

The Genera of Fungi—G3: *Aleurocystis*, *Blastacervulus*, *Clypeophysalospora*, *Licrostroma*, *Neohendersonia* and *Spumatoria*

Alejandra Giraldo^{1,2} · Pedro W. Crous^{1,2,3,4} · René K. Schumacher⁵ ·
Ratchadawan Cheewangkoon⁴ · Masoomeh Ghobad-Nejhad⁶ · Ewald Langer⁷

Received: 10 October 2016 / Revised: 1 January 2017 / Accepted: 3 January 2017 / Published online: 30 January 2017
© The Author(s) 2017. This article is published with open access at Springerlink.com

Abstract The current paper represents the third contribution in the Genera of Fungi series, linking the type species of fungal genera to their morphology and DNA sequence data, and, where possible, ecology. In this issue, we have focused on six genera, including macro- and microfungi, four of which the type species is epitypified. In addition, two new families within Pleosporales and Xylariales are proposed to accommodate two of them. The genera treated here include: *Aleurocystis* (*Aleurocystis hakgallae*; incertae sedis, Agaricales), *Blastacervulus* (*Blastacervulus eucalypti*; Asterinaceae, Asterinales), *Clypeophysalospora* (*Clypeophysalospora latitans*; Clypeophysalosporaceae, Xylariales), *Licrostroma* (*Licrostroma subgiganteum*;

Peniophoraceae, Russulales), *Neohendersonia* (*Neohendersonia kickxii*; Neohendersoniaceae, Pleosporales) and *Spumatoria* (*Spumatoria longicollis*; Ophiostomataceae, Ophiostomatales). Authors interested in contributing accounts of individual genera to larger multi-authored papers should contact the associate editors listed on the List of Protected Generic Names for Fungi.

Keywords DNA barcodes · Fungal systematics · ITS · LSU · Typification

Section Editor: Kevin Hyde and Marc Stadler

This article is part of the “Special Issue in honour of the 70th birthday of Dr. Eric McKenzie”.

✉ Pedro W. Crous
p.crous@cbs.knaw.nl

¹ Westerdijk Fungal Biodiversity Centre, Uppsalalaan 8, 3584 CT Utrecht, The Netherlands

² Department of Microbiology and Plant Pathology, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, P. Bag X20, 0028 Pretoria, South Africa

³ Microbiology, Department of Biology, Utrecht University, Padualaan 8, 3584 CH Utrecht, The Netherlands

⁴ Department of Entomology and Plant Pathology, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand

⁵ Hölderlinstraße 25, Fürstenwalde/Spree 15517, Germany

⁶ Department of Biotechnology, Iranian Research Organization for Science and Technology (IROST), P.O. Box 3353-5111, Tehran 3353136846, Iran

⁷ Department of Ecology, University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel, Germany

Introduction

The Genera of Fungi project (<http://www.GeneraOfFungi.org>; Crous et al. 2014a) aims to revise the generic names of fungi that are currently accepted (Kirk et al. 2013) and anticipated to obtain ‘protected status’ at the next International Botanical Congress (IBC XIX) in China in 2017. Because the majority of fungal genera were described before the DNA era, their type species need to be recollected, epi- or neotypes designated and assigned an MBT number to ensure traceability of the nomenclatural act (Robert et al. 2013), and sequence data obtained to resolve their true higher order phylogeny. Furthermore, to move to a single nomenclature for fungi (Crous et al. 2015a), their sexual–asexual links also need to be confirmed.

Materials and methods

Isolates

Several genera were re-described based on cultures obtained from the Westerdijk Fungal Biodiversity Centre in Utrecht,

The Netherlands (formerly known as CBS-KNAW) and the working collection of P.W. Crous (CPC), housed at the CBS. For fresh collections, leaves and twigs were placed in damp chambers and incubated at room temperature for 1–2 days. Single conidial or ascospore colonies were established from sporulating conidiomata or ascomata in Petri dishes containing 2% malt extract agar (MEA), as described previously (Crous et al. 1991). In the case of the dung samples, small pieces were placed on moist sterile filter paper on the lid of Petri dishes containing MEA, until the spores were shot onto the surface of the agar. After 1–2 days, single spores were picked up and transferred to fresh MEA plates. Colonies were sub-cultured onto 2% potato dextrose agar (PDA), oatmeal agar (OA), MEA (Crous et al. 2009c), autoclaved pine needles on 2% tap water agar (PNA) (Smith et al. 1996) and incubated at 25 °C under continuous near-ultraviolet light to promote sporulation. Reference strains and specimens are maintained at the CBS and CPC.

DNA isolation, amplification and analyses

Genomic DNA was extracted from fungal colonies growing on MEA using the UltraClean™ Microbial DNA Isolation Kit (MO BIO Laboratories, Inc., Solana Beach, CA, USA), according to the manufacturer's protocol. The primers V9G (de Hoog and Gerrits van den Ende 1998) or ITS5 (White et al. 1990) and LR5 (Vilgalys and Hester 1990) were used to amplify part (ITS) of the nuclear rDNA operon spanning the 3' end of the 18S nrRNA gene, the first internal transcribed spacer (ITS1), the 5.8S nrRNA gene, the second ITS region (ITS2) and approximately 900 bp of the 5' end of the 28S nrRNA gene. The primers ITS4 (White et al. 1990) and LROR (Vilgalys and Hester 1990) were used as internal sequence primers to ensure good quality sequences over the entire length of the amplicon. Amplification conditions followed Cheewangkoon et al. (2008). The program SeqMan v.7.0.0 (DNASTAR, Madison, WI, USA) was used to obtain consensus sequences of each isolate. BLAST searches using ITS and LSU sequences were performed for each isolate and the closest matches were retrieved from GenBank and included in the phylogenetic analysis. The multiple sequence alignments and subsequent phylogenetic analyses of the LSU data were carried out using ClustalW and maximum likelihood (ML), respectively, under MEGA v.6.06 (Tamura et al. 2013). Sequence data were deposited in GenBank (Table 1) and the alignments and trees in TreeBASE (<http://www.treebase.org>). In addition, 186 LSU sequences retrieved from GenBank were included in the phylogenetic analyses (Table 2).

Morphology

Slide preparations were mounted in lactic acid or Shear's mounting fluid from colonies sporulating on the media previously mentioned. Sections of fruiting bodies were made by hand. Observations were made

with a Zeiss V20 Discovery stereo-microscope (Zeiss, Oberkochen, Germany) and with a Zeiss Axio Imager 2 light microscope using differential interference contrast (DIC) illumination and a Nikon DS-Ri2 camera and software. Colony characters and pigment production were noted after 1 month of growth on MEA and OA (Crous et al. 2009c) incubated at 25 °C. Colony colours (surface and reverse) were rated according to the colour charts of Rayner (1970). Taxonomic novelties and new typifications were deposited in MycoBank (<http://www.MycoBank.org>; Crous et al. 2004).

Results

Phylogeny

The LSU alignment was used to resolve the generic placement of strains (Figs. 1, 2, 3 and 4) and the ITS (not shown) was used for species identification. According to the BLAST search results using the LSU and ITS sequences of *Blastacervulus eucalypti*, it was closely related with members of Asterinales (Dothideomycetes). Thus, the currently accepted members of this order as well as other orders from Dothideomycetes were included in our analysis. The final alignment contained 62 taxa including the outgroup, and 862 characters including alignment gaps; 338 of these were phylogenetically informative, 40 were variable and phylogenetically-uninformative, and 454 were constant. Tamura–Nei with Gamma distribution (TN93 + G) was used as the best-fit nucleotide substitution model for the ML analysis. The single isolate of *Blastacervulus eucalypti* was clustered in a well-supported clade (99% BS) together with *Aulographina eucalypti* and species of *Alysidiella*, being distinct from those species. This clade was phylogenetically related [98% bootstrap support (BS) value] with other members of Asterinaceae (Guatimosim et al. 2015) and all of them were grouped within the Asterinales clade (Fig. 1).

The BLAST search result using the LSU and ITS regions of the five isolates of *Clypeophysalospora latitans* showed them to be the closest taxa members of Xylariales and, therefore, representatives of different families if this order were added to the alignment. The final alignment included 42 taxa, including the outgroup sequences. The alignment comprised 794 bp, including alignment gaps; 179 of these were phylogenetically informative, 195 were variable and phylogenetically-uninformative, and 598 were conserved. Kimura 2-parameter with Gamma distribution (K2 + G) was used as the best-fit nucleotide substitution model for the ML analysis. The five isolates of *Clypeophysalospora* were placed

Table 1 Details of the strains included in this study

Species name	Strain accession number ^a	Locality	Substrate	Collector(s)	GenBank accession numbers ^b	
					ITS	LSU
<i>Aleurocystis hakgallae</i>	CFMR	USA: Hawaii	<i>Sapindus saponaria</i>	R.L.G. Gilbertson	KX358899	KX358900
<i>Blastocercivulus eucalypti</i>	CBS 124759, CPC 13956, ex-epitype	Australia: Mullion Creek	<i>Eucalyptus robertsonii</i> subsp. <i>hemisphaerica</i> , living leaves	B.A. Summerell	GQ303271	GQ303302
<i>Clypeophysalospora latitans</i>	CBS 141463, CPC 14930, ex-epitype	Portugal: Algarve region, Faro	<i>Eucalyptus</i> sp., leaves	P.W. Crous	KX820250	KX820261
	CPC 14931	Portugal: Algarve region, Faro	<i>Eucalyptus</i> sp., leaves	P.W. Crous	KX820251	KX820262
	CPC 14932	Portugal: Algarve region, Faro	<i>Eucalyptus</i> sp., leaves	P.W. Crous	KX820252	KX820263
	CPC 19661	South Africa: Stellenbosch mountain	<i>Eucalyptus</i> sp., leaves	P.W. Crous	KX820253	KX820264
	CPC 27352	France: Corsica, Porto	<i>Eucalyptus</i> sp., leaves	A. van Iperen	KX820254	KX820265
<i>Microstroma subgiganteum</i>	CFMR	USA: Maine	<i>Acer rubrum</i> , dead snag	R.J. Pinette	KX358901	KX358902
<i>Neohendersonia kickxii</i>	CBS 112403, ex-epitype	Italy: Pian di Novello	<i>Fagus sylvatica</i> , bark of twigs	R. Danti	KX820255	KX820266
	CBS 114276	Sweden: Uppland	<i>Fagus</i> sp.	K. & L. Holm	KX820256	KX820267
	CBS 122938	Austria: Carinthia, Sankt Margareten im Rosental	<i>Fagus sylvatica</i>	W. Jaklitsch	KX820257	KX820268
	CBS 122941	Austria: Grieskirchen, Natterbach	<i>Fagus sylvatica</i>	H. Voglmayr	KX820258	KX820269
<i>Neohendersonia</i> sp.	CPC 24865	Germany	<i>Fagus sylvatica</i> , twigs	R.K. Schumacher	KX820259	KX820270
<i>Spumatoria longicollis</i>	CBS 141464, CPC 30521, ex-epitype	Netherlands: near Oostvoorne	Cow's (Galloway) dung	J. van der Lee	KX820260	KX820271

^a CBS: Westerdijk Fungal Biodiversity Centre Utrecht, The Netherlands; CFMR: Center for Forest Mycology Research, Madison, USA; CPC: Collection Pedro Crous, housed at CBS

^b ITS: internal transcribed spacers and intervening 5.8S nrDNA; LSU: partial 28S nrDNA. Sequences newly generated in this study are indicated in **bold**

in a fully supported monophyletic clade (100% BS), phylogenetically related with the type species of *Plectosphaera eucalypti*, *Neophysalospora eucalypti* and species of *Bagadiella* (Fig. 2). The clade containing these genera represents a new lineage within the Xylariales and, therefore, a new family is proposed below to accommodate them.

The analysis of the LSU and ITS sequences from the five isolates of *Neohendersonia kickxii* using BLAST searches showed them to be the closest matches to members of Pleosporales (Dothideomycetes) but without resolution at the family level. The manually adjusted LSU alignment was constructed with representatives of different families of that order and contained 75 sequences (including the outgroup sequences) and 809 characters, including alignment gaps. In total, 224 bp were phylogenetically informative, 252 bp were variable and phylogenetically-uninformative, and 548 bp were

constant. The Kimura 2-parameter model with Gamma distribution and invariable sites (K2 + G + I) was used as the best-fit nucleotide substitution model for the ML analysis. In this analysis, the isolates of *Neohendersonia kickxii* clustered in a strongly supported monophyletic clade (100% BS), representing a novel family lineage within Pleosporales (Fig. 3).

The BLAST search result using the LSU, ITS and β -tubulin regions of *Spumatoria longicollis* showed them to be the closest matches to members of Ophiostomataceae (Ophiostomatales) and, therefore, they were included in the phylogenetic tree (Fig. 4). The final alignment included 21 taxa, including the outgroup, and 689 characters, including alignment gaps; 69 of these were phylogenetically informative, 91 were variable and phylogenetically-uninformative, and 598 were constant. Tamura–Nei with Gamma distribution and invariable sites (TN93 + G + I) was used as the

Table 2 Taxa used in the phylogenetic analyses, along with their GenBank accession numbers

Species name	Strain accession number ^a	Origin	GenBank accession number (LSU) ^b	Reference
<i>Medicopsis romeroi</i>	CBS 128765	Kuwait, human subcutaneous cyst	KF015621	Ahmed et al. (2014)
<i>Aliquandostipite khaoyaiensis</i>	CBS 118232	Thailand, decaying branch	GU301796	Schoch et al. (2009a)
<i>Alysidiella eucalypti</i>	CBS 120122	Uruguay, <i>Eucalyptus dunnii</i>	DQ885893	Crous et al. (2006a)
<i>Alysidiella kleinziiense</i>	CBS 120138	South Africa, <i>Eucalyptus</i> sp.	EF110616	Crous et al. (2007b)
<i>Alysidiella parasitica</i>	CBS 120088	South Africa, <i>Eucalyptus</i> sp.	DQ923525	Summerell et al. (2006)
<i>Alysidiella suttonii</i>	CBS 124780	Cyprus, <i>Eucalyptus</i> sp.	HM628777	Cheewangkoon et al. (2012)
<i>Apiospora montagnei</i>	ICMP 6967	Unknown	DQ414530	Tang et al. (2007)
<i>Apiospora sinensis</i>	Unknown	Unknown	DQ810215	Unpublished
<i>Apiosporina collinsii</i>	CBS 118973	Canada, <i>Amelanchier alnifolia</i>	GU301798	Schoch et al. (2009a)
<i>Apiosporina morbosa</i>	Unknown	USA, <i>Prunus</i> sp.	EF114694	Winton et al. (2007)
<i>Arthrimum phaeospermum</i>	HKUCC 3395	Unknown	AY083832	Unpublished
<i>Arthrimum saccharicola</i>	CBS 191.73	Netherlands, air	KF144966	Crous and Groenewald (2013)
<i>Ascocylindrica marina</i>	MD6012*	Saudi Arabia, Unknown host	KT252906	Unpublished
<i>Ascocylindrica marina</i>	MD6011*	Saudi Arabia, decayed wood at a sandy beach	KT252905	Unpublished
<i>Asterina chrysophylli</i>	VIC 42823	Brazil, Cerrado biome	KP143738	Guatimosim et al. (2015)
<i>Asterina melastomatis</i>	VIC 42822	Brazil, Atlantic rainforest	KP143739	Guatimosim et al. (2015)
<i>Asterotexis cucurbitacearum</i>	VIC 42814	Brazil, conserved area of Atlantic rainforest	KP143734	Guatimosim et al. (2015)
<i>Asterotexis cucurbitacearum</i>	PMA M-01412-24*	Panama, <i>Sechium edule</i>	HQ610510	Unpublished
<i>Aulographina eucalypti</i>	CPC 12986	Australia, <i>Eucalyptus cloeziana</i>	HM535600	Cheewangkoon et al. (2012)
<i>Bagadiella koalae</i>	CPC 17682	Australia, <i>Eucalyptus globulus</i>	JF951162	Crous et al. (2011)
<i>Bagadiella lunata</i>	CBS 124762	Australia, <i>Eucalyptus globulus</i>	GQ303300	Cheewangkoon et al. (2009)
<i>Bagadiella victoriae</i>	CPC 17688	Australia, <i>Eucalyptus</i> sp.	JF951161	Crous et al. (2011)
<i>Bambusicola bambusae</i>	MFLUCC 11-0614	Thailand, Bamboo	JX442035	Dai et al. (2015)
<i>Bambusicola loculata</i>	MFLU 15-0056	Thailand, Bamboo	KP761729	Dai et al. (2015)
<i>Bambusicola massarinia</i>	MFLUCC 11-0389	Thailand, Bamboo	JX442037	Dai et al. (2015)
<i>Batistinula gallsiae</i>	VIC 42514	Brazil, Atlantic rainforest	KP143736	Guatimosim et al. (2015)
<i>Batistinula gallsiae</i>	Unknown	Brazil, <i>Caesalpinia echinata</i>	KM111255	Unpublished
<i>Beltrania pseudorhombica</i>	CBS 138003	China, <i>Pinus tabulaeformis</i>	KJ869215	Crous et al. (2014b)

