
16. Mycoparasitic on powdery mildew ..... ***Ampelomyces***
17. Conidiomata dark brown, no sexual state reported .... ***Paraphoma***
17. Conidiomata pale brown, olivaceous to olivaceous-black, sexual state: ascospores cylindrical, hyaline, 3-septate, with enlarged in second cell from apex ...... ***Setophoma***
18. Conidiomata setose or covered by mycelium 19
18. Conidiomata glabrous 21
19. Conidia 1–3-septate 20
19. Conidia more than 3-septate .... ***Wojnowicia***
20. Conidiophores present, hyaline, 1-septate conidia .... ***Chaetosphaeronema***
20. Conidiophores absent, yellowish, typically 0–1(−3)-septate conidia .... ***Neosetophoma***
21. Conidia 1-septate 22
21. Conidia more than 1-septate 23
22. Conidia with appendage .... ***Tiarospora***
22. Conidia without appendage .... ***Neostagonospora***
23. Conidia hyaline 24
23. Conidia pigmented 26
24. One type of conidia, cylindrical to obclavate 25
24. Two types of conidia (macroconidia subcylindrical to narrowly obclavate; microconidia aseptate, pear-shaped to globose or ellipsoid) .... ***Vrystaatia***
25. Conidiomata exuding a creamy conidial mass, conidiophores absent; sexual state: phaeosphaeria-like .... ***Parastagonospora***
25. Conidiomata exuding a pink to orange conidial mass, conidiophores branched; sexual state: ?? *Setomelanomma* .... ***Xenoseptoria***
26. Conidia usually 3-septate 27
26. Conidia usually more than 3-septate 29
27. Conidia produced one type of conidia 28
27. Conidia produced two types of conidia (microconidia globose to ellipsoidal, hyaline) ..... ***Phaeostagonospora***
28. Conidia subcylindrical, pale brown, minutely verruculose .... ***Sclerostagonospora***
28. Conidia subcylindrical, wider in the middle, yellowish-brown, smooth-walled .... ***Septoriella oudemansii***
29. Conidia fusiform, 5–6-septate, apical cell attenuated into a short, beak-like, appendage .... ***Scolecosporiella***
29. Conidia curved to sigmoid, 6–7-septate, with hyaline end cells .... ***Scolicosporium minkeviciusii***

Amarenographium O.E. Erikss., Mycotaxon 15: 199 (1982), *Faces of Fungi number*: FoF00237.

Saprobic on marine grasses. **Sexual state:** see notes. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary, immersed to erumpent through host tissue by papilla, uniloculate, ellipsoidal to subglobose, glabrous, brown to dark brown, ostiole central, with papilla. *Conidiomata walls* thin, composed of thick-walled, reddish-brown to dark brown cells, arranged in *textura angularis* to *textura prismatica. Conidiophores* mostly reduced to conidiogenous cells, hyaline to brown, septate, branched. *Conidiogenous cells* holoblastic, phialidic, discrete, determinate, ampulliform, rarely cylindrical, hyaline, smooth-walled, produced macro- and microconidia. *Macroconidia* dictyosporous, blastic-phialidic, broadly ellipsoidal to clavate or fusiform, brown to dark brown, paler at the ends cells, muriform, septate, smooth-walled, with mucoid appendage at apex. *Microconidia* amerosporous, blastic-phialidic, hyaline, smooth-walled (from Eriksson 1982; Nag Raj 1989).

Type species: ***Amarenographium metableticum***

Phylogenetic study: Hodhod et al. (2012)

Notes: *Amarenographium metableticum* (Trail) O.E. Eriks. is the type of *Amarenographium* which was introduced as the asexual state of *Amarenomyces* (Eriksson 1982; Nag Raj 1989; Hodhod et al. 2012). *Amarenographium metableticum* had previously been identified as *Camarosporium metableticum* which was not congeneric with *Camarosporium stephensii*, the generic type of *Camarosporium* at that time (Sutton 1980; Eriksson 1982). Therefore, Eriksson (1982) transferred *Camarosporium metableticum* to a new genus based on the different morphological characters (Hodhod et al. 2012; Hyde et al. 2013). *Amarenographium* differs from *Camarosporium* by its conidiophores and conidia. In *Amarenographium* conidiophores are longer and branched and conidia have gelatinous appendages (Eriksson 1982; Hodhod et al. 2012). Hodhod et al. (2012) introduced a new species of *Amarenographium*, *Am. solium* Abdel-Wahab et al. from mangroves and noted that *Amarenographium* did not belong in *Phaeosphaeriaceae* but clusters with *Pleosporales*, genera *incertae sedis*, while *Amarenomyces* formed a clade with *Phaeosphaeria* in *Phaeosphaeriaceae* (Zhang et al. 2009, 2012). However, Hodhod et al. (2012) did not study the type species and the type species of *Amarenographium* lacks molecular data to confirm the relationships between these genera. Thus we presently maintain the genus in *Phaeosphaeriaceae*.

Amarenographium metableticum (Trail) O.E. Erikss., Mycotaxon 15: 199 (1982), *Faces of Fungi number*: FoF00238, Fig. 5.

≡ *Camarosporium metableticum* Trail, Scott. Natural., N.S. 2 (‘8’): 267 (1886) [1885–1886]

Saprobic on *Ammophila*. **Sexual state:** see notes. **Asexual state:** *Conidiomata* 160–215.5 μm high, 150–270 μm diam., pycnidial, scattered, solitary, immersed to erumpent, visible as black spots on host surface, uniloculate, globose to subglobose, glabrous, dark brown, ostiole central, with short to long papilla. *Conidiomata walls* 13–19 μm wide, thin-walled, of equal thickness, composed of 3–5 layers of flattened, brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis* to *textura prismatica. Conidiophores* arising from basal cavity of conidioma, mostly reduced to conidiogenous cells, hyaline to brown, septate. *Conidiogenous cells* (1.5–)3–4(−9) × 1.5–2.5(−5) μm ($\bar{x}$ = 3.9 × 2.3 μm, n=10), holoblastic, phialidic, discrete, oblong to ampulliform, hyaline to brown, 1-septate at the base, smooth-walled. *Conidia* (20–)24–27(−29) × 12–15(−17) μm ($\bar{x}$ = 25.4 × 13.4 μm, n=30), solitary, dictyosporous, muriform, ellipsoidal, ovoid, or lageniform, with obtuse ends or sometimes truncate at the basal cell, initially hyaline, becoming brown to yellowish-brown at maturity, mostly 3–4 transverse septa, 1–4 longitudinal septa, with several segments, smooth and thick-walled, with indistinct mucoid appendage.

Material examined: SWEDEN, Öland, Böda parish, Lugnet beach, on *Ammophila arenari* (L.) Link (*Poaceae*), 2 June 1963, B. Eriksson & O. Eriksson 2022c (S-F207509).

Amarenomyces O.E. Erikss., Op. bot. 60: 124 (1981), *Faces of Fungi number*: FoF00235.

Type species: ***Amarenomyces ammophilae***

Phylogenetic study: Zhang et al. (2009, 2012), Hyde et al. (2013)

Amarenomyces ammophilae (Lasch) O.E. Erikss., Op. bot. 60: 124 (1981), *Faces of Fungi number*: FoF00236, Fig. 6.

≡ *Sphaeria ammophilae* Lasch Flora, Jena 33: 282 (1850)

Saprobic on *Ammophila*. **Sexual state:** *Ascomata* 170–290 μm high, 170–285 μm diam., scattered, immersed to erumpent through host tissue, visible as small black spots on host surface, uniloculate, globose to subglobose, glabrous, dark brown, ostiole central, with short papilla (50–130 μm long). *Peridium* 7.5–25 μm wide, thin-walled, of equal thickness, composed of 3–5 layers of flattened, dark brown, pseudoparenchymatous cells, arranged in *textura angularis* to *textura prismatica. Hamathecium* composed of numerous, 1.5–3 μm wide, filiform, distinctly septate, frequently anastomosing, narrow cellular pseudoparaphyses, embedded in mucilaginous matrix. *Asci* (112–)140–160(−173) × (28–)30–35(−37) μm ($\bar{x}$= 140 × 32.4 μm, n=25), 8-spored, bitunicate, fissitunicate, broadly cylindrical, subsessile with minute knob-like pedicel, apically rounded, with a well-developed ocular chamber. *Ascospores* 39–47(−50) × 12–14 μm ($\bar{x}$ = 43.4 × 13.2 μm, n=30), overlapping 1–3-seriate, phragmosporous, broadly fusiform, rarely cylindric-clavate, widest at the middle cell, pale yellowish when immature, becoming yellowish-brown to brown at maturity, 6-septate, slightly constrict at the septum, smooth and thick-walled.

Material examined: BELGIUM, West-Vlaanderen, Blankenbergh, on *Ammophila arenaria* L. (*Poaceae*), Westendorp (S-F77691); ITALY, Sardegna, Cagliari, La Maddelena, March 1866, Marcucci (S-F77741).

Notes: *Amarenomyces* was introduced by Eriksson (1981) to accommodate the single species from a marine grass, which traditionally has been identified as *Sphaeria ammophilae* Lasch. Eriksson (1981) mentioned that the genus should belong in *Botryosphaeriaceae* rather than *Phaeosphaeriaceae* as its morphological characters differed from *Phaeosphaeria*.

Fig. 5 ***Amarenographium metableticum*** (S-F207509). **a** Specimens and herbarium label of *Amarenographium metableticum* **b** Conidiomata visible on host surface. **c** Section through conidiomata. **d** Section through conidiomata wall. **e–g** Conidiogenous cells. **h–k** Conidia. Scale bars: c=100 *μm*, d=20 *μm*, e, h, i, j, k=10 *μm*, f, g=5 *μm*

Zhang et al. (2009) listed *Amarenomyces* as a synonym of *Phaeosphaeria* based on phylogenetic evidence. The generic type of *Amarenomyces*, *A. ammophilae* often clusters with other *Phaeosphaeria* species (Zhang et al. 2009, 2012; Hyde et al. 2013). Thus the earlier name as proposed by Kohlmeyer and Kohlmeyer (1965) and Leuchtmann (1984) was reinstated as *Phaeosphaeria ammophilae* (Suetrong et al. 2009; Zhang et al. 2009).

Several *Phaeosphaeria* species have previously been transferred to other genera based on the phylogenetic evidence and due to their asexual state. For example *Phaeosphaeria nodorum* which was transferred to *Parastagonospora*, as *Pa. nodorum*. On the other hand, Shoemaker and Babcock (1989b) divided *Phaeosphaeria* into six subgenera by combining *Phaeosphaeria* species with similar morphological characters, but differing in ascospore characters, host

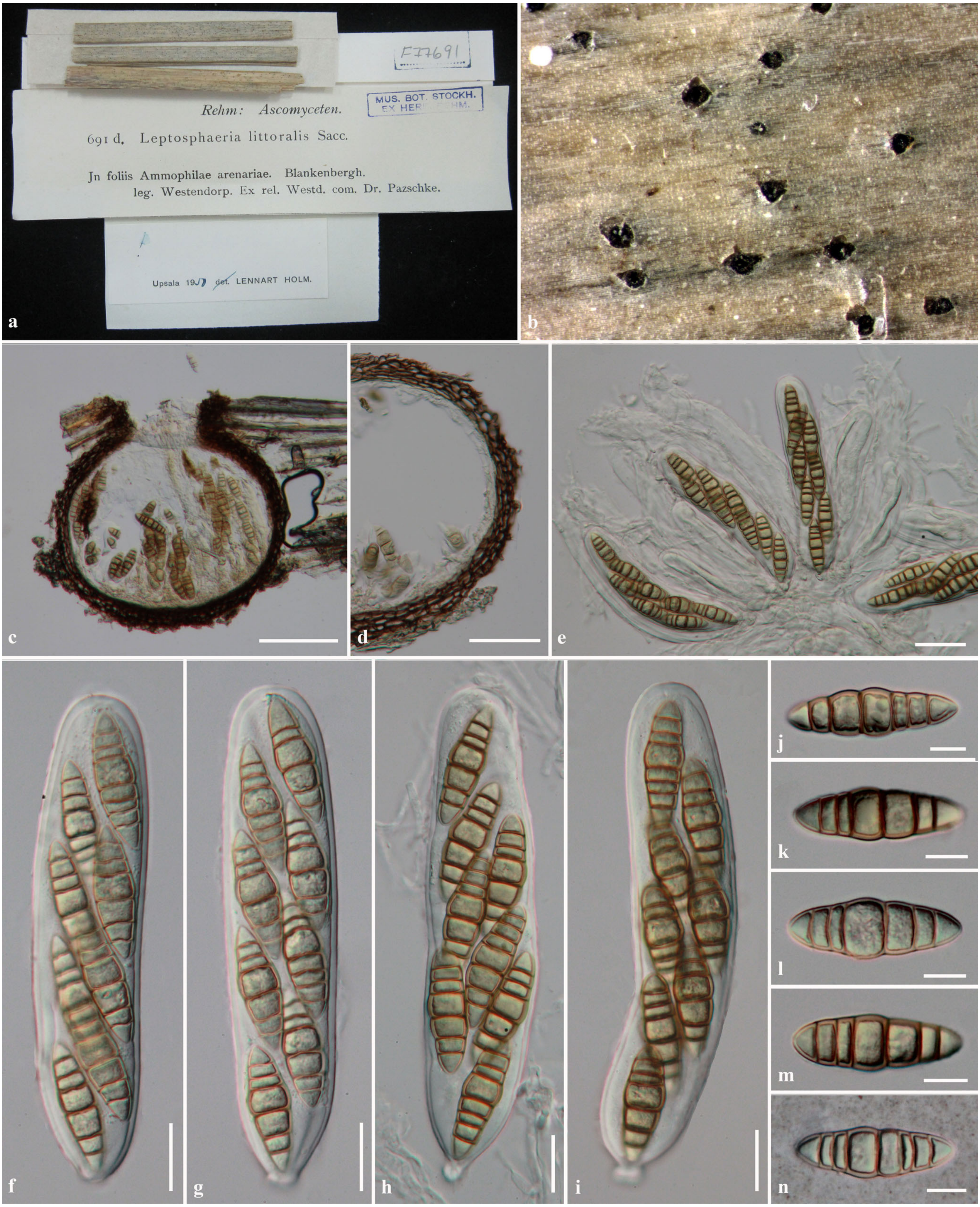


Fig. 6 ***Amarenomyces ammophilae*** (S-F77691). **a** Specimens and herbarium label **b** Ascomata visible on host surface. **c** Section through ascoma. **d** Section through peridium. **e** Asci with cellular pseudoparaphyses. **f**–**i** Asci. **j**–**m** Ascospores. **n** Ascospore stained in indian ink. Scale bars: c=100μm, c, d=50μm, e, f, g, h, i=20μm, j, k, l, m, n=10μm

preference and asexual state (Câmara et al. 2002; Zhang et al. 2012; Quaedvlieg et al. 2013). The asexual state of *Phaeosphaeria* has been reported as *Phaeoseptoria* and this is supported by phylogenetic data (Quaedvlieg et al. 2013). Quaedvlieg et al. (2013) transferred *Phaeosphaeria* species which did not produce *Phaeoseptoria* asexual states to other genera. Therefore, the genus *Amarenomyces* is reinstated in this study based on the phylogenetic analysis as *A. ammophilae* forms a separate clade to the type species, *Phaeosphaeria oryzae*. Although *A. ammophilae* has often been reported to be the sexual state of *Amarenographium metableticum* (Trail) O.E. Erikss., they are not treated as congeneric here. The presumed link was established as both species occur on the same host in close proximity. There is, however, no sequence data for *Amarenographium metableticum* and it might be predicted that if both species were host-specific then it would not be surprising that they both occur on the same host. We therefore refrain from combining the taxa until molecular data confirms the link.

Ampelomyces Ces. ex Schlecht., Bot. Zeit. 10: 302 (1852), *Faces of Fungi number*: FoF00291.

Hyperparasitic on *Erysiphales* or saprobic. **Sexual state:** unknown. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary, superficial, uniloculate, globose or elongated to pyriform, pale brown, ostiolate, sometimes papillate. *Conidiomata walls* thick, composed of pale brown cells, arranged in *textura angularis. Conidiophores* mostly reduced to conidiogenous cells. *Conidiogenous cells* enteroblastic, phialidic, determinate, discrete, doliiform to ampulliform, hyaline, smooth-walled, channel and collarette minute, periclinal wall towards apex thickened, formed directly from the pycnidial wall cells. *Conidia* amerosporous, cylindrical to fusiform, straight to curved, very pale brown, aseptate, thin and smooth-walled, with guttules. (Sutton 1980)

Type species: ***Ampelomyces quisqualis*** Ces., Bot. Ztg. 10: 301 (1852).

Phylogenetic study: Kiss and Nakasone (1998), Szentiványi et al. (2005), Liang et al. (2007), De Gruyter et al. (2009), Aveskamp et al. (2010), Hyde et al. (2013), Wijayawardene et al.(2013a)

Notes: Ampelomyces species have been reported as mycoparasites on powdery mildews (*Erysiphaceae*) and are worldwide in nature (de Bary 1870; Griffith 1899; Kiss 1998; Kiss et al. 2004). The genus was introduced by Cesati (1852) to accommodate taxa that formed pycnidia as intracellular mycoparasites on powdery mildews (De Bary 1870; Kiss et al. 2004). Previously, *Ampelomyces* had varied morphological and cultural characteristic with species differentiated based on pycnidia, cultures and conidial types in isolates of pycnidial mycoparasites from powdery mildews (Clare 1964; Belsare et al. 1980; Kiss et al. 2004). In Kiss et al. (2004), *Ampelomyces* species could be distinguished into slow and fast growing types. Based on the rDNA ITS region phylogenetic analysis, Kiss et al. (2004) concluded that strains from the two types of differentiated growth rate were not congeneric. The slow-growing isolates, obtained from intracellular pycnidia in powdery mildew mycelia was *Ampelomyces sensu stricto*. While fast growing isolates from sessile pycnidia on mildew-infected leaves, were closely related to *Phoma* species. *Ampelomyces quercinus* (Syd.) Rudakov, *A. humuli* (Fautrey) Rudakov and *A. heraclei* (Dejeva) Rudakov are example of fast growing species (Rudakov 1979; Kiss and Nakasone 1998; Sullivan and White 2000). De Gruyter et al. (2009) included two isolates of the type species; *A. quisqualis* in their phylogenetic analysis and showed that the type species of *Ampelomyces* can be accommodated in *Phaeosphaeriaceae*. Whereas *Ampelomyces quercinus* grouped in *Didymellaceae*; thus, Aveskamp et al. (2010) introduced *A. quercinus* as new combination within *Phoma* in *Didymellaceae*.

Bricookea M.E. Barr, Mycotaxon 15: 346 (1982), *Faces of Fungi number*: FoF00239.

Saprobic on *Juncaceae*. **Sexual state***: Ascomata* scattered or clustered, immersed to semi-immersed, becoming erumpent through host tissue or superficial at maturity, uni- to multi-loculate, globose to subglobose, glabrous, brown to dark brown, ostiole central, with slit-like opening. *Peridium* thin-walled, composed of brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* composed of numerous, filamentous, distinctly septate, broad cellular pseudoparaphyses, anastomosing at the apex. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, narrow towards apex, short pedicellate, apically rounded, with well-developed ocular chamber. *Ascospores* overlapping, 1–3-seriate, phragmosporous, ellipsoidal to broadly fusiform, hyaline, septate, slightly curved, constricted at the median septum, smooth and thick-walled. **Asexual state:** Unknown.

Type species: ***Bricookea sepalorum***

Phylogenetic study: None

Notes: Barr (1982) introduced *Bricookea* to accommodate *B. sepalorum* that was previously identified as *Leptosphaeria sepalorum* (Vleugel) Lind (Lind 1928). Holm (1957) observed the collections from Sweden and compared the morphological characters with specimens from North America. He mentioned that the ascospores and asci of Swedish collections were smaller than North American specimens and regarded the species as synonym of *Lizonia emperigonia* (Auersw.) de Not. (Barr 1982; Shoemaker and Babcock 1989a; Zhang et al. 2012). Barr (1982) did not agree with Holm (1957) and designated the new genus, *Bricookea* to accommodate *Leptosphaeria sepalorum*. Barr (1982) suggested placing *Bricookea* in *Phaeosphaeriaceae* with its uniquely opening ostioles and lack of known asexual state. Barr (1982) mentioned that *Sphaerulina inquinans* Rehm may be provided as earlier epithet of *Bricookea sepalorum*.

However, Shoemaker and Babcock (1989a) studied the type specimens of *Bricookea* from S herbaria and mentioned that no material was found under the name *Sphaerulina inquinans*. Subsequently, Shoemaker and Babcock (1989a) introduced the new species, *Bricookea barrae* from a North American collection which had been examined by Barr (1982). *Bricookea barrae* [as *Br. barriae*] was synonymized under the name *Lophiostoma barriae* in *Lophiostomataceae* by Eriksson (2007) leaving the genus monotypic. Zhang et al. (2012) tentatively place *Bricookea* in *Phaeosphaeriaceae*. Currently, *Bricookea* is generally treated in *Lophiostomataceae* based on its slit-like ostioles, but the type species, *Br. sepalorum* has been synonymized under the earlier name in *Leptosphaeriaceae* as *Leptosphaeria sepalorum* (Index Fungorum 2014).

We examined the collection from North America and type specimen from S herbaria. Both collections have similar morphological characters. However, the specimens from North America differ in having larger ascoma, asci and ascospores than the type specimen from Europe. In this study, *Bricookea* forms a group in pseudostroma, with slit-like ostioles; characters typical of *Lophiostomataceae*. However, we tentatively place *Bricookea* in *Pheaosphaeriaceae* as its peridium is thin-walled, composed of pseudoparenchymatous cells, asci are clavate with a subsessile to short acute pedicel and ascospores are phragmosporous. Fresh collection, epitypification and molecular analysis are needed to confirm the natural placement.

Bricookea sepalorum (Vleugel) M.E. Barr, Mycotaxon 15: 346 (1982), *Faces of Fungi number*: FoF00240, Fig. 7.

≡ *Metasphaeria sepalorum* Vleugel, *Svensk bot. Tidskr.* **2**(4): 369 (1908)

Saprobic on *Juncus* spp. **Sexual state:** *Ascomata* 130–210 μm high, 170–250 μm diam., scattered to clustered, gregarious, immersed to semi-immersed under epidermis, becoming erumpent through host tissue, to superficial at maturity, visible as black dots in rows or groups on host surface, uni- to multi-loculate, globose to subglobose, glabrous, dark brown to black, ostioles central, with slit-like opening. *Peridium* 10–20 μm wide, thin-walled, of equal thickness, composed of 2–3 layers of large, brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis*. *Hamathecium* composed of numerous, 1.5–2 μm wide, filamentous, distinctly septate, cellular pseudoparaphyses, embedded in mucilaginous matrix, anastomosing at the apex. *Asci* (60–)65–75(−80)×12–14(−16) μm ($\bar{x}$ = 71.5×13.5 μm, *n*=30), 8-spored, bitunicate, fissitunicate, cylindric-clavate, narrowing towards the apex, with subsessile to shortly acute pedicel, apically rounded with well-developed ocular chamber. *Ascospores* 17.5–19(−21)×6–7.5 μm ($\bar{x}$ = 19×6.4 μm, *n*=30), overlapping 1–2-seriate, phragmosporous, ellipsoidal to broadly fusiform, hyaline to subhyaline, initially forming one median septate, becoming 3-septate at maturity, slightly curved, constricted at the median septum, easily breaking into part spores at the median septum, smooth and thin to thick-walled. **Asexual state:** Unknown.

Material examined: SWEDEN, Suecia. Holmön, Västerbotten, on dead sepals of *Juncus filiformis* Linn. (*Juncaceae*), July 1907, J. Vleugel (S-F49661, **type**); USA, California, Squaw Valley Creek Meadows, Mt. Shasta, Siskiyou Co. alt. 8,500 ft., on dead sepals of *Juncus parryi* Engelm. (*Juncaceae*), 10 July 1947, W. B. Cooke & V. G. Cooke (BPI 737398); Washington, Mt. Baker National Forest, Whatcom Co. Subalpine Meadows along Washington Route #1 near Baker Lodge, on dead sepals of *Juncus parryi* Engelm. (*Juncaceae*), 12 July 1948, W. B. Cooke & V. G. Cooke 24247 (BPI 737397); California, King Creek Trail, Lassen Volcanic National Park. alt. 8,000 ft., on dead sepals of *Juncus parryi* Engelm. (*Juncaceae*), 1 July 1954 W. B. Cooke & V. G. Cooke 29530 (BPI 737400); California, King Creek Trail, Lassen Volcanic National Park. alt. 8,000 ft., on dead sepals of *Juncus parryi* Engelm. (*Juncaceae*), 1 July 1954, W. B. Cooke & V. G. Cooke 29530 (BPI 737399); California, Panther Creek Meadows, Mt. Shasta, Siskiyou Co. alt. 7,600 ft., on dead sepals of *Juncus parryi* Engelm. (*Juncaceae*), 4 July 1948, W. B. Cooke 24055 (BPI 737401).

Chaetosphaeronema Moesz, Bot. Közl. 14: 152 (1915), *Faces of Fungi number*: FoF00241.

Saprobic or *pathogenic* on *Malus*, *Euphorbia*, *Anthyllis* and *Dorycnium* spp. **Asexual state:** Unknown *Conidiomata* pycnidial, scattered, immersed to semi-immersed, uniloculate, globose, setose, brown to dark brown, ostiole central, with setose papilla. *Conidiomata walls* thin, arranged in a *textura prismatica*, pale brown, outer layers comprising dark brown, thick-walled cells. *Conidiophores* arising from basal cavity of conidiomata mostly reduced to conidiogenous cells. *Conidiogenous cells* enteroblastic, phialidic, discrete or integrated, cylindrical, hyaline, smooth-walled, with minute channel or collarette, hardly distinguishable from the inner wall cells. *Conidia* didymosporous, oblong to cylindrical, with obtuse ends, straight or slightly curved, hyaline, 1-septate, thin and smooth-walled, with guttules (from Sutton 1980; Quaedvlieg et al. 2013)

Type species: ***Chaetosphaeronema hispidulum*** (Corda) Moesz, Bot. Közl. 14: 152 (1915)

= *Sphaeronaema hispidulum* Corda, Icon. fung. (Prague) 4: 39 (1840)

Phylogenetic study: Schoch et al. (2009), De Gruyter et al. (2009, 2010), Zhang et al. (2009, 2012), Hyde et al. (2013), Quaedvlieg et al. (2013).

Notes: *Chaetosphaeronema* was introduced by Moesz (1915) as typified by *Ch. hispidulum* to accommodate species of *Sphaeronaema* that were not congeneric. A partial morphological treatment of the genus was provided by Sutton (1980). Petrak (1944) treated *Ch. herbarum* (Hollós) Moesz as a synonym of *Ch. hispidulum* and accepted three species in

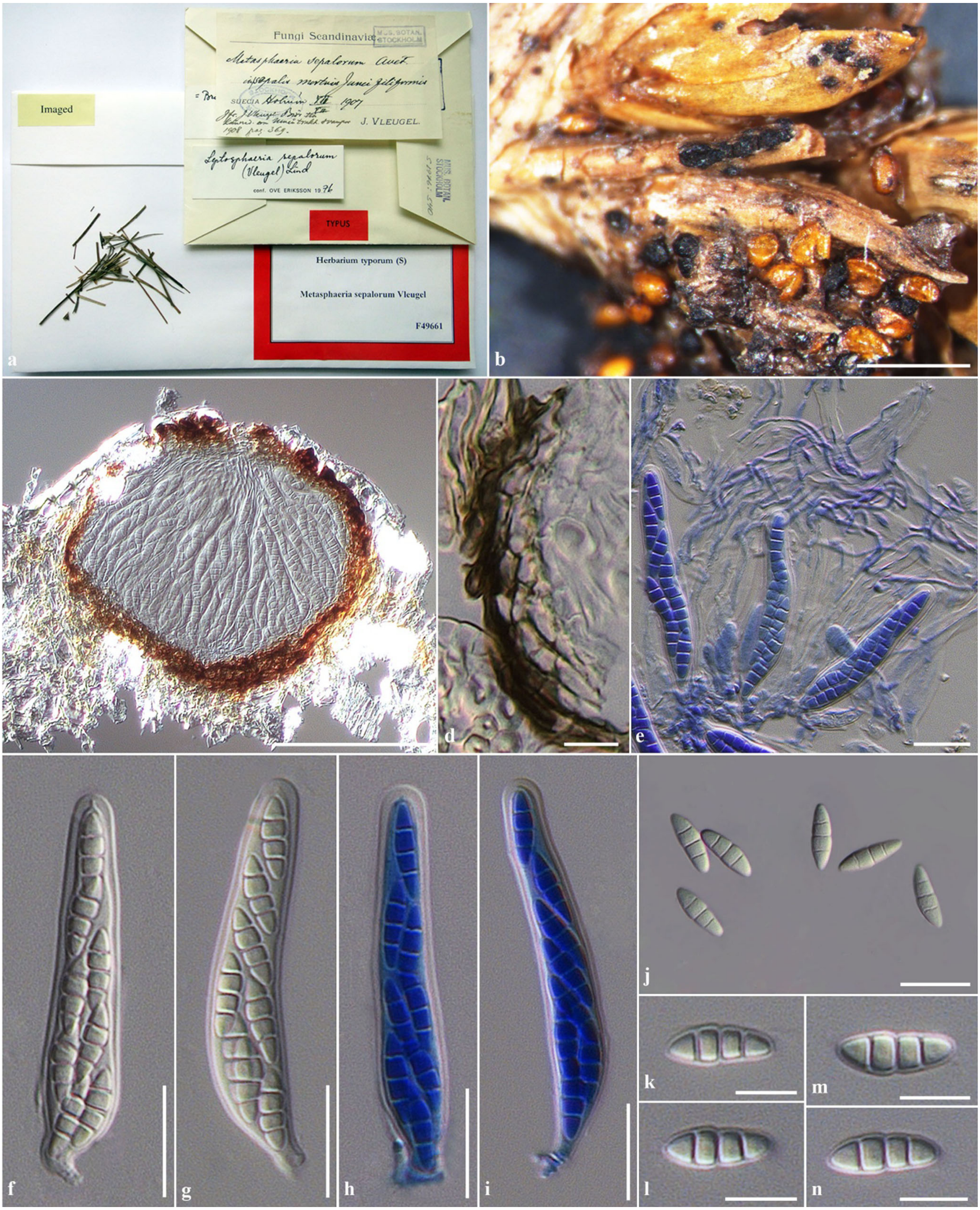


Fig. 7 ***Bricookea sepalorum*** (S-F49661**, type**). **a** Herbarium label and specimens **b** Ascomata on substrate. **c** Section through stroma **d** Section through peridium. **e** Asci with cellular pseudoparaphyses strained in cotton blue reagent. **f**–**g** Asci. **h**–**i** Asci stained in cotton blue reagent. **j** Ascospores. **k**–**n** Ascospores. Scale bars: b=1000 μm, c=100 μm, e, f, g, h, i, j=20 μm, d, k, l, m, n=10 μm

the genus; *Ch. collivagum* (Petr.) Petr., *Ch. galii* (Petr.) Petr. and *Ch. hispidulum* (Sutton 1980). However, *Chaetosphaeronema* was subsequently limited to the type species (De Gruyter et al. 2009, 2010; Zhang et al. 2012; Hyde et al. 2013; Quaedvlieg et al. 2013). De Gruyter et al. (2009) showed, using molecular data that *Chaetosphaeronema* was related to *Phaeosphaeriaceae* and *Pleosporaceae*. De Gruyter et al. (2010) introduced a new species, *Ch. coonsii* (Boerema & Loer.) Gruyter et al., and treated *Chaetosphaeronema sensu stricto* in *Phaeosphaeriaceae*. This placement has been widely accepted by subsequent authors based on the phylogenetic evidence, while no sexual state is presently known (Schoch et al. 2009; Zhang et al. 2009, 2012; Hyde et al. 2013; Quaedvlieg et al. 2013).

In this study, *Chaetosphaeronema* clusters with various sexual genera and is closely related to *Ophiobolus cirsii* (MFLUCC13-0218) as propose by Petrak (1944) and Zhang et al. (2009) who suggested that *Chaetosphaeronema* may be asexual state of *Ophiobolus*. The link between these genera has not yet equivocally been proven. Epitypification with molecular data is therefore needed to confirmed the natural placement of these genera and confirm asexual-sexual connections.

Dematiopleospora Wanasinghe et al., Cryptog. Mycol. 35 (2): 105-11(2014), *Faces of Fungi number*: FoF00242.

Saprobic on *Ononis spinosa* L (*Fabaceae*). **Sexual state:** *Ascomata* scattered, solitary, superficial, uniloculate, globose to subglobose, glabrous, dark brown to black, coriaceous, cupulate when dry, ostiole central, minute papilla, with thick, brown, periphyses. *Peridium* thin-walled, composed of pseudoparenchymatous cells, outer layer comprising heavily pigmented, thick-walled, reddish to dark brown cells, arranged in *textura angularis*, inner layer comprising 2–3 cell layers of thin-walled, hyaline cells, arranged in a *textura angularis. Hamathecium* composed of numerous, filamentous, distinctly septate, broad cellular pseudoparaphyses. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded with minute ocular chamber. *Ascospores* overlapping 1–2-seriate, dictyosporous, muriform, ellipsoidal to subfusiform, widest in the upper part, slightly curved, 5–9 transverse septa, with 3–6 longitudinal septa, constricted at the central septum, initially hyaline, becoming yellowish-brown at maturity, smooth-walled. **Asexual state:** Unknown (from Wanasinghe et al. 2014)

Type species: ***Dematiopleospora mariae*** Wanasinghe et al., Cryptog. Mycol. 35 (2): 105-11(2014)

Phylogenetic study: Wanasinghe et al. (2014).

Notes: *Dematiopleospora* was introduced by Wanasinghe et al. (2014) to accommodate *D. mariae*. The genus is characterized by thick, brown, periphyses in the ostiole, superficial ascomata and muriform ascospores. *Dematiopleospora* is similar to *Nodulosphaeria* in its periphysate ostiole, but they differ in peridium structure and ascospore morphology. *Dematiopleospora* has muriform ascospores similar to those characterized in *Phaeosphaeria vagans* (Niessl) O.E. Erikss., *Ph. phragmiticola* Leuchtm., *Ph. phragmitis* (Hollós) Leuchtm and *Pleoseptum yuccaesedum* A.W. Ramaley & M.E. Barr (Shoemaker and Babcock 1989b; Zhang et al. 2012; Wanasinghe et al. 2014). *Dematiopleospora* is similar to *Pleoseptum*, but they differ in peridium structures and papillate ostioles. *Pleoseptum* lacks of molecular data to confirm its natural placement. Therefore, the genus is tentatively placed in *Pleosporaceae* based on its muriform ascospores and thick-walled peridium that are dominant characters in *Pleosporaceae*. Multigene phylogenetic analyses indicated that *Dematiopleospora* belongs to *Phaeosphaeriaceae* which forms a separate clade from those *Phaeosphaeria* species and groups with *Chaetosphaeronema*, *Entodesmium*, *Loratospora* and *Nodulosphaeria*. No asexual morph is known for *Dematiopleospora*.

Dothideopsella Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 124: 70 (1915), *Faces of Fungi number*: FoF00295

Saprobic on dead wood and stems in terrestrial habitats. **Sexual state:** *Ascomata* scattered, gregarious, immersed to semi-immersed, or erumpent, nearly superficial, globose, uniloculate, subglobose or obypyriform, glabrous, dark brown to black, ostiole central, broadly or narrowly conical, with a dark brown to black papilla. *Peridium* thin to thick, of unequal thickness, slightly thick at the basal ascoma, composed of dark brown to black, thin-walled, pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* composed of numerous, filamentous, distinctly septate, cellular pseudoparaphyses, anastomosing without a gelatinous coating. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical to oblong, with a knob like pedicel, apically rounded with well-developed ocular chamber *Ascospores* phragmosporous, ellipsoidal to fusiform, brown or yellowish brown, septate, slightly constricted at the septum, smooth-walled. **Asexual state**: Unknown (from Ariyawansa et al. 2013).

Type species: ***Dothideopsella agminalis*** (Sacc. & Morthier) Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 124: 70 (1915)

Phylogenetic study: None

Notes: Dothideopsella was introduced by Höhnel (1915) and is typified by *Dothideopsella agminalis* (Sacc. & Morthier) Höhn. The genus was established to accommodate Dothideomycetes species characterized by a broad peridium structure, with conical, papillate ostioles, and phragmosporous, brown ascospores (Ahn and Shearer 1998; Ariyawansa et al. 2013). Lumbsch and Huhndorf (2010) treated *Dothideopsella* in Dothideomycetes, genera *incertae sedis*, while Index Fungorum (2014) lists the genus in

Leptosphaeriaceae. Ariyawansa et al. (2013) tentatively placed *Dothideopsella* in *Phaeosphaeriaceae* based on its morphological characters which are typical of *Chaetoplea*. *Dothideopsella* however differs from *Chaetoplea* in having a peridium composed of pseudoparenchymatous cells, while the peridium in *Chaetoplea* is composed of scleroplectenchymatous cells. The placement of the genus in *Phaeosphaeriaceae* was supported by Wijayawardene et al. (2014b). Thus we tentatively place *Dothideopsella* in *Phaeosphaeriaceae* until molecular date proves otherwise.

Entodesmium Riess, Hedwigia 1(6): 28 (1854), *Faces of Fungi number*: FoF00243.

Saprobic or *parasitic*? on various dicotyledonous and some monocotyledonous hosts. **Sexual state:** *Ascomata* scattered, solitary to gregarious, immersed to erumpent through host tissue with long neck, uniloculate, globose to subglobose, glabrous, dark brown to black, ostiole central, with long neck. *Neck* with thick walls of *textura angularis*, dark brown to black, cylindrical to cylindric-clavate, carbonaceous, with periphyses. *Peridium* thick-walled, composed of brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis*. *Hamathecium* composed of numerous, filamentous, distinctly septate, broad cellular pseudoparaphyses, not constricted at the septa and anastomosing at the apex. *Asci* 8-spored, bitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded, with well-developed ocular chamber. *Ascospores* fasciculate, scolecosporous, filiform or filamentous, initially hyaline to pale brown, becoming brown or reddish-brown at maturity, multi-septate, constricted at the septa, separating into numerous part spores, smooth-walled. **Asexual state:** Unknown.

Type species: ***Entodesmium rude***

Phylogenetic study: Liew et al. (2000), Schoch et al. (2009), Zhang et al. (2009, 2012)

Notes: *Entodesmium* was introduced by Riess (1854) and is typified by *E. rude*. The genus was introduced to accommodate a Dothideomycete species with long beaked ascomata and scolecosporous ascospores, which break into numerous part-spores and occur on legumes. The placement of *Entodesmium* was previously unclear as Von Arx and Müller (1975) disposed the genus in *Pleosporaceae*, while Barr (1987b) suggested that *Entodesmium* should be placed in *Phaeosphaeriaceae* and this was accepted by Eriksson and Hawksworth (1991). Barr (1992b) assigned *Entodesmium* to *Lophiostomataceae* based on its short, blackish beak and periphysate ostiole. Barr (1992b) mentioned that these characters are more typical of *Lophiostomataceae*. Zhang et al. (2009, 2012) disagreed with Barr (1992b) and mentioned that the morphological characters of *Entodesmium* best fit in *Phaeosphaeriaceae*.

