

doi.org/10.3114/fuse.2020.05.04

The Genera of Fungi – G5: *Arthrinium*, *Ceratosphaeria*, *Dimerosporiopsis*, *Hormodochis*, *Lecanostictopsis*, *Lembosina*, *Neomelanconium*, *Phragmotrichum*, *Pseudomelanconium*, *Rutola*, and *Trullula*

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Key words:

biodiversity
ITS barcodes
multi-gene phylogeny
new taxa
systematics
typification

Abstract: The present paper represents the fifth contribution in the Genera of Fungi series, linking type species of fungal genera to their morphology and DNA sequence data. This paper focuses on 11 genera of microfungi, for seven of which the type species are neo- or epitypified here: *Arthrinium* (*Arthrinium caricicola*; *Apiosporaceae*, *Xylariales*, *Sordariomycetes*), *Ceratosphaeria* (*Ceratosphaeria lampadophora*; *Magnaporthaceae*, *Magnaporthales*, *Sordariomycetes*), *Dimerosporiopsis* (*Dimerosporiopsis engleriana*; *Venturiaceae*, *Venturiales*, *Dothideomycetes*), *Hormodochis* (*Hormodochis melanochlora*; *Stictidaceae*, *Ostropales*, *Ostropomycetidae*, OSLEUM clade, *Lecanoromycetes*), *Lecanostictopsis* (*Lecanostictopsis kamatii*; *Mycosphaerellaceae*, *Capnodiales*, *Dothideomycetes*), *Lembosina* (*Lembosina aulographoides*; *Lembosinaceae* fam. nov., *Lembosinales* ord. nov., *Dothideomycetes*), *Neomelanconium* (*Neomelanconium gelatosporum*; *Cenangiaceae*, *Helotiales*, *Leotiomycetes*), *Phragmotrichum* (*Phragmotrichum chailletii*; *Melanommataceae*, *Pleosporales*, *Pleosporomycetidae*, *Dothideomycetes*), *Pseudomelanconium* gen. nov. (*Pseudomelanconium spartii*; *incertae sedis*, *Pezizomycotina*), *Rutola* (*Rutola graminis*; *Torulaceae*, *Pleosporales*, *Pleosporomycetidae*, *Dothideomycetes*), and *Trullula* (*Trullula oreoselini*; *incertae sedis*, *Pezizomycotina*).

Effectively published online: 22 August 2019.

INTRODUCTION

This paper represents the fifth contribution to the Genera of Fungi (GoF) project (www.GeneraOfFungi.org; Crous *et al.* 2014), which has the aim to revise the generic names of fungi. The 11 genera treated are supplemented with recently collected specimens, with those designated as epi- or neotypes registered in MycoBank (Robert *et al.* 2013). Furthermore, in keeping with the one fungus = one name initiative for fungi (Hawksworth *et al.* 2011, Crous *et al.* 2015), a single morph is indicated for each genus. Mycologists and other researchers wishing to contribute to future issues of GoF are encouraged to contact Pedro Crous (p.crous@wi.knaw.nl).

MATERIALS AND METHODS

Isolates

Freshly collected twigs were placed in damp chambers, and incubated at room temperature (*ca.* 20 °C) for 1–2 d. Single conidial colonies were grown from sporulating sporocarps in Petri

dishes containing 2 % malt extract agar (MEA) as described by Crous *et al.* (1991). Leaf and stem tissues bearing ascomata were soaked in water for approximately 2 h, after which they were attached to the undersides of the lids of Petri dishes containing MEA. Ejected ascospore germination patterns were determined on MEA after 24 h, and single ascospore or conidial cultures were established following the method described by (Crous 1998). Colonies were sub-cultured on 2 % potato-dextrose agar (PDA), oatmeal agar (OA), MEA (Crous *et al.* 2019), 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 of the studied fungi are maintained in the CBS culture collection (CBS) of the Westerdijk Fungal Biodiversity Institute (WI), Utrecht, the Netherlands.

DNA extraction, amplification (PCR) and phylogeny

Fungal mycelium (Table 1) was scraped from the agar surface of cultures with a sterile scalpel and the genomic DNA was isolated using the Wizard® Genomic DNA Purification Kit (Promega Corporation, WI, USA) following the manufacturers' protocols.

Table 1. Collection details and GenBank accession numbers of species treated or newly sequenced in the present study.

Species	Strain(s) ¹	Country	Substrate/Host	Collector and Collection date	ITS	GenBank accession numbers ²			
						LSU	rpb2	tef1	Other loci
<i>Arthrinium caricicola</i>	ALV16691	Germany	<i>Carex ericetorum</i>	R. Jarling, 23 Jun. 2018	MK014871.1	MK014838.1	–	MK017948.1	tub2: MK017977.1
	CPC 33297 = CBS 145903, ex-epitype	Germany	<i>Carex ericetorum</i> , dead and attached leaves	R.K. Schumacher, 4 Apr. 2017	MN313782.1	MN317266.1	–	–	tub2: MN313861.1
	CPC 33299 = CBS 144986	Germany	<i>Carex ericetorum</i> , dead and attached leaves	R.K. Schumacher, 4 Apr. 2017	MN313783.1	MN317267.1	–	–	tub2: MN313862.1
	CPC 33368	Germany	<i>Carex ericetorum</i> , dead and attached leaves	R.K. Schumacher, 4 Apr. 2017	MN313784.1	MN317268.1	–	–	–
	CBS 117555	France	<i>Populus tremula</i> , decorticated wood	J. Fournier, 11 Apr. 2001	–	AY761084.1	–	–	SSU: AY761088.1
<i>Ceratospheeria lampadophora</i>	CBS 125415 = MR 1834 = JF 01115	France	<i>Populus tremula</i> , decorticated wood	J. Fournier, 18 Jun. 2001	MH863598.1	MH875074.1	–	–	–
	CPC 33633 = CBS 144991	France	<i>Populus nigra</i> , fallen and partly decorticated stem	M. Wilhelm, 15 Mar. 2017	MN313785.1	MN317269.1	–	–	act: MN313860.1
	Voucher SMH4822	France	Branch on the ground	A.N. Miller et al., 25 Sep. 2002	–	AY346270.1	–	–	–
<i>Dimerosporiopsis engleriana</i>	HPC 2591, epitype specimen	South Africa	<i>Erica</i> sp., stems	A. Wood, 24 Sep. 2014	MN313786.1	MN317270.1	–	–	–
<i>Hormodochis aggregata</i> , sp. nov.	CPC 24027	Germany	<i>Cytisus scoparius</i> (= <i>Sarothamnus scoparius</i>), twig	R.K. Schumacher, 21 Dec. 2013	MN313787.1	MN317271.1	MN313819.1	–	tub2: MN313863.1
	CPC 24159	Germany	<i>Cytisus scoparius</i> (= <i>Sarothamnus scoparius</i>), twig	R.K. Schumacher, 21 Dec. 2013	MN313788.1	MN317272.1	MN313820.1	–	tub2: MN313864.1
	CPC 24593	Germany	<i>Frangula alnus</i> , twig	R.K. Schumacher, 5 Apr. 2014	MN313789.1	MN317273.1	MN313821.1	–	tub2: MN313865.1
	CPC 26669	Germany	<i>Ulmus laevis</i> , twig	R.K. Schumacher, 7 Mar. 2015	MN313790.1	MN317274.1	MN313822.1	MN313842.1	–
	CPC 30017	Germany	<i>Prunus</i> (= <i>Cerasus</i>) sp., twig	R.K. Schumacher, 9 Jan. 2016	MN313791.1	MN317275.1	MN313823.1	–	–
<i>Sorbus aucuparia</i>	CPC 30413	Germany	<i>Sorbus aucuparia</i>	R.K. Schumacher, 17 Feb. 2016	MN313792.1	MN317276.1	MN313824.1	MN313843.1	–
	CPC 30453	Germany	<i>Sambucus racemosa</i> , twig	R.K. Schumacher, 12 Feb. 2016	MN313793.1	MN317277.1	MN313825.1	MN313844.1	–
	CPC 30528	Germany	<i>Berberis vulgaris</i> , twig	R.K. Schumacher, 2 Apr. 2016	MN313794.1	MN317278.1	MN313826.1	MN313845.1	–
	CPC 30530	Germany	<i>Sambucus nigra</i> , twig	R.K. Schumacher, 11 Mar. 2016	MN313795.1	MN317279.1	MN313827.1	MN313846.1	–
	CPC 30580	Germany	<i>Solanum dulcamara</i> , twig	R.K. Schumacher, 20 Apr. 2016	MN313796.1	–	–	–	–
	CPC 30630	Germany	<i>Sambucus nigra</i> , twig	R.K. Schumacher, 1 Mar. 2016	MN313797.1	–	–	MN313847.1	–
	CPC 30683 = CBS 145904, ex-type	Germany	<i>Sorbus aucuparia</i> , twig and bud	R.K. Schumacher, 27 Apr. 2016	MN313798.1	MN317280.1	MN313828.1	MN313848.1	tub2: MN313866.1

Table 1. (Continued).

Species	Strain(s) ¹	Country	Substrate/Host	Collector and Collection date	ITS	LSU	GenBank accession numbers ²		
							rpb2	tef1	Other loci
	CPC 30685	Germany	<i>Taxus baccata</i> , twig	R.K. Schumacher, 2 May 2016	MN317799.1	MN317281.1	MN313829.1	MN313849.1	–
	CPC 30737	Germany	<i>Hippophae rhamnoides</i> (= <i>Elaeagnus rhamnoides</i>), twig	R.K. Schumacher, 30 Apr. 2016	MN313800.1	MN317282.1	MN313830.1	MN313850.1	–
	CPC 30990	Hungary	<i>Lycium barbarum</i> , twig	R.K. Schumacher, 1 May 2016	MN313801.1	MN317283.1	MN313831.1	MN313851.1	–
	CPC 33325	Germany	<i>Ulmus laevis</i> , twig	R.K. Schumacher, 3 Feb. 2017	MN313802.1	–	MN313832.1	–	tub2: MN313867.1
	CPC 33331	Germany	<i>Platanus hispanica</i> , twig	R.K. Schumacher, 11 Mar. 2017	MN313803.1	MN317284.1	MN313833.1	–	–
	CPC 33913	Germany	<i>Viburnum opulus</i> , twig	R.K. Schumacher, 2 Jun. 2017	MN313804.1	MN317285.1	MN313834.1	–	–
	CPC 35471 = CBS 145905	Germany	<i>Prunus cerasifera</i> , attached dead twig	R.K. Schumacher, 25 Apr. 2018	MN313805.1	MN317286.1	MN313835.1	MN313852.1	tub2: MN313868.1
	CPC 35475	Germany	<i>Viscum album</i> on <i>Populus alba</i>	R.K. Schumacher, 27 Mar. 2018	MN313806.1	MN317287.1	MN313836.1	MN313853.1	–
	CPC 37499	Germany	<i>Crataegus</i> sp., dead, attached, twig	R.K. Schumacher, 15 Feb. 2019	MN313807.1	MN317288.1	MN313837.1	MN313854.1	–
<i>Hormodochis melanochlora</i>	CPC 24125 = CBS 138861, ex-epitype	Germany	<i>Cytisus scoparius</i> (= <i>Sarothamnus scoparius</i>), dead twig	R.K. Schumacher, 21 Dec. 2013	KP004459.1	MN313838.1	MN313855.1	tub2: MN313869.1	–
<i>Lecanostictopsis syzygii</i>	HPC 2573, epitype specimen	South Africa	<i>Syzygium cordatum</i> , living leaves	P.W. Crous, 11 Aug. 2018	MN313808.1	MN317289.1	–	–	–
<i>Lembosina aulographoides</i>	CPC 33049 = CBS 145946, ex-epitype	Netherlands	<i>Rhododendron</i> sp., stems	P.W. Crous, 1 Feb. 2017	MN313809.1	MN317290.1	MN313839.1	–	–
<i>Neomelanconium gelatosporum</i>	CPC 31126 = CBS 144985, ex-epitype	Germany	<i>Tilia platyphyllos</i> , dead, corticated and attached twig	R.K. Schumacher, 2 May 2016	MN313810.1	MN317291.1	–	MN313856.1	rpb1: MN313870.1
<i>Phragmotrichum chailletii</i>	CPC 31127, ex-epitype	Germany	<i>Tilia platyphyllos</i> , dead, corticated and attached twig	R.K. Schumacher, 2 May 2016	MN313811.1	MN317292.1	–	MN313857.1	rpb1: MN313871.1
	CPC 33263 = CBS 144994, ex-neotype	Switzerland	<i>Picea abies</i> , fallen cones	J. Gilgen & R.K. Schumacher, 7 Mar. 2017	MN313812.1	MN317293.1	MN313840.1	MN313858.1	–
	CPC 33341 = CBS 144993	Switzerland	<i>Picea abies</i> , fallen cones	J. Gilgen & R.K. Schumacher, 7 Mar. 2017	MN313813.1	MN317294.1	MN313841.1	MN313859.1	–
<i>Rutola graminis</i>	CPC 33267 = CBS 145906, ex-epitype	Germany	<i>Typha</i> sp., dead and still attached leaf	R.K. Schumacher, 1 Apr. 2017	MN313814.1	MN317295.1	–	–	–
	CPC 33695	Norway	<i>Scirpus sylvaticus</i>	Kaare Hombles, 3 May 2017	MN313815.1	MN317296.1	–	–	–
	CPC 33715	Germany	<i>Scirpus sylvaticus</i> , dead and still attached leaf	R.K. Schumacher, 3 May 2017	MN313816.1	MN317297.1	–	–	–

Table 1. (Continued).