Table 2 (continued)

Species name	Strain accession number ^a	Origin	GenBank accession number (LSU) ^b	Reference
<i>Beltraniella endiandrae</i>	CBS 137976	Australia, <i>Endiandra introrsa</i>	KJ869185	Crous et al. (2014b)
<i>Beltraniopsis neolitsea</i>	CBS 137974	Australia, <i>Neolitsea australiensis</i>	KJ869183	Crous et al. (2014b)
<i>Botryosphaeria dothidea</i>	CBS 115476	Switzerland, <i>Prunus</i> sp.	DQ377852	Crous et al. (2006b)
<i>Capnodium coffeae</i>	CBS 147.52	Zaire, <i>Coffea robusta</i>	DQ247800	Schoch et al. (2006a)
<i>Capnodium salicinum</i>	CBS 131.34	Indonesia, <i>Bursaria spinosa</i>	DQ678050	Schoch et al. (2006b)
<i>Ceratocystiopsis minima</i>	CMW162	USA, <i>Pinus banksiana</i>	DQ294361	Zipfel et al. (2006)
<i>Ceratocystiopsis minuta-bicolor</i>	CMW1018	Unknown, Ips gallery in <i>Pinus</i>	DQ294359	Zipfel et al. (2006)
<i>Ceratocystiopsis rollhanseni</i>	CW13791*	Norway, beetle galleries in <i>Pinus sylvestris</i>	DQ294362	Zipfel et al. (2006)
<i>Clypeosphaeria uniseptata</i>	HKUCC 6349	Unknown	AY083830	Unpublished
<i>Cochliobolus sativus</i>	DAOM 226212	Unknown, from Poaceae	DQ678045	Schoch et al. (2006b)
<i>Corynespora cassiicola</i>	CBS 100822	Netherlands, <i>Saintpaulia ionantha</i>	GU301808	Schoch et al. (2009a)
<i>Corynespora smithii</i>	CABI 5649b	Unknown	GU323201	Schoch et al. (2009a)
<i>Corynespora torulosa</i>	CBS 136419	Mexico, <i>Musa acuminata</i>	KF777207	Crous et al. (2013)
<i>Cryptosphaeria eunomia</i>	CBS 216.97	New Zealand, rabbit dung	AY083826	Unpublished
<i>Cucurbitaria berberidis</i>	CBS 394.84	Netherlands, <i>Berberis julianae</i>	GQ387605	de Gruyter et al. (2010)
<i>Cucurbitaria berberidis</i>	CBS 130007	Austria, <i>Berberis vulgaris</i>	KC506793	Unpublished
<i>Diaporthe padi</i>	AR3419	Austria, <i>Prunus padus</i>	AF408354	Castlebury et al. (2002)
<i>Diaporthe perijuncta</i>	AR3461	Austria, <i>Ulmus glabra</i>	AF408356	Castlebury et al. (2002)
<i>Diplodia mutila</i>	CBS 431.82	Netherlands, <i>Fraxinus excelsior</i>	DQ377863	Crous et al. (2006b)
<i>Dissoconium aciculare</i>	CBS 204.89	Germany, <i>Astragalus</i> sp.	GU214419	Crous et al. (2009a)
<i>Dissoconium commune</i>	CBS 110747	South Africa, <i>Eucalyptus nitens</i>	GQ852589	Crous et al. (2009b)
<i>Dissoconium dekkeri</i>	CBS 111282	Zambia, <i>Eucalyptus globulus</i>	GU214425	Crous et al. (2009a)
<i>Eutypa</i> sp.	HKUCC 337	Unknown	AY083825	Unpublished
<i>Gibbera conferta</i>	CBS 191.53	Switzerland, <i>Vaccinium uliginosum</i>	GU301814	Schoch et al. (2009a)
<i>Gloniopsis arciformis</i>	GKM L166A	Unknown	GU323211	Schoch et al. (2009a)
<i>Glonium circumserpens</i>	CBS 123342	Tasmania, decorticated hardwood	FJ161208	Boehm et al. (2009)
<i>Glonium circumserpens</i>	CBS 123343	Tasmania, saxicolous on limestone	FJ161200	Boehm et al. (2009)
<i>Helicomycetes roseus</i>	CBS 283.51	Switzerland, submerged bark	AY856881	Tsui and Berbee (2006)
		Japan, dead wood	AB807521	Tanaka et al. (2015)

Table 2 (continued)

Species name	Strain accession number ^a	Origin	GenBank accession number (LSU) ^b	Reference
<i>Helminthosporium dalbergiae</i>	HHUF 27971			
<i>Helminthosporium magnisporum</i>	HHUF 27968	Japan, dead wood	AB807522	Tanaka et al. (2015)
<i>Helminthosporium massarinum</i>	HHUF 27573	Japan, <i>Berchemia racemosa</i>	AB807523	Tanaka et al. (2015)
<i>Helminthosporium velutinum</i>	HHUF 30140	Japan, submerged woody plant	AB807529	Tanaka et al. (2015)
<i>Hysterium angustatum</i>	CBS 123334	USA, <i>Pinus rigida</i>	FJ161207	Boehm et al. (2009)
<i>Hysteropatella clavispora</i>	BCC 28877	Unknown	GU371829	Schoch et al. (2009a)
<i>Idriella lunata</i>	CBS 204.56	USA, <i>Fragaria chiloensis</i> var. <i>ananassa</i>	KP858981	Hernández-Restrepo et al. (2016)
<i>Idriella lunata</i>	CBS 177.57	USA, unknown host	KP858980	Hernández-Restrepo et al. (2016)
<i>Inocyclus angularis</i>	VIC 39749	Brazil, Atlantic rainforest	KP143733	Guatimosim et al. (2015)
<i>Inocyclus angularis</i>	VIC 39747	Brazil, epiphytic on garden tree	KP143731	Guatimosim et al. (2015)
<i>Inocyclus angularis</i>	VIC 39748	Brazil, epiphytic on garden tree	KP143732	Guatimosim et al. (2015)
<i>Jahnula aquatica</i>	R68-1*	Unknown	EF175655	Campbell et al. (2007)
<i>Jahnula bipileata</i>	F49-1*	Unknown	EF175657	Campbell et al. (2007)
<i>Jahnula seychellensis</i>	SS2113.1*	Unknown	EF175665	Campbell et al. (2007)
<i>Keissleriella cladophila</i>	CBS 104.55	Pakistan, <i>Smilax parvifolia</i>	JX681090	Verkley et al. (2014)
<i>Latorua caligans</i>	CBS 576.65	Brazil, soil	KR873266	Crous et al. (2015a)
<i>Latorua grootfonteinensis</i>	CBS 369.72	Namibia, sandy soil	KR873267	Crous et al. (2015a)
<i>Lembosia abaxialis</i>	VIC 42825	Brazil, Cerrado biome	KP143737	Guatimosim et al. (2015)
<i>Lentithecium lineare</i>	IFRD 2008	Unknown	FJ795435	Zhang et al. (2009b)
<i>Leptosphaeria conoidea</i>	CBS 616.75	Netherlands, <i>Lunaria annua</i>	JF740279	de Gruyter et al. (2013)
<i>Leptosphaeria doliolum</i>	CBS 505.75	Netherlands, <i>Urtica dioica</i>	GQ387576	de Gruyter et al. (2010)
<i>Leptoxyphium fumago</i>	CBS 123.26	Indonesia, <i>Hibiscus tiliaceus</i>	GU214430	Crous et al. (2009a)
<i>Lophiostoma arundinis</i>	KT606	Japan, <i>Phragmites australis</i>	AB618998	Hirayama and Tanaka (2011)
<i>Lophiostoma macrostomum</i>	KT508	Japan, <i>Morus bombycis</i>	AB619010	Hirayama and Tanaka (2011)
<i>Macrodiplodiopsis desmazieri</i>	CPC 24972	Switzerland, <i>Platanus</i> sp.	KR873273	Crous et al. (2015a)
<i>Macrodiplodiopsis desmazieri</i>	CBS 123811	Austria, <i>Platanus</i> × <i>acerifolia</i>	KR873268	Crous et al. (2015a)
<i>Macrophomina phaseolina</i>	CBS 227.33	Unknown, <i>Zea mays</i>	DQ377906	Crous et al. (2006b)
<i>Massarina eburnea</i>	H 3953*	UK, <i>Fagus</i> sp.	AB521735	Hirayama et al. (2010)

Table 2 (continued)

Species name	Strain accession number ^a	Origin	GenBank accession number (LSU) ^b	Reference
<i>Massarina eburnea</i>	CBS 473.64	Switzerland, <i>Fagus sylvatica</i>	FJ201983	Zhang et al. (2008)
<i>Medicopsis romeroi</i>	CBS 252.60	Venezuela, maduromycosis in man	EU754207	Aveskamp et al. (2010)
<i>Melanomma pulvis-pyrius</i>	CBS 109.77	Netherlands, <i>Salix</i> sp.	FJ201986	Zhang et al. (2008)
<i>Melanomma pulvis-pyrius</i>	CBS 124080	France, <i>Salix caprea</i>	GU456323	Zhang et al. (2009a)
<i>Microdochium majus</i>	CBS 741.79	Germany, <i>Triticum aestivum</i>	KP858937	Hernández-Restrepo et al. (2016)
<i>Microdochium nivale</i>	CBS 116205	England, <i>Triticum aestivum</i>	KP858944	Hernández-Restrepo et al. (2016)
<i>Morosphaeria ramunculicola</i>	BCC 18404	Malaysia, Mangrove wood	GQ925853	Suetrong et al. (2009)
<i>Morosphaeria velatispora</i>	BCC 17059	USA, Mangrove wood	GQ925852	Suetrong et al. (2009)
<i>Murilentithecium clematidis</i>	MFLUCC 14-0561	Italy, <i>Clematis vitalba</i>	KM408758	Wanasinghe et al. (2014)
<i>Mycosphaerella punctiformis</i>	CBS 113265	Netherlands, <i>Quercus robur</i>	DQ470968	Spatafora et al. (2006)
<i>Neoscochyta europaea</i>	CBS 819.84	Germany, <i>Hordeum vulgare</i>	KT389728	Chen et al. (2015)
<i>Neoscochyta europaea</i>	CBS 820.84	Germany, <i>Hordeum vulgare</i>	KT389729	Chen et al. (2015)
<i>Neoscochyta</i> sp.	CBS 689.97	Norway, hay	KT389744	Chen et al. (2015)
<i>Neoscochyta</i> sp.	CBS 516.81	Italy, <i>Oryza sativa</i>	KT389743	Chen et al. (2015)
<i>Neophysalospora eucalypti</i>	CBS 138864	Mozambique, <i>Corymbia henryi</i>	KP004490	Crous et al. (2014c)
<i>Neoscytalidium dimidiatum</i>	CBS 145.78	UK, human foot	DQ377922	Crous et al. (2006b)
<i>Neoscytalidium novaehollandiae</i>	CMW 26170	Unknown	KF766374	Slippers et al. (2013)
<i>Neottiosporina paspali</i>	CBS 331.37	USA, <i>Paspalum notatum</i>	EU754172	de Gruyter et al. (2009)
<i>Ophiostoma eucalyptigena</i>	CBS 139899	Australia, <i>Eucalyptus marginata</i>	KR476756	Crous et al. (2015b)
<i>Ophiostoma fusiforme</i>	CMW9968	Azerbaijan, <i>Populus nigra</i>	DQ294354	Zipfel et al. (2006)
<i>Ophiostoma ips</i>	CMW7075	USA, <i>Ips integer</i>	DQ294381	Zipfel et al. (2006)
<i>Ophiostoma lunatum</i>	CMW10564	Austria, <i>Larix deciduas</i>	DQ294355	Zipfel et al. (2006)
<i>Ophiostoma multiannulatum</i>	CMW2567	USA, <i>Pinus</i>	DQ294366	Zipfel et al. (2006)
<i>Ophiostoma nigrocarpum</i>	CMW651	USA, <i>Pseudotsuga menziesii</i>	DQ294356	Zipfel et al. (2006)
<i>Ophiostoma novo-ulmi</i>	CMW10573	Austria, <i>Picea abies</i>	DQ294375	Zipfel et al. (2006)
<i>Ophiostoma phasma</i>	CMW20676	Unknown	DQ316151	Unpublished
<i>Ophiostoma pluriannulatum</i>	CMW75	Unknown	DQ294365	Zipfel et al. (2006)
<i>Ophiostoma pulvinisporum</i>	CMW9022	Mexico, <i>Pinus pseudostrobus</i>	DQ294380	Zipfel et al. (2006)
<i>Ophiostoma stenoceras</i>	CMW3202	Norway, pine pulp	DQ294350	Zipfel et al. (2006)
<i>Ophiostoma thermanum</i>	CMW38930	South Africa, <i>Euphorbia ingens</i>	KR051127	van der Linde et al. (2016)

Table 2 (continued)