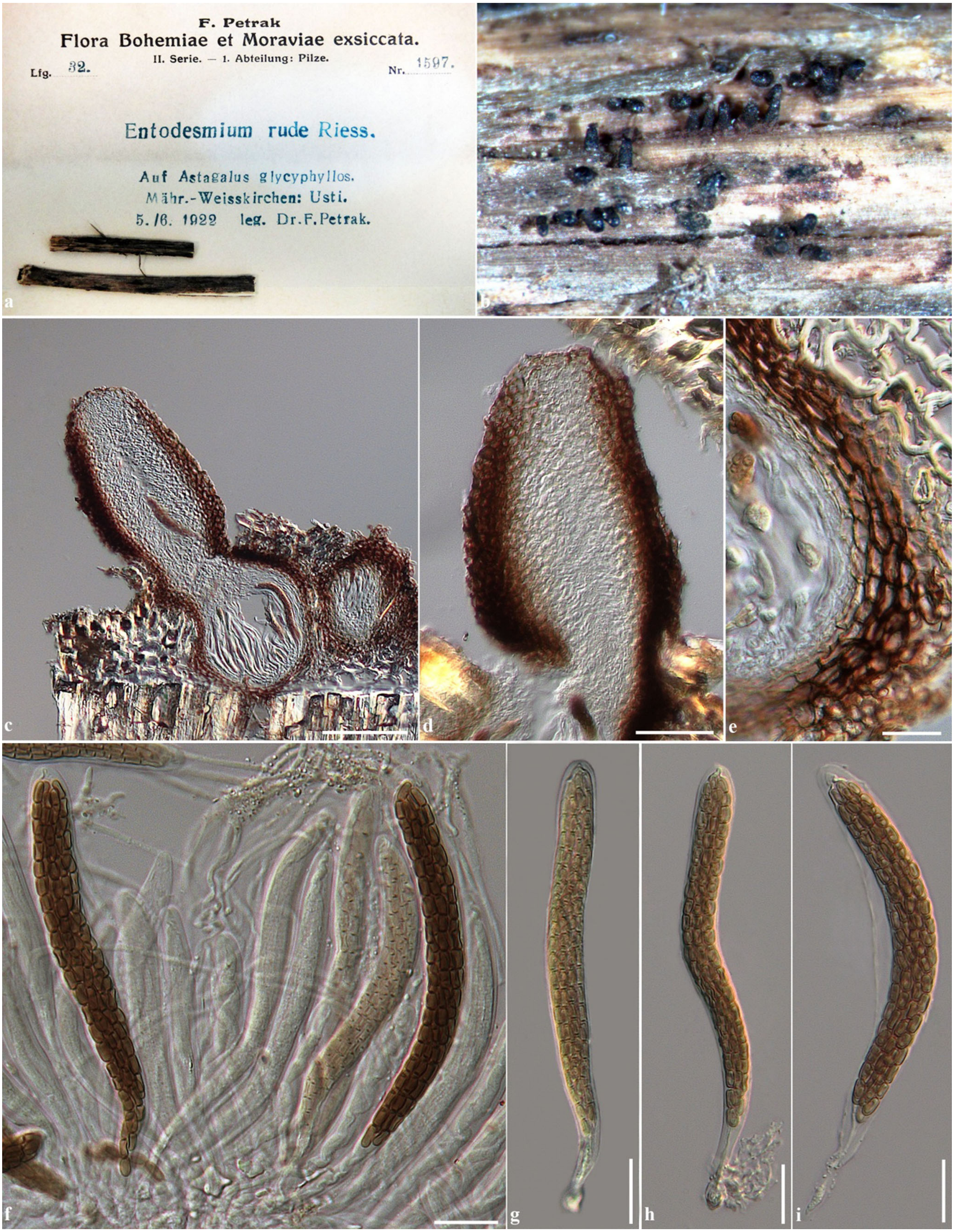
Entodesmium was thought to be family-specific and associated only with legumes (Barr 1992b; Shoemaker 1984; Zhang et al. 2009, 2012). Holm (1957) and Shoemaker (1984) re-described *Entodesmium* and reported six species associated with legumes from Europe; although, Wehmeyer (1952) identified some collections from North America (Barr 1992b). Furthermore, there is a report of *E. niesslianum* from *Dieffenbachia* (monocotyledon) in West Indies by Minter et al. (2001) in Farr and Rossman (2014). Six species are presently accommodated in *Entodesmium*; *E. eliassonii* L. Holm, *E. lapponicum* (L. Holm) L. Holm, *E. mayorii* (E. Müll.) L. Holm, *E. nevadense* Petr., *E. niesslianum* (Rabenh. ex Niessl) L. Holm and *E. rude* (Index Fungorum 2014). *Entodesmium multiseptatum* (G. Winter) L. Holm was assigned to *Leptosphaeriaceae* and *Entodesmium vermisporum* (Ellis) M.E. Barr (1992b) was treated in *Lophiostomataceae* (Winter 1872; Barr 1992b; Zhang et al. 2009, 2012; Index Fungorum 2014). However, Zhang et al. (2009, 2012) mentioned that *E. multiseptatum* and *E. niessleanum* are more similar to *Phaeosphaeria* than *Leptosphaeria* or *Entodesmium*.

Zhang et al. (2009) accepted the scolecosporous genera *Entodesmium* and *Ophiosphaerella* in *Phaeosphaeriaceae* based on phylogenetic evidence. Multigene phylogenetic analysis based on this sequence data has indicated that *Entodesmium* belongs to *Phaeosphaeriaceae* which has been widely accepted (Schoch et al. 2009; Zhang et al. 2009, 2012; Hyde et al. 2013).

In this study, the iconotype is re-drawn while the type specimens could not be located. Based on morphology (thin-walled peridium composed of pseudoparenchymatous cells, and scolecosporous, brown, multi-septate ascospores breaking into part-spores) and multigene phylogenetic analysis, we retain *Entodesmium* in *Phaeosphaeriaceae. Entodesmium* forms a weakly-supported clade with other genera (*Chaetosphaeronema*, *Dematiopleospora*, *Loratospora*, *Nodulosphaeria modesta*, *Ophiobolus cirsii* and *O. erythrosporus*) in *Phaeosphaeriaceae*. However, the sequence data is from a putative strain of *Entodesmium rude* from CBS, thus epitypification and molecular work is needed to confirm its natural placement.

Entodesmium rude Riess, *Hedwigia* 1(6): 28 (1854), *Faces of Fungi number*: FoF00244, Fig. 8, and 9.

Saprobic on *Astragalus*, *Coronilla* and *Lathyrus* spp. **Sexual state:** *Ascomata* 160–240 μm high (excluding neck), 160–255 μm diam., scattered, solitary to gregarious, immersed to erumpent through host tissue with long neck, visible as black dots, in rows or groups on host surface, uniloculate, globose to subglobose, glabrous, dark brown to black, ostiole oblique, with long carbonaceous neck. *Neck* 175.5–295 μm high, 90–150 μm diam., thick-walled, cylindrical to cylindric-clavate, arranged in a *textura angularis*, dark brown to black, carbonaceous, with periphyses. *Peridium* 15–30 μm wide, thick-walled, of equal thickness, comprising two layers, outer layer comprising 3–5 cell layers of brown to dark brown, thick-walled cells, arranged in *textura angularis* to *textura*



F. Petrak
Flora Bohemiae et Moraviae exsiccata.
II. Serie. — 1. Abteilung: Pilze.
Lfg. 32. Nr. 1597.

Entodesmium rude Riess.

Auf Astagalus glycyphyllos.
Mähr.-Weisskirchen: Usti.
5. /6. 1922 leg. Dr. F. Petrak.

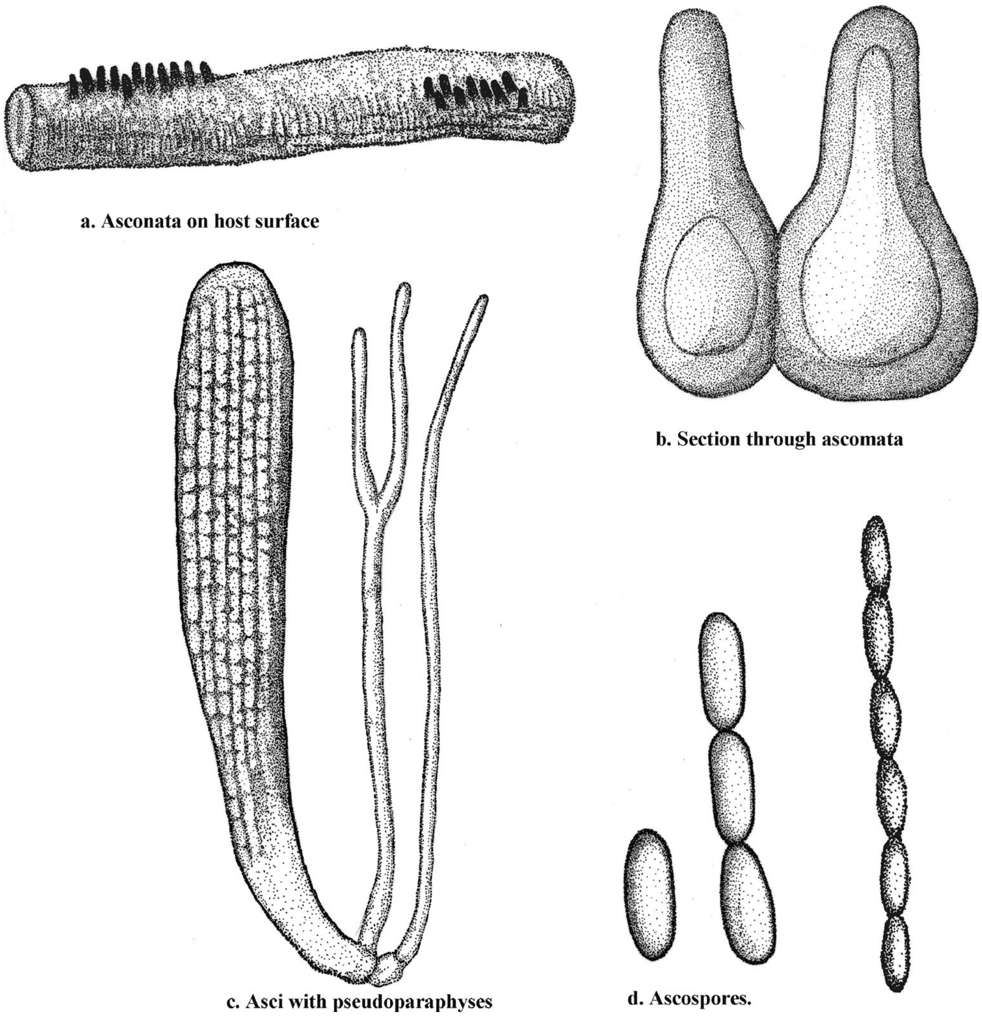
◀ **Fig. 8** ***Entodesmium rude*** (BR 5020100367693). **a** Herbarium packet and specimens. **b** Ascomata on substrate. **c** Section through ascomata. **d** Section through neck. **e** Section through peridium. **f** Asci with pseudoparaphyses. **g**–**i** Asci. Scale bars: c=100 μm, d=50 μm, e, f, g, h, i=20 μm

globulosa, inner layers comprising 1–2 cell layers of thin-walled, hyaline, flattened cells, arranged in *textura angularis* to *textura prismatica. Hamathecium* composed of numerous, 2–3 μm wide, filiform, distinctly septate, broad cellular pseudoparaphyses, embedded in mucilaginous matrix, anastomosing at the apex. *Asci* (124–)130–145(−156)×(11–)13–15(−18) μm ($\bar{x}$ = 137.4×14.4 μm, n=25), 8-spored, bitunicate, broadly cylindrical to cylindric-clavate, short pedicellate, apically rounded with well-developed ocular chamber. *Ascospores* (100–)110–120(−135)×3–4 μm ($\bar{x}$= 115.5×3.5 μm, n=25), fasciculate, scolecosporous, filiform, initially hyaline to pale brown, becoming brown to reddish-brown at maturity, multi-septate, with 18–20 septa, constricted at the septa, easily separating into part spores, smooth-walled.

Material examined: GERMANY, on stem of *Astragalus glycyphyllos*, December 1853, H. Riess, Hedwigia 1(6): Tab IV, (Fig 4., **iconotype**) (1854); CZECHOSLOVAKIA, Usti, on *Astragalus glycyphyllos* L. (*Fabaceae*), 6 May 1922, F. Petrak (BR 5020100367693); CZECHOSLOVAKIA, Moravia, Hranice (Maehr.-weisskirchen), on branches of *Astragalus glycyphyllos* L. (*Fabaceae*), July 1924, F. Petrak (BPI 626664).

Eudarluca Speg., Revta Mus. La Plata 15: 22 (1908), *Faces of Fungi number*: FoF00245. *Hyperparasitic* associated with rust species (but not necessarily parasitic) on various hosts. **Sexual state:** *Ascomata* scattered, solitary to gregarious, immersed to semi-immersed under pseudoclypeus, uni- to multi-loculate, subglobose to irregular in shape, glabrous, dark brown to black, ostiole central, with minute papilla. *Peridium* thin-walled, composed of brown to dark brown, flattened, pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* composed of numerous, filamentous, distinctly septate, frequently anastomosing, broadly cellular pseudoparaphyses. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical, short pedicellate, apically rounded,

Fig. 9 ***Entodesmium rude*** (iconotype) redrawn from Riess (1854). **a** Ascomata on host surface. **b** Section through ascomata. **c** Ascus with pseudoparaphyses. **d** Ascospores



with well-developed ocular chamber. *Ascospores* phragmosporous, overlapping 2-seriate, fusiform or oblong with rounded ends, pale brown, septate, smooth-walled. **Asexual state:** see notes.

Type species: ***Eudarluca australis***

Phylogenetic study: None

Notes: *Eudarluca* was introduced by Spegazzini (1908) and typified by *Eu. australis* which is associated with a rust on leaves of *Canna*. Eriksson (1966) treated *Eu. australis* as a synonym of *Eudarluca caricis* (Fr.) O.E. Erikss. *Eudarluca caricis* has been reported from various hosts, mostly in its presumed asexual state, *Sphaerellopsis* (Yuan et al. 1998; Nischwitz et al. 2005; Zhang et al. 2012). The asexual and sexual state connection between *Eudarluca caricis* and *Sphaerellopsis filum* was derived from ascospores growing on *Puccinia extensicola-oenotherae* (Mont.) Arthur on *Carex* sp. in Pennsylvania, USA (Keener 1951) and confirmed by Yuan et al. (1998). Yuan et al. (1998) grew ascospores of *Eudarluca caricis* on PDA and derived *Sphaerellopsis* conidia and conidiomata after 12 days. Zhang et al. (2012) compared the ITS sequence of *Eudarluca caricis* strain MullMK in GenBank with *Leptosphaeria* species and mentioned that *Eudarluca* should be treated in *Leptosphaeriaceae* due to comparable sequences and also morphological characters. However, both the generic type of *Eudarluca* and *Sphaerellopsis* have never been linked (Wijayawardene et al. 2014b).

Molecular studies on *Eudarluca* are limited to species variation and are based on *Sphaerellopsis* strains (Nischwitz et al. 2005; Bayon et al. 2006; Zhang et al. 2012). The ITS gene phylogenetic analysis showed that *Eudarluca ciricis* (strains MosID6 and MullMK) cluster in *Leptosphaeriaceae*. However, the generic type of *Sphaerellopsis* has found on *Quercus*, while the type of *Eudarluca* is from *Canna*. These two generic types have not been linked by molecular data. We suggest that caution should be followed when treating these taxa, as *Eu. australis* is immersed in the *Canna* leaves and although associated with the rust fungi (*Sphaerellopsis*) on *Canna*, it does not seem to grow on the rust.

In this study, we tentatively place *Eudarluca* in *Phaeosphaeriaceae* based on its morphological characters which are typical of *Phaeosphaeria* as the peridium is thin-walled, and composed of pseudoparenchymatous cells, asci are cylindrical, subsessile to short pedicellate and ascospores are fusiform and phragmosporous. Fresh collections of *Eu. australis* are needed for epitypification and molecular study. *Sphaerellopsis* may belong in *Leptosphaeriaceae* where it is tentatively assigned.

Eudarluca australis Speg., Revta Mus. La Plata 15: 22 (1908), *Faces of Fungi number*: FoF00246, Fig. 10.

Hyperparasitic associated with rust fungi on leaves of *Canna indica* L. (*Cannaceae*). **Sexual state:** *Ascomata* 110–180 μm high, 170–280 μm diam., scattered, solitary to gregarious, immersed to semi-immersed, visible as raised, black tiny spots in black pseudostromata on leaf lesions, uniloculate, subglobose to irregular, glabrous, dark brown to black, ostiole central, with minute papilla. *Peridium* 5–13 μm wide, thin-walled, of unequal thickness, slightly thickened at the apex, composed of 1–3 layers of brown to dark brown, flattened, pseudoparenchymatous cells, arranged in *textura angularis. Hamathecium* composed of numerous, 1.5–3 μm wide, filiform, distinctly septate, frequently anastomosing, broadly cellular pseudoparaphyses, embedded in mucilaginous matrix. *Asci* (44–)50–65 × 8–10 μm ($\bar{x}$ = 57 × 9 μm, *n*=25), 8-spored, bitunicate, fissitunicate, cylindrical, short pedicellate or subsessile, apically rounded, with indistinct ocular chamber. *Ascospores* 15–17(−18) × 3–4.5 μm ($\bar{x}$= 16.7 × 4.1 μm, *n*=30), phragmosporous, overlapping or 2-seriate, fusiform, or oblong with rounded ends, pale brown, 2-septate, rarely 1-septate, slightly curved, not constricted at the septa, smooth-walled. **Asexual state:** see notes.

Material examined: BRAZIL, São Paulo, Botanical Gardens, associated with rust (*Pucciniaceae*) on leaves of *Canna indica* L., 10 August 1905, A. Usteri (S-F11420, **isotype**).

Loratospora Kohlm. & Volkm.-Kohlm., Syst. Ascom. 12(1–2): 10 (1993), *Faces of Fungi number*: FoF00247.

Type species: ***Loratospora aestuarii***

Phylogenetic study: Schoch et al. (2009), Suetrong et al. (2009), Zhang et al. (2012), Hyde et al. (2013).

Loratospora aestuarii Kohlm. & Volkm.-Kohlm., Syst. Ascom. 12(1–2): 10 (1993), *Faces of Fungi number*: FoF00248, Fig. 11.

Saprobic on *Juncus roemerianus* Scheele. **Sexual state:** *Ascomata* 130–250 μm high, 160–310 μm diam., scattered to clustered, solitary, immersed to erumpent through host surface, visible as small black spots on host surface, uni to biloculate, globose to subglobose, glabrous, brown to dark brown, ostiole central, with minute papilla, with brown periphyses. *Peridium* 18–42 μm wide, thin-walled, of unequal thickness, thickened at the apex, composed of several layers of brown to dark brown, pseudoparenchymatous cells, arranged in *textura angularis* to *textura globulosa. Hamathecium* absent, visible as mucilaginous matrix between asci. *Asci* (60–)70–85(−110) × (23–) 25–30(−35) μm ($\bar{x}$ = 80.9 × 28.2 μm, *n*=20), 8-spored, bitunicate, fissitunicate, ovoid to ampulliform, thick-walled at the apex, sessile to subsessile, apically rounded with indistinct ocular chamber, sparse in mucilaginous matrix. *Ascospores* 40–50(−55) × 5–7(−8) μm ($\bar{x}$ = 46.7 × 6.7 μm, *n*=30), overlapping or parallel, 4–5-seriate, phragmosporous, cylindrical, or narrowly elongate fusiform with rounded ends, initially hyaline to subhyaline, pale yellowish at maturity, 3-septate, slightly curved, not constricted at the septa, rough-walled, surrounded by a thin, distinct sheath. **Asexual state:** Unknown.

Material examined: USA, North Carolina, on dead culms of *Juncus roemerianus* (*Juncaceae*), Kohlmeyer_5505 (**holotype**), 5520, 5523, 5525, 5535 (NY_Slide box: 17, Tray no. 21); *ibid.* Broad Creek (Atlantic Ocean) 34° 43′ 00″

Fig. 10 ***Eudarluca australis*** (S-F11420, **isotype**). **a** Herbarium label and specimens. **b** Fruiting bodies on host surface. **c** Section through ascoma. **d** Section through peridium. **e** Pseudoparaphyses. **f** Asci with pseudoparaphyses. **g**–**j** Asci. **k**–**o** Ascospores. Scale bars: c=100 μm, d, f, g, h, i, j=20 μm, e=10 μm, k, l, m, n, o, = 5 μm

N, 76° 55′ 07″W (34.717, −76.919), standing dead culms of *Juncus roemerianus*, J. Kohlmeyer 5520 with B. Kohlmeyer, 13 October 1993 (NY 01276343).

Notes: The monotypic genus *Loratospora* was established by Kohlmeyer and Volkmann-Kohlmeyer (1993) to accommodate *L. aestuarii*. The taxon occurs on dead culms of

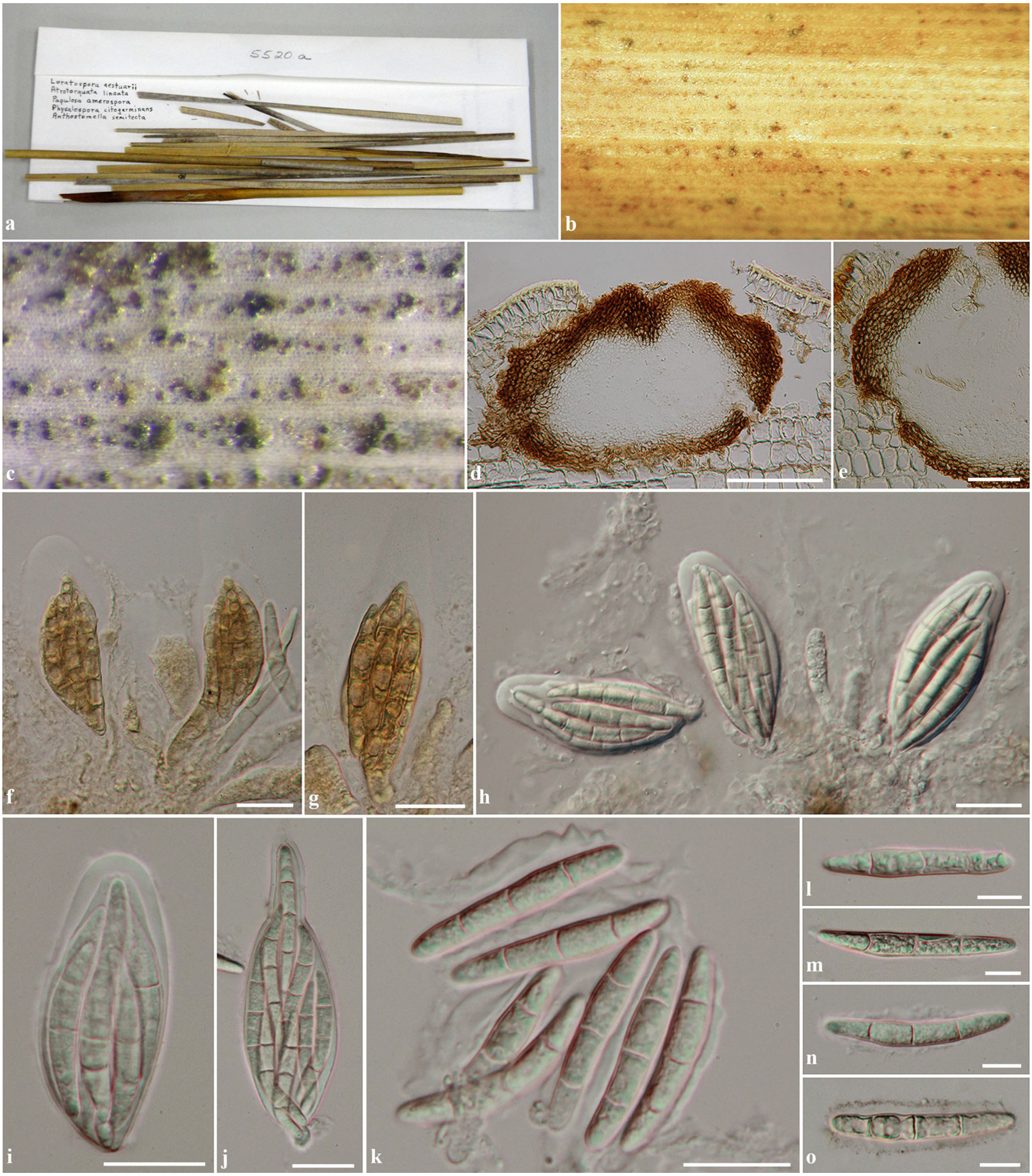


Fig. 11 ***Loratospora aestuarii*** **a** Herbarium label and specimens (Kohlmeyer_5505). **b, c** Ascomata on host surface (Kohlmeyer_5505, Kohlmeyer_5520). **d** Section through ascoma (Kohlmeyer_5505). **e** Section through peridium (Kohlmeyer_5505) **f–g** Asci (Kohlmeyer _5505). **h** Asci embedded in a gelatinous matrix (Kohlmeyer_5520). **i–j** Asci (Kohlmeyer_5520). **k** Ascospores (Kohlmeyer_5520) **l–n** Ascospores (Kohlmeyer_5520). **o** Ascospore (Kohlmeyer_5505). Scale bars: d=100 μm, e=50 *μm*, f, g, h, I, j, k=20 *μm*, l, m, n, o=10 *μm*

Juncus roemerianus (Jones et al. 2009; Suetrong et al. 2009; Monkai et al. 2013). Kohlmeyer and Volkmann-Kohlmeyer (1993) mentioned that the species often developed on culms which were not regularly submerged in salt water. *Loratospora* is similar to *Leptosphaerulina* (*Didymellaceae*), *Monascostroma* (*Didymellaceae*) and *Wettsteinina*

(Dothideomycetes genera *incertae sedis*), but *Leptosphaerulina* and *Monascostroma* have smaller ascomata, lack periphyses, and have a thin-walled peridium. Ascospores in *Leptosphaerulina* are muriform and didymosporous in *Monascostroma* (Kohlmeyer and Volkmann-Kohlmeyer 1993; Jones et al. 2009). *Loratospora* forms large ascomata with brown ostiolar periphyses, a thick-walled peridium at the apex and phragmosporous, cylindrical ascospores (Kohlmeyer and Volkmann-Kohlmeyer 1993; Jones et al. 2009; Suetrong et al. 2009). *Wettsteinina* differs from *Loratospora* in lacking ostiolar periphyses, in having a thick-walled peridium of equal width and ellipsoidal to broadly fusiform ascospores (Kohlmeyer and Volkmann-Kohlmeyer 1993)

Loratospora was re-circumscribed by Jones et al. (2009) and Monkai et al. (2013). The genus was accommodated in *Planistromellaceae* by Barr (1996) due to its periphysate ostiole (Jones et al. 2009; Suetrong et al. 2009; Monkai et al. 2013). Based on multigene phylogenetic analysis, *Loratospora* was placed in *Phaeosphaeriaceae* (Schoch et al. 2009; Zhang et al. 2012; Hyde et al. 2013).

In the multigene phylogenetic analyses (Fig. 2), *Loratospora* forms a strongly supported clade with *Chaetosphaeronema*, *Dematiopleospora*, *Entodesmium*, *Nodulosphaeria* and *Ophiobolus*. However, the genus has a differentiated centrum type as compared with other genera. *Loratospora* lacks of pseudoparaphyses but has an internal mucilaginous hamathecium, while most genera in *Phaeosphaeriaceae* have pseudoparaphyses. It seem like the centrum-type is not significant to distinguish genera at the family level. There is only one species listed in *Loratospora* in Index Fungorum (2014) and no asexual state is known. The sequences data of *Loratospora* is limited to only one strain.

Neosetophoma Gruyter et al., in Gruyter et al. Mycologia 102(5): 1075 (2010), *Faces of Fungi number*: FoF00249.

Pathogenic on the grasses, *Phlox paniculata* L. and *Urtica dioica* L., or associated with soil. **Sexual state:** Unknown. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary or gregarious, superficial on agar, uniloculate, globose or irregular, setose, olivaceous to dark olivaceous, ostiole central, with papilla or long neck. *Conidiomata walls* composed of pseudoparenchymatous cell. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, discrete, hyaline. *Conidia* ellipsoidal to cylindrical, attenuate at one end, yellowish, aseptate or septate, not constricted at the septum, smooth-walled, with guttules (from De Gruyter et al. 2010; Quaedvlieg et al. 2013).

Type species: ***Neosetophoma samararum*** (Desm.) Gruyter et al. [as 'samarorum'], in De Gruyter et al. Mycologia 102(5): 1075 (2010).

≡ *Phoma samararum* Desm., Pl. Crypt. Nord France, Edn 1 7: no. 349 (1828)

Phylogenetic study: De Gruyter et al. (2010, 2012), Zhang et al. (2012), Hyde et al. (2013), Quaedvlieg et al. (2013).

Notes: Neosetophoma was introduced by De Gruyter et al. (2010) to accommodate *N. samararum. Neosetophoma* often forms a single clade in *Phaeosphaeriaceae*. The genus has been widely accepted in *Phaeosphaeriaceae* by various authors (De Gruyter et al. 2010, 2012; Zhang et al. 2012; Hyde et al. 2013; Quaedvlieg et al. 2013).

Neostagonospora Quaedvlieg et al., Stud. Mycol. 75: 364 (2013), *Faces of Fungi number*: FoF00250.

Pathogenic on *Carex acutiformis* Ehrh and *Elegia cuspidate* Mast., or soil borne. **Sexual state**: Unknown. **Asexual state:** *Conidiomata* pycnidial, scattered, semi-immersed to superficial, uniloculate, globose, glabrous, producing pale luteous to creamy conidial mass on host surface. *Conidiomata walls* thin, composed of 2–3 layers of pale brown cells, arranged in a *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, integrated, ampulliform to doliiform, hyaline, smooth-walled, lining the inner cavity, with prominent periclinal thickening. *Conidia* narrow fusoid-ellipsoidal to subcylindrical, apically subobtuse to rounded, truncate at the base, hyaline, septate, initially non-constricted at the septum, becoming constricted at the septa when mature, smooth-walled, with granules (from Quaedvlieg et al. 2013).

Type species: ***Neostagonospora caricis*** Quaedvlieg et al., Stud. Mycol. 75: 364 (2013).

Phylogenetic study: Quaedvlieg et al. (2013).

Notes: The asexual genus *Neostagonospora* was introduced by Quaedvlieg et al. (2013) to accommodate the stagonospora-like species in *Phaeosphaeriaceae*. Two species were placed in this genus; *Neostagonospora caricis* and *Ne. elegiae* Quaedvlieg et al. with *Ne. caricis* being the type species. *Neostagonospora* is similar to *Stagonospora* but differs in its conidiogenous cells. *Neostagonospora* has determinate phialidic conidiogenous cells, with prominent periclinal thickening while *Stagonospora* has percurrent proliferation of conidiogenous cells. Based on phylogenetic analysis, *Neostagonospora* is related to *Phaeosphaeriaceae*, while the type species of *Stagonospora*, *St. paludosa* clusters in *Massarinaceae* (Quaedvlieg et al. 2013). In the phylogeny in Fig. 2, *Neostagonospora* forms a sister clade with *Parastagonospora* for which no sexual state is known. *Phaeosphaeria sensu lato* taxa are polyphyletic and therefore, it is likely that *Neostagonospora* may be an asexual state of phaeosphaeria-like species.

Nodulosphaeria Rabenh., Klotzschii Herb. Viv. Mycol., Edn 2: no. 725 (in sched.) (1858), *Faces of Fungi number*: FoF00251.

Saprobic or *hemibiotrophic* mostly on herbaceous dicotyledons. **Sexual state:** *Ascomata* scattered, solitary to gregarious, immersed to semi-immersed, or erumpent through host epidermis at maturity, visible as black dots on host surface, uniloculate, globose to subglobose, setose, covered by hyphae, dark brown to black, ostiole central, papillate, with broad setae in ostiolar canal, towards the apex. *Peridium* thin- to thick-walled, of equal thickness, composed of two types of brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis* to *textura globulosa. Hamathecium* composed of numerous, filamentous, anastomosing, broad cellular pseudoparaphyses, with distinct septa. *Asci* 8-spored, bitunicate, fissitunicate, clavate to cylindric-clavate, subsessile to short pedicellate, apically rounded with indistinct ocular chamber. *Ascospores* overlapping 2–4-seriate, phragmosporous, cylindrical or elongated fusiform, brown to yellowish-brown, septate, with an enlarged cell near apex, smooth-walled. **Asexual state:** Unknown.

Type species: ***Nodulosphaeria hirta***

Phylogenetic study: this study.

Notes: *Nodulosphaeria* was introduced by Rabenhorst (1858) to accommodate Dothideomycete species forming phragmosporous, brown, septate ascospores with an enlarged cell, and setose ascomata with broad setae in the papilla apex, mostly found on herbaceous dicotyledonous especially *Asteraceae* (Shoemaker 1984; Zhang et al. 2012). *Nodulosphaeria* has been reported from various hosts and may be host-specific with more than 60 species named, however it is lacking in molecular data (Shoemaker 1984). The genus was previously treated as a synonym of *Leptosphaeria*, but later reinstated by Holm (1957) as typified by *N. hirta* (Clements and Shear 1931; Zhang et al. 2012). *Nodulosphaeria* was treated in *Phaeosphaeriaceae* by Barr (1979) based on its morphological characters which are similar to *Ophiobolus* as the ascospores form an enlarged cell(s). The genera have often been confused and the identification of species can be subjective (Zhang et al. 2012). Shoemaker (1976) re-circumscribed the genus *Nodulosphaeria* and transferred various species to *Ophiobolus*. Later many species were added to *Nodulosphaeria* based on morphology by various authors, but no asexual morph is known (Shoemaker 1984; Shoemaker and Babcock 1987; Zhang et al. 2012). There are 64 epithets listed under *Nodulosphaeria* and unfortunately no sequences available for this genus in GenBank.

Multigene phylogenetic analyses (Figs. 1 and 2) indicate that *Nodulosphaeria* belongs in *Phaeosphaeriaceae*. The genus clusters with *Chaetosphaeronema*, *Dematiopleospora*, *Entodesmium*, *Loratospora* and *Ophiobolus*.

Nodulosphaeria hirta **Rabenh.**, *Klotzschii Herb. Viv. Mycol.*, Edn 2: no. 725 (in sched.) (1858), *Faces of Fungi number*: FoF00252, Fig. 12.

Saprobic on herbaceous dicotyledons. **Sexual state:** *Ascomata* 230–380 μm high (including papilla), 225–395 μm diam., scattered, solitary to gregarious, semi-immersed, or erumpent through host epidermis at maturity, visible as black dots on host surface, uniloculate, globose to subglobose, setose, covered by hyphae, dark brown to black, ostiole central, papillate, with broad setae in ostiolar canal, towards the apex. *Peridium* 21–44 μm wide, thin, of equal thickness, composed of several layers of brown to dark brown, pseudoparenchymatous cells, outer layer comprising 1–2 layers of brown to dark brown, thickened cells, arranged in *textura angularis* to *textura globulosa*, inner layers comprised 2–3 layers of brown to dark brown, flattened cells, arranged in *textura angularis. Hamathecium* composed of numerous, 3–5 μm wide, filamentous, broad cellular pseudoparaphyses, with distinct septa, embedded in mucilaginous matrix, anastomosing at the apex. *Asci* (83–)90–110(−115)×(13.5–)15–20 μm ($\bar{x}$ = 100×16.8 μm, *n*=25), 8-spored, bitunicate, fissitunicate, clavate to cylindric-clavate, subsessile or short pedicellate, apically rounded with well-developed ocular chamber. *Ascospores* 48–55×5–7(−7.5) μm ($\bar{x}$ = 51.2×6.5 μm, *n*=30), overlapping 3–4-seriate, phragmosporous, cylindrical or elongated fusiform, with narrow ends, brown to yellowish-brown, 8-septate, slightly curved, smooth-walled, enlarged at the forth cell from the apex. **Asexual state:** Unknown.

Fig. 12 ***Nodulosphaeria hirta*** (S-F70410, **type). a** Herbarium label and specimen of *Nodulosphaeria hirta*. **b** Ascostromata on host surface. **c** Section through ascostroma. **d** Section through peridium. **e** Asci with cellular pseudoparaphyses. **f–i** Asci. **j–n** Ascospores. Scale bars: c= 100 μm, d, e, f, g, h, i=20 μm, j, k, l, m, n=10 μm

Material examined: GERMANY, Sachsen, Dresdae, on dead stems, May 1858, G.L. Rabenhorst (S-F70410, **type**).

Nodulosphaeria modesta (Desm.) Munk ex L. Holm, in Holm, Symb. bot. upsal. 14(no. 3): 80 (1957), *Faces of Fungi number*: FoF00253, Fig. 13.

≡ *Sphaeria modesta* Desm., Ann. Mag. nat. Hist., Ser. 1: 1786 (1840)

Saprobic on dead stems. **Sexual state:** *Ascomata* 130–200 μm high, 150–250 μm diam., scattered, solitary to gregarious, immersed, erumpent to superficial, base not easy to remove from the substrate, visible as small, black dots on the host surface, uniloculate, coriaceous, globose to subglobose, setose, covered by hyphae, dark brown to black, ostiole central, with blunt brown hairs around the ostiole, papillate. *Peridium* 7–10 μm wide, thin-walled, of equal thickness, composed of two layers of pseudoparenchymatous cells, outer layer comprising 2–3 cell layers of dark brown to black, thickened cells, arranged in a *textura angularis*, inner layer comprising 3–5 cell layers of thin-walled cells, hyaline, flattened cells, arranged in *textura angularis* to *textura prismatica. Hamathecium* composed of numerous, 2–3 μm wide, filamentous, broad cellular pseudoparaphyses, with distinct septa, embedded in a mucilaginous matrix, anastomosing at the apex. *Asci* 60–70×13–17 μm ($\bar{x}$= 67×15 μm, *n*=20), 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, subsessile to short pedicellate, apically rounded, with well-developed ocular chamber. *Ascospores* 29–40×5–6 μm ($\bar{x}$ = 35×6 μm, *n*=40), partially overlapping 1–2 seriate,

F70410

Rabenhorst, Herb. mycologicum. Ed. II.

Nodulosphaeria Rabenh. (nov. genus!)

Perith. minuta, globosa, depressa, ostiolo brevi conico, primo discreta dein plus minus libera, saepius pube velata. Nucleus subgelatinosus. Asci perfecti persistentes, saepius paraphysibus immixtis. Sporae fusiformes, 5-multicellulares. medio vel ad apicem cellula unica noduloso-turgescente.

(Sphaeriae sp. Autt.)

MUS. BOT. STOCKH.
EX HERB. REHM.

725. N. hirta Rabenh. Mspt. perith. globoso-depressis nigricantibus, pube fusco-nigricante vestitis; ascis clavatis sporis octonis dense farctis; sporis fusiformibus, leviter curvatis 9-10-cellularibus, lutescentibus; cellula quarta (ab apice) noduloso-turgida.

Sphaeria hirta Fries Syst. et Summ.

Dresdae, in herbarum caulibus emortuis perrara, exeunte majo 1858 leg. ipse.

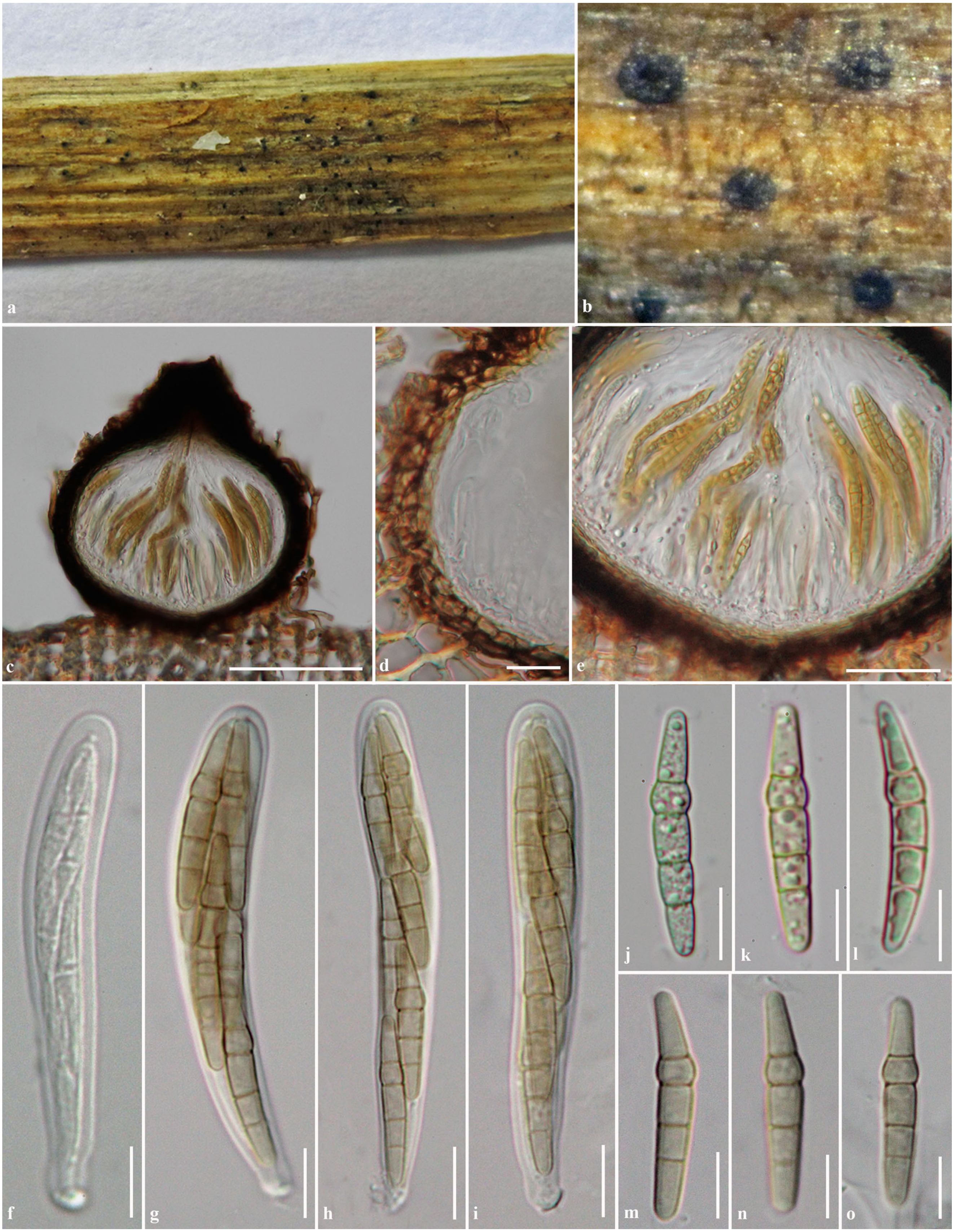
NB. Ad hunc nov. genus pertinent: Sphaeria Cibostii De N., Sphaeria Heufleri Rabenh., Sph. tunicata Rabenh. etc.