Species	Strain(s) ¹	Country	Substrate/Host	Collector and Collection date	GenBank accession numbers ²				
					ITS	LSU	<i>rpb2</i>	<i>tef1</i>	Other loci
<i>Torula herbarum</i>	CPC 24114 = CBS 140066, ex-neotype	Netherlands	<i>Phragmites australis</i> , culms	W. Quaedvlieg, 24 Jan. 2014	KR873260.1	KR873288.1	–	–	–
	CPC 24115	Netherlands	<i>Phragmites australis</i> , culms	W. Quaedvlieg, 24 Jan. 2014	MN313817.1	–	–	–	–
	CPC 33688 = CBS 144995	Germany	<i>Deschampsia cespitosa</i> , dead culm base and dead leaf sheath	R.K. Schumacher, 3 May 2017	MN313818.1	MN317298.1	–	–	–

¹CBS: Westerdijk Fungal Biodiversity Institute, Utrecht, The Netherlands; CPC: Culture collection of Pedro Crous, housed at CBS.

²ITS: internal transcribed spacers and intervening 5.8S nrDNA; LSU: large subunit (28S) of the nrRNA gene operon; *act*: partial actin gene; *rpb1*: partial DNA-directed RNA polymerase II largest subunit gene; *rpb2*: partial DNA-directed RNA polymerase II second largest subunit gene; SSU: small subunit (18S) of the nrRNA gene operon; *tef1*: partial translation elongation factor 1-alpha gene; *tub2*: partial beta-tubulin gene.

Seven loci were amplified following previously published protocols. First, the 28S nrRNA gene (LSU) and internal transcribed spacer regions with intervening 5.8S nrRNA gene (ITS) of the nrDNA operon were sequenced for all the isolates included in this study (for amplification conditions, see Fan *et al.* 2018). Other loci were sequenced for various species or genera using primers and conditions specific for those groups of fungi (Table 1). Amplification of the partial DNA-directed RNA polymerase II second largest subunit gene (*rpb2*), the partial translation elongation factor 1-alpha gene (*tef1*) and the partial beta-tubulin gene (*tub2*) followed Braun *et al.* (2018), while the amplification of the partial actin gene (*act*) followed Videira *et al.* (2016) and the partial DNA-directed RNA polymerase II largest subunit gene (*rpb1*) followed Klaubauf *et al.* (2014). The resulting fragments were sequenced in both directions using the respective PCR primers and the BigDye Terminator Cycle Sequencing Kit v. 3.1 (Applied Biosystems Life Technologies, Carlsbad, CA, USA); DNA sequencing amplicons were purified through Sephadex G-50 Superfine columns (Sigma-Aldrich, St. Louis, MO) in MultiScreen HV plates (Millipore, Billerica, MA). Purified sequence reactions were analysed on an Applied Biosystems 3730xl DNA Analyzer (Life Technologies, Carlsbad, CA, USA). The DNA sequences were analysed and consensus sequences were computed using SeqMan Pro v. 13 (DNASTAR, Madison, WI, USA).

The sequences for each gene region were subjected to megablast searches (Zhang *et al.* 2000) to identify closely related sequences in the NCBI's GenBank nucleotide database. The results are provided as part of the species notes or as selected phylogenetic trees where applicable. Phylogenetic trees were generated using Bayesian analyses performed with MrBayes v. 3.2.6 (Ronquist *et al.* 2012) for the overview trees (Figs 1–3) and Maximum Parsimony analyses performed with PAUP v. 4.0b10 (Swofford 2003) for the species tree (Fig. 4) as explained in Braun *et al.* (2018). All resulting trees were printed with Geneious v. 11.0.3 (<http://www.geneious.com>, Kearse *et al.* 2012) and the layout of the trees was done in Adobe Illustrator v. CC 2017. Statistical measures calculated included posterior probabilities, parsimony bootstrap values, tree length (TL), consistency index (CI), retention index (RI) and rescaled consistency index (RC).

Morphology

Slide preparations were mounted in Shear's mounting fluid or water, from colonies sporulating on MEA, PDA, PNA or OA. Sections through conidiomata were made by hand. Observations were made with a Nikon SMZ25 dissection-microscope, and with a Zeiss Axio Imager 2 light microscope using differential interference contrast (DIC) illumination and images recorded on a Nikon DS-Ri2 camera with associated software. Colony characters and pigment production were noted after 2–4 wk of growth on MEA, PDA and OA (Crous *et al.* 2019) incubated at 25 °C. Colony colours (surface and reverse) were scored using the colour charts of Rayner (1970). Sequences derived in this study were deposited in GenBank (Table 1), the alignment in TreeBASE (www.treebase.org; study number S24788), and taxonomic novelties in MycoBank (www.MycoBank.org; Crous *et al.* 2004).

RESULTS

Phylogeny

Dothideomycetes LSU phylogeny (Fig. 1): The alignment contained 88 isolates and *Magnaporthiopsis maydis* (strain M84, GenBank KM009148.1) which was used as outgroup. The final alignment contained a total of 757 characters used for the phylogenetic analyses, including alignment gaps. The alignment contained a total of 297 unique site patterns. Based on the results of MrModelTest, dirichlet base frequencies and the GTR+I+G model was used for the Bayesian analysis. The Bayesian analyses generated 30 402 trees from which 22 802 were sampled after 25 % of the trees were discarded as burn-in. The tree revealed the following associations for the species treated in this

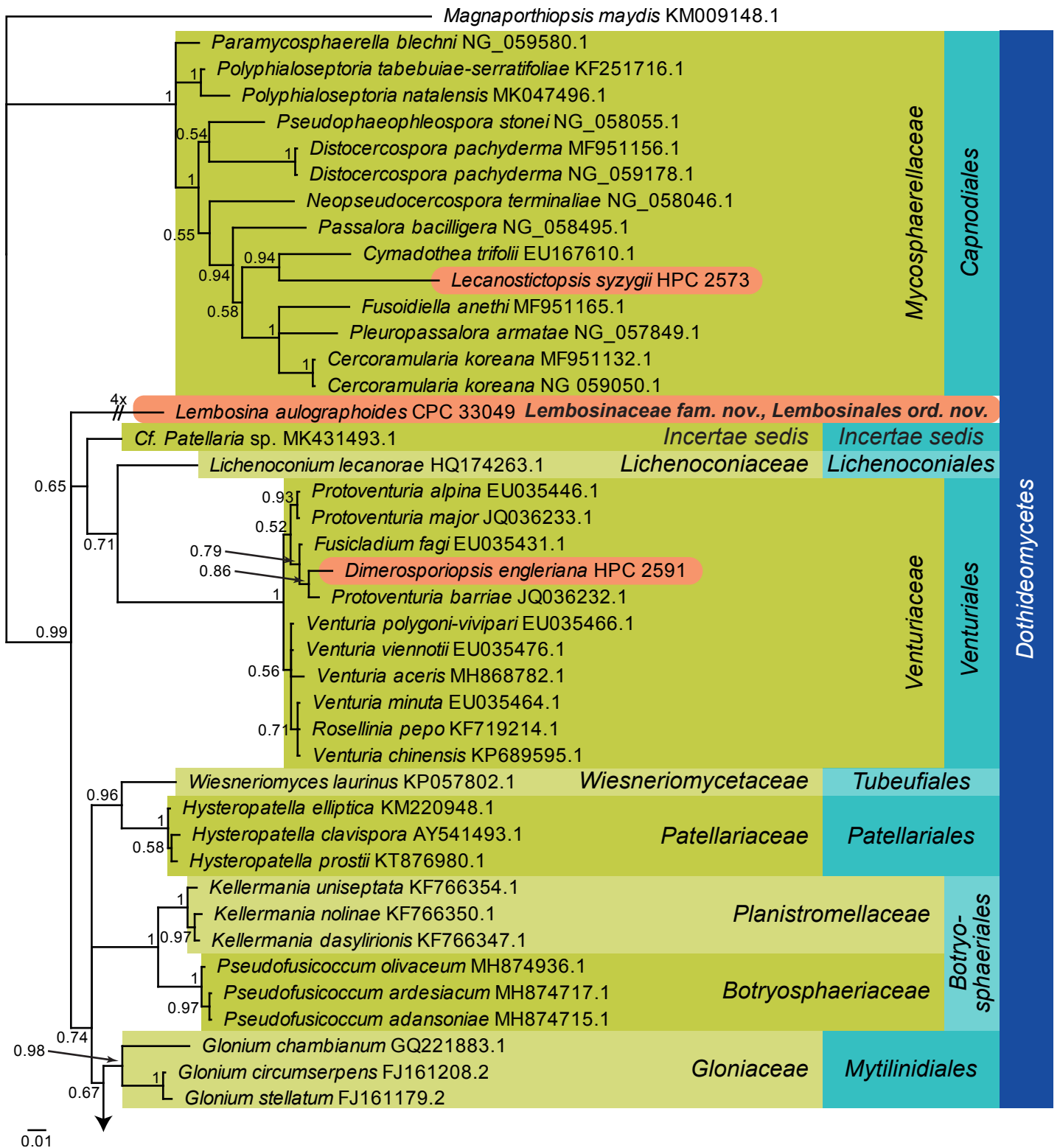


Fig. 1. Bayesian phylogeny calculated from the *Dothideomycetes* LSU sequence alignment. Bayesian posterior probabilities are shown at the nodes and the scale bar represents the expected changes per site. Classes, families and orders are indicated with coloured blocks to the right of the tree. GenBank accession or culture numbers are indicated behind the species names. The tree was rooted to *Magnaporthiopsis maydis* (GenBank KM009148.1) and the species treated in this study for which LSU sequence data were available are indicated in coloured rounded rectangles.

manuscript: *Lecanostictopsis syzygii* in *Mycosphaerellaceae* (*Capnodiales*); *Dimerosporiopsis engleriana* in *Venturiaceae* (*Venturiales*); *Phragmotrichum chaillietii* and *Rutola graminis* in *Melanommataceae* and *Torulaceae* (both *Pleosporales*), respectively. *Lembosina aulographoides* did not cluster with any known family or order and therefore a family and order are introduced below to accommodate it.

Lecanoromycetes LSU phylogeny (Fig. 2): The alignment contained 30 isolates and *Protoventuria alpina* (CBS 373.53, GenBank EU035446.1) which was used as outgroup. The final alignment contained a total of 747 characters used for the phylogenetic analyses, including alignment gaps. The alignment contained a total of 158 unique site patterns. Based on the results of MrModelTest, dirichlet base frequencies and

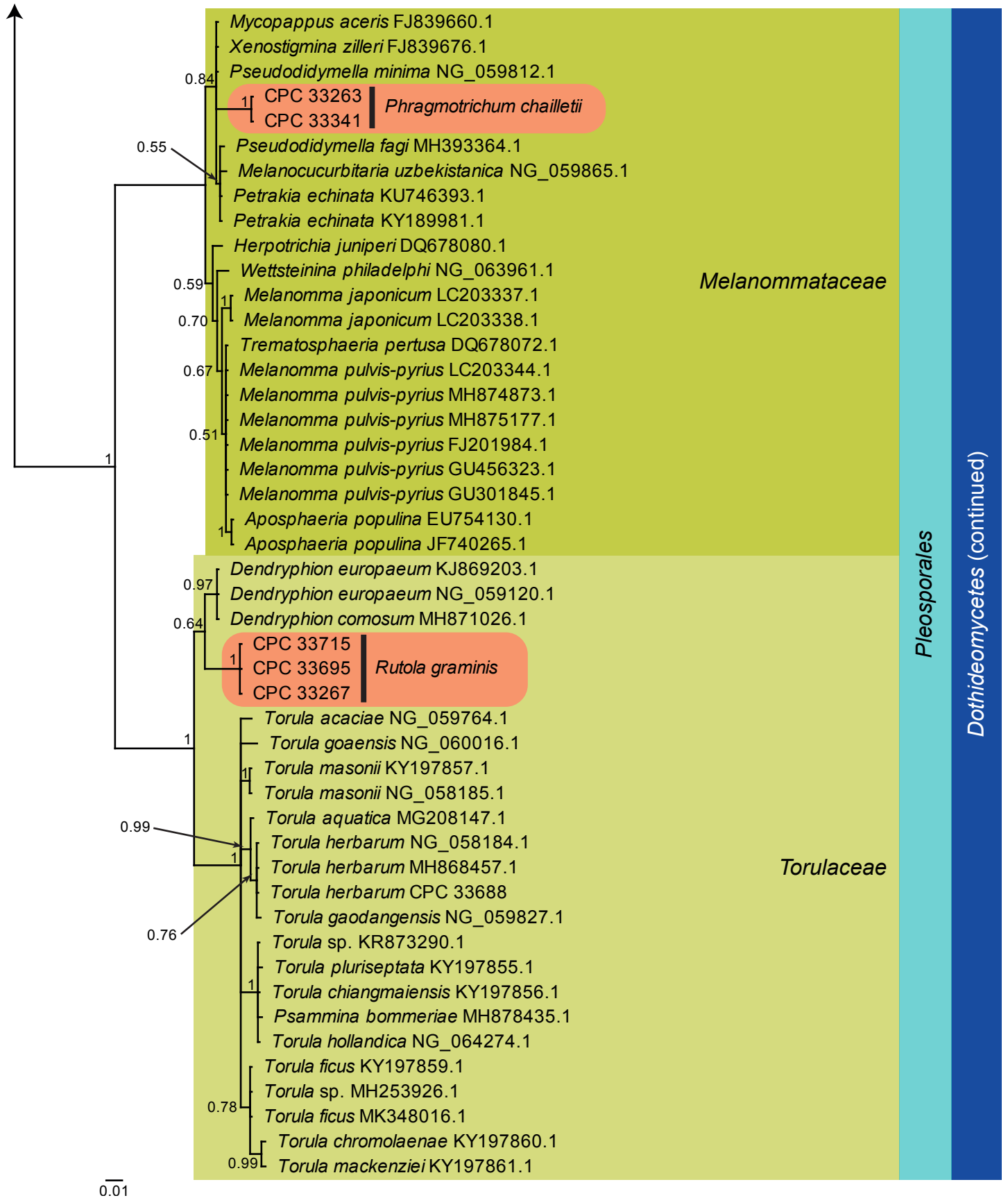


Fig. 1. (Continued).

the GTR+I+G model was used for the Bayesian analysis. The Bayesian analyses generated 1 902 trees from which 1 428 were sampled after 25 % of the trees were discarded as burn-in. *Hormodochis* is shown to be a member of *Stictidaceae* (*Ostropales*).

Leotiomycetes and *Sordariomycetes* LSU phylogeny (Fig. 3): The alignment contained 40 isolates and *Protoventuria alpina* (CBS 373.53, GenBank EU035446.1) which was used as outgroup. The final alignment contained a total of 780 characters used for the phylogenetic analyses, including

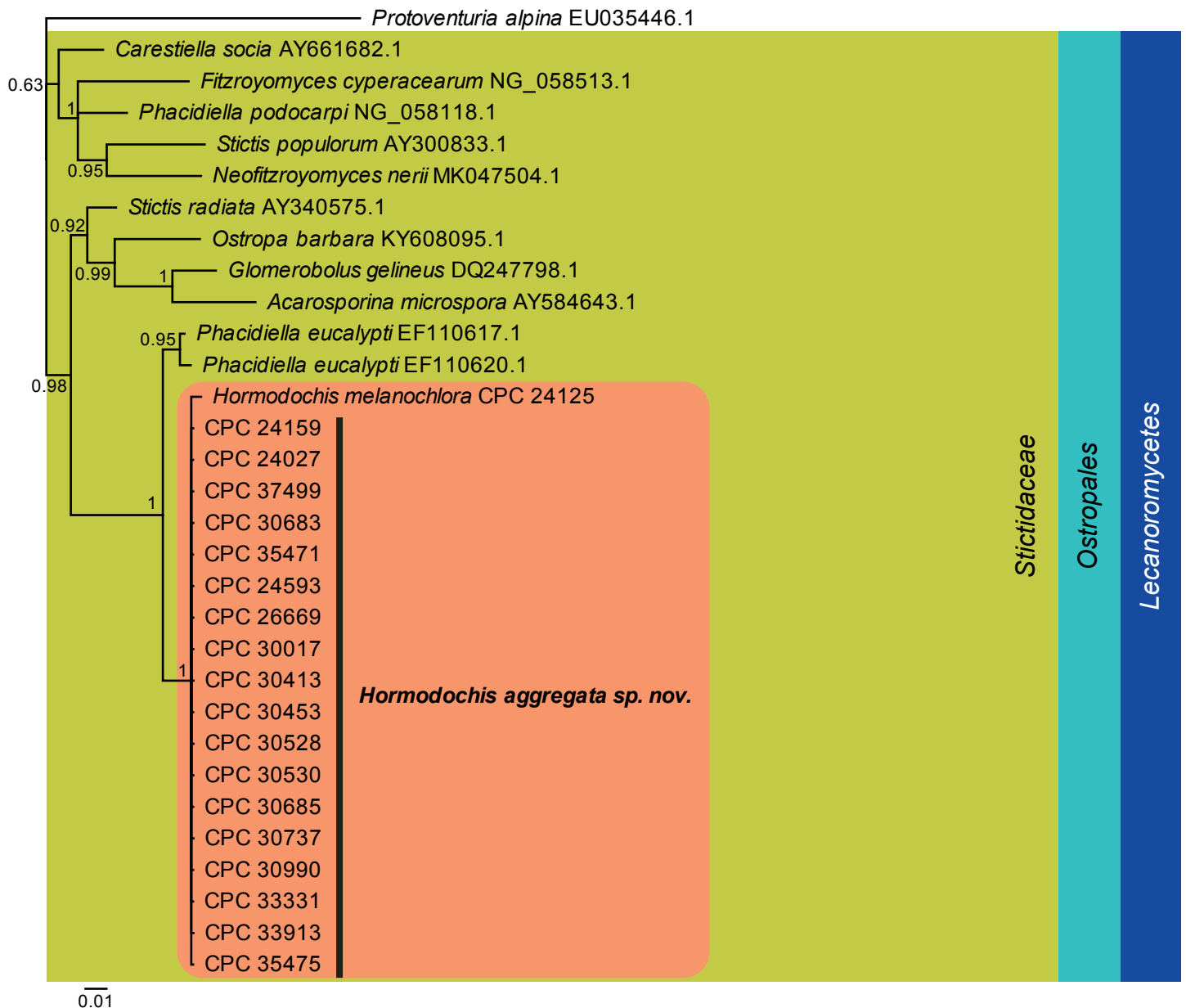


Fig. 2. Bayesian phylogeny calculated from the *Lecanoromycetes* LSU sequence alignment. Bayesian posterior probabilities are shown at the nodes and the scale bar represents the expected changes per site. Classes, families and orders are indicated with coloured blocks to the right of the tree. GenBank accession or culture numbers are indicated behind the species names. The tree was rooted to *Protoventuria alpina* (GenBank EU035446.1) and the species treated in this study for which LSU sequence data were available are indicated in the coloured rounded rectangle.

alignment gaps. The alignment contained a total 240 unique site patterns. Based on the results of MrModelTest, dirichlet base frequencies and the GTR+I+G model was used for the Bayesian analysis. The Bayesian analyses generated 24 702 trees from which 18 528 were sampled after 25 % of the trees were discarded as burn-in. *Neomelanconium gelatosporum* is placed in *Cenangiaceae* (*Helotiales*, *Leotiomyces*), while *Arthrinium caricicola* (including GenBank MK014838.1; Pintos *et al.* 2019) is placed in *Apiosporaceae* (*Xylariales*, *Sordariomycetes*) with other species of *Arthrinium* and *Ceratospaeria lampadophora* (including GenBank AY346270.1, AY761084.1 and MH875074.1; Huhndorf *et al.* 2004, Réblová 2006 and Vu *et al.* 2019) is placed in *Magnaporthaceae* (*Magnaporthales*, *Sordariomycetes*).

THE GENERA

Arthrinium Kunze, *Mykologische Hefte* (Leipzig) 1: 9. 1817.

Synonyms: See Crous & Groenewald (2013).

Classification: *Apiosporaceae*, *Xylariales*, *Sordariomycetes*.

Colonies compact, black to dark brown, superficial to erumpent. *Mycelium* immersed and superficial. *Conidiophores* arising from basal cells that are subcylindrical, subhyaline with refractive, thick transverse septa, brown to dark brown, forming conidia laterally and terminally; conidiophores frequently aggregated in a brown stroma, forming black sporodochia on the host and in culture. *Setae* present or absent, brown, smooth, erect, sparsely septate, tapering to subacute apex, intermingled among conidiophores. *Conidiogenous cells* discrete, doliiform,

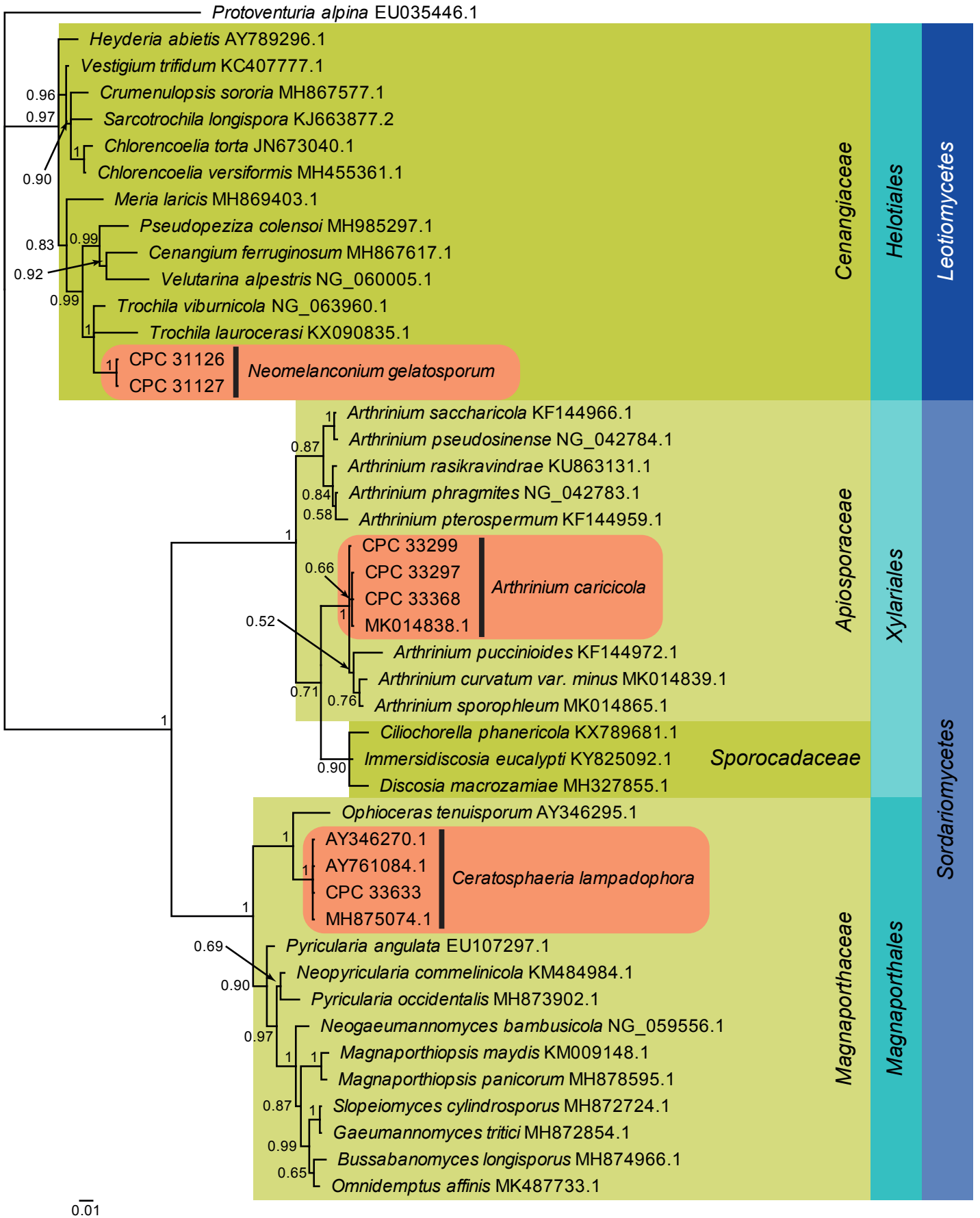


Fig. 3. Bayesian phylogeny calculated from the *Leotiomyces* and *Sordariomyces* LSU sequence alignment. Bayesian posterior probabilities are shown at the nodes and the scale bar represents the expected changes per site. Classes, families and orders are indicated with coloured blocks to the right of the tree. GenBank accession or culture numbers are indicated behind the species names. The tree was rooted to *Protoventuria alpina* (GenBank EU035446.1) and the species treated in this study for which LSU sequence data were available are indicated in the coloured rounded rectangles.

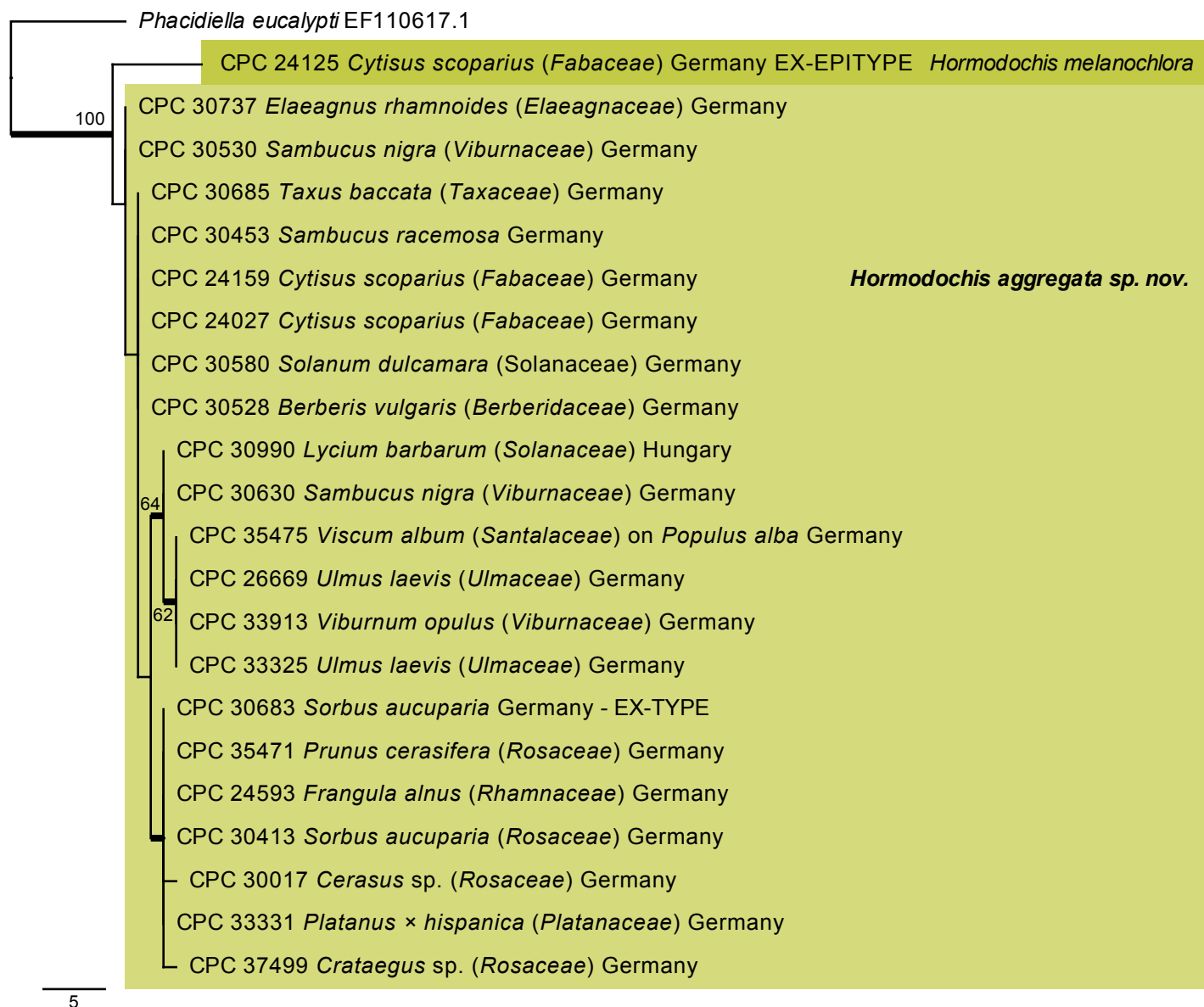


Fig. 4. The first of two equally most parsimonious trees obtained from a phylogenetic analysis of the *Hormodochis* ITS alignment (23 strains including the outgroup; 491 characters analysed: 463 constant, 22 variable and parsimony-uninformative and 6 parsimony-informative). The tree was rooted to *Phacidiella eucalypti* (GenBank EF110617.1) and the scale bar indicates the number of changes. Bootstrap support values higher than 49 % are shown at the nodes and the species clades are highlighted with coloured boxes. Species names are indicated to the right of the tree. Strain numbers are followed by the substrate and country of origin. Branches present in the strict consensus tree are thickened. Tree statistics: TL = 32, CI = 0.938, RI = 0.923, RC = 0.865.

ampulliform to subcylindrical, subhyaline to pale brown, smooth to finely verruculose, aggregated on aerial hyphae, giving rise to clusters of conidia; at times reduced to lateral pegs on hyphae, holoblastic, proliferating sympodially (at times clearly phialidic with periclinal thickening, rarely with percurrent proliferation). *Conidia* aseptate, brown to dark brown, smooth to verruculose, guttulate to granular, with distinctive shape (round, curved, curved with two horns, oblong, irregular, limoniform, fusiform, navicular, dentate or lobed), at times flattened, with equatorial slit of lighter pigment. *Sterile cells* when formed replace conidia, usually smaller and paler than conidia, with different shape, frequently containing refractive cubical bodies. *Stromata* immersed in epidermis, becoming erumpent through a longitudinal split, revealing rows of densely arranged perithecial ascomata. *Ascomata* globose with papillate ostioles; wall composed of 6–9 layers of pseudoparenchymatous cells. *Paraphyses* broadly

filiform, septate, deliquescing early. *Asci* 8-spored, unitunicate (appearing bitunicate when young), clavate to broadly cylindrical. *Ascospores* smooth, hyaline, bi- to tri-seriate, ellipsoid, inequilateral, tapered at both ends, apiosporous, 1-septate near the lower end, with the lower, smaller cell subglobose; ascospores with or without mucoid sheath (from Crous & Groenewald 2013).

Type species: Arthrimum caricicola Kunze

Arthrimum caricicola Kunze, *Mykologische Hefte* (Leipzig) 1: 9. 1817. Fig. 5.

Colonies compact, pulvinate, 150–400 µm diam, dark blackish brown. *Mycelium* immersed and superficial, composed of a network of branched and anastomosing, septate, brown to dark brown, smooth-walled, 4–7 µm diam hyphae; immersed hyphae

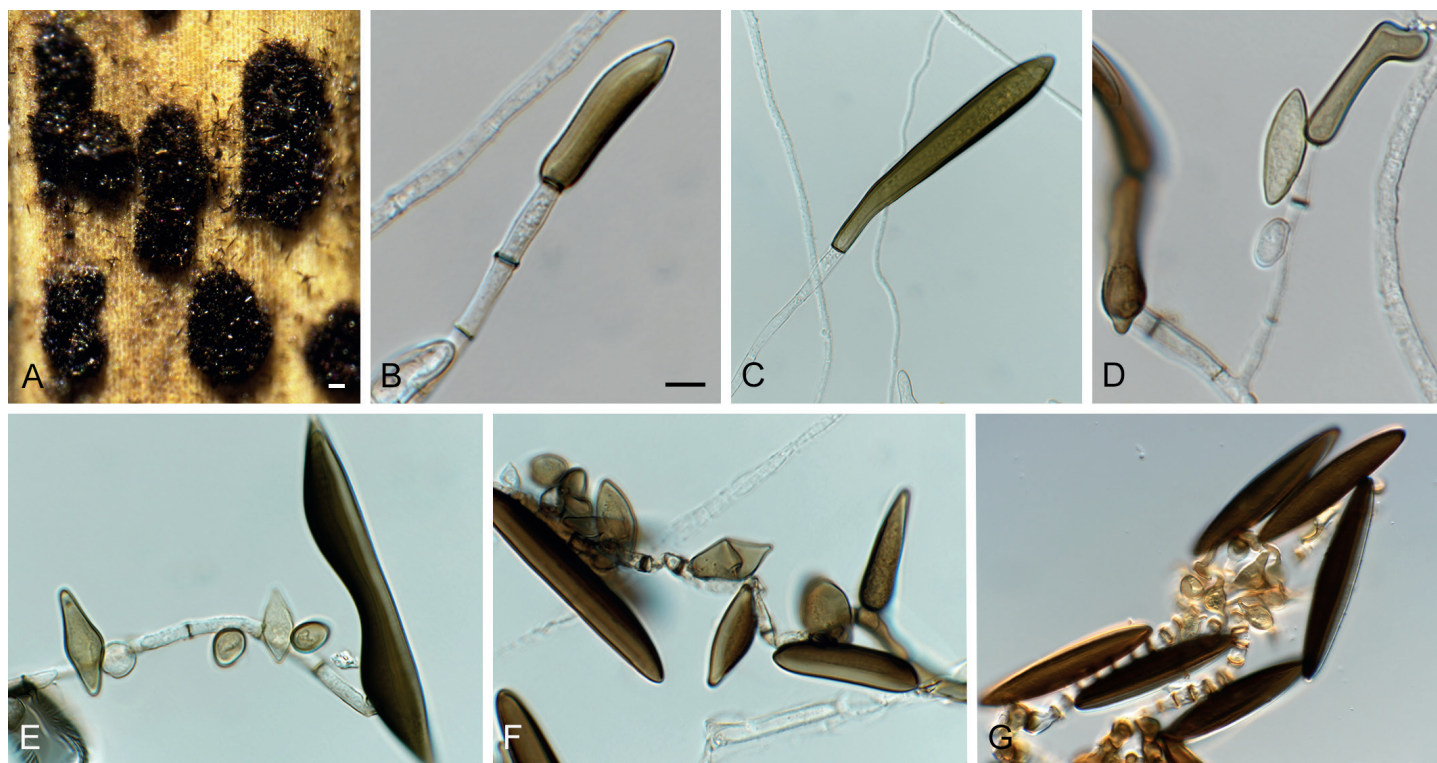


Fig. 5. *Arthrimum caricicola* (CPC 33297). **A.** Colonies on host material. **B–F.** Sterile cells. **G.** Conidiophore mother cells ad conidia. Scale bars: A = 400 μm , B = 10 μm , applies to all others.

pale to dark brown, 2–6 μm diam. *Conidiophore mother cells* subspherical to lageniform, 5–8 \times 5–7 μm . *Conidiophores* erect, simple, flexuous, cylindrical, pale brown or dark brown, with thick, dark brown transverse septa, smooth-walled, 20–120 μm tall, 2–5 μm diam. *Conidia* fusoid or cigar-shaped in face view, navicular in side view, dark brown with distinct hyaline rim, (31–) 40–50(–56) \times (7.5–)8–11(–15) μm . *Sterile cells* much smaller and paler than conidia, irregularly lobed.

Culture characteristics: Colonies covering the dish in 2 wk with moderate, fluffy aerial mycelium, and smooth, even margins. On MEA surface pale olivaceous grey, reverse umber; on PDA surface olivaceous grey, reverse isabelline; on OA surface dirty white.

Typus: **Germany**, Berlin, “Jungfernheide”, dead leaf of *Carex ericetorum* (= *C. ciliata*) (Cyperaceae), Apr. 1817 or before, G. Kunze (**isotype** BPI 422608, designated as **lectotype** here, MBT388205); near Berlin, on dead and attached leaves of *Carex ericetorum*, 4 Apr. 2017, R.K. Schumacher, RKS 86 = HPC 2039 (**epitype** designated here CBS H-24083, MBT388206, cultures ex-epitype CPC 33297 = CBS 145903, CPC 33298 = CBS 145903).

Additional materials examined: **Germany**, near Berlin, on dead and attached leaves of *Carex ericetorum*, 4 Apr. 2017, *leg. et det.* R.K. Schumacher, RKS 87 = HPC 2040, cultures PC 33299 = CBS 144986, CPC 33300; near Berlin, on dead and attached leaves of *Carex ericetorum*, 4 Apr. 2017, *leg. et det.* R.K. Schumacher, RKS 88 = HPC 2041, cultures CPC 33368, CPC 33369.

Notes: *Arthrimum* [sexual morph (synonym) *Apiospora*; *Apiosporaceae*] was recently treated by Crous & Groenewald (2013). Since this study, several other species have been added

to the genus (Jiang *et al.* 2018, Wang *et al.* 2018, Pintos *et al.* 2019). The present study fixes the application of the genus *Arthrimum* by designating an epitype for the type species *Arthrimum caricicola*. Our ITS, LSU and tub2 sequences are identical to those of strain ALV16691 (Pintos *et al.* 2019), also from *Carex ericetorum*, Germany.

Ceratosphaeria Niessl, *Verh. nat. Ver. Brünn* 14: 203. 1876.

Classification: *Magnaporthaceae*, *Magnaporthales*, *Sordariomycetes*.

Ascomata perithecial, singly to densely crowded, immersed, later erumpent, more or less globose with a central and long rostrum, black, thick, rough. *Peridium* multi-layered, consisting of a *textura prismatica*. *Paraphyses* numerous, longer than the asci, basally moniliform, upwards tapered and filiform, unbranched, no anastomoses, hyaline. *Asci* 8-spored, clavate, apically conical rounded and thick-walled, otherwise thin-walled, pedicel short and furcate, apex diaphragmoid, inoperculate, inamyloid, spores bi- to triseriate overlapping. *Ascospores* transversely septate, fusoid, slightly curved, end cells tapered, hyaline, thin-walled, smooth, septa thin-walled. Harpophora-like morph in culture. *Mycelium* consisting of hyaline, smooth, hyphae that become pigmented in fertile regions. *Conidiophores* reduced to conidiogenous cells, or septate, branched, solitary, erect. *Conidiogenous cells* terminal and intercalary, pale brown, smooth, subcylindrical with apical taper and flared collarette. *Conidia* aggregating in mucoid mass, aseptate, hyaline, smooth, curved, narrowly fusoid with obtuse ends.

Type species: *Ceratosphaeria lampadophora* (Berk. & Broome) Niessl

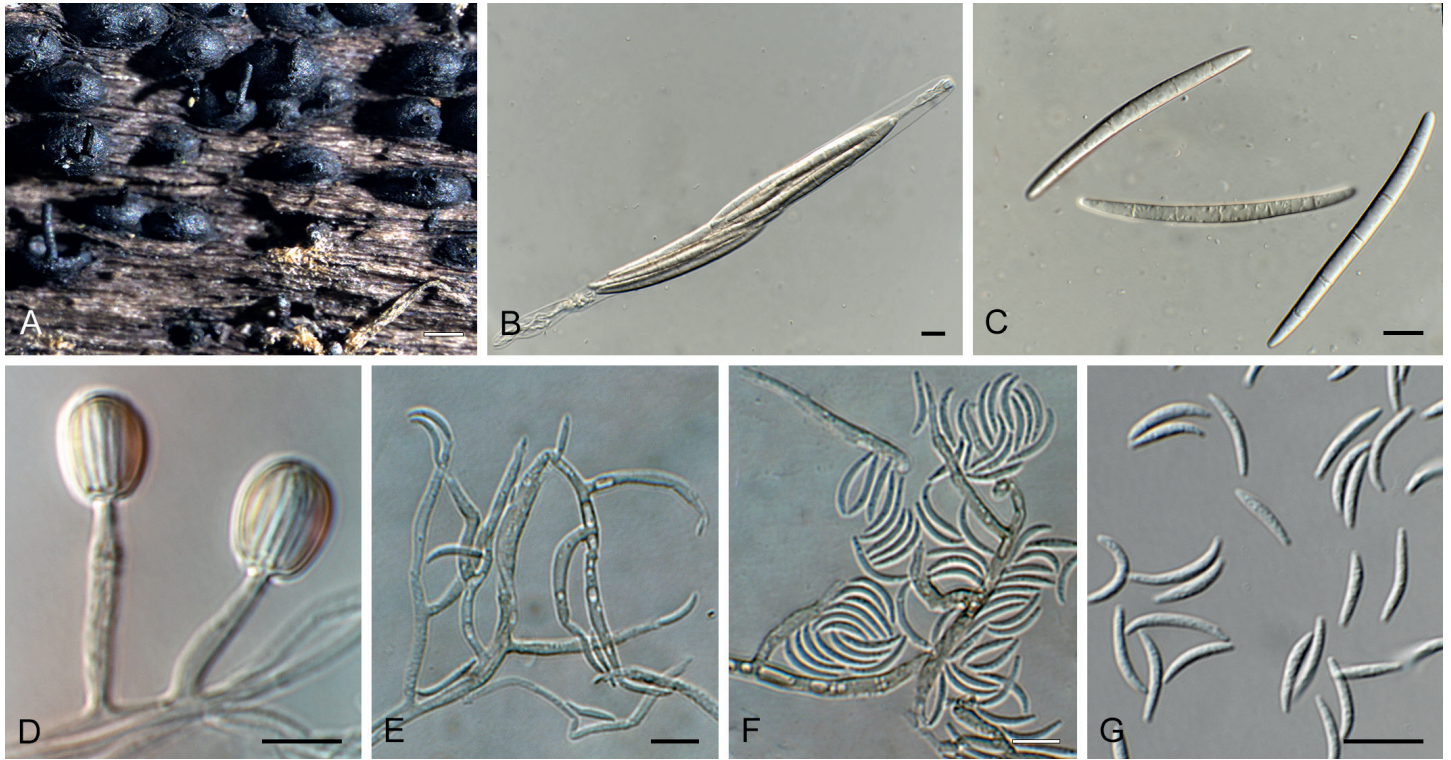


Fig. 6. *Ceratosphaeria lampadophora* (CPC 33633). **A.** Black perithecial ascomata. **B.** Ascus. **C.** Ascospores. **D–F.** Conidiophores giving rise to conidia. **G.** Conidia. Scale bars: A = 3 mm, all others = 10 μ m.

Ceratosphaeria lampadophora (Berk. & Broome) Niessl, *Verh. nat. Ver. Brünn* **14**: 203. 1876. Fig. 6.

Basionym: *Sphaeria lampadophora* Berk. & Broome, *Ann. Mag. nat. Hist.*, Ser. 3 **3**(17): 372. 1859.

Occurring on dead twigs. *Ascomata* perithecial, singly to densely crowded, immersed, later erumpent, more or less globose with a central and long rostrum, black, thick, rough, up to 1 000 μ m diam, 400–650 μ m high. *Peridium* multi-layered, consisting of a *textura prismatica*, inner layers hyaline and outer layers red-brown. *Paraphyses* numerous, longer than the asci, basally moniliform, upwards tapered and filiform, unbranched, no anastomoses, hyaline. *Asci* 8-spored, clavate, apically conical rounded and thick-walled, otherwise thin-walled, pedicel short and furcate, apex diaporthoid, inoperculate, inamyloid (water + Lugol), spores bi- to triseriate overlapping. *Ascospores* 5–7-septate, fusoid, slightly curved, end cells tapered, hyaline, thin-walled, smooth, septa thin-walled and smooth, one small to middle sized guttule per cell, examined in water, living and mature, (54–)60–66(–72) \times (3.5–)4 μ m. Harpophora-like morph in culture. *Mycelium* consisting of hyaline, smooth, 1.5–2 μ m diam hyphae that become pigmented in fertile regions. *Conidiophores* reduced to conidiogenous cells, or 1-septate, branched, solitary, erect, 10–30 \times 2.5–3 μ m. *Conidiogenous cells* terminal and intercalary, pale brown, smooth, subcylindrical with apical taper and flared collarette, 10–17 \times 2.5–3 μ m. *Conidia* aggregating in mucoid mass, aseptate, hyaline, smooth, curved, narrowly fusoid with obtuse ends, (5–)8–10(–13) \times 1–1.5 μ m.

Culture characteristics: Colonies spreading, erumpent with smooth, lobate margins, reaching 25 mm diam after 2 wk on MEA, but covering dish on OA, with moderate aerial mycelium. On MEA surface amber, isabelline at margin, with diffuse sepia

pigment, reverse sepia; on PDA surface and reverse cream, with dark sepia diffuse pigment; on OA surface honey.

Typus: **UK**, Combe Hay, on decayed wood, *leg.* C.E. Broome, Apr. 1855 (**holotype** K(M)82672).

Material examined: **France**, Kembs/Elsass, alt. 240 m a.s.l., on fallen and partly decorticated stem of *Populus nigra* (*Salicaceae*), 15 Mar. 2017, *leg.* M. Wilhelm, *det.* R.K. Schumacher, RKS 72 = HPC 2013, cultures CPC 33633 = CBS 144991, CPC 33634.

Notes: *Ceratosphaeria lampadophora* was originally described from decayed wood collected in the UK. A re-examination of the holotype reported ascospores to be 5–7(–8)-septate, 72–82 \times 3.5–4 μ m (Hyde *et al.* 1997), somewhat longer than observed in the present European collection. Huhndorf *et al.* (2008) cite a collection from France as also having smaller ascospores, namely 5–7-septate, 52–72 \times 3.5–4.5 μ m. The present collection is thus not designated as epitype, as it is quite possible that two cryptic species might be involved. Of interest is the harpophora-like morph observed in culture, which is typical of *Magnaporthaceae*. Our ITS sequence differs with an extra T nucleotide from the sequence of CBS 125415 (Vu *et al.* 2019), while the LSU sequence is identical to three sequences in GenBank (AY346270.1, AY761084.1 and MH875074.1; Huhndorf *et al.* 2004, Réblová 2006, Vu *et al.* 2019).

Dimerosporiopsis Henn., *Fungi Europ. Extraeur. Exs.*, Cent. **43**: no. 4260. 1901.

Classification: Venturiaceae, Venturiales, Dothideomycetes.

Caulicolous, causing some thickening and distortion of the affected parts, covering them with a dark brown to black mycelial

growth. *Mycelium* extending through the cortex, giving rise to tufts of erect hyphae, which cover the stem with a turf-like growth. *Ascomata* pseudothecial, intermixed amongst the erect hyphae and attached to them at the base, globose or somewhat flattened, non-setose, collapsing and becoming cupulate when dry; wall rough externally, grossly verrucose, olivaceous, composed of several layers of irregularly polygonal cells 10–15 µm diam; without true ostiole, but with an irregular pore. *Asci* bitunicate, 8-spored, cylindrical, rounded at apex, tapering to a well-defined foot. *Pseudoparaphyses* hyaline, septate, filiform. *Ascospores* bi-seriate, 1-septate, pale olivaceous, clavate-ellipsoid, rounded at ends, slightly constricted at the septum, guttulate.

Type species: Dimerosporiopsis engleriana (Henn.) Henn.

Dimerosporiopsis engleriana (Henn.) Henn., *Fungi Eur. Extraeur. Exs.*, Cent. **43**: no. 4260. 1901. Fig. 7.

Basionym: Dimerosporium englerianum Henn., *Die Pflanzenwelt Ost-Afrikas und der Nachbargebiete*, Teil C: 31. 1895.

Synonymy: Dimerium englerianum (Henn.) Sacc. & P. Syd., *Syll. fung.* **17**: 537. 1905.

Dimerosporis engleriana (Henn.) Clem., *Gen. fung.*: 32. 1909.

Phaeodimeriella engleriana (Henn.) Speg., *Revista Mus. La Plata* **15**(2): 13. 1908.

Antennularia engleriana (Henn.) Höhn., *Sber. Akad. Wiss. Wien.* **119**: 920. 1910.

Gibbera engleriana (Henn.) Van der Byl, *S. African J. Sci.* **25**: 182. 1928.

Protoventuria engleriana (Henn.) Sivan., *Trans. Brit. Mycol. Soc.* **63**(3): 590. 1974.

Caulicolous, causing some thickening and distortion of the affected parts, and covering them with a dark brown to black mycelial growth, which is often continuous for several centimetres. *Mycelium* extending through the cortex, and producing in the tissues of the host numerous small cushions, cellular in structure and irregular in form and size; these are brown, and formed of cells which may be irregularly polygonal and 5–10 µm diam, or, especially towards the periphery, with a tendency to become cubical and to develop in rows at right angles to the surface of the stem. At the surface, these cushions

give rise to tufts of erect hyphae, which become so numerous as to completely clothe the stem with a turf-like growth. Erect hyphae brown, thick-walled, 5–6 µm thick, up to 400 µm high, septate; cells 20–25 µm long; sparingly branched and often tortuous and tangled. *Ascomata* pseudothecial, numerous, nestling amongst the erect hyphae and attached to them at the base, globose or somewhat flattened, non-setose, 220–350 µm diam, 250–300 µm high, collapsing and becoming cupulate when dry. Perithecial wall rough externally, grossly verrucose, olivaceous, composed of several layers of irregularly polygonal cells 10–15 µm diam; without true ostiole, but with a thin place at the apex which breaks down and forms an irregular pore. *Asci* bitunicate, 8-spored, cylindrical, rounded at apex with small apical chamber, 90–130 × 11–13 µm. *Pseudoparaphyses* numerous, hyaline, filiform, branched, septate, anastomosing, 2–3 µm diam. *Ascospores* distichous, medianly 1-septate, pale olivaceous, smooth, clavate-ellipsoid with rounded ends, constricted at septum, pluri-guttulate, (16–)17–19(–22) × 6–7 µm (up to 9 µm diam when mounted in water) (adapted from Doidge 1941).

Typus: Tanzania, on the mountain “Mawensi”, volcano “Kisimba”, on inflorescens of *Erica mannii* (= *Ericinella mannii*) (*Ericaceae*), Sep. 1893, G.L.A. Volkens (*isotype*, LE117684 ex Flora des Kilimandscharo nr. 945, selected here as *lectotype*, MBT388207). **South Africa**, Western Cape Province, Bontebok National Park, on stems of *Erica* sp., 24 Sep. 2014, A. Wood, HPC 2591 (*epitype* designated here CBS H-24086, MBT388208).

Notes: The present fungus has had a very confused history, and has been placed in numerous genera (see synonymy above). For many years it was referred to in literature as *Antennularia engleriana*, until Sivanesan (1974) placed it in *Protoventuria*. *Dimerosporiopsis engleriana* is a member of the *Venturiaceae*, and clusters close to species described in “*Protoventuria*”. However, the genus *Protoventuria* (1887) (based on *Venturia rosae*, CBS 312.58), clusters with *P. alpina* (CBS 140.83), but both are related to species of *Cadophora* (*Helotiales*), suggesting that these strains could be incorrectly identified. Several other species of *Protoventuria* cluster with *Dimerosporiopsis*, as would be expected based on their morphology. Based on the distinct lineage shown by Zhang *et al.* (2011), Rossman *et al.* (2015)

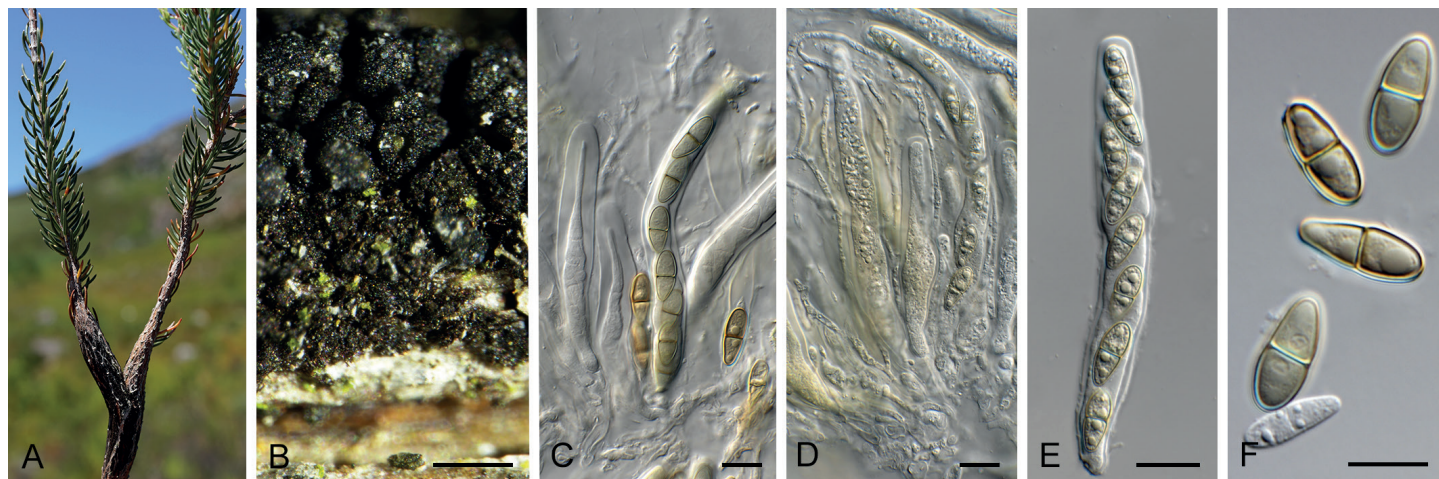


Fig. 7. *Dimerosporiopsis engleriana* (HPC 2591). **A.** Branch canker on *Erica* sp. **B.** Ascomata. **C–E.** Asci and pseudoparaphyses. **F.** Ascospores. Scale bars: B = 250 µm, all others = 10 µm.

concluded that the genus *Ramalia* Bat., 1957, is a synonym of *Protoventuria*, but as stated here, we suspect that these isolates have been misidentified. The best course of action would thus be to recollect *Venturia rosae* (on *Rosa alpina*, Italy), and *R. veronicae* (on *Parasterina veronicae* and *Asteromella veronicae*, on *Veronica derwentia*: New South Wales, Australia) before this matter can be resolved.

All attempts to culture *D. engleriana* failed, hence an ITS and LSU sequence were generated from DNA isolated directly from fungal material.

Hormodochis Clem., *Gen. fung.* (Minneapolis): 163. 1909.

Classification: *Stictidaceae*, *Ostropales*, *Ostropomycetidae*, OSLEUM clade, *Lecanoromycetes*.

Conidiomata erumpent, globose, brown, separate to aggregated, opening via irregular rupture wall of thin-walled brown *textura angularis*. *Conidiophores* lining the inner layer, arising from stromatic cells, hyaline, smooth, guttulate, branched below or not, cylindrical, straight or slightly curved, septate, upper cell fertile, becoming septate, and disarticulating into arthroconidia via basipetal secession, intact chains. *Conidia* aseptate, arranged in cylindrical chains, olivaceous brown, smooth, subcylindrical to somewhat doliiform, with truncate ends, with minute marginal frill.

Type species: *Hormodochis melanochlora* (Desm.) Clem.

Hormodochis aggregata Crous & R.K. Schumach., *sp. nov.* MycoBank MB832085. Fig. 8.

Etymology: Referring to its aggregated conidiomata.

Conidiomata erumpent, globose, brown to black, up to 300 µm diam, stromatic, multilocular, solitary to aggregated, immersed to erumpent, opening via irregular rupture wall of thin-walled brown *textura angularis*. *Conidiophores* lining the inner layer, arising from stromatic cells, hyaline, smooth, branched below or not, forming a rosette, cylindrical, straight or slightly curved, septate, 5–20 × 2–3 µm, upper cell fertile, becoming septate, and disarticulating into arthroconidia via basipetal secession, forming long intact chains. *Conidia* aseptate, basipetal, arranged

in unbranched or branched cylindrical chains, olivaceous brown to green-brown, smooth, subcylindrical to somewhat doliiform, with truncate ends, with minute marginal frill, (4–)5–6 × 2(–2.5) µm.

Culture characteristics: Colonies flat, spreading, surface folded, with moderate aerial mycelium, and smooth, lobed margins, reaching 20 mm diam after 2 wk at 25 °C in the dark. On MEA, PDA and OA surface dirty white, reverse ochreous.

Typus: **Germany**, near Berlin, on twig and bud of *Sorbus aucuparia* (*Rosaceae*), 27 Apr. 2016, R.K. Schumacher RKS 0986 = HPC 1188 (**holotype** CBS H-24084, culture ex-type CPC 30683 = CBS 145904).

Additional material examined: **Germany**, near Berlin, on attached dead twig of *Prunus cerasifera* (*Rosaceae*), 25 Apr. 2018, R.K. Schumacher RKS161 = HPC 2312 = CBS H-24085, culture CPC 35471 = CBS 145905.

Notes: The two strains of *H. aggregata* studied here were quite variable in conidial morphology, with conidia of the ex-type strain being (3–)4–5 × 2(–2.5) µm (CPC 30683, on *Sorbus aucuparia*), while they were larger, (4–)5–6(–8) × (2–)2.5(–3) µm in CPC 35471, isolated from *Prunus cerasifera*. The genus *Hormodochis* appears to be quite common, and to occur on a wide host range. Although only two species are treated here (Figs 2, 4; *rpb2*, *tef1* and *tub2* data in GenBank), several others remain to be named. Although *H. aggregata* and *H. melanochlora* are highly similar on LSU [Fig. 2; 972/1 002 (97 %)–796/799 (99 %)] and ITS (Fig. 4; 622/650 (96 %)–554/573 (97 %)), the other loci are much more variable (*rpb2*: on average 774/864 (90 %), *tef1*: 546/613 (89 %)–502/550 (91 %) and *tub2*: 229/271 (85 %)–511/583 (88 %)).

Hormodochis melanochlora (Desm.) Clem., *Gen. fung.* (Minneapolis): 163. 1909. Fig. 9.

Basionym: *Epidochium melanochlorum* Desm., *Annls Sci. Nat., Bot.*, sér. 3, 16: 327. 1851.

Synonyms: *Hormodochium melanochlorum* (Desm.) Höhn., *Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1*, **120**(4): 465. 1911.

Trullula melanochlora (Desm.) Höhn., *Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1*, **124**(1–2): 97. 1915.

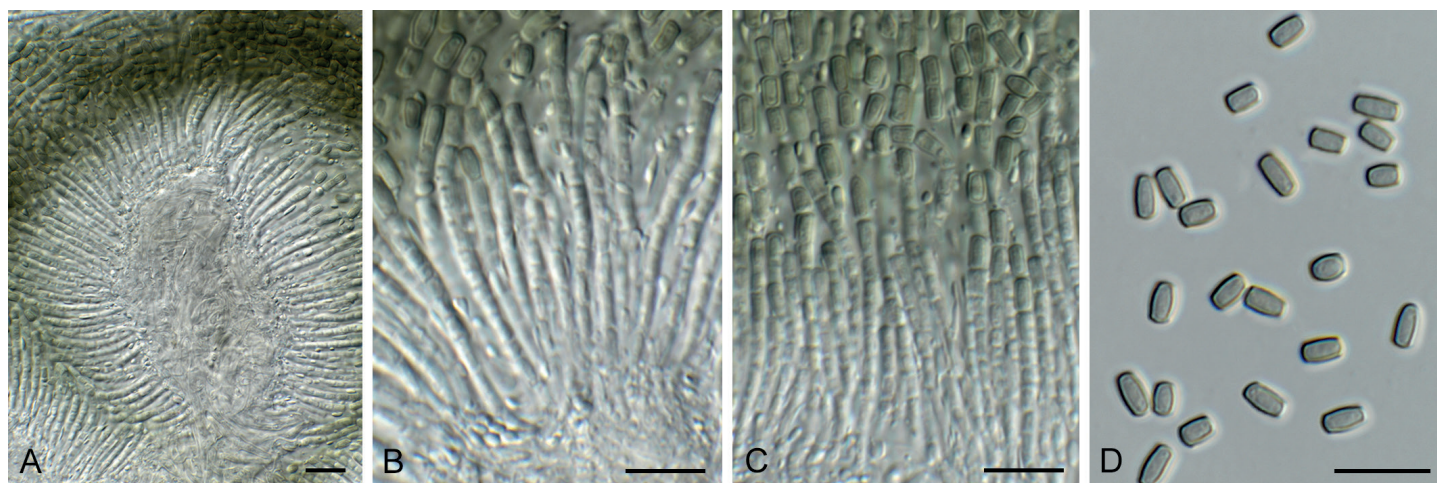


Fig. 8. *Hormodochis aggregata* (CPC 30683). **A.** Section through conidioma. **B, C.** Conidiophores giving rise to conidia. **D.** Conidia. Scale bars = 10 µm.

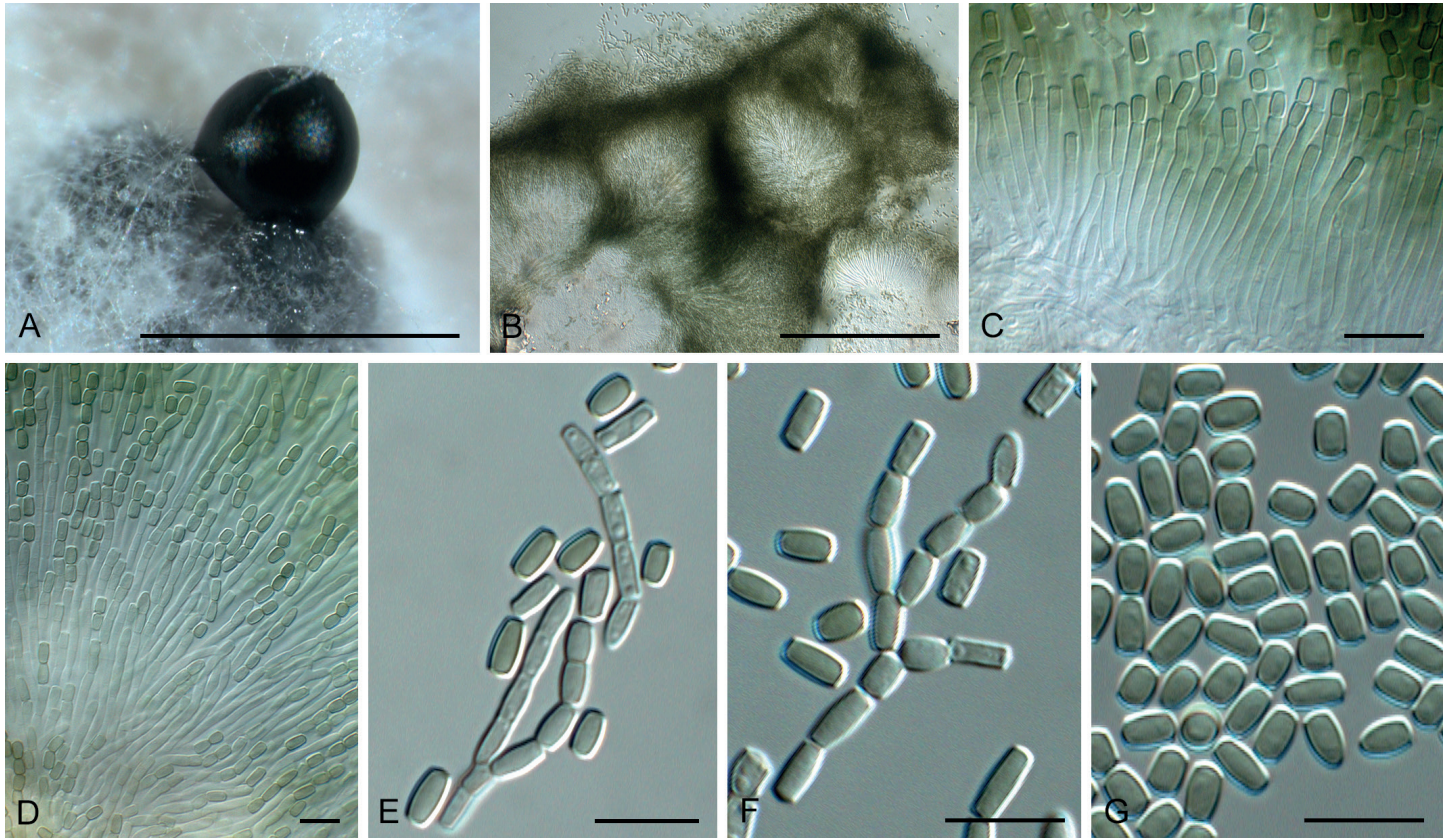


Fig. 9. *Hormodochis melanochlora* (CPC 24125). **A.** Erumpent conidioma. **B.** Section through aggregated conidiomata. **C–F.** Conidiophores giving rise to conidia. **G.** Conidia. Scale bars: A, B = 300 μm , all others = 10 μm .

Conidiomata erumpent, globose, brown, up to 300 μm diam, separate to aggregated, opening via irregular rupture of the wall of thin-walled brown *textura angularis*. *Conidiophores* lining the inner layer, arising from stromatic cells, hyaline, smooth, guttulate, branched below or not, cylindrical, straight or slightly curved, 1–2-septate, 5–20 \times 1.5–3 μm , upper cell fertile, becoming septate, and disarticulating into arthroconidia via basipetal secession, intact chains up to 70 μm long. *Conidia* aseptate, arranged in cylindrical chains, olivaceous brown, smooth, subcylindrical to somewhat doliiform, with truncate ends, with minute marginal frill, (4–) 5–6(–7) \times (2–) 2.5–3 μm .

Culture characteristics: Colonies erumpent, spreading, with sparse aerial mycelium, and feathery, lobed margins, reaching 7 mm diam after 2 wk at 25 $^{\circ}\text{C}$ in the dark. On MEA, PDA and OA surface and reverse white.

Typus: **France**, no locality given, on twig of *Laburnum anagyroides* (= *Cytisus laburnum*) (*Fabaceae*), spring–summer 1849 or before, anonymous (**isotype**, *Plantes cryptogames du nord de la France* 1851, edit. 1, fasc. 44, nr. 2166 = K(M)249048, selected as **lectotype** here MBT388210). Isolectotypes: Desm., *Plantes cryptogames du nord de la France* 2166 (e.g., BM, FH, G, NY). **Germany**, near Berlin, on dead twig of *Cytisus scoparius* (= *Sarothamnus scoparius*) (*Fabaceae*), 21 Dec. 2013, R.K. Schumacher, RKS 0433 (**epitype** designated here CBS H-21993, MBT388211, culture ex-type CPC 24125 = CBS 138861).

Notes: The description of Höhnelt (1911: 465) is based on the specimen nr. 2166 (publ. 1851). Pirozynski & Morgan-Jones

(1968) provided a modern account of the genus under the name *Trullula olivascens* (conidia 3–6.5 \times 1.5–2.5 μm , IMI 124616 ex K), which was followed by Sutton (1980). Our specimen chosen as epitype of *Hormodochis melanochlora* closely matches the lectotype in morphology. *Hormodochis melanochlora* is genetically distinct on all sequenced loci from the other species described here, *H. aggregata* (Figs 2, 4; also see species notes under *H. aggregata*).

Lecanostictopsis B. Sutton & Crous, *Mycol. Res.* **101**: 215. 1997.

Classification: *Mycosphaerellaceae*, *Capnodiales*, *Dothideomycetes*.

Mycelium immersed, intercellular, branched, septate, dark to reddish brown. *Conidiomata* epidermal to subepidermal, erumpent, eustromatic, acervular to sporodochial, composed of thick-walled, dark to reddish brown *textura angularis*. *Conidiophores* dark to reddish brown, coarsely verrucose, cylindrical, unbranched, septate, formed from the upper cells of the conidiomata. *Conidiogenous cells* integrated, dark to reddish brown, coarsely verrucose to tuberculate, cylindrical, with several percurrent enteroblastic proliferations. *Conidia* holoblastic, dark to reddish brown, coarsely verrucose to tuberculate, with 0–several eusepta, straight or curved, obtuse or acute at the apex, truncate at the base, cylindrical to fusiform (adapted from Sutton & Crous 1997).

Type species: *Lecanostictopsis kamatii* (Ullasa) B. Sutton & Crous

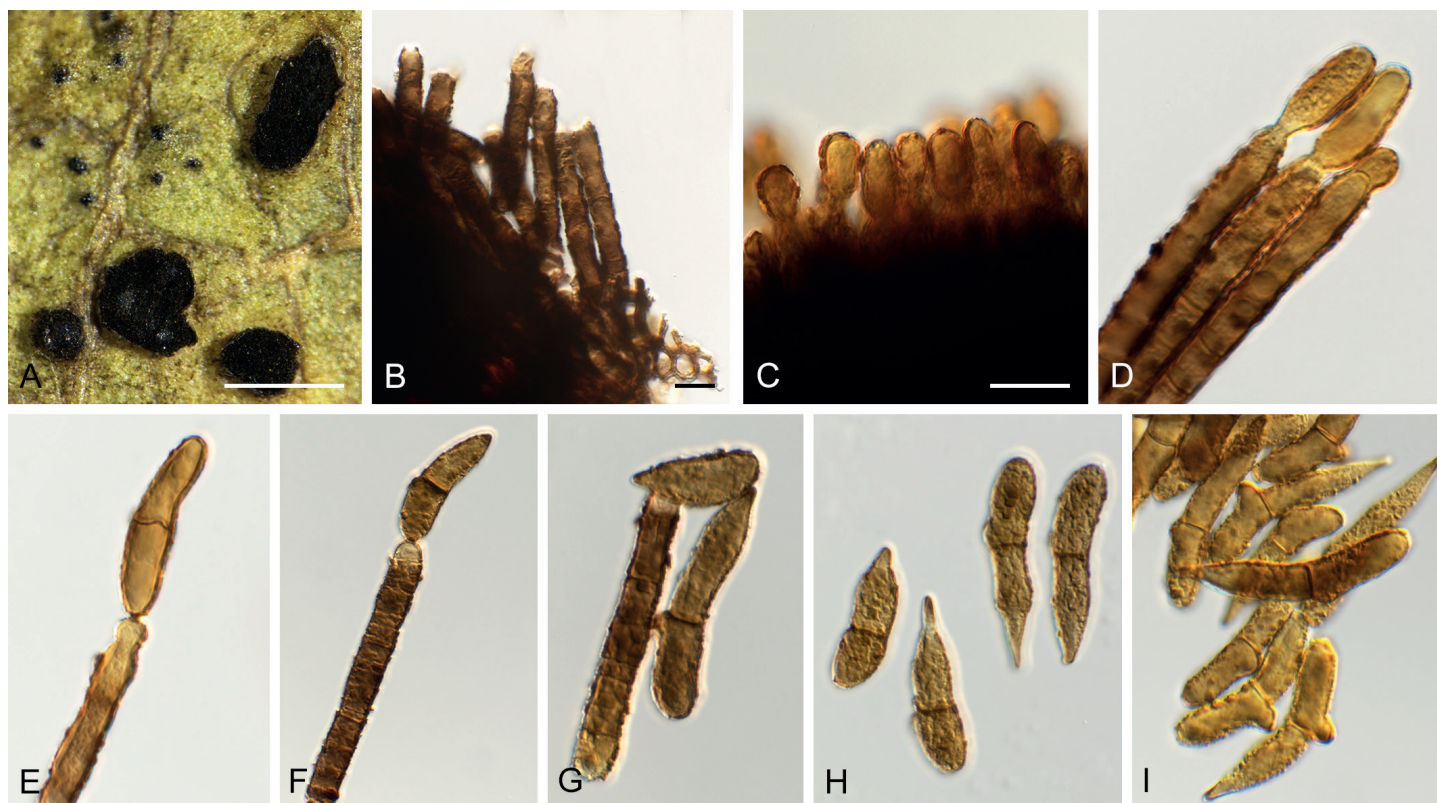


Fig. 10. *Lecanostictopsis syzygii* (HPC 2573). **A.** Conidiomata on leaf. **B–G.** Conidiogenous cells giving rise to conidia. **H, I.** Conidia. Scale bars: A = 1 mm, all others = 10 μ m, and C applies to D–I.

Lecanostictopsis syzygii (Ciccar.) B. Sutton & Crous, *Mycol. Res.* **101**: 218. 1997. Fig. 10.

Basionym: *Scolicosporium syzygii* Ciccar. [as “*syzigii*”], *Mycopath. Mycol. appl.* **5**: 230. 1951.

Description and illustration: Sutton & Crous (1997).

Typus: **Ethiopia**, Uoccia, near Omo Bottego River, on living leaves of *Syzygium guineense* (*Myrtaceae*), 25 Jan. 1939, A. Ciccarone, U.S. National Fungus Collections **isotype** BPI 404952A (**holotype** of *Scolecosporium syzygii*, IMI 367859, associated with *Miconectria syzygii*). **South Africa**, KwaZulu-Natal Province, St. Lucia wetlands, on living leaves of *Syzygium cordatum*, 11 Aug. 2018, P.W. Crous, HPC 2573 (**epitype** designated here CBS H-24087, MBT388212).

Additional materials examined: **South Africa**, KwaZulu-Natal, Eshowe, on living leaves of *Syzygium cordatum*, Apr. 1941, A.P.D. McClean, Union Dept Agriculture, Mycological Herbarium 33092, IMI 45164a, associated with *Kamatella apiospora* and *Mycohypallage congesta*. **Zambia**, nr Kawambse, on living leaves of *Syzygium guineense* var. *macrocarpum*, 7 Apr. 1961, A. Angus M1096, PPNR 3363, IMI 89987b, associated with *Mycohypallage congesta*, *Asterina syzygii* var. *microspora* and *Microthyriella* sp.

Notes: The genus *Lecanostictopsis* is a foliar pathogen of *Syzygium* (*Myrtaceae*). Since it was described, *Lecanostictopsis* was assumed to be a member of the *Mycosphaerellaceae* (Sutton & Crous 1997). However, all attempts to cultivate species of the genus have thus far proven unsuccessful, as conidia germinate, but die immediately post germination (irrespective of culture medium or temperature used). In the present study we have

thus used selective primers (Videira *et al.* 2017) to amplify the ITS rDNA, which resolved *Lecanostictopsis* as a distinct genus in the *Mycosphaerellaceae*, allied to *Cymadothea*, confirming it as additional member of the *Mycosphaerellaceae* (Fig. 1).

Lembosinales Crous, **ord. nov.** MycoBank MB832086.

Etymology: Name reflects the genus *Lembosina*.

Classification: *Lembosinaceae*, *Lembosinales*, *Dothideomycetes*.

Ascomata thyriothecial or hysterothecial, linear, rarely y-shaped, solitary, gregarious, superficial, loose on host surface, black, opening with linear fissures. Upper wall comprising a thin layer of mostly neatly arranged dark cells, which are branched at the outer rim, base poorly developed. *Hamathecium* comprising, sparse, filiform pseudoparaphyses. *Asci* 8-spored, bitunicate, subglobose to oblong. *Ascospores* overlapping 2–4-seriate, 1-septate, with an upper cell slightly wider and shorter than the lower cell, hyaline, becoming brown with age, with basal protrusion.

Type family: *Lembosinaceae* Crous

Lembosinaceae Crous, **fam. nov.** MycoBank MB832087.

Etymology: Name reflects the genus *Lembosina*.

Ascomata thyriothecial or hysterothecial, linear, rarely y-shaped, solitary, gregarious, superficial, loose on host surface, black, opening with linear fissures. Upper wall comprising a thin layer of mostly neatly arranged dark cells, which are branched at the outer

rim, base poorly developed. *Hamathecium* comprising, sparse, filiform pseudoparaphyses. *Asci* 8-spored, bitunicate, subglobose to oblong. *Ascospores* overlapping 2–4-seriate, 1-septate, with an upper cell slightly wider and shorter than the lower cell, hyaline, becoming brown with age, with basal protrusion.

Type genus: Lembosina Theiss.

Lembosina Theiss., *Annls Mycol.* **11**(5): 437. 1913.

Ascomata thyriothecial or hysterothecial, linear, rarely y-shaped, solitary, gregarious, superficial, loose on host surface, black, opening with linear fissures. Upper wall comprising a thin layer of mostly neatly arranged dark cells, which are branched at the outer rim, base poorly developed. *Hamathecium* comprising, sparse, filiform pseudoparaphyses. *Asci* 8-spored, bitunicate, subglobose to oblong. *Ascospores* overlapping 2–4-seriate, 1-septate, with an upper cell slightly wider and shorter than the lower cell, hyaline, becoming brown with age, with basal protrusion.

Type species: Lembosina aulographoides (E. Bommer *et al.*) Theiss. (≡ *Lembosia aulographoides* E. Bommer *et al.*)

Lembosina aulographoides (E. Bommer *et al.*) Theiss., *Annls mycol.* **11**(5): 437. 1913. Fig. 11.

Basionym: Lembosia aulographoides E. Bommer *et al.*, *Bull. Soc. R. Bot. Belg.* **29**(1): 238. 1890.

Synonyms: Echidnodes aulographoides (E. Bommer *et al.*) N.F. Robertson, *Trans. Br. mycol. Soc.* **33**: 108. 1950.

Microthyrium rhododendri Grove, *J. Bot., London* **71**: 287. 1933.

Hypostroma well-developed, subcuticular, consisting of brown, smooth *textura angularis* to *epidermoidea*, cells compact, 6–12

µm long, 5–7 µm wide. *Mycelium* consisting of dark brown, verruculose, 2.5–3.5 µm diam, branched, septate hyphae, frequently covered in mucoid sheath. *Hysterothecioid* ascomata superficial, loose on surface, opening by central split, rarely with star-shaped central split, dark brown, 180–250 µm wide, 250–700 µm long; margin of dark brown hyphal cells, bluntly rounded, crenulate edge; surface cells 2.5–5 µm diam. *Asci* ovoid to obovoid or broadly ellipsoid, apex obtuse, with apical chamber, 2–3 µm diam, bitunicate, fissitunicate, wall thick, 3–5 µm in apical part, endotunica appearing multi-layered, base flat, 4–5 µm diam, attached to base of cavity, 30–50 × 20–30 µm. *Pseudoparaphyses* hyaline, smooth, branched, septate, hyphae-like, 2–3.5 µm diam; end cells frequently somewhat swollen. *Ascospores* multiseriate in asci, broadly fusoid-ellipsoid, widest in middle of apical cell, medianly 1-septate, constricted at septum, wall 1–2 µm thick, with irregular, prominent guttules, with basal mucoid appendage (plug), 5–6 µm diam, 2–8 µm long, persistent, (20–)22–23(–27) × (9–)10–12(–13) µm; ascospores turning brown and verruculose with age in asci; ascospores germinate irregularly, with germ tubes mostly from one cell, growing down into agar, brown, verruculose; ascospores not distorting upon germination.

Typus: Belgium, Tervuren, on dead branch of *Rhododendron ponticum* (*Ericaceae*), Jul. 1889, E. Bommer & M. Rousseau (**holotype** BR-MYC 049457,84). **Netherlands**, Bilthoven, on stems of *Rhododendron* sp., 1 Feb. 2017, P.W. Crous (**epitype** designated here CBS H-24088, MBT388213, culture ex-epitype CBS 145946 = CPC 33049).

Notes: Von Arx & Müller (1975) placed *Lembosina* in the *Leptopeltidaceae*, while Hawksworth *et al.* (1995) regarded it as a member of *Asterinaceae*, and Hyde *et al.* (2013) placed it in *Aulographaceae*. As shown here, *Lembosina* clusters in a

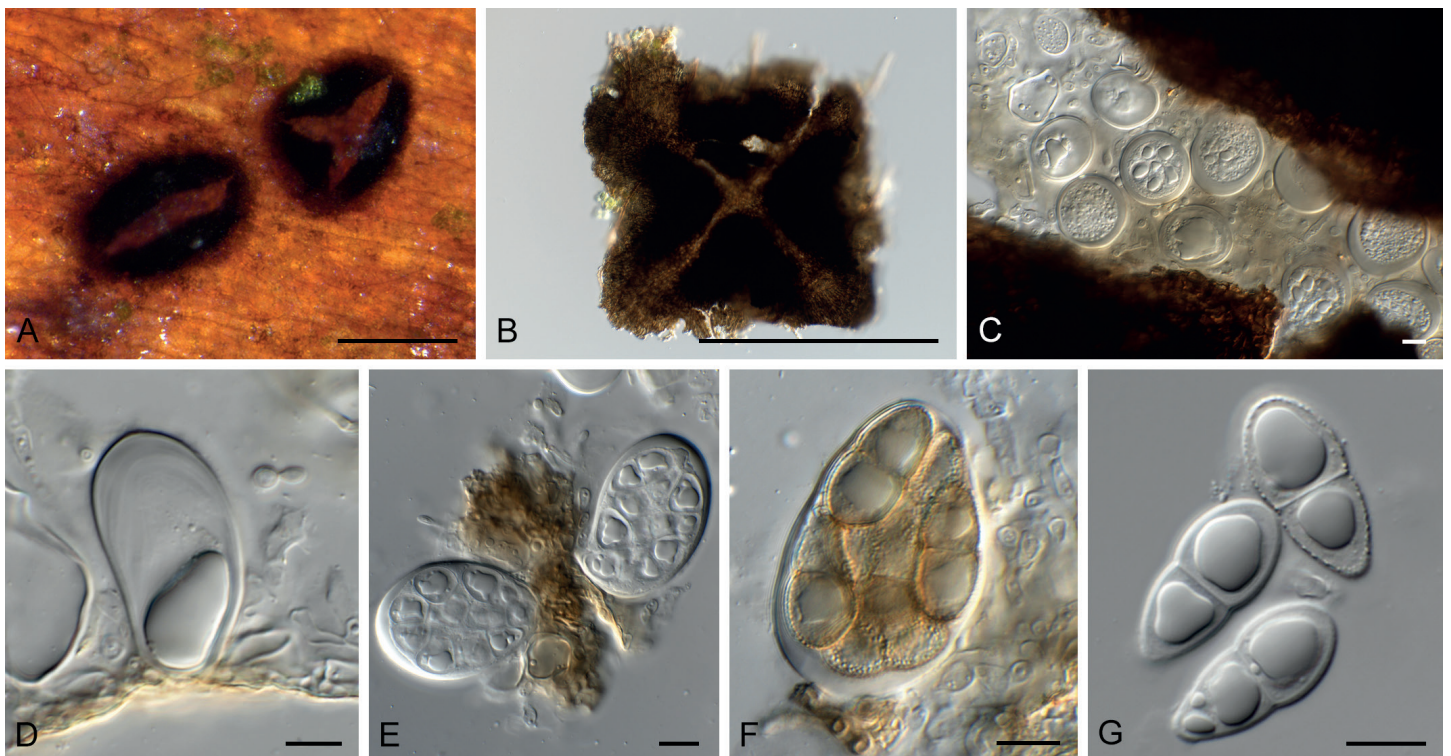


Fig. 11. *Lembosina aulographoides* (CPC 33049). **A.** Hysterothecioid ascomata on host tissue. **B.** Superficial view of hysterothecium. **C.** Asci viewed from above. **D–F.** Asci. **G.** Ascospores. Scale bars: A, B = 250 µm, all others = 10 µm.

separate clade next to *Lichenoconiales* (Fig. 1), an order based on *Lichenonium*, which is a lichenicolous coelomycete genus with no known sexual morph (Hyde *et al.* 2013). A new order and family are therefore introduced to accommodate *Lembosina*.

Neomelanconium Petr., *Annls mycol.* **38**(2–4): 208. 1940.

Classification: Cenangiaceae, Helotiales, Leotiomyces.

Conidiomata acervular, intracorticolous, somewhat erumpent single, gregarious, lens-shaped with a flattened base sitting on a white to cream basal layer, exuding conidia in a black mucoid droplet. *Conidiophores* mostly reduced to conidiogenous cells arranged in a basal layer, hyaline, smooth, subcylindrical, proliferating percurrently at apex. *Conidia* aseptate, solitary, red-brown, ovoid to broadly ellipsoid, or pyriform to clavate, apex obtuse, base truncate, thick-walled, prominently coarsely guttulate, outer wall roughened, surrounded by prominent mucoid sheath.

Type species: Neomelanconium gelatosporum (H. Zimm.) Petr. (= *Melanconium gelatosporum* H. Zimm.)

Neomelanconium gelatosporum (H. Zimm.) Petr., *Annls mycol.* **38**(2–4): 209. 1940. Fig. 12.

Basionym: Melanconium gelatosporum H. Zimm., *Verh. nat. Ver. Brünn* **52**: 111. 1914.

Conidiomata acervular, intracorticolous, somewhat erumpent by tearing the bark, single, gregarious, lens-shaped with a flattened base sitting on a white to cream basal layer, exuding

conidia in a black mucoid droplet. *Macroconidiophores* mostly reduced to macroconidiogenous cells arranged in a basal layer, hyaline, smooth, subcylindrical, 10–25 × 3–4 μm, proliferating percurrently at apex. *Macroconidia* aseptate, solitary, red-brown, ovoid to broadly ellipsoid, or pyriform to clavate, apex obtuse, base truncate, thick-walled, prominently coarsely guttulate, outer wall roughened, surrounded by prominent mucoid sheath, up to 18 μm thick (3 μm thick if dry), (22–)25–28(–35) × (15–)16–17(–18) μm. *Microconidia* forming in same conidioma on OA, intermingled among macroconidia. *Microconidiophores* aggregated, hyaline, smooth, subcylindrical, 0–2-septate, branched or not, 15–30 × 3–4 μm. *Microconidiogenous cells* subcylindrical, hyaline, smooth, terminal and intercalary, 10–20 × 3–4 μm, phialidic with minute periclinal thickening. *Microconidia* hyaline, smooth, guttulate, subcylindrical to somewhat clavate, apex obtuse, base truncate, 3–8 × 2.5–3 μm.

Culture characteristics: Colonies reaching 40 mm diam on OA after 2 wk at 25 °C, only 20 mm diam on MEA and PDA; surface folded, margin smooth, lobate. On MEA salmon to ochreous, reverse ochreous; on PDA surface and reverse ochreous, on OA cream to saffron.

Typus: Czechia, near Lednice (formerly “Eisgrub”), “Unterwald”, on dead stems and branches of *Tilia* sp. (*Malvaceae*), 15 Jan. 1913, H. Zimmermann (isotype, Petrak, Flora Bohemiae et Moraviae exsiccata, ser. 2, Abt. 1, Pilze, Lieferung 14–15 (nrs. 651–750), 1913, specimen nr. 669 in Herbarium H, Hamburg, Germany, selected here as lectotype MBT388214). **Germany**, near Berlin, green area, dead, corticated and attached twig of *Tilia platyphyllos*, 2 May 2016, R.K. Schumacher, RKS 1028 =

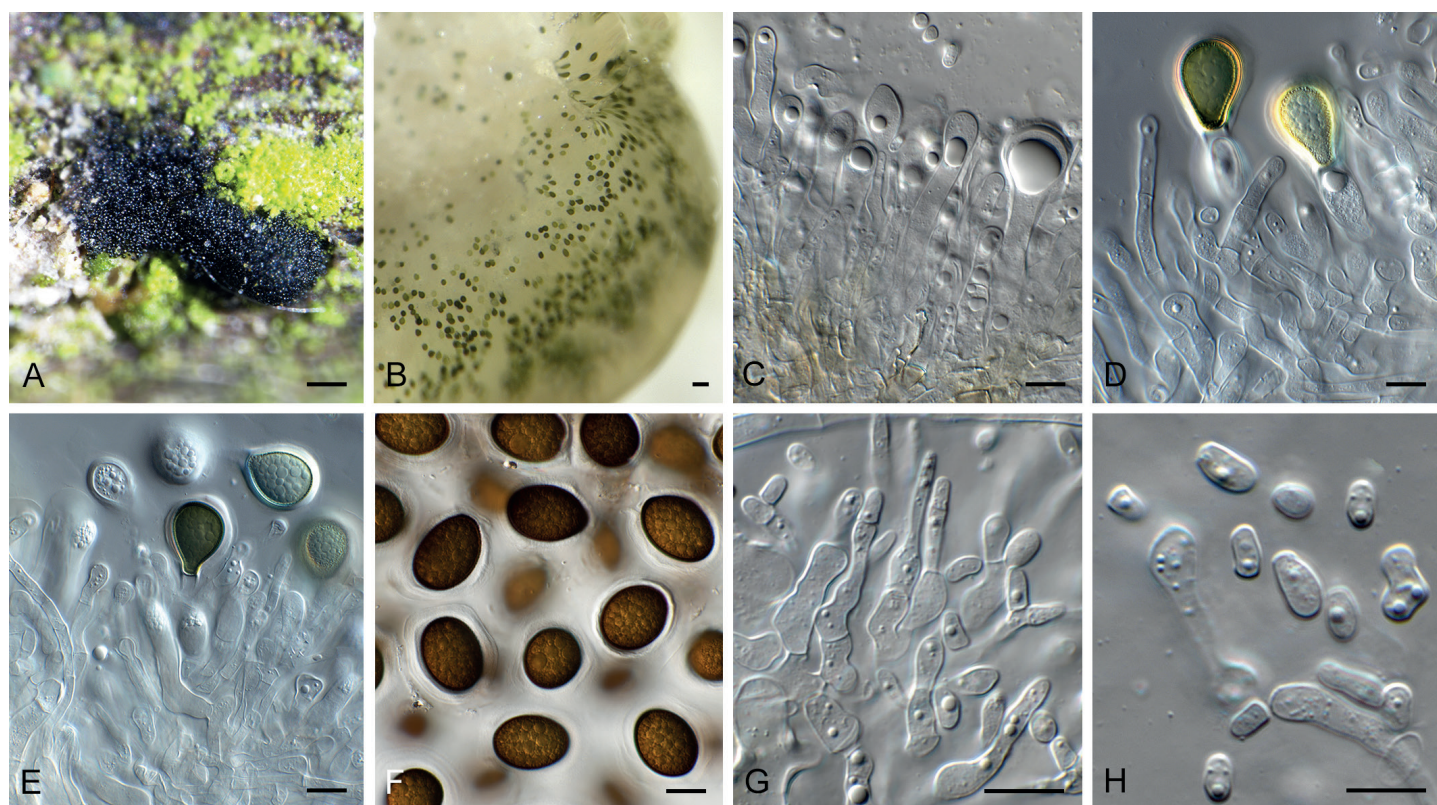


Fig. 12. *Neomelanconium gelatosporum* (CPC 31126). **A.** Conidioma oozing conidia on host. **B.** Mucoid conidial droplet. **C–E.** Macroconidiogenous cells giving rise to macroconidia. **F.** Macroconidia. **G, H.** Microconidiogenous cells giving rise to microconidia. Scale bars: A = 250 μm, B = 30 μm, all others = 10 μm.

HPC 1227 (**epitype** designated here CBS H-24089, MBT388215, cultures ex-epitype CPC 31126 = CBS 144985, CPC 31127).

Notes: Sutton (1980) did not see any material of *Melanconium gelatosporum*, and based his interpretation of *Neomelanconium* on *N. deightonii*, noting that the two species differ in the fact that *N. deightonii* lacks a conidial sheath. Although the phylogeny of *N. deightonii* remains unknown, a subsequent species, *N. spartii* (Wijayawardene et al. 2016), morphologically clearly represents a distinct genus from *Neomelanconium*, for which the name *Pseudomelanconium* is proposed below. No sequence data related to *N. spartii* were found in GenBank, nor is there any reference to such data in the original publication. A sequence-based comparison was therefore not possible. In our phylogenetic analysis, *N. gelatosporum* clusters in *Leotiomyces* (Fig. 3). