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Planistromellaceae (Botryosphaeriales)

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Abstract – In this paper, we re-examine, re-describe and illustrate all sexual generic type specimens of *Planistromellaceae* including *Comminutispora agavacearum, Eruptio acicola*, *Loratospora aestuarii*, *Microcyclus angolensis*, *Mycosphaerellopsis myricariae, Planistroma yuccigenum* and *Planistromella yuccifoliorum.* We also use molecular data from GenBank to show the taxonomic placement of some of these genera. Members of family *Planistromellaceae* (*Botryosphaeriales*) are saprobes or pathogens on various plants and characterized by multi or uniloculate ascostromata which are erumpent through cracking or splitting of host tissues and have periphysate ostioles. The ascostromata comprise several layers of brown to black thick-walled cells, pseudoparaphyses are not obvious in mature specimens, and asci are bitunicate. The asexual morphs were previously reported to be found in the genera *Aposphaeria*-like*, Fusicladium, Hyphospora*, *Kellermania, Lecanosticta, Pazschkeella* and *Piptarthron*. Following this study, phylogenetic analyses based on molecular data from LSU and ITS genes provide strong support for the monophyly of the *Planistromellaceae* in the *Botryosphaeriales*, while the *Planistromellaceae* clade separates into three different groups represented by the type species of *Piptarthron*, *Planistroma* and *Kellermania*, respectively. We accept *Kellermania* (= *Planistromella* and possibly *Piptarthron*), *Planistroma* and *Mycosphaerellopsis* (the latter with no molecular support) in *Planistromellaceae*, while four other genera are redisposed of as follows: *Comminutispora* clusters in *Capnodiales*, *Eruptio* and *Microcyclus* have been shown to be members of *Mycosphaerellaceae*, and *Loratospora* has been shown to belong in *Phaeosphaeriaceae.*

***Aposphaeria*-like / *Comminutispora* / *Eruptio* / *Fusicladium* / *Hyphospora* / *Kellermania* / *Lecanosticta* / *Loratospora* / *Microcyclus* / molecular phylogeny / *Mycosphaerellopsis* / *Pazschkeella* / *Piptarthron* / *Planistroma* / *Planistromella* / taxonomy / type specimens**

INTRODUCTION

The class *Dothideomycetes* contains the largest species numbers and is the most phylogenetically diverse group in the phylum *Ascomycota*. Development in this group is ascolocular and asci are bitunicate (Kirk *et al.*, 2008). Previously, the classification of *Dothideomycetes* was determined using morphological characters

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such as ascomatal characters, the type of pseudoparaphyses and anamorphic states (Luttrell, 1955; von Arx & Müller, 1975; Eriksson, 1981; Barr, 1987; Liu *et al*., 2011, 2012; Boonmee *et al.*, 2011, 2012; Zhang *et al*., 2009, 2011). Several studies have focused on molecular phylogenies of *Dothideomycetes* to elucidate the confusing classification which has resulted from using morphological characters (Berbee, 1996; Silva-Hanlin & Hanlin, 1999; Liew *et al.*, 2000; Lindemuth *et al*., 2001; Lumbsch & Lindemuth, 2001; Schoch *et al*., 2009; Chomnunti *et al*., 2011, 2012b; Zhang *et al*., 2012). These studies showed that the *Dothideomycetes* is not monophyletic. Recent phylogenetic analyses using multigene data have shown the *Dothideomycetes* to comprise several lineages among a class wide context (Schoch *et al.*, 2006, 2009; Chomnunti *et al*., 2011, 2012a, b).

The *Planistromellaceae* was introduced by Barr (1996) with the generic type *Planistromella*. Presently, the genera *Comminutispora, Eruptio*, *Loratospora*, *Microcyclus*, *Mycosphaerellopsis, Planistroma* and *Planistromella* are included in this family (Lumbsch & Huhndorf, 2010). Species of these genera usually grow on living or dead leaves or on stems of various plants, and are mostly saprobes, but some species, especially in the asexual genera, are pathogens (Evan, 1984; Ramaley, 1991, 1992, 1993, 1995, 1998; Kohlmeyer & Volkmann-Kohlmeyer, 1993; Barr, 1996; Sivanesan & Shivas, 2002; Lieberei, 2007; Minnis *et al*., 2012). The important morphological characters of *Planistromellaceae* were deemed to be multi- or uniloculate ascostromata, locules opening by cracking or splitting of host tissue, or periphysate ostioles, and bitunicate asci interspersed with interthecial tissues. Asexual genera included *Aposphaeria*-like*, Fusicladium, Hyphospora*, *Kellermania, Lecanosticta, Pazschkeella* and *Piptarthron* (Wijayawardene *et al*., 2012). These taxa were thought to be similar to members of the *Pseudosphaeriaceae* in having multi or uniloculate ascostromata and in lacking any true peridial structure. In *Pseudosphaeriaceae*, the locules open by a simple, lysigenous pore or by dehiscence of a cap-like structure. The *Mycosphaerellaceae* also resembles genera of *Planistromellaceae* especially ascus, ascospore and anamorph morphology. The classification of *Eruptio, Loratospora*, *Microcyclus* and *Planistroma* is confused as morphological characters are quite similar to other related genera. Recently, molecular phylogeny has validated some members of the family. However, molecular data is only available for a few genera including *Comminutispora* (Tsuneda *et al*., 2004), *Eruptio* (Verkley *et al.*, 2004), *Hyphospora* (Sterflinger *et al*., 1999), *Kellermania* (Minnis *et al*., 2012), *Lecanosticta* (Crous *et al*., 2001; Crous *et al*., 2009a; Crous *et al*., 2009b), *Loratospora* (Suetrong *et al.*, 2009), *Microcyclus* (Chee & Holiday, 1986; Le Guen, 2004) and *Piptarthron* (Minnis *et al*., 2012).

The purpose of the present study is to re-examine the type specimens of the sexual states of this family. We have also downloaded sequence data from GenBank to provide a tree that shows taxonomic placement of the members of this family. We provide a new treatment for this family, re-describe the genera and link the asexual states where possible, and we relocate the excluded genera previously placed in the family by Lumbsch & Huhndorf (2010) to other families.

MATERIALS AND METHODS

Examination of herbarium material

Type specimens of genera were obtained from the Herbaria BPI, DAOM, IMI, K, S and UC. The herbarium specimens were rehydrated in 5% KOH prior to examination. Ascomata were sectioned by free-hand under a Motic

SMZ 168 Series microscope. Morphological characters were studied using a Nikon ECLIPSE 80i microscope with a Canon 450D digital camera. The measurements were made using Tarosoft (R) Image Frame Work program (Liu *et al*., 2010).

Phylogenetic analysis

The reference nucleotide sequences of ITS and LSU regions of various taxa were obtained from GenBank (Table 1). Fungal members from different genera of the *Botryosphaeriales* and close orders were included in the analyses. Sequences were aligned using Bioedit (Hall, 1999) and ClustalX v. 1.83 (Thompson *et al*., 1997). The alignments were checked visually and improved manually where necessary. Phylogenetic analyses were performed by using PAUP v. 4.0b10 (Swofford, 2002) for Maximum-parsimony (MP) and MrBayes v. 3.0b4 (Ronquist & Huelsenbeck, 2003) for Bayesian analyses.

Maximum-parsimony analyses were performed using the heuristic search option with 1000 random taxa addition and tree bisection and reconnection (TBR) as the branch-swapping algorithm. All characters were unordered and of equal weight and gaps were treated as missing data. Maxtrees were unlimited, branches of zero length were collapsed and all multiple, equally parsimonious trees were saved. Clade stability was assessed using a bootstrap (BT) analysis with 1000 replicates, each with 10 replicates of random stepwise addition of taxa (Hillis & Bull, 1993). The phylogram with bootstrap values above the branches is presented in Fig. 1 by using graphical options available in TreeDyn v. 198.3 (Chevenet *et al*., 2006).

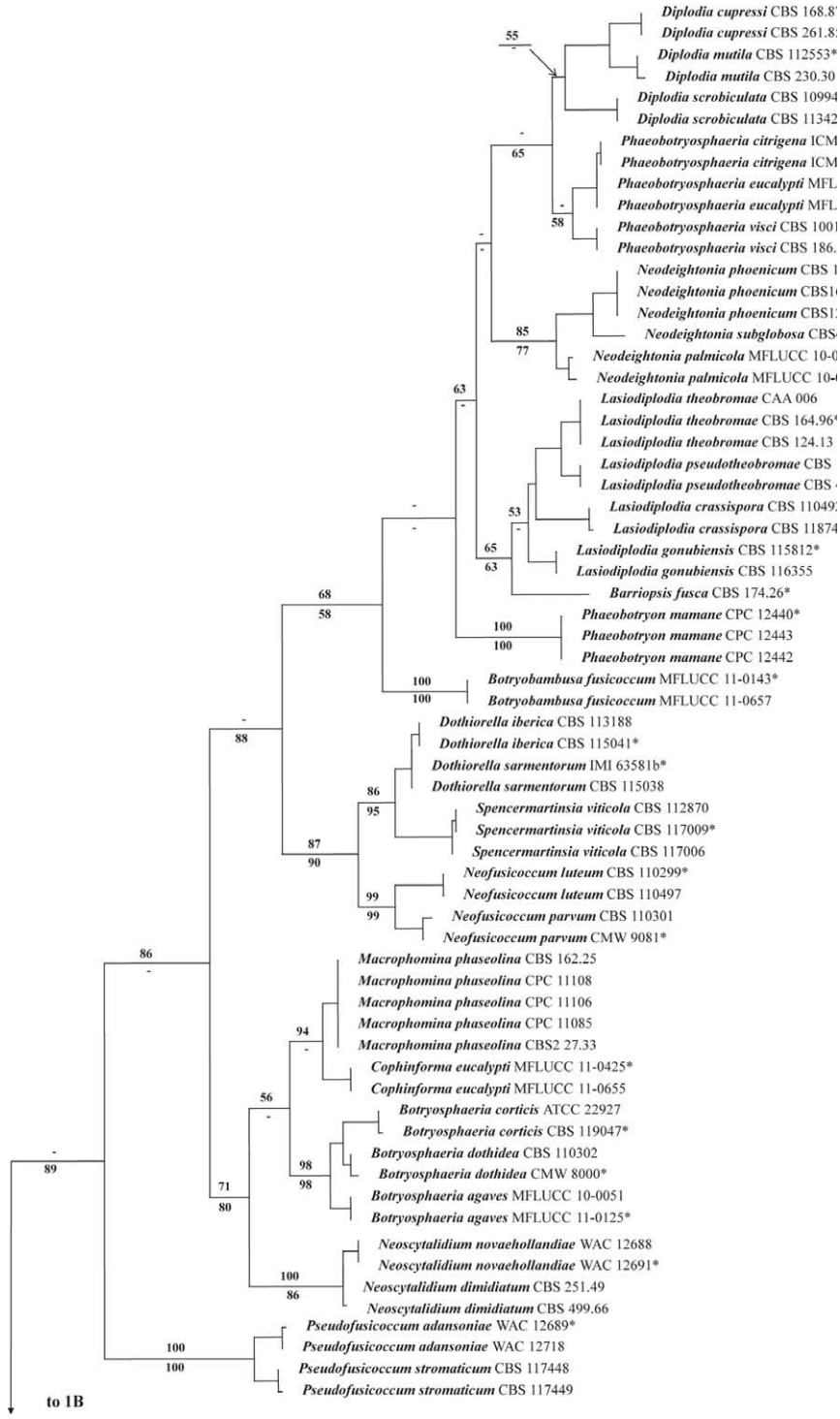
A maximum likelihood analysis was performed at the CIPRES webportal (Miller *et al*., 2010) using RAxML v. 7.2.8 as part of the "RAxML-HPC2 on TG" tool (Stamatakis, 2006; Stamatakis *et al*., 2008). A general time reversible model (GTR) was applied with a discrete gamma distribution and four rate classes. Fifty thorough maximum likelihood (ML) tree searches were done in RAxML v. 7.2.7 under the same model, with each one starting from a separate randomised tree and the best scoring tree selected with a final ln value of -13974.356237. One thousand non parametric bootstrap iterations were run with the GTR model and a discrete gamma distribution.

The model of evolution was estimated by using MrModeltest 2.2 (Nylander, 2004). Posterior probabilities (PP) (Rannala & Yang, 1996; Zhaxybayeva & Gogarten, 2002) were determined by Markov Chain Monte Carlo sampling (BMCMC) in MrBayes v. 3.0b4 (Huelsenbeck & Ronquist, 2001). Six simultaneous Markov chains were run for 1000000 generations and trees were sampled every 100th generation (resulting in 10000 total trees). The phylogram is presented in Fig. 2.

RESULTS

DNA sequencing - combined LSU and ITS gene phylogenies

DNA sequence data from the LSU and ITS gene regions were combined, and the data set consists of 108 taxa, with *Dothidea insculpta* and *D. sambuci* as the outgroup taxa. The dataset consists of 1486 characters after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Diplodia cupressi CBS 261.8
Diplodia mutila CBS 112553*
Diplodia mutila CBS 230.30
Diplodia scrobiculata CBS 10994
Diplodia scrobiculata CBS 11342
Phaeobotryosphaeria citrigena ICM
Phaeobotryosphaeria citrigena ICM
Phaeobotryosphaeria eucalypti MFL
Phaeobotryosphaeria eucalypti MFL
Phaeobotryosphaeria visci CBS 100
Phaeobotryosphaeria visci CBS 186.
Neodeightonia phoenicum CBS 1
Neodeightonia phoenicum CBS1
Neodeightonia phoenicum CBS1
Neodeightonia subglobosa CBS
Neodeightonia palmicola MFLUCC 10-0
Neodeightonia palmicola MFLUCC 10-
Lasiodiplodia theobromae CAA 006
Lasiodiplodia theobromae CBS 164.96
Lasiodiplodia theobromae CBS 124.13
Lasiodiplodia pseudotheobromae CBS
Lasiodiplodia pseudotheobromae CBS
Lasiodiplodia crassispora CBS 11049
Lasiodiplodia crassispora CBS 11874
Lasiodiplodia gonubiensis CBS 115812*
Lasiodiplodia gonubiensis CBS 116355
Barriopsis fusca CBS 174.26*
Phaeobotryon mamane CPC 12440*
Phaeobotryon mamane CPC 12443
Phaeobotryon mamane CPC 12442
Botryobambusa fusicoccum MFLUCC 11-0143*
Botryobambusa fusicoccum MFLUCC 11-0657
Dothiorella iberica CBS 113188
Dothiorella iberica CBS 115041*
Dothiorella sarmentorum IMI 63581b*
Dothiorella sarmentorum CBS 115038
Spencermartinsia viticola CBS 112870
Spencermartinsia viticola CBS 117009*
Spencermartinsia viticola CBS 117006
Neofusicoccum luteum CBS 110299*
Neofusicoccum luteum CBS 110497
Neofusicoccum parvum CBS 110301
Neofusicoccum parvum CMW 9081*
Macrophomina phaseolina CBS 162.25
Macrophomina phaseolina CPC 11108
Macrophomina phaseolina CPC 11106
Macrophomina phaseolina CPC 11085
Macrophomina phaseolina CBS2 27.33
Cophinforma eucalypti MFLUCC 11-0425*
Cophinforma eucalypti MFLUCC 11-0655
Botryosphaeria corticis ATCC 22927
Botryosphaeria corticis CBS 119047*
Botryosphaeria dothidea CBS 110302
Botryosphaeria dothidea CMW 8000*
Botryosphaeria agaves MFLUCC 10-0051
Botryosphaeria agaves MFLUCC 11-0125*
Neoscytalidium novaehollandiae WAC 12688
Neoscytalidium novaehollandiae WAC 12691*
Neoscytalidium dimidiatum CBS 251.49
Neoscytalidium dimidiatum CBS 499.66
Pseudofusicoccum adansoniae WAC 12689*
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Pseudofusicoccum stromaticum CBS 117448
Pseudofusicoccum stromaticum CBS 117449
to 1B