L. decora (Desk. et Br.)
Nodulosphaeria d.
Upsala 19 5/1 det. LENNART HOLM.

Herbarium typorum (S)

Nodulosphaeria hirta Rabenh.

F70410


a
b
c
d
e
f
g
h
i
j
k
l
m
n
o

◀ **Fig. 13** ***Nodulosphaeria modesta*** (MFLU 12-2214). **a** Ascomata on host substrate. **b** Close up of ascoma. **c−d** Section of ascoma. **e** Close up of the peridium. **f** Hamathecium of dense long cellular pseudoparaphyses. **g−j** Asci with short, broad pedicel bearing 8 spores. **k−n** Mature and immature ascospores. Scale bars: c=100 *μm*, e=20 *μm*, d, f, g, h, i, j, k, l, m, n, o=10 *μm*

phragmosporous, cylindrical with slightly narrow ends, initially hyaline to subhyaline with small guttules, becoming yellowish-brown to brown at maturity, 4-septate, slightly curved, constricted at the septa, smooth-walled, with small, globose appendages, without a refractive sphere near the apices, enlarged at the second cell below the apex. **Asexual state:** Unknown.

Material examined: ITALY, Forlì-Cesena, Montevescovo, on dead stem, 8 February 2012, E. Camporesi (MFLU 14-0304), living culture=MFLUCC 11-0461=MUCL.

Notes: Based on the morphological comparison, our isolate is similar to *Nodulosphaeria modesta* due to its small ascomata covered by hairs and short, broad setae at the papilla apex, the asci are bitunicate and clavate and the ascospores are cylindrical, brown, 4-septate with narrow apices, and an enlarged cell at the second cell below the apex. The multigene phylogenetic analysis indicates that *Nodulosphaeria* belongs to *Phaeosphaeriaceae* (Figs. 1 and 2).

Ophiobolus Riess, Hedwigia 1(6): 27 (1854), *Faces of Fungi number*: FoF00254.

Saprobic or *hemibiotrophic* on various hosts. *Ascomata* solitary to gregarious, scattered, semi-immersed to erumpent though host tissue with short to long beak, uniloculate, subglobose or ovoid or ampulliform, glabrous or covered by hyphae, dark brown to black, ostiolate, papillate. *Peridium* thick-walled, composed of dark brown to black, scleroplectenchymatous cells, arrange in *textura angularis* to *textura globulosa*. *Hamathecium* composed of numerous, filiform, cellular pseudoparaphyses, with distinct septa, anastomosing at the apex. *Asci* 8-spored, bitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded with indistinct ocular chamber. *Ascospores* fasciculate, 3–4-seriate, scolecosporous, filiform or filamentous, with enlarged central cells, yellowish-brown to brown, multi-septate, non-constricted at the septa, separating into two part spores, smooth-walled, with or without appendages.

Type species: ***Ophiobolus disseminans***

Phylogenetic study: Dong et al. 1998; Ariyawansa et al. (2014c)

Notes: *Ophiobolus* was introduced by Riess (1854) and typified by *O. disseminans*. Ascomata were described as discrete with distinct ostioles and ascospores as filiform and multi-septate (Zhang *et al*. 2012). *Ophiobolus* has been found on a wide range of hosts, mostly reported from Europe and North America (Farr and Rossman 2014). Holm (1948) and Müller (1952) used a broad concept of the genus *Ophiobolus*; however, Holm (1957) treated *Ophiobolus* in a much narrower sense, based on European collections (Shoemaker 1976). Three species were accepted by Holm (1957) and most *Ophiobolus* species were transferred to *Nodulosphaeria* and *Leptospora* (Holm 1957; Shoemaker 1976; Zhang et al. 2012). Shoemaker (1976) re-circumscribed species of *Ophiobolus* from Canada and some North American collections and accepted 31 species with two new species and five new combinations. Walker (1980) provided various illustrations of scolecosporous taxa from type material which had previously been accommodated in *Ophiobolus* (Saccardo 1883; Zhang et al. 2012). *Ophiobolus* species were also transferred to *Acanthophiobolus*, *Entodesmium*, *Gaeumannomyces*, *Leptosphaeria* and *Leptospora* (Shoemaker 1976; Walker 1980; Zhang et al. 2012). Barr (1979) initially accommodated *Ophiobolus* in *Phaeosphaeriaceae* and later transferred it to *Leptosphaeriaceae* (Barr 1987b). However, Zhang et al. (2012) reinstated the genus in *Phaeosphaeriaceae* based on morphological characters which are similar to *Nodulosphaeria* and *Ophiosphaerella*. There are 357 epithets listed in *Ophiobolus* in Index Fungorum (2014).

There is very little sequence data for *Ophiobolus* available in GenBank with two sequences of *O. fulgidus*. Zhang et al. (2012) mentioned that the genus should be placed in *Phaeosphaeriaceae* based on morphology and the phylogenetic investigation of Dong et al. (1998). However, Dong et al. (1998) could not resolve the placement of *Ophiobolus* as too few strains were used in their molecular analysis. Thus the genus needs to re-circumscribed using fresh collections (Zhang et al. 2012).

The asexual state of *Ophiobolus* has been reported in several genera such as coniothyrium-like, *Rhabdospora*, phoma-like and *Scolecosporiella* (Shoemaker 1976; Sivanesan 1984; Hyde et al. 2011; Wijayawardene et al. 2012; Zhang et al. 2012). However, these need confirmation as *Ophiobolus* is probably polyphyletic.

In this study, two species of *Ophiobolus* are included in the phylogenetic analysis. The detailed descriptions are provided in Ariyawansa et al. (2014c) and a description of the generic type is provided below. Based on multigene phylogenetic analysis (Figs. 1 and 2), *Ophiobolus* clusters in *Phaeosphaeriaceae*. However, there are limited sequences in GenBank and the type species lacks molecular data to confirm its natural placement. Thus *Ophiobolus* is tentatively placed in *Phaeosphariaceae* until the generic type strain is sequenced to confirm the natural placement (Table 2).

Ophiobolus disseminans Riess, *Hedwigia* 1(6): 27 (1854), *Faces of Fungi number*: FoF00255, Figs. 14, and 15.

Saprobic on *Cirsium* (*Asteraceae*). **Sexual state:** *Ascomata* 140–390 *μm* high (excluding papilla), 160–340 *μm* diam., scattered or sometimes clustered, solitary to gregarious, semi-immersed, or erumpent through host tissue, visible as

Table 2 Synopsis of *Ophiobolus* species discussed in this study

Species	Size (μm)			Septation	Ascospore color	Appendage	Enlarge cells	Hosts	Source references
	Ascospores	Asci	Ascomata (diam.)						
O. cirsii	142–170×4–5	170–210×4–10	350–420	15	Brown	Not observed	Not observed	Dead wood	Ariyawansa et al. (2014c)
O. disseminans (isotype)	150–160×2–3	170–190×10–12	160–340	Up to 15 septa	Brown	Not observed	2	*Cirsium arvense*	This study
O. erythrosporus	100–125×3–3.5	100–150×8–10	230–400	16–20	Hyaline to pale yellowish	Absent	No	*Urtica brandnetel*	Ariyawansa et al. (2014c)

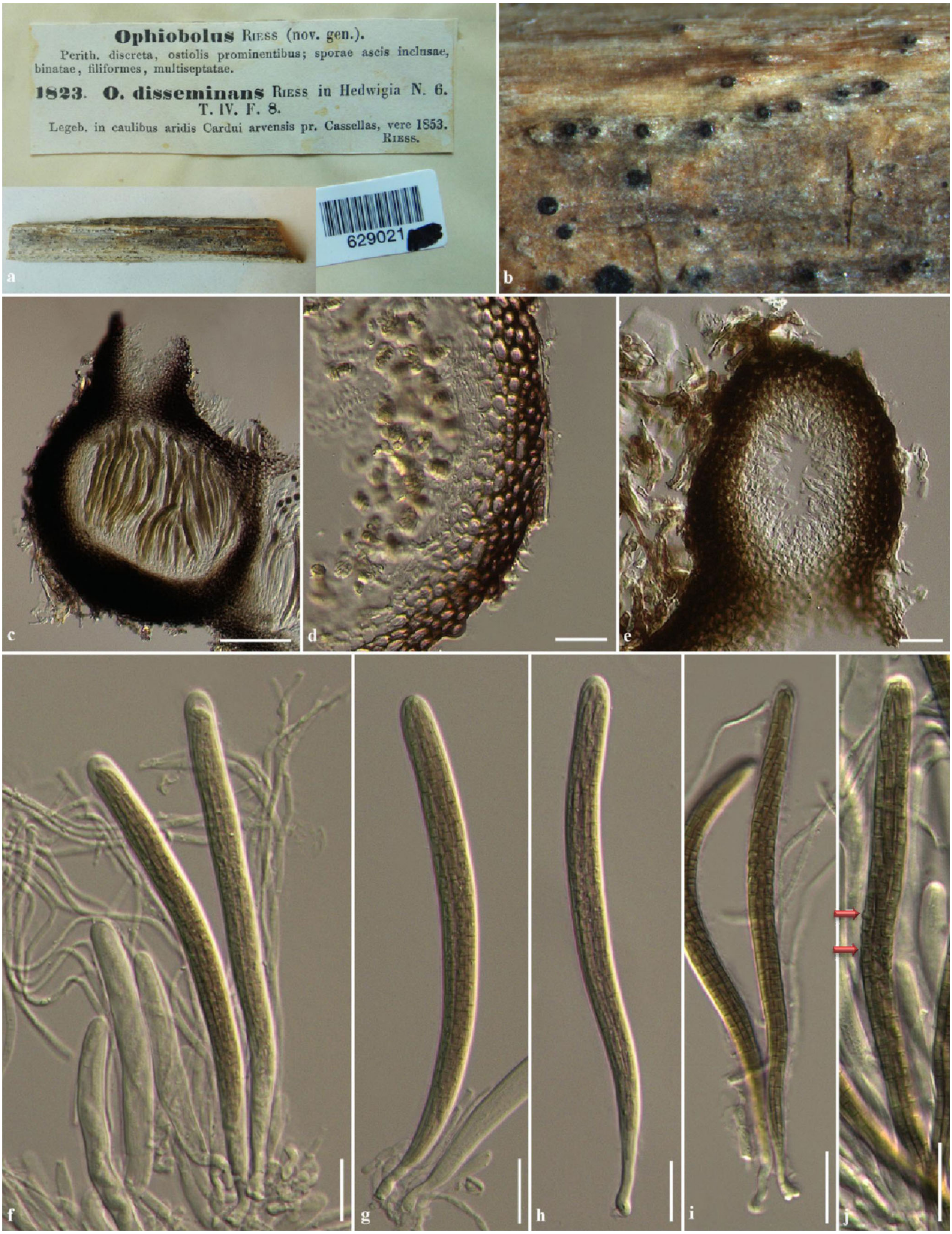
Fig. 14 ***Ophiobolus disseminans*** (BPI 629021, **isotype**). **a** Herbarium label and specimen. **b** Ascomata on substrate. **c** Section through ascoma. **d** Section through peridium. **e** Papilla. **f** Asci with cellular pseudoparaphyses. **g–i** Ascus. **j** Ascospores in ascus**.** Note the swollen part of the ascospores (*arrowed*). Scale bars: c=100 μm, d, e, f, g, h, i, j= 20 μm ▶

slightly raised, small, black dots on the host surface, uniloculate, subglobose to ovoid or ampulliform, glabrous, dark brown to black, ostiole central, with periphyses, short papillate. *Necks* 60–150 μm high, 85–140 μm diam, with thick-walled cells, arranged in a *textura angularis*, subglobose to oblong, dark brown to black, apically rounded or obtuse, coriaceous. *Peridium* 30–50 μm wide, thick-walled, of unequal thickness, slightly thick at the base, composed of several layers of broadly scleroplectenchymatous cells, outer layers consisting of several layers of brown to dark brown, thickened cells, arranged in a *textura angularis*, inner layers comprising several layers of hyaline, flattened cells, arranged in a *textura epidermoidea* to *textura porrecta. Hamathecium* composed of numerous, 2–3 μm wide, filamentous, broad cellular pseudoparaphyses, with distinct septa, embedded in mucilaginous matrix, anastomosing at the apex. *Asci* (156–)170–190(−203)×10–12(−13) μm ($\bar{x}$ = 178.9×11.4 μm, n=20), 8-spored, bitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded with indistinct ocular chamber. *Ascospores* (125–)150–160(−163)×2–3 μm ($\bar{x}$ = 152.8×2.9 μm, n=15), fasciculate, in parallel or spiral, scolecosporous, filiform or filamentous, with two enlarged cells near the centre, but with 3–4 narrow cells in between the enlarged cells, brown, multi-septate, with up to 15 septa, not constricted at the septa, smooth-walled, separating into two part spores in the centre of the spores between the enlarged cells. **Asexual state:** Unknown.

Material examined: ITALY, Cassellas Vicinity, on dead stem of *Cirsium arvense*, 1853, Riess 1823 (BPI 629021, **isotype**); *ibid* on dead stem of *Cirsium arvense*, 1853, H. Riess, Hedwigia 1(6): Tab IV, (Fig. 8, **iconotype**) (1854).

Ophiosphaerella Speg., Anal. Mus. nac. B. Aires, Ser. 3 12: 401 (1909), *Faces of Fungi number*: FoF00256.

Pathogenic or *saprobic* mostly on various monocotyledons and some flowering shrubs or dicotyledons especially *Poaceae*, *Asteraceae* and *Fagaceae* (Farr and Rossman 2014). **Sexual state:** *Ascomata* scattered, solitary, semi-immersed, or erumpent through host tissue with papilla visible as raised, small, black dots on host surface, uniloculate, globose to subglobose, glabrous, dark brown to black, ostiole central, with periphyses, papillate. *Peridium* thick-walled, composed of hyaline to brown or dark brown, pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* composed of numerous, filamentous, broad cellular pseudoparaphyses, with distinct septa, embedded in mucilaginous matrix, anastomosing at the apex. *Asci* 8-spored, bitunicate, cylindrical to cylindric-clavate, short pedicellate,



Ophiobolus Riess (nov. gen.).

Perith. discreta, ostiolis prominentibus; sporae ascis inclusae, binatae, filiformes, multiseptatae.

1823. O. disseminans Riess in Hedwigia N. 6. T. IV. F. 8.

Legeb. in caulibus aridis Cardui arvensis pr. Cassellas, vere 1853.
Riess.

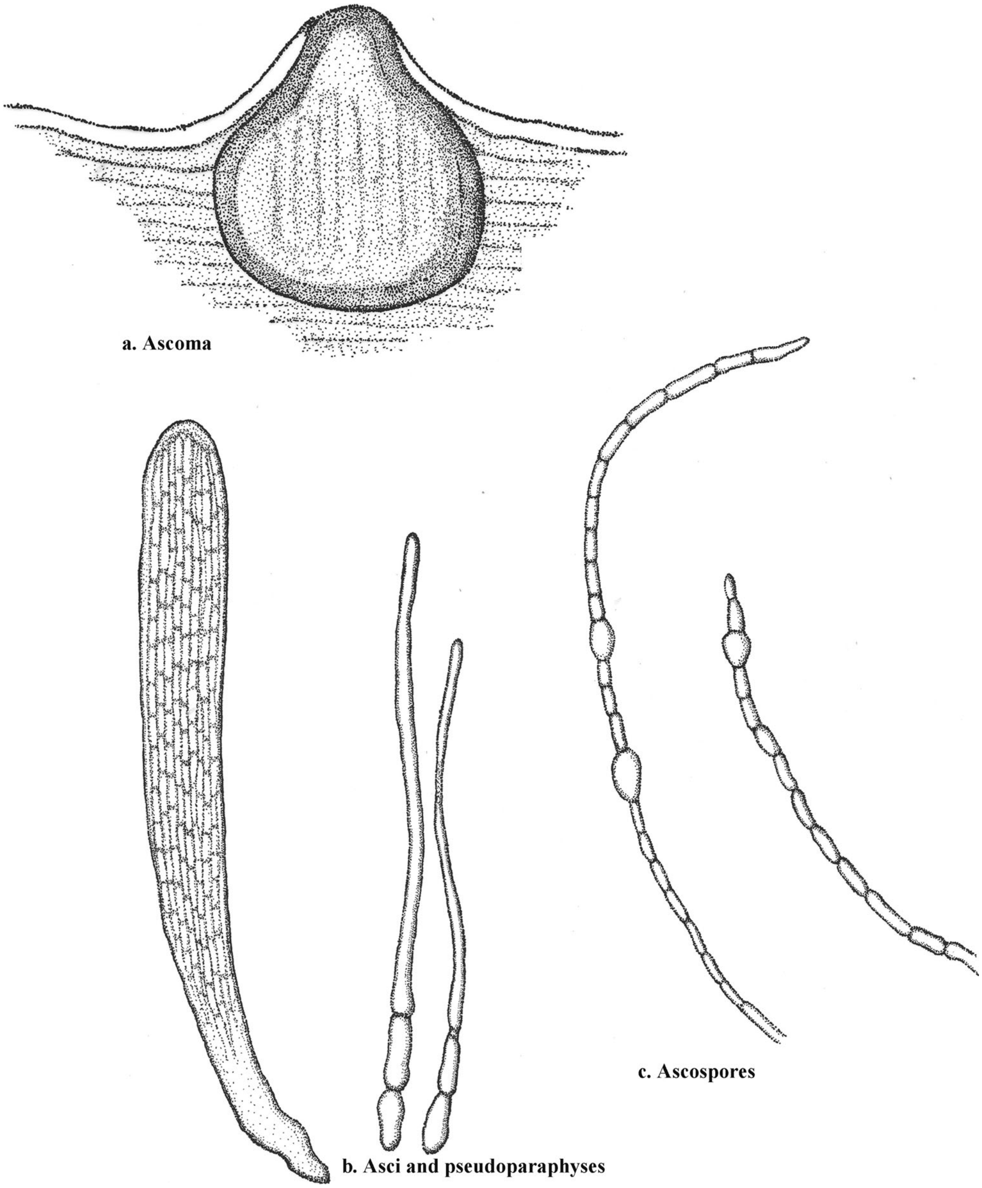


Fig. 15 ***Ophiobolus disseminans*** **(iconotype)** redrawn from Riess (1854). **a** Section through ascoma. **b** Ascus and pseudoparaphyses. **c** Ascospores

apically rounded with indistinct ocular chamber. *Ascospores* fasciculate, lying parallel or spiral, scolecosporous, filiform or filamentous, pale brown to brown, multi-septate, not constricted at the septum, smooth-walled. **Asexual state:** see under *Scolecosporiella*.

Type species: ***Ophiosphaerella graminicola***

Phylogenetic study: Wetzel et al. (1999), Câmara et al. (2000), Hsiang et al. (2003), Schoch et al. (2006, 2009), Zhang et al. (2009, 2012), Hyde et al. (2013).

Notes: Ophiosphaerella was introduced by Spegazzini (1909) as typified by *Op. graminicola*. Most species of *Ophiosphaerella* are often found as pathogens or saprobes worldwide on *Poaceae* and *Cyperaceae* (Câmara et al. 2000). Spegazzini (1909) did not introduce the genus separately but described and illustrated a new species, and later the genus was validly published by Stafleu et al. (1972) (Walker 1980; Zhang et al. 2012). However, Petrak and Sydow (1936) treated *Ophiosphaerella graminicola* as a synonym of *Ophiobolus graminicolus* (Speg.) after observing the type specimens which was accepted by Ainsworth et al. (1971) and von Arx and Müller (1975) (Walker 1980; Zhang et al. 2012). Walker (1980) examined the type specimens of *Ophiosphaerella* and confirmed that the genus belongs to *Pleosporales*, but differs from *Ophiobolus. Ophiosphaerella* is most similar to *Ophiobolus* and subsequently often confused in morphological characters. However *Ophiosphaerella* differs from *Ophiobolus* by the lack of central swollen ascospore cells which do not separate into part spores (Zhang et al. 2012).

The phylogenetic relationships of *Ophiosphaerella* were first investigated by Wetzel et al. (1999) who treated *Ophiosphaerella* as monophyletic genus distinguished from

Phaeosphaeria and other *pleosporaceous* genera. Various authors subsequently accepted the genus in *Phaeosphaeriaceae* based on the multigene phylogenetic investigation with *Ophiosphaerella* forming a monophyletic clade as a sister group of *Phaeosphaeria* (Schoch et al. 2006, 2009; Zhang et al. 2009, 2012; Hyde et al. 2013). However, the phylogenetic analysis was limited to one strain (*Ophiosphaerella herpotricha* CBS 620.86).

In the present multigene phylogenetic analyses, two strains of *Ophiosphaerella agrostidis* (MFLUCC 11-0152 and MFLUCC 12-0007) and *Op. herpotricha* (CBS 620.86) are included. The phylogenetic relationships show that *Op. agrostidis* (MFLUCC 11-0152 and MFLUCC 12-0007) forms a distinct clade separated from *Op. herpotricha* (CBS 620.86) in *Phaeosphaeriaceae*. Thus *Ophiosphaerella* seem to be polyphyletic genus. However, there are few sequences available in GenBank, thus fresh collections and molecular data are needed to for more natural understanding.

Ophiosphaerella graminicola Speg., Anal. Mus. nac. B. Aires, Ser. 3 12: 401 (1909), *Faces of Fungi number*: FoF00257, Fig. 16, and 17.

Pathogenic or *saprobic* on monocotyledons. **Sexual state:** *Ascomata* 230–300 μm high, 170–230 μm diam., scattered, solitary, immersed to semi immersed or erumpent through host tissue with minute papilla, visible as raised, small black dots on host surface, uniloculate, globose to subglobose, glabrous, dark brown to black, ostiole central, with periphyses, with minute papilla. *Peridium* 20–40 μm wide, thick-walled, of unequal thickness, broad at the apex towards sides of ascoma, composed of several layers of pseudoparenchymatous cells, outer layers comprising several layers of brown to dark brown thickened cells at sides and apex, arranged in a *textura angularis*, hyaline at the base of ascoma, inner layers comprising several layers of thin-walled, flattened, hyaline cells of *textura prismatica. Hamathecium* composed of numerous, 2–3 μm wide, filamentous, broadly cellular pseudoparaphyses, with distinct septa, embedded in a mucilaginous matrix, anastomosing at the apex. *Asci* (128–)133–150(−160)×9–12(−12.5) μm ($\overline{x}$ = 148.7× 11.2 μm, *n*=20), 8-spored, bitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded with indistinct ocular chamber. *Ascospores* (118–)130–150(−160)×3–3.5 μm ($\overline{x}$= 142.4×3.2 μm, *n*=30), fasciculate, lying parallel or spiral in the centre, scolecosporous, filiform or filamentous, narrowing towards the ends, pale brown to brown, 15–18-septate, not constricted at the septa, smooth-walled. **Asexual state:** Unknown.

Material examined: ARGENTINA, in garden near Tucumán, on leaf sheath of *Leptochloa virgata* (L.) P. Beauv. (*Poaceae*), April 1906, C. Spegazzini (**iconotype**); VENEZUELA, Edo, Aragua, Parque Nacional Henri Pittier, on the Maracay-Ocumare Rd., ca. 15 km north of Maracay, 4.5 km south of Rancho Grande Biological Station where creek crosses road, alt. 950 m. ca. 10°21′N 67°41″W, on grass culm, 5 December 1990, G.J. Samuels, B. Hein, S.M. Huhndorf (BPI 748267).

Ophiosphaerella agrostidis Dern. et al. [as 'agrostis'], in Câmara et al., Mycologia 92(2): 320 (2000), *Faces of Fungi number*: FoF00258, Fig. 18.

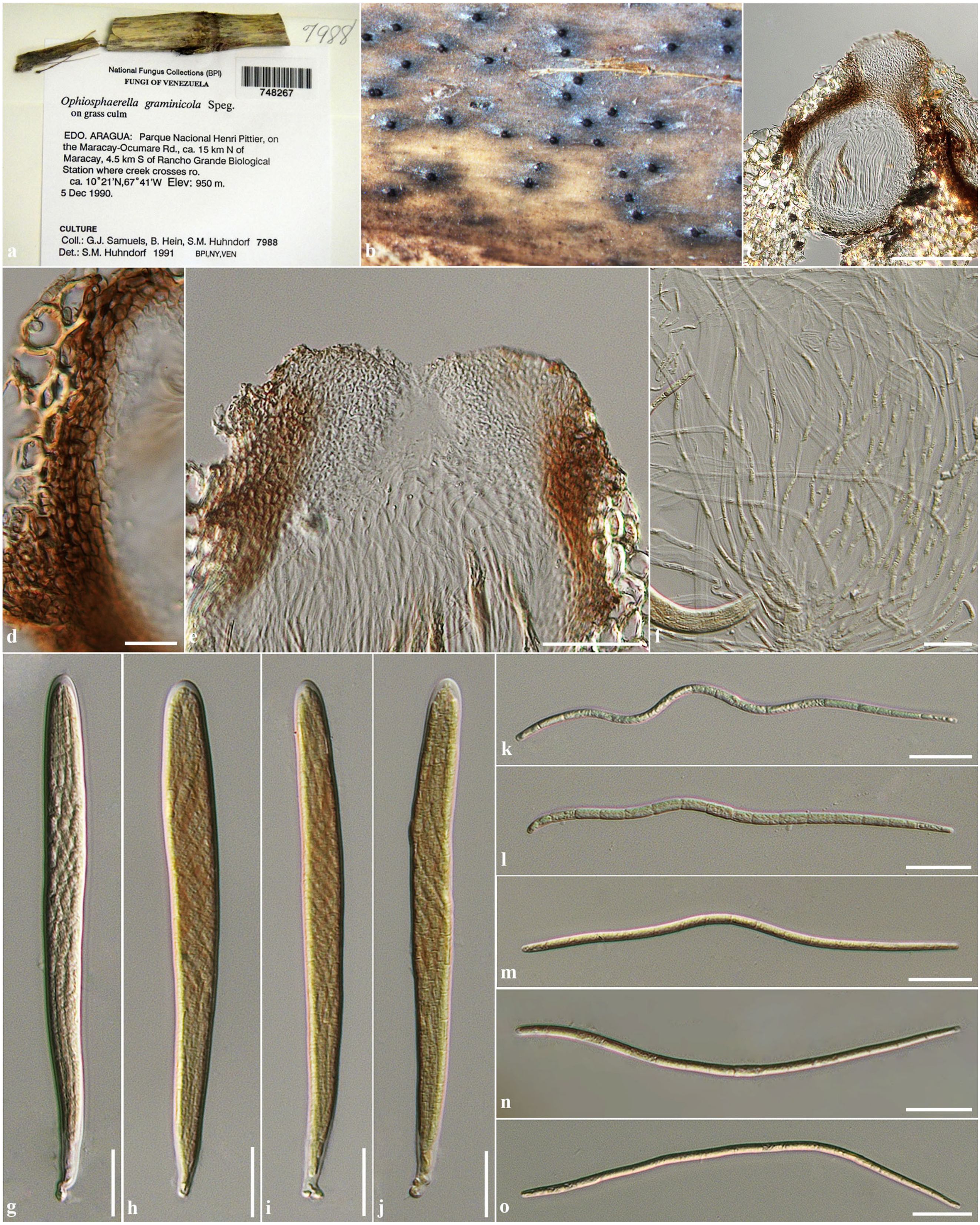
Pathogenic or *saprobic* on monocotyledonous hosts. **Sexual state:** *Ascomata* 275–355 μm high (including papilla), 175–310 μm diam., scattered, solitary, semi immersed or erumpent through host tissue with papilla, visible as raised, small black dots on host surface, uniloculate, globose to subglobose, glabrous, dark brown to black, ostiole central, oblique, papilla, carbonaceous. *Peridium* 15–25 μm wide, thin-walled, of equal thickness, composed of several layers of brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis* to *textura globulosa. Hamathecium* composed of numerous, 1.5–2.5 μm wide, filamentous, broad cellular pseudoparaphyses, with distinct septa, embedded in mucilaginous matrix, anastomosing at the apex. *Asci* (97–)100–135×7–9(−11) μm ($\overline{x}$= 111.5×8.5 μm, *n*=25), 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded, with a well-developed ocular chamber. *Ascospores* (90–)98–120(−130)× 2–2.5 μm ($\overline{x}$ = 110.3× 2.3 μm, *n*=30), fasciculate, parallel or spiral, scolecosporous, filiform, narrowing towards ends, pale brown to brown, 15-septate, not constricted at the septa, smooth-walled. **Asexual state:** Unknown.

Material examined: THAILAND, Phrae, Rongkwang District, Maejo University Phrae Campus, on dead culms of grass, 20 August 2010, R. Phookamsak (MFLU 11-0188), living culture=MFLUCC 11-0152; Chiang Rai, Muang District, Ta Sai, on dead culm of grass, 30 June 2011, R. Phookamsak (MFLU 11-0246), living culture=MFLUCC 12-0007.

Notes: The scolecosporous specimens were collected from dead culms of grass in Thailand. These collections are morphologically similar to *Ophiosphaerella agrostidis*, *Op. graminicola*, and *Op. herpotricha* with these species sharing similar ascomata, asci and ascospores, including septation of ascospores. The Thailand collections are most similar to *Op. agrostidis* according to the size of the ascomata, asci and ascospores, and also the septation of ascospores. However, *Op. agrostidis* has been reported as a pathogen on grass while the collections in the present study were saprobes. Therefore these collections are named as *Op. agrostidis* based on the morphological characters and these can be treated as authentic specimens until epitypification. The phylogenetic tree (Figs. 1 and 2) shows that two isolates of *Op. agrostidis* form a single clade in *Phaeosphaeriaceae* (Table 3).

Paraphoma Morgan-Jones & J.F. White, Mycotaxon 18(1): 58 (1983), *Faces of Fungi number*: FoF00259.

Saprobic on various hosts, or soil borne. *Mycelium* abundance branched, septate, subhyaline to pale brown, smooth-



7988

National Fungus Collections (BPI)
FUNGI OF VENEZUELA
748267

Ophiosphaerella graminicola Speg.
on grass culm

EDO. ARAGUA: Parque Nacional Henri Pittier, on
the Maracay-Ocumare Rd., ca. 15 km N of
Maracay, 4.5 km S of Rancho Grande Biological
Station where creek crosses ro.
ca. 10°21'N,67°41'W Elev: 950 m.
5 Dec 1990.

CULTURE
Coll.: G.J. Samuels, B. Hein, S.M. Huhndorf 7988
Det.: S.M. Huhndorf 1991 BPI,NY,VEN

walled. **Sexual state:** Unknown. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary to gregarious, in agar semi-immersed to superficial, uniloculate, globose to subglobose, setose, brown to dark brown, ostiole central, circular.

◀ **Fig. 16** ***Ophiosphaerella graminicola*** (BPI 748267). **a** Herbarium label and specimens of *Ophiosphaerella graminicola*. **b** Ascomata on host surface. **c** Section through ascoma **d** Section through peridium. **e** Papilla with periphyses. **f** Pseudoparaphyses stained in Meltzer's reagent. **g** Ascus. **h**–**j** Asci stained in Meltzer's reagent. **k**–**l** Ascospores. **m**–**o** Ascospores stained in Meltzer's reagent. Scale bars: c=100 *μm*, e=50 *μm*, d, f, g, h, i, j, k, l, m, n, o=20 *μm*

Conidiomata walls thick, outer layers comprising 2 layers of scleroplectenchymatous cells, dark brown, inner layers comprising 4–5 layers of pseudoparenchymatous cells, arranged in a *textura angularis*, subhyaline to pale brown. *Setae* numerous, thick-walled, straight to slightly curved, acuminate, septate, smooth to verruculose. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* monophialidic, discrete, determined, lageniform, hyaline to subhyaline, lining the inner cavity. *Conidia* enteroblastic, amerosporous, ellipsoidal, hyaline, aseptate, smooth-walled, with guttules (from Sutton 1980; De Gruyter et al. 2009, 2010; Quaedvlieg et al. 2013).

Type species: ***Paraphoma radicina*** (McAlpine) Morgan-Jones & J.F. White, Mycotaxon 18(1): 60 (1983)

≡ *Pyrenochaeta radicina* McAlpine, Fungus Diseases of stone-fruit trees in Australia: 127 (1902)

Phylogenetic study: De Gruyter et al. (2009, 2010, 2012), Aveskamp et al. (2010), Zhang et al. (2012), Hyde et al. (2013), Quaedvlieg et al. (2013).

Notes: Paraphoma as typified by *P. radicina* was previously treated in *Pyrenochaeta* by McAlpine (1902) and later, Boerema and Dorenbosch (1979) transferred the species to *Phoma*. Morgan-Jones and White (1983) introduced a new genus, *Paraphoma* to accommodate the species that produced heavily setose pycnidia and transferred *P. radicina* to this genus. However, the genus was treated as a section of *Phoma* (Boerema 1997) until De Gruyter et al. (2010) reinstated the genus and placed it in *Phaeosphaeriaceae* based on phylogenetic evidence. Recently, four species are accommodated in this genus for which no sexual state is known.

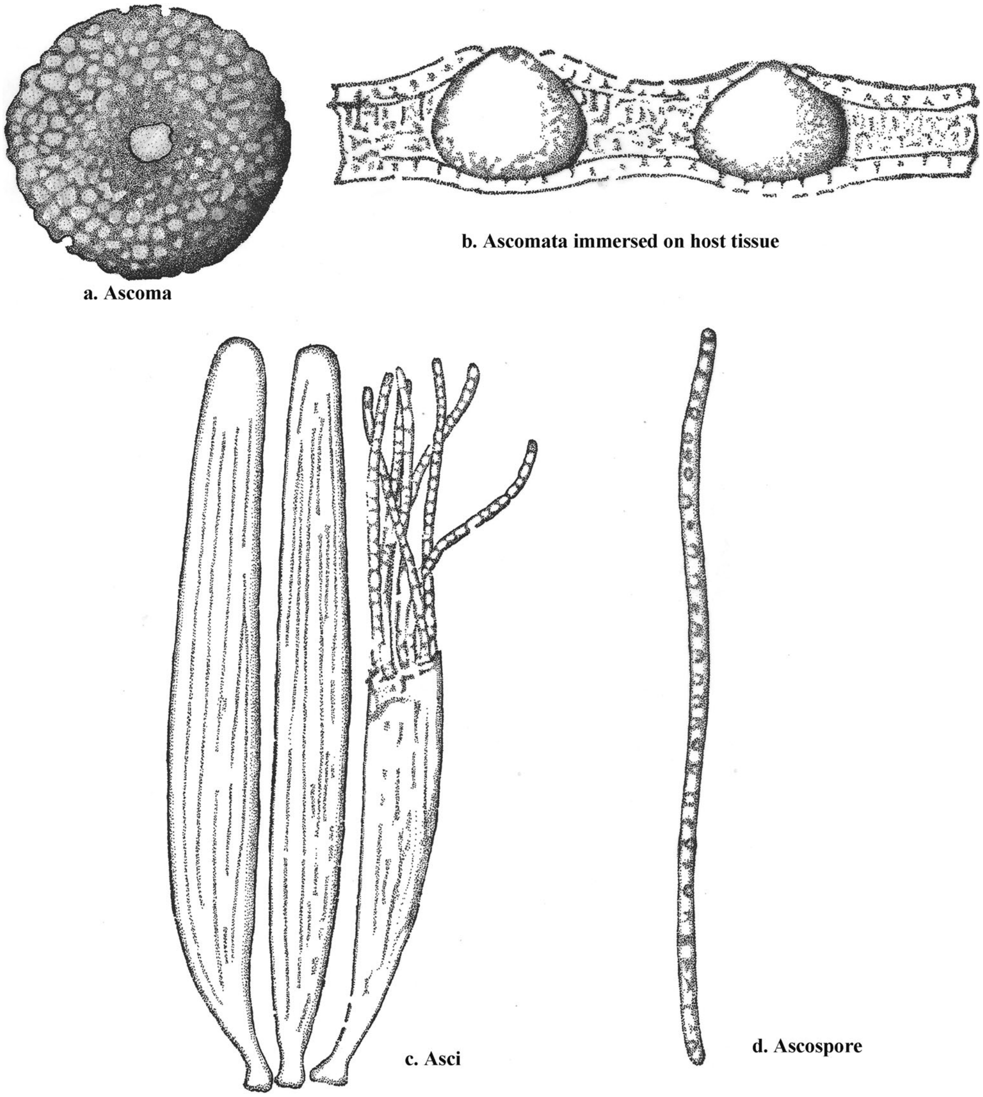


Fig. 17 ***Ophiosphaerella graminicola*** **(iconotype)** redrawn from Spegazzini (1909). **a** Ascoma. **b** Ascomata immersed on host tissue. **c** Asci. **d** Ascospore

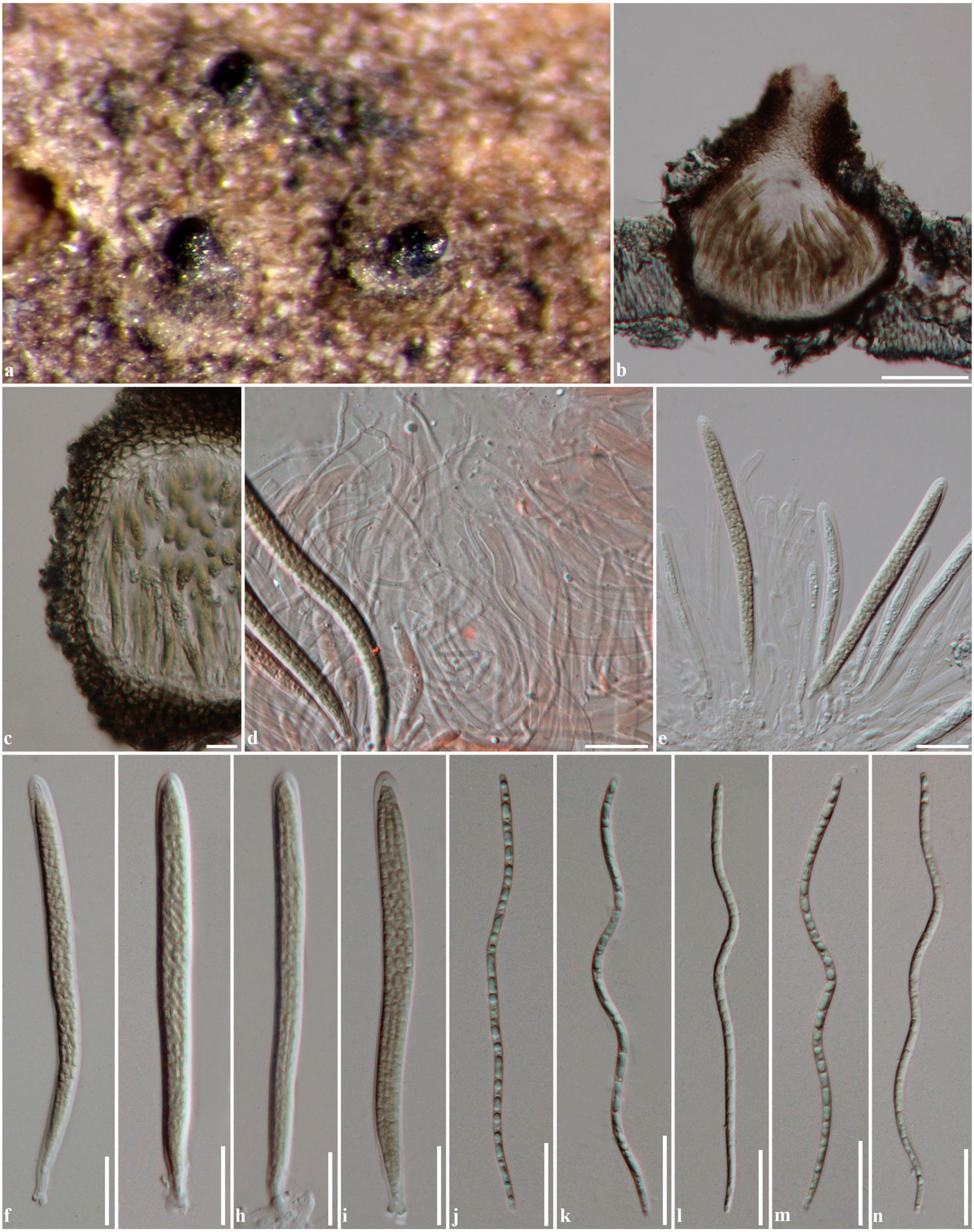


Fig. 18 ***Ophiosphaerella agrostidis*** (MFLU 11-0188). **a** Ascomata on host surface. **b** Section through ascoma **c** Section through peridium. **d** Cellular pseudoparaphyses stained in congo red. **e**–**i** Asci. **j**–**n** Ascospores. Scale bars: b=100*µm*, c–n=20*µm*

Table 3 Synopsis of *Ophiosphaerella* species discussed in this study

Species	Size (*µm*)			Septation	Hosts	Source references
	Ascospores	Asci	Ascomata (diam.)			
Op. agrostidis	75–150×2–2.5	100–230×10–15	130–350	6–15	*Agrostis* and *Cynodon×dactylon*	Câmara et al. (2000), Farr and Rossman (2014)
Op. agrostidis (MFLUCC11-0152)	98–130×2–2.5	98–130×7–9(−11)	175–310	15	Grass culm	This study
Op. graminicola (holotype)	140×3	150×10	180–200	12–20	*Leptochloa virgata*	Spegazzini (1909), Walker (1980)
Op. graminicola (BPI748267)	142.4×3.2	148.7×11.2	170–230	15–18	grass culm	Farr and Rossman (2014)
Op. herpotricha	140–180×2–2.5(−3)	150–190×7–9	300–400	12–16	*Arrhenatherum*, *Bromus*, *Buchloe*, *Cynodon*, *Dactylis*, *Puccinellia*, *Secale*, *Triticum*, *Vetiveria*, *Zoysia*	Farr and Rossman (2014) Walker (1980)
Op. korrae	120–180×4–5(−5.5)	145–200×10–13(−15)	300–500	(3–6)7(−15)	*Axonopus*, *Cynodon*, *Poa*, *Zoysia*	Farr and Rossman (2014)

Parastagonospora Stud. Mycol. 75: 362 (2013), *Faces of Fungi number*: FoF00260.

Pathogenic on various cereal crops (*Poaceae*). **Sexual state:** *Ascomata* scattered, solitary to gregarious, immersed, uniloculate, globose, glabrous, brown to black, ostiole central, with papilla. *Peridium* thick-walled, composed of 3–6 layers of brown pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* composed of numerous, filiform, cellular pseudoparaphyses, with distinct septa. *Asci* 8-spored, bitunicate, cylindrical to clavate, short pedicellate. *Ascospores* phragmosporous, fusiform, subhyaline to pale brown, septate (−3 septa), constricted at the septa, swollen at penultimate cell. **Asexual state:** *Conidiomata* pycnidial, scattered, immersed to semi-immersed, uniloculate, subglobose, glabrous, black, exuding creamy conidial mass, ostiole central. *Conidiomata walls* thin, composed of 2–3 layers of brown cells, arranged in *textura angularis. Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, integrate, ampulliform to subcylindrical, hyaline, smooth-walled, lining the inner cavity, with percurrent proliferation near apex. *Conidia* phragmosporous, cylindrical, apically obtuse with truncate base, hyaline, septate, thin and smooth-walled, with granules or multiguttules (from Quaedvlieg et al. 2013).

Type species: ***Parastagonospora nodorum*** (Berk.) Quaedvlieg et al. Stud. Mycol. 75: 363 (2013)

≡ *Depazea nodorum* Berk., Gard. Chron., London: 601 (1845)

Phylogenetic study: Quaedvlieg et al. (2013)

Notes: Parastagonospora was introduced by Quaedvlieg et al. (2013) to accommodate stagonospora-like species which have been reported as asexual state of phaeosphaeria-like taxa. The genus accommodated five species; *Pa. avenae* (A.B.. Frank) Quaedvlieg et al., *Pa. caricis* Quaedvlieg et al., *Pa. nodorum* (Berk.) Quaedvlieg et al., *Pa. poae* Quaedvlieg et al. and *Pa. poagena* Crous & Quaedvlieg with *Pa. nodorum* as the type (Index Fungorum, 2014). *Parastagonospora* is similar to *Stagonospora*; however, they differ in the morphology of the conidiogenous cells (Quaedvlieg et al. 2013). Based on multigene phylogenetic analysis, *Parastagonospora* clusters in *Phaeosphaeriaceae* which forms a clade with *Phaeosphaeria avenaria* (synonymized under *Parastagonospora avenae*), *Ph. eustoma* and *Ph. nigrans*. These *Phaeosphaeria* species may be the sexual states of *Parastagonospora*.

Phaeosphaeria I. Miyake, Bot. Mag., Tokyo 23: 93 (1909), *Faces of Fungi number*: FoF00233.

= *Phaeoseptoria* Speg., Revta Mus. La Plata 15: 39. 1908.

Saprobic or *pathogenic* mostly on monocotyledons. **Sexual state**: *Ascomata* solitary to gregarious, immersed, visible as slightly raised, small, black dots on the host surface, uniloculate, globose to subglobose, glabrous, brown, ostiole central, with minute papilla. *Peridium* thin-walled, of equal thickness, composed of flattened, brown, pseudoparenchymatous cells, arranged in *textura angularis. Hamathecium* composed of sparse, filiform, broad cellular pseudoparaphyses, with distinct septa, slightly constricted at the septa, rarely anastomosing at the apex. *Asci* 8-spored, bitunicate, fissitunicate, broadly cylindrical, short pedicellate or subsessile, apically rounded, with an indistinct ocular chamber. *Ascospores* overlapping 2–3-seriate, phragmosporous, narrowly fusiform, pale brown to brown or yellowish-brown, septate, straight or slightly curved, constricted or not constricted at the septa, walls smooth or rough, echinulate or verruculose, with or without mucilaginous sheaths. **Asexual**

state: *Conidiomata* stromatic, pycnidial, scattered to gregarious, immersed, uni- to multi-loculate, globose to subglobose, brown. *Conidiomata walls* thin, composed of thin-walled, of brown pseudoparenchymatous cells, arranged in *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, phialidic, flattened ampulliform to doliiform, hyaline to pale brown, hardly distinguishable from inner cells walls of conidioma. *Conidia* phragmosporous, oblong to cylindrical, pale brown to brown, septate, straight or slightly curved with obtuse at the base, smooth-walled with guttules.

Type species: ***Phaeosphaeria oryzae***

Phylogenetic study: Câmara et al. (2002); Schoch et al. (2006, 2009); Zhang et al. (2009, 2012); De Gruyter et al. (2010, 2012); Quaedvlieg et al. (2013); Hyde et al. (2013, 2014); Wijayawardene et al. (2014b)

Notes: Phaeosphaeria was established by Miyake (1909). Miyake (1910) accommodated *Phaeosphaeria* in *Mycosphaerellaceae* and mentioned that the genus differs from *Sphaerulina* and *Leptosphaeria* in ascospore colour and lack of pseudoparaphyses (Eriksson 1967). *Phaeosphaeria* was considered as a synonym of *Leptosphaeria* for a long time (Müller 1950; Munk 1957; Zhang et al. 2009, 2012). The genus was however, reinstated by Holm (1957) who found pseudoparaphyses in *Phaeosphaeria oryzae* and 17 mostly graminicolous species were transferred to *Phaeosphaeria* (Eriksson 1967; Zhang et al. 2009). Barr (1979) established the new family *Phaeosphaeriaceae* and designated *Phaeosphaeria* as the generic type and later, Eriksson (1981) introduced a broad generic concept for *Phaeosphaeria* which included relatively small ascomata, dictyospores, as well as ascospores with several wall layers, and an occurrence on monocotyledons (Câmara et al. 2002; Zhang et al. 2012). Subsequent authors also included *Phaeosphaeria* species from dicotyledonous hosts (Dennis 1978; Sivanesan 1984; von Arx and Müller 1975; Eriksson 1967; Hedjaroude 1969; Shoemaker and Babcock 1989b; Zhang et al. 2012). Shoemaker and Babcock (1989b) re-circumscribed *Phaeosphaeria* and divided the genus into six subgenera based on the differences in ascospore shape and septation *viz. Fusispora*, *Ovispora*, *Phaeosphaeria*, *Sicispora*, *Spathispora* and *Vagispora*. Various authors subsequently indicated that *Phaeosphaeria* was heterogeneous and shared several characters with *Leptosphaeria. Phaeosphaeria* however, differs from *Leptosphaeria* in morphology and these genera have been distinguished in different families by phylogenetic analysis (Câmara et al. 2002; Schoch et al. 2009; Zhang et al. 2009, 2012; Hyde et al. 2013). Presently, there are 200 epithets for *Phaeosphaeria* in Index Fungorum (2014) with 18,983 nucleotide sequences available in GenBank. However, several species of *Leptosphaeria sensu stricto* and *Phaeosphaeria* are confused in having similar morphology and lack phylogenetic investigation.

The asexual states of *Phaeosphaeria* have been reported as coelomycetes and some as hyphomycetes namely hendersonia-like, *Mauginiella*, *Microsphaeropsis*, *Neostagonospora*, *Parastagonospora*, *Phaeoseptoria*, *Scolecosporiella* and stagonospora-like (Leuchtmann 1984; Shoemaker and Babcock 1989b; Câmara et al. 2002; Abdullah et al. 2005; Kirk et al. 2008; Hyde et al. 2011, 2013; Wijayawardene et al. 2012; Zhang et al. 2012; Quaedvlieg et al. 2013). However, Leuchtmann (1984) treated the asexual state of *Phaeosphaeria* as species of *Stagonospora* and mentioned that the asexual state of *Phaeosphaeria* often formed pycnidial conidiomata, possessed holoblastic conidiogenous cells and had elongated to filiform, hyaline to pale brown, multiseptate conidia, which was also mentioned by Câmara et al. (2002). Câmara et al. (2002) suggested that *Phaeosphaeria* shares common ancestors with *Leptosphaeria* and that multigene phylogenetic analysis was necessary to understand the boundaries of taxa. The peridium type, asexual state and host preferences can distinguish fungal taxa in these two genera (Câmara et al. 2002)

Quaedvlieg et al. (2013) studied *Septoria*, *Stagonospora* and related genera such as *Phaeosphaeria* and *Phaeoseptoria* using molecular analysis and concluded that *Stagonospora* (based on the type species, *S. paludosa*) belongs to *Massarinaceae*. They introduced two new genera (*Neostagonospora* and *Parastagonospora*) to accommodate stagonospora-like genera in *Phaeosphaeriaceae* (Quaedvlieg et al. 2013). Additionally, *Phaeosphaeria* was linked to the asexual state *Phaeoseptoria* based on the phylogenetic analysis with the type species of *Phaeosphaeria*, *Ph. oryzae* forming a well-supported clade with *Phaeoseptoria papayae*, the type species of *Phaeoseptoria* (Quaedvlieg et al. 2013). Thus Quaedvlieg et al. (2013) synonymized the earlier name *Phaeoseptoria* under *Phaeosphaeria* as the latter was well-studied and taxonomy less confused than *Phaeoseptoria* which have been confused with several septoria-like in pigmented conidia (Walker et al. 1992). *Hendersonia*, which was treated as a synonym of *Stagonospora*, and *Microsphaeropsis* were placed in *Didymellaceae* (Sutton 1977; Swart and Walker 1988; Kirk et al. 2008; De Gruyter et al. 2009; Aveskamp et al. 2010). *Mauginiella* was treated as an asexual state of *Phaeosphaeria* by Abdullah et al. (2005); however, this has not been confirmed by phylogenetic investigation. In this study *Mauginiella* could not be resolved in *Phaeosphaeriaceae*. The genus is currently placed in asexual *Pezizomycotina* (Kirk et al. 2008). Therefore we exclude *Mauginiella* from *Phaeosphaeriaceae*. Other asexual genera of *Phaeosphaeria* still lack phylogenetic investigation. Therefore we accept three asexual genera (*Neostagonospora* Quaedvlieg et al., *Parastagonospora* Quaedvlieg et al., and *Phaeoseptoria* Speg.) for *Phaeosphaeria sensu lato*.

Phaeosphaeria oryzae was designated as typified of *Phaeosphaeria* by Miyake (1909). However, Miyake (1909) did not mention the detail of the type specimen in his publication and this type has not been found in any herbarium in Japan. Eriksson (1967) translated the protologue and found Miyake's specimen in Sydow's herbarium as labeled "*Leptosphaeria oryzae* Hori=*Phaeosphaeria oryzae* Miy. — on *Oryza sativa* L. — Prov. Susuya Shizuoka — 1907.09". He found that most characters of this specimen match with the diagnosis except the presence of pseudoparaphyses. Thus Eriksson (1967) designated Sydow's specimen as a lectotype of *Phaeosphaeria oryzae*. However, the mucilaginous sheath or appendages were not seen in Eriksson's (1967) observation (Shoemaker and Babcock 1989b). Shoemaker and Babcock (1989b) carried out a monograph of *Phaeosphaeria* with *Phaeosphaeria oryzae* treated in subgenus *Phaeosphaeria*. The species description included echinulate ascospores; however Miyake (1909, 1910) and Eriksson (1967) did not mention this character. Quaedvlieg et al. (2013) epitypified *Phaeosphaeria oryzae* and *Phaeoseptoria papayae*, the type species of *Phaeosphaeria* and *Phaeoseptoria* and indicated that *Phaeoseptoria* is the asexual state of *Phaeosphaeria* based on phylogenies.

In the present study the lectotype of *Phaeosphaeria oryzae* was examined and the morphological characters compared with the diagnosis of Miyake (1910). On examination it appears that *Phaeosphaeria oryzae* lectotype has smooth-walled ascospores, but this was not mentioned by Miyake (1910) either. In addition, the asci and ascospores size in the lectotype are larger than Miyake's diagnosis (1910) (see Table 4). Quaedvlieg et al. (2013) epitypified *Phaeosphaeria oryzae* and described the ascospores as echinulate following the description of Shoemaker and Babcock (1989b). Further specimens that have been determined to be *Phaeosphaeria oryzae* from BPI have been examined in the present study and some specimens have echinulate ascospores, while others do not. It appears that *Phaeosphaeria oryzae* may be a species complex which has been epitypified by a specimen that is probably a different species to the lectotype.

Based on our multigene phylogenetic analysis, *Phaeosphaeria* species separated in several subclades in *Phaeosphaeriaceae*. Several *Phaeosphaeria sensu stricto* specimens collected from various hosts in Thailand formed a strongly supported clade with the type species, *Phaeosphaeria oryzae* and also *Ph. papayae* and *Ph. musae*. These *Phaeosphaeria* (*sensu stricto*) species differ morphologically (see Table 4), but the phylogenies indicate that they are closely related species. We therefore analyzed the phylogenetic relationships among species, with *Phaeosphaeria sensu stricto* strains forming a distinct clade with high bootstrap support. A pair wise comparison of ITS and *TEF1* helped to significantly differentiate the cryptic species (ITS pair wise comparison see Fig. 4). Currently, many plant pathogens causing serious disease of economic crops are reported as the species complexes (Wikee et al. 2011; Cannon et al. 2012; Manamgoda et al. 2012; Udayanga et al. 2012; Weir et al. 2012) which seem to be the case in *Phaeosphaeria*. *Phaeosphaeria sensu stricto* species are morphologically similar, but differ in the size of ascomata, asci, and ascospores, habitat and host occurrence. The combined gene phylogenetic analysis can distinguish taxa of *Phaeosphaeria sensu stricto* at the species level.

The *Phaeosphaeria sensu stricto* taxa collected from various monocotyledons in Thailand are introduced as two novel species and *Phaeosphaeria musae* is reported on other hosts from Thailand with descriptions and illustrations below.

Phaeosphaeria oryzae I. Miyake, *Bot. Mag*., Tokyo 23: 93 (1909), *Faces of Fungi number*: FoF00234, Fig. 19.

= *Phaeoseptoria oryzae* I. Miyake (1910).

Saprobic on leaves of *Oryza sativa. Ascomata* 70–130 μm high, 90–150 μm diam., solitary, sometimes clustered, immersed, visible as slightly raised, small, black dots on the host surface, uniloculate, globose to subglobose, glabrous, brown to dark brown, ostiole central, with minute papilla. *Peridium* 5–10 μm wide, of equal thickness, composed of 2–3 layers of thin-walled, brown to dark brown, flattened pseudoparenchymatous cells, arranged in *textura angularis. Hamathecium* composed of sparse, 2.5–4 μm wide, filiform, broad cellular pseudoparaphyses, distinctly constricted at the septa, rarely anastomosing at the apex. *Asci* (50–)55–70(−80) × 10–13.5(−15) μm ($\bar{x}$= 65.4 × 11.9 μm, *n*=25), 8-spored, bitunicate, fissitunicate, broadly cylindrical, short pedicellate or subsessile, apically rounded with indistinct ocular chamber. *Ascospores* (22–)25–27(−29) × 5–6 μm ($\bar{x}$ = 26 × 5.2 μm, *n*= 30), overlapping 2-seriate, phragmosporous, narrowly fusiform, brown, mostly 3-septate, rarely 1–2 septa, indistinctly constricted at the septa, slightly curved, smooth-walled. **Asexual state:** *Phaeoseptoria*.

Material examined: JAPAN, Shizuoka, Suruya, on *Oryza sativa* L. (*Poaceae*), September 1907 (S-F9572, **lectotype**); EL SALVADOR, intercepted Washington Dc #26812, on *Oryza sativa*, 10 March 1952, F.P. Hubert (BPI 622541); JAPAN, intercepted San Diego California #4872, on *Oryza sativa* L., 27 December 1957, E.B. Francis (BPI 622542); JAPAN, intercepted San Francisco California #17349, 17352, 17367, on *Oryza sativa*, 13 December 1940, F.J. Phelan (BPI 622544); NICARAGUA, Monagua, on living leaves of *Oryza sativa*, 4 November 1954, C. Pineda 37, (BPI 622545); THAILAND, Chiang Mai Province, Mae Wang District, Mae Sapok Royal Project, on dead branches of *Etlingera* sp. (*Zingiberaceae*), 5 October 2010, R. Phookamsak RP0086 (MFLU 11-0206), living culture=MFLUCC 11-0170.

Phaeosphaeria chiangraina Phookamsak & K.D. Hyde, sp. nov., *Index Fungorum number:* IF550736; *Faces of Fungi number*: FoF00261, Fig. 20.

Etymology: Referring to Province in Thailand, in which the fungus was found.

Table 4 Synopsis of *Phaeosphaeria* discussed in this study

Species name	Size						
	Ascomata (high×diam.)	Asci (l/w)	Ascospore (l/w)	Ascospore walls	Ascospore sheath	Constricted at the septum	Host
P. chiangraina	120–180×130–180 µm	(44–)47–60(−65)×8–9(−10) µm	(13.5–)15–17(−18)×3.5–4.5 µm	Smooth	Present	Slightly constrict	*Oryza sativa*
P. musae (CBS 120026; type)	Up to 130 µm diam.	38–60×7–8 µm	15–)17–19(−21)×(3.5–)4 µm	Verruculose	Not mentioned	Not constricted	*Musa* sp.
P. musae (MFLUCC 11-0133)	110–140.5×120–160 µm	(58.5–)65–70(−76)×13–15(−17) µm	25–30(−33.5)×5–7.5 µm	Verruculose	Present	Slightly constrict	*Calathea* sp.
P. musae (MFLUCC 11-0151)	70–105×85–130 µm	40–50 (−53)×9–10(−13) µm	16–18×3–4 µm	Verruculose	Present	Not constricted	*Cordyline* sp.
P. oryzae (Miyake 1910)	90–125×70–125 µm	35–55×7–9 µm	16–23×4–5 µm	Not mentioned	Not mentioned	Slightly constrict	*Oryza sativa*
Ph. oryzae (epitype; Quaedvlieg et al. 2013)	Up to 150 µm diam.	30–55×7–9 µm	(15–)17–20(−23)×4–5 µm	Verruculose	Present	Slightly curved	*Oryza sativa*
P. oryzae (lectotype)	70–130×90–150 µm	(50–)55–70(−80)×10–13.5(−15) µm	(22–)25–27(−29)×5–6 µm	Smooth	Undetected	Slightly constrict	*Oryza sativa*
P. oryzae (collection in Thailand)	90–140×130–200 µm	(36–)43–57(−62)×(7–)8–10(−11) µm	13–15(−17)×3–4 µm	Echinulate	Present	Not constricted	*Etlingera* sp.
Ph. thysanolaenicola	70–100×100–130 µm	(41.5–)43–50(−57)×7–9 µm	(15–)17–19(−20)×3–4 µm	Echinulate	Present	Not constricted	*Thysanolaena maxima*

Holotypus: MFLU 12-2472

Saprobic on leaves of *Oryza sativa*. **Sexual state**: *Ascomata* 120–180 µm high, 130–180 µm diam., scattered, immersed, visible as slightly raised, small, black dots on the host surface, uniloculate, globose to subglobose or irregular in shape, glabrous, brown to dark brown, ostiole central with minute papilla. *Peridium* 7–16 µm wide, thin-walled, of equal thickness, composed of 1–3 layers of flattened, brown to dark brown, elongated, pseudoparenchymatous cells, arranged in *textura angularis*. *Hamathecium* composed of numerous, 1.5–3 µm wide, filiform, broad cellular pseudoparaphyses, with small guttules, indistinctly constricted at the septa, embedded in mucilaginous matrix, rarely anastomosing at the apex. *Asci* (44–)47–60(−65)×8–9(−10) µm ($\bar{x}$= 52.6×8.9 µm, n=25), 8-spored, bitunicate, fissitunicate, broadly cylindrical, short pedicellate or subsessile, apically rounded with ocular chamber. *Ascospores* (13.5–)15–17(−18)×3.5–4.5 µm ($\bar{x}$ = 16.4×4.1 µm, n=30), overlapping 2-seriate, phragmosporous, fusiform with obtuse ends, pale brown when young, becoming yellowish-brown to brown at maturity, dark brown when stained in 5 % of KOH, 3-septate, not constricted at the septa, slightly curved, smooth-walled with small to large guttules in each cell, surrounded by a distinct mucilaginous sheath. **Asexual state:** produced on media agar after 8 weeks. *Conidiomata* 100–305 µm high, 120–290 µm diam., pycnidial, scattered to clustered, immersed, with dark brown to black stromatic tissues embedded in the media agar, uni- to multi-loculate, globose to irregular, ostioles not observed, brown to dark brown. *Conidiomata walls* 13–35 µm wide, composed of several layers of brown, pseudoparenchymatous cells, arranged in a *textura angularis*, covered by vegetative hyphae. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* (2–)3–6×(2–)4–7 µm ($\bar{x}$ = 4.4×4.3 µm, n=20), holoblastic, phialidic, ampulliform or flattened, hyaline to pale brown, difficult to distinguish from the pycnidial wall. *Conidia* (15–)17–21.5(−26)×2–3 µm ($\bar{x}$= 19.4×2.5 µm, n=30), solitary, cylindrical, pale brown to brown, 1–3-septate, slightly curved, obtuse at the apex, truncate at the base, not constricted at the septa, smooth-walled with guttules.

Culture characters: Colonies on PDA 77–80 mm diam. after 4 weeks at 25–30 °C, white to pale yellowish at the edge, pale yellowish to grey in the centre, forming different colour sectors of grey to dark grey; reverse pale yellowish at the edges, becoming yellowish-brown to brown at the centre, slightly radiating outwardly, forming dark sectors; medium dense, forming black stromatic tissues immersed in media after 8 weeks, circular to irregular, flattened to slightly raised, dull with entire edge, floccose to fairly fluffy, slightly radiating at the lower part, not pigmented.

Material examined: THAILAND, Chiang Rai Province, Muang District, Nanglae Village, on dead leaves of *Oryza sativa*, 20 January 2013, R. Phookamsak RP0131 (MFLU 12-2472, **holotype**), ex-type living culture=MFLUCC 13-0231=MUCL.

Fig. 19 ***Phaeosphaeria oryzae*** (S-F9572, **lectotype**) **a** Herbarium label and specimens. **b** Ascomata on host surface. **c** Section through ascoma. **d** Section through peridium. **e** Asci with sparse pseudoparaphyses. **f–i** Asci. **j–o** Ascospores. Scale bars: c=50 *μm*, e, f, g, h, i, j=20 *μm*, d, k, l, m, n, o=10 *μm*

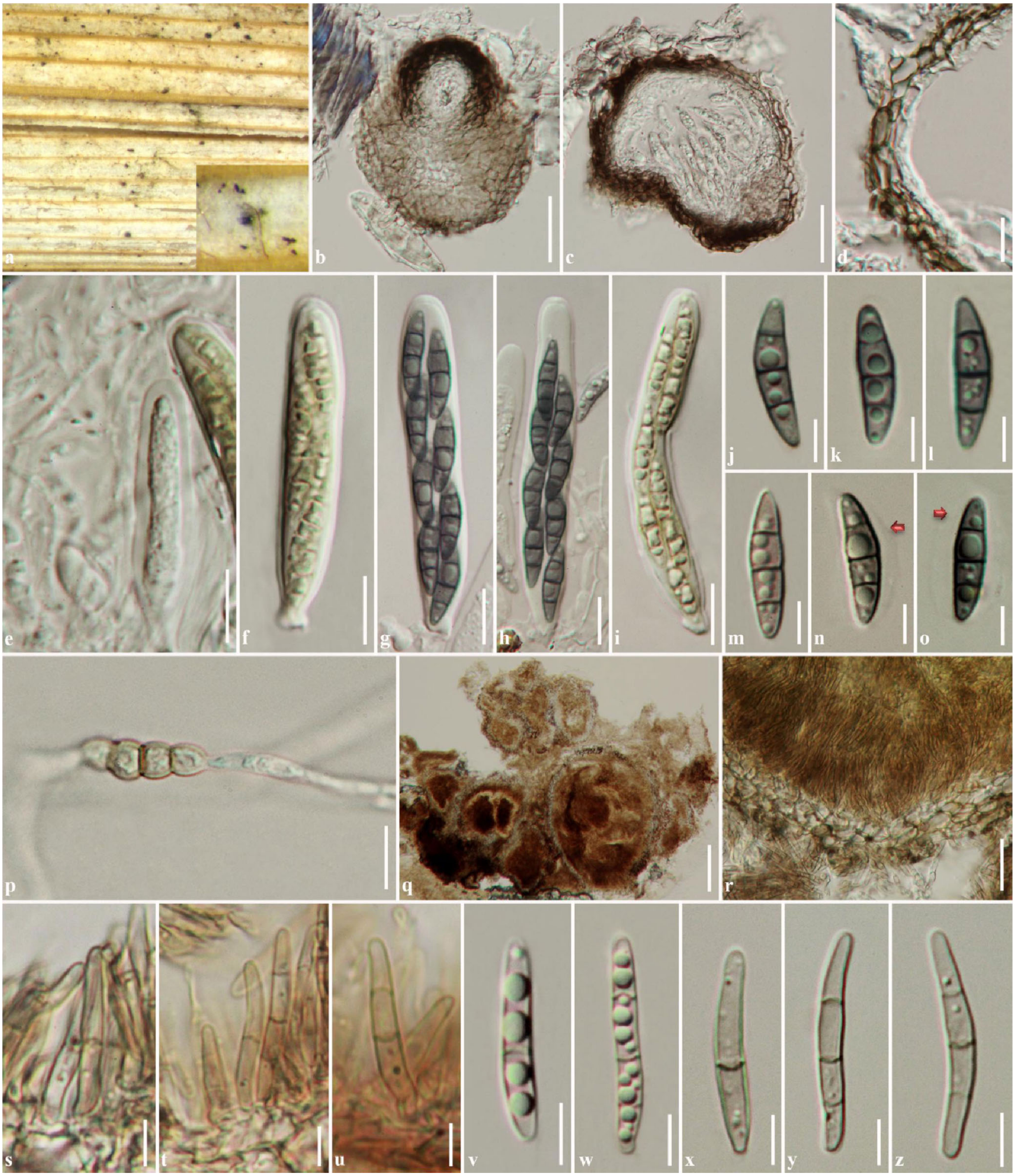


Fig. 20 ***Phaeosphaeria chiangraina*** (MFLU 12-2472, **holotype**). **a** Ascomata of *Phaeosphaeria oryzae* on host surface. **b** Ascomata visualized under compound microscope. **c** Section through ascoma. **d** Section through peridium. **e** Asci with rare pseudoparaphyses. **f, i** Asci. **g, h** Asci stained in 5 % KOH. **j- o** Ascospores stained in 5 % of KOH. **m, n** Ascospores. **p** Ascospore germination on WA. **q** Section through conidioma. **r** Section through conidioma wall. **s–u** Conidiogenous cells. **v–z** Conidia. Scale bars: q=100 *μm*, b, c=50 *μm*, d, r=20 *μm*, e, f, g, h, i, p=10 *μm*, j, k, l, m, n, o, s, t, u, v, w, x, y, z=5 *μm*

Notes: Phaeosphaeria chiangraina was collected on *Oryza* in Thailand. This is the same host of the generic type of *Phaeosphaeria*, *P. oryzae*. A morphological comparison based on species described in Shoemaker and Babcock

(1989b) shows that *Ph. chiangraina* is similar to *Phaeosphaeria avenaria*, *Ph. eustoma*, *Ph. oryzae* and *Ph. tritici*. *Phaeosphaeria chiangraina* differs from *Ph. oryzae* in the size of ascomata, asci and ascospores. *Phaeosphaeria chiangraina* has smaller ascospores (13.5–18 × 3.5–4.5 *μm*) than *Ph. oryzae* (15–23 × 4–5 *μm*). *Phaeosphaeria tritici* has similar sized ascospores to *Ph. chiangraina*; however, *Ph. tritici* has a larger asci and smaller ascomata. Additionally, *Phaeosphaeria tritici* ascospores are enlarged at the second cell and slightly constricted at the first septa and produce a phoma-like asexual state, as while *Ph. chiangraina* lacks an enlarged cell, is not constricted at the septa and forms a septoria-like asexual state.

Multigene phylogenetic analysis using MP shows that *Phaeosphaeria chiangraina* can be distinguished from *Phaeosphaeria avenaria* and *Ph. eustoma*, and forms a strongly supported clade with *Ph. thysanolaenicola* and *Ph. oryzae* (CBS 110110) (Fig. 3). However, *Ph. chiangraina* morphologically differs from *Ph. thysanolaenicola* and can be separated from the epitype of *Ph. oryzae* due to its smooth-walled ascospores with a distinct sheath and based on phylogenetic evidence (Fig 3).

Phaeosphaeria musae Sawada, Special Publication College of Agriculture, National Taiwan University 8: 66 (1959) *Faces of Fungi number*: FoF00262, Fig. 21.

Pathogen on *Asparagaceae* and *Marantaceae*. **Sexual state**: *Ascomata* 110–140.5 *μm* high, 120–160 *μm* diam., solitary, scattered, immersed, visible as slightly raised, small black dots on host surface, uniloculate, brown to dark brown, globose to subglobose, central ostiole with minute papilla. *Peridium* 7–24 *μm* wide, thin-walled, of unequal thickness, slightly thick at the apex, composed of 1–3 layers of brown to dark brown, pseudoparenchymatous cells multi-layered and elongated, at the apex, arranged in *textura angularis*. *Hamathecium* composed of numerous, 1.5–3 *μm* wide, filiform, broad cellular pseudoparaphyses, with distinct septa, slightly constricted at the basal septa, embedded in gelatinous matrix, rarely anastomosing at the apex. *Asci* (40–)65–70(−76) × (9–)13–15(−17) *μm* ($\bar{x}$ = 69 × 14.2 *μm*, *n*=25), 8-spored, bitunicate, fissitunicate, broadly cylindric-clavate to clavate, subsessile, with acute ends, apically rounded with indistinct ocular chamber. *Ascospores* (16–)25–30(−33.5) × 5–7.5 *μm* ($\bar{x}$ = 27.6 × 5.8 *μm*, *n*=30), overlapping 2–3-seriate, phragmosporous, fusiform, yellowish-brown to brown, becoming dark brown when stained in 5 % KOH, 3-septate, slightly constricted at the central septa, enlarged at the second cell, slightly curved, rarely straight, rough-walled, echinulate, surrounded by narrow mucilaginous sheath. **Asexual state**: Unknown.

Culture characters: Colonies on MEA 25–27 mm diam. after 4 weeks at 25–30 °C, white yellowish or grey in the centre and edges; reverse yellowish-brown to greyish-yellow or olive brown, with rare tufting, radiating with dark brown colouration separating the margin from the centre; medium dense, irregular, flattened to slightly raised, dull with undulate edge, floccose or velvety, forming black stromatic tissues, embedded in agar after 8 weeks, agar tinted with yellowish-brown pigmentation.

Material examined: THAILAND, Pha Yao Province, Mae Jai District, Sri Don Kaew Village, on living leaves of *Calathea* sp. (*Marantaceae*), 19 August 2010, R. Phookamsak RP0049 (MFLU 11-0169), living culture= MFLUCC 11-0133; THAILAND, Chiang Rai Province, Muang District, Pakha village, on living leaves of *Cordyline* sp. (*Asparagaceae*), 15August 2010, S. Wikee (RP0067), MFLU11-0187, living culture=MFLUCC 11-0151.

Notes: Phaeosphaeria species (MFLUCC 11-0133 and MFLUCC 11-0151) were isolated from necrotic leaf spots symptoms on *Calathea* sp. and *Cordyline* sp. from Thailand. These two collections have similar morphological characters with *Phaeosphaeria musae* and *Ph. panici* (P. Syd.) Shoemaker & C.E. Babc. However they differ from *Phaeosphaeria panici* in having larger ascomata and asci and being associated with a different host. *Phaeosphaeria panici* lacks molecular data to confirm a natural placement, while these isolates form a strongly-supported clade (70 % MP) with *Ph. musae* in the *Phaeosphaeria sensu stricto* clade. Based on the ITS and *TEF1* pair wise comparisons and multigene phylogenetic evidence, it appears that these isolates are conspecific with *Phaeosphaeria musae*. Thus, they are identified as *Phaeosphaeria musae*, and the species is reported associated with leaf spot disease on *Calathea* sp. and *Cordyline* sp. from Thailand. Pathogenicity was not confirmed.

Phaeosphaeria thysanolaenicola Phookamsak & K.D. Hyde, sp. nov., *Index Fungorum number:* IF550735; *Faces of Fungi number*: FoF00263, Fig. 22.

*Etymology***:** Referring to the host on which the fungus was found.

Holotypus: MFLU 11-0157

Pathogen associated with *Paraphaeosphaeria* on leaves of *Thysanolaena maxima*. **Sexual state:** *Ascomata* 70–100 *μm* high, 100–130 *μm* diam., scattered or sometimes clustered, immersed, visible as raised, black dots on the host surface, uni- to bi-loculate, subglobose, brown to dark brown, ostiole central, with minute papilla. *Peridium* 5–10 *μm* wide, thin-walled, of equal thickness, composed of 1–3 layers of brown to dark brown, pseudoparenchymatous cells, arranged in *textura angularis*. *Hamathecium* composed of numerous, 2–5 *μm* wide, filiform, broad cellular pseudoparaphyses, with distinct septa, slightly constricted at the septa, embedded in a gelatinous matrix, rarely anastomosing at the apex. *Asci* (41.5–)43–50(−57) × 7–9 *μm* ($\bar{x}$ = 49.3 × 8.4 *μm*, *n*=25), 8-spored, bitunicate, fissitunicate, broadly cylindrical or cylindric-clavate, sessile to subsessile, apically rounded with ocular

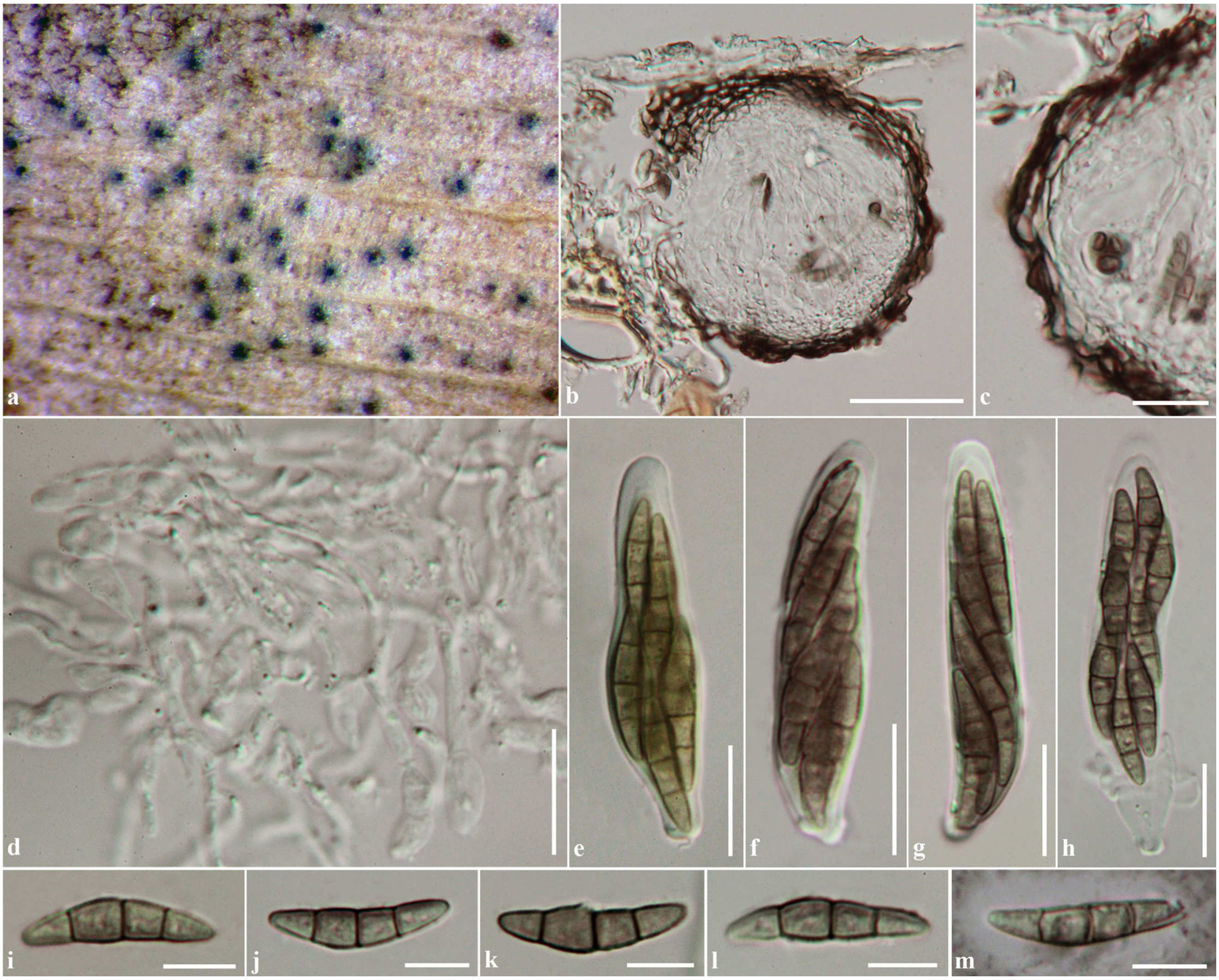


Fig. 21 ***Phaeosphaeria musae.*** (MFLU 11-0169). **a** Ascomata on host surface. **b** Section through ascoma. **c** Section through peridium. **d** Pseudoparaphyses. **e**–**h** Asci. **i**–**m** Ascospores. Note sheath in m. Scale bars: b=50 μm, c, d, e, f, g, h, = 20 μm, i, j, k, l, m=10 μm

chamber. *Ascospores* (15–)17–19(−20)×3–4 μm ($\bar{x}$ = 17.8× 3.8 μm, n=30), overlapping 1–3-seriate, phragmosporous, narrowly fusiform, with obtuse ends, yellowish-brown to brown, 3-septate, rarely 1–2-septate, slightly constrict at the central septum, straight to curved, rough-walled, echinulate, surrounded by mucilaginous sheath. **Asexual state:** Unknown.

Culture characters: Colonies on PDA 33–35 mm diam. after 4 weeks at 25–30 °C, white to pale yellowish-brown at the edge, white with grey sectors in the centre; reverse white to yellowish at the edges, becoming orange brown to grey at the centre with orange radiations separating the edges from the centre; medium dense, circular to irregular, flattened to raised, or umbonate, rough with entire to slightly undulate edge, floccose to velvety or cottony, radiating in the lower part, not producing pigments.

Material examined: THAILAND, Chiang Rai Province, Phan District, Pukang Waterfall, on living leaves of *Thysanolaena maxima* Kuntze (*Poaceae*), 22 May 2010, R. Phookamsak (RP0036) (MFLU 11-0157, **holotype**), ex-type living culture=MFLUCC 10-0563=MUCL.