Species name	Strain accession number ^a	Origin	GenBank accession number (LSU) ^b	Reference
<i>Ophiostoma ulmi</i>	CMW1462	USA, <i>Ulmus procer</i>	DQ294374	Zipfel et al. (2006)
<i>Parabambusicola bambusina</i>	H 4321*	Japan, <i>Sasa kurilensis</i>	AB807536	Tanaka et al. (2015)
<i>Parabambusicola bambusina</i>	KH 139	Japan, <i>Sasa</i> sp.	AB807537	Tanaka et al. (2015)
<i>Paraphaeosphaeria michotii</i>	CBS 652.86	Switzerland, <i>Typha latifolia</i>	GQ387581	de Gruyter et al. (2010)
<i>Paraphaeosphaeria michotii</i>	ETH 9483*	Switzerland, <i>Typha latifolia</i>	JX496216	Verkley et al. (2014)
<i>Paraphaeosphaeria minitans</i>	CBS 122788	UK, unknown host	EU754173	de Gruyter et al. (2009)
<i>Parmularia styracis</i>	VIC 42450	Brazil, conserved area of Cerrado biome	KP143729	Guatimosim et al. (2015)
<i>Parmularia styracis</i>	VIC 42447	Brazil, conserved area of Cerrado biome	KP143728	Guatimosim et al. (2015)
<i>Parmularia styracis</i>	VIC 42587	Brazil, abandoned area	KP143730	Guatimosim et al. (2015)
<i>Patellaria</i> cf. <i>atrata</i>	BCC 28876	Unknown	GU371828	Schoch et al. (2009a)
<i>Patellaria</i> cf. <i>atrata</i>	BCC 28877	Unknown	GU371829	Schoch et al. (2009a)
<i>Periconia macrospinosa</i>	CBS 135663	Hungary, roots of host of <i>Festuca vaginata</i>	KP184038	Knapp et al. (2015)
<i>Periconia pseudodigitata</i>	KT 1395	Japan, <i>Phragmites australis</i>	AB807564	Tanaka et al. (2015)
<i>Periconia pseudodigitata</i>	KT 1195A	Japan, submerged herbaceous plant	AB807563	Tanaka et al. (2015)
<i>Phaeocryptopus gaeumannii</i>	CBS 267.37	Germany, <i>Phaeocryptopus gaeumannii</i>	EF114698	Winton et al. (2007)
<i>Phaeotrichum benjaminii</i>	CBS 541.72	Unknown, dung of rodent	AY779311	Lumbsch et al. (2005)
<i>Plectosphaera eucalypti</i>	CBS 120063	Australia, <i>Eucalyptus orbifolia</i>	DQ923538	Summerell et al. (2006)
<i>Pleospora herbarum</i>	CBS 191.86	India, <i>Medicago sativa</i>	GU238160	Aveskamp et al. (2010)
<i>Polyschema congolensis</i>	CBS 542.73	Zaire, soil	EF204502	Unpublished
<i>Polyschema larviformis</i>	CBS 463.88	Turkey, soil	EF204503	Unpublished
<i>Polyschema terricola</i>	CBS 301.65	Brazil, soil	EF204504	Unpublished
<i>Prillieuxina baccharidincola</i>	VIC 42817	Brazil, unknown host	KP143735	Guatimosim et al. (2015)
<i>Pseudobeltrania ocoteae</i>	CPC 26219	La Reunion, <i>Ocotea</i> sp.	KT950870	Unpublished
<i>Pseudocercospora fijiensis</i>	AFTOL-ID 2021	Unknown	DQ678098	Unpublished
<i>Pseudocercospora vitis</i>	CPC 11595	South Korea, <i>Vitis vinifera</i>	JX901912	Quaedvlieg et al. (2012)
<i>Pseudodictyosporium elegans</i>	CBS 688.93	Taiwan, decaying stem	DQ018106	Unpublished
<i>Pseudodictyosporium wauense</i>	NBRC 30078	Japan, decayed leaf	DQ018105	Unpublished
<i>Psiloglonium simulans</i>	CBS 206.34	USA, <i>Tilia</i>	FJ161178	Boehm et al. (2009)
<i>Pyrenochaeta quercina</i>	CBS 115095	Italy, <i>Quercus robur</i>	GQ387619	de Gruyter et al. (2010)

Table 2 (continued)

Species name	Strain accession number ^a	Origin	GenBank accession number (LSU) ^b	Reference
<i>Pyrenochaeta quercina</i>	CBS 297.74	Montenegro, sea water	GQ387620	de Gruyter et al. (2010)
<i>Rhytidhysteron rufulum</i>	CBS 306.38	Unknown, <i>Pistacia chinensis</i>	FJ469672	Schoch et al. (2009b)
<i>Rosellinia necatrix</i>	HKUCC 9037	Unknown	AY083824	Unpublished
<i>Rousoella acaciae</i>	CBS 138873	Tanzania, <i>Acacia tortilis</i>	KP004497	Crous et al. (2014c)
<i>Rousoella percutanea</i>	CBS 128203	India, <i>Homo sapiens</i>	KF366448	Ahmed et al. (2014)
<i>Rousoella percutanea</i>	CBS 868.95	Aruba, <i>Homo sapiens</i>	KF366449	Ahmed et al. (2014)
<i>Rousoella scabrispora</i>	MFLUCC 11-0624	Thailand, bamboo	KJ474844	Liu et al. (2014)
<i>Saccharomyces cerevisiae</i>	DAOM 216365	Unknown	JN938921	Schoch et al. (2012)
<i>Schizothyrium pomi</i>	CBS 228.57	Italy, unknown host	EF134947	Batzer et al. (2008)
<i>Schizothyrium pomi</i>	CBS 486.50	Netherlands, <i>Polygonum sachalinense</i>	EF134948	Batzer et al. (2008)
<i>Seimatosporium sorbi</i>	MFLUCC 14-0469	Italy, unknown host	KT281911	Unpublished
<i>Seimatosporium vitis</i>	MFLUCC 14-0051	Italy, <i>Vitis vinifera</i>	KR920362	Senanayake et al. (2015)
<i>Seiridium cardinale</i>	CBS 172.56	Unknown	AF382376	Jeewon et al. (2002)
<i>Seiridium papillatum</i>	CBS 340.97	Tasmania, <i>Eucalyptus delegatensis</i>	DQ414531	Unpublished
<i>Seiridium phylicae</i>	CPC 19965	UK, <i>Phylica arborea</i>	KC005809	Crous et al. (2012)
<i>Seiridium phylicae</i>	CPC 19962	UK, <i>Phylica arborea</i>	NG042759	Crous et al. (2012)
<i>Sporothrix inflata</i>	CMW12527	Germany, host soil in wheat field	DQ294351	Zipfel et al. (2006)
<i>Sporothrix pallida</i>	CBS 131.56	South Africa, sporophore	EF139121	de Meyer et al. (2008)
<i>Sporothrix schenckii</i>	CMW7614	South Africa, human sporotrichosis	DQ294352	Zipfel et al. (2006)
<i>Sporothrix stylites</i>	CMW14543	South Africa, wood pole	EF139115	de Meyer et al. (2008)
<i>Stagonospora paludosa</i>	CBS 135088	Netherlands, <i>Carex acutiformis</i>	KF251760	Quaedvlieg et al. (2013)
<i>Stagonospora pseudocaricis</i>	S610*	France, <i>Carex acutiformis</i>	KF251763	Quaedvlieg et al. (2013)
<i>Sulcatispora acerina</i>	KT 2982	Japan, <i>Acer palmatum</i>	LC014610	Tanaka et al. (2015)
<i>Sulcatispora berchemiae</i>	KT 1607	Japan, <i>Berchemia racemosa</i>	AB807534	Tanaka et al. (2015)
<i>Teratosphaeria</i> cf. <i>bellula</i>	CPC 18280	South Africa, <i>Phaenocoma prolifera</i>	JF499864	Crous and Groenewald (2011)
<i>Teratosphaeria fibrillosa</i>	CBS 121707	South Africa, <i>Protea</i> sp.	KF902075	Quaedvlieg et al. (2014)
<i>Teratosphaeria stellenboschiana</i>	CBS 116428	South Africa, <i>Eucalyptus</i> sp.	EU019295	Crous et al. (2007a)
<i>Teratosphaeria suberosa</i>	CPC 11032	Colombia, <i>Eucalyptus</i> sp.	GU214512	Crous et al. (2009a)
<i>Torula ficus</i>	CBS 595.96	Cuba, <i>Ficus religiosa</i>	KF443385	Ahmed et al. (2014)
<i>Torula herbarum</i>	CBS 140066		KR873288	Crous et al. (2015a)

Table 2 (continued)

Species name	Strain accession number ^a	Origin	GenBank accession number (LSU) ^b	Reference
		Netherlands, <i>Phragmites australis</i>		
<i>Torula hollandica</i>	CBS 220.69	Netherlands, <i>Delphinium</i> sp.	KF443384	Ahmed et al. (2014)
<i>Torula masonii</i>	CBS 245.57	UK, <i>Brassica</i> sp.	KR873289	Crous et al. (2015a)
<i>Trematosphaeria pertusa</i>	CBS 122371	France, <i>Platanus</i> sp.	FJ201992	Zhang et al. (2008)
<i>Trematosphaeria pertusa</i>	CBS 122368	France, <i>Fraxinus excelsior</i>	FJ201990	Zhang et al. (2008)
<i>Trichodelitschia bisporula</i>	CBS 262.69	Netherlands, dung of rabbit	GU348996	Schoch et al. (2009a)
<i>Tubeufia paludosa</i>	CBS 120503	USA, rotten wood	GU301877	Schoch et al. (2009a)
<i>Venturia inaequalis</i>	CBS 176.42	France, <i>Pyracantha coccinea</i>	GU348998	Schoch et al. (2009a)
<i>Venturia populina</i>	CBS 256.38	Italy, <i>Populus canadensis</i>	GU323212	Schoch et al. (2009a)
<i>Vialaea mangifia</i>	MFLUCC 12-0808	Thailand, <i>Mangifera indica</i>	KF724975	Senanayake et al. (2014)
<i>Vialaea minutella</i>	BRIP 56959	Australia, <i>Mangifera indica</i>	KC181924	McTaggart et al. (2013)
<i>Wojnowiciella eucalypti</i>	CBS 139904	Colombia, <i>Eucalyptus grandis</i>	KR476774	Crous et al. (2015b)
<i>Wojnowiciella viburni</i>	MFLUCC 120733b	China, <i>Viburnum utile</i>	KC594287	Unpublished
<i>Xylaria frustulosa</i>	ANM 1300	USA, unknown host	JN673055	Raja et al. (2011)

^a AFTOL: Assembling the Fungal Tree of Life project; ANM: A.N. Miller personal collection; AR: Amy Y. Rossman personal collection; BCC: Belgian Coordinated Collections of Microorganisms; BRIP: Plant Pathology Herbarium, Department of Agriculture, Fisheries and Forestry, Queensland, Australia; CABI: International Mycological Institute, CABI-Bioscience, Bakeham Lane, Egham, UK; CBS: Westerdijk Fungal Biodiversity Centre, Utrecht, The Netherlands; CMW: Mike Wingfield personal collection; CPC: Collection Pedro Crous; DAOM: Plant Research Institute, Department of Agriculture (Mycology), Ottawa, Canada; GKM: G.K. Mugambi personal collection; HHUF: Herbarium of Hirosaki University, Japan; HKUCC: University of Hong Kong Culture Collection, Department of Ecology and Biodiversity, Hong Kong, China; ICMP: International Collection of Microorganisms from Plants, Plant Diseases Division, DSIR, Auckland, New Zealand; IFRDCC: Culture Collection, International Fungal Research & Development Centre, Chinese Academy of Forestry, Kunming, China; KT: K. Tanaka personal collection; MFLUCC/MFLU: Mae Fah Luang University Culture Collection, Chiang Rai, Thailand; NBRC: NITE Biological Resource Centre, Japan; VIC: Herbarium of the Universidade Federal de Viçosa. *Strain designation from GenBank

^b LSU: partial 28S nrDNA

best-fit nucleotide substitution model for the ML analysis. *Spumatoria longicollis* was placed on a single branch, phylogenetically separated from the species included (De Beer et al. 2013, 2016; van der Linde et al. 2016).

The genera

Aleurocystis Lloyd ex G. Cunn., Trans. & Proc. Roy. Soc. N.Z. 84: 234 (1956).

Synonym: *Matula* Masee, J. Roy. Microscop. Soc. 4: 176 (1888).

Classification: Incertae sedis, Agaricales, Agaricomycetes.

Current generic circumscription: Basidiomata annual, as small pustules, cupulate-discoid to resupinate with raised margin, pale ochre to light pink, gelatinous when fresh, horny when dry. Hyphal system monomitic, generative hyphae thin- to thick-walled, with clamps. Lamprocystidia (metuloid cystidia) present, hymenial to subhymenial, thick-walled. Gloeocystidia present in one species. Dendrohyphidia present in some species, usually only slightly branched. Basidia clavate, with four sterigmata. Basidiospores large, subglobose to ellipsoid, walls thin, smooth, non-amyloid.

Type species: *Aleurocystis hakgallae* (Berk. & Broome) G. Cunn. 1956.

Fig. 1 Maximum composite likelihood tree based on the analysis from the partial LSU sequences from species included in different orders from Dothideomycetes. Bootstrap support values above 70% are shown at the nodes. Clades are delineated based on the phylogeny of Guatimosim et al. (2015). The tree was rooted with *Saccharomyces cerevisiae*

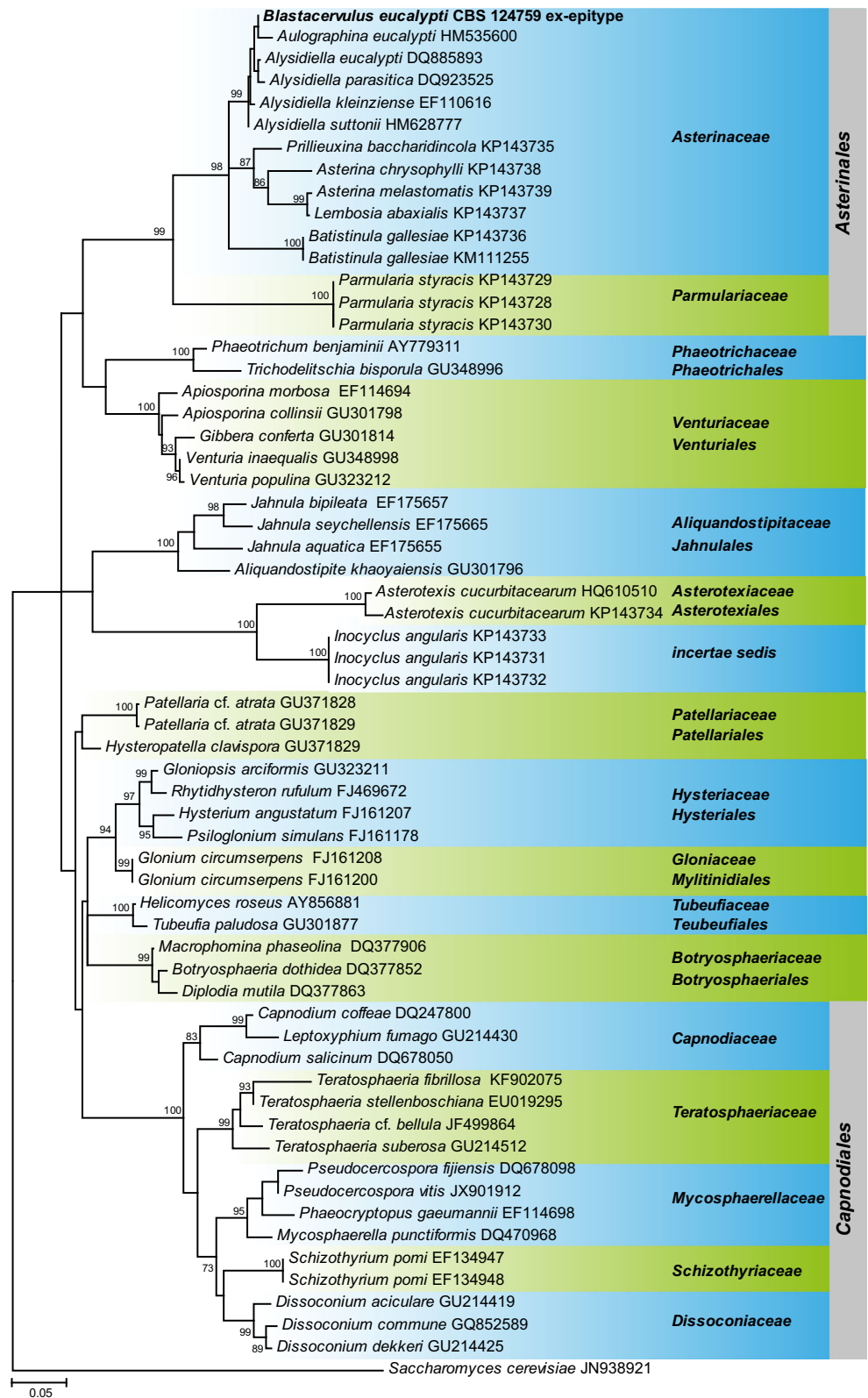
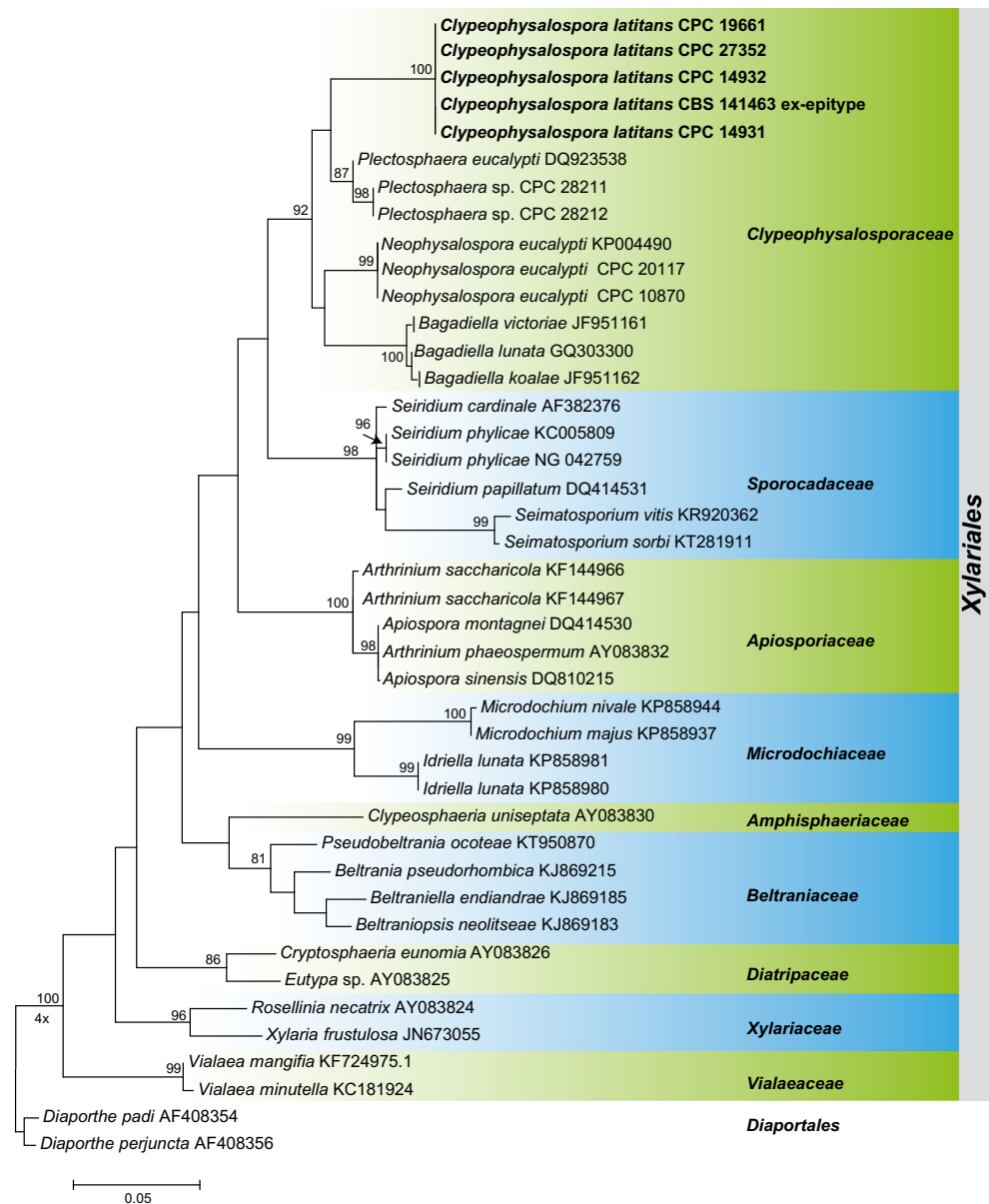


Fig. 2 Maximum composite likelihood tree based on the analysis from the partial LSU sequences from species included in different families from Xylariales. Bootstrap support values above 70% are shown at the nodes. Species from which their LSU sequences were generated here are shown in **bold**. The tree was rooted with *Diaporthe padi* and *D. perijuncta* (Diaporthales)



Aleurocystis hakgallae (Berk. & Broome) G. Cunn. [as ‘*habgallae*’], Trans. & Proc. Roy. Soc. N.Z. 84: 235 (1956). Fig. 5a, b

Mycobank: MB 292367

Basionym. *Corticium hakgallae* Berk. & Broome [as ‘*habgallae*’], J. Linn. Soc., Bot. 14: 72 (1873) [1875].

Synonyms. *Peniophora hakgallae* (Berk. & Broome) Cooke, Grevillea 8: 20 (1879).

Matula poroniiiforme (Berk. & Broome) Masee [as ‘*poroniaeformis*’], J. Roy. Microscop. Soc. 4: 176 (1888).

Cytidia cornea Lloyd, Mycol. Writ. 5: 656 (1917).

Aleurodiscus capensis Lloyd, Mycol. Writ. 6 (Letter 62): 930 (1920).

Cytidia hakgallae (Berk. & Broome) G.W. Martin, Lloydia 5: 160 (1942).

Aleurodiscus hakgallae (Berk. & Broome) Donk, Persoonia 1: 68 (1959).

Description: Basidiomata annual, cupulate-discooid to resupinate with raised margin, as small separate pustules, round to orbicular, about 5 mm in diam., more thickened in the middle, texture (in dried material) dense cartilaginous. Abhymenial surface more or less smooth, few hyaline hairs may be present. Hymenial surface whitish cream to pale ochre, smooth.

Fig. 3 Maximum composite likelihood tree based on the analysis from the partial LSU sequences from species included in different families from Pleosporales. Bootstrap support values above 70% are shown at the nodes. Clades are delineated based on the phylogeny of Tanaka et al. (2015). Species from which their LSU sequences were generated here are shown in **bold**. The tree was rooted with *Neoscytalidium novaehollandiae* and *N. dimidiatum* (Botryosphaeriales)

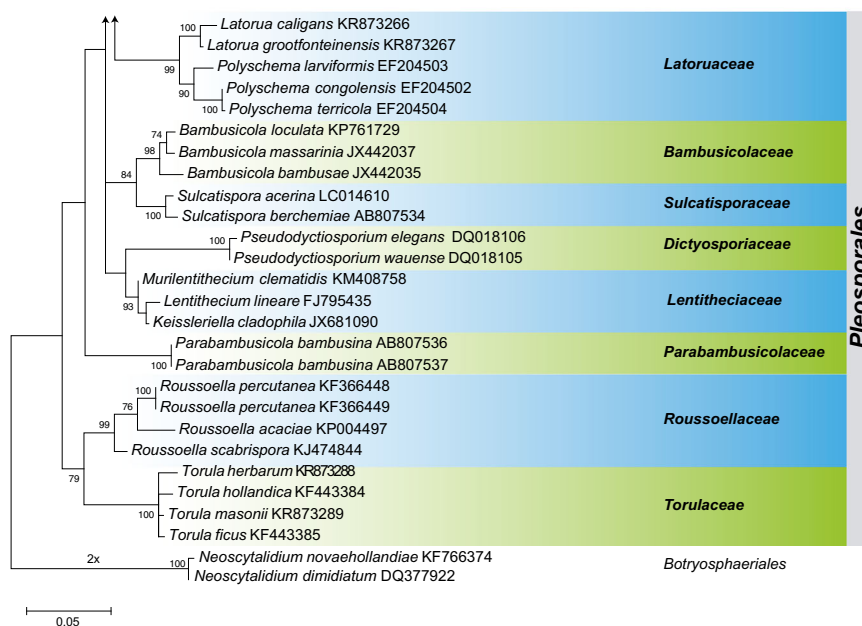
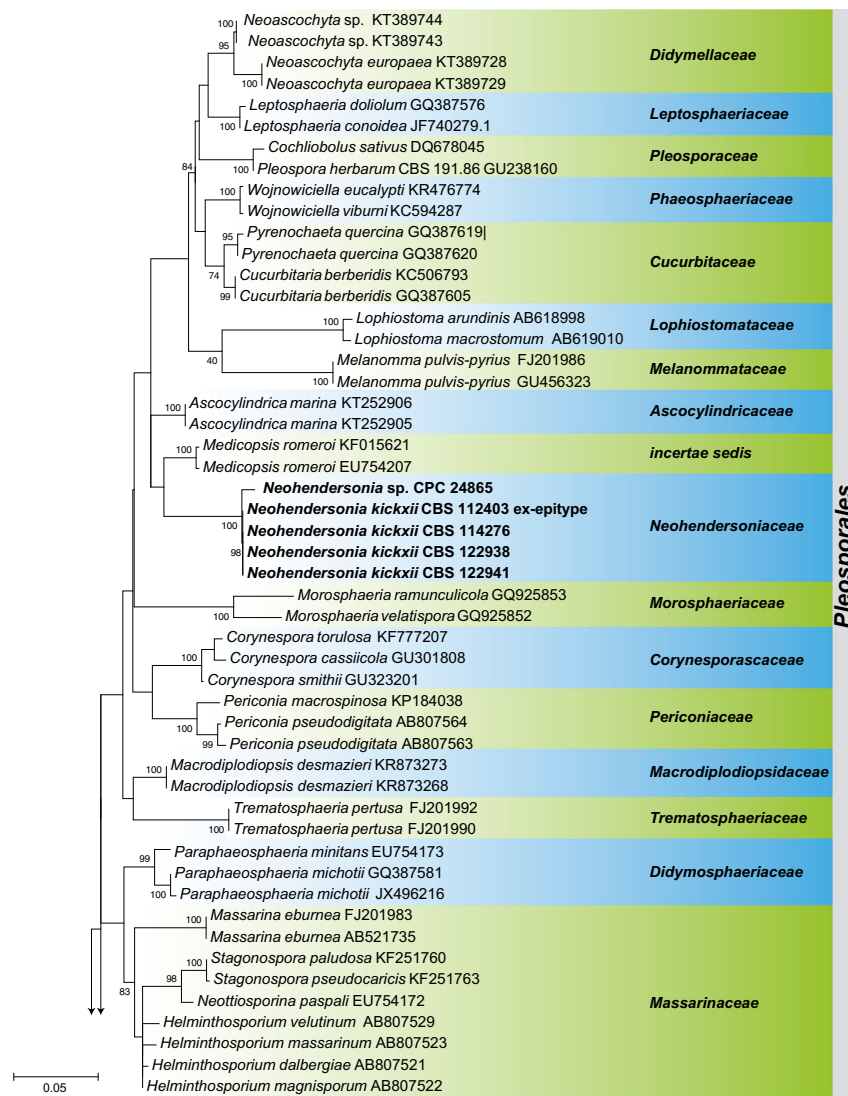
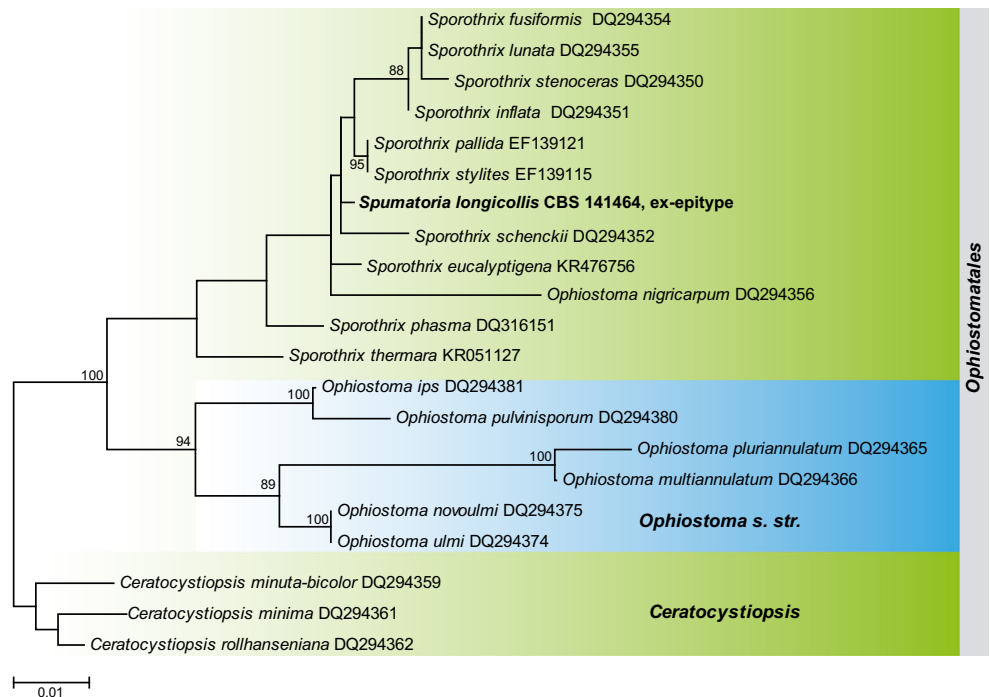


Fig. 4 Maximum composite likelihood tree based on the analysis from the partial LSU sequences from species included in the *Ophiostoma* and *Sporothrix* clades from the Ophiostomatales according to De Beer et al. (2016) and van der Linde et al. (2016). Bootstrap support values above 70% are shown at the nodes. Species from which their LSU sequences were generated here are shown in **bold**. The tree was rooted with *Ceratocystiopsis* species (Ophiostomatales)



Hyphal system monomitic, all hyphae with clamps, thin-walled in the subhymenium, thick-walled in subiculum,

gelatinised in KOH, intricate and difficult to discern, 4–7 μm wide, hymenial elements with granular, oily substances



Fig. 5 Species of *Corticium*, *Aleurocystis* and *Licrostroma*. **a** *Corticium hakgallae* (holotype, K). **b** *Aleurocystis hakgallae* (Gilbertson RLG-23290, CFMR). **c** *Corticium subgiganteum* (holotype, K). **d**

Conidiomata of *Licrostroma subgiganteum* (Pinette RJP-7289, CFMR). **e** Basidiomata of *Licrostroma subgiganteum* (Pinette RJP-7290, CFMR). Scale bars: 2 cm

as seen in KOH (large acicular crystals present on hymenial and tramal hyphae in RLG-23290). Subiculum thin, subicular hyphae branched, 3–9 µm wide. Lamprocystidia (metuloid cystidia) present in hymenium and subhymenium, thick-walled, conical, acute, coarsely encrusted in upper half, more or less ventricose and stalked in the subhymenium, slightly projecting above the hymenial layer, 50–140 × 9–14 µm, hyaline. Dendrohyphidia scattered among basidia, little-branched in the upper part, widened in the lower, unbranched part, about 40–50 × 4.5–7 µm. Basidia clavate to cylindrical, 50–80 × 12–18 µm, bearing four sterigmata. Basidiospores large, subglobose to widely ellipsoid, with a small, prominent apiculus, thin-walled, hyaline, smooth, with granular, oily substances as seen in KOH, negative in Melzer's reagent, 16–23 × 13–16 µm. Conidia globose, thick-walled, walls 2.5–3 µm thick, smooth, negative in Melzer's reagent, 17–20 µm in diameter.

Specimens examined: Sri Lanka, Hakgala, on dead bark of an angiosperm tree, sine dat., Thwaites 339 [K(M) 203643 – holotype]. USA, Hawaii, Bird park, HUNP, Kau District County, on *Sapindus saponaria*, 15 Jan. 2000, Gilbertson RLG-23290 (CFMR – reference material designated here); ex-reference material sequences, GenBank nos. KX358899 (ITS), KX358900 (LSU).

Notes: The genus *Aleurocystis*, typified with *A. hakgallae*, comprises three corticioid species with cupuloid to discoid basidiomes, lamprocystidia, monomitic hyphal system with clamped hyphae, and large, non-amyloid basidiospores. Morphologically, the genus was assumed by Ryvarden (1998) to be related to the genera *Cytidia* (in Corticiales) and *Aleurodiscus* (in Russulales). We scrutinised the bibliographic literature on the generic type to locate its original material. In his study on types of corticioid fungi described by M. J. Berkeley, Hjortstam (1989) also listed *C. 'hakgallae'* as the generic type for *Aleurocystis*. Upon an inquiry to K herbarium, we received a material filed as *Peniophora hakgallae* (Fig. 5a). The material contains a handwritten name and number matching the protologue by Berkeley and Broome (1875). Therefore, we are of the opinion that K(M) 203643 represents the original material of *Corticium hakgallae*. No conidial stage was detected on this K(M) 203643 specimen. The specimen from CFMR (Fig. 5b) morphologically conforms the type and we could obtain ITS and LSU sequences from it.

A MegaBLAST search of the GenBank nucleotide database at NCBI (as of 25 May 2016) showed that the best three hits using the new LSU sequence were *Gloeostereum incarnatum*, *Baeospora myosura* and *Xeromphalina campanella*, with 94–95% identity over 100% query coverage. Using the new ITS sequence, the best hits were *Tephrocybe* cf. *carbonaria* and *Lyophyllum* spp., with 82–83% identity over 91% query coverage. Therefore,

Aleurocystis sensu *typi* is shown to belong to the order Agaricales.

Authors: M. Ghobad-Nejhad and E. Langer

Blastacervulus H.J. Swart, Trans. Br. Mycol. Soc. 90: 289 (1988).

Classification: Asterinaceae, Asterinales, Dothideomycetes

Current generic circumscription: Follicolous, plant pathogenic. Conidiomata acervular, brown, subcuticular with a single layer of brown epidermal cells; conidioma with brown hyphal threads, verruculose, septate, 3–4 µm diam., giving rise to conidia in a sympodial fashion, holoblastic. Conidia in a dry powdery mass, globose to ellipsoidal, medium brown, thick-walled, verruculose, guttulate, frequently in chains of two, at times with a thin mucoid sheath, base truncate, unthickened.

Type species: *Blastacervulus eucalypti* H.J. Swart 1988.

Blastacervulus eucalypti H.J. Swart, Trans. Br. Mycol. Soc. 90: 289 (1988). Fig. 6

Mycobank: MB 133297

Description: Leaf spots not extending through leaf lamina; circular to subcircular or irregular, 2–6 mm diam., becoming confluent, brown, raised with a yellow halo. Conidiomata acervular, up to 350 µm diam., brown, subcuticular with a single layer of brown epidermal cells, frequently arranged in a radiating pattern, or in circles, from centre of leaf spot. Conidioma with brown hyphal threads, verruculose, septate, 3–4 µm diam., giving rise to conidia in a sympodial fashion, holoblastic. Conidia in a dry powdery mass, globose to ellipsoidal, medium brown, thick-walled, verruculose, guttulate, frequently in chains of two, at times with a thin mucoid sheath, base truncate, unthickened, 2–3 µm diam., apex obtuse, (4)6–7(8) × (4)5–6 µm.

Culture characteristics: Colonies on MEA and SNA attaining 10 mm diam. after 1 month at 25 °C, black, membranous with scarce aerial mycelium.

Specimens examined: Australia, Victoria, Calder Highway near Woodend, on living leaves of *Eucalyptus obliqua*, 13 Oct. 1979, H.J. Swart (holotype DAR 58998); Mullion Creek, on *Eucalyptus robertsonii* subsp. *hemisphaerica*, 26 Jan. 2007, B.A. Summerell (epitype designated here, CBS H-20278, MycoBank MBT373086; culture ex-epitype CBS 124759 = CPC 13956).

Notes: Swart (1988) regarded *B. eucalypti* as reminiscent of the genus *Staninwardia*, but distinct in having thallic, 1-septate conidia with truncate, flat hila. Phylogenetically, the two genera are members of Dothideomycetes, but according to the phylogeny of Cheewangkoon et al. (2009), *Staninwardia* (represented by *S. suttoni*) is closely related to Capnodiales, and recently it was accommodated in the Extremaceae (Quaedvlieg et al. 2014). *Blastacervulus*, on the other hand, belongs to Asterinales. Another similar genus is the monotypic *Fairmaniella* (Sutton 1980), but in the case of *F. eucalypti*,

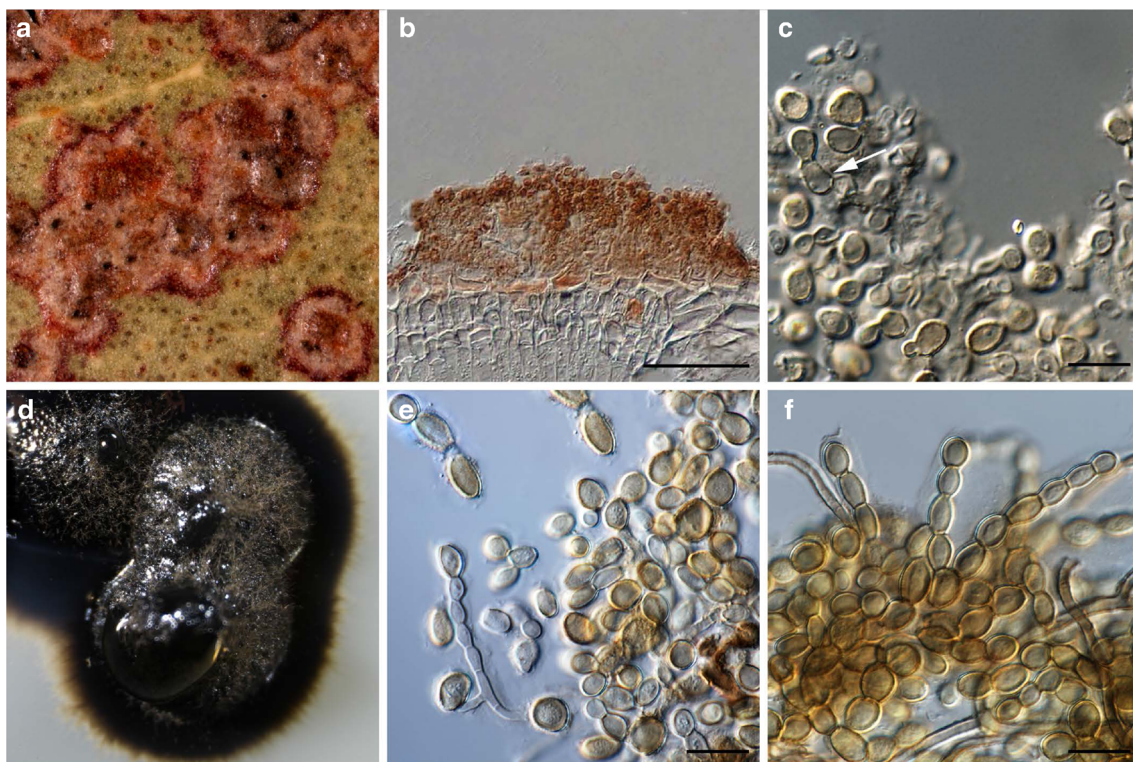


Fig. 6 *Blastacervulus eucalypti* (CBS 124759). **a** Leaf symptoms. **b** Vertical sections through conidioma **c** Conidiogenous cells (arrow) and conidia from leaves. **d** Colony sporulating on MEA. **e, f** Conidia in chains. Scale bars: **b** = 100 μm , all others = 10 μm

conidia are smaller ($4\text{--}7.5 \times 3\text{--}4.5 \mu\text{m}$) and ellipsoid-fusoid in shape. The LSU analysis showed that *B. eucalypti* belongs to Asterinaceae (Asterinales), which includes species forming foliicolous or lichenicolous, superficial, dark brown to black colonies (Hyde et al. 2013; Guatimosim et al. 2015). *Blastacervulus eucalypti* is closely related with *Aulographina eucalypti* and *Alysidiella* species (Fig. 1), all of them associated with target spot and chocolate spot disease on *Eucalyptus*, respectively (Cheewangkoon et al. 2012).

Authors: A. Giraldo and P.W. Crous

Clypeophysalosporaceae Giraldo & Crous, fam. nov.

Mycobank: MB 818514

Description: Endophytic, saprobic or plant pathogenic. Ascum perithecial, brown or black, immersed, single, rarely in pairs, globose, sometimes with clypeus or pseudoclypeus, wall of several layers of brown and flattened cells. Asci mixed with paraphyses, cylindrical or obclavate, hyaline, unitunicate, 8-spored, with apical mechanism staining in Melzer's reagent. Ascospores uniseriate or biseriata, unicellular, hyaline, fusoid-ellipsoidal, commonly surrounded by a mucoid sheath. Asexual morph coelomycetes or hyphomycetes. Conidiomata pycnidial, globose, solitary to aggregated, brown. Conidiophores differentiated or reduced to conidiogenous cells (pycnidial form), forming fascicles or rosettes on leaves, or solitary on the hyphae (hyphomycetal form), cylindrical to

subcylindrical, brown to pale grey-brown. Conidiogenous cells phialidic, ampulliform, lageniform or subcylindrical, terminal and intercalary, pale to medium brown, apex with flared collarette. Conidia solitary or in slimy heads, subcylindrical, curved, hyaline, obtuse apex and truncate to subtruncate base.

Type genus: *Clypeophysalospora* H.J. Swart. 1981.

Type species: *Clypeophysalospora latitans* (Sacc.) H.J. Swart.

Genera included: *Bagadiella*, *Clypeophysalospora*, *Neophysalospora* and *Plectosphaera*.

Clypeophysalospora H.J. Swart, Trans. Br. Mycol. Soc. 76: 93 (1981).

Classification: Clypeophysalosporaceae, Xylariales, Sordariomycetes.

Current generic circumscription: Ascum perithecial, scattered, immersed, single or rarely in pairs, covered by a dark clypeus, with a wall consisting of darkened, flattened, thin-walled cells and with a narrow periphysate ostiole. Asci paraphysate, cylindrical or slightly swollen, unitunicate, with an amyloid apical ring and a pulvillus. Ascospores mostly uniseriate or irregularly arranged, hyaline, ellipsoid, with mucous outer wall layer. Asexual morph unknown.

Type species: *Clypeophysalospora latitans* (Sacc.) H.J. Swart 1981.

Clypeophysalospora latitans (Sacc.) H.J. Swart, Trans. Br. Mycol. Soc. 76: 95 (1981). Fig. 7

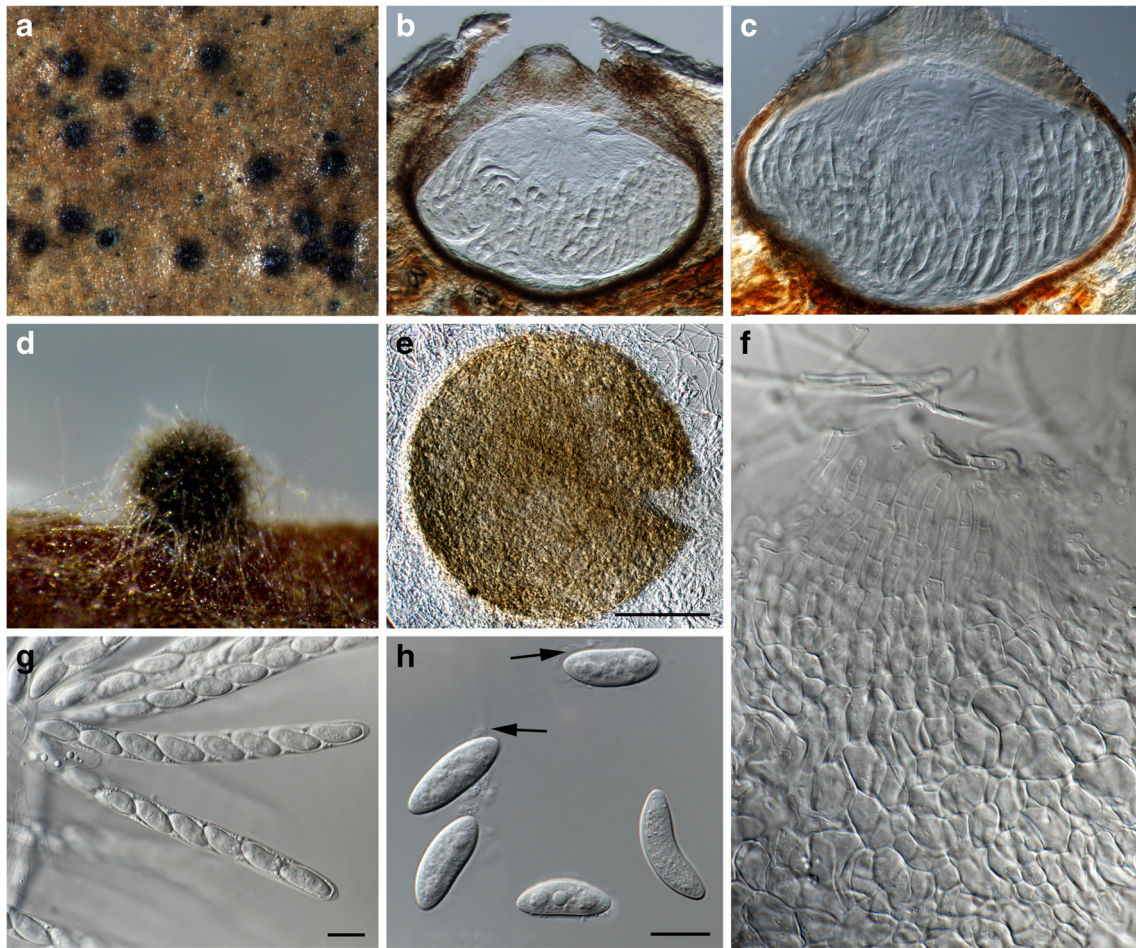


Fig. 7 *Clypeophysalospora latitans* (CPC 14930). **a** Leaf symptoms. **b, c** Vertical sections through ascoma. **d** Ascoma on PNA. **e** Ascoma. **f** Details of ostiolar region and peridium. **g** Asci. **h** Ascospores (arrows denote mucoid sheaths). Scale bars: **e** = 50 μ m, all others = 10 μ m

Mycobank: MB 112195

Basionym. *Physalospora latitans* Sacc. Flora. Myc. Lusitan. 67 (1893).

Synonym. *Amerostege latitans* (Sacc.) Theiss. Annales. Mycologici. 14: 411 (1917).

Description: Ascomata visible as erumpent, hemispherical, brown on the host surface; in vertical section 320–450 μ m diam., immersed, globose, clypeate, with a central periphysate ostiolar canal, surface of textura epidermoidea or globosa. Peridium 13–16 μ m wide, comprising several layers of brown compressed cells. Clypeus composed of dark brown compressed host cells and fungal hyphae. Paraphyses up to 6.4 μ m in diam., hypha-like, flexuose, septate, numerous, hyaline and embedded in a gelatinous matrix. Asci 8-spored, cylindrical, unitunicate, thin-walled, with a J+ and an amyloid apical ring, in vivo 115–141 \times 11–16 μ m, in vitro (107)108–117(118) \times 9–10 μ m. Ascospores uniseriate, unicellular, ellipsoidal, slightly curved, smooth-walled, in vivo 13–22 \times 6–9 μ m, in vitro (11)13–19(20) \times 5–7 μ m, hyaline, surrounded by a thin mucilaginous sheath. Asexual morph not observed.

Culture characteristics: Colonies on OA and MEA attaining 10 mm diam. after 3 weeks at 25 $^{\circ}$ C, flat, floccose to granulose, dirty white to pale rose.