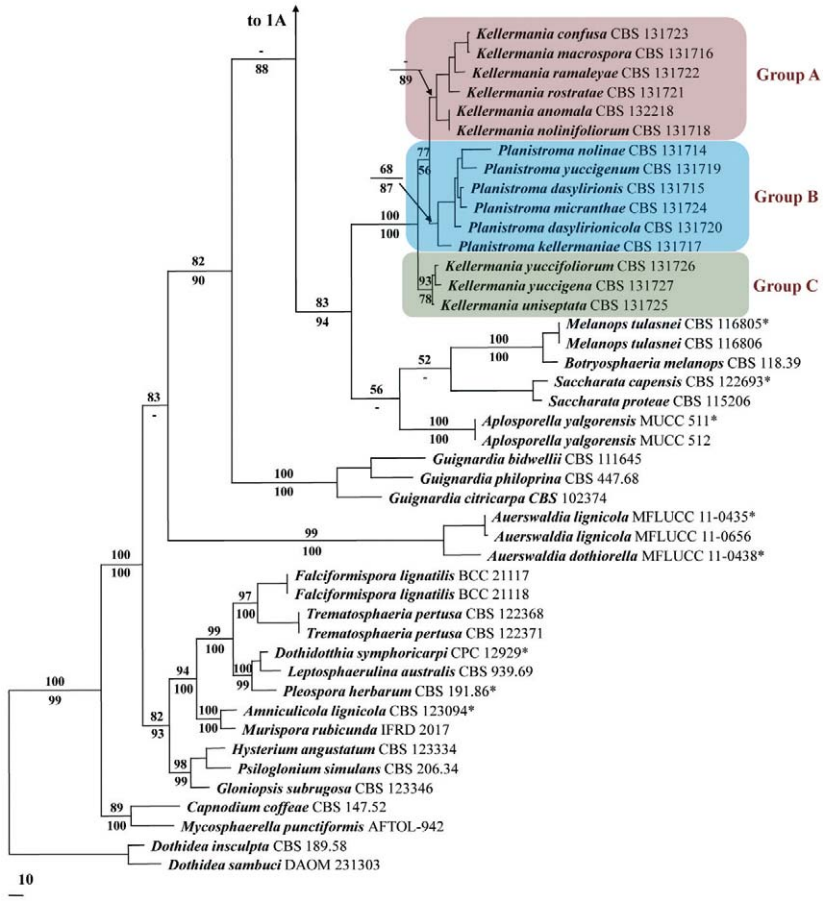
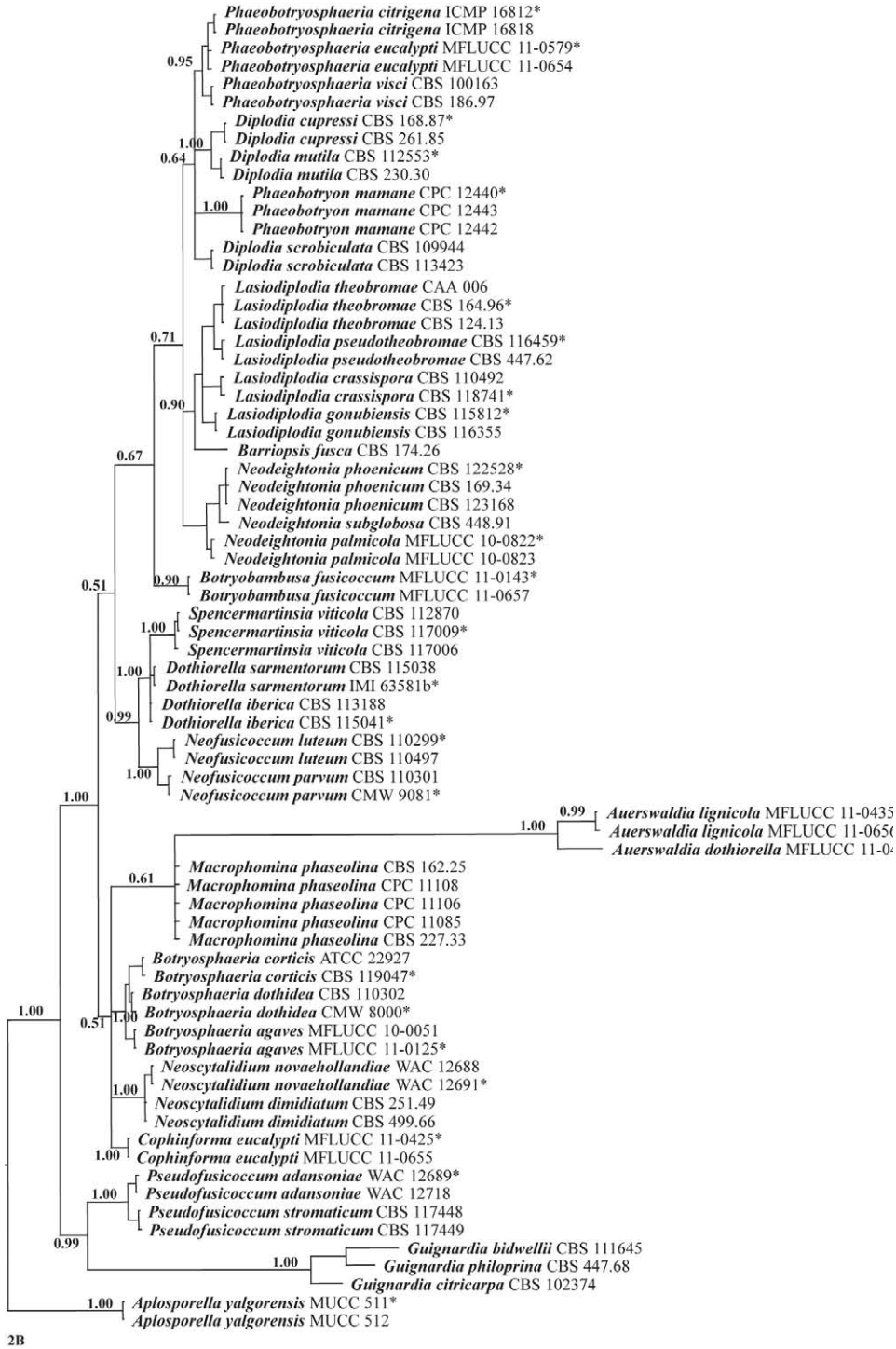


Fig. 1. **A-B.** The first of 1000 equally most parsimonious trees obtained from a heuristic search with 1000 random taxon additions of the combined dataset of LSU and ITS sequences alignment using PAUP v. 4.0b10. The scale bar shows 10 changes. Bootstrap support values for maximum parsimony (MP) and maximum likelihood (ML) greater than 50% above and under the nodes. Hyphen ("–") indicates a value lower than 50% (BS). The original isolate numbers are noted after the species names, ex-type/ex-epitype isolates are marked by an asterisk "*". The tree is rooted to *Dothidea insculpta* and *Dothidea sambuci*.

alignment. Of the included bases, 634 sites (42.66%) are parsimony-informative. A heuristic search with random addition of taxa (1000 replicates) and treating gaps as missing characters generated six equally parsimonious trees. All trees were similar in topology and not significantly different (data not shown). The first of 1000 equally most parsimonious trees is shown in Fig. 1 (TL = 2247, CI = 0.495, RI = 0.832, RC = 0.412). Bootstrap support (BS) values of MP and ML (equal to or above 50% based on 1,000 replicates) are shown on the upper and lower branches. A phylogenetic tree derived from a Bayesian analysis is shown in Fig. 2. Values of the Bayesian posterior probabilities (PP) from MCMC analyses are shown.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Phaeobotryosphaeria visci CBS 100163
Phaeobotryosphaeria visci CBS 186.97
Diplodia cupressi CBS 168.87*
Diplodia cupressi CBS 261.85
Diplodia mutila CBS 112553*
Diplodia mutila CBS 230.30
Phaeobotryon mamane CPC 12440*
Phaeobotryon mamane CPC 12443
Phaeobotryon mamane CPC 12442
Diplodia scrobiculata CBS 109944
Diplodia scrobiculata CBS 113423
Lasiodiplodia theobromae CAA 006
Lasiodiplodia theobromae CBS 164.96*
Lasiodiplodia theobromae CBS 124.13
Lasiodiplodia pseudotheobromae CBS 116459*
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Lasiodiplodia crassispora CBS 110492
Lasiodiplodia crassispora CBS 118741*
Lasiodiplodia gonubiensis CBS 115812*
Lasiodiplodia gonubiensis CBS 116355
Barriopsis fusca CBS 174.26
Neodeightonia phoenicum CBS 122528*
Neodeightonia phoenicum CBS 169.34
Neodeightonia phoenicum CBS 123168
Neodeightonia subglobosa CBS 448.91
Neodeightonia palmicola MFLUCC 10-0822*
Neodeightonia palmicola MFLUCC 10-0823
Botryobambusa fusicoccum MFLUCC 11-0143*
Botryobambusa fusicoccum MFLUCC 11-0657
Spencermartinsia viticola CBS 112870
Spencermartinsia viticola CBS 117009*
Spencermartinsia viticola CBS 117006
Dothiorella sarmentorum CBS 115038
Dothiorella sarmentorum IMI 63581b*
Dothiorella iberica CBS 113188
Dothiorella iberica CBS 115041*
Neofusicoccum luteum CBS 110299*
Neofusicoccum luteum CBS 110497
Neofusicoccum parvum CBS 110301
Neofusicoccum parvum CMW 9081*
Auerswaldia lignicola MFLUCC 11-0435
Auerswaldia lignicola MFLUCC 11-065
Auerswaldia dothiorella MFLUCC 11-0
Macrophomina phaseolina CBS 162.25
Macrophomina phaseolina CPC 11108
Macrophomina phaseolina CPC 11106
Macrophomina phaseolina CPC 11085
Macrophomina phaseolina CBS 227.33
Botryosphaeria corticis ATCC 22927
Botryosphaeria corticis CBS 119047*
Botryosphaeria dothidea CBS 110302
Botryosphaeria dothidea CMW 8000*
Botryosphaeria agaves MFLUCC 10-0051
Botryosphaeria agaves MFLUCC 11-0125*
Neoscytalidium novaehollandiae WAC 12688
Neoscytalidium novaehollandiae WAC 12691*
Neoscytalidium dimidiatum CBS 251.49
Neoscytalidium dimidiatum CBS 499.66
Cophinforma eucalypti MFLUCC 11-0425*
Cophinforma eucalypti MFLUCC 11-0655
Pseudofusicoccum adansoniae WAC 12689*
Pseudofusicoccum adansoniae WAC 12718
Pseudofusicoccum stromaticum CBS 117448
Pseudofusicoccum stromaticum CBS 117449
Guignardia bidwellii CBS 111645
Guignardia philoprina CBS 447.68
Guignardia citricarpa CBS 102374
Aplosporella yalgorensis MUCC 511*
Aplosporella yalgorensis MUCC 512
0.95
1.00
0.64
1.00
0.71
0.90
0.67
0.51
0.90
1.00
1.00
0.99
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0.99
1.00
0.61
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2B

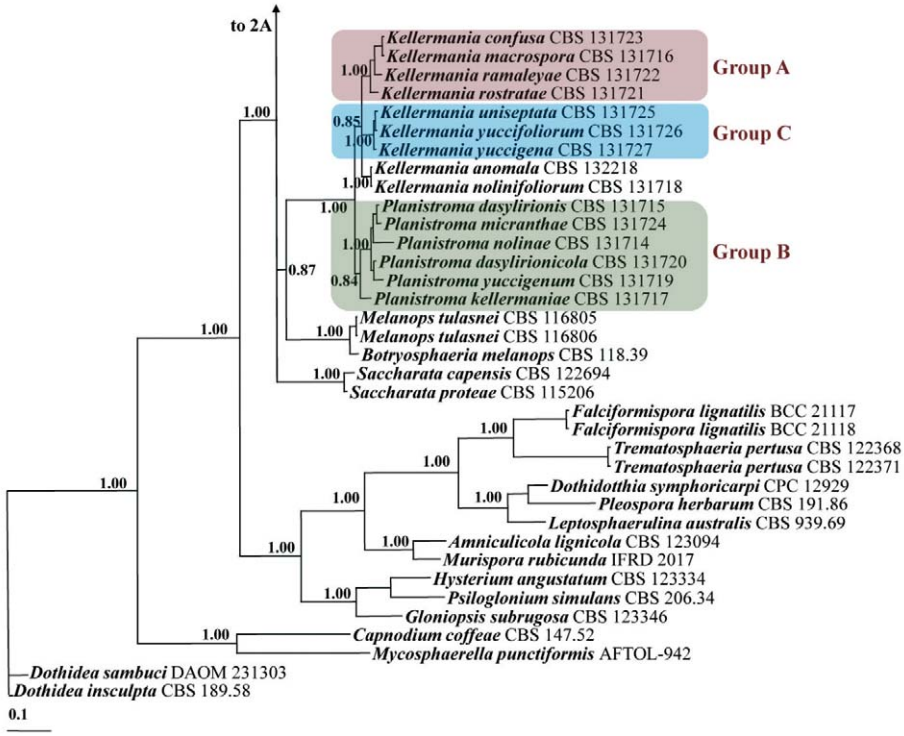

Fig. 2. **A-B.** Phylogenetic tree derived from a Bayesian analysis of an alignment of LSU and ITS sequences. The scale bar shows 0.1 changes. The original isolate numbers are noted after the species names, ex-type/ex-epitype isolates are marked by an asterisk "*".

No protein genes such as EF1- and β-tubulin sequences are available for the genus *Kellermania*. We therefore chose LSU and ITS for combined phylogenetic analysis; the positions of some genera of *Botryosphaeriales* are not stable, especially the complex sections such as *Aplosporella*, *Auerswaldia*, *Diplodia*, *Lasiodiplodia*, *Macrophomina*, *Melanops*, *Phaeobotryon* and *Saccharata*. All strains of *Kellermania* clustered in a strongly supported clade (100% MP, 1.00 PP) in both maximum parsimonious and Bayesian analysis. Within this clade, 15 strains divided into three groups in the parsimonious tree (Fig. 1): 1) Group A represented the type of *Piptarthron* (*Kellermania macrospora* = *Piptarthron macrospora*); 2) Group B represented the type of *Planistroma* (*Planistroma yuccigenum*); 3) Group C represented the type of *Kellermania* (*Kellermania yuccifoliorum*). In Bayesian analysis (Fig. 2), the taxa also clustered into three groups, representing the type species of *Piptarthron, Planistroma* and *Kellermania*, however, two strains, *Kellermania anomala* CBS 132218 and *K. nolinifoliorum* CBS 131718 were unstable and clustered differently at the base of Group C.

Table 1. Isolates used in this study

Taxon	*Culture Accession No.*[1]	*GenBank Accession No.*	
		LSU	*ITS*
Amniculicola lignicola	CBS 123094	EF493861	–
Aplosporella yalgorensis	MUCC 512	EF591944	EF591927
Aplosporella yalgorensis	MUCC 511 [T]	EF591943	EF591926
Auerswaldia dothiorella	MFLUCC 11-0438 [T]	JX646813	JX646796
Auerswaldia lignicola	MFLUCC 11-0435 [T]	JX646814	JX646797
Auerswaldia lignicola	MFLUCC 11-0656	JX646815	JX646798
Barriopsis fusca	CBS 174.26 [T]	DQ377857	EU673330
Botryobambusa fusicoccum	MFLUCC 11-0143 [T]	JX646809	JX646792
Botryobambusa fusicoccum	MFLUCC 11-0657	JX646810	JX646793
Botryosohaeria melanops	CBS 118.39	DQ377856	FJ824771
Botryosphaeria agaves	MFLUCC 10-0051	JX646807	JX646790
Botryosphaeria agaves	MFLUCC 11-0125 [T]	JX646808	JX646791
Botryosphaeria corticis	CBS 119047 [T]	EU673244	DQ299245
Botryosphaeria corticis	ATCC 22927	EU673245	DQ299247
Botryosphaeria dothidea	CMW 8000 [T]	AY928047	AY236949
Botryosphaeria dothidea	CBS 110302	EU673243	AY259092
Capnodium coffeae	CBS 147.52	DQ247800	–
Cophinforma eucalypti	MFLUCC 11-0425 [T]	JX646817	JX646800
Cophinforma eucalypti	MFLUCC 11-0655	JX646818	JX646801
Diplodia cupressi	CBS 168.87 [T]	EU673263	DQ458893
Diplodia cupressi	CBS 261.85	EU673264	DQ458894
Diplodia mutila	CBS 112553 [T]	AY928049	AY259093
Diplodia mutila	CBS 230.30	EU673265	DQ458886
Diplodia scrobiculata	CBS 113423	EU673267	DQ458900
Diplodia scrobiculata	CBS 109944	EU673268	DQ458899
Dothidea insculpta	CBS 189.58	DQ247802	AF027764
Dothidea sambuci	DAOM 231303	AY544681	DQ491505
Dothidotthia symphoricarpi	CPC 12929 [T]	EU673273	–
Dothiorella iberica	CBS 115041 [T]	AY928053	AY573202
Dothiorella iberica	CBS 113188	EU673230	AY573198
Dothiorella sarmentorum	IMI 63581b [T]	AY928052	AY573212
Dothiorella sarmentorum	CBS 115038	DQ377860	AY573206
Falciformispora lignatilis	BCC 21117	GU371826	–
Falciformispora lignatilis	BCC 21118	GU371827	–
Gloniopsis subrugosa	CBS 123346	FJ161210	–
Guignardia bidwellii	CBS 111645	DQ377876	FJ824766
Guignardia citricarpa	CBS 102374	DQ377877	FJ824767
Guignardia philoprina	CBS 447.68	DQ377878	FJ824768
Hysterium angustatum	CBS 123334	FJ161207	–
Kellermania anomala	CBS 132218	JX444869	JX444853
Kellermania confusa	CBS 131723	JX444870	JX444854
Kellermania macrospora	CBS 131716	JX444874	JX444858
Kellermania nolinifoliorum	CBS 131718	JX444877	JX444861
Kellermania ramaleyae	CBS 131722	JX444879	JX444863
Kellermania rostratae	CBS 131721	JX444880	JX444864
Kellermania uniseptata	CBS 131725	JX444881	JX444866
Kellermania yuccifoliorum	CBS 131726	JX444882	JX444867
Kellermania yuccigena	CBS 131727	JX444883	JX444868

Table 1. Isolates used in this study *(continued)*

Lasiodiplodia crassispora	CBS 110492	EU673251	EF622086
Lasiodiplodia crassispora	CBS 118741 [T]	DQ377901	DQ103550
Lasiodiplodia gonubiensis	CBS 115812 [T]	DQ377902	DQ458892
Lasiodiplodia gonubiensis	CBS 116355	EU673252	AY639594
Lasiodiplodia pseudotheobromae	CBS 447.62	EU673255	EF622081
Lasiodiplodia pseudotheobromae	CBS 116459 [T]	EU673256	EF622077
Lasiodiplodia theobromae	CBS 124.13	AY928054	DQ458890
Lasiodiplodia theobromae	CBS 164.96 [T]	EU673253	AY640255
Lasiodiplodia theobromae	CAA 006	EU673254	DQ458891
Leptosphaerulina australis	CBS 939.69	EU754167	–
Macrophomina phaseolina	CBS 227.33	DQ377906	–
Macrophomina phaseolina	CBS 162.25	DQ377905	–
Macrophomina phaseolina	CPC 11108	DQ377912	–
Macrophomina phaseolina	CPC 11085	DQ377910	–
Macrophomina phaseolina	CPC 11106	DQ377911	–
Melanops tulasnei	CBS 116805 [T]	FJ824764	FJ824769
Melanops tulasnei	CBS 116806	FJ824765	FJ824770
Murispora rubicund	IFRD-2017	FJ795507	–
Mycosphaerella punctiformis	AFTOL-942	DQ470968	–
Neodeightonia palmicola	MFLUCC 10-0822 [T]	HQ199222	HQ199221
Neodeightonia palmicola	MFLUCC 10-0823	HQ199225	HQ199224
Neodeightonia phoenicum	CBS 169.34	EU673259	EU673338
Neodeightonia phoenicum	CBS 122528 [T]	EU673261	EU673340
Neodeightonia phoenicum	CBS 123168	EU673260	EU673339
Neodeightonia subglobosa	CBS 448.91	DQ377866	EU673337
Neofusicoccum luteum	CBS 110299 [T]	AY928043	AY259091
Neofusicoccum luteum	CBS 110497	EU673229	EU673311
Neofusicoccum parvum	CMW 9081 [T]	AY928045	AY236943
Neofusicoccum parvum	CBS 110301	AY928046	AY259098
Neoscytalidium dimidiatum	CBS 251.49	DQ377923	FM211430
Neoscytalidium dimidiatum	CBS 499.66	DQ377925	FM211432
Neoscytalidium novaehollandiae	WAC 12691 [T]	EF585548	EF585543
Neoscytalidium novaehollandiae	WAC 12688	EF585549	EF585542
Phaeobotryon mamane	CPC 12440 [T]	EU673248	EU673332
Phaeobotryon mamane	CPC 12442	DQ377899	EU673333
Phaeobotryon mamane	CPC 12443	EU673249	EU673334
Phaeobotryosphaeria citrigena	ICMP 16812 [T]	EU673246	EU673328
Phaeobotryosphaeria citrigena	ICMP 16818	EU673247	EU673329
Phaeobotryosphaeria eucalypti	MFLUCC 11-0579 [T]	JX646819	JX646802
Phaeobotryosphaeria eucalypti	MFLUCC 11-0654	JX646820	JX646803
Phaeobotryosphaeria visci	CBS 186.97	DQ377868	EU673325
Phaeobotryosphaeria visci	CBS 100163	DQ377870	EU673324
Pleospora herbarum	CBS 191.86 [T]	DQ247804	GU238232
Planistroma dasylirionicola	CBS 131720	JX444872	JX444856
Planistroma dasylirionis	CBS 131715	JX444873	JX444857
Planistroma kellermaniae	CBS 131717	JX444876	JX444860
Planistroma micranthae	CBS 131724	JX444875	JX444859
Planistroma nolinae	CBS 131714	JX444871	JX444855
Planistroma yuccigenum	CBS 131719	JX444878	JX444862
Pseudofusicoccum adansoniae	WAC 12689 [T]	EF585554	EF585534
Pseudofusicoccum adansoniae	WAC 12718	EF585555	EF585533
Pseudofusicoccum stromaticum	CBS 117448	DQ377931	AY693974

Table 1. Isolates used in this study *(continued)*

Pseudofusicoccum stromaticum	CBS 117449	DQ377932	DQ436935
Psiloglonium simulans	CBS 206.34	FJ161178	–
Saccharata capensis	CBS 122693 T	EU552130	EU552130
Saccharata proteae	CBS 115206	DQ377882	AF452560
Spencermartinsia viticola	CBS 117006	EU673236	AY905555
Spencermartinsia viticola	CBS 112870	DQ377872	AY343376
Spencermartinsia viticola	CBS 117009 T	DQ377873	AY905554
Trematosphaeria pertusa	CBS 122368 T	FJ201990	FJ201991
Trematosphaeria pertusa	CBS 122371	FJ201992	FJ201993

AFTOLI: Assembling the Fungal Tree of Life; **AR:** Culture collection of Amy Rossman, housed at U.S. National Fungus Collections (BPI), Beltsville, MD, USA; **ATCC:** American Type Culture Collection, Virginia, USA; **BCC:** BIOTEC Culture Collection, Bangkok, Thailand; **CAA:** A. Alves, Universidade de Aveiro, Portugal; **CBS:** Centraalbureau voor Schimmelcultures, Utrecht, The Netherlands; **CMW:** Tree Pathology Co-operative Program, Forestry and Agricultural Biotechnology Institute, University of Pretoria, South Africa; **CPC:** Collection of Pedro Crous housed at CBS; **DAOM:** Plant Research Institute, Department of Agriculture (Mycology), Ottawa, Canada; **ICMP:** International Collection of Micro-organisms from Plants, Landcare Research, New Zealand; **IFRDCC:** Culture Collection, International Fungal Research & Development Centre, Chinese Academy of Forestry, Kunming, China; **IMI:** International Mycological Institute, CABI-Bioscience, Egham, Bakeham Lane, U.K; **MFLUCC:** Mae Fah Luang University Culture Collection, ChiangRai, Thailand; **MUCC:** Murdoch University Algal Culture Collection, Murdoch, Western Australia; **STE-U:** Culture collection of the Department of Plant Pathology, University of Stellenbosch, South Africa; **WAC:** Department of Agriculture Western Australia Plant Pathogen Collection, South Perth, Western Australia. **T:** ex-type/ex-epitype isolates.

Taxonomy

Botryosphaeriales

For characters of this order see Liu *et al.* (2012)

Planistromellaceae M.E. Barr, Mycotaxon 60: 437 (1996)

MycoBank: MB 81919

Biotrophic, hemibiotrophic or *saprobic* on leaves and stems of various plants in terrestrial habitats. *Ascostromata* multi- or uniloculate, immersed to erumpent through cracking or splitting of the host tissue, solitary to gregarious, with periphysate ostioles, with or without papillate. *Cells of ascostromata* thick-walled, composed of several layers of dark brown cells, arranged in a *textura angularis*. *Locules* ovoid to globose, developing in the same stroma of the conidiogenous and/or spermatogenous locules, collapsing with the empty locule which previously producing conidia or spermatia or both, periphysate ostiole. *Peridium* of locules composed of a few layers of hyaline to light brown flattened cells. *Hamathecium* lacking pseudoparaphyses, interascal cells abundant even at maturity. *Asci* 8-spored, bitunicate, fissitunicate, oblong, clavate to nearly cylindrical, with a pedicel and with an ocular chamber, forming in a basal layer, often interspersed with and covered by cellular remnants of interthecial tissues. *Ascospores* overlapping 1-3-seriate, hyaline or lightly pigmented, yellowish to brownish, ellipsoid to broadly obovoid, aseptate or one to two transverse septa; wall thin, with or without gelatinous sheath, contents guttulate. *Conidiomata* subepidermal, dark, immersed to erumpent, solitary to gregarious, pycnidia, locules or acervuli in a stroma or bearing conidia over stroma surface prior to locule formation, ostiolate. *Conidiomata walls* comprising several layers with cells

of *textura angularis*, the outer layers composed of dark thick-walled cells, lighter towards the inner layers of hyaline cells. *Conidiogenous cells* short cylindric, conidiogenesis holoblastic, hyaline, smooth. *Conidia* oblong, ellipsoid-cylindric, aseptate or one to several transversely septate, hyaline to brown, wall smooth or verruculose, with or without one or more apical appendages at times. *Spermatial state* developing in the same or separate locules. *Spermatogenous cells* discrete or integrated, phialidic, cylindric to elongate-conical, determinate, hyaline, smooth. *Spermatia* bacillary, hyaline, aseptate, smooth.

Included genera: *Kellermania* (= *Planistromella* and ?*Piptarthron*), *Planistroma* and *Mycosphaerellopsis*

Notes: The *Planistromellaceae* is reduced to include *Kellermania* and *Planistroma* based on molecular data. *Mycosphaerellopsis* is tentatively included, based on morphology, however there is no molecular data to support this. The family belongs in the *Botryosphaeriales* (Minnis *et al*., 2012; this study). The type species, *Kellermania yuccifoliorum* is characterized by subepidermal, immersed, multilocular ascostromata with periphysate ostioles, bitunicate, slightly clavate or nearly cylindric asci, and smooth, hyaline, septate ascospores. The asexual state of *K. yuccifoliorum* is characterized by uniloculate conidiomata, which develop in the same stroma as the ascogenous locules and has 2-septate conidia with a unique apical appendage (Ramaley, 1993). Molecular data indicates that *Comminutispora* does not belong in *Botryosphaeriales*, as it clusters and is more typical of *Capnodiales* (Hambleton *et al.*, 2003; Crous *et al*., 2009a; Schoch *et al.,* 2009). *Eruptio* is typical of the *Mycosphaerellaceae* and this is confirmed by molecular data (Crous *et al*., 2001; Verkley *et al*., 2004; Crous *et al*., 2009a, 2009b). Molecular data (Suetrong *et al*., 2009) places *Loratospora* in the family *Phaeosphaeriaceae* and the characters of this genus are also in concordance with this finding. *Microcyclus* may be a member of *Mycosphaerellaceae* based on its morphology.

Family type: *Kellermania* Ellis & Everh.

Kellermania Ellis & Everh., *J. Mycol*. 1(12):153 (1885) **Figs 3, 4**

≡ *Piptarthron* Mont. ex Höhn., Hedwigia 60: 203 (1918)
≡ *Alpakesa* Subram. & K. Ramakr., J. Indian Bot Soc. 33: 204 (1954)
≡ *Septoplaca* Petr., Sydowia 17: 271 (1964,‘1963’)
≡ *Planistromella* A.W. Ramaley, Mycotaxon 47: 260 (1993)
MycoBank: MB 22437

Biotrophic, hemibiotrophic and *saprotrophic* on leaves and stems. *Ascostromata* subepidermal, immersed, becoming erumpent, solitary to gregarious, multilocular, subglobose to ovoid, dark brown to black, thick-walled. *Cells of ascostromata* composed of several layers of dark brown cells, *textura angularis.* The upper part of the ascostromata comprises columns of elongated cells attached with the host epidermis. *Locules* ovoid to globose, the collapsed locule producing conidia or spermatia or both, periphysate ostiole. *Peridium* of locules composed of a few layers of hyaline to light brown flattened cells. *Hamathecium* lacking pseudoparaphyses when mature, interascal cells abundant, filamentous. *Asci* 8-spored, bitunicate, fissitunicate, clavate to nearly cylindrical, with a short knob-like pedicel and an ocular chamber. *Ascospores* overlapping 1-2-seriate, ellipsoid and slightly curved with bluntly rounded ends, hyaline, 1-2-septate, guttulate. *Conidiomata* subepidermal, dark, immersed, erumpent by remaining at the rim covered by epidermis, solitary to gregarious, unilocular, ostiolate. *Conidiomata walls* comprising several layers with cells of *textura angularis*, the outer layers composed of 6-12 layers of dark, thick-walled cell, lighter toward the inner layers composed of 2-3 layers of hyaline cells. *Conidiogenesis* holoblastic.