Notes: Phaeosphaeria thysanolaenicola is most similar to *Ph. oryzae* as they share a similar ascoma, asci and ascospore size range. However, they differ in habitat and host preferences, as *Ph. thysanolaenicola* is associated with other fungi on leaf spots of *Thysanolaena maxima*. Whereas *Ph. oryzae* was found as a saprobe on *Oryzae sativa*. The ITS pair wise comparison shows that they differ in eight base positions. Phylogenetic analysis performed with a combination of ITS, LSU, *RPB2* and *TEF1* genes shows that *Ph. thysanolaenicola* forms a clade with *Ph. chiangraina*. *Phaeosphaeria thysanolaenicola* differs from *Ph. chiangraina* in its smaller asci and ascospores, habitat, host occurrence and ascospore ornamentation. *Phaeosphaeria thysanolaenicola* has echinulate ascospores while *Ph. chiangraina* has smooth-walled ascospores.

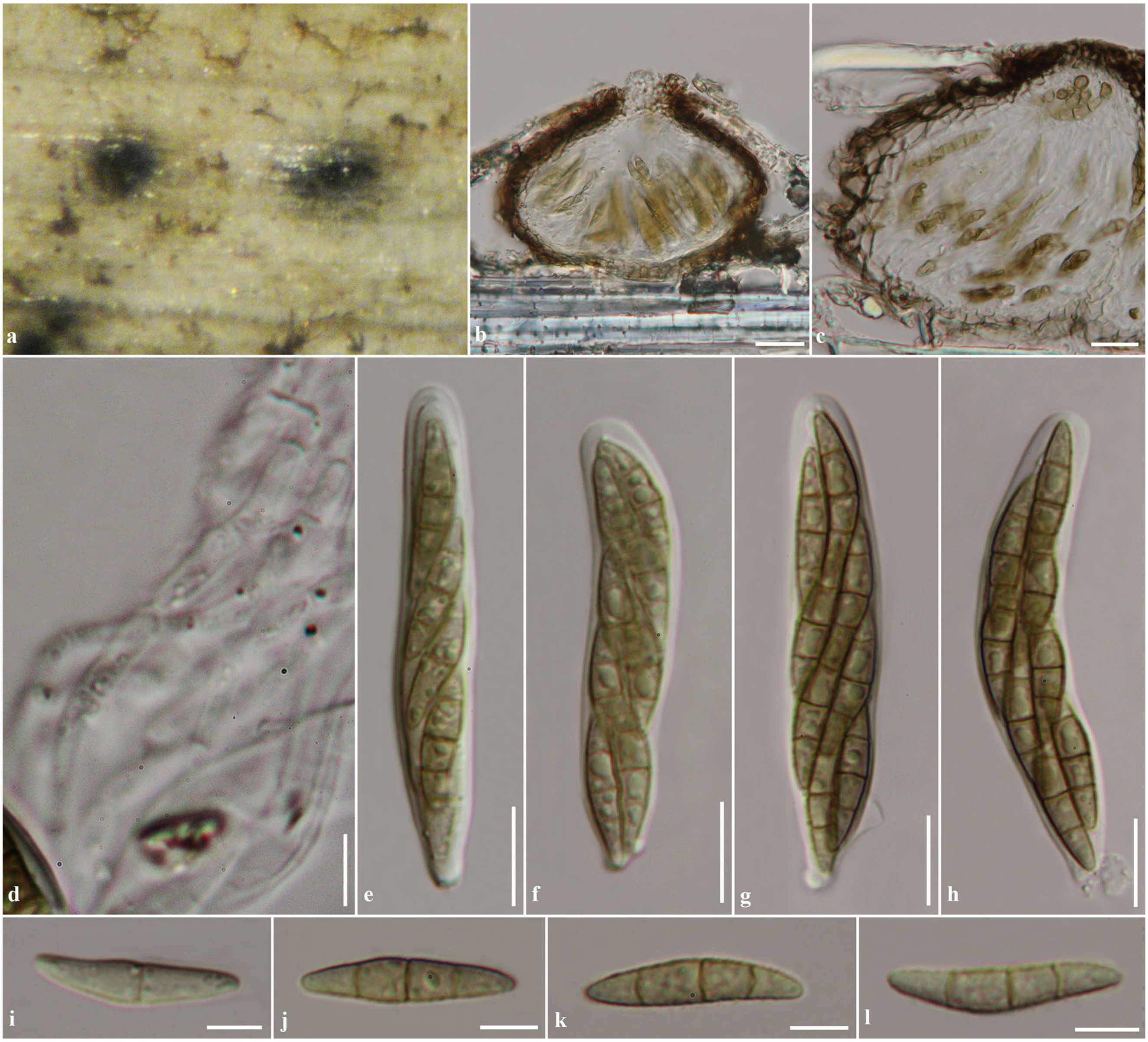


Fig. 22 ***Phaeosphaeria thysanolaenicola*** (MFLU 11-0157, **holotype**). **a** Ascomata on host surface. **b** Section through ascoma. **c** Section through peridium. **d** Cellular pseudoparaphyses. **e**–**h** Asci. **i**–**l** Ascospores. Scale bars: b=20 μm, c, e, f, g, h, = 10 μm, d, i, j, k, l=5 μm

Phaeosphaeriopsis M.P.S. Câmara et al., in Câmara et al., Mycol. Res. 107(5): 519 (2003), *Faces of Fungi number*: FoF00264.

Saprobic or *pathogenic* on various monocotyledons. **Sexual state:** *Ascomata* scattered to clustered, immersed, visible as small, black spots on host surface, uni- to biloculate, globose to subglobose, glabrous, brown, ostiole central, penetrating through host surface. *Peridium* thin-walled, of equal thickness, composed of brown to dark brown, pseudoparenchymatous cells of *textura angularis. Hamathecium* composed of numerous, filiform, frequently anastomosing, broad cellular pseudoparaphyses, with distinct septa and constricted at the septa. *Asci* 8-spored, bitunicate, fissitunicate, broadly cylindrical to cylindric-clavate, subsessile to short pedicellate, apically rounded, with indistinct ocular chamber. *Ascospores* overlapping 1–3-seriate, phragmosporous, oblong to cylindrical, often with one enlarged cell, yellowish-brown to brown or reddish-brown, 3–5-transeptate, slightly curved, not constricted at the septa, walls smooth or rough, echinulate or verruculose, surrounded by mucilaginous sheath. **Asexual state:** see under *Phaeostagonospora*.

Type species: ***Phaeosphaeriopsis glaucopunctata***

Phylogenetic study: Câmara et al. (2003); Schoch et al. (2009); Zhang et al. (2012); Quaedvlieg et al. (2013); Hyde et al. (2013), Thambugala et al. (2014).

Notes: Phaeosphaeriopsis was introduced by Câmara et al. (2003) and typified by *Ps. glaucopunctata* to accommodate non congeneric species of *Paraphaeosphaeria. Phaeosphaeriopsis* *agavensis* (A.W. Ramaley et al.) Câmara et al., *Ps. amblyspora* A.W. Ramaley, *Ps. glaucopunctata* (Grev.) Câmara et al., *Ps. nolinae* (A.W. Ramaley) Câmara et al., and *Ps. obtusispora* (Speg.) Câmara et al. were introduced in the genus based on morphological characters and phylogenetic analyses of *Phaeosphaeriopsis glaucopunctata* (CBS 653.86) (Câmara et al. 2003; Zhang et al. 2012; Thambugala et al. 2014). Farr et al. (2006) transferred *Sphaeria phacidiomorpha* to *Phaeosphaeriopsis phacidiomorpha* based on the type morphological characters and microsphaeropsis-like asexual state which was most similar to *Phaeosphaeriopsis*. However, *Sphaeria phacidiomorpha* differs from other *Phaeosphaeriopsis* species by its hyaline ascospores (Farr et al. 2006; Thambugala et al. 2014). *Phaeosphaeriopsis phacidiomorpha* is currently synonymized under the name *Glomerella phacidiomorpha* (Ces.) Petr. (Index Fungorum 2014; Thambugala et al. 2014).

Phaeosphaeriopsis musae was introduced and accommodated in *Phaeosphaeriaceae* by Arzanlou and Crous (2006) and is a pathogen causing leaf spots on banana. Subsequent phylogenetic analysis indicated that *Ps. musae* clusters with *Phaeosphaeria oryzae* and separate to *Phaeosphaeriopsis glaucopunctata* (Zhang et al. 2012; Hyde et al. 2013; Phookamsak et al. 2013, 2014). Thus, Thambugala et al. (2014) synonymized *Phaeosphaeriopsis musae* under the older name *Phaeosphaeria musae* Sawada (1959) based on morphological characters and phylogenetic evidence. Additionally, Thambugala et al. (2014) epitypified *Phaeosphaeriopsis glaucopunctata* and described the new species *Phaeosphaeriopsis triseptata* K.M. Thambugala & K.D. Hyde with sexual and asexual morphs. Six species are listed in Index Fungorum (2014) and 59 sequences are available in GenBank. Molecular analysis confirms the placement of *Phaeosphaeriopsis* in *Phaeosphaeriaceae* (Zhang et al. 2012; Hyde et al. 2013; Quaedvlieg et al. 2013; Thambugala et al. 2014; Wijayawardene et al. 2014b).

A collection of *Phaeosphaeriopsis* was made which causes leaf spots on leaves of *Dracaena lourieri* Gagnep in Thailand. Based on morphological characters and multigene phylogenetic analysis, a new species, *Phaeosphaeriopsis dracaenicola*, is introduced to accommodate this taxon in the present paper.

Phaeosphaeriopsis glaucopunctata (Grev.) M.P.S. Câmara et al. [as 'glauco-punctata'], in Câmara et al., Mycol. Res. 107(5): 519 (2003), *Faces of Fungi number*: FoF00265, Fig. 23.

≡ *Cryptosphaeria glaucopunctata* Grev., *Fl. Edin*.: 1-478 (1824)

Saprobic on *Ruscus aculeatus* (*Asparagaceae*). **Sexual state:** *Ascomata* 110–145 μm high, 130–220 μm diam, scattered, solitary, immersed, visible as small, brown spots surrounded by pale yellowish region, uniloculate, subglobose, glabrous, with central black ostiole penetrating through host surface. *Peridium* 7–18 μm wide, thin-walled, of unequal thickness, composed of 3–4 layers of thickened, brown, pseudoparenchymatous cells, arranged in a *textura angularis*. *Hamathecium* composed of sparse, 1–3 μm wide, filiform, frequently anastomosing, broad cellular pseudoparaphyses, with distinct septa, constricted at the septa. *Asci* (55–)60–75(−76)×(11–)12–14(−15) μm ($\bar{x}$ = 68.2×13.4 μm, n=20), bitunicate, 8-spored, broadly cylindrical to cylindric-clavate, subsessile to short pedicellate, apically rounded with indistinct ocular chamber. *Ascospores* 18–20(−22)×(3–)4–5.5 μm ($\bar{x}$ = 20×4.8 μm, n=20), overlapping 1-3-seriate, phragmosporous, cylindrical, narrower and longer at the lower cell, brown to dark brown, 4-septate, often enlarged at the forth cell, rough-walled, echinulate, surrounded by mucilaginous sheath. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary, immersed to superficial (in agar), uniloculate, globose, glabrous, brown to black, ostiolate, with black droplets. *Conidiomata walls* thin, comprising 2–3 layers of yellowish-brown to brown, pseudoparenchymatous cells, arranged in *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, phialidic, annellidic, with a short collarette, ampulliform to subcylindrical, hyaline, lining the inner cavity of conidioma. *Conidia* amerosporous, cylindrical to oblong, with rounded ends, hyaline to yellow, becoming yellowish-brown at maturity, aseptate, smooth to finely verruculose, accumulating in a huge bluish-black slimy mass at the tip of ostiole (from Thambugala et al. 2014).

Material examined: UK, near Edinburgh, Slateford, on dead leaves of *Ruscus aculeatus* L. (*Asparagaceae*), 15 August 1824, R.K. Greville (E 00074283, **syntype**).

Phaeosphaeriopsis dracaenicola Phookamsak & K.D. Hyde, sp. nov., *Index Fungorum number:* IF550737; *Faces of Fungi number*: FoF00266, Fig. 24.

Etymology: referring to the host, of which the fungus was found.

Holotypus: MFLU 11-0193

Pathogenic causing necrotic leaf spot on *Dracaena lourieri*; lesions 3–6 cm, infecting mostly on leaf margin, oval-shaped, pale brown to yellowish-brown, separated from healthy tissue by a reddish-brown to orange-brown margin. **Sexual state:** *Ascomata* 88.5–170 μm high, 140–200 μm diam., solitary to gregarious, immersed, visible as slightly raised, small black spots on host surface, subglobose, brown to dark brown, ostiole central. *Peridium* 5–17.5 μm wide, thin-walled, of equal thickness, composed of 3–4 layers of dark brown, pseudoparenchymatous cells, arranged in *textura angularis*, outer layer comprising 2–3 layers of thick-walled cells, inner layers comprising 1–2 layers of thin-walled hyaline cells. *Hamathecium* composed of numerous, 1.5–4 μm wide, frequently septate, frequently anastomosing, branching, broad cellular pseudoparaphyses, embedded in mucilaginous matrix. *Asci* 62–78×9–12 μm ($\bar{x}$ = 71.5×10.8 μm, n=25), 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-

Fig. 23 ***Phaeosphaeriopsis glaucopunctata*** (E00074283, **syntype**). **a** Herbarium label and specimens of *Phaeosphaeriopsis glaucopunctata*. **b** Ascomata on host surface. **c** Section through ascomata **d** Section through peridium. **e** Asci with pseudoparaphyses. **f** Cellular pseudoparaphyses. **g** Ascus. **h**–**i** Asci stained by KOH reagent. **j**–**o** Ascospores. Scale bars: c= 100 μm, d–i=20 μm, j–o=5 μm

clavate, short pedicelate, apically rounded, with well-developed ocular chamber. *Ascospores* 16–19×(3.5–)4–5 μm ($\bar{x}$ = 17.4×4.5 μm, n=30), overlapping 2–3-seriate, phragmosporous, oblong to cylindrical, initially yellowish becoming brown to reddish-brown, 4–5 septate, usually widest in the third cell, narrower at the lowest cell, smooth-walled, guttulate, surrounded by thick mucilaginous sheath. **Asexual state:** forming on bamboo pieces on water agar (WA) after 8 weeks. *Conidiomata* 42–135.5 μm high, 50–140 μm diam., pycnidial, solitary, superficial on bamboo pieces, or semi-immersed on agar, visible as black slimy or shiny spots on surface, globose to subglobose or cup-shaped when sectioned through conidiomata, centrally ostiolate. *Conidiomata walls* 5–12 μm wide, composed of 3–4 layers of dark brown cells, arranged in *textura angularis*, outer layers comprising 2–3 layers of thick-walled cells, brown to dark brown, paler at the


a
b
c
d
e
f
g
h
i
j
k
l
m
n
o
p
q
r
s
t
u
v
w
x
y
z
aa
ab

◀ **Fig. 24** ***Phaeosphaeriopsis dracaenicola*** (MFLU11-0193, **holotype**). on living leaves of *Dracaena lourieri*. **a** Leaf lesion on host. **b** Ascomata visible on host surface. **c** Section through ascoma. **d** Section through peridium. **e** Asci with pseudoparaphyses. **f–i** Asci. **j** Ascospores stained in Indian ink. **k–n** Ascospores. **o** Conidiomata forming on bamboo pieces on water agar. **p** Pycnidia. **q** Section through pycnidium. **r** Section through pycnidial wall. **s–u** Conidiogenous cells. **v** Conidia. **w–ab** Conidia. Scale bars: c=100 μm, p, q=50 μm, d, e, f, g, h, i=20 μm, j, k, l, m, n, r, s, v=10 μm, t, u, w, x, y, z, aa, ab=2 μm

base, inner layer comprising 2–3 layers of thin-walled cells, hyaline. *Conidiophores* simple, rarely branched, doliiform to cylindrical or ampulliform, septate, hyaline, mostly reduced to conidiogenous cells. *Conidiogenous cells* 4–12×3–4 μm, holoblastic, phialidic, single, discrete, sometimes integrated, ampulliform or cylindric-clavate, hyaline, arising from basal stratum. *Conidia* 3–4.5×3–4.5 μm ($\bar{x}$ = 3.9×3.6 μm, n=30), amerosporous, globose to subglobose, initially hyaline, becoming brown to dark brown, aseptate, smooth-walled.

Culture characters: Colonies on malt extract agar (MEA) 34–34.5 mm diam. after 20 days at 25–30 °C, white to cream at the margins, pale yellowish to yellowish-brown in the middle and pale brown to brown or orange-brown at the centre, with small white to grey droplets; reverse white to cream at the margins, brown to orange-brown in the middle and pale yellowish to yellowish at the centre; medium dense, irregular, flattened to slightly raised, with rough surface, undulate edge with entire to slightly radiating margins, floccose to fairly fluffy, no pigment produced in agar.

Material examined: THAILAND, Chiang Rai Province, Muang District, Nang Lae Village, on living leaves of *Dracaena lourieri* Gagnep (*Asparagaceae*), 21 September 2010, S. Wikee, RP0073 (MFLU11-0193, **holotype**), ex-type living culture=MFLUCC 11-0157=MUCL; *ibid*. Chiang Mai Province, Mae Wang District, Doi Inthanon, Royal Project, on living *Dracaena loureiri*, 16 November 2010, R. Phookamsak, RP0109 (MFLU 11-0229, **paratype**), ex-paratype living culture=MFLUCC 11-0193=MUCL.

Notes: Phaeosphaeriopsis dracaenicola is typical of *Phaeosphaeriopsis*, due to the asexual state, habitat and host preferences and it shares similar morphological characters to *Ps. agavensis*, *Ps. nolinae*, and *Ps. obtusispora* in its brown, 5-septate ascospores. However, these can be differentiated by size of ascomata, asci and ascospores. *Phaeosphaeriopsis dracaenicola* has smaller ascospores, asci and ascomata than the other species in the genus, and ascospores are smooth-walled, while the other species have rough-walled, echinulate or punctuate ascospore ornamentation. In addition, *Phaeosphaeriopsis dracaenicola* was found associated with lesions on leaves of *Dracaena*, while the other species are saprobic on *Agave* and *Nolina* (Ramaley 1997; Câmara et al. 2001, 2003; Thambugala et al. 2014). Pathogenicity was not confirmed. *Phaeosphaeriopsis dracaenicola* formed an asexual state similar to *Ps. agavensis* and *Ps. obtusispora*, but differed from *Ps. nolinae* as conidia are globose. Multigene phylogenetic analysis shows that *Ps. dracaenicola* formed a robust clade (100 % ML/ 100 % MP/ 1.00 PP) at the basal of *Phaeosphaeriopsis* species in *Phaeosphaeriaceae*.

Phaeostagonospora A.W. Ramaley, Mycotaxon 61: 351 (1997), *Faces of Fungi number*: FoF00267.

Saprobic on *Nolina erumpens* (Torr.) S. Wats. **Sexual state:** reported as *Phaeosphaeriopsis*. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary, immersed or subepidermal, uniloculate, elongated to globose, flattened at the apex against the host epidermis, with small papilla penetrating the host epidermis. *Conidiomata walls* thick, composed of 3–6 layers of brown-walled cells, with 1–2 hyaline interior layers, abundant light brown hyphae from walls associated with host substrate. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, discrete, doliiform, ampulliform or irregular in shape, hyaline, smooth-walled, lining inner cavity of conidiomata. *Macroconidia* phragmosporous, ellipsoidal to cylindrical, with rounded ends, brown, 1–3-septate, rough-walled, foveolate. *Microconidia* globose or ellipsoidal, hyaline, smooth-walled, forming on the conidiomatal wall near the ostiole (from Ramaley 1997).

Type species: ***Phaeostagonospora nolinae*** A.W. Ramaley, Mycotaxon 61: 351 (1997).

Phylogenetic study: None

Notes: When Câmara et al. (2003) introduced the genus *Phaeosphaeriopsis*; they also mentioned the asexual state of this genus as *Phaeostagonospora*. This was based on co-occurrence on the host (Ramaley 1997; Câmara et al. 2001). The sexual and asexual connection was, however, not equivocally confirmed. Thambugala et al. (2014) epitypified *Phaeosphaeriopsis glaucopunctata* and described the asexual state from cultures. The asexual state of *P. glaucopunctata* differs from *Phaeostagonospora nolinae* as conidia are aseptate, smaller, and verruculose, while *Phaeostagonospora nolinae* has septate conidia and it produces larger microconidia (Ramaley 1997; Thambugala et al. 2014). Therefore the link between *Phaeostagonospora* and *Phaeosphaeriopsis* requires confirmation.

Sclerostagonospora Höhn., Hedwigia 59: 252 (1917), *Faces of Fungi number*: FoF00268.

Pathogenic or *saprobic* on various monocotyledons and dicotyledons. **Sexual state:** phaeosphaeria-like. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary, immersed, uniloculate, globose, glabrous, dark brown to black, ostiole central, with papilla. *Conidiomata walls* thin, composed of thick-walled cells, arranged in *textura angularis*, dark brown, inner layers lined with a hyaline cells bearing conidiogenous cells. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, discrete, determinate, ampulliform to irregular, hyaline, smooth-walled, lining inner cavity of conidiomata. *Conidia* phragmosporous, cylindrical to tapered slightly to the base, obtuse at the apex, with truncate base, pale brown, septate, slightly constricted at the septa, thin and rough-walled, verruculose (from Quaedvlieg et al. 2013).

Type species: ***Sclerostagonospora heraclei*** (Sacc.) Höhn., Hedwigia 59: 252. 1917.

Phylogenetic study: Crous et al. (2008), Quaedvlieg et al. (2013).

Notes: Sclerostagonospora was introduced by Höhnel (1917) and typified by *S. heraclei* (Sacc.) Höhn. The genus is similar to *Stagonospora* but differs in having pigmented conidia (Sutton 1980; Quaedvlieg et al. 2013). Crous et al. (2008) included *Sclerostagonospora* species in their phylogenetic analysis and *Sclerostagonospora* form a clade with other *Phaeosphaeria* species. Quaedvlieg et al. (2013) introduced a new species, *S. phragmiticola* from *Phragmites australis* (*Poaceae*) and confirmed that *Sclerostagonospora* is asexual genus belongs to *Phaeosphaeriaceae* based on their phylogenetic investigation. Quaedvlieg et al. (2013) mentioned that the sexual state of this genus is phaeosphaeria-like.

In this study, two species of *Sclerostagonospora* form a distinct clade in our multigene phylogenetic analyses (Fig. 2). *Sclerostagonospora phragmiticola* (CBS 338.86) groups with *Phaeosphaeria phragmiticola* (CBS 459.84) in clade E and other genera in *Phaeosphaeriaceae* with weak bootstrap support. Whereas *Sclerostagonospora cycadis* (CBS 123538) clusters with *Parastagonospora* in clade H (Fig. 2). However, *Sclerostagonospora* is not represented by their type species. This genus needs better populating as it is presently not well-resolved.

Scolecosporiella Petr., Annls mycol. 19(1/2): 30 (1921), *Faces of Fungi number*: FoF00269.

Saprobic or *pathogenic* on various host plants. **Sexual state:** reported as *Ophiosphaerella* and *Phaeosphaeria*. **Asexual state:** *Conidiomata* stromatic, pycnidial, amphigenous, scattered to gregarious, immersed to subepidermal, uniloculate, glabrous, depressed-globose to globose or ovoid, pale brown to brown, ostiole central, circular, non-papillate, with dark tendrils of conidia extruding through ostiole. *Conidiomata walls* thin, composed of thin-walled, subhyaline to pale brown cells, arranged in *textura angularis. Conidiophores* reduced to conidiogenous cells. Conidiogenous cells holoblastic, annellidic, discrete, ampulliform, globose or irregular, hyaline, smooth-walled. *Conidia* phragmosporous, fusiform, with acute apex and a truncate base, subhyaline to pale brown, multi-septate, constricted at the septa, thick and smooth-walled, apical cell attenuated into a short, beak-like, appendage (from Nag Raj 1989).

Type species: ***Scolecosporiella typhae*** (Oudem.) Petr., Annls mycol. 19(1/2): 31 (1921).

≡ *Hendersonia typhae* Oudem., Ned. kruidk. Archf, 2 sér. 1: 255 (1873)

Phylogenetic study: None

Notes: *Scolecosporiella* was introduced by Petrak (1921) with *S. typhae* (Oudemans) Petr. as the type species. The genus was treated by Sutton (1968, 1980) and Sutton and Alcorn (1974) with five species being accommodated. Nag Raj (1989) re-examined the type species of *Scolecosporiella*, *S. typhae* and described the morphological characters in detail. Nag Raj (1989) distinguished *Urohendersoniella mastigospora* Petr. from *Scolecosporiella typhae* and reinstated the genus *Urohendersoniella* as this monospecific genus had been synonymized as *Scolecosporiella mastigospora* (Petr.) B. Sutton in Sutton (1980). Additionally, a new genus *Orphanocoela* was established to accommodate non-congeneric species of *Scolecosporiella* (Nag Raj 1989). Six species are listed in Index Fungorum (2014).

Scolecosporiella has been reported as the asexual state of *Ophiosphaerella herpotricha* (Farr et al. 1989; Câmara et al. 2000; Zhang et al. 2012). However, there are no phylogenic evidence to confirm the connection between the sexual and asexual state, thus the generic connection is still questionable.

Scolicosporium Lib. ex Roum., Fungi Selecti Galliaei Exs.: no. 676 (1880)

Type species: ***Scolicosporium fagi*** Lib. ex Roum., in Roumeguère, Revue mycol., Toulouse 2: 22, 676 (1880)

Phylogenetic study: Wijayawardene et al. (2013a)

Notes: Scolicosporium Lib. ex Roum. was introduced by Roumeguère (1880) and typified by *S. fagi* Lib. ex Roum. Sutton (1980) treated *Scolicosporium fagi*, the type species of *Scolicosporium* as a synonym of *S. macrosporium* (Berk.) B. Sutton and designated *S. macrosporium* as the type species of *Scolicosporium*. However, *Scolicosporium fagi* is currently reported as the type species in Index Fungorum (2014). *Scolicosporium* was treated as a hyphomycete by Spooner and Kirk (1982) and Seifert et al. (2011). However, Treigiene and Mel'nik (2002) introduced *S. minkeviciusii* Treigiene as coelomycete, while Wijayawardene et al. (2013a) confirmed the species as a coelomycete. Furthermore, Wijayawardene et al. (2013a) showed that *S. minkeviciusii* belongs to *Phaeosphaeriaceae*, *Pleosporales*, in their molecular analyses. However, the genus was not represented by the type species, hence further collections of the type species of *Scolicosporium*, *S. fagi* are essential to confirm the familial placement of *Scolicosporium sensu stricto*. Below we only discuss *S. minkeviciusii*.

Scolicosporium minkeviciusii Treigiene., in Treigiene.& Mel'nik, Mikol. Fitopatol. 36(6): 45 (2002), *Faces of Fungi number*: FoF00270.

Saprobic on bark of *Quercus pubescens* Willd. and *Q. robur* L. **Sexual state:** Unknown. **Asexual state:** *Conidiomata* 100–120 μm high, 120–180 μm diam., pycnidial, solitary to gregarious, uniloculate, elongate-globose, dark brown. *Ostiole* central, sometimes towards one side, papillate when young, opening longitudinally at maturity. *Conidiomata walls* comprising 3–4 layers, outer layers 8–10 μm wide, dark brown, cells of *textura angularis*, inner layers hyaline, 5–40 μm wide. *Conidiophores* 13–30×2–3 μm, 1–2-septate, branched at the base, hyaline, cylindrical. *Conidiogenous cells* annellidic, hyaline, cylindrical. *Conidia* 60–65×7–9 μm ($\bar{x}$ = 62.2×7.7 μm, *n*=20), phragmosporous, curved to sigmoid, pale to moderately dark brown, with hyaline end cells, 6–7-transverse eusepta, smooth-walled, tapered to the obtuse apex, base truncate (Wijayawardene et al. 2013a).

Septoriella Oudem., Ned. kruidk. Archf, 2 sér. 5: 52 (1889)

Type species: ***Septoriella phragmitis*** Oudem. [as 'phragmitidis'], Ned. kruidk. Archf, 2 sér. 5: 54 (1889)

Phylogenetic study: Crous et al. (2014)

Notes: Septoriella was introduced by Oudemans (1889) with the generic type *Septoriella phragmitis*. Crous et al. (2014) introduced a new species *Septoriella oudemansii* based on a megablast nucleotide search in GenBank. The species was similar to *Phaeosphaeria caricis*, *Ph. ammophilae* and *Ophiosphaerella herpotricha* (Crous et al. 2014). The taxon clusters with the asexual species, *Wojnowicia hirta* and *Amarenomyces ammophilae* in *Phaeosphaeriaceae* in LSU gene phylogenetic analysis (data is not shown). However, the type species of *Septoriella* is not represented in GenBank. Thus, we tentatively include *Septoriella* in *Phaeosphaeriaceae*. Below we only discuss *S. oudemansii*.

Septoriella oudemansii Crous & Quaedvl., Persoonia, Mol. Phyl. Evol. Fungi 32: 281 (2014), *Faces of Fungi number*: FoF000304.

Saprobic on *Phragmites australis* (Cav.) Trin. ex Steud (*Poaceae*). **Sexual state:** Unknown. **Asexual state:** *Conidiomata* up to 250 μm diam., pycnidial, solitary, immersed, uniloculate, globose, glabrous, brown, ostiole central, with a brown, oozing, conidial cirrhus. *Conidiomata walls* composed of 3–4 layers, brown, arranged in *textura angularis. Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* 5–11×4–5 μm, ampulliform, hyaline, smooth-walled, apex with minute periclinal thickening or percurrent proliferation, lining the inner cavity. *Conidia* (17–)23–32(−35)×(3.5–)4(−6), solitary, subcylindrical, with obtuse ends, slightly wider in the middle, yellowish-brown, 3(−5)-septate, becoming slightly constricted at the septa with age, smooth-walled, with guttules and flared mucoid appendages at the ends (from Crous et al. 2014).

Setomelanomma M. Morelet, Bull. Soc. Sci. nat. Arch. Toulon et du Var 227: 15 (1980), *Faces of Fungi number*: FoF00271.

Type species: ***Setomelanomma holmii***.

Phylogenetic study: Rossman et al. (2002), Schoch et al. (2009), Zhang et al. (2009, 2012), Hyde et al. (2013), Wijayawardene et al. (2014b).

Notes: Setomelanomma was introduced by Morelet (1980) as typified by *S. holmii* to accommodate the monotypic genus from France associated with branches of *Picea*. Morelet (1980) however, did not illustrate the fungus and did not provide a detailed description (Rossman et al. 2002; Zhang et al. 2012). Rossman et al. (2002) re-circumscribed the type species and compared the morphological characters with North American collections. Detailed descriptions using morphology and molecular phylogeny were given by Zhang et al. (2012). Rossman et al. (2002) placed the genus in *Phaeosphaeriaceae* due to the morphology and phylogenetic data and this was later accepted by various authors (Kodsueb et al. 2006, 2007; Schoch et al. 2009; Zhang et al. 2009, 2012; Hyde et al. 2013). The genus is morphologically typical of *Phaeosphaeriaceae* as the ascomata are relatively small, the peridium is thin-walled comprising pseudoparenchymatous cells, pseudoparaphyses are cellular; and brown to yellowish-brown, and ascospores are phragmosporous (Rossman et al. 2002; Zhang et al. 2012). *Setomelanomma* however, differs from other genera in *Phaeosphaeriaceae* by its setose ascomata. No asexual state is known for the genus. There are two species, *S. holmii* and *S. prolata* K.J. Leonard & Suggs listed in Index Fungorum (2014)

Based on the multigene phylogenetic analyses (Figs. 1 and 2), *Setomelanomma* forms a strongly supported clade with the asexual species, *Xenoseptoria neosaccardoi* and *Paraphoma radicina* (CBS 111.79) in *Phaeosphaeriaceae* and these genera may be the asexual morphs of *Setomelanomma*.

Setomelanomma holmii M. Morelet, Bull. Soc. Sci. nat. Arch. Toulon et du Var 36(no. 227): 15 (1980), *Faces of Fungi number*: FoF00272, Fig. 25.

Pathogenic on branches of *Picea*. **Sexual state:** *Ascomata* 100–150 μm high, 140–175 μm diam., scattered, gregarious semi-immersed to erumpent through host tissue, becoming superficial, visible as abundant, small black dots on the host surface, uniloculate, globose to subglobose, covered by setae, dark brown to black, with central ostiole. *Peridium* 12.5–26 μm wide, thin-walled, of equal thickness, composed of 5–7 layers of black, broadly pseudoparenchymatous cells, arranged in a *textura angularis* to *textura globulosa*. *Hamathecium* composed of numerous, 1.5–3 μm wide, filamentous, frequently anastomosing, broad cellular pseudoparaphyses, with distinct septa, embedded in mucilaginous matrix. *Asci* (67–)68–77(−85)×(13–)15–17(−20) μm ($\bar{x}$= 75.2×15.2 μm, *n*=20), 8-spored, bitunicate, fissitunicate, broadly cylindrical to cylindric-clavate, subsessile to short pedicellate, apically rounded with well-developed ocular chamber. *Ascospores* (18–)21–23(−24)×(6–)7–9(−11) μm ($\bar{x}$ = 21.3×8.2 μm, *n*=20), overlapping 1–2-seriate, phragmosporous, ellipsoidal to broadly fusiform, initially hyaline to pale yellowish, becoming light brown to brown or yellowish-brown at maturity, initially forming one median septum, becoming 3-septate at maturity, slightly curved, often constricted at the median septum, smooth and thick-walled. **Asexual state:** see under *Xenoseptoria neosaccardoi* Quaedvlieg et al. (2013)

Fig. 25 ***Setomelanomma holmii*** (BPI 620251) **a** Herbarium label and specimens. **b** Ascomata on substrate. **c** Section through ascoma. **d** Section through peridium. **e** Cellular pseudoparaphyses. **f**–**i** Asci. **j**–**n** Ascospores. Scale bars: c=50 μm, d, e, f, g, h, i=20 μm, j, k, l, m, n=10 μm

Material examined: USA, Kansas, Shawnee Coounty, on branches of *Picea pungens* Engelm (*Pinaceae*), 5 May 1959, B. Herbert (BPI 620251).

Setophoma Gruyter et al., in De Gruyter et al. Mycologia 102(5): 1077 (2010), *Faces of Fungi number*: FoF00273, Fig. 26.

Pathogenic or *saprobic* on various hosts (*Alliaceae*, *Asteraceae* and *Poaceae*). **Sexual state:** *Ascomata*, scattered, gregarious, immersed, visible as raised, minute black dots on host surface, uniloculate, globose to subglobose, glabrous, brown to dark brown, ostiole central, with minute papilla. *Peridium* thin-walled, of equal thickness, composed of pseudoparenchymatous cells, arranged in flattened *textura angularis* to *textura prismatica. Hamathecium* composed of numerous, filiform, broad cellular, pseudoparaphyses, with distinct septa, anastomosing at the apex. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded, with well-developed narrowly ocular chamber. *Ascospores* overlapping 2-seriate, phragmosporous, cylindrical to cylindric-clavate, hyaline, 3-septate, usually enlarge at the second cell from apex, smooth-walled with large guttules. **Asexual state:** produced on rice straw and bamboo pieces on water agar after four weeks. *Conidiomata* scattered to clustered, gregarious, superficial, globose to subglobose, setose, and sometimes glabrous when mature, initially light brown, becoming brown to dark brown. *Conidiomata walls* thin, composed of light brown to brown pseudoparenchymatous cells, arranged in a *textura angularis. Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* enteroblastic, phialidic, determinate, discrete, unbranched, oblong to cylindrical, or ampulliform, hyaline, slightly curved, aseptate, lining the inner cavity of conidioma. *Conidia* amerosporous, oblong to ellipsoidal, rarely irregular, with rounded or obtuse ends, hyaline, aseptate, smooth-walled (from De Gruyter et al. 2010; Phookamsak et al. 2014).

Type species: ***Setophoma terrestris*** (H.N. Hansen) Gruyter et al., in De Gruyter et al. Mycologia 102(5): 1077 (2010).

≡ *Phoma terrestris* H.N. Hansen, Phytopathology 19(8): 699 (1929)

Phylogenetic study: De Gruyter et al. (2010), Quaedvlieg et al. (2013), Phookamsak et al. (2014)

Notes: Setophoma was introduced by De Gruyter et al. (2010) to accommodate phoma-like species and is typified by *S. terrestris*. Two species, *S. sacchari* (Bitanc.) Gruyter et al. and *S. terrestris* (H.N. Hansen) Gruyter were accommodated in this genus. Quaedvlieg et al. (2013) introduced a new species *Setophoma chromolaenae* Quaedvlieg et al. on leaves of *Chromolaena odorata* from Brazil. No sexual state was reported. Phookamsak et al. (2014) reported the sexual state of *Setophoma* based on asexual-sexual connection of *S. sacchari* and phylogenetic data. The sexual state of *Setophoma* is similar to *Phaeosphaeria* species, but differs in ascospore colour and asexual state (Phookamsak et al. 2014). *Setophoma chromolaenae*, *S. sacchari*, *S. terrestris* and *S. vernoniae* Crous & Alfenas are presently accommodated in the genus (Index Fungorum 2014; Crous et al. 2014; Phookamsak et al. 2014). Based on multigene phylogenetic analysis, we accept *Setophoma* in *Phaeosphaeriaceae* which forms a single clade at basal of the family (Fig. 2).

Tiarospora Sacc. & Marchal, Revue mycol., Toulouse 7(no. 26): 148 (1885), *Faces of Fungi number*: FoF00274.

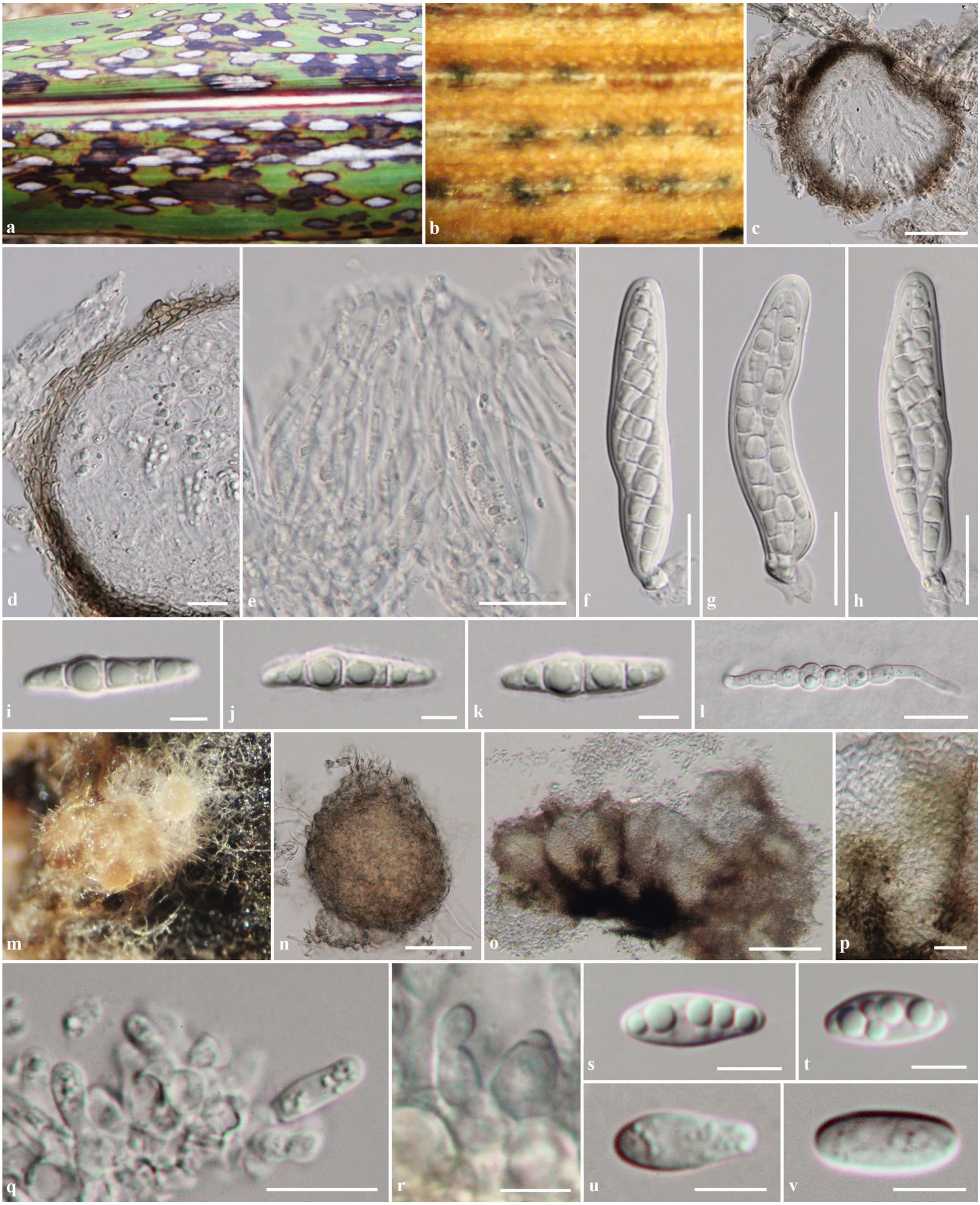
Saprobic or *pathogenic* on *Ammophila* Host, *Deschampsia* P. Beauv., *Elymus* L. (*Poaceae*) and *Dryas grandis* Jurtzev (*Rosaceae*). **Sexual state:** Unknown. **Asexual state:** *Conidiomata* scattered, gregarious, immersed to semi-immersed, uniloculate, globose, glabrous, brown, ostiole central, with short papilla. *Conidiomata walls* thick, composed on several layers, outer layers comprising thick-walled dark brown, flattened cells of *textura angularis*, inner layers comprising thin-walled paler cells. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, sympodial, discrete, doliiform, cylindrical or lageniform, hyaline, smooth-walled. *Conidia* didymosporous, broadly ellipsoid, with obtuse to flattened ends, hyaline to pale brown, 1-septate, continuous, thick and smooth-walled, with guttules or irregular or cap-like gelatinous appendage (from Sutton 1980).