Specimens examined: France, Corsica, Porto-Vecchio, on living leaves of *Eucalyptus* sp., 2 May 2005, P. W. Crous (CPC 27352). Portugal, Algarve, Faro, on living leaves of *Eucalyptus* sp., 24 Jan. 2008, P. W. Crous (epitype designated here, CBS H-20289, MycoBank MBT373087; culture epitype CBS 141463 = CPC 14930, CPC 14931, CPC 14932); Beira Litoral, Coímbra (PAD 2747 lectotype). South Africa, Stellenbosch Mountain, on living leaves of *Eucalyptus* sp., 8 Aug. 2011, P. W. Crous (CPC 19661).

Notes: After the morphological examination of fresh material of *Clypeophysalospora latitans*, Kang et al. (1999) considered that the presence of immersed and clypeate ascomata, among other morphological characteristics, were similar to those observed in the genus *Clypeosphaeria*, and, therefore, *C. latitans* was accommodated in Clypeosphaeriaceae together with the other 16 allied genera (Kang et al. 1999). However, no molecular data were provided at that time. Although the type species of that family is *Clypeosphaeria mamillana*, Senanayake et al.

(2015) used the LSU and ITS sequences of *C. uniseptata* (the only species from the genus having living culture at that moment) to demonstrate the affinity of this family with the order Amphisphaeriales, previously considered as a family in the Xylariales. However, presently, the Amphisphaeriales is no longer accepted as a separate order, and it is treated as one of the families in Xylariales (Crous et al. 2015a; Maharachchikumbura et al. 2016). Recently, *C. mamillana* has been epitypified and the polyphyly of the genus has been demonstrated (Jaklitsch et al. 2016). *Clypeosphaeria mamillana* belongs to Xylariaceae and *C. uniseptata* was combined in *Lepteutypa* (Amphisphaeriaceae). In consequence, the concept of the family Clypeosphaeriaceae (based on *C. uniseptata*; Senanayake et al. 2015) is no longer valid (Jaklitsch et al. 2016).

We have included the sequence of *C. uniseptata* in our LSU analysis (Fig. 2) and, according to our results, this species is not related at the family level with *Clypeophysalospora latitans*, and, therefore, we have proposed a new family to accommodate the latter taxon. The members of the new family, i.e. *Bagadiella*, *Clypeophysalospora*, *Neophysalospora* and *Plectosphaerella*, share morphological characteristics with each other, in terms of both sexual and asexual morph, host specificity (mainly *Eucalyptus* spp.) and distribution (Australia, South Africa). However, in the case of *N. eucalypti*, it has also been isolated from *Corymbia henryi* (Myrtaceae) in Mozambique and *C. latitans* was originally described on *Eucalyptus* leaves from Europe (Swart 1981; Cheewangkoon et al. 2009; Crous et al. 2011, 2014c).

Authors: A. Giraldo and P.W. Crous

Licrostroma P.A. Lemke, Canad. J. Bot. 42: 762 (1964).

Synonym: *Michenera* Berk. & M.A. Curtis, J. Linn. Soc., Bot. 10: 333 (1868) [1869].

Classification: Peniophoraceae, Russulales, Agaricomycetes.

Current generic circumscription: Basidiomata resupinate to effused-reflexed, smooth, cream to ochre, confluent, more or less membranaceous. Hyphal system dimitic, generative hyphae simple-septate, binding hyphae as ‘bovista-type’, antler-like, branched hyphae especially present in basal layers, negative in Melzer’s reagent. Dendrohyphidia present, simple and little-branched. Cystidia smooth, long cylindrical to subclavate, thin- to thick-walled, flexuous, with rounded or tapering apices, not projecting above the hymenium. Basidia large, clavate to cylindrical, with four strigmata. Basidiospores large, globose to subglobose, thick-walled, smooth, negative in Melzer’s reagent.

Conidial state (see Fig. 5d): Conidiomata cupulate, brown, rounded, ca. 1 cm wide, with yellowish cream outer surface, attached centrally to the substratum, composed of chlamydospores and simple-septate hyphae. Chlamydospores fusoid, walls brown, 3–3.5 µm thick, smooth.

Type species: *Licrostroma subgiganteum* (Berk.) P.A. Lemke 1964.

Licrostroma subgiganteum (Berk.) P.A. Lemke, Canad. J. Bot. 42: 763 (1964). Fig. 5d, e

Mycobank: MB 333369

Basionym. *Corticium subgiganteum* Berk., Grevillea 2: 3 (1873).

Synonyms. *Peniophora subgigantea* (Berk.) Masee, J. Linn. Soc., Bot. 25: 142 (1889).

Terana subgigantea (Berk.) Kuntze, Revis. Gen. Pl. (Leipzig) 2: 873 (1891).

Aleurodiscus subgiganteus (Berk.) Höhn., Sber. Akad. Wiss. Wien, Math.-Natur. Kl. Sitzungsab. 121: 342 (1912).

Michenera artocreas Berk. & M.A. Curtis, J. Linn. Soc., Bot. 10: 333 (1868).

Aleurodiscus orientalis Lloyd, Mycol. Writ. 6 (Letter 62): 927 (1920).

Aleurodiscus reflexus Yasuda, Bot. Mag., Tokyo 35 (no. 420): 269 (1921).

Description and illustration: Lemke (1964), Ryvarden (2010).

Specimens examined. USA, South Carolina, Aiken, on *Magnolia glauca*, sine dat., Ravenel 1669 (K(M)203642 – holotype); Maine, Aroostook, on dead snag of *Acer rubrum*, 31 Oct. 2006, R. J. Pinette RJP-7289 (CFMR – reference material designated here); ex-reference material sequences, GenBank nos. KX358901, KX358903 (ITS); KX358902, KX358904 (LSU).

Notes: *Licrostroma* is a monotypic genus of corticioid basidiomycetes. It has thick, effused-reflexed basidiomes with compact texture, a dimitic hyphal system, simple-septate generative hyphae and branched binding-like hyphae called ‘bovista-type hyphae’ by Lemke (1964), who proposed the genus to be related to *Aleurodiscus*. Indeed, the ‘bovista-type’ hyphae mentioned by Lemke (1964) somehow resemble dichohyphae in *Scytinostroma* and asterosetae (asterohyphae) in *Asterostroma*. *Licrostroma* and *Scytinostroma*, as well as *Asterostroma*, are dimitic and have simple-septate generative hyphae (except for a few *Scytinostroma* species, which have clamps). However, unlike the two latter genera, *Licrostroma* does not react with Melzer’s reagent.

We examined two specimens at CFMR, one containing only brown conidiomata (Fig. 5d) and the other specimen with resupinate basidiomata (Fig. 5e). Both samples have been collected on the same date and substratum, and from the same locality. We obtained the ITS and LSU sequences from both specimens and believe that they represent the same species, probably a single collection divided into sexual and asexual specimens. Morphologically, the CFMR collection conforms to the original material of *Corticium subgiganteum* (Fig. 5c) that we received from K. We could also observe some chlamydospores within the hyphae of the K type specimen.

A MegaBLAST search of the GenBank nucleotide database at NCBI (as of 25 May 2016) showed that the top hits using the new LSU sequences of *L. subgiganteum* were *Scytinostroma* spp., *Asterostroma* spp. and *Gloiothele* spp. [all in Peniophoraceae sensu Miller et al. (2006)], with 92–94% identity over 97–100% coverage. Using the new ITS sequences, the top hits were *Scytinostroma* and *Gloiothele*, as well as hits of *Helicobasidium* and *Tuberculina maxima* (asexual morph *Helicobasidium*). Although we are not able to interpret the latter hits, the morphological similarities between *Licrostroma* and *Scytinostroma/Asterostroma* described above suggest their close relationships. Upon this, *Licrostroma* sensu *typi* is proposed to belong to Peniophoraceae, Russulales.

Authors: M. Ghobad-Nejhad and E. Langer

Neohendersoniaceae Giraldo & Crous, fam. nov.

Mycobank MB 818515.

Description: Conidiomata single or gregarious, immersed, globose to collabent, papillate, dark brown to black, unilocular or multilocular; wall thick, of textura porrecta, intricata or angularis. Ostiole single, papillate. Conidiophores reduced to conidiogenous cells. Conidiogenous cells discrete, determinate or indeterminate, cylindrical, lageniform, doliiform or ampulliform, hyaline, smooth, with percurrent proliferations. Conidia obovoid, cylindrical, clavate or fusiform, distoseptate or euseptate, basal or apical cells paler than the median cells, thick-walled, base truncate, apex obtuse.

Type genus: *Neohendersonia* Petr., 1921.

Type species: *Neohendersonia kickxii* (Westend.) Sutton & Pollack.

Neohendersonia Petr., *Annls Mycol.* 19 (3–4): 190 (1921).

Classification: Neohendersoniaceae, Pleosporales, Dothideomycetes.

Current generic circumscription: Mycelium immersed, branched, septate, pale brown. Conidiomata pycnidial, eustromatic, separate or aggregated, immersed, globose or collabent, papillate, dark brown to black, uni- or multilocular, thick-walled, the outer one dark brown with textura porrecta or intricata, and the inner one hyaline with textura angularis. Ostiole single, circular, papillate. Conidiophores reduced to conidiogenous cells. Conidiogenous cells holoblastic, single or annellidic, discrete, determinate or indeterminate, cylindrical, lageniform, doliiform or ampulliform, hyaline, smooth, with 0–3 percurrent proliferations. Conidia obovoid, cylindrical, clavate or fusiform, transversely distoseptate or euseptate, versicoloured, basal and sometimes apical cells paler than the median cells, thick-walled, smooth, truncated at base, obtuse at the apex, eguttulate.

Type species: *Neohendersonia kickxii* (Westend.) Sutton and Pollack 1974.

Neohendersonia kickxii (Westend.) Sutton & Pollack, *Mycopath. Mycol. Appl.* 52: 334 (1974). Fig. 8

Mycobank: MB 318608

Basionym. *Stilbospora kickxii* Westend., *Bull. Acad. R. Sci. Belg., Cl. Sci.* 18: 409 (1851).

Synonyms. *Hendersonia loricata* Sacc. & Roum., *Michelia* 2 (8): 629 (1882).

Coryneum kickxii (Westend.) Traverso, *Bol. Soc. Bot. Ital.* 215 (1904).

Neohendersonia pyriformis (G.H. Otth) Petr., *Annls Mycol.* 19 (3–4): 191 (1921).

Stilbospora pyriformis (G.H. Otth) Grove, *British Stem- and Leaf-Fungi (Coelomycetes)* (Cambridge) 2: 326 (1937).

Description: Conidiomata pycnidial, separate or aggregated, immersed, subperidermal, not protruding, black, smooth, ampulliform, uni- or multilocular, up to 1300 μm diam., outer layer dark brown, 30 μm wide, inner layer pale brown becoming hyaline towards the conidiogenous cells, 40–60 μm wide. Ostiole single, circular, up to 250 μm diam., slightly papillate, thin-walled and pale brown. Conidiogenous cells holoblastic, annellidic, with up to seven annellations, discrete, hyaline, smooth, cylindrical to obpyriform, in vivo 4–9 \times 2–6 μm , in vitro 6–9 \times 6–8 μm . Conidia solitary, obovoid to clavate, pyriform 2–3 distoseptate, slightly constricted at the prominent septa, apical cell larger than the other ones, thick- and smooth-walled, apex obtuse, base truncated, brown with paler basal cell, in vivo 21–45.5 \times 12.5–20 μm , (2)3(6)-celled and seldom with one longitudinal septum per conidium, in vitro (20)22–26(28) \times 11–14 μm . Microconidia were observed in culture growing directly from the hyphae, cylindrical with rounded apex and truncate base, hyaline, thick- and smooth-walled, 2–4 \times 2–3 μm .

Culture characteristics: Colonies on MEA and OA black, flat, cottony, aerial mycelium dirty white, diffusible amber pigment, reverse honey to isabelline.

Specimens examined: Austria, Carinthia, Sankt Margareten im Rosental, on *Fagus sylvatica*, unknown date, W. Jaklitsch (CBS 122938); Grieskirchen, Natternbach, on *Fagus sylvatica*, unknown date, H. Voglmayr (CBS 122941). Belgium, Courtrai, Parc Saint-George, on branch of *Fagus sylvatica* (“substrate originally determined as *Betula pubescens* and later corrected with *Fagus sylvatica*”), Mar. G.D. Westendorp (holotype IMI 168433 ex BR). Germany, mixed forest, on twigs of *Fagus sylvatica*, 19 Apr. 2014, R.K. Schumacher (CPC 24865). Italy, Pian di Novello, on bark of twigs from *Fagus sylvatica*, 8 May 1996, R. Danti (epitype designated here, MycoBank MBT373088; culture ex-epitype CBS 112403). Sweden, Uppland, on *Fagus* sp. 12 Mar 1989, K. & L. Holm (CBS 114276 = UPSC 2890).

Notes: *Neohendersonia* was established by Petrak (1921) based on *Neohendersonia pyriforme*, described from *Fagus*

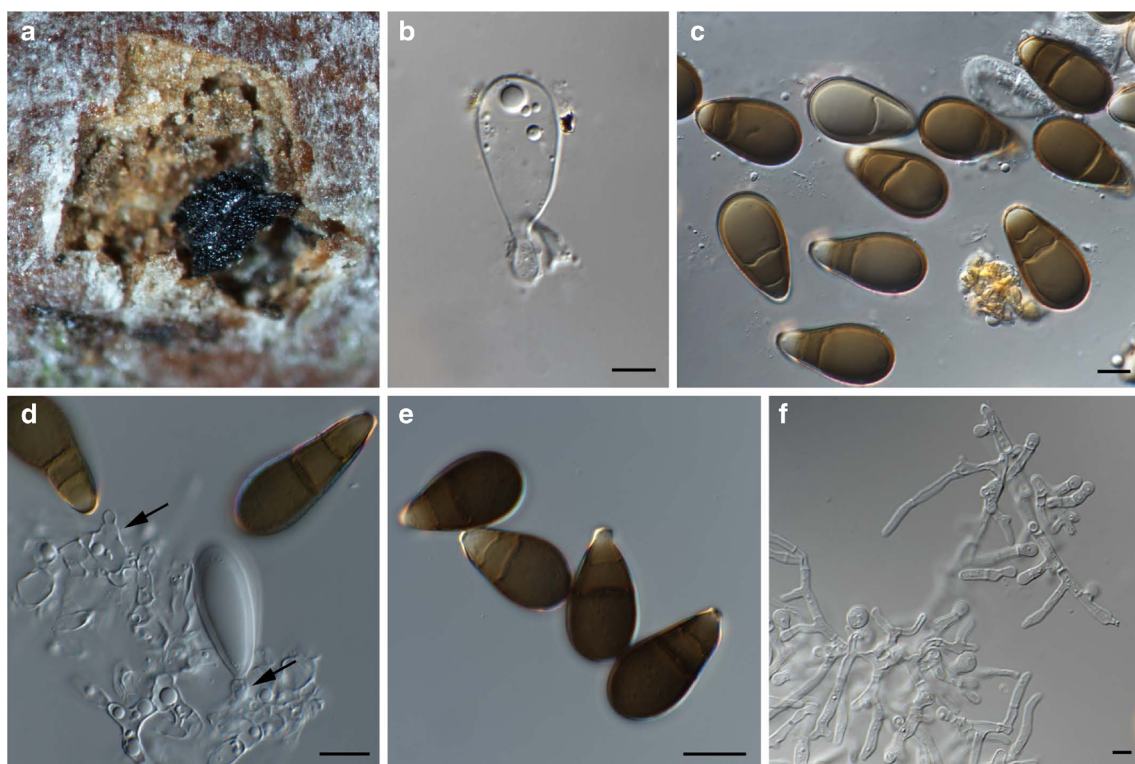


Fig. 8 *Neohendersonia kickxii* (CBS 112403). **a** Conidioma on *Fagus sylvatica*. **b** Conidiogenous cell in vivo. **c** Conidia in vivo showing the paler basal cell. **d** Conidiogenous cells in vitro (arrows). **e** Conidia

in vitro. **f** Second kind of conidia growing directly from the hyphae. Scale bars: **b–e** = 10 μ m, **f** = 5 μ m

sylvatica in Belgium. Sutton and Pollack (1974) subsequently combined *Stilbospora kickxii* into *Neohendersonia*, and *N. kickxii* was proposed as the type species, being the older name. After the inclusion of *N. congoensis*, the generic concept was expanded to include species with euseptate conidia (Sutton 1975). Recently, a third species, *N. fagi*, has been described from the same source in Italy (Wijayawardene et al. 2016). Currently, from the three species accepted in the genus, only *N. kickxii* has living type material, and, therefore, we cannot elucidate the monophyly of the genus and the species boundaries. However, the three species can be morphologically distinguished by the presence of euseptate conidia in *N. congoensis* and the size of the distoseptate conidia in *N. fagi* (30–48 \times 10–15 μ m) and *N. kickxii* (21–45.5 \times 12.5–20 μ m) (Sutton 1975, 1980; Wijayawardene et al. 2016).

From the material examined here, the culture CPC 24865 was found to be phylogenetically distinct from the other isolates of *N. kickxii* and it could represent a different taxon. However, we prefer to not assign a name to this culture yet, since we did not find sufficient morphological characteristics to propose it as a different species.

Neohendersonia kickxii has been reported as a specific endophyte of beech twigs in Europe (Danti et al. 2002; Sieber 2007) and from beech bark in North American forests (Griesmer-Zakhar 2013), while *N. congoensis* and *N. fagi*

have been described on stems of *Aloe* or *Agave* in Congo and branch of *Fagus* in Italy, respectively.

Authors: A. Giraldo, R.K. Schumacher and P.W. Crous.

Spumatoria Masee and E.S. Salmon, Ann. Bot. Lond. 15: 350 (1901).

Classification: Ophiostomataceae, Ophiostomatales, Sordariomycetes.

Current generic circumscription: Saprobic, coprophilous. Ascomata perithecial, single, gregarious, immersed, erumpent, loculus globose with one or seldom two necks per perithecial. Ascromatal neck centrally, terete, apically paler and conspicuously long fimbriate, basally dark brown to black, felty, textura prismatica. Peridium dark brown to black, slightly hard, rough, basally with red brown hyphae, textura angularis. Paraphyses longer than the asci. Asci 8-spored, clavate, apically rounded and with an ocular chamber, pedicel mostly short and not furcate, thick-walled, bitunicate. Ascospores obliquely biseriata, overlapped, 2(–3)-celled, clavate, straight, hyaline, thin-walled, smooth, coarsely guttulate, septa smooth and thin-walled. Asexual morph sporothrix-like (in culture). Conidiophores more or less differentiated, unbranched, cylindrical. Conidiogenous cells polyblastic, sympodial, terminal, denticulate. Conidia solitary, dacrioid, hyaline. Blastoconidia growing directly from undifferentiated hyphae, lateral, globose to subglobose.

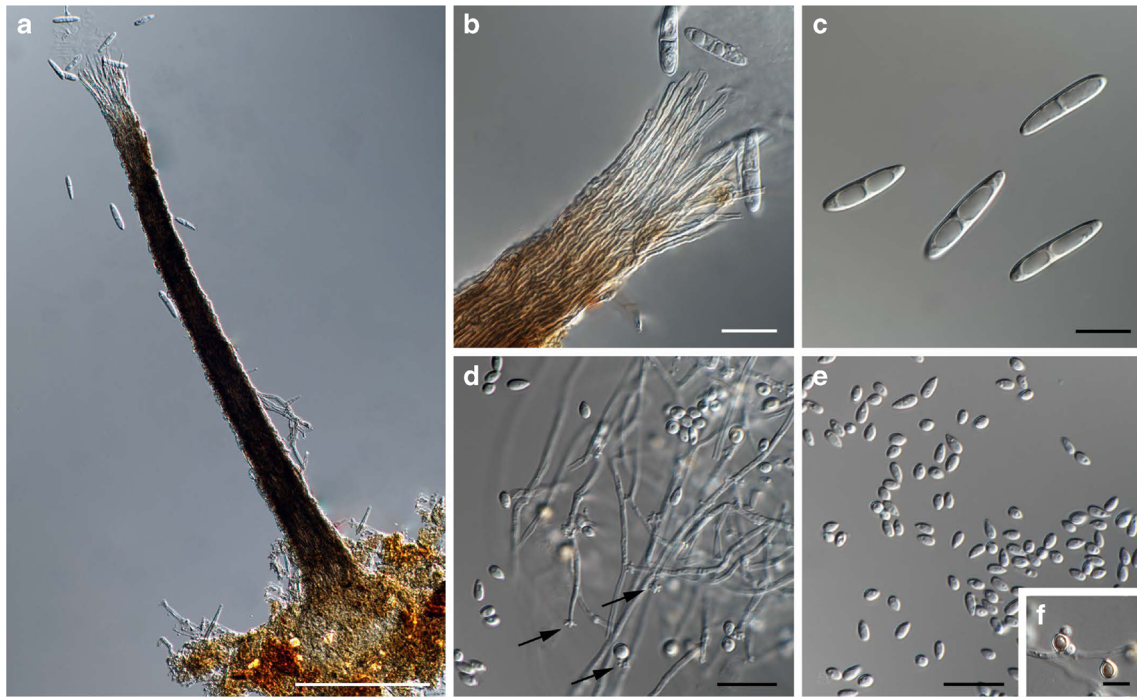


Fig. 9 *Spumatoria longicollis* (CBS 141464). **a** Ascoma. **b** Ostiolar hyphae. **c** Ascospores. **d** Conidiogenous cells (*arrows* denote the denticles). **e** Conidia. **f** Blastoconidia. Scale bars: **a** = 100 μm , all others = 10 μm

Type species: *Spumatoria longicollis* Masee & E.S. Salmon 1901.

Spumatoria longicollis Masee and E.S. Salmon, Ann. Bot. Lond. 15: 351 (1901). Fig. 9

Mycobank: MB 171713

Description: Ascomata single, gregarious, immersed, erumpent, loculus globose with one or seldom two necks per perithecium, up to 500 μm long \times 39–60 μm wide. Ascum central, terete, apically paler and conspicuously long fimbriate, basally dark brown to black, felty, textura prismatica, up to 430 μm long \times 28–30 μm wide. Peridium dark brown to black, slightly hard, rough, basally with red brown hyphae, textura angularis. Paraphyses longer than the asci. Asci dehiscent, 8-spored, clavate, apically rounded and with an ocular chamber, pedicel mostly short and not furcate, thick-walled, bitunicate. Ascospores obliquely biseriolate, overlapped, 2(–3)-celled, clavate, straight, hyaline, thin-walled, smooth, coarsely guttulate, septa smooth and thin-walled, (17)18–23(26) \times 4–7.5 μm . Asexual morph sporothrix-like (in culture). Conidiophores poorly differentiated, unbranched, cylindrical, up to 30 μm long. Conidiogenous cells polyblastic, sympodial, terminal, denticulate. Conidia dacrioid, hyaline, smooth- and thin-walled, 3–4.5 \times 1.5–2 μm . Blastoconidia growing directly from undifferentiated hyphae, lateral, globose to subglobose, smooth- and thick-walled, light brown, 3–4 \times 2–4 μm wide.

Culture characteristics: Colonies on OA attaining 13–20 mm diam. after 1 week at 25 $^{\circ}\text{C}$, flat, scarce aerial

mycelium, dark brown. On MEA flat, creamy with scarce aerial mycelium, dirty white turning dark brown with age.

Specimens examined: England, Essex, Epping Forest, horse dung, G.E. Masee & E.S. Salmon [Masee G.E and E.S. Salmon, Ann. Bot. Lond. 15, Fig. 27] (Lectotype designed here, MycoBank MBT373089). Netherlands, near Oostvoorne, dune grassland, on cow (Galloway) dung, 26 Jan. 2016, coll. J. van der Lee, det. R.K. Schumacher, iso. A. Giraldo (epitype designated here, CBS H-22665, MycoBank MBT373090; culture ex-epitype CBS 141464 = CPC 30521).

Notes: As far as we know, this is the first report of this fungus after its original description. The sexual morph was only observed in natural substrata; many attempts to obtain this morph in culture resulted only in the sporothrix-like asexual morph. Several macroscopic and microscopic pictures were observed to corroborate the identity from the specimen. In the original protologue, Masee and Salmon (1901) mentioned cylindrical asci, 110–113 \times 13–15 μm , versus narrow clavate in the illustration, and 2-celled, ellipsoidal ('oblongis utrinque rotundatis') spores, 15–19 \times 5 μm . Unfortunately, due to the dehiscent nature of the asci and the scarce material available, these structures were not observed in this study. The authors refer the perithecia at the conidium-bearing stage to the genus *Rhynchophoma*, a similar genus described from the wood of *Tilia ulmifolia* (Karsten 1884). However, the type of this fungus is apparently lost and, according to De Beer et al. (2013), this genus does not belong to either Ophiostomatales or Microascales.

Among the coprophilous fungi, *Kathistes* is one of the genera morphologically similar to *Spumatoria* in having transversely septate ascospores and perithecia with long and dark necks, but can be differentiated by its narrower ascospores, particular sporidiomata and absence of paraphyses (Malloch and Blackwell 1990). Based on their morphological similarities and common habit, they were placed together with *Klasterskya* in the Kathistaceae within Ophiostomatales (Hawksworth et al. 1995; Kirk et al. 2008). However, the analysis of the SSU region showed the affinity of this family to be with the Dothideomycetes rather than the Ophiostomatales (Blackwell and Spatafora 1994); consequently, *Klasterskya* and *Spumatoria* were excluded from the latter order based on the morphological characters as reported in the original description (De Beer et al. 2013). It is important to mention that, from the approximately 300 genera currently included in the Ophiostomatales, *Spumatoria* is the only genus showing septate ascospores. However, our results of the molecular data, which include LSU (Fig. 4), ITS and β -tubulin (data not shown) loci, demonstrate the inclusion of the latter genus within the Ophiostomatales. Based on phylogenetic placement, *Spumatoria* could be considered a synonym of the older name *Sporothrix* (Hektoen and Perkins 1900). Although *S. longicollis* also have a sporothrix-like asexual state, it differs from other *Sporothrix* spp. based on septate ascospores, light coloured ascomata and dung-inhabiting biology. We, thus, suggest that further study including sequences of multiple gene regions and more taxa is needed in order to elucidate its relation with the type species of *Sporothrix*, *S. schenckii* and other species in the genus.

Authors: RK Schumacher, A Giraldo and PW Crous

Acknowledgements Alejandra Giraldo is grateful for the financial support received from the postdoctoral fellowship programme from the University of Pretoria. MG-N and EL thank the curators of K and CFMR herbaria for their kind permission to publish photographs from the loaned material, and acknowledge the support received from the Department of Ecology, University of Kassel.

Open Access This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

References

- Ahmed SA, van de Sande WWJ, Stevens DA et al (2014) Revision of agents of black-grain eumycetoma in the order Pleosporales. *Persoonia* 33:141–154
- Aveskamp MM, de Gruyter J, Woudenberg JH, Verkley GJ, Crous PW (2010) Highlights of the Didymellaceae: a polyphasic approach to characterise *Phoma* and related pleosporalean genera. *Stud Mycol* 65:1–60
- Batzer JC, Arias MM, Harrington TC et al (2008) Four species of *Zygophiala* (Schizothyriaceae, Capnodiales) are associated with the sooty blotch and flyspeck complex on apple. *Mycologia* 100: 246–258
- Berkeley MJ, Broome CE (1875) Enumeration of the fungi of Ceylon. Part II. *Bot J Linn Soc* 14:29–141
- Blackwell M, Spatafora JW (1994) Molecular data sets and broad taxon sampling in detecting morphological convergence. In: Hawksworth DL (ed) First international workshop on Ascomycetes systematics. Plenum Press, New York, pp 243–248
- Boehm EW, Schoch CL, Spatafora JW (2009) On the evolution of the Hysteriaceae and Mytiliniaceae (Pleosporomycetidae, Dothideomycetes, Ascomycota) using four nuclear genes. *Mycol Res* 113:461–479
- Campbell J, Ferrer A, Raja HA, Sivichai S, Shearer CA (2007) Phylogenetic relationships among taxa in the Jahnuales inferred from 18S and 28S nuclear ribosomal DNA sequences. *Can J Bot* 85:873–882
- Castlebury LA, Rossman AY, Jaklitsch WJ, Vasilyeva LN (2002) A preliminary overview of the Diaportheales based on large subunit nuclear ribosomal DNA sequences. *Mycologia* 94:1017–1031
- Cheewangkoon R, Crous PW, Hyde KD, Groenewald JZ, To-anan C (2008) Species of *Mycosphaerella* and related anamorphs on *Eucalyptus* leaves from Thailand. *Persoonia* 21:77–91
- Cheewangkoon R, Groenewald JZ, Summerell BA et al (2009) Myrtaceae, a cache of fungal biodiversity. *Persoonia* 23:55–85
- Cheewangkoon R, Groenewald JZ, Hyde KD, To-anun C, Crous PW (2012) Chocolate spot disease of *Eucalyptus*. *Mycol Prog* 11:61–69
- Chen Q, Jiang JR, Zhang GZ, Cai L, Crous PW (2015) Resolving the *Phoma* enigma. *Stud Mycol* 82:137–217
- Crous PW, Groenewald JZ (2011) Why everlasting don't last. *Persoonia* 26:70–84
- Crous PW, Groenewald JZ (2013) A phylogenetic re-evaluation of *Arthrinium*. *IMA Fungus* 4:133–154
- Crous PW, Wingfield MJ, Park RF (1991) *Mycosphaerella nubilosa*, a synonym of *M. molleriana*. *Mycol Res* 95:628–632
- Crous PW, Gams W, Stalpers JA, Robert V, Stegehuis G (2004) MycoBank: an online initiative to launch mycology into the 21st century. *Stud Mycol* 50:19–22
- Crous PW, Groenewald JZ, Wingfield MJ (2006a) *Heteroconium eucalypti*. *Fungal Planet* no. 10
- Crous PW, Slippers B, Wingfield MJ et al (2006b) Phylogenetic lineages in the Botryosphaeriaceae. *Stud Mycol* 55:235–253
- Crous PW, Braun U, Groenewald JZ (2007a) *Mycosphaerella* is polyphyletic. *Stud Mycol* 58:1–32
- Crous PW, Mohammed C, Glen M, Verkley GJM, Groenewald JZ (2007b) *Eucalyptus* microfungi known from culture. 3. *Eucasphaeria* and *Symptoventuria* genera nova, and new species of *Furcaspora*, *Harknessia*, *Heteroconium* and *Phacidiella*. *Fungal Divers* 25:19–36
- Crous PW, Schoch CL, Hyde KD et al (2009a) Phylogenetic lineages in the Capnodiales. *Stud Mycol* 64:17–47
- Crous PW, Summerell BA, Carnegie AJ et al (2009b) Unravelling *Mycosphaerella*: do you believe in genera? *Persoonia* 23:99–118
- Crous PW, Verkley GJM, Groenewald JZ, Samson RA (2009c) Fungal biodiversity. CBS Laboratory Manual Series no.1. CBS-KNAW Fungal Biodiversity Centre, Utrecht, the Netherlands
- Crous PW, Groenewald JZ, Shivas RG et al (2011) Fungal planet description sheets: 69–91. *Persoonia* 26:108–156
- Crous PW, Summerell BA, Shivas RG et al (2012) Fungal planet description sheets: 107–127. *Persoonia* 28:138–182
- Crous PW, Wingfield MJ, Guarro J et al (2013) Fungal planet description sheets: 154–213. Higher order classification of taxonomic novelties. *Persoonia* 31:186–296

- Crous PW, Giraldo A, Hawksworth DL et al (2014a) The Genera of fungi: fixing the application of type species of generic names. *IMA Fungus* 5:141–160
- Crous PW, Shivas RG, Quaedvlieg W et al (2014b) Fungal planet description sheets: 214–280. *Persoonia* 32:184–306
- Crous PW, Wingfield MJ, Schumacher RK et al (2014c) Fungal planet description sheets: 281–319. *Persoonia* 33:212–289
- Crous PW, Carris LM, Giraldo A et al (2015a) The Genera of Fungi—fixing the application of the type species of generic names—G 2: *Allantophomopsis*, *Latorua*, *Macrodiplodiopsis*, *Macrohylum*, *Milospium*, *Protostegia*, *Pyricularia*, *Robillarda*, *Rotula*, *Septoriella*, *Torula*, and *Wojnowicia*. *IMA Fungus* 6:163–198
- Crous PW, Wingfield MJ, Guarro J et al (2015b) Fungal planet description sheets: 320–370. *Persoonia* 34:167–266
- Cunningham GH (1956) Thelephoraceae of New Zealand. Part IX. The genus *Stereum*. Part X. The genera *Cytidia* and *Aleurocystis*. Part XI. The genus *Aleurodiscus*. *Trans Roy Soc NZ* 84:201–268
- Dai DQ, Bahkali AH, Li WJ, Bhat DJ, Zhao RL, Hyde KD (2015) *Bambusicola loculata* sp. nov. (Bambusicolaceae) from bamboo. *Phytotaxa* 213:122–130
- Danti R, Sieber TN, Sanguineti G (2002) Endophytic mycobiota in bark of European beech (*Fagus sylvatica*) in the Apennines. *Mycol Res* 106:1343–1348
- De Beer ZW, Seifert KA, Wingfield MJ (2013) The ophiostomatoid fungi: their dual position in the Sordariomycetes. In: Seifert KA, de Beer ZW, Wingfield MJ (eds) *The Ophiostomatoid fungi: expanding frontiers*. CBS Biodiversity Series no. 12. CBS-KNAW Fungal Biodiversity Centre, Utrecht, the Netherlands, pp 1–19
- De Beer ZW, Duong TA, Wingfield MJ (2016) The divorce of *Sporothrix* and *Ophiostoma*: solution to a problematic relationship. *Stud Mycol* 83:165–191
- de Gruyter J, Aveskamp MM, Woudenberg JH, Verkley GJ, 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 JH, Aveskamp MM, Verkley GJ, Groenewald JZ, Crous PW (2013) Redisposition of phoma-like anamorphs in Pleosporales. *Stud Mycol* 75:1–36
- de Hoog GS, Gerrits van den Ende AHG (1998) Molecular diagnostics of clinical strains of filamentous Basidiomycetes. *Mycoses* 41:183–189
- de Meyer EM, de Beer ZW, Summerbell RC et al (2008) Taxonomy and phylogeny of new wood- and soil-inhabiting *Sporothrix* species in the *Ophiostoma stenoceras*–*Sporothrix schenckii* complex. *Mycologia* 100:647–661
- Griesmer-Zakhar RE (2013) Beech bark disease distribution and resistance in Michigan and fungal endophyte ecology of resistant and susceptible beech (*Fagus grandifolia* Ehrh.). Master's thesis, Michigan Technological University
- Grove WB (1937) *British stem- and leaf-fungi (Coelomycetes)*. Volume 2. Cambridge University Press, Cambridge
- Guatimosim E, Firmino AL, Bezerra JL, Pereira OL, Barreto RW, Crous PW (2015) Towards a phylogenetic reappraisal of Parmulariaceae and Asterinaceae (Dothideomycetes). *Persoonia* 35:230–241
- Hawksworth DL, Kirk PM, Sutton BC, Pegler DN (1995) *Ainsworth & Bisby's dictionary of the fungi*, 8th edn. Commonwealth Agricultural Bureau International, Wallingford, Oxon, UK
- Hektoen L, Perkins CF (1900) Refractory subcutaneous abscesses caused by *Sporothrix schenckii*. A new pathogenic fungus. *J Exp Med* 5:77–89
- Hernández-Restrepo M, Groenewald JZ, Crous PW (2016) Taxonomic and phylogenetic re-evaluation of *Microdochium*, *Monographella* and *Idriella*. *Persoonia* 36:57–82
- Hirayama K, Tanaka K (2011) Taxonomic revision of *Lophiostoma* and *Lophiotrema* based on reevaluation of morphological characters and molecular analyses. *Mycoscience* 52:401–412
- Hirayama K, Tanaka K, Raja HA, Miller AN, Shearer CA (2010) A molecular phylogenetic assessment of *Massarina ingoldiana* sensu lato. *Mycologia* 102:729–746
- Hjortstam K (1989) Corticioid fungi described by M. J. Berkeley. *Kew Bull* 44:301–315
- Hyde KD, Jones EBG, Liu J-K et al (2013) Families of Dothideomycetes. *Fungal Divers* 63:1–313
- Jaklitsch WM, Gardiennet A, Voglmayr H (2016) Resolution of morphology-based taxonomic delusions: *Acrocordiella*, *Basiseptospora*, *Blogiascospora*, *Clypeosphaeria*, *Hymenoplella*, *Lepteutypa*, *Pseudapiospora*, *Requienella*, *Seiridium* and *Strickeria*. *Persoonia* 37:82–105
- Jeewon R, Liew EC, Hyde KD (2002) Phylogenetic relationships of *Pestalotiopsis* and allied genera inferred from ribosomal DNA sequences and morphological characters. *Mol Phylogenet Evol* 25:378–392
- Kang JC, Hyde KD, Kong RYC (1999) Studies on the Amphisphaeriales I. The Clypeosphaeriaceae. *Mycoscience* 40:151–164
- Karsten PA (1884) *Fragmenta mycologica IX*. *Hedwigia* 23:18–20
- Kirk PM, Cannon PF, Minter DW, Stalpers JA (2008) *Dictionary of the fungi*, 10th edn. Commonwealth Agricultural Bureau International, Wallingford, Oxon, UK
- Kirk PM, Stalpers JA, Braun U et al (2013) A without-prejudice list of generic names of fungi for protection under the International Code of Nomenclature for algae, fungi and plants. *IMA Fungus* 4:381–443
- Knapp DG, Kovács GM, Zajta E, Groenewald JZ, Crous PW (2015) Dark septate endophytic pleosporalean genera from semiarid areas. *Persoonia* 35:87–100
- Lemke PA (1964) The genus *Aleurodiscus* (sensu lato) in North America. *Can J Bot* 42:723–768
- Liu JK, Phookamsak R, Dai DQ et al (2014) Roussoellaceae, a new pleosporalean family to accommodate the genera *Neorousoella* gen. nov., *Rousoella* and *Rousoellopsis*. *Phytotaxa* 181:1–33
- Lumbsch HT, Schmitt I, Lindemuth R et al (2005) Performance of four ribosomal DNA regions to infer higher-level phylogenetic relationships of inoperculate euascomycetes (Leotiomyceta). *Mol Phylogenet Evol* 34:512–524
- Maharachchikumbura SSN, Hyde KD, Jones EBG et al (2016) Families of Sordariomycetes. *Fungal Divers* 79:1–317
- Malloch D, Blackwell M (1990) *Kathistes*, a new genus of pleomorphic Ascomycetes. *Can J Bot* 68:1712–1721
- Masse GE, Salmon ES (1901) Researches on coprophilous fungi. *Ann Bot* 15:313–357
- McTaggart AR, Grice KR, Shivas RG (2013) First report of *Vialaea minutella* in Australia, its association with mango branch dieback and systematic placement of *Vialaea* in the Xylariales. *Aust Plant Dis Notes* 8:63–66
- Miller SL, Larsson E, Larsson KH, Verbeken A, Nuytinck J (2006) Perspectives in the new Russulales. *Mycologia* 98:960–970
- Petrak F (1921) *Mykologische Notizen*. III. *Annals Mycol* 19:176–223
- Quaedvlieg W, Groenewald JZ, de Jesús Yáñez-Morales M, Crous PW (2012) DNA barcoding of *Mycosphaerella* species of quarantine importance to Europe. *Persoonia* 29:101–115
- Quaedvlieg W, Verkley GJ, Shin HD et al (2013) Sizing up *Septoria*. *Stud Mycol* 75:307–390
- Quaedvlieg W, Binder M, Groenewald JZ et al (2014) Introducing the consolidated species concept to resolve species in the Teratosphaeriaceae. *Persoonia* 33:1–40

- Raja H, Schoch CL, Hustad V, Shearer C, Miller A (2011) Testing the phylogenetic utility of MCM7 in the Ascomycota. *MycKeys* 1:63–94
- Rayner RW (1970) A mycological colour chart. Commonwealth Mycological Institute, Kew
- Robert V, Vu D, Amor ABH et al (2013) MycoBank gearing up for new horizons. *IMA Fungus* 4:371–379
- Ryvarden L (1998) The genus *Aleurocystis*. *Cryptogam Mycol* 19:93–97
- Ryvarden L (2010) Stereoid fungi of America. *Syn Fung* 28:1–206
- Schoch CL, Kohlmeyer J, Volkmann-Kohlmeyer B, Tsui CK, Spatafora JW (2006a) The halotolerant fungus *Glomerobolus gelineus* is a member of the Ostropales. *Mycol Res* 110:257–263
- Schoch CL, Shoemaker RA, Seifert KA, Hambleton S, Spatafora JW, Crous PW (2006b) A multigene phylogeny of the Dothideomycetes using four nuclear loci. *Mycologia* 98:1041–1052
- Schoch CL, Crous PW, Groenewald JZ, Boehm EWA (2009a) A class-wide phylogenetic assessment of Dothideomycetes. *Stud Mycol* 64:1–15
- Schoch CL, Sung GH, López-Giráldez F et al (2009b) The Ascomycota tree of life: a phylum-wide phylogeny clarifies the origin and evolution of fundamental reproductive and ecological traits. *Syst Biol* 58:224–239
- Schoch CL, Seifert KA, Huhndorf S et al (2012) Nuclear ribosomal internal transcribed spacer (ITS) region as a universal DNA barcode marker for Fungi. *Proc Natl Acad Sci U S A* 109:6241–6246
- Senanayake IC, Maharachchikumbura SSN, Mortimer PE, Xu J, Bhat JD, Hyde KD (2014) *Vialaeaceae*; introducing a novel species *Vialaea mangiferae*. *Sydowia* 66:203–216
- Senanayake IC, Maharachchikumbura SSN, Hyde KD et al (2015) Towards unraveling relationships in Xylariomycetidae (Sordariomycetes). *Fungal Divers* 73:73–144
- Sieber TN (2007) Endophytic fungi in forest trees: are they mutualists? *Fungal Biol Rev* 21:75–89
- Slippers B, Boissin E, Phillips AJ et al (2013) Phylogenetic lineages in the Botryosphaerales: a systematic and evolutionary framework. *Stud Mycol* 76:31–49
- Smith H, Wingfield MJ, Coutinho TA, Crous PW (1996) *Sphaeropsis sapinea* and *Botryosphaeria dothidea* endophytic in *Pinus* spp. and *Eucalyptus* spp. in South Africa. *S Afr J Bot* 62:86–88
- Spatafora JW, Sung GH, Johnson D et al (2006) A five-gene phylogeny of Pezizomycotina. *Mycologia* 98:1018–1028
- Suetrong S, Schoch CL, Spatafora JW et al (2009) Molecular systematics of the marine Dothideomycetes. *Stud Mycol* 64:155–173
- Summerell BA, Groenewald JZ, Carnegie AJ, Summerbell RC, Crous PW (2006) *Eucalyptus* microfungi known from culture. 2. *Alysiidiella*, *Fusculina* and *Phlogicylindrium* genera nova, with notes on some other poorly known taxa. *Fungal Divers* 23:323–350
- Sutton BC (1975) Coelomycetes. V. *Coryneum*. *Mycol Pap* 138:1–224
- Sutton BC (1980) The Coelomycetes: fungi imperfecti with pycnidia, acervuli, and stromata. Commonwealth Mycological Institute, Kew
- Sutton BC, Pollack FG (1974) Microfungi on *Cercocarpus*. *Mycopathol Mycol Appl* 52:331–351
- Swart HJ (1981) Australian leaf-inhabiting fungi: XI. *Phyllachora eucalypti*. *Trans Br Mycol Soc* 76:89–95
- Swart HJ (1988) Australian leaf-inhabiting fungi. XXVI. Some noteworthy Coelomycetes on *Eucalyptus*. *Trans Br Mycol Soc* 90:279–291
- 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 K, Hirayama K, Yonezawa H et al (2015) Revision of the Massarineae (Pleosporales, Dothideomycetes). *Stud Mycol* 82:75–136
- Tang AM, Jeewon R, Hyde KD (2007) Phylogenetic utility of protein (RPB2, beta-tubulin) and ribosomal (LSU, SSU) gene sequences in the systematics of Sordariomycetes (Ascomycota, Fungi). *Antonie Van Leeuwenhoek* 91:327–349
- Tsui CK, Berbee ML (2006) Phylogenetic relationships and convergence of helicosporous fungi inferred from ribosomal DNA sequences. *Mol Phylogenet Evol* 39:587–597
- van der Linde JA, Six DL, de Beer WZ, Wingfield MJ, Roux J (2016) Novel ophiostomatalean fungi from galleries of *Cyrtogenius africanus* (Scolytinae) infesting dying *Euphorbia ingens*. *Antonie Van Leeuwenhoek* 109:589–601
- Verkley GJM, Dukik K, Renfurm R, Göker M, Stielow JB (2014) Novel genera and species of coniothyrium-like fungi in Montagnulaceae (Ascomycota). *Persoonia* 32:25–51
- Vilgalys R, Hester M (1990) Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several *Cryptococcus* species. *J Bacteriol* 172:4238–4246
- Wanasinghe DN, Jones EBG, Camporesi E et al (2014) An exciting novel member of Lentitheciaceae in Italy from *Clematis vitalba*. *Cryptogam Mycol* 35:323–337
- White TJ, Bruns T, Lee J, Taylor SB (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 Press, San Diego, pp 315–322
- Wijayawardene NN, Hyde KD, Wanasinghe DN et al (2016) Taxonomy and phylogeny of dematiaceous coelomycetes. *Fungal Divers* 77:1–316
- Winton LM, Stone JK, Hansen EM, Shoemaker RA (2007) The systematic position of *Phaeocryptopus gaumannii*. *Mycologia* 99:240–252
- Zhang YI, Fournier J, Pointing SB, Hyde KD (2008) Are *Melanomma pulvis-pyrius* and *Trematosphaeria pertusa* congeneric? *Fungal Divers* 33:47–60
- Zhang Y, Schoch CL, Fournier J et al (2009a) Multi-locus phylogeny of Pleosporales: a taxonomic, ecological and evolutionary re-evaluation. *Stud Mycol* 64:85–102
- Zhang Y, Wang HK, Fournier J et al (2009b) Towards a phylogenetic clarification of *Lophiostoma/Massarina* and morphologically similar genera in the Pleosporales. *Fungal Divers* 38:225–251
- Zipfel RD, de Beer ZW, Jacobs K, Wingfield BD, Wingfield MJ (2006) Multi-gene phylogenies define *Ceratocystiopsis* and *Grosmannia* distinct from *Ophiostoma*. *Stud Mycol* 55:75–97