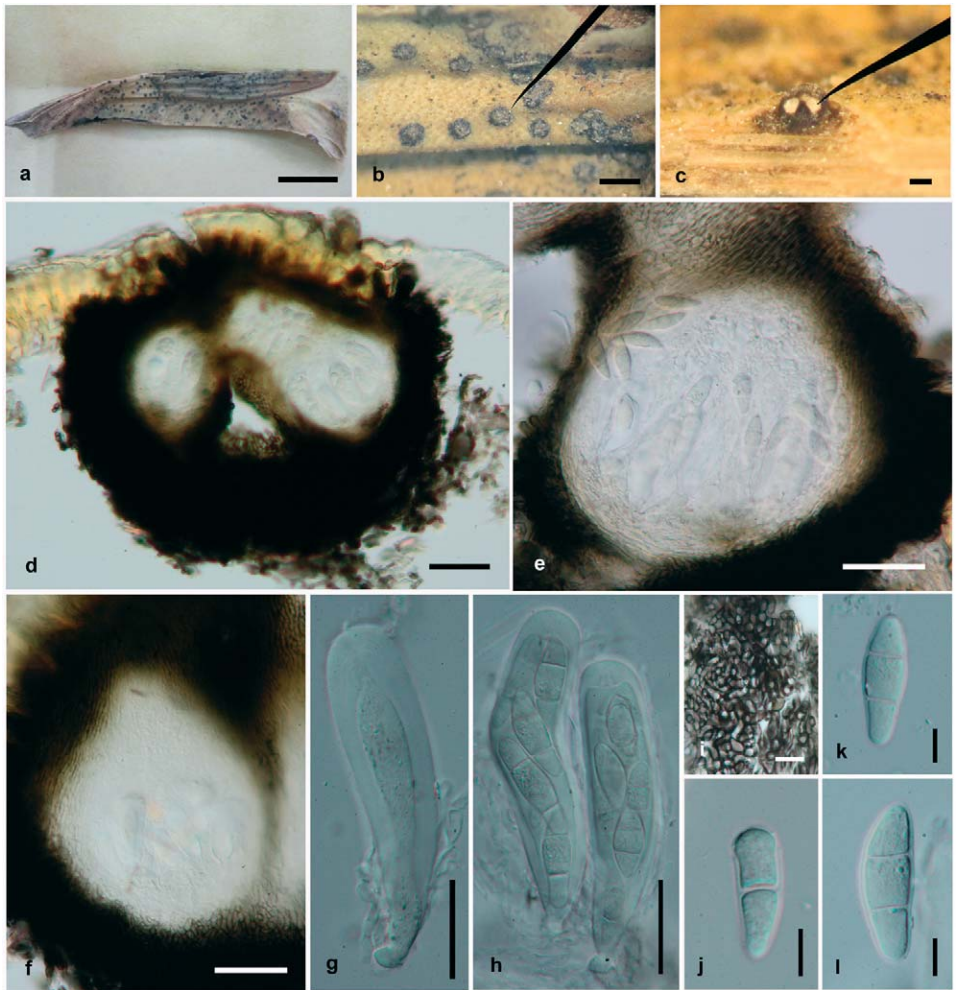

Fig. 3. *Kellermania yuccifoliorum* (holotype of *Planistromella yuccifoliorum*) on leaves of *Yucca brevifolia.* **a-b.** Ascostromata on the host surface. **c-d.** Section of ascostroma. **e-f.** Ascoma. **g.** Immature ascus. **h.** Mature asci. **i.** Cells of ascostroma. **j.** Immature ascospore. **k-l.** Mature ascospores. Scale bars: a = 1 cm, b = 1000 µm, c = 200 µm, d = 100 µm, e-f = 50 µm, g-h = 30 µm, i = 20 µm, j-l = 10 µm.

Conidiophores absent. *Macroconidiogenous cells* short cylindric, hyaline, smooth, each forming acrogenous holoblastic conidia. *Macroconidia* narrowly ellipsoid-cylindric, the base bluntly rounded, the apex more pointed and often surrounded by an appendage, mostly 2-septate. *Microconidiogenous cells* arising on the upper wall of conidioma and in ostiolar channel. *Microconidia* more or less cylindric, aseptate, smooth-walled, hyaline. *Spermatia* formed in the central locule of a stroma or in the locule in the vertical column of the lateral walls of some conidiomata. *Spermatogenous cells* discrete or integrated on one-celled conidiophores, phialidic, cylindric to elongate-conical. *Spermatia* bacillary, hyaline, smooth (asexual morph description follows Ramaley, 1993).

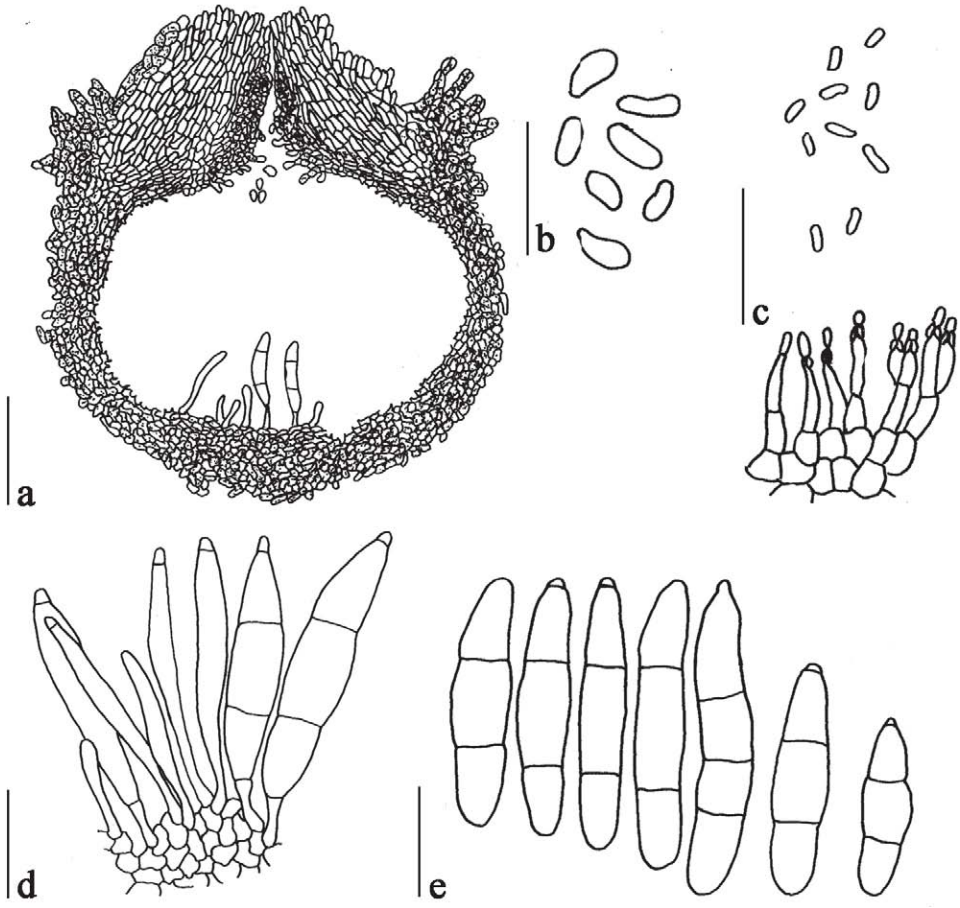

Fig. 4. *Kellermania yuccifoliorum* (redrawn from Ramaley, 1993). **a.** Conidioma. **b.** Microconidia. **c.** Spermatia and spermatiogenesis. **d.** Conidiogenesis and appearance of apical appendage. **e.** Conidia. Scale bars: a = 80 µm, b-d = 27 µm, e = 40 µm.

Notes: The type species of *Kellermania* (*K. yuccifoliorum* = *Planistromella yuccifoliorum*) differs from other genera in *Planistromellaceae* in having 1-2 septate ascospores (Ramaley, 1993; Barr, 1996). The asexual state of *K. yuccifoliorum* is characterized by uniloculate conidiomata, which develops in the same stroma as the ascogenous locules and has 2-septate conidia with a unique apical appendage (Ramaley, 1993). Several other species of *Kellermania* are illustrated by Minus *et al.*, (2012) and range from having 0 to several trans-septa and with or lacking appendages. Species in this genus are known from the genera *Agave* and *Nolina* (*Asparagaceae*). There are 13 species recorded in *Index Fungorum* (http://www.indexfungorum.org, access on 17/11/12). Five species have been reported with both sexual and asexual states (Ramaley, 1993, 1995, 1998; Barr, 1996). Phylogenetic analyses based on combined LSU and ITS gene data show that the type of *Kellermania,* which is also the type of "Planistromella", cluster in Group C and contains three *Kellermania* species which are linked to "Planistromella" sexual states (Figs 1, 2). However, the other two strains, which are linked with

"Planistromella" sexual states, i.e. *Kellermania anomala* (CBS 132218) and *K. nolinifoliorum* (CBS 131718), cluster in Bayesian analysis as a sister group to the other three species (Fig. 2).

The generic type of *Piptarthron* (= *K. macrospora*) (Group A) clusters separately from *Kellermania* (Group C) and *Planistroma* (Group B), with strong support in both maximum-parsimony and Bayesian analyses (Figs 1, 2). This may indicate that *Piptarthron* may prove to be a good genus once the tree includes more taxa. Minnis *et al*. (2012) combined *Piptarthron, Planistroma* and *Planistromella* under *Kellermania* as they could find little molecular support for retaining these entities. In our study, we accept *Planistroma* as both molecular and morphological data show this genus to be different. We however, follow Minnis *et al*. (2012) in treating *Piptarthron* as a synonym of *Kellermania* because the separation of genera is only supported by molecular data with no obvious morphological similarities.

We have tried to establish groupings based on morphology. Group A which includes the type of *Piptarthron* mostly has conidia with 1-5 septa which lack appendages. Group B which contains the type of *Planistroma* has conidia lacking septa and appendages, while Group C includes the type of *Planistromella,* mostly have conidia with 1-3 septa and appendages. There are however exceptions. For example, conidia of *Kellermania nolinae* (Minus *et al*., 2012, Fig 5g) has three septa and appendages but clusters in group B. Part of the problem may lie with the fact that some of the links between the sexual and asexual states are based on the fact that the taxa developed on the same samples (Ramaley, 1993, 1995, 1996). Isolates were made from both the conidia or ascospores from separate conidiomata and ascomata and thus may have not have been related. Another problem is that the cultures used by Minnis *et al.* (2012) were not generally type strains. This group obviously needs further study with many more taxa being sequenced and carefully isolated from fresh material to establish their correct identification.

Generic type

Kellermania yuccifoliorum A.W. Ramaley, Mycotaxon 47: 262 (1993) **Figs 3-4**
≡ *Planistromella yuccifoliorum* A.W. Ramaley, Mycotaxon 47: 261 (1993)
MycoBank: MB 360149

Biotrophic, hemibiotrophic and *saprotrophic* on leaves and stems. *Ascostromata* 0.4-0.6 mm diam., up to 0.5 mm high, subepidermal, immersed, becoming erumpent, solitary to gregarious, multilocular, subglobose to ovoid, dark brown to black, with 1-5 locules, thick-walled (Fig. 3b-e). *Cells of ascostromata* 84.5-116 µm wide, composed of several layers of dark brown cells, *textura angularis.* The upper part of the ascostromata comprises columns of elongated cells attached with the host epidermis(Fig. 3d,i). *Locules* 150 µm wide × 90-244 µm high, ovoid to globose, the collapsed locule producing conidia or spermatia or both, periphysate ostiole (Fig. 3e, f). *Peridium* of locules composed of a few layers of hyaline to light brown flattened cells (Fig. 3e-f). *Hamathecium* lacking pseudoparaphyses when mature, interascal cells abundant, filamentous (Fig. 3g-h). *Asci* 93-153 × 25-35 µm ($\bar{x}$ = 120.8 × 29.3 µm, n = 13), 8-spored, bitunicate, fissitunicate, clavate to nearly cylindrical, with a short knob-like pedicel up to 9 µm wide × 7 µm high, and with an ocular chamber up to 2.5 µm wide × 5 µm high (Fig. 3g-h). *Ascospores* 32-40 × 11-14 µm ($\bar{x}$ = 36.3 × 12.6 µm, n = 15), overlapping 1-2-seriate, ellipsoid and slightly curved with bluntly rounded ends, hyaline, 2-septate, young ascospore with 1-septate, distoseptate, small guttules, granulate ornamentation (Fig. 3j-l). *Conidiomata*

subepidermal, dark, immersed, erumpent by remaining at the rim cover by epidermis, solitary to gregarious, 250-600(-800) µm diam., up to 500 µm thick, unilocular, ostiolate (Fig. 4a). *Conidiomata walls* comprising several layers with cells of *textura angularis*, the outer layers composed of 6-12 layers of dark, thick-walled cell, lighter toward the inner layers composed of 2-3 layers of hyaline cells (Fig. 4a). *Conidiogenesis* holoblastic (Fig. 4d). *Conidiophores* absent. *Macroconidiogenous cells* short cylindric, hyaline, smooth, each forming acrogenous holoblastic conidium (Fig. 4d). *Macroconidia* narrowly ellipsoid-cylindric, the base bluntly rounded, the apex more pointed and often surmounted by an appendage up to 5 µm long, mostly 2-septate, 50-100 × (8-)13-14(-16) µm (Fig. 4e). *Microconidiogenous cells* arising on the upper wall of conidioma and in ostiolar channel (Fig. 2a). *Microconidia* more or less cylindric, aseptate, smooth-walled, hyaline 5-10 × 2.5-4 µm (Fig. 4b). *Spermatia* formed in the central locule of a stroma or in the locule in the vertical column of the lateral walls of some conidiomata. *Spermatogenous cells* discrete or integrated on one-celled conidiophores, phialidic, cylindric to elongate-conical, 8-16 × 2-3.5 µm. *Spermatia* bacillary, hyaline, smooth, 3-7 × 1.5-2.5 µm (Fig. 4c) (asexual morph description follows Ramaley, 1993).

Material examined: USA: California, San Bernardino County, Roadside 20 miles east of Baker (Hwy. 91/466), on leaves of *Yucca brevifolia* Engelmann, 14 April 1960, Isabelle Tavares No.466 (UC 1202973, holotype).