Type species: ***Tiarospora westendorpii*** Sacc. & Marchal, Revue mycol., Toulouse 7(no. 26): 148 (1885).

Phylogenetic study: None

Notes: Tiarospora was introduced by Saccardo and Marchal (1885) and is typified by *T. westendorpii* Sacc. & Marchal. Four species were accommodated under *Tiarospora*; *T. deschampsiae* Krusch., *T. perforans* (Sacc.) Höhn., *T. pirozynskii* Chleb. and *T. westendorpii* Sacc. & Marchal. However, *Tiarospora perforans* was transferred to *Montagnulaceae* by Aptroot (2006). *Tiarospora* is similar to *Tiarosporella* Höhn.; however, they differ in the morphology of their conidia. *Tiarospora* has 1-septate conidia, while *Tiarosporella* has aseptate conidia (Abbas et al. 2012). *Tiarospora* was described in Sutton (1980); however, no family placement was given for the genus. Kirk et al. (2001, 2008) treated the genus under *Phaeosphaeriaceae* but did not mention any literature to confirm this and this was accepted by Wijayawardene et al. (2012). Oertel (2011) however, mentioned that the type species of *Tiarospora*, *T. westendorpii* is a synanamoph of *Amarenographium metableticum*, which is the asexual state of *Amarenomyces*, also in *Phaeosphaeriaceae*. Therefore the current placement of this genus is somewhat unclear. The genus is relatively poorly known, lacks molecular data and no sexual state is known. We tentatively place *Tiarospora* in *Phaeosphaeriaceae* until molecular data resolves this issue.

Vrystaatia Quaedvlieg et al. Stud. Mycol. 75: 372 (2013), *Faces of Fungi number*: FoF00275, Fig. 27.



Saprobic on *Aloe maculata* (*Aloaceae*). **Sexual state:** Unknown. **Asexual state:** *Conidiomata* pycnidial, clustered, gregarious, erumpent on culture, with substromata on host, globose, glabrous, black, ostiole central, surrounded by dark brown area exuding cirrhus of orange conidia. *Conidiomata walls* thin, composed of 6–8 layers, arranged in *textura*

◀ **Fig. 26** ***Setophoma sacchari*** (MFLU 11-0190 and MFLU 12-2470) on living leaves of *Saccharum officinarum*. **a** Symptoms on host (MFLU 11-0190). **b** Ascomata immersed in host tissue (MFLU 11-0190). **c** Section through ascoma (MFLU 11-0190). **d** Section through peridium (MFLU 11-0190). **e** Cellular pseudoparaphyses (MFLU 11-0190). **f–h** Asci (MFLU 11-0190). **i–k** Ascospores (MFLU 11-0190). **l** Spore germination (MFLU 11-0190). **m** Immature conidiomata on living culture (MFLU 11-0190) **n** Conidiomata on WA (MFLU 12-2470). **o** Section through conidiomata (MFLU 12-2470). **p** Section through conidiomata walls (MFLU 12-2470). **q–r** Conidiogenous cells (MFLU 12-2470). **s**, **t** Conidia (MFLU 11-0190). **u**, **v** Conidia (MFLU 12-2470) Scale bars: n, o=100 *μm*, c=50 *μm*, d, e, f, g, h, l, p=20 *μm*, q=10 *μm*, i, j, k, r, s, t, u, v=5 *μm*

angularis, pale brown. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* enteroblastic, annellidic, discrete, globose to ampulliform, hyaline, smooth-walled, with prominent periclinal thickening, or proliferating several times percurrently near apex, producing macro- and microconidia. *Macroconidia* scolecosporous, subcylindrical to narrowly obclavate, apex obtuse to subobtuse, with truncate base, hyaline, (1–)3-septate, smooth-walled, with guttules, widest at the basal septum. *Microconidia* pear-shaped to globose or ellipsoidal, apex obtuse, with truncate base, hyaline, aseptate, smooth-walled (from Quaedvlieg et al. 2013).

Type species: ***Vrystaatia aloeicola*** Quaedvlieg et al. Stud. Mycol. 75: 372 (2013)

Phylogenetic study: Quaedvlieg et al. (2013).

Notes: Vrystaatia was introduced by Quaedvlieg et al. (2013) to accommodate a non-congeneric species of *Septoria sensu stricto* and typified by *V. aloeicola*. *Vrystaatia* is similar to *Septoria sensu stricto*, but differs in conidiogenous cells morphology and forms macro- and microconidia in culture, which was not typical of *Septoria* (Quaedvlieg et al. 2013). Based on multigene phylogenetic analysis (Fig. 2), *Vrystaatia* forms a single clade at the basal of *Paraphoma*, *Setomelanomma* and *Xenoseptoria* clade. Thus we accept *Vrystaatia* for which no sexual state is known in *Phaeosphaeriaceae*.

Wojnowicia Sacc., Syll. fung. (Abellini) 10: 328 (1892), *Faces of Fungi number*: FoF00276.

Pathogenic on monocotyledonous or dicotyledonous hosts. **Sexual state:** Unknown. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary, immersed to superficial on host tissue, globose, glabrous or setose, dark brown, ostiole central, with minute papillate or pore-like opening. *Conidiomata walls* thick, composed of pseudoparenchymatous cells, outer layers thick-walled, arranged in *textura angularis*, dark brown, inner layers thin-walled, hyaline, thinner towards inner conidiogenous cells. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* enteroblastic, phialidic, discrete, determine, doliiform to ampulliform, hyaline, smooth-walled, with minute collarette and channel, lining inner cavity of conidiomata. *Conidia* phragmosporous, fusiform to cylindrical, with obtuse ends, pale brown to brown, continuous, septate, straight to curved, thin and smooth-walled, guttulate.

Type species: ***Wojnowicia hirta*** (J. Schröt.) Sacc., in Saccardo & Sydow, Syll. fung. (Abellini) 14(2): 960 (1899).

Phylogenetic study: De Gruyter et al. (2009), Wijayawardene et al. (2013b).

Notes: *Wojnowicia* was introduced by Saccardo (1892) and is typified by *W. hirta*. The genus was discussed by Sutton (1975, 1980) who accepted two species, *W. hirta* and

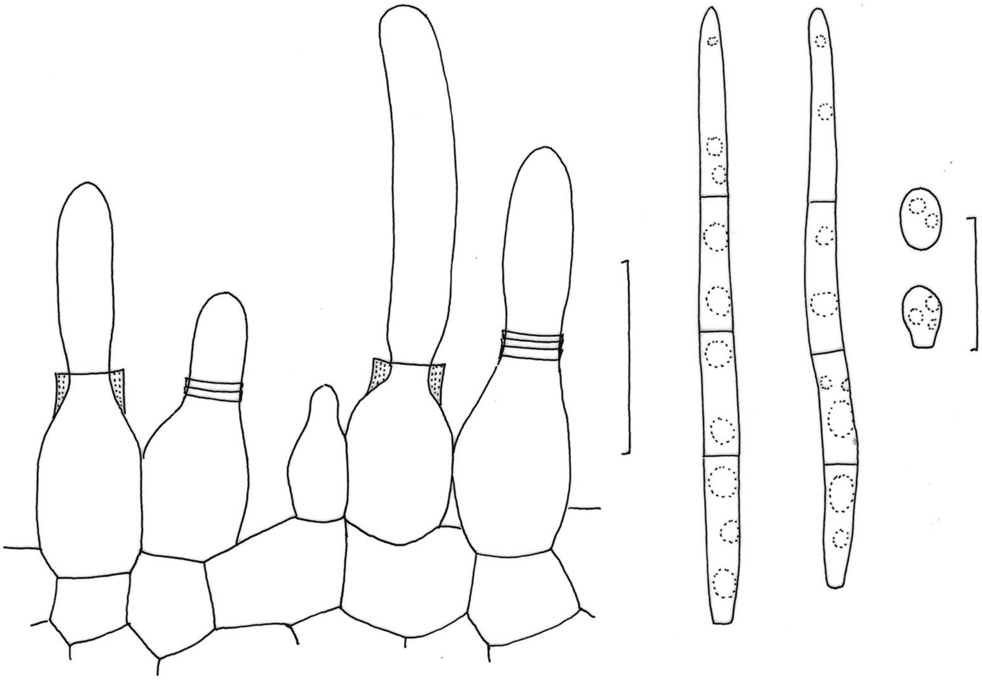


Fig. 27 ***Vrystaatia aloeicola***, redrawn from Quaedvlieg et al. (2013). Scale bars=10 *μm*

W. ephedrae Hollós. Sutton (1980) treated *W. tenella* Pat. and *W. graminis* (McAlpine) Sacc. & D. Sacc as synonyms of *W. hirta*. Farr and Bills (1995) named a collection from *Juniperus deppeana* Steud. and *Pinus edulis* Engelm. As *W. colluvium* D.F. Farr & Bills. Eleven species are listed in Index Fungorum (2014). Molecular data is only available for two species in GenBank. De Gruter et al. (2009) included two strains of *Wojnowicia hirta* in their analysis and showed that *W. hirta* belongs to *Phaeosphaeriaceae*. Wijayawardene et al. (2013b) introduced a new species, *W. viburni* Wijayaw. et al. on leaves of *Viburnum utile* Hemsl. ex Forb. & Hemsl. from China and confirmed that *Wojnowicia* belongs in *Phaeosphaeriaceae*. They also suggested that *Wojnowicia* should be the asexual state of *Ophiosphaerella* based on phylogenetic evidence (Wijayawardene et al. 2013b). However, Wijayawardene et al. (2013b) and De Gruyter et al. (2009) did not include many isolates of *Phaeosphaeriaceae* in their analysis. In this study with several sexual and asexual genera, the multigene phylogenetic analysis (Fig. 2) indicates that *Wojnowicia hirta* (CBS 160.73, CBS 295.69) clusters with *Amarenomyces*, *Ophiosphaerella herpotricha* (CBS 620.86) and other *Phaeosphaeria sensu lato* species while *W. viburni* forms a single clade at the base of *Neostagonospora*. Therefore the findings of Wijayawardene et al. (2013b) and De Gruyter et al. (2009) that *Wojnowicia* may be an asexual state of *Ophiosphaerella* is questionable, while *Ophiosphaerella* is obviously polyphyletic and requires further work.

Xenoseptoria Quaedvlieg et al. Stud. Mycol. 75: 371 (2013), *Faces of Fungi number*: FoF00277.

Pathogenic on *Lysimachia vulgaris* var. *davurica* (Ledeb.) R. Knuth (*Primulaceae*). **Sexual state**: unknown but possibly *Setomelanomma*. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary, immersed to erumpent, uniloculate, globose, glabrous, brown, ostiole developing 1–3 papilla or necks, exuding a pink to orange conidial mass. *Conidiomata walls* thin, composed of 4–8 layers of brown cells, arranged in *textura angularis*. *Conidiophores* reduced to conidiogenous cells, hyaline, septate, branched, smooth-walled. *Conidiogenous cells* enteroblastic, mono- to polyphialidic, with prominent periclinal thickening, or percurrent proliferation, discrete or integrated, ampulliform to doliiform or subcylindrical, hyaline, smooth-walled. *Conidia* scolecosporous, cylindrical to obclavate, tapering to subobtuse apex, with obtuse base, straight to irregular curved, hyaline, septate, smooth-walled, with guttules (from Quaedvlieg et al. 2013)

Type species: ***Xenoseptoria neosaccardoi*** Quaedvlieg et al., Stud. Mycol. 75: 371 (2013).

Phylogenetic study: Quaedvlieg et al. (2013)

Notes: Xenoseptoria was introduced by Quaedvlieg et al. (2013) and was typified by *X. neosaccardoi*. The genus was introduced to accommodate a single species associated with leaf spot disease of *Lysimachia vulgaris* var. *davurica* (*Primulaceae*). The genus can be distinguished from *Septoria sensu stricto* as *Xenoseptoria* has multi-papillate conidiomata and mono- to polyphialidic conidiogenous cells (Quaedvlieg et al. 2013). In multigene phylogenetic analysis, *Xenoseptoria* clusters with the sexual genus *Setomelanomma* and the asexual genus *Paraphoma* with strong support (91 % ML, 1.00 PP). The genus is closely related to *Setomelanomma*. These genera may need placing in synonymy with *Setomelanomma*, but it would be unwise to do so until the tree becomes better populated.

Genera transferred to other families

Botryosphaeriaceae

Recent accounts of *Botryosphaeriaceae* include those of Liu et al. (2012) and Hyde et al. (2013, 2014)

Metameris Theiss. & Syd., Annls mycol. 13(3/4): 342 (1915), *Faces of Fungi number*: FoF00289.

Saprobic or *parasitic* on ferns and *Bougainvillea*. **Sexual state:** *Ascostromata* scattered, solitary to gregarious, erumpent through host epidermis, visible as slightly raised, black lines or black spots on the host surface. *Locules* clustered in pseudostroma, uni to bi-loculate, globose to subglobose, glabrous, black, ostiole in centre of each locule, with minute papilla. *Peridium* thick-walled, composed of thickened, black, scleroplectenchymatous cells, arranged in a *textura angularis*. *Hamathecium* composed of numerous, filamentous, broad cellular pseudoparaphyses, anastomosing at the apex. *Asci* 8-spored, bitunicate, cylindrical to cylindric-clavate, subsessile to short pedicellate, apically rounded, with well-developed ocular chamber. *Ascospores* overlapping 1–2-seriate, 2-celled, oblong to cylindrical, narrow towards lower end cell, hyaline, septate, smooth-walled, cytoplasm stains blue in cotton blue reagent, the large guttules in the upper part of the upper cell not staining. **Asexual state:** Unknown.

Type species: ***Metameris japonica***

Phylogenetic study: None.

Notes: Metameris was established to accommodate *Monographus japonicus* Syd. by Theissen and Sydow (1915). *Metameris* forms linear pseudostromata, and has hyaline, 1-septate ascospores and Clements and Shear (1931) treated the genus under *Dothideaceae* (Zhang et al. 2012). Müller and von Arx (1962) treated *Metameris* as a synonym of *Scirrhia* and placed the genus in *Mycosphaerellaceae* (Crous et al. 2011). Later, von Arx and Müller (1975) assigned the genus to *Pleosporaceae* and did not accept that *Metameris* was synonymous with *Scirrhia* (Crous et al. 2011; Zhang et al. 2012). Recently, *Metameris* was accommodated in *Phaeosphaeriaceae* due to its small ascomata, broad cylindrical to obclavate asci with a knob-like pedicel and monocotyledons host preferences (Eriksson 2006; Lumbsch and Huhndorf 2007, 2010; Crous et al. 2011; Zhang et al. 2012; Hyde et al. 2013). However, the genus lacks molecular data to confirm its familial placement (Crous et al. 2011; Zhang et al. 2012).

There are five epithets listed for *Metameris* in Index Fungorum (2014); however, three species are synonymized under *Scirrhia*. In this study, we exclude *Metameris* from *Phaeosphaeriaceae*. The large, elongated pseudostromata, with a peridium of thickened scleroplectenchymatous cells, broad, or irregularly cellular pseudoparaphyses, ascus morphology and didymosporous ascospores are characters typical of genera in *Botryosphaeriaceae* where it is tentatively referred. *Leptoguignardia* is probably most similar (Liu et al. 2012) and should be compared in future studies of fresh collections.

Metameris japonica (Syd.& P. Syd.) Syd., in Theissen & Sydow, Annls mycol. 13(3/4): 342 (1915), *Faces of Fungi number*: FoF00290, Fig. 28.

≡ *Monographus japonicus* Syd. & P. Syd., Annls mycol. 10(4): 408 (1912)

Saprobic on *Osmunda regalis* var. *japonica* L. **Sexual state:** *Ascostromata* 170–240 μm high, 370–640 μm diam., clustered, solitary to gregarious, erumpent through host epidermis, visible as slightly raised, black, elongate lining on host surface. *Locules* 160–240 μm high, 200–250 μm diam, clustered, immersed in pseudostroma, uni to bi-loculate, globose to subglobose, glabrous, black, ostiole in centre of each locule, with minute papilla. *Peridium* 23–67 μm wide, thick-walled, of unequal thickness, slightly thick at the base towards sides of pseudostroma, composed of several layers of thickened, dark brown to black, scleroplectenchymatous cells, arranged in *textura angularis*. *Hamathecium* composed of numerous, 3–7 μm wide, filamentous, broad, irregular cellular pseudoparaphyses, with distinct septa which are constricted at the septum, embedded in mucilaginous matrix, anastomosing at the apex. *Asci* 80–110(−118)×(12.5–)13–18 μm ($\bar{x}$ = 99.2×14.9 μm, n=25), 8-spored, bitunicate, cylindrical to cylindric-clavate, narrow towards the apex, subsessile to short pedicellate, apically rounded with well-developed ocular chamber, arising from the basal ascoma. *Ascospores* (22–)24–28×6–8 μm ($\bar{x}$ = 26.7×6.8 μm, n=30), overlapping 1–2 seriate, 2-celled, oblong to cylindrical, narrow towards lower end cell, hyaline, 1-septate, constricted at the septum, smooth-walled, mostly upper cell larger than lower cell, cytoplasm stains blue in cotton blue reagent, the large guttules in the upper part of the upper cell not staining. **Asexual state:** Unknown.

Material examined: Japan, Mino, Kawauye-mura, on *Osmunda regalis* L. var. *japonica* (*Osmundaceae*), 10 May 1912, K. Hara (S-F7166, **holotype**).

Didymellaceae

For a discussion of *Didymellaceae* see Hyde et al. (2013). Zhang et al. (2012) questioned whether the placement *Mixtura* in *Phaeosphaeriaceae* was natural. The genus is considered to belong in *Didymellaceae* and is transferred herein.

Mixtura O.E. Erikss. & J.Z. Yue, Mycotaxon 38: 203 (1990), *Faces of Fungi number*: FoF00278.

Type species: ***Mixtura saginata***

Phylogenetic study: None.

Mixtura saginata (Syd.) O.E. Erikss. & J.Z. Yue, Mycotaxon 38: 203 (1990), *Faces of Fungi number*: FoF00279, Fig. 29.

≡ *Leptosphaeria saginata* Syd., Annls mycol. 37(4/5): 377 (1939).

Pathogen causing necrotic leaf spots on *Chusquea serrulata* Pilger. *Lesions* up to 2–5 cm long, infecting mostly the leaf margin, elongate cylindrical, pale brown to yellowish-brown, dry, separated from healthy tissue by a reddish-brown to purple-brown or black margin. **Sexual state:** *Ascomata* 120–260 μm high, 180–335 μm diam., scattered, sometimes clustered, solitary, immersed, visible as raised, small black dots on leaf lesions, uniloculate, globose to subglobose, glabrous, dark brown to black, ostiole central with minute papilla. *Peridium* 12–40 μm wide, thin-walled, of unequal thickness, thickened at apex at sides, composed of 3 or more layers of brown to dark brown, pseudoparenchymatous cells, arranged in a *textura angularis*, outer layers comprising 2–5 layers of thickened cells, brown to dark brown, inner layers comprising several layers of flattened cells, hyaline to pale brown. *Hamathecium* composed of numerous, 3–8 μm wide, filamentous, frequently anastomosing, broad cellular pseudoparaphyses, with distinct septa which are constricted at the septa, embedded in mucilaginous matrix. *Asci* (105–)112–135(−142)×(57–)60–100(−127) μm ($\bar{x}$ = 121.3×80.3 μm, n=20), 8-spored, bitunicate, fissitunicate, globose to subglobose, or ovoid, sessile to subsessile, apically rounded with well-developed ocular chamber, producing a few asci, arising from the basal ascoma. *Ascospores* 60–90(−95)×(19–)22–25(−27) μm ($\bar{x}$ = 81.2×23 μm, n=30), irregular overlapping 4-seriate, phragmosporous, broadly fusiform with rounded, germ pore at the ends, initially hyaline to pale brown, becoming yellowish-brown or brown at maturity, paler at the end cells, distoseptate with 7-septa, slightly curved, rough, thick-walled, surrounded by thin, distinct sheath. **Asexual state:** Unknown.

Material examined: ECUADOR, Tungurahua, Hacienda San Antonio pr. Baños, on leaves of *Chusquea serrulata* Pilger (*Poaceae*), 9 January 1938, H. Sydow (S-F8935, **lectotype**).

Notes: The monotypic genus *Mixtura* was introduced by Eriksson and Yue (1990) to accommodate *Mi. saginata* which causes leaf spots on *Chusquea serrulata*. *Mixtura* is an

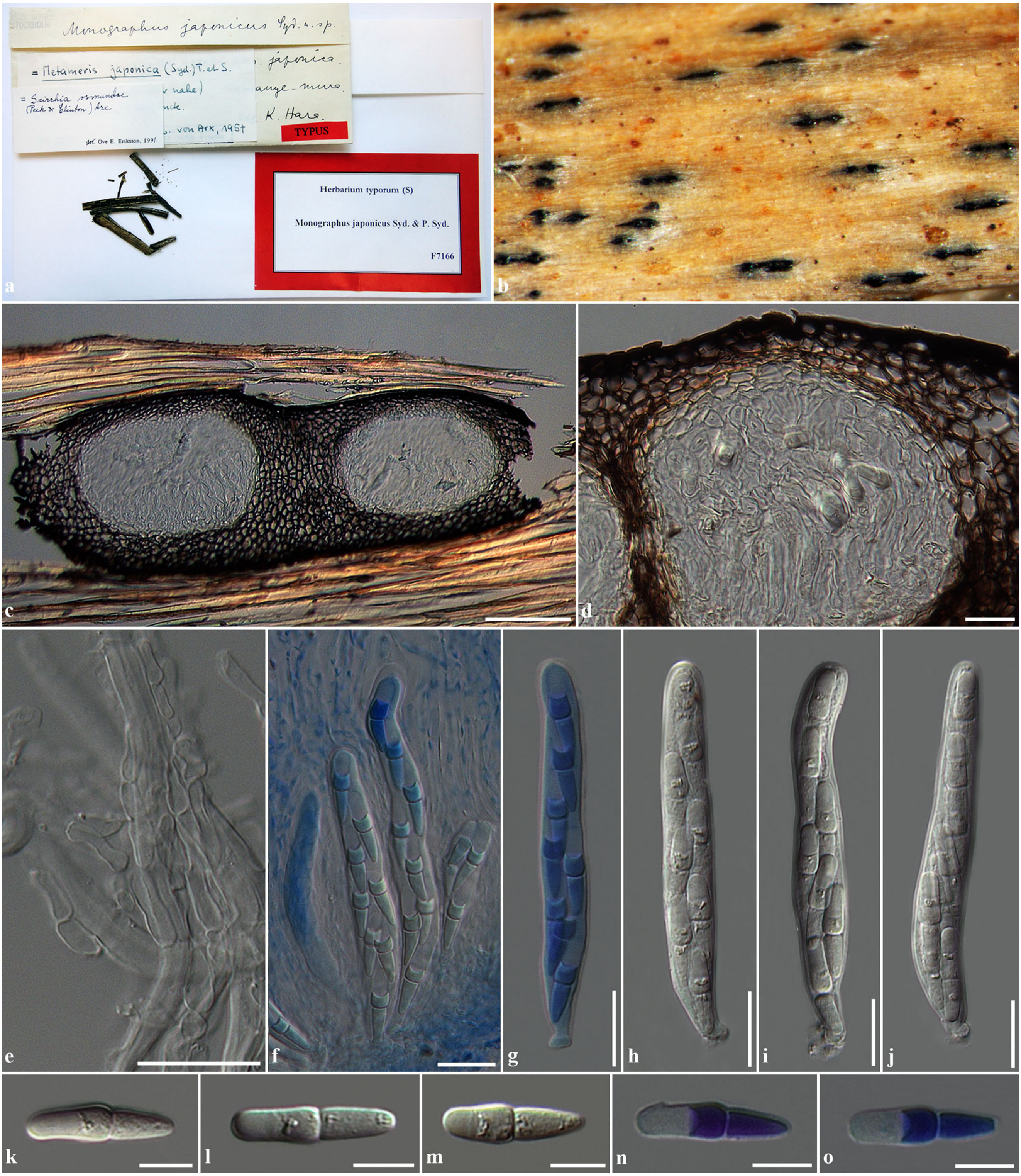


Fig. 28 ***Metameris japonica*** **(holotype)**. **a** Herbarium label and specimens. **b** Ascostromata on host surface. **c** Section through ascostroma. **d** Section through peridium. **e** Pseudoparaphyses. **f** Asci and pseudoparaphyses strained in cotton blue reagent. **g** Ascus stained in cotton blue reagent. **h–j** Asci. **k–m** Ascospores. **n–o** Ascospores stained in cotton blue reagent. Scale bars: c=100 μm, d, e, f, g, h, i, j=20 μm, k, l, m, n, o=10 μm

uncertain genus with morphological characters and habitat agreeing with several genera such as *Mycosphaerella*, *Phaeosphaeria*, *Teratosphaeria*, *Trematosphaeria* and *Wettsteinina* (Eriksson and Yue 1990; Zhang et al. 2012). *Mixtura* is similar to *Mycosphaerella* and *Phaeosphaeria* species in causing a leaf spot disease on monocotyledons,

Fig. 29 ***Mixtura saginata*** (S-F8935, **lectotype**). **a** Herbarium label and specimens. **b** Ascomata on leaf lesion. **c** Section through ascoma **d** Section through peridium. **e** Pseudoparaphyses stained in cotton blue reagent. **f** Immature ascus. **g–i** Asci. **j** Ocular chamber of asci stained in cotton blue reagent. **k** Immature ascospore stained in cotton blue reagent. **l–m** Mature ascospores. Scale bars: c=100 *μm*, d–m=20 *μm*

but differs from *Mycosphaerella* species in its centrum type (Eriksson and Yue 1990). *Mixtura* differs from *Trematosphaeria* due to its fusiform, olive brown ascospores and the genus differs from *Wettsteinina* as its rather thick-walled peridium and ellipsoidal asci (Eriksson and Yue 1990). Eriksson and Yue (1990) treated the genus in *Phaeosphaeriaceae* based on the peridium structure. However, Zhang et al. (2012) disagreed with Eriksson and Yue (1990) and placed the genus in *Teratosphaeriaceae* with *Mixtura* having relatively similar morphology to the type species of *Teratosphaeria*.

Mixtura is similar to other genera in *Phaeosphaeriaceae* such as *Hadrospora* and *Loratospora* in its saccate asci and large ascospores in *Hadrospora*. However, these genera differ in their centrum type. *Mixtura* forms dense, thick, cellular pseudoparaphyses, while *Hadrospora* forms trabeculate pseudoparaphyses, and pseudoparaphyses are lacking in *Loratospora*. *Hadrospora* is excluded as a member of *Phaeosphaeriaceae* in this study, but *Loratospora* is confirmed based on phylogenetic evidence. *Mixtura* is similar to *Leptosphaerulina* in habitat on host and asci. However, they differ in the ascospores and centrum type as *Leptosphaerulina* lacks pseudoparaphyses and has muriform ascospores. *Mixtura* has dense pseudoparaphyses and phragmosporous ascospores with distosepta. Therefore, we agree with Zhang et al. (2012) and exclude *Mixtura* from *Phaeosphaeriaceae*. The genus is tentatively placed in *Didymellaceae*.

Didymosphaeriaceae

For an account of this family see Ariyawansa et al. (2014b). *Barria* and *Wilmia* were transferred from *Phaeosphaeriaceae* to *Didymosphaeriaceae* in Ariyawansa et al. (2014b and are only briefly discussed here.

Barria Z.Q. Yuan, Mycotaxon 51: 313 (1994), *Faces of fungi number:* FoF00031.

Type species: ***Barria piceae*** Z.Q. Yuan, Mycotaxon 51: 314 (1994).

Phylogenetic study: None.

Notes: *Barria* is a monotypic genus introduced by Yuan (1994) based on *Barria piceae*. The genus was reported as pathogenic on needles of *Picea schrenkiana* Fisch. & C.A. Mey. *Barria* is excluded from *Phaeosphaeriaceae* in this study based on its morphology. *Barria* is associated with gymnosperms, asci are clavate and short pedicellate, and ascospores are didymosporous with thick walls. Whereas the generic type, *Phaeosphaeria* is associated mostly with angiosperms, asci are often broad cylindrical to cylindric-clavate and subsessile and ascospores are phragmosporous (Yuan 1994; Zhang et al. 2012; Hyde et al. 2013; Quaedvlieg et al. 2013). Additionally, most genera with confirmed phylogenetic placement in *Phaeosphaeriaceae* have phragmospores, scolecospores, or muriform ascospores, but there are no didymosporous taxa (Zhang et al. 2012; Hyde et al. 2013; Quaedvlieg et al. 2013). *Barria* is associated in the same host family as *Setomelanomma* which was confirmed as phaeosphaeriacous based on phylogenetic evidence. *Barria* has didymosporous ascospores, while *Setomelanomma* has phragmosporous ascospores. Most didymosporous genera in *Phaeosphaeriaceae* lack molecular phylogenetic data to confirm their current placements. Furthermore, *Barria* is more similar to genera in *Didymosphaeriaceae* rather than *Phaeosphaeriaceae* (Ariyawansa et al. 2014b), where is it tentatively accommodated. Zhang et al. (2012) accepted *Lautitia* in *Phaeosphaeriaceae*; in contrast, all genera of marine and freshwater fungi (*Carinispora*, *Isthmosporella* and *Ocala*) were excluded from *Phaeosphaeriaceae* in Zhang et al. (2012). However, *Lautitia* differs from other genera in *Phaeosphaeriaceae* in having clavate asci with long pedicels and forming a pseudostromata with the peridium arranged in a *textura porrecta*. Other genera in *Phaeosphaeriaceae* mostly have cylindrical asci with subsessile to short pedicels and uniloculate ascomata with the peridium arranged in a *textura angularis*. *Metameris* forms large, elongated pseudostromata, with a thick-walled peridium of scleroplectenchymatous cells which is rarely found in other genera of *Phaeosphaeriaceae*. A new species of *Letendraea* (=*Wilmia*) was introduced based on phylogenetic evidence and belongs in *Didymosphaeriaceae* (see Ariyawansa et al. 2014b).

Wilmia Dianese et al., Mycologia 93(5): 1014 (2001), *Faces of fungi number:* FoF00046.

Type species: ***Wilmia brasiliensis*** Dianese et al., Mycologia 93(5): 1014 (2001).

Phylogenetic study: Ariyawansa et al. (2014a).

Notes: Wilmia was introduced by Dianese et al. (2001) to accommodate a monotypic genus, *Wilmia brasiliensis* that caused a leaf spot disease of *Memora peduncula ta* (Vell.) Miers. in Brazil. Dianese et al. (2001) treated *Wilmia* in *Phaeosphaeriaceae* based on the morphological characters which fitted Barr's concept (Barr 1987b, 1992a). *Wilmia* is similar to other genera in *Phaeosphaeriaceae viz. Barria*, *Lautitia* and *Metameris* in having didymosporous ascospores and a coelomycetous asexual morph (Dianese et al. 2001; Zhang et al. 2012). Zhang et al. (2012) tentatively placed *Wilmia* in *Phaeosphaeriaceae* as the genus is poorly known and lacks molecular data, although Zhang et al. (2012) mentioned that the genus should be accommodated in *Leptosphaeriaceae* based on its dicotyledonous host habit.

A Dothideomycete species was collected from living and dead leaves of *Cordyline* sp. in Thailand. The species also caused leaf spot disease and had similar morphological characters to *Wilmia brasiliensis*. Ariyawansa et al. (2014b synonymized *Wilmia* under *Letendraea* based on morphology and phylogeny. Thus, the new species collected from *Cordyline* sp. was accommodated in *Didymosphaeriaceae* and named *Letendraea cordylinicola* Phookamsak et al. (Ariyawansa et al. 2014b).

Leptosphaeriaceae

For a discussion on *Leptosphaeriaceae* see Hyde et al. (2013); *Chaetoplea* is considered to belong in this family and is transferred herein.

Chaetoplea (Sacc.) Clem., in Clements & Shear, Gen. fung., Edn 2 (Minneapolis): 275 (1931), *Faces of Fungi number*: FoF00280.

≡ *Pyrenophora* subgen. *Chaetoplea* Sacc., Syll. fung. (Abellini) 2: 279 (1883)

Saprobic on woody stems or herbaceous dicotyledonous. **Sexual state:** *Ascomata* solitary, gregarious, semi-immersed to superficial, or erumpent through host tissue, uniloculate, subglobose, glabrous, brown to dark brown, ostioles central, with short papilla. *Peridium* thick-walled, of equal thickness, composed of dark brown to black, scleroplectenchymatous cells of *textura angularis* or *textura globulosa*. *Hamathecium* composed of numerous, filamentous, distinctly septate, broad cellular pseudoparaphyses, anastomosing at the apex. *Asci* 8-spored, bitunicate, clavate to cylindric-clavate, short pedicellate, apically rounded, with an ocular chamber. *Ascospores* overlapping 1–2-seriate, phragmosporous, fusiform or broadly fusiform to ellipsoidal, brown to yellowish-brown, septate, slightly constricted at the septa, smooth-walled. **Asexual state:** *Conidiomata* pycnidial, scattered, solitary to gregarious, semi-immersed to erumpent, uniloculate, ellipsoidal to broadly fusiform with rounded apex, glabrous, dark brown to black, ostioles central, with pore-like opening. *Conidiomata walls* thin-walled, composed of flattened, scleroplectenchymatous cells, arranged in *textura angularis* to *textura prismatica*, brown to dark brown. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, phialidic, discrete, ampulliform, hyaline, smooth-walled, hard to distinguish from the inner wall cells. *Conidia* oblong to ellipsoidal, with obtuse ends, brown, 1-septate, smooth-walled.

Type species: ***Chaetoplea calvescens***

Phylogenetic study: None

Notes: *Chaetoplea* was introduced by Clements and Shear (1931) to accommodate Dothideomycete species from woody substrates which included species transferred from *Cucurbitaria*, *Leptosphaeria*, *Pleospora*, *Pyrenophora*, *Sphaeria* and *Teichospora* (Shoemaker 1961; Wehmeyer 1961; von Arx and Müller 1975; Barr 1990b; Yuan and Barr 1994; Zhang et al. 2012). Barr (1987b, 1990a, b) treated *Chaetoplea sensu lato* in *Phaeosphaeriaceae*. The type specimen has not been recovered from any herbaria worldwide. Zhang et al. (2012) however observed the isotype which is a slide from the Farlow Herbarium (FH) and has only asci and ascospores. Zhang et al. (2012) mentioned that *Chaetoplea* may be heterogeneous in nature and occurs in a wide range of substrates such as herbaceous stalks, decorticated wood and periderm tissues.

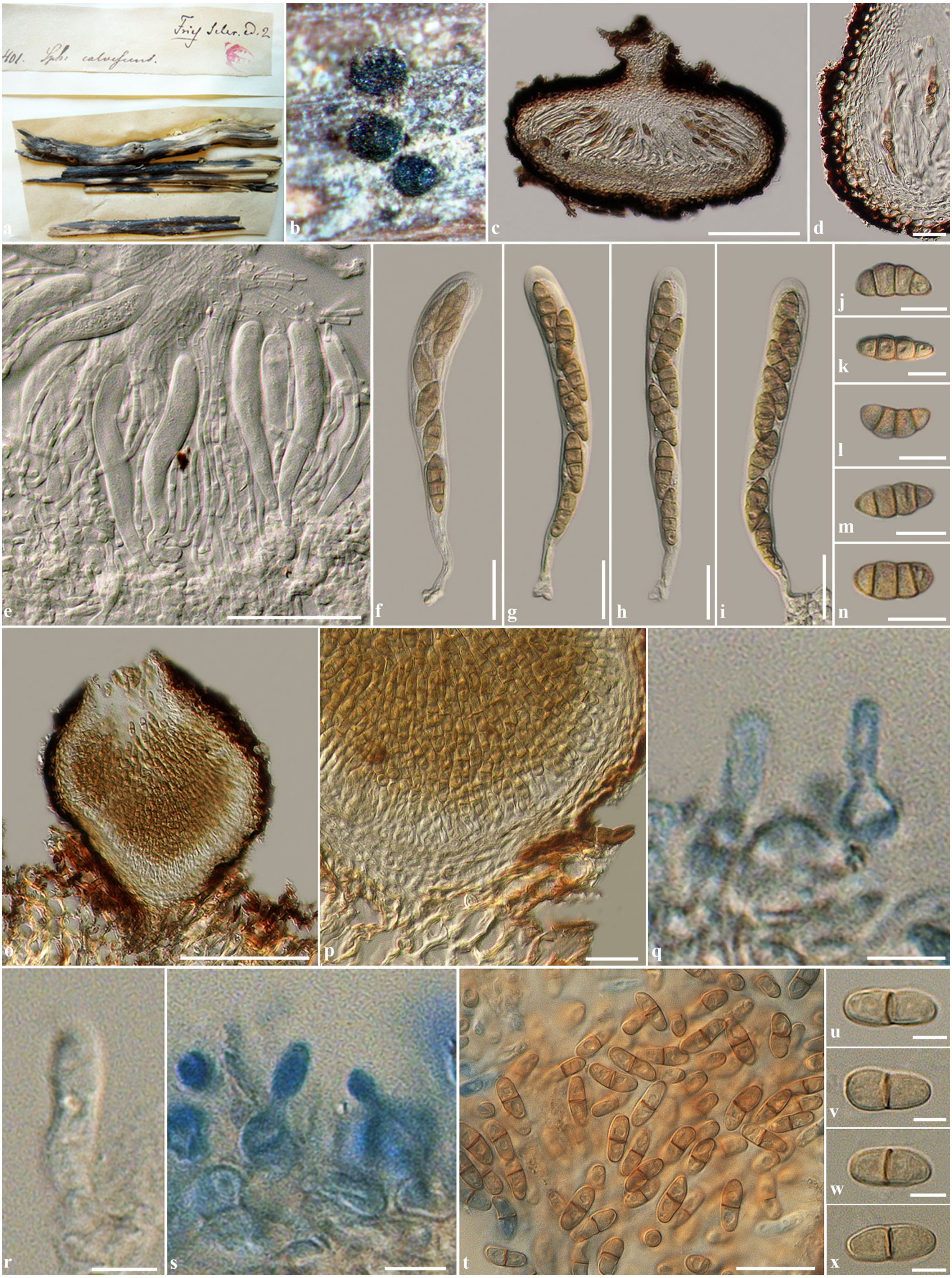
The asexual state of *Chaetoplea* (for *Pyrenophora calvescens* (Fr.) Sacc.) was first reported as *Dendryphium comosum* Walk. (Saccardo 1883). Later Webster and Lucas (1959) treated *Microdiplodia henningsii* Staritz. as the asexual state of *Chaetoplea* and this was accepted by Barr (1987b). However, Crous et al. (2006) treated *Microdiplodia* as an asexual state of *Karstenula* placed in the family *Montagnulaceae*. Ramaley (1995) reported *Parahendersonia* as the asexual state of *Chaetoplea dasylirionis* being saprobic on *Dasylirion* (*Agavaceae*) and placed it in *Leptosphaeriaceae*. In this study, the asexual state of *Chaetoplea* was observed occurring on the same host as the lectotype. The asexual state of *Chaetoplea* forms oblong to ellipsoidal, brown, 1-septate, smooth-walled conidia which are microdiplodia-like.

After examining Fries exsiccatus (Scler. Suecicae exsiccatus no. 401) in the US National Fungus Collections (BPI) it was determined that this should be designated as a lectotype in this study. Based on morphology, *Chaetoplea* is more similar to *Leptosphaeriaceae* than *Phaeosphaeriaceae* and this supports the current placement of *Chaetoplea* as listed in Index Fungorum (2014). Therefore *Chaetoplea* should currently be placed in *Leptosphaeriaceae*. Recollection, epitypification, and molecular data are needed to confirm the natural placement of *Chaetoplea*.

Chaetoplea calvescens (Fr.) Clem., in Clements & Shear, *Gen. fung*., Edn 2 (Minneapolis): 275 (1931), *Faces of Fungi number*: FoF00281, Fig. 30.

≡ *Sphaeria calvescens* Fr., Sclerom. Suec.: no. 401 (1822)

Saprobic on herbaceous dicotyledonous hosts. **Sexual state:** *Ascomata* 140–220 µm high, 280–350 µm diam., scattered, solitary to gregarious, semi-immersed to superficial, visible as small black dots on the host surface, uniloculate, subglobose, glabrous, dark brown to black, ostiole central, with short papilla. *Peridium* 15–40 µm wide, thick-walled, of equal thickness, composed of several layers of scleroplectenchymatous cells, outer layers comprising 2–3 cell layers of thick-walled, black, *textura angularis* to *textura globulosa*, inner layers comprising 4–5 cell layers of thin-walled, hyaline to pale brown, flattened cells of *textura angularis* to *textura prismatica. Hamathecium* composed of numerous, 2–3 µm wide, filamentous, broad cellular pseudoparaphyses, with distinct septa, not constricted at the septa, anastomosing at the apex. *Asci* (80–)90–115(−120)× 11–13(−15) µm ($\bar{x}$ = 100×12.1 µm, n=20), 8-spored, bitunicate, fissitunicate, clavate, short pedicellate, apically rounded, with indistinct ocular chamber. *Ascospores* (14–)15–17(−119)×6–8.5 µm ($\bar{x}$ = 16.7×7.4 µm, n=30), overlapping 1–2-seriate, phragmosporous, broadly fusiform to ellipsoidal, enlarged at the second cell, brown to yellowish-brown, 3-septate, rarely 2-septate, straight or curved, constricted at the septa, smooth-walled. **Asexual state:** *Conidiomata* growing with sexual state, 170–190 µm high, 150–190 µm diam., pycnidial, solitary to gregarious, semi-immersed to erumpent, visible as black dots on the host surface, uniloculate, ellipsoidal to broadly fusiform, with rounded apex, glabrous, dark brown to black, ostiole central, with minute papilla. *Conidiomata walls* 13.5–25 µm wide, thick-walled, of equal thickness, composed of several layers of flattened, scleroplectenchymatous cells, outer layers comprising 2–3 cell layers of thick-walled, dark brown to black cells, arranged in a *textura angularis*, inner layers comprising 3–5 layers of


Fries Scler. S. 2
401. Sph. calvescens.
a
b
c
d
e
f
g
h
i
j
k
l
m
n
o
p
q
r
s
t
u
v
w
x

◀ **Fig. 30** ***Chaetoplea calvescens*** (**lectotype** of *Sphaeria calvescens*). **a** Label and specimen of *Chaetoplea calvescens*. **b** Ascomata on host surface. **c** Section through ascoma. **d** Section through peridium. **e** Immature asci with pseudoparaphyses. **f–i** Asci. **j–n** Ascospores. **o** Section through conidioma. **p** Section through conidioma wall. **q**, **s** Conidiogenous cells stained in cotton blue reagent. **r** Conidiogenous cell. **t** Conidia stained in cotton blue reagent. **u–x** Conidia. Scale bars: c, o=100 μm, e=50 μm, d, f, g, h, i, p, t=20 μm, j, k, l, m, n=10 μm, q, r, s, u, v, w, x=5 μm

thin-walled, hyaline to pale brown cells, arranged in *textura angularis* to *textura prismatica. Conidiophores* arising from basal cavity of conidioma, mostly reduced to conidiogenous cells, hyaline, aseptate. *Conidiogenous cells* (3–)5–7(−11)× (3–)4–6(−7) μm ($\bar{x}$ = 6.2×4.6 μm, *n*=25) holoblastic, phialidic, discrete, ampulliform or lageniform, hyaline, aseptate, smooth-walled, hardly distinguished from inner wall cells. *Conidia* (11–)12–14(−15)×4–6(−7) μm ($\bar{x}$= 13× 5.2 μm, *n*=30), solitary, didymosporous, oblong to ellipsoidal, with rounded or obtuse ends, brown, 1-septate, smooth-walled.

Material examined: SWEDEN, on dead wood, 1822, E.M. Fries, no. 401 (Fries SBARBARO COLLECTION), BPI (**lectotype** of *Sphaeria calvescens* designated here).

Sphaerellopsis Cooke, Grevillea 12(no. 61): 23 (1883), *Faces of Fungi number*: FoF00292.

Type species: ***Sphaerellopsis quercuum*** Cooke, Grevillea 12(no. 61): 23 (1883).

Phylogenetic study: Nischwitz et al. (2005), Bayon et al. (2006).

Notes: Based on ITS gene phylogenetic analysis (data not shown), *Sphaerellopsis* forms a basal clade in *Leptosphaeriacea*e. For details see under *Eudarluca*.

Pleosporaceae

Pleoseptum is considered to belong in this family and is transferred herein. For an account of the family see Hyde et al. (2013).

Pleoseptum A.W. Ramaley & M.E. Barr, Mycotaxon 54: 76 (1995), *Faces of Fungi number*: FoF00282.

Type species: ***Pleoseptum yuccaesedum***.

Phylogenetic study: None.

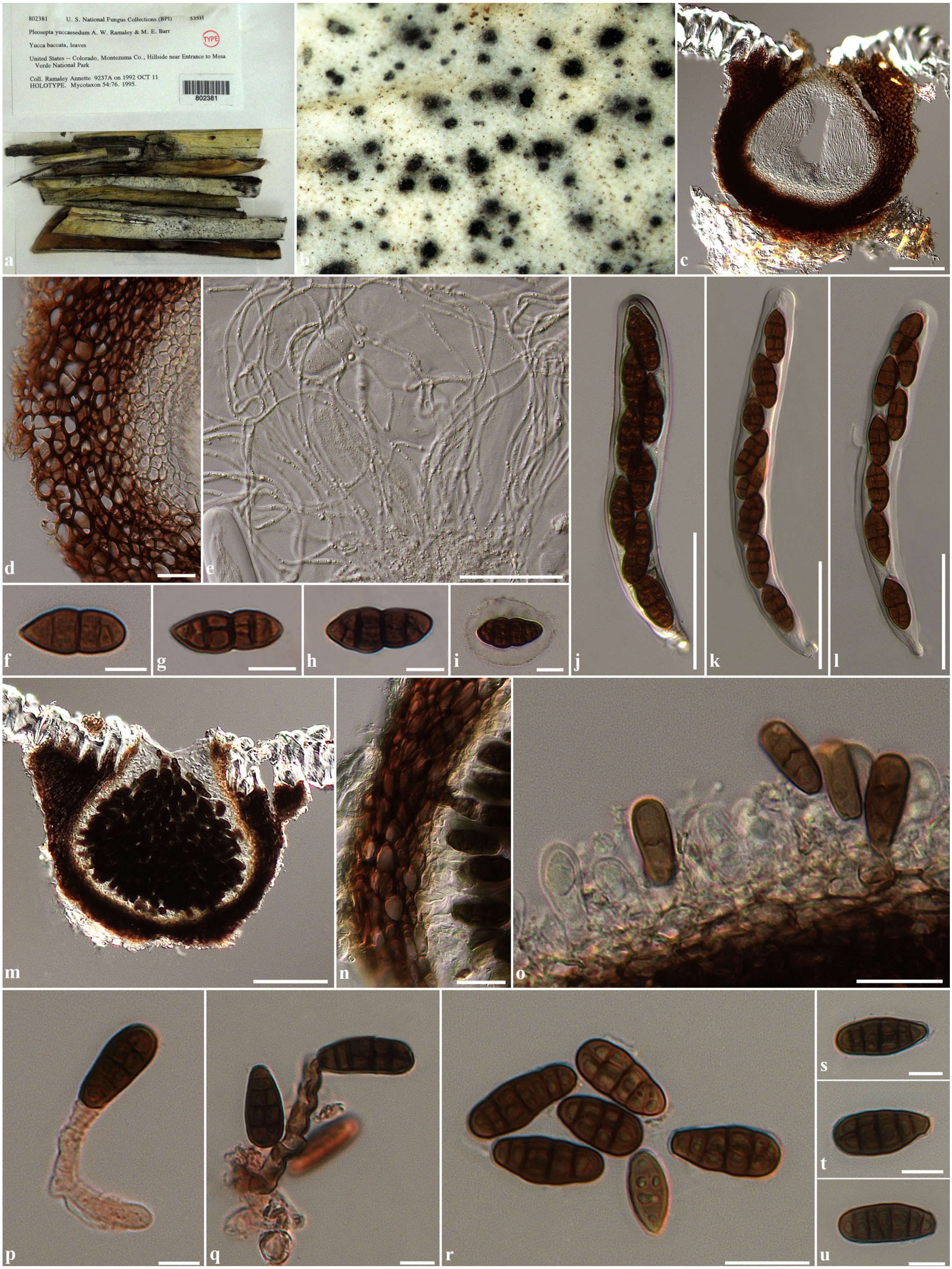
Pleoseptum yuccaesedum A.W. Ramaley & M.E. Barr, Mycotaxon 54: 76 (1995), *Faces of Fungi number*: FoF00283, Fig. 31.

= *Camarosporium yuccaesedum* Fairm., Mycologia 10(5): 261 (1918)

Saprobic on leaves of *Yucca baccata* Torr. **Sexual state:** *Ascomata* 250–360 μm high, 230–470 μm diam., scattered, solitary, immersed, visible as numerous black spots on host surface, uniloculate, globose to ovoid or conoid, dark brown to black, glabrous, with centrally opening ostiole penetrating the host epidermis. *Peridium* 70–90 μm wide, thick-walled, of unequal thickness, broad at the apex, composed of two layers of thickened pseudoparenchymatous cells, outer layer comprising several layers of thick-walled cells, arranged in a *textura angularis*, brown to dark brown, inner layers comprising several layers of thin-walled cells, hyaline, arranged in *textura angularis*. *Hamathecium* composed of numerous, 2–3 μm wide, filiform, distinctly septate, frequently anastomosing, narrow cellular pseudoparaphyses, embedded in mucilaginous matrix. *Asci* (125–)130–170(−185)×18–22(−24) μm ($\bar{x}$= 153.7×20.9 μm, *n*=25), 8-spored, bitunicate, fissitunicate, cylindrical to cylindric-clavate, short pedicellate, apically rounded, with well-developed ocular chamber. *Ascospores* (23–)25–28(−29)×10–12(−13.5) μm ($\bar{x}$ = 25.9×11.7 μm, *n*= 30), overlapping 1-seriate, dictyosporous, muriform, ellipsoidal to fusiform or obovoid, brown to dark brown, with 3–5 transverse septa, and 0–2 longitudinal septa, constricted at the central septum, smooth-walled, with distinct mucilaginous sheath. **Asexual state:** *Conidiomata* growing with the sexual state, 270–355 μm high, 265–390.5 μm diam., pycnidial, scattered, solitary to gregarious, immersed, visible as black spots on host surface, uniloculate, globose to ovoid or conoid, brown to dark brown, glabrous, with ostiolar opening penetrating the host epidermis. *Conidiomata walls* 30–65 μm wide, thick-walled, of unequal thickness, broad at the apex, composed of several layers of thickened pseudoparenchymatous cells, arranged in *textura angularis*, brown to dark brown. *Conidiophores* (10–)15–30(−45)×5–7(−8.5) μm ($\bar{x}$ = 23.8× 6.4 μm, *n*=20), discrete, oblong to cylindrical, usually unbranched, hyaline to brown, septate, arising from basal cavity of conidiomata. *Conidiogenous cells* enteroblastic, annellidic or sympodial. *Conidia* (22–)24–27(−28)×10–12(−14) μm ($\bar{x}$= 25.9×11.7 μm, *n*=30), muriform, oblong to obovoid or ellipsoidal with rounded or obtuse ends, with truncate base, initially hyaline, becoming brown to reddish-brown or dark brown at maturity, mostly with 3–5 transverse septa and 1–3 longitudinal septa, with several segments, smooth-walled.

Material examined: USA, Colorado. Montezuma County, hillside near entrance to Mesa Verde National Park, on leaves of *Yucca baccata* Torr. (*Asparagaceae*), 11 October 1992, A. Ramaley 9237 (BPI 802381, **holotype**).

Notes: The monotypic genus *Pleoseptum* was established by Ramaley and Barr (1995) to accommodate *P. yuccaesedum*. The genus was tentatively treated in *Phaeosphaeriaceae* based on its morphological characters and asexual morph (Lumbsch and Huhndorf 2010; Zhang et al. 2012; Hyde et al. 2013). *Pleoseptum* was compared with many genera such as *Chaetoplea*, *Curreya*, *Heptameria* and was considered most similar to *Leptosphaeria* based on its peridium structure (Ramaley and Barr 1995; Zhang et al. 2012). However, these genera differ in asexual states as in *Pleoseptum* conidia are dictyosporous, whereas in *Leptosphaeria*, they are stated to be amerosporous (De Gruyter et al. 2012; Hyde et al. 2013; Wijayawardene et al. 2014b).



802381 U. S. National Fungus Collections (BPI) 535H

Pleosepta yuccaesedum A. W. Ramaley & M. E. Barr

Yucca baccata, leaves

United States -- Colorado, Montezuma Co., Hillside near Entrance to Mesa Verde National Park

Coll. Ramaley Annette 9237A on 1992 OCT 11
HOLOTYPE. Mycotaxon 54:76. 1995.

◀ **Fig. 31** ***Pleoseptum yuccaesedum*** (BPI 802381, **holotype**). **a** Herbarium label and specimens of *Pleoseptum yuccaesedum*. **b** Ascomata on host surface. **c** Section through ascoma. **d** Section through peridium. **e** Pseudoparaphyses. **f**–**h** Ascospores. **i** Ascospore stained in Indian ink. **j**–**l** Asci. **m** Section through conidiomata. **n** Pycnidial wall. **o** Conidiogenous cells. **p**–**q** Conidiogenous cells stained in congo red reagent (p=annellidic, q=sympodial proliferation). **r**–**u** Conidia. Scale bars: c, m=100 μm, e, j, k, l=50 μm, d, n, o, r, = 20 μm, f, g, h, i, p, q, s, t, u=10 μm

Pleoseptum is a poorly known genus represented by only one species in Index Fungorum (2014) that lacks molecular sequence data in GenBank. The species has muriform spores which are similar to *Dematiopleospora* (Wanasinghe et al. 2014). *Pleoseptum* differs from *Dematiopleospora* by its peridium structure which is very thick, composed of heavily pigmented, thick-walled cells with ostiole and typical of *Pleosporaceae* in the former. Whereas the peridium is thinner, composed of lighter pigmented, thin-walled cells, with thick periphyses in the ostioles and typical of *Phaeosphaeriaceae* in *Dematiopleospora*. In *Pleoseptum* pseudoparaphyses are narrow, and additionally *Pleoseptum* forms a camarosporium-like asexual state. *Pleoseptum* is therefore excluded for *Phaeosphaeriaceae* whose genera typically have a thin-walled peridium and broad cellular pseudoparaphyses and tentatively placed in *Pleosporaceae*. However, *Pleoseptum yuccaesedum* needs recollecting and subjected to molecular study to confirm this placement is correct.

Camarosporium yuccaesedum was introduced as the asexual state of *Pleoseptum yuccaesedum* by Ramaley and Barr (1995) as both states co-inhabited the same host. Sexual-asexual links were connected by culture comparisons with conidia produced in culture from a sexual state (Ramaley and Barr (1995). *Camarosporium* however, has also been reported as the asexual state in various genera in *Botryosphaeriales* and *Cucurbitariaceae* (Kirk et al. 2008; Zhang et al. 2012; Hyde et al. 2013). Recent molecular based research on *Camarosporium* by Crous et al. (2014) and Wijayawardene et al. (2014a, c, d) showed that *Camarosporium sensu lato* is highly polyphyletic in *Pleosporales*, while *Camarosporium sensu stricto* is well-established genus in *Pleosporineae*, *Pleosporales* (Wijayawardene et al. 2014a). Thus, *Neocamarosporium* Crous & M.J. Wingf. (*Pleosporales incertae sedis fide* Crous et al. 2014), *Paracamarosporium* Wijayaw. & K.D. Hyde (*Montagnulaceae fide* Wijayawardene et al. 2014a), *Pseudocamarosporium* Wijayaw. & K.D. Hyde (*Montagnulaceae fide* Wijayawardene et al. 2014c) and *Eucamarosporium* Wijayaw. & K.D. Hyde (*Didymellaceae fide* Wijayawardene et al. 2014d) have been introduced to accommodate several camarosporium-like taxa in *Pleosporales*. Significantly, Ramaley and Barr (1995) reported microconidia from *Camarosporium yuccaesedum* which have not been reported from *Camarosporium sensu stricto* (Crous et al. 2013; Wijayawardene et al. 2014a). However, Crous et al. (2013) reported macroconidia from *Camarosporium psoraleae* Crous & M.J. Wingf. (current name *Paracamarosporium psoraleae* (Crous & M.J. Wingf.) Wijayaw. & K.D. Hyde *fide* Wijayawardene et al. 2014c), hence the status of *Camarosporium yuccaesedum* is uncertain. *Camarosporium yuccaesedum* is synonymized under *Pleoseptum yuccaesedum* herein.

Trematosphaeriaceae

For accounts of this family see Suetrong et al. (2011) and Hyde et al. (2013).

Hadrospora Boise, Mem. N. Y. bot. Gdn 49: 310 (1989), *Faces of Fungi number*: FoF00285.

Saprobic on woody or monocotyledonous hosts. **Sexual state:** *Ascomata* scattered, solitary, immersed to semi-immersed, or erumpent through host tissue, visible as tiny, small, black dots on the host surface, uniloculate, globose to subglobose, glabrous, dark brown to black, ostiole central with a minute papilla. *Peridium* thin-walled, composed of black, broad pseudoparenchymatous cells, arranged in a *textura angularis*. *Hamathecium* composed of numerous, filamentous, distinctly septate, frequently anastomosing, narrow cellular pseudoparaphyses. *Asci* 8-spored, bitunicate, fissitunicate, ovoid to ampulliform, sessile to minutely pedicellate, apically rounded, with indistinct ocular chamber. *Ascospores* overlapping 1–3-seriate, phragmosporous, broadly fusiform, vermiform, brown to reddish-brown, paler at the end cells, septate, smooth-walled. **Asexual state:** Unknown.

Type species: ***Hadrospora fallax***

Phylogenetic study: None

Notes: *Hadrospora* was introduced to accommodate two species, originally placed in *Trematosphaeria* by Boise (1989), and was typified by *Hadrospora fallax*. *Hadrospora* has been reported from various hosts and habitats, both terrestrial and freshwater, from Belgium, China, Italy, Japan, Switzerland, and the United States (Boise 1989; Shearer and Crane 1971; Fisher and Webster 1992; Webster 1993; Tanaka and Harada 2003; Zhang et al. 2012). The genus was tentatively placed in *Phaeosphaeriaceae* due to its small ascomata, thin-walled peridium and narrow pseudoparaphyses (Boise 1989; Zhang et al. 2012). However, *Hadrospora* differs from other genera in *Phaeosphaeriaceae* by its large vermiform ascospores, ampulliform to saccate asci, trabeculate pseudoparaphyses and the hyphomycetous asexual morph with the type species which was treated as an amphibious species (Shearer 1993; Boise 1989; Tanaka and Harada 2003; Zhang et al. 2012). Other genera of *Phaeosphaeriaceae* are mostly terestial and have cylindrical to cylindri-clavate asci with broad cellular pseudoparaphyses and produce coelomycetous asexual morphs. *Hadrospora* is similar to *Mixtura* in its large ascospores, and saccate asci; although *Hardrospora* has been reported as saprobic on various hosts, while *Mixtura* was found as plant pathogen of bamboo. The second species, *Hadrospora clarkii* (Sivan.) Boise is listed as *Trematosphaeria clarkii* Sivan. in Index fungorum (2014).

A zalerion-like asexual morph was reported for *Hadrospora* with conidia being produced on PDA after 4 months (Tanaka and Harada 2003). The genus is characterized by holoblastic, helicoid, multiseptate, brown to dark brown, smooth-walled conidia which are constricted at the septum (Tanaka and Harada 2003). Jones et al. (2009), however, treated *Zalerion maritima* as asexual morph of *Lulwoana* (*Lulworthiales*) and introduced a new genus, *Halenospora* to accommodate a non-congeneric species of *Zalerion maritima*.

Hardrospora is a poorly known genus which lacks sequences in GenBank. In this study, the proposal of Zhang et al. (2012) is followed excluding the genus from *Phaeosphaeriaceae*, based on its morphological characters, and it is tentatively placed in *Trematosphaeriaceae*.

Hadrospora fallax (Mouton) Boise, Mem. N. Y. bot. Gdn 49: 310 (1989), *Faces of Fungi number*: FoF00286, Fig. 32.

≡ *Trematosphaeria fallax* Mouton, Bull. Soc. R. Bot. Belg. 25: 155 (1886)

Saprobic on woody hosts. *Ascomata* 200–350 μm high, 180–400 μm diam., scattered, sometimes clustered, solitary, immersed to semi-immersed, becoming erumpent through host tissue, visible as tiny, black dots on the host surface, uniloculate, globose to subglobose, glabrous, dark brown to black, ostiole central, with minute papilla, truncate at the apex. *Peridium* 20–50 μm wide, thick-walled, of equal thickness, composed of several layers of black, broad pseudoparenchymatous cells, arranged in a *textura angularis. Hamathecium* composed of numerous, 1–1.7 μm wide, filamentous, distinctly septate, anastomosing, narrow cellular pseudoparaphyses, embedded in mucilaginous matrix, with few asci. *Asci* 140–160(−186)×(54–)60–67 μm ($\bar{x}$ = 157.3×61.8 μm, n=10), 8-spored, bitunicate, fissitunicate, ovoid to ampulliform, sessile to minutely pedicellate, apically rounded with indistinct ocular chamber, broad at the apex. *Ascospores* (50–)65–75(−80)×(18–)21–23(−28) μm ($\bar{x}$ = 72×21.3 μm, n=25), irregularly overlapping 1–3-seriate, phragmosporous, broad fusiform, vermiform, widest at the median cells, reddish-brown to dark brown, with lighter end cells, 8-septate, slightly constricted at the median septum, smooth and thick-walled.

Material examined: BELGIUM, Beaufays, on recently cut wood, V. Mouton 245, (BR5 020009617141, **holotype**, microslide); SLOVAKIA, Kal'niste (East Slovakia), on stems of over wintered *Triticum aestivum* L. (*Poaceae*), 20 February 2009, M. Pastircak (BPI 878936).

Pleosporales*, genera *incertae sedis

For notes on *Pleosporales*, genera *incertae sedis* see Hyde et al. (2013)

Setophaeosphaeria Crous & Y. Zhang ter, Persoonia, Mol. Phyl. Evol. Fungi 32: 271 (2014), *Faces of Fungi number*: FOF000305.

Pathogenic on *Hemerocallis fulva* L. (*Hemerocallidaceae*). **Sexual state:** *Ascomata* scattered, immersed to subepidermal, uniloculate, globose, glabrous, ostiole central, somewhat papillate. *Peridium* composed of 2–3 layers of brown cells arranged in *textura angularis. Hamathecium* composed of hyaline, hyphal pseudoparaphyses. *Asci* 8-spored, bitunicate, narrowly ellipsoid, rostrate, short pedicellate, apically rounded with inconspicuous ocular chamber. *Ascospores* 2–3-seriate, fusoid to ellipsoidal, pale brown, 5-septate, enlarged at the second cell from apex, smooth-walled, with guttules and mucoid caps at each end. **Asexual state:** forming in culture. *Conidiomata* pycnidial, scattered, erumpent with papilla, uniloculate, globose, setose, brown, ostiole central, with round to ellipsoid papilla. *Conidiomata walls* thin, composed of 2–3 layers, of pale brown cells, arranged in *textura angularis. Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* ampulliform, hyaline, smooth, percurrently proliferating at the apex. *Conidia* subcylindrical, rounded or obtuse at the apex, base truncate, with marginal frill, hyaline, aseptate, smooth-walled, with guttules (from Crous et al. 2014).

Type species: ***Setophaeosphaeria hemerocallidis*** Crous & Y. Zhang ter, Persoonia, Mol. Phyl. Evol. Fungi 32: 271 (2014).

Phylogenetic study: Crous et al. (2014).

Notes: Setophaeosphaeria was introduced by Crous et al. (2014). The genus was established to accommodate non-congeneric species of *Phaeosphaeria*. Crous et al. (2014) introduced two new species, *Setophaeosphaeria badalingensis* and *Sp. hemerocallidis* and synonymized *Phaeosphaeria setosa* under the genus. Crous et al. (2014) mentioned that *Setophaeosphaeria* differs from the type species of *Phaeosphaeria*, *Ph. oryzae*, based on its asexual state. *Phaeosphaeria oryzae* forms a septoria-like asexual state, while *Setophaeosphaeria* species form phoma-like asexual states (Quaedvlieg et al. 2013; Crous et al. 2014). Based on phylogenetic analysis, the type species, *Setophaeosphaeria hemerocallidis* is closely related to *Phaeosphaeria setosa*, but can be distinguished by dimensions of their spores (Crous et al. 2014). Thus, Crous et al. (2014) introduced a new genus to accommodate these three species in *Phaeosphaeriaceae*. Phylogenetic analysis of ITS and LSU combined genes (data is not shown) indicates that the type species, *Setophaeosphaeria hemerocallidis* forms a clade outside *Phaeosphaeriaceae*, close to *Cucurbitariaceae*, while *Sp. badalingensis* clusters with *Phaeosphaeria sensu stricto* in *Phaeosphaeriaceae*. Thus, *Setophaeosphaeria* is polyphyletic and excluded from *Phaeosphaeriaceae* and tentatively placed in *Pleosporales*, genera *incertae sedis*. The second species, *Setophaeosphaeria badalingensis* may

Fig. 32 ***Hadrospora fallax*** (BR 5020009617141, **holotype**). **a** Fruiting bodies on host surface (BPI 878936). **b** Section through ascoma (BPI 878936). **c** Section through peridium (BPI 878936). **d** Pseudoparaphyses (BPI 878936). **e**–**g** Asci (BPI 878936). **h**–**i** Ascospores (BPI 878936). **j**–**l** Ascospores (BR5020009617141). Scale bars: B=100 μm, d, e, f, g=50 μm, c, h, i, j, k, l=20 μm

need to be synonymized under *Phaeosphaeria* based on its phylogenetic relationships.

Dothideomycetes, genera *incertae sedis*

One-hundred and sixteen genera are listed as genera *incertae sedis* in the class *Dothideomycetes* in Lumbsch and Huhndorf (2010) and updated to 322 genera in Wijayawardene et al. (2014b), as this included asexual genera. *Lautitia* previously placed in *Phaeosphaeriaceae* were also added here.

Lautitia S. Schatz, Can. J. Bot. 62(1): 31 (1984), *Faces of Fungi number*: FoF00287. *Type species*: ***Lautitia danica.***

Phylogenetic study: None.

Lautitia danica (Berl.) S. Schatz, Can. J. Bot. 62(1): 31 (1984), *Faces of Fungi number*: FoF00288, Fig. 33.

≡ *Leptosphaeria danica* Berl., Icon. fung. (Abellini) 1(2): 87 (1892)

Biotrophic in red algae (*Chondrus crispus* Stackh.). *Ascostromata* 600–1000 μm diam., scattered, immersed to semi-immersed, visible as raised, black circular or irregular regions on the host surface. *Locules* 180–240 μm high, 170–270 μm diam., uni to multi-loculate under pseudoclypeus, globose to subglobose, glabrous, pale brown, ostiole central, with pore-like opening. *Peridium* 10–22 μm wide, thin-walled, of unequal thickness, slightly thickened at the base, composed of several layers of prosenchymatous cells, arranged in *textura epidermoidea* at the apex and sides, with subhyaline to pale brown cells of *textura porrecta* at the base.

Fig. 33 ***Lautitia danica*** (NY 01390859). **a** Herbarium label and specimens of *Lautitia danica*. **b** Ascostromata on host tissue. **c** Section through ascostroma. **d** Section through peridium stained in congo red. **e** Asci with pseudoparaphyses strained in congo red. **f–h** Asci. **i–j** Asci stained in congo red. **k–n** Ascospores. **o** Ascospore stained in Indian ink. Scale bars: c=100 μm, d, e=20 μm, f–j=10 μm, = 20 μm

Hamathecium composed of numerous, 1–1.5 μm wide, filamentous, anastomosing, rough-walled, narrow cellular pseudoparaphyses, with distinct septa, embedded in a mucilaginous matrix. *Asci* (57–)70–90(−104) × (12–)15–18(−20) μm ($\bar{x}$ = 78.8 × 15.9 μm, *n*=25), 8-spored, bitunicate, clavate, long pedicellate, apically rounded to truncate, with an indistinct ocular chamber. *Ascospores* (31–)35–40(−42) × 5–7 μm ($\bar{x}$ = 35.9 × 5.8 μm, *n*=30), overlapping 1–3-seriate, 2-celled, obclavate with narrow upper cell, mostly the upper cell longer than the lower cell, hyaline, 1-septate, slightly constricted at the septum, rough-walled with appendage on upper cell.

Material examined: FRANCE, Belclem near Roscoff, Finistère (Atlantic Ocean), on *Chondrus crispus* (*Gigartinaceae*), 5 October 1971 J. Kohlmeyer no. 2920 (NY 01390859); USA, Massachusetts, Gloucester, Halibus Point, 2 m deep, on *Chondrus crispus*, 28 September 1980, Kate van den Bosch; *ibid*. Rhode Island, Watch Hill Lighthouse (Atlantic Ocean), on *Laminaria*, 20 August 1966, J. Kohlmeyer_no. 1988 (NY 01390747); no. 1988a, (NY 01389139); Slide Box 15, Tray 20, S. Schatz (NY 01319510–NY 01319526).

Notes: The monotypic genus *Lautitia* was introduced by Schatz (1984) as typified by *L. danica* and placed in Dothideomycetes (Schatz 1984). A detailed description and taxonomic history were given by Wilson and Knoyle (1961) who treated the species then named *Didymosphaeria danica* (Schatz 1984). Berlese (1892) considered the species as a *Leptosphaeria* based on its hyaline, 1-septate, immature ascospores. Lind (1913) transferred the species to *Didymosphaeria* as *D. marina* (Rostrup) Lind, due to the ascospores turning brown and being 1-septate at maturity.Wilson and Knoyle (1961) could not find brown ascospores, but retained the species in *Didymosphaeria*. Schatz (1984) disagreed with Wilson and Knoyle (1961) as the species has cellular pseudoparaphyses, while genera in *Didymosphaeria* have trabeculate pseudoparaphyses. Thus Schatz (1984) designated a new genus, *Lautitia*, to accommodate the taxon. Schatz (1984) treated *Lautitia* as a member *Phaeosphaeriaceae* due to its pseudoparenchymatous to prosenchymatous peridium, and elongate, hyaline asymmetric ascospores. The genus was accepted in *Phaeosphaeriaceae* by Zhang et al. (2012) and Hyde et al. (2013).

In this study, we exclude *Lautitia* from *Phaeaosphaeriaceae* based on its morphology. *Lautitia* can be distingiushed from other genera in *Phaeosphaeriaceae* which differ in peridium structure, asci and ascospores. *Lautitia* has prosenchymatous perdial cells, clavate asci with long pedicels, and asymmetric didymosporous ascospores, while other genera in *Phaeoaperiaceae* have pseudoparenchymatous peridial cells, cylindrical to cylindric-clavate asci which are subsessile to short pedicellate, and phragmosporous, scolecosporous or muriform ascospores (Zhang et al. 2009, 2012; Hyde et al. 2013). It is difficult to place this species in any family or order any thus we refer it to Dothideomycetes, genera *incertae sedis*.

Acknowledgments The Royal Golden Jubilee Ph. D. Program (PHD/0090/2551) under Thailand Research Fund, Humidtropics, a CGIAR Research Program that aims to develop new opportunities for improved livelihoods in a sustainable environment and Mae Fah Luang University (grant for study Dothideomycetes No. 56101020032) are gratefully thanked for partially funding this work. KD Hyde acknowledges The Chinese Academy of Sciences, project number 2013T2S0030, for the award of Visiting Professorship for Senior International Scientists at Kunming Institute of Botany. Wen Jing Li and International Fungal Research & Development Centre, Research Institute of Resource Insects, Chinese Academy of Forestry; Ruvishika S. Jayawardena and Institute of Plant and Environment Protection, Beijing Academy of Agriculture and Forestry Sciences; Jun-Bo Yang and Plant Germplasm and Genomics Center in Germplasm Bank of Wild Species, Kunming Institute of Botany are gratefully thanked for the molecular laboratory support. The curators from BPI, BR, NY, S, and UB herbaria are gratefully thanked for loaning specimens and type information. Amy Y. Rossman, Chatsachee Chatpapamon, Dhanushka N. Wanasinghe, Dhanushka Udayanga, E. B. Gareth Jones, Joanne E. Taylor, Saowanee Wikee, Saranyaphat Boonme and Supalak Yacharoen are gratefully thanked for taxonomic literature information, cultures preparation and general assistance.

References

Abbas SQ, Iftikhar T, Niaz M, Ali I, Iftikhar N, Abbas A (2012) A new species of *Tiarosporella azadarrichta* and new fungal records on Azadirachta indica from Pakistan. Pak J Bot 44(6):2093–2102

Abdullah SK, Asensio L, Monfort E, Gomez-Vidal S, Palma-Guerrero J, Salinas J, Lopez-Llorca LV, Jansson HB, Guarro J (2005) Occurrence in Elx, SE Spain of inflorescence rot disease of date palms caused by *Mauginiella scaettae*. J Phytopathol 153:417–422

Ahn YM, Shearer CA (1998) Re-examination of taxa in *Leptosphaeria* originally described on host species in *Ranunculaceae*, *Papaveraceae*, and *Magnoliaceae*. Can J Bot 76:258–280

Ainsworth GC, James PW, Hawksworth DL (1971) Ainsworth & Bisby's dictionary of the fungi, 6th edn. CAB, Kew

Aptroot A (2006) *Mycosphaerella* and its anamorphs 2. Conspectus of *Mycosphaerella*. CBS Biodivers Ser 5:1–231

Ariyawansa HA, Kang JC, Alias SA, Chukeatirote E, Hyde KD (2013) Towards a natural classification of Dothideomycetes: the genera *Dermatodothella*, *Dothideopsella*, *Grandigallia*, *Hysteropeltella* and *Gloeodiscus* (Dothideomycetes *incertae sedis*). Phytotaxa 147(2):35–47

Ariyawansa HA, Phookamsak R, Tibpromma S, Kang JC, Hyde KD (2014a) A molecular and morphological reassessment of *Diademaceae*. Sci World J. doi:10.1155/2014/675348

Ariyawansa HA, Tanaka K, Thambugala KM, Phookamsak R, Tian Q, Camporesi E, Hongsanan S, Monkai J, Wanasinghe DN, Chukeatirote E, Kang JC, Xu JC, McKenzie EHC, Jones EBG, Hyde KD (2014b) A molecular phylogenetic reappraisal of the *Didymosphaeriaceae* (*Montagnulaceae*). Fungal Divers. 68. doi:10.1007/s13225-014-0305-6

Ariyawansa HA, Thambugala KM, Maharachchikumbura SSN, Udayanga D, Manamgoda DS, Daranagama A, Shivas RG, Jayawardena R, Phookamsak R, Senanayake IC, Liu JK, Tian Q, Camporesi E, McKenzie EHC, Lücking R, Hawksworth DL, Kang JC, Alias SA, Chukeatirote E, Mortimer PE, Xu JC, Jones EBG, Hyde KD (2014c) Epitypification and neotypification. Fungal Divers (in press)

Arzanlou M, Crous PW (2006) *Phaeosphaeriopsis musae*. Fungal Planet 9. CBSKNAW Fungal Biodiversity Centre, Utrecht

Aveskamp MM, de Gruyter J, Woudenberg JHC, Verkley GJM, Crous PW (2010) Highlights of the *Didymellaceae*: a polyphasic approach to characterise *Phoma* and related pleosporalean genera. Stud Mycol 65:1–60

Barr ME (1979) A classification of Loculoascomycetes. Mycologia 71: 935–957

Barr (1982) *Leptosphaeria sepalorum*. Mycotaxon 15:345–348

Barr ME (1987a) New taxa and combinations in the Loculoascomycetes. Mycotaxon 29:501–505

Barr ME (1987b) Prodromus to Class Loculoascomycetes. University of Massachusetts, Massachusetts, Amherst

Barr ME (1990a) *Melanommatales* (Loculoascomycetes). N Am Flora 13(II):1–129

Barr ME (1990b) Some dictyosporous genera and species of *Pleosporales* in North America. Mem N Y Bot Gard 62:1–92

Barr ME (1992a) Additions to and notes on the *Phaeosphaeriaceae* (*Pleosporales*, Loculoascomycetes). Mycotaxon 43:371–400

Barr ME (1992b) Notes on the *Lophiostomataceae* (*Pleosporales*). Mycotaxon 45:191–221

Barr ME (1996) *Planistromellaceae*, a new family in the Dothideales. Mycotaxon 60:433–442

Barr ME (2002) *Teichosporaceae*, another family in the *Pleosporales*. Mycotaxon 82:373–389

Barr ME, Rogerson CT (1999) Some Loculoascomycete species form the Great Basin, USA. Mycotaxon 71:473–480

Bayon C, Yuan Z-W, Ruiz C, Liesebach M, Pei MH (2006) Genetic diversity in the mycoparasite *Sphaerellopsis filum* inferred from AFLP analysis and ITS–5.8S sequences. Mycol Res 110:1200–1206

Belsare SW, Moniz L, Deo VB (1980) The hyperparasite *Ampelomyces quisqualis* Ces. from Maharashtra State, India. Biovigyanam 6: 173–176

Berlese AN (1892) *Leptosphaeria danica*. Icones Fungorum 1(2):67–90

Boerema GH (1982) *Phoma*-soorten van de sectie *Plenodomus*. Verslagen en Mededelingen Plantenziektenkundige Dienst Wageningen 158(Jaarboek 1981):28–30

Boerema GH (1997) Contributions towards a monograph of *Phoma* (Coelomycetes) - V. Subdivision of the genus in sections. Mycotaxon 64:321–333

Boerema GH, Dorenbosch MMJ (1979) Mycologisch-taxonomisch onderzoek in Jaarboek 1978. Verslagen en Mededelingen Plantenziektenkundige Dienst 153:17–21

Boerema GH, De Gruyter J, Noordeloos ME, Hamers MEC (2004) *Phoma* identification manual. Differentiation of specific and infraspecific taxa in culture. CABI Publishing, United Kingdom

Boise JR (1989) On *Hadrospora*, a new genus in the *Phaeosphaeriaceae* and *Byssothecium alpestris*. Mem N Y Bot Gard 49:308–310

Boonmee S, Ko Ko TW, Chukeatirote E, Hyde KD, Chen H, Lei C, McKenzie EHC, Jones EBG, Rampai K, Bahkali AH (2012) Two new *Kirschsteiniothelia* species with *Dendryphiopsis* anamorphs cluster in *Kirschsteiniotheliaceae* fam. nov. Micologia 104(3): 698–714

Calatayud V, Etayo J (2001) Five new species of lichenicolous conidial fungi from Spain. Can J Bot 79:223–230

Câmara MPS, O'Neill NR, van Berkum P, Dernoeden PH, Palm ME (2000) *Ophiosphaerella agrostis* sp. nov. and its relationship to other species of *Ophiosphaerella*. Mycologia 92:317–325

Câmara MPS, Palm ME, van Berkum P, Stewart EL (2001) Systematics of *Paraphaeosphaeria*: a molecular and morphological approach. Mycol Res 105:41–56

Câmara MPS, Palm ME, van Berkum P, O'Neill NR (2002) Molecular phylogeny of *Leptosphaeria* and *Phaeosphaeria*. Mycologia 94: 630–640

Câmara MPS, Ramaley AW, Castlebury LA, Palm ME (2003) *Neophaeosphaeria* and *Phaeosphaeriopsis*, segregates of *Paraphaeosphaeria*. Mycol Res 107:516–522

Cannon PF, Damm U, Johnston PR, Weir BS (2012) *Colletotrichum*–current status and future directions. Stud Mycol 73:181–213

Carson ML (2005) Yield loss potential of *Phaeospharia* leaf spot of maize caused by *Phaeosphaeria maydis* in the United States. Plant Dis 89:986–988

Cesati V (1852) *Ampelomyces quisqualis* Ces. Botanische Zeitung 10: 301–302

Cheng TF, Jia XM, Ma XH, Lin HP, Zhao YH (2004) Phylogenetic study on *Shiraia bambusicola* by rDNA sequence analyses. J Basic Microbiol 44:339–350

Chomnunti P, Hongsanan S, Aguirre-Hudson B, Tian Q, Peršoh D, Dhami MK, Alias AS, Xu JC, Liu X, Stadler M, Hyde KD (2014) The sooty moulds. Fungal Divers 66:1–36

Clare BG (1964) *Ampelomyces quisqualis* (*Cicinnobolus cesatii*) on Queensland *Erysiphaceae*. University of Queensland Papers 4: 147–149

Clements FE, Shear CL (1931) Genera of fungi, 2nd edn. H.W. Wilson Company, New York

Corda ACI (1840) Icones Fungorum hucusque Cognitorum 4: i–iii, 1–63. Prague; apud J.G. Calve [Fridericum Ehrlich]

Crivelli PG (1983) Über die heterogene Ascomycetengattung *Pleospora* Rabh.: vorschlag für eine Aufteilung. Dissertation ETH Nr. 7318, Zürich, Germany

Crous PW, Palm ME (1999) Systematics of selected foliicolous fungi associated with leaf spots of *Proteaceae*. Mycol Res 103:1299–1304

Crous PW, Slippers B, Wingfield MJ, Rheeder J, Marasas WFO, Philips AJL, Alves A, Burgess TI, Barber PA, Groenewald JZ (2006) Phylogenetic lineages in the *Botryosphaeriaceae*. Stud Mycol 55: 235–253

Crous PW, Groenewald JZ, Lombard L, Wingfield MJ (2008) *Homortomyces* gen. nov., a new dothidealean pycnidial fungus from the Cradle of Humankind. IMA Fungus 3(2):109–115

Crous PW, Minnis AW, Pereira OL, Alfenas AC, Alfenas RF, Rossman AY, Groenewald JZ (2011) What is *Scirrhia*? IMA Fungus 2:127–133

Crous PW, Wingfield MJ, Guarro J, Cheewangkoon R et al (2013) Molecular phylogeny and evolution of fungi – Fungal Planet description sheets: 154–213. Persoonia 31:188–296

Crous PW, Shivas RG, Quaedvlieg W, van der Bank M, Zhang Y, Summerell BA, Guarro J, Wingfield MJ, Wood AR, Alfenas AC, Braun U, Cano-Lira JF, García D, Marin-Felix Y, Alvarado P, Andrade JP, Armengol J, Assefa A, den Breeÿen A, Camele I, Cheewangkoon R, De Souza JT, Duong TA, Esteve-Raventós F, Fournier J, Frisullo S, García-Jiménez J, Gardiennet A, Gené J, Hernández-Restrepo M, Hirooka Y, Hospenthal DR, King A, Lechat C, Lombard L, Mang SM, Marbach PAS, Marincowitz S, Marin-Felix Y, Montaño-Mata NJ, Moreno G, Perez CA, Pérez Sierra AM, Robertson JL, Roux J, Rubio E, Schumacher RK, Stchigel AM, Sutton DA, Tan YP, Thompson EH, van der Linde E, Walker AK, Walker DM, Wickes BL, Wong PTW, Groenewald JZ (2014) Fungal Planet Description Sheets: 214–280. Persoonia 32: 184–306

Cunfer BM (2000) *Stagonospora* and *Septoria* diseases of barley, oat, and rye. Can J Plant Pathol 22:332–348

Cunfer BM, Ueng PP (1999) Taxonomy and identification of *Septoria* and *Stagonospora* species on small-grain cereals. Annu Rev Phytopathol 37:267–284

De Bary A (1870) Eurotium, Erysiphe, Cicinnobolus, nebst Bemerkungen über die Geschlechtsorgane der Ascomyceten. In: Beiträge zur Morphologie und Physiologie der Pilze (A. De Bary & M. Woronin, eds). Verlag von C. Winter, Frankfurt, pp 1–95

De Gruyter J, Aveskamp MM, Woudenberg JHC, Verkley GJM, Groenewald JZ, Crous PW (2009) Molecular phylogeny of *Phoma* and allied anamorph genera: towards a reclassification of the *Phoma* complex. Mycol Res 113:508–519

De Gruyter J, Woudenberg JH, Aveskamp MM, Verkley GJ, Groenewald JZ, Crous PW (2010) Systematic reappraisal of species in *Phoma* section *Paraphoma*, *Pyrenochaeta* and *Pleurophoma*. Mycologia 102:1066–1081

De Gruyter J, Woudenberg JHC, Aveskamp AA, Verkley GJM, Groenewald JZ, Crous PW (2012) Redisposition of phoma-like anamorphs in *Pleosporales*. Stud Mycol 75:1–36

Dennis RWG (1978) British Ascomycetes, 3rd edn. J. Cramer, Vaduz

Dianese JC, Inácio CA, Dornelo-Silva D (2001) *Wilmia*, a new genus of phaeosphaeriaceous ascomycetes on *Memora pedunculata* in central Brazil. Mycologia 93:1014–1018

Doilom M, Liu JK, Jaklitsch WM, Ariyawansa H, Wijayawardene NN, Chukeatirote E, Zhang M, McKenzie EHC, Geml J, Voglmayr H, Hyde KD (2013) An outline of the family *Cucurbitariaceae*. Sydowia 65(1):167–192

Dong JW, Chen WD, Crane JL (1998) Phylogenetic studies of the *Leptosphaeriaceae*, *Pleosporaceae* and some other Loculoascomycetes based on nuclear ribosomal DNA sequences. Mycol Res 102:151–156

Eriksson OE (1966) On *Eudarluca caricis* (Fr.) O. Erikss., comb. nov., a cosmopolitan uredinicolous pyrenomycete. Bot Not 119:33–69

Eriksson OE (1967) On graminicolous pyrenomycetes from Fennoscandia. I, II, III. Ark Bot Ser 26:339–466

Eriksson OE (1981) The families of bitunicate ascomycetes. Opera Bot 60:1–220

Eriksson OE (1982) Notes on ascomycetes and coelomycetes from NW. Europe Mycotaxon 15:189–202

Eriksson OE (2006) Outline of Ascomycota–2006. Myconet 12:1–82

Eriksson OE (2007) Ascomycet-Nytt 1. Svensk Mykologisk Tidskrift 28(2):38–41

Eriksson OE, Hawksworth DL (1990) Outline of the Ascomycetes—1989. Syst Ascomyc Reprint of Volumes 1–4 (1982–1985) 8 (2): 119–318

Eriksson OE, Hawksworth DL (1991) Outline of the Ascomycetes–1990. Syst Ascomyc Reprint of Volumes 1–4 (1982–1985) 9: 39–271

Eriksson OE, Hawksworth DL (1993) Outline of the Ascomycetes – 1993. Syst Ascomyc 12(1–2):51–257

Eriksson OE, Yue J-Z (1990) Notes on bambusicolous pyrenomycetes. Nos. 1–10. Mycotaxon 38:201–220

Farr DF, Bills GF (1995) *Wojnowicia colluvium* sp. nov. isolated from conifer litter. Mycologia 87(4):518–524

Farr DF, Rossman AY (2014) Fungal databases, systematic mycology and microbiology laboratory, ARS, USDA. Retrieved September 1, 2014, from http://nt.ars-grin.gov/fungaldatabases/

Farr DF, Bills GF, Chamuris GP, Rossman AY (1989) Fungi on plants and plant products in the United States. APS Press, St. Paul

Farr DF, Aime MC, Rossman AY, Palm ME (2006) Species of colletotrichum on agavaceae. Mycol Res 110(12):1395–1408

Fisher PJ, Webster J (1992) A *Trematosphaeria* endophyte from rice roots and its *Zalerion* anamorph. Nova Hedw 54:77–81

Gams W (2000) *Phialophora* and some similar morphologically little-differentiated anamorphs of divergent ascomycetes. Stud Mycol 45: 187–200

Griffith D (1899) The common parasite of the powdery mildews. Bull Torrey Bot Club 26:184–188

Hall TA (1999) BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. In: Nucleic Acids Symposium Series, pp 95–98

Hawksworth DL (1985) *Kirschsteiniothelia* a new genus for the *Microthelia* incrustans–group (Dothideales). Bot J Linn Soc 91:181–202

Hedjaroude A (1969) Études taxonomiques sur les *Phaeosphaeria* Miyake et leurs formes voisines (ascomycètes). Sydowia 22:57–107

Hodhod MS, Abdel-Wahab MA, Bahkali AHA, Hyde KD (2012) *Amarenographium solium* sp nov from Yanbu mangroves in the Kingdom of Saudi Arabia. Cryptogam Mycol 33(3):285–294

Holm L (1948) Taxonomical notes onAscomycetes. 1. The Swedish species of the genus *Ophiobolus* Riess sensu Sacc. Sven Bot Tidskr 42:337–347

Holm L (1957) Etudes taxonomiques sur les pléosporacées. Symb Bot Upsaliens 14:1–188

Hsiang T, Chen F, Goodwin PH (2003) Detection and phylogenetic analysis of mating type genes of *Ophiosphaerella korrae*. Can J Bot 81(4):307–315

Huelsenbeck JP, Ronquist F (2001) MRBAYES: Bayesian inference of phylogenetic trees. Bioinformatics 17(8):754–755

Hyde KD (1992) Fungi from decaying inter-tidal fronds of *Nypa fruticans*, including three new genera and four new species. J Linn Soc Bot 110:95–110

Hyde KD (1994) Fungi from palms. XII. Three new intertidal ascomycetes from submerged palm fronds. Sydowia 46:257–264

Hyde KD, McKenzie EHC, KoKo TW (2011) Towards incorporating anamorphic fungi in a natural classification – checklist and notes for 2010. Mycosphere 2:1–88

Hyde KD, Jones EBG, Liu JK, Ariyawansa HA, Boehm E, Boonmee S, Braun U, Chomnunti P, Crous PW, Dai DQ, Diederich P, Dissanayake AJ, Doilom M, Doveri F, Hongsanan S, Jayawardena R, Lawrey JD, Li YM, Liu YX, Lücking R, Monkai J, Muggia L, Nelsen MP, Pang KL, Phookamsak R, Senanayake I, Shearer CA, Seutrong S, Tanaka K, Thambugala KM, Wijayawardene NN, Wikee S, Wu HX, Zhang Y, Aguirre-Hudson B, Alias SA, Aptroot A, Bahkali AH, Bezerra JL, Bhat JD, Camporesi E, Chukeatirote E, Gueidan C, Hawksworth DL, Hirayama K, De Hoog S, Kang JC, Knudsen K, Li WJ, Li X, Liu ZY, Mapook A, McKenzie EHC, Miller AN, Mortimer PE, Phillips AJL, Raja HA, Scheuer C, Schumm F, Taylor JE, Tian Q, Tibpromma S, Wanasinghe DN, Wang Y, Xu JC, Yan J, Yacharoen S, Zhang M (2013) Families of Dothideomycetes. Fungal Divers 63:1–313

Hyde KD, Nilsson RH, Alias SA, Ariyawansa HA, Blair JE, Cai L, de Cock AWAM, Dissanayake AJ, Glockling SL, Goonasekara ID, Gorczak M, Hahn M, Jayawardena RS, van Kan JAL, Laurence MH, Lévesque CA, Li X, Liu JK, Maharachchikumbura SSN, Manamgoda DS, Martin FN, McKenzie EHC, McTaggart AR, Mortimer PE, Nair PVR, Pawłowska J, Rintoul TL, Shivas RG, Spies CFJ, Summerell BA, Taylor PWJ, Terhem RB, Udayanga D, Vaghefi N, Walther G, Wilk M, Wrzosek M, Xu JC, Yan JY, Zhou N (2014) One stop shop: backbones trees for important phytopathogenic 5 genera: I (2014). Fungal Divers. doi:10.1007/s13225-014-0298-1

Index Fungorum (2014) http://www.indexfungorum.org/Names/Names.asp

Jones EBG, Sakayaroj J, Suetrong S, Somrithipol S, Pang KL (2009) Classification of marine Ascomycota, anamorphic taxa and Basidiomycota. Fungal Divers 35:1–187

Keener PD (1951) An ascigerous stage of *Darluca filum* (Biv.) Castagne. Plant Dis Rep 35:86–87

Khashnobish A, Shearer CA (1996) Phylogenetic relationships in some *Leptosphaeria* and *Phaeosphaeria* species. Mycol Res 100:1355–1363

Kirk PM, Cannon PF, David JC, Stalpers JA (2001) Dictionary of the Fungi 9th edn. CABI, Wallingford

Kirk PM, Cannon PF, Minter DW, Staplers JA (2008) Dictionary of the Fungi 10th edn. CABI Bioscience, UK

Kiss L (1998) Natural occurrence of *Ampelomyces* intracellular mycoparasites in mycelia of powdery mildew fungi. New Phytol 140:709–714

Kiss L, Nakasone KK (1998) Ribosomal DNA internal transcribed spacer sequences do not support the species status of *Ampelomyces quisqualis*, a hyperparasite of powdery mildew fungi. Curr Genet 33:362–367

Kiss L, Russell J, Szentiványi O, Xu X, Jeffries P (2004) Biology and biocontrol potential of *Ampelomyces* mycoparasites, natural antagonists of powdery mildew fungi. Biocontrol Sci Tech 14:635–651

Kodsueb R, Dhanasekaran V, Aptroot A, Lumyong S, McKenzie EHC, Hyde KD, Jeewon R (2006) The family *Pleosporaceae*: intergeneric relationships and phylogenetic perspectives based on sequence analyses of partial 28S rDNA. Mycologia 98:571–583

Kodsueb R, Lumyong S, Ho WH, Hyde KD, McKenzie EHC, Jeewon R (2007) Morphological and molecular characterization of *Aquaticheirospora* and phylogenetics of *Massarinaceae* (*Pleosporales*). Bot J Linn Soc 155:283–296

Kohlmeyer J, Kohlmeyer E (1965) *Phaeosphaeria ammophilae*. Icones Fungorum Maris 3

Kohlmeyer J, Volkmann-Kohlmeyer B (1993) A trotorquata and *Loratospora*: new ascomycete genera on *Juncus roemerianus*. Syst Ascomyc 12:7–22

Kruys A, Eriksson OE, Wedin M (2006) Phylogenetic relationships of coprophilous *Pleosporales* (Dothideomycetes, Ascomycota), and the classification of some bitunicate taxa of unknown position. Mycol Res 110:527–536

Lawrey JD, Diederich P, Nelsen MP, Freebury C, Broeck DVD, Sikaroodi M, Ertz D (2012) Phylogenetic placement of lichenicolous Phoma species in the *Phaeosphaeriaceae* (*Pleosporales*, Dothideomycetes). Fungal Divers 55:195–213

Leuchtmann A (1984) Über *Phaeosphaeria* Miyake und andere bitunicate Ascomyceten mit mehrfach querseptierten Ascosporen. Sydowia 37:75–194

Liang C, Yang J, Kovács GM, Szentiványi O, Li B, Xu XM, Kiss L (2007) Genetic diversity of *Ampelomyces* mycoparasites isolated from different powdery mildew species in China inferred from analyses of rDNA ITS sequences. Fungal Divers 24:225–240

Liew ECY, Aptroot A, Hyde KD (2000) Phylogenetic significance of the pseudoparaphyses in Loculoascomycete taxonomy. Mol Phylogenet Evol 16:392–402

Lind J (1913) Danish fungi, as represented in the herbarium of E. Rostrup. 1–650. Denmark, Copenhagen

Liu YJ, Whelen S, Hall BD (1999) Phylogenetic relationships among ascomycetes: evidence from an RNA polymerase II subunit. Mol Biol Evol 16:1799–1808

Liu JK, Phookamsak R, Jones EBG, Zhang Y, Ko-Ko TW, Hu HL, Boonmee S, Doilom M, Chukeatirote E, Bahkali AH, Wang Y, Hyde KD (2011) *Astrosphaeriella* is polyphyletic, with species in *Fissuroma* gen. nov., and *Neoastrosphaeriella* gen. nov. Fungal Divers 51:135–154

Liu JK, Phookamsak R, Doilom M, Wiki S, Mei LY, Ariyawansa HA, Boonmee S, Chomnunti P, Dai DQ, Bhat DJ, Romero AI, Xhuang WY, Monkai J, Jones EBG, Chukeatirote E, KoKo TW, Zhoa YC, Wang Y, Hyde KD (2012) Towards a natural classification of *Botryosphaeriales*. Fungal Divers 57:149–210

Liu YX, Hyde KD, Ariyawansa HA, Li WJ, Zhou DQ, Yang YL, Chen YM, Liu ZY (2013) *Shiraiaceae*, new family of *Pleosporales* (Dothideomycetes, Ascomycota). Phytotaxa 103(1):51–60

Lumbsch HT, Huhndorf SM (eds.) (2007) Outline of Ascomycota–2007. Myconet 13:1–58

Lumbsch HT, Huhndorf SM (2010) Outline ofAscomycota–2009. Fieldiana Life Earth Sci 1:1–60

Manamgoda DS, Cai L, McKenzie EHC, Crous PW, Madrid H, Chukeatirote E, Shivas RG, Tan YP, Hyde KD (2012) A phylogenetic and taxonomic re–evaluation of the *Bipolaris*, *Cochliobolus*, *Curvularia* Complex. Fungal Divers 56:131–144

McAlpine D (1902) Fungus diseases of stone-fruit trees in Australia and their treatment, pp 1–165

Minter DW, Rodríguez Hernández M, Mena Portales J (2001) Fungi of the Caribbean: an annotated checklist. PDMS Publishing: 946 pp

Miyake I (1909) Studies on the parasitic fungi of rice in Japan. Bot Mag Tokyo 23:85–97

Miyake I (1910) Studien über die Pilze der Reispflanze in Japan. J Coll Agric Tokyo 2:237–276

Moesz G (1915) Mykologiai közlemények. II. közlemény. Botanikai Kölzlemények 14(5–6):145–158

Monkai J, Liu JK, Boonmee S, Chomnunti P, Chukeatirote E, Jones EBG, Wang Y, Hyde KD (2013) *Planistromellaceae* (*Botryosphaeriales*). Cryptogam Mycol 34:45–77

Morales VM, Jasalavich CA, Pelcher LE, Petrie GA, Taylor JL (1995) Phylogenetic relationships among several *Leptosphaeria* species based on their ribosomal DNA sequences. Mycol Res 99:593–603

Morelet M (1980) Sur quatre *Dothideales*. Bull Soc Sci Nat Archeol Toulon 227:14–15

Morgan-Jones G, White JF (1983) Studies on the genus *Phoma*. III. *Paraphoma*, a new genus to accommodate *Phoma radicina*. Mycotaxon 18(1):57–65

Müller E (1950) Die schweizerischen Arten der Gattung *Leptosphaeria* und ihrer Verwandten. Sydowia 4:185–319

Müller E (1952) Die schweizerischen Arten der Gattung *Ophiobolus* Riess. Ber Schweiz Bot Ges 62:307–339

Müller E, von Arx JA (1962) Die Gattungen der didymosporen Pyrenomyceten. Beitr Krypt Fl Schweiz 11:1–92

Munk A (1957) Danish pyrenomycetes. A preliminary flora. Dansk Bot Ark 17:1–491

Nag Raj TR (1989) Genera coelomycetum. XXVI. *Amarenographium*, *Callistospora*, *Hyalothyridium*, *Orphanocoela* anam.-gen.nov., *Scolecosporiella*, and *Urohendersoniella*. Can J Bot 67(3169–3):186

Nischwitz C, Newcombe G, Anderson LC (2005) Host specialization of the mycoparasite *Eudarluca caricis* and its evolutionary relationship to *Ampelomyces*. Mycol Res 109(4):421–428

Nylander JAA (2004) MrModeltest 2.0. Program distributed by the author. Evolutionary Biology Centre, Uppsala University

Oertel B (2011) Pilzgattungen Europas-Liste 6: Notizbuchartige Auswahlliste zur Bestimmungsliteratur für Coelomyceten

Page RDM (1996) TreeView: an application to display phylogenetic trees on personal computers. Comput Appl Biosci 12: 357–358

Petrak F (1921) Mykologische Notizen. II Ann Mycol 19(1–2):17–128

Petrak F (1944) Über die Gattungen *Chaetopyrena* Pass., *Sclerochaeta* v. Höhn., *Sclerochaetella* v. Höhn., *Vermiculariella* Oud., *Chaetosphaeronema* Moesz und *Pseudophoma* v. Höhn. Ann Mycol 42:58–71

Petrak F, Sydow H (1936) Kritisch-systematische Originaluntersuchungen über Pyrenomyzeten, Sphaeropsideen und Melanconieen. VII. Annal Mycol 34(1–2):11–52

Phookamsak R, Liu JK, Chukeatirote E, McKenzie EHC, Hyde KD (2013) Phylogeny and morphology of *Leptosphaerulina saccharicola* sp. nov. and *Pleosphaerulina oryzae* and relationships with *Pithomyces*. Cryptogam Mycol 34(4):303–319

Phookamsak R, Liu JK, Manamgoda DS, Chukeatirote E, Mortimer PE, McKenzie EHC, Hyde KD (2014) The sexual state of *Setophoma*. Phytotaxa 176:260–269

Priest MJ (2006) Fungi of Australia: *Septoria*. CSIRO publishing, Melbourne, Australia, ABRS, Canberra

Quaedvlieg W, Verkley GJM, Shin H-D, Barretto RW, Alfenas AC, Swart WJ, Groenewald JZ, Crous PW (2013) Sizing up *Septoria*. Stud Mycol 75:307–390

Rabenhorst (1858) Herb myc, ed. 2 no. 725 (in sched)

Raja HA, Ferrer A, Shearer CA (2009) Freshwater ascomycetes: a new genus, *Ocala scalariformis* gen. et sp. nov, and two new species, *Ayria nubispora* sp. nov. and *Rivulicola cygnea* sp. nov. Fungal Divers 34:79–86

Ramaley AW (1995) New fungi from *Dasylirion* (*Agavaceae*). Aliso 14: 147–153

Ramaley AW (1997) New *Paraphaeosphaeria* species and their anamorphs. Mycotaxon 61:347–358

Ramaley AW, Barr ME (1995) New dictyosporous species from leaves of *Agavaceae*. Mycotaxon 54:75–90

Rannala B, Yang Z (1996) Probability distribution of molecular evolutionary trees: a new method of phylogenetic inference. J Mol Evol 43(3):304–311

Reddy PV, Patel R, White JF Jr (1998) Phylogenetic and developmental evidence supporting reclassification of cruciferous pathogens *Phoma lingam* and *Phoma wasabiae* in *Plenodomus*. Can J Bot 76:1916–1922

Rehner S (2001) Primers for elongation factor 1-α (EF1-α). http://ocid.NACSE.ORG/research/deephyphae/EF1primer.pdf

Reiss MLC (1854) Neue Kernpilze. Hedwigia 1:23–28

Ronquist F, Huelsenbeck JP (2003) MrBayes 3: Bayesian phylogenetic inference under mixed models. Bioinformatics 19(12):1572–1574

Rossman AY, Farr DF, Castlebury LA, Shoemaker R, Mengistu A (2002) *Setomelanomma holmii* (*Pleosporales*, *Phaeosphaeriaceae*) on living spruce twigs in Europe and North America. Can J Bot 80:1209–1215

Roumeguère C (1880) Revisio Reliquiae Libertianae. – Pars 1(1). Revue Mycologique 2:15–24

Rudakov OL (1979) Fungi of the genus *Ampelomyces* Ces. Ex Schlecht. Mikol Fitopatol 13:104–110 [In Russian.]

Saccardo PA (1883) Sylloge Fungorum 2, Italy, Pavia, p 815

Saccardo PA (1892) Supplementum Universale, Pars II. Discomyceteae-Hyphomyceteae. Syll Fun 10:1–964

Saccardo PA, Marchal E (1885) Reliquiae mycologicae Westendorpianae. Revue Mycol Toulouse 7:140–149

Saleh AA, Leslie JF (2004) *Cephalosporium maydis* is a distinct species in the *Gaeumannomyces-Harpophora* species complex. Mycologia 96(6):1294–1305

Sánchez Márquez S, Bills GF, Zabalgogeazcoa I (2007) The endophytic mycobiota of the grass *Dactylis glomerata*. Fungal Divers 27:171–195

Sawada K (1959) Descriptive catalogue of Taiwan (Formosan) fungi. Part XI. Spec Publ Coll Agric National Taiwan Univ 8:1–268

Schatz S (1984) The life history, developmental morphology, and taxonomy of *Lautitia danica* gen. nov., comb. nov. Can J Bot 62:28–32

Schoch CL, Shoemaker RA, Seifert KA, Hambleton S, Spatafora JW, Crous PW (2006) A multigene phylogeny of the Dothideomycetes using four nuclear loci. Mycologia 98:1041–1052

Schoch CL, Crous PW, Groenewald JZ, Boehm EWA, Burgess TI, de Gruyter J, de Hoog GS, Dixon LJ, Grube M, Gueidan C, Harada Y, Hatakeyama S, Hirayama K, Hosoya T, Huhndorf SM, Hyde KD, Jones EBG, Kohlmeyer J, Kruys Å, Li YM, Lücking R, Lumbsch HT, Marvanová L, Mbatchou JS, McVay AH, Miller AN, Mugambi GK, Muggia L, Nelsen MP, Nelson P, Owensby CA, Phillips AJL, Phongpaichit S, Pointing SB, Pujade-Renaud V, Raja HA, Rivas Plata E, Robbertse B, Ruibal C, Sakayaroj J, Sano T, Selbmann L, Shearer CA, Shirouzu T, Slippers B, Suetrong S, Tanaka K, Volkmann-Kohlmeyer B, Wingfield MJ, Wood AR, Woudenberg JHC, Yonezawa H, Zhang Y, Spatafora JW (2009) A class–wide phylogenetic assessment of Dothideomycetes. Stud Mycol 64:1–15

Seifert K, Morgan-Jones G, Gams W, Kendrick B (2011) The genera of Hyphomycetes. CBS-KNAW Fungal Biodiversity Centre, Utrecht

Shearer CA (1993) Reexamination of eight taxa originally described in *Leptosphaeria* on members of the *Asteraceae*. Mycologia 85:825–834

Shearer CA, Crane JL (1971) Fungi of the Chesapeake Bay and its tributaries. I. Patuxent River. Mycologia 63:237–260

Shearer CA, Crane JL (1999) Freshwater Ascomycetes: *Isthmosporella pulchragen*. and sp. nov. Mycologia 91:141–144

Shearer CA, Raja HA, Miller AN, Nelson P, Tanaka K, Hirayama K, Marvanová L, Hyde KD, Zhang Y (2009) The molecular phylogeny of freshwater Dothideomycetes. Stud Mycol 64:145–153

Shoemaker RA (1961) *Pyrenophora phaeocomes* (Reb. ex Fr.) Fr. Can J Bot 39:901–908

Shoemaker RA (1976) Canadian and some extralimital *Ophiobolus* species. Can J Bot 54:2365–2404

Shoemaker RA (1984) Canadian and some extralimital *Nodulosphaeria* and *Entodesmium* species. Can J Bot 62:2730–2753

Shoemaker RA, Babcock CE (1987) *Wettsteinina*. Can J Bot 65:373–405

Shoemaker RA, Babcock CE (1989a) *Bricookea barrae* n. sp. compared with *Bricookea sepalorum*. Stud Mycol 31:165–169

Shoemaker RA, Babcock CE (1989b) *Phaeosphaeria*. Can J Bot 67: 1500–1599

Shoemaker RA, Babcock CE (1992) Applanodictyosporous *Pleosporales*: *Clathrospora*, *Comoclathris*, *GraphyIlium*, *Macrospora*, and *Platysporoides*. Can J Bot 70(8):1617–1658

Silva-Hanlin DMW, Hanlin RT (1999) Small subunit ribosomal RNA gene phylogeny of several loculoascomycetes and its taxonomic implications. Mycol Res 103:153–160

Silvestro D, Michalak I (2011) raxmlGUI: a graphical front-end for RAxML. Org Divers Evol 12:335–337

Sivanesan A (1984) The bitunicate ascomycetes and their anamorph. J. Cramer, Vaduz, 701 pp

Solomon PS, Lowe RGT, Tan KC, Waters ODC, Oliver RP (2006) *Stagonospora nodorum*: cause of *Stagonospora nodorum* blotch of wheat. Mol Plant Pathol 7:147–156

Spegazzini C (1908) Fungi aliquot paulistani. Revista del Museo de La Plata 15:7–48

Spegazzini C (1909) *Ophiosphaerella*. Anales del Museo Nacional de Historia Natural Buenos Aires 19(12):401 [ser. 3, 12]

Spooner BM, Kirk PM (1982) Taxonomic notes on *Excipularia* and *Scolicosporium*. Trans Br Mycol Soc 78:247–257

Stafleu FA et al (eds) (1972) International Code of Botanical Nomenclature. International Association for Plant Taxonomy, Utrecht, p 426

Stamatakis A, Hoover P, Rougemont J (2008) A rapid bootstrap algorithm for the RAxML Web Servers. Syst Biol 57:758–771

Stukenbrock EH, Banke S, McDonald BA (2006) Global migration patterns in the fungal wheat pathogen *Phaeosphaeria nodorum*. Mol Ecol 15:2895–2904

Suetrong S, Schoch CL, Spatafora JW, Kohlmeyer J, Volkmann Kohlmeyer B, Sakayaroj J, Phongpaichit S, Tanaka K, Hirayama K, Jones EBG (2009) Molecular systematics of the marine Dothideomycetes. Stud Mycol 64:155–173

Sullivan RF, White JF Jr (2000) *Phoma glomerata* as a mycoparasite of powdery mildew. Appl Environ Microbiol 66:425–427

Sutton BC (1968) *Kellermania* and its generic segregates. Can J Bot 46: 181–196

Sutton BC (1975) *Wojnowicia* and *Angiopomopsis*. Česka Mykologie 29: 97–104

Sutton BC (1977) Coelomycetes VI. Nomenclature of generic names proposed for coleomycetes. Mycol Pap 141:1–253

Sutton BC (1980) The Coelomycetes: fungi Imperfecti with pycnidia, acervuli and stromata. Commonwealth Mycological Institute, Kew

Sutton BC, Alcorn JL (1974) *Neottiosporina*. Aust J Bot 22(3):517–530

Swart HJ, Walker J (1988) Australian leaf-inhabiting fungi. XXVIII. Hendersonia on Eucalyptus. Trans Br Mycol Soc 90(4):633–641

Swofford DL (2002) PAUP: phylogenetic analysis using parsimony, version 4.0 b10. Sinauer Associates, Sunderland

Szentiványi O, Kiss L, Russell JC, Kovács GM, Varga K, Jankovics T, Lesemann S, Xu XM, Jeffries P (2005) *Ampelomyces* mycoparasites from apple powdery mildew identified as a distinct group based on single-stranded conformation polymorphism analysis of the rDNA ITS region. Mycol Res 109:429–438

Tamura K, Stecher G, Peterson D, Filipski A, Kumar S (2013) MEGA6: Molecular evolutionary genetics analysis version 6.0. Mol Biol Evol 30:2725–2729

Tanaka E, Harada Y (2003) *Hadrospora fallax* (*Pleosporales*) found in Japan. Mycoscience 44:245–248

Tanaka K, Harada Y (2005) Bambusicolous fungi in Japan (6): *Katumotoa*, a new genus of phaeosphaeriaceous ascomycetes. Mycoscience 46:313–318

Tanaka K, Hirayama K, Yonezawa H, Hatakeyama S, Harada Y, Sano T, Shirouzu T, Hosoya T (2009) Molecular taxonomy of bambusicolous fungi: *Tetraplosphaeriaceae*, a new pleosporalean family with tetraploa-like anamorphs, and notes on the phylogeny of selected species from bamboo. Stud Mycol 64:175–209

Thambugala KM, Camporesi E, Ariyawansa HA, Phookamsak R, Liu ZY, Hyde KD (2014) Phylogeny and morphology of *Phaeosphaeriopsis triseptata* sp. nov., and *Phaeosphaeriopsis glaucopunctata*. Phytotaxa 176:238–250

Theissen F, Sydow H (1915) Die Dothideales. Kritisch-systematisch Originaluntersuchungen. Ann Mycol 13:147–74

Torres MS, Bergen M, Singh S, Bischoff J, Sullivan RF, White JF Jr (2005) *Plenodomus morganjonesii* sp. nov. and a discussion of the genus *Plenodomus*. Mycotaxon 93:333–343

Treigiene A, Mel'nik VA (2002) Interesting records of deuteromycetes from Lithuania (in Russian). Mikologiyai Fitopatologiya 36:42–47

Udayanga D, Liu X, Crous PW, McKenzie EHC, Chukeatirote E, Hyde KD (2012) A multi-locus phylogenetic evaluation of *Diaporthe* (*Phomopsi*s). Fungal Divers 56(1):157–171

Vergnes DM, Zhanarbekova A, Renard M-E, Duveiller E, Maraite H (2006) Mating types of *Phaeosphaeria nodorum* (anamorph *Stagonospora nodorum*) from Central Asia. Phytopathology 154: 317–319

Verkley GJM, da Silva M, Wicklow DT, Crous PW (2004) *Paraconiothyrium*, a new genus to accommodate the mycoparasite *Coniothyrium minitans*, anamorphs of *Paraphaeosphaeria*, and four new species. Stud Mycol 50:323–335

Verkley GJM, Renfurm R, Göker M, Stielow JB (2014) Novel genera and species of coniothyrium-like fungi in *Montagnulaceae* (Ascomycota). Persoonia 32:25–51. doi:10.3767/003158514X679191

Vilgalys R, Hester M (1990) Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several *Cryptococcus* species. J Bacteriol 172:4238–4246

von Arx JA, Müller E (1975) A re-evaluation of the bitunicate ascomycetes with keys to families and genera. Stud Mycol 9:1–159

von Höhnel FXR (1915) Fragmente zur Mykologie (XVII. Mitteilung, Nr. 876 bis 943). Sitzungsberichten der Kaiserliche Akademie der Wissenschaften in Wien Mathematische-Naturwissenschaftliche Klasse, Abt. 1 124: 49–159

von Höhnel FXR (1917) Fungi imperfecti. Beiträge zur Kenntnis derselben. Hedwigia 59:236–284

Walker JM (1980) *Gaeumannomyces*, *Linocarpon*, *Ophiobolus* and several other genera of scolecospored ascomycetes and *Phialophora* conidial states, with a note on hyphopodia. Mycotaxon 11:1–129

Walker JM, Sutton BC, Pascoe IG (1992) *Phaeoseptoria eucalypti* and similar fungi on Eucalyptus, with description of Kirramyces gen. nov. (Coelomycetes). Mycol Res 96(11):911–924

Wanasinghe DN, Jones EBG, Camporesi E, Boonmee S, Karunarathna SC, Thines M, Mortimer PE, Xu J, Hyde KD (2014) *Dematiopleospora mariae* gen. sp. nov., from *Ononis spinosain* Italy. Crypto Mycol 35(2):105–117

Wang Y, Guo L, Hyde KD (2005) Taxonomic placement of sterile morphotypes of endophytic fungi from *Pinus tabulaeformis* (*Pinaceae*) in northeast China based on rDNA sequences. Fungal Divers 20:235–260

Webster J (1993) A rice root endophyte identified as *Hadrospora fallax*. Nova Hedw 57:141–142

Webster J, Lucas MT (1959) Observations on British species of *Pleospora*. Trans Brit Mycol Soc 42:332–342

Wehmeyer LE (1952) The genera *Leptosphaeria*, *Pleospora* and *Clathrospora* in Mt Rainier National Park. Mycologia 44:621–655

Wehmeyer LE (1961) A world monograph of the genus *Pleospora* and its segregates. University of Michigan Press, Michigan

Weir BS, Johnston PR, Damm U (2012) The *Colletotrichum gloeosporioides* species complex. Stud Mycol 73:115–180

Wetzel HC, Hulbert SH, Tisserat NA (1999) Molecular evidence for the presence of *Ophiosphaerella narmarin*. comb., a cause of spring dead spot of bermuda grass, in North America. Mycol Res 103:981–989

White TJ, Bruns T, Lee S, Taylor J (1990) Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. In: Innis MA, Gelfand DH, Sninsky JJ, White TJ (eds) PCR protocols: a guide to methods and applications. Academic, San Diego, pp 315–322

Wijayawardene NN, McKenzie EHC, Hyde KD (2012) Towards incorporating anamorphic fungi in a natural classification checklist and notes for 2011. Mycosphere 3:157–228

Wijayawardene NN, Camporesi E, Song Y, Dai DQ, Bhat DJ, Mckenzie EHC, Chukeatirote E, Mel'nik VA, Wang Y, Hyde KD (2013a) Multi-gene analyses reveal taxonomic placement of *Scolicosporium minkeviciusiiin Phaeosphaeriaceae* (*Pleosporales*). Cryptogam Mycol 34(4):357–366

Wijayawardene NN, Song Y, Bhat DJ, McKenzie EHC, Chukeatirote E, Wang Y, Hyde KD (2013b) *Wojnowicia viburni* sp. nov. from China and its phylogenetic placement. Sydowia 65(1):113–128

Wijayawardene NN, Bhat DJ, Hyde KD, Camporesi E, Wikee S, Chethana KWT, Tangthirasunun N, Wang Y (2014a) *Camarosporium sensu stricto* in *Pleosporinae*, *Pleosporales* with two new species. Phytotaxa (Accepted)

Wijayawardene NN, Crous PW, Kirk PM, Hawksworth DL et al (2014b) Naming and outline of Dothideomycetes–2014. Fungal Divers 68 (inpress)

Wijayawardene NN, Hyde KD, Bhat DJ, Camporesi E, Schumacher RK, Chethana KWT, Wikee S, Bahkali AH, Wang Y (2014c) Camarosporium-like species are polyphyletic in *Pleosporales*; introducing *Paracamarosporium* and *Pseudocamarosporium* gen. nov. in *Montagnulaceae*. Cryptogam Mycol 35(2):177–198

Wijayawardene NN, Hyde KD, Bhat DJ, Wanasinghe DN, Song Y, Camporesi E, Schumacher RK, Wang Y (2014d) Additions to coelomycetous taxa in *Pleosporinae*; introducing *Eucamarosporium* gen. sp. nov. (in prep)

Wikee S, Udayanga D, Crous PW, Chukeatirote E, Mckenzie EHC, Bahkali AH, Dai DQ, Hyde KD (2011) Phyllosticta—an overview of current status of species recognition. Fungal Divers 51:43–61

Wilson IM, Knoyle JM (1961) Three species of *Didymosphaeria* on marine algae: *D. danica* (Berlese) comb. nov., *D. pelvetiana* Suth. and *D. fucicola* Suth. Trans Br Mycol Soc 44:55–71

Winter G (1872) Diagnosen neuer Pilze. Hedwigia 11:147–148

Yang Z (1994) Maximum likelihood phylogenetic estimation from DNA sequences with variable rates over sites: approximate methods. J Mol Evol 39:306–314

Yuan ZQ (1994) *Barria*, a new ascomycetous genus in the *Phaeosphaeriaceae*. Mycotaxon 51:313–316

Yuan ZQ, Barr ME (1994) Species of *Chaetoplea* on desert plants in China. Mycotaxon 52:495–499

Yuan ZW, Pei MH, Hunter T, Royle DJ (1998) *Eudarluca caricis*, the teleomorph of the mycoparasite *Sphaerellopsis filum*, on blackberry rust *Phragmidium violaceum*. Mycol Res 102:866–868

Yuan ZL, Lin FC, Zhang CL, Kubicek CP (2010) A new species of *Harpophora* (*Magnaporthaceae*) recovered from healthy wild rice (*Oryza granulata*) roots, representing a novel member of a bene¢cial dark septate endophyte. FEMS Microbiol Lett 307(1):94–101

Zhang Y, Schoch CL, Fournier J, Crous PW, De Gruyter J, Woudenberg JHC, Hirayama K, Tanaka K, Pointing SB, Hyde KD (2009) Multi-locus phylogeny of the *Pleosporales*: a taxonomic, ecological and evolutionary re-evaluation. Stud Mycol 64:85–102

Zhang Y, Crous PW, Schoch CL, Bahkali AH, Guo LD, Hyde KD (2011) A molecular, morphological and ecological re-appraisal of *Venturiales*—a new order of Dothideomycetes. Fungal Divers 51: 249–277

Zhang Y, Crous PW, Schoch CL, Hyde KD (2012) *Pleosporales*. Fungal Divers 53:1–221

Zhaxybayeva O, Gogarten JP (2002) Bootstrap, Bayesian probability and maximum likelihood mapping: exploring new tools for comparative genome analyses. BMC Genomics 3(1):4