Planistroma A.W. Ramaley, *Mycotaxon* 42: 69 (1991) **Fig. 5**

MycoBank: MB 25358

Biotrophic or *saprotrophic* on leaves and stems. *Ascostromata* subepidermal, immersed, partially erumpent remaining at the rim covered by epidermis, solitary to gregarious, multilocular, hemispherical, dark brown to black, thick-walled. *Cells of ascostromata* at the side composed of several layers of dark brown columns of elongate cells, reaching from the base to the top, at the base composed of several layers of dark brown cells, *textura angularis*. *Locules* ovoid to globose, developing in the same stroma of the conidiogenous and/or spermatogenous locules, which previously produced conidia or spermatia or both, periphysate ostiole. *Peridium of locules* composed of a few layers of hyaline to light brown flattened cells. *Hamathecium* lacking pseudoparaphyses when mature, filamentous, cylindrical or irregularly curved interascal cells which are swollen at the ends. *Asci* 8-spored, bitunicate, fissitunicate, cylindrical, with a long fan-shaped pedicel and with an ocular chamber. *Ascospores* overlapping 1-2-seriate, ellipsoid, hyaline, aseptate, many guttules, rough, sometimes surrounded by a slime layer. *Stromata* subepidermal, black, immersed, erumpent by remaining at the rim cover by epidermis, solitary to gregarious, hemispherical, multilocular. *Stromata wall* composed of dark brown, thick-walled cells of *textura angularis*, lighter colored toward the interior, the top layers of the stromata composed of columns of elongated cells, extending from the base and the sides to the top surface of the stromata. *Conidiophores* absent. *Microconidiogenous cells* form on the wall of locules, short cylindric, hyaline, smooth, and each forming acrogenous holoblastic conidia. *Macroconidia* fusiform, curved or bent, tapering toward the apex or the base, base truncate, mostly aseptate, smooth, hyaline. *Microconidia* cylindric, irregularly swelled or bent, aseptate, smooth-walled, hyaline. *Spermatia* formed on a part of walls of a macroconidiogenous locule or in one or more separate locules in a stroma. *Spermatogenous cells* phialidic, cylindric to elongate-conical, discrete or integrated on one-celled conidiophores, determinate, hyaline, smooth, forming acrogenous spermatia. *Spermatia* bacillary, hyaline, aseptate, smooth (asexual morph description follows Ramaley, 1991).

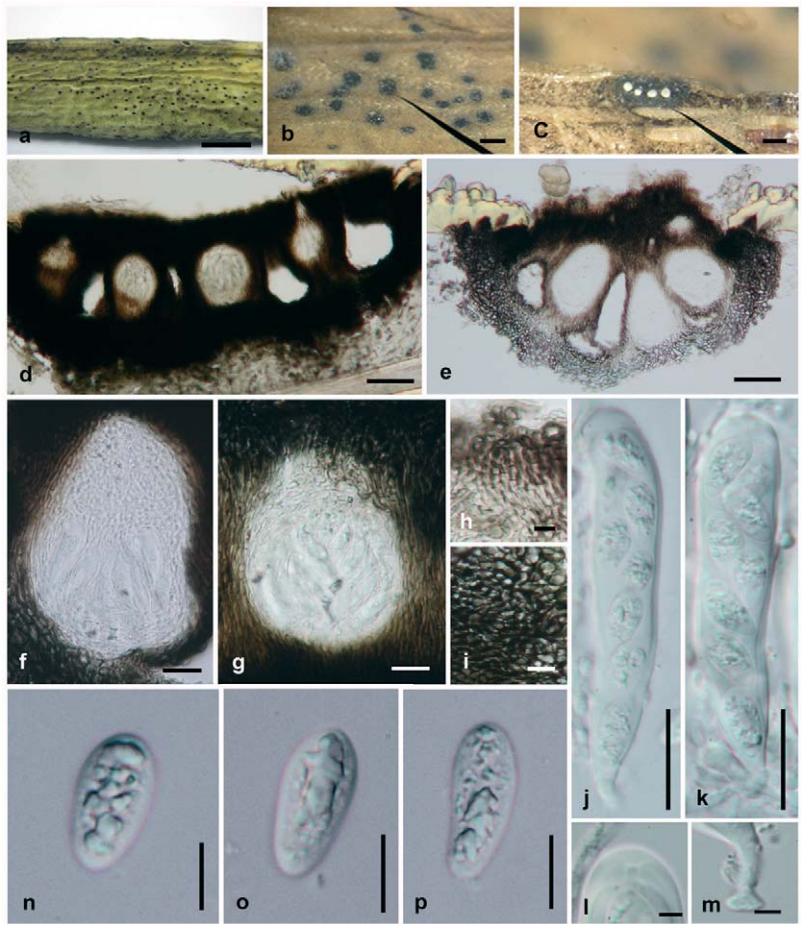

Fig. 5. *Planistroma yuccigenum* (holotype of *Planistroma yuccigenum*) on leaves of *Yucca baccata.* **a-b.** Ascostromata on the host surface. **c-e.** Section of ascostroma. **f.** Young ascoma. **g.** Mature ascoma. **h.** Cells of ascostroma at the side. **i.** Cells of ascostroma at the base. **j-k.** Asci. **l.** Ocular chamber. **m.** Pedicel. **n-p.** ascospores. Scale bars: a = 1 cm, b = 1 mm, c = 0.5 mm, d-e = 100 µm, f-g = 25 µm, h-i = 10 µm, j-k = 20 µm, l-m = 5 µm, n-p = 10 µm.

Notes: Planistroma was established by Ramaley (1991), and similar to *Kellermania* in ascostromata characters, but *Planistroma* differs with aseptate ascospores (Barr, 1996). *Planistroma* species inhabit the *Agavaceae*, with four species: *P. kellermania, P. nolinae, P. obtusilunatum* and *P. yuccigenum* listed in *Index Fungorum* (http://www.indexfungorum.org, access on 17/11/12). All species have been connected to asexual states which are characterized by thick-walled ostiolate conidiomata, holoblastic conidiogenous cell and conidia lacking appendages (Ramaley, 1991, 1992, 1995, 1998). The asexual states of *Planistroma* resemble the asexual morphs of *Kellermania* except in having apically appendaged conidia in the latter genus (Ramaley, 1995). Phylogenetic analysis of *Kellermania* and *Piptarthron* based on SSU, ITS and LSU genes showed that both genera group in the same clade and Minnis *et al.*, (2012) synonymised *Piptarthron*,

Planistroma, *Planistromella* under *Kellermania.* However, in our study based on molecular data from LSU and ITS genes, the phylogenetic tree shows that most species of *Planistroma* which are linked to *Piptarthron* are included in Group B.

Generic type

Planistroma yuccigenum A.W. Ramaley, *Mycotaxon* 42: 69 (1991) **Fig. 5**

≡ *Piptarthron pluriloculare* A.W. Ramaley, *Mycotaxon* 42: 63 (1991)

≡ *Kellermania plurilocularis* (A.W. Ramaley) Minnis & A.H. Kenn., *Persoonia* 29: 21 (2012)

MycoBank: MB 358836

Biotrophic or *saprotrophic* on leaves and stems. *Ascostromata* black ellipsoid to subcircular on surface of leaves, subepidermal, immersed, partially erumpent remaining at the rim covered by the epidermis, solitary to gregarious, multilocular, hemispherical, 0.5-0.7 mm diam., forming elongate stroma up to 1 mm long, up to 0.5 mm thick, dark brown to black, 2-10 locules, variable arrangement of locules, thick-walled (Fig. 5b-e). *Cells of ascostromata* 48-127 µm wide at the side, composed of several layers of dark brown columns of elongate cells, reaching from the base to the top, 81.5-197 µm wide at the base, composed of several layers of dark brown cells *textura angularis* (Fig. 5e,h-i). *Locules* 43-153 µm wide × 56-161 µm high, ovoid to globose, developing in the same stroma of the conidiogenous and/or spermatogenous locules, collapsing with the empty locule which previously producing conidia or spermatia or both, periphysate ostiole (Fig. 5d-g). *Peridium of locules* composed of a few layers of hyaline to light brown flattened cells (Fig. 5f, g). *Hamathecium* lacking pseudoparaphyses when mature filamentous, cylindrical or irregularly curved interascal cells which are swollen at their tips. *Asci* 73-111 × 14-18 µm ($\bar{x}$ = 89.3 × 16 µm, n = 30), 8-spored, bitunicate, fissitunicate, cylindrical, with a long fan-shaped pedicel 7-8 µm up to 15 µm high, at the stipe 5.5 µm wide, and with an ocular chamber up to 3 µm wide × 3 µm high (Fig. 5j-m). *Ascospores* 15.5-22 × 7-10.5 µm ($\bar{x}$ = 18.8 × 8.5 µm, n = 30), overlapping 1-2-seriate, ellipsoid with broadly rounded ends at the apex and narrowly rounded ends or tapering toward the base, hyaline, aseptate, irregularly many guttules, rough, sometimes surrounded by a slime layer (Fig. 5n-p). *Stromata* subepidermal, black, immersed, erumpent by remaining at the rim covered by the epidermis, solitary to gregarious, hemispherical, 0.4-1 mm diam, up to 0.5 mm thick, multilocular, 4-30 or more locules in stromata. *Stromata wall* 70-100 µm thick, composed of dark brown, thick-walled cells of *textura angularis*, lighter colored toward the interior, the top layers of the stromata composed of columns of elongated cells, extending from the base and the sides to the top surface of the stromata. *Conidiophores* absent. *Microconidiogenous cells* form on the wall of locules, short cylindric, hyaline, smooth, 6.5-14.5 × 3.5-5.5 µm, each forming an acrogenous holoblastic conidium. *Macroconidia* fusiform, curved or bent, tapering toward the apex or the base, base truncate, mostly aseptate, smooth, hyaline, (48-)59-76(-98) × (4-)5.5-7(-8) ($\bar{x}$ = 67.8 × 6.5) µm. *Microconidia* cylindric, irregularly swelled or bent, aseptate, smooth-walled, hyaline 5.5-25 × 2.5-3.5 µm. *Spermatia* formed on a part of walls of a macroconidiogenous locule or in one or more separate locules in a stroma. *Spermatogenous cells* phialidic, cylindric to elongate-conical, ca 8-16 × 1.5-3 µm, discrete or integrated on one-celled conidiophores, determinate, hyaline, smooth, forming acrogenous spermatia. *Spermatia* bacillary, hyaline, aseptate, smooth, 3.5-5.5 × 1.5 µm (asexual morph description follows Ramaley, 1991).

Material examined: USA: Colorado, La Plata County, Durango, below Fort Lewis College, Roadside, on leaves of *Yucca baccata*, 26 September 1990, Annette W. Ramaley, (UC 1475061, holotype).

Notes: Ramaley (1991) introduced *Piptarthron pluriloculare* as the anamorph of *Planistroma yuccigenum* by confirming the anamorph-teleomorph connection.

Taxonomic changes

Planistroma dasylirionicola (Minnis & A.H. Kenn) Monkai, J.K Liu & K.D. Hyde, **comb. nov.**

MycoBank: MB803335

Basionym: *Kellermania dasylirionicola* Minnis & A.H. Kenn., *Persoonia* 29: 21 (2012)

Planistroma dasylirionis (A.W. Ramaley) Monkai, J.K Liu & K.D. Hyde, **comb. nov.**

MycoBank: MB 803009

Basionym: *Piptarthron dasylirionis* A.W. Ramaley, *Mycotaxon* 55: 263 (1995)

≡ *Kellermania dasylirionis* (A.W. Ramaley) Minnis & A.H. Kenn., *Persoonia* 29: 21 (2012)

Planistroma kellermaniae A.W. Ramaley, *Mycotaxon* 66: 510 (1998)

Basionym: *Bartalinia nolinae* Pollack, *Mycologia* 39: 620 (1947)

≡ *Alpakesa nolinae* (Pollack) Morgan-Jones, Nag Raj & W.B. Kendr., *Canad. J. Bot*. 50: 879 (1972)

≡ *Kellermania nolinae* (Pollack) Nag Raj, in Nag Raj, *Coelomycetous anamorphs with appendage-bearing conidia*: 442 (1993)

Planistroma micranthae (Minnis & A.H. Kenn) Monkai., J.K Liu & K.D. Hyde, **comb. nov.**

MycoBank: MB803336

Basionym: *Kellermania micranthae* Minnis & A.H. Kenn., Persoonia 29: 21 (2012)

Planistroma nolinae A.W. Ramaley, *Mycotaxon* 55: 258 (1995)

Basionym: *Piptarthron crassisporum* A.W. Ramaley, *Mycotaxon* 55: 261 (1995)

≡ *Kellermania crassispora* (A.W. Ramaley) Minnis & A.H. Kenn., *Persoonia* 29: 21 (2012)

Mycosphaerellopsis Höhn., *Annales Mycologici* 16(1/2): 157 (1918) **Fig. 6**

MycoBank: MB 3345

Biotrophic or *saprotrophic* on leaves. *Ascostromata*, uniloculate, solitary, gregarious, immersed to semi-immersed, globose to subglobose, brown to dark brown. *Cells of ascostromata* composed of brown-walled cells arranged in a *textura globulosa*. *Ostioles* periphysate. *Hamathecium* lacking pseudoparaphyses at maturity. *Asci* 8-spored, bitunicate, fissitunicate, oblong to saccate, with a long pedicel, and an ocular chamber. *Ascospores* 1-3 seriate and partially overlapping, ellipsoid to broadly obovoid, broadly rounded at the apex, narrowly rounded at the base, hyaline, 1-septate, constricted at the central septum, with one guttule in

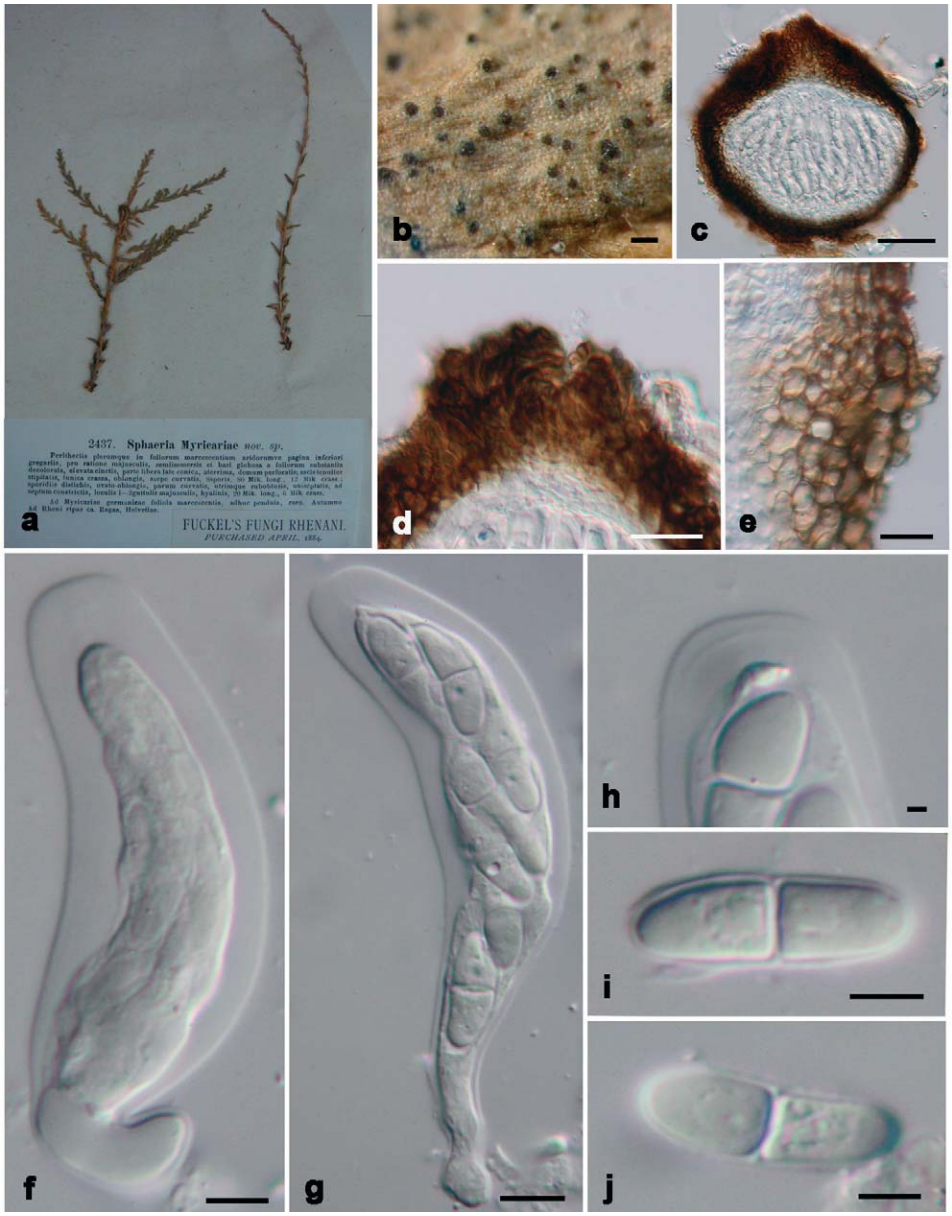

Fig. 6. *Mycosphaerellopsis myricariae* (holotype of *Sphaeria myricariae*) on dead leaves of *Myricariae germanicae*. **a-b.** Ascostromata on the host surface. **c.** Section of an ascostroma. **d.** Close up of the ostiole. Note periphyses. **e.** Section of the peridium. **f.** Immature ascus. **g.** Mature ascus. **h.** Close up of ocular chamber. **i-j.** Ascospores. Scale bars: b = 200 µm, c = 30 µm, d = 10 µm, e = 5 µm, f = 3 µm, g = 5 µm, h = 1 µm, i-j = 3 µm.

each cell, slightly roughened. *Conidiomata* pycnidia. *Conidiogenous cells* short, holoblastic. *Conidia* oblong, uniseptate, hyaline (asexual morph description follows Barr, 1996).

Notes: There are two *Mycosphaerellopsis* species recorded *M. myricariae* and *M. moravica* (http://www.indexfungorum.org, access on 17/11/12). *Mycosphaerellopsis* differs from other genera in *Planistromellaceae* in having uniloculate ascomata and 1-septate, broadly obovoid ascospores. Although we place this genus in *Planistromellaceae* its inclusion must be tentative until confirmation with molecular data. We have used the term ascostromata for the fruiting body of this species, however this is rather a loose term and if the genus proved to not belong in *Planistromellaceae* these could be termed ascomata. The characters are typical of *Botryosphaeriales* and fresh material is required for sequencing and placement of this genus.

Generic type

Mycosphaerellopsis myricariae (Fuckel) Höhn,
Annales Mycologici 16(1/2):157 (1918) **Fig. 6**

Sphaeria myricariae Fuckel, *Jb. nassau. Ver. Naturk.* 27-28: 22 (1874) [1873-74]

MycoBank: MB 499606

Biotrophic or *saprotrophic* on leaves. *Ascostromata* 77-146 µm high × 93-156 µm ($\bar{x}$ = 110 × 117.3 µm, n = 25) diam., uniloculate, solitary, gregarious, immersed to semi-immersed, globose to subglobose, brown to dark brown. *Cells of ascostromata* 12-22 µm wide, composed of 3-6 layers of brown-walled cells arranged in a *textura globulosa* (Fig. 4b-e). *Ostioles* periphysate (Fig. 6d). *Hamathecium* lacking pseudoparaphyses at maturity. *Asci* 45.5-64 × 10-13 µm ($\bar{x}$ = 53.7 × 11.5 µm, n = 25), 8-spored, bitunicate, fissitunicate, oblong to saccate, with a 4-5 µm long pedicel, and a 1-3 µm wide × 0.5-2 µm high ocular chamber (Fig. 6f-h). *Ascospores* 10-12 × 4-5 µm ($\bar{x}$ = 10.9 × 4.2 µm, n = 25), 1-3 seriate and partially overlapping, ellipsoid to broadly obovoid, broadly rounded at the apex, narrowly rounded at the base, hyaline, two-celled, constricted at the central septum, with one guttule in each cell, slightly roughened (Fig. 6i-j). *Conidiomata* pycnidia. *Conidiogenous cells* short, holoblastic. *Conidia* oblong, uniseptate, hyaline (asexual morph description follows Barr, 1996).

Material examined: UK: England, Kew, Royal Botanic Gardens, on *Myricariae germanicae*, April 1884, Fuckel's fungi rhenani (2437, holotype).

Capnodiales genera incertae sedis

Comminutispora A.W. Ramaley, *Mycologia* 88(1):132 (1996) **Figs 7-8**

MycoBank: MB 27576

≡ *Hyphospora* A.W. Ramaley, *Mycologia* 88(1):133 (1996)

Saprobic on dead leaves of *Asparagaceae*. *Ascostromata* apothecial and elongate hysterothecium, scattered to loosely, immersed, dark brown to black, rather dull, carbonaceous, thick-walled, composed of *textura angularis*, opening by a sunken longitudinal slit. *Asci* 8-spored, bitunicate, fissitunicate, saccate, clavate or cylindrical, with a long pedicel, apically rounded, apex wall thick, with a large ocular chamber. *Ascospores* biseriate and overlapping in ascus, obovoid, ellipsoid to fusoid, with broadly to narrowly rounded ends, 0-3 septate when immature, transversely 1-5 septate and many longitudinal septate with ultimately forming tiny secondary ascospores when mature, roughened, with thin gelatinous coat. *Colonies* growing on MA (Malt Agar), flat to slightly effuse, radiating, edge fimbriate, hyphae generally dark brown in surface view, outward hyphae pale brownish to hyaline, darkened interior, slightly raised hairy, partly superficial and

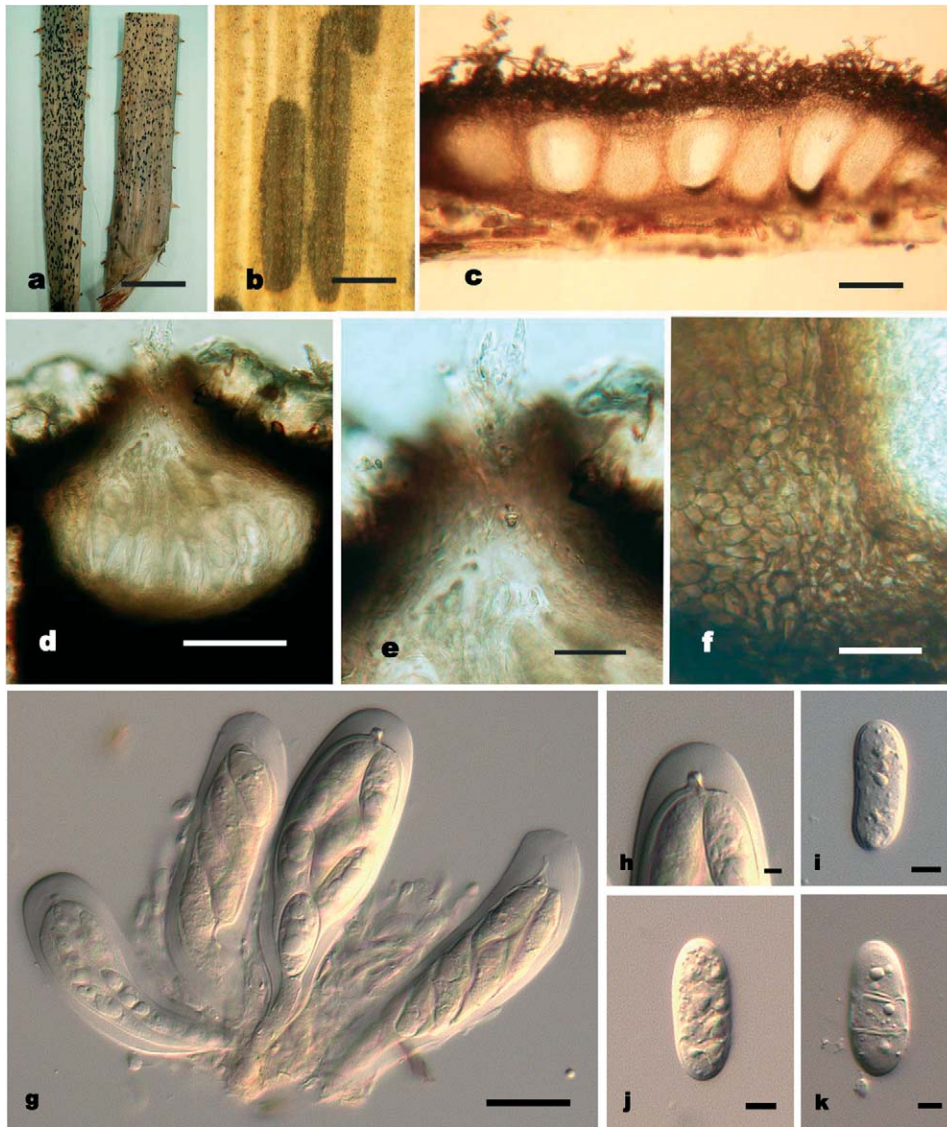

Fig. 7. *Comminutispora agavacearum* (holotype of *Comminutispora agavacearum*) on dead leaves of *Dasylirion leiophyllum*. **a-b.** Ascostromata on host surface. **c.** Ascostromata. **d-e.** Close-up of ascostroma locule and ostiole. **f.** Close-up of ascostromata wall. **g.** Asci and pseudoparaphyses. **h.** Close-up of ocular chamber. **i-k.** Immature ascospores. Scale bars = a-c = 100 µm, d-f = 10 µm, g = 25 µm, h-k = 5 µm.

immersed. The small conidiogenous cells differentiated from vegetative hyphae developing endoconidia of dictyochlamydospores, elongation or long chains, variable shape, with transverse and longitudinal septation, dark brown constricted at the septa, smooth or slightly verrucose.

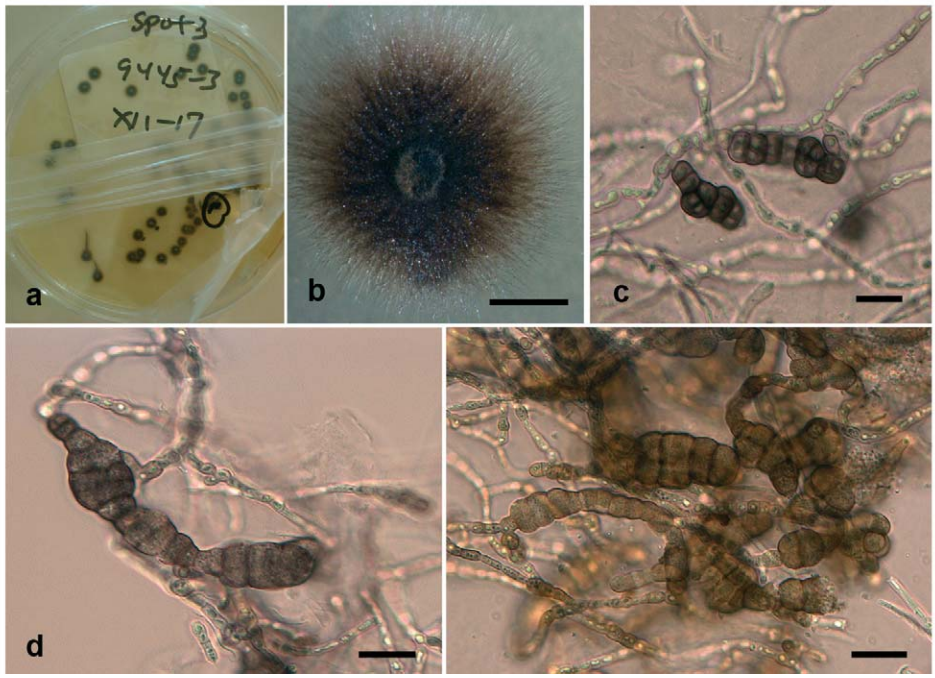

Fig. 8. *Hyphospora agavacearum* (holotype of *Hyphospora agavacearum*) on dried cultures at 1 week. **a.** Material on dried cultures. **b.** Colonies on MA. **c-e.** Dictyochlamydospores. Scale bars: b = 500 µm, c-e = 20 µm.

Notes: *Comminutispora* was established by Ramaley (1996) as a monotypic genus based on *C. agavacearum* and *Hyphospora agavacearum* as an asexual morph. *C. agavacearum* is characterized by unilocular ascomata, immersed, ostiolar canal periphysate and forming transversely and longitudinally septate ascospores (Ramaley, 1996). Ramaley (1996) placed *Comminutispora* in the *Dothidiales sensu* Lindau 1897. However, following the classification by Lumbsch & Huhndorf (2010) *Comminutispora* is a member of the family *Planistromellaceae*.

Molecular analysis of the type species; *C. agavacearum* (strain CBS 619.95) was studied by Hambleton *et al.* (2003) and Schoch *et al.* (2009) on the basis of SSU and LSU genes. DNA sequence data for SSU showed that *C. agavacearum* falls in a large clade of *Capnodiales* (Hambleton *et al.*, 2003), and thus is unrelated to *Planistromellaceae* based on SSU and LSU genes (Schoch *et al.,* 2009). *C. agavacearum* formed a poorly supported clade with two strains of *Racondium rupestre* in the *Capnodiales* (Schoch *et al.,* 2009), while in a larger sample of species in the order these taxa were designated *incertae sedis* (Crous *et al*., 2009a). Furthermore, Crous *et al*. (2009a) regarded the saprobes *Comminutispora* and *Phaeotheca* as an ancestral assemblage of taxa in the *Capnodiales*.

Generic type

Comminutispora agavacearum A.W. Ramaley [as 'agavaciensis'], *Mycologia* 88(1): 133 (1996) **Figs 7-8**

≡ *Hyphospora agavacearum* A.W. Ramaley [as '*agavaciensis*'], *Mycologia* 133 (1996)

MycoBank: MB 414805

Saprobic on dead leaves. *Ascostromata* 0.6-2 mm length × 0.3-0.4 mm wide, measured at the surface of host, 300-600 µm high, and 250-300 µm diameter, within host tissue, apothecium and elongate hysterothecium, scattered to loosely, immersed, dark brown to black, rather dull, carbonaceous, thick-walled, composed of *textura angularis*, opening by a sunken longitudinal slit (Fig. 7a-f). *Asci* 105-135 ×27.5-35 µm ($\bar{x}$ = 120.3 × 29.3 µm, n = 10), 8-spored, bitunicate, fissitunicate, saccate, clavate or cylindrical, with a 5-22.5 µm long pedicel, apically rounded, apex wall 5-7.5 µm thick, with an ocular chamber up to 5 µm wide × 2.5 µm high (Fig. 7g-h). *Ascospores* 22.5-35.5 ×7.5-12.5 µm ($\bar{x}$ = 27.5 ×9.1 µm, n = 20), biseriate and overlapping in ascus, obovoid, ellipsoid to fusoid, with broadly to narrowly rounded ends, 0-3 septate when immature, roughened, with thin gelatinous coat (Fig. 7i-k). Colonies growing on MA (Malt Agar), reaching 500 µm diam. in one week at 23-25°C, flat to slightly effuse, radiating, edge fimbriate, hyphae generally dark brown on surface view, outward hyphae pale brownish to hyaline, darkened interior, slightly raised hairy, partly superficial and immersed (Fig. 8a-b). The small conidiogenous cells differentiated from vegetative hyphae developing endoconidia of dictyochlamydospores, elongation or long chains, variable shape, with (36.5-)93-150(-167) µm long × 15-23(-32.5) µm wide, with transverse and longitudinally septation, dark brown pigmented, constricted at the septa, smooth or slightly verrucose (Fig. 8c-e).

Material examined: USA: Texas, National Fungus Collections, on dead leaves of *Dasylirion leiophyllum*, October 1994 (BPI 802958, holotype of *Comminutispora agavacearum*). USA: Texas, Brewster, Big Bend National Park, on dead leaves of *Dasylirion leiophyllum*, 25 October 1994, Ramaley Annette 9445(BPI 802959, holotype of *Hyphospora agavacearum*).

Notes: In the type specimen ascospores of *C. agavacearum* are immature and lack septa, while in the protologue they are reported to have transversely 1-5 septate and many longitudinal septate with ultimately forming tiny secondary ascospores (Ramaley, 1996); one ascospore (in Fig. 7k) has 3-septa.

Genera transferred to *Mycosphaerellaceae incertae sedis*

Eruptio (Dearn.) M.E. Barr, *Mycotaxon* 60:437 (1996) **Fig. 9**

MycoBank: MB 27768

Biotrophic on leaves. *Ascostromata* uniloculate or multiloculate, linear, scattered to gregarious, immersed, erumpent through cracking or splitting of host tissues, globose to subglobose, black. *Locules* small, ovoid to globose, periphysate ostioles. *Cells of ascostromata* reddish brown to dark brown, composed pseudoparenchymatous cells of *textura globulosa*. *Hamathecium* not observed in herbarium material. *Asci* 8-spored, bitunicate, obclavate, usually wider in the base and narrowed towards the apex, pedicellate, with an ocular chamber. *Ascospores* uniseriate at the top, biseriate in the middle and triseriate in the base of asci partially overlapping, 1-septate, oblong to cuneate, bluntly rounded at one end, tapering fusiform at other, hyaline, rough, 4-guttulate. *Asexual states* are recorded as *Lecanosticta* and *Dothistroma*. *Lecanosticta* is characterized by stromata;

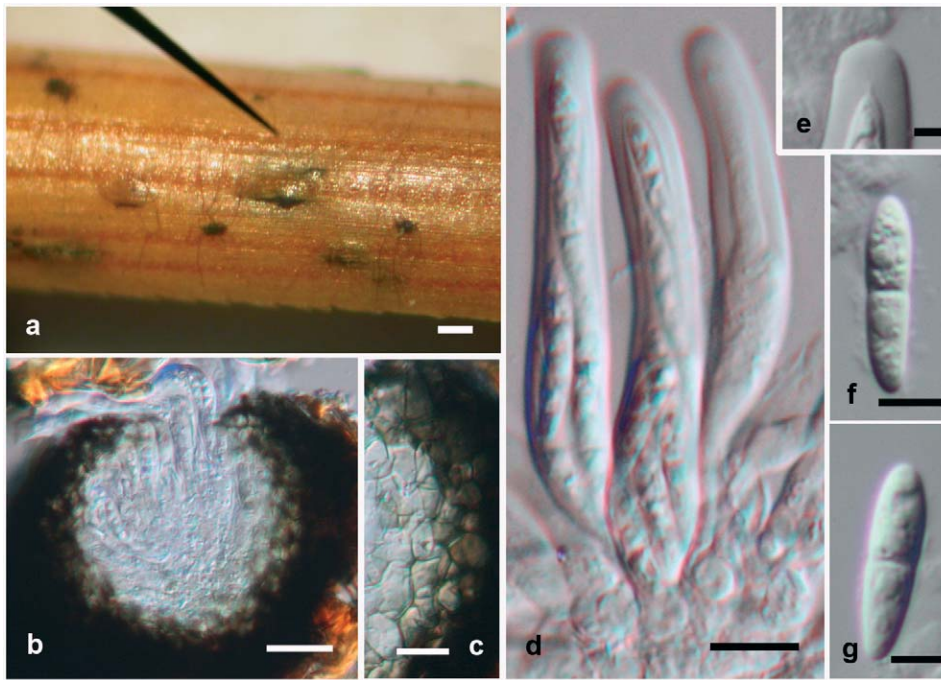

Fig. 9. *Eruptio acicola* (holotype of *Eruptio acicola*) on withered needles of *Yucca brevifolia*. **a.** Ascostromata on the host surface. **b.** Section of ascostroma locule. **c.** Cells of ascostroma. **d.** Asci. **e.** Ocular chamber. **f-g.** Ascospore. Scale bars: a = 50 µm, b = 25 µm, c = 20 µm, d = 10 µm, e = 3 µm, f-g = 5 µm.

elongate, erumpent, the locules opening widely, the bases lined with short hyaline conidiophores, conidia; brown, elongate, tapered at apex, blunt at base, 3-septate, bent, the wall roughened, microconidial state: locules in immature stromata contain microconidia, hyaline, 1-celled (asexual morph description follows Barr, 1972). *Dothistroma* is characterized by *conidiomata* predominantly occurring in red bands on the upper and lower needle surfaces, separate to aggregated, sub-epidermal, becoming erumpent, and splitting the needle surface with one or two longitudinal slits; at maturity acervular, black, lined internally with pseudoparenchymatous cells giving rise to conidiophores; these cells are brown, becoming paler at the point of conidiophore attachment. *Conidiophores* pale brown to hyaline, smooth, densely aggregated, subcylindrical to irregular, 1-4 septate, branched or simple. *Conidiogenous cells* integrated, hyaline, smooth, subcylindrical, tapering towards the bluntly rounded apices, proliferating sympodially or percurrently near the apex. *Conidia* aggregated in cream to pale brown, slimy masses; smooth, thin-walled, hyaline, subcylindrical to narrowly obclavate or irregular (asexual morph description follows Barnes *et al*., 2004).

Notes: This fungus has a complicated history with many synonyms. *Oligostroma acicola* was established by Dearness (1926) on needles of *Pinus palustris*. Barr (1972) transferred the species to *Mycosphaerella* using locule and ascus development as generic concepts rather than the position of ascomata. Barr (1996) later introduced the family *Planistromellaceae* and included *Eruptio* based on multilocular pseudothecia, with ostioles forming through cracking or splitting of

host tissues, and with periphysate ostioles. *Eruptio* differs from *Planistromellaceae* as ascospores are 1-septate, narrow, oblong to fusoid and are more typical of *Mycosphaerellaceae.* Presently, *Eruptio* has three species; *E. acicola*, *E. pini* and *E. gaubae* (http://www.indexfungorum.org, access on 17/11/12). The asexual states, *Lecanosticta acicola* (*E. acicola*) and *Dothistroma pini* (*E. pini*), cause pine needle blight (Evans, 1984). The asexual states form acervuli in the stromata, conidia are hyaline to brown, septate, and cylindrical. *Lecanosticta* species have 1-3 septate conidia and produce microconidia, whereas *Dothistroma* species have 1-5 septate conidia (Barr, 1972; Barnes *et al*., 2004). *Lecanosticta gaubae* (*E. gaubae*) was removed from *Mycosphaerella* by Crous (1999) because of the different ascomatal characters and no *Lecanosticta* species are known to have asexual states in *Mycosphaerella.* Molecular analysis of the type species *E. acicola* was carried out by Crous *et al*. (2001) using an ITS rDNA sequence. *Eruptio* clustered in the same clade as *Mycosphaerella.* This result has since been supported in several studies based on LSU rRNA gene data (Verkley *et al*., 2004; Crous *et al*., 2009b) and SSU, ITS, LSU rRNA gene data (Crous *et al*., 2009a). *Lecanosticta* clustered with other asexual morphs of *Mycosphaerella* in these studies. We therefore place *Eruptio* and its asexual morphs in *Mycosphaerellaceae.*

Generic type

Eruptio acicola (Dearn.) M.E. Barr, *Mycotaxon* 60: 438 (1996) **Fig. 9**

MycoBank: MB 436296

≡ *Cryptosporium acicola* Thüm. (1878)

≡ *Septoria acicola* (Thüm.) Sacc. (1884)

≡ *Lecanosticta pini* H. Sydow apud Sydow & Petrak (1922)

≡ *Lecanosticta acicola* (Thüm.) Syd., in Sydow & Petrak, Annls mycol. 22(3/6): 400 (1924)

≡ *Oligostroma acicola* Dearn, Mycologia 18(5): 251 (1926)

≡ *Scirrhia acicola* (Dearn.) Sigg., Phytopathology 29: 1076 (1939)

≡ *Systremma acicola* (Dearn.) F.A. Wolf & Barbour, Phytopathology 31: 70 (1941)

≡ *Dothidea acicola* (Dearn.) M. Morelet, Annales de la Société des Sciences Naturelles et d'Archéologie de Toulon et du Var 177: 9 (1968)

≡ *Mycosphaerella dearnessii* M.E. Barr, *Contr. Univ. Mich. Herb.* 9: 587 (1972)

Biotrophic on leaves. *Ascostromata* 0.1-0.4 mm diam., up to 1.5 mm. high, uniloculate or multiloculate, linear, scattered to gregarious, immersed, erumpent through cracking or splitting of host tissues, globose to subglobose, black (Fig. 9a, b). *Locules* 88-98 µm high × 61-83.5 µm diam., small, ovoid to globose, periphysate ostioles (Fig. 9b). *Cells of ascostromata* 24-28 µm thick, reddish brown to dark brown, composed pseudoparenchymatous cells of *textura globulosa* (Fig. 9c). *Hamathecium* not observed in herbarium material. *Asci* 40-59 × 9-14 µm ($\bar{x}$ = 50.9 × 10.4 µm), 8-spored, obclavate, usually wider in the base and narrowed towards the apex, pedicellate, with an ocular chamber 0.5 µm wide (Fig. 9d, e). *Ascospores* 11-15 × 2-4 µm ($\bar{x}$ = 13.8 × 3.5 µm), uniseriate at the top, biseriate in the middle and triseriate at the base of asci partially overlapping, 1-septate, oblong to cuneate, bluntly rounded at one end, tapering fusiform at other, hyaline, rough, 4-guttulate (Fig. 9f, g). *Asexual state* is *Lecanosticta acicola*: *stromata* elongate, erumpent, the locules opening widely, the bases lined with short hyaline conidiophores; *conidia* 20-28 × 2.5-3 µm, brown, elongate, tapered at apex, blunt

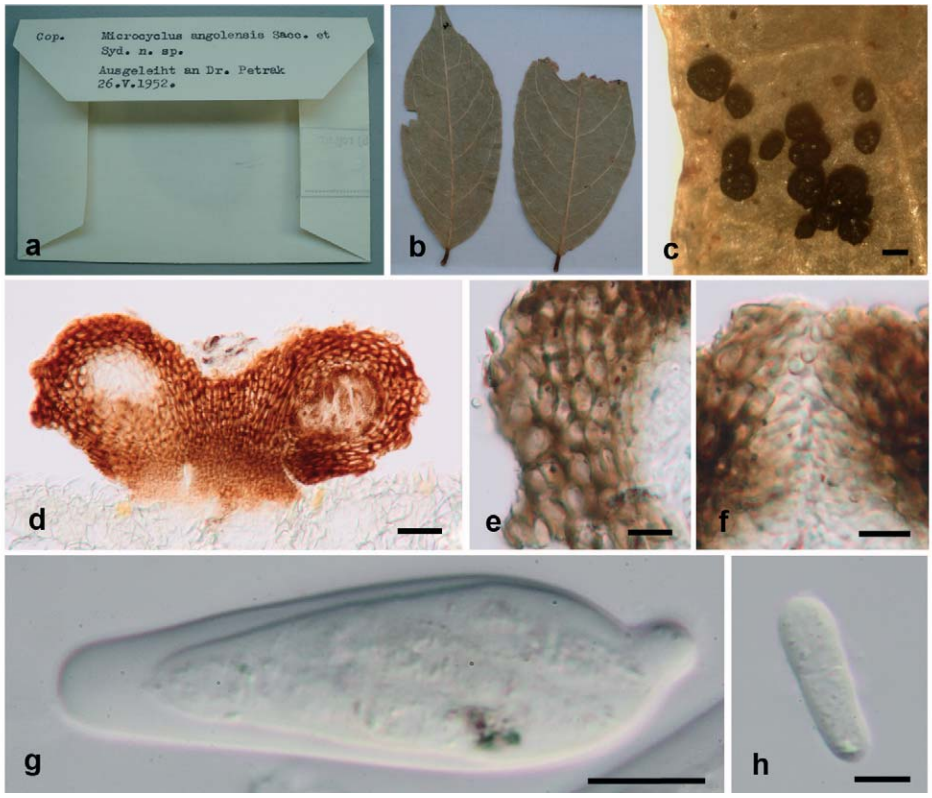

Fig. 10. *Microcyclus angolensis* (holotype) on living leaves of *Millettiae thonningii*. **a.** Herbarium packet. **b-c.** Ascostromata on the host surface. **d.** Section of ascostromata. **e.** Cells of ascostroma. **f.** Periphysate ostiole. **g.** Immature ascus. **h.** Ascospore. Scale bars: c = 200 μm, d = 30 μm, e-g = 10 μm, h = 5 μm.

at base, 3-septate, bent, the wall roughened. *Microconidial state* locules in immature stromata contain microconidia, these hyaline, 2-3 × 1 μm, 1-celled (asexual morph description follows Barr, 1972).

Material examined: CANADA: Ontario, Ottawa; on withered needles of *Pinus palustris*, 27 February 1919, G. G. Hedgcock: 32146 (D:5831, holotype).

Microcyclus Sacc., Syd. & P. Syd., in Sydow & Sydow, Annales Mycologici 2(2): 165 (1904) **Figs 10-11**

MycoBank: MB 3160

Biotrophic on leaves and stems. *Ascostromata* pulvinate, irregularly shaped, developing from central basal hypostroma, superficial, multilocular, composed of pseudoparenchymatous cells; *textura angularis*, thick-walled, reddish brown. *Ostiole* papillate, periphysate. *Asci* 8-spored, thick-walled, bitunicate, fissitunicate, cylindrical to clavate, with an ocular chamber, with a long pedicel. *Ascospores* 1-3 seriate partially overlapping, 1-septate, obovoid, upper cell shorter and wider than lower, not or slightly constricted at the septum, smooth wall, granular, hyaline. Two asexual morphs have been reported for *Microcyclus*

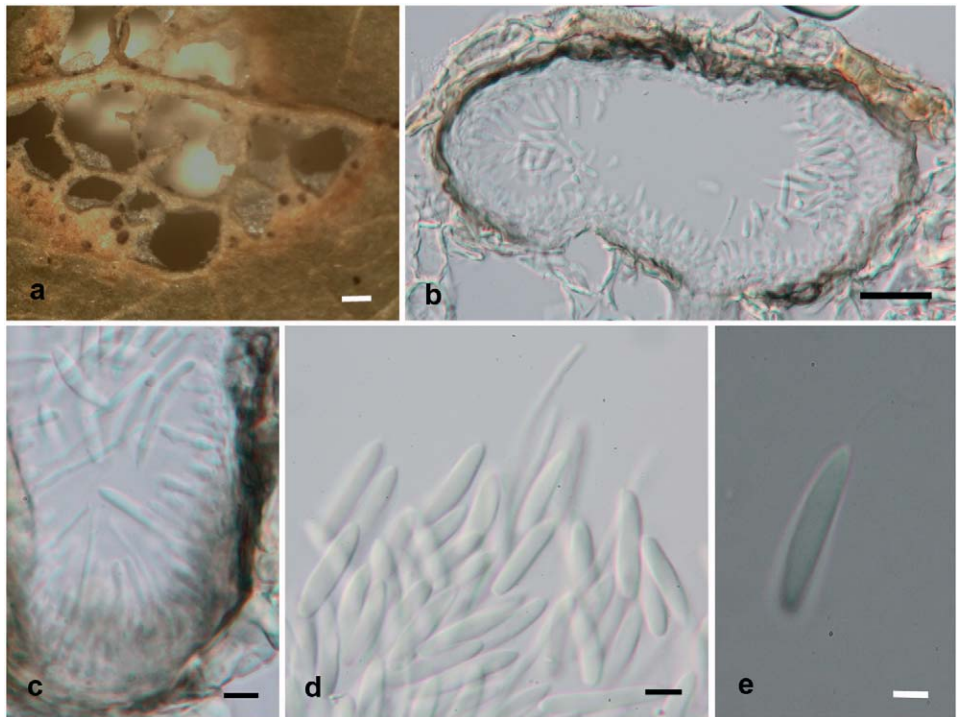

Fig. 11. "Pazschkeella like" asexual morph of *Microcyclus angolensis* (holotype), on living leaves of *Millettiae thonningii*. **a.** Conidiomata on the host surface. **b.** Section of conidioma. **c.** Conidiogenous cells. **d.** Conidia and paraphyses. **e.** Conidia with appendage. Scale bars: a, b = 100 µm, c, d = 5 µm, e = 3 µm.

species including *Fusicladium* Bonorden and *Pazschkeella* Syd. & P. Syd. (Sivanesan, 1984). *Fusicladium* is described by mycelium immersed, sometimes subcuticular. *Stroma* often present, sometimes subcuticular. *Setae* absent. Hyphopodia absent. *Conidiophores* macronematous, mononematous, simple or occasionally once branched, often olivaceous brown, septate, usually fasciculate, bursting through the cuticle of the host plant. *Conidiogenous* cells integrated, terminal, polyblastic, sympodial, cicatrized; old conidial scars usually thickened, conspicuous and prominent, sometimes situated at the end of short lateral projections, numerous and often crowded, giving the conidiophore a nodular appearance. *Conidia* solitary or occasionally in short chains, dry, variable in shape but often tending to be broadly fusiform, truncate at the base and pointed at the apex, 0-3- (often 0- or 1-) septate, pale to mid olive or olivaceous brown, frequently minutely verruculose (Ellis, 1971). *Pazschkeella* is characterized by *conidiomata* pycnidial, solitary to gregarious, immersed to semi-immersed, becoming erumpent, thin dark brown to black wall surrounding with host tissue. *Conidiophores* hyaline, septate, cylindrical, smooth. *Conidiogenous cells* holoblastic, integrated, hyaline, cylindrical, producing a single apical conidium. *Paraphyses* non-septate, unbranched, not-anastomosed. *Conidia* hyaline, smooth, thin walled, aseptate, fusiform to cylindrical, sometimes irregular cylindrical, base obtuse, tapering toward apex attached with an appendage.

Notes: Barr (1996) arranged *Microcyclus* in the new family *Planistromellaceae* and distinguished this genus from others in the family based on its widely erumpent, multiloculate ascostromata, and 1-septate and obovoid ascospores. The type species *M. angolensis* (Sacc.) Syd. & P. Syd. was described with periphysate ostioles by Theissen & Sydow (1915) and Müller & Sanwal (1954). Many species in this genus are biotrophic on leaves and stems of various plants in tropical and subtropical regions (Barr, 1996; Cannon *et. al.*, 1995). There are 36 species recorded in *Index Fungorum* (http://www.indexfungorum.org access on 17/11/12). One important species is *Microcyclus ulei* (Henn.) von Arx, an economically important pathogen that causes leaf blight on rubber trees in South America (Lieberei, 2007). The type of *Microcyclus* is similar to other genera of *Mycosphaerellaceae* in the form of its asci and ascospores, while ascostromata are also found in *Cymadothea* (type, *C. trifolii* F.A. Wolf, Simon *et al*., 2009), *Euryachora* (type *E. sedii* Fuckel, genera presently placed in *Mycosphaerellaceae*, Lumbsch & Huhndorf, 2010).

Generic type

Microcyclus angolensis (Sacc.) Syd. & P. Syd., *Annales Mycologici* 2(2): 165 (1904) **Figs 10-11**

MycoBank: MB 152201

Biotrophic on leaves and stems. *Ascostromata* 0.2-0.3 mm wide, 66.5-116 µm high × 58-109 µm diam., pulvinate, irregularly shaped, developing from central basal hypostroma, superficial, multilocular, composed of pseudo-parenchymatous cells; *textura angularis*, thick-walled, reddish brown (Fig. 10b-e). *Ostiole* papillate, periphyses (Fig. 10f). *Asci* 45-70 × 13-19 µm ($\bar{x}$ = 54.5 × 15.8 µm, n = 25), 8-spored, thick-walled, bitunicate, fissitunicate, cylindrical to clavate,with an ocular chamber 1-1.5 µm wide × 0.5-1 µm high, with a pedicel, 4-6 µm long (Fig. 10g). *Ascospores* 14-18 × 4-6 µm ($\bar{x}$ = 16.4 × 5.1 µm, n = 25), 1-3 seriate partially overlapping, 1-septate, obovoid, upper cell shorter and wider than lower, not or slightly constricted at the septum, smooth wall, granular, hyaline (Fig. 10h). An asexual morph is also present on the leaves as *Pazschkeella* sp.; *Conidiomata* 21-42.5 µm high × 49-76 µm diam., pycnidial, solitary to gregarious, immersed to semi-immersed, becoming erumpent, thin dark brown to black wall surrounded by with host tissue (Fig. 11a-b). *Conidiophores* hyaline, septate, cylindrical, smooth. *Conidiogenous cells* 1-3 µm wide, holoblastic, integrated, hyaline, cylindrical, producing a single apical conidium (Fig. 11c). *Paraphyses* 1-1.5 µm wide, non-septate, unbranched, not-anastomosed (Fig. 11c-d). *Conidia* 13-15 × 2-3 µm ($\bar{x}$ = 14 × 2.8 µm, n = 25), hyaline, smooth, thin-walled, aseptate, fusiform to cylindrical, sometimes irregular cylindrical, base obtuse, tapering toward apex attached with an appendage (7-8 µm long) (Fig. 11d-e).

Material examined: Angola, Africa; on living leaves of *Millettiae thonningii*, Welwitsch (F8592, F8593, holotype).

Genus transferred to *Phaeosphaeriaceae*

Loratospora Kohlm. & Volkm.-Kohlm., Syst. Ascom. 12(1-2): 10 (1993) **Fig. 12**

MycoBank: MB 26473

Saprobic on dead culms of *Juncus roemerianus*. *Ascostromata* immersed in host tissue under a slightly raised darkened area, subglobose, solitary, gregarious, with periphysate ostioles. *Cells of ascostromata* composed of 4-5 layers of brown thick-walled, cuboid or angular cells. *Asci* 8-spored, bitunicate,

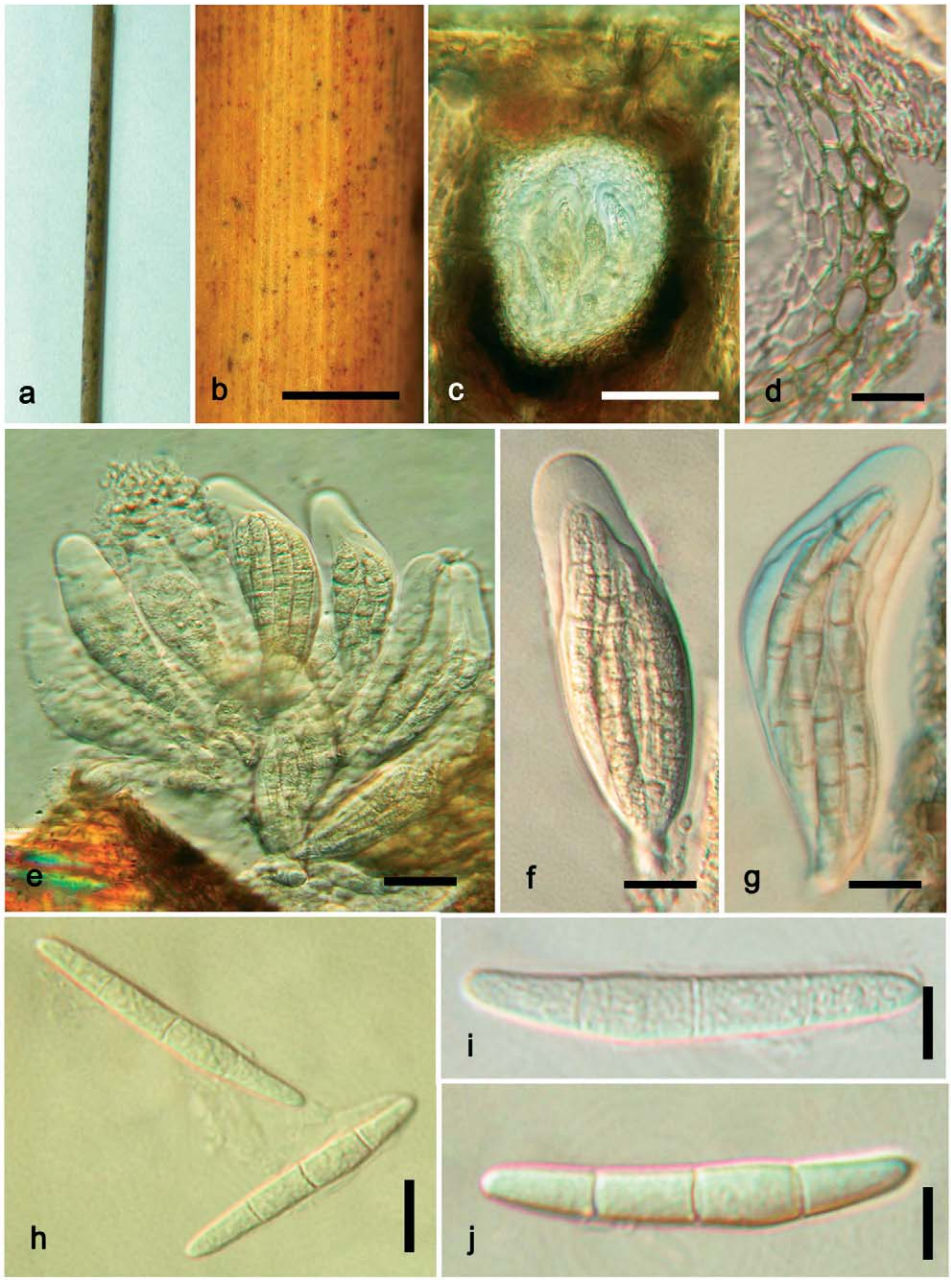

Fig. 12. *Loratospora aestuarii* (holotype of *Loratospora aestuarii*) on dead culms of *Juncus roemerianus*. **a-b.** Ascostromata forming in host tissue. **c.** Vertical section through the ascostroma with asci. **d.** Close-up of the peridium at the ascoma side. (note that the wall is not divided into distinct layers). **e-g.** Asci 8-spored. **h-j.** Ascospores 3-septate. Scale bars: b-c = 100 µm, d-g = 25 µm, h-j = 5 µm.

fissitunicate, clavate to ovoid, with a short knob-like pedicel, apically rounded apex, and with ocular chamber. *Ascospores* 3-4 overlapping seriate, hyaline, narrowly obovoid, fusoid or clavate, 3-septate, slightly constricted septum, smooth-walled, surrounded by a thin mucilaginous sheath. *Asexual state* not established.

Notes: Loratospora is a monotypic genus represented by *L. aestuarii* (http://www.indexfungorum.org, access on 17/11/12). This species is an obligate to facultative marine taxon and is characterized by unilocular ascostromata that are immersed in host tissue, with 3-septate, elongate ascospores (Kohlmeyer & Volkmann-Kohlmeyer, 1993; Jones *et al*., 2009). Barr (1996) placed *L. aestuarii* in *Planistromellaceae* because its locules open through cracking or splitting of the host tissue and its periphysate ostioles. Combined multigene molecular analysis of *L. aestuarii* strain JK 5535D based on SSU, LSU and RPB2 gene data was carried out by Suetrong *et al.* (2009). *L. aestuarii* grouped in *Phaeosphaeriaceae* and this is followed here.

Generic type

Loratospora aestuarii Kohlm. & Volkm.-Kohlm., Systema Ascomycetum. 12(1-2): 10 (1993) **Fig. 12**

MycoBank: MB 360815

Saprobic on dead culms of *Juncus roemerianus*. *Ascostromata* immersed in host tissue under a slightly raised darkened area (Fig 12a, b). *Locule*s 97.5-125 µm diam. × 117.5-175 µm high, subglobose, solitary, gregarious, with periphysate ostioles (Fig. 12c). *Cells of ascostromata* 17.5-18.8 µm thick ($\bar{x}$ = 17 µm, n = 5), composed of 4-5 layers of, brown thick-walled, cuboid or angular cells (Fig. 12d). *Asci* 75-137.5 µm × 20-32.5 µm ($\bar{x}$ = 95.5 × 26.3 µm, n = 20), 8-spored, bitunicate, fissitunicate, clavate to ovoid, with a short knob-like pedicel, apically rounded with 10-22.5 µm thick apex, and 0.5-1 µm wide ocular chamber (Fig. 12e-g). *Ascospores* 42.5-55-(-57.5) µm × 5-6 µm ($\bar{x}$ = 53.5 × 6.8 µm, n = 20), 3-4 overlapping seriate, hyaline, narrowly obovoid, fusoid or clavate, 3-septate, slightly constricted at septum, smooth-walled, surrounded by a thin mucilaginous sheath (Fig. 12h-j). *Asexual state* not established.

Material examined: USA, North Carolina, Broad Creek, on dead culms of *Juncus roemerianus*, 6 April 1993, J.K. 5505 (holotype: IMS).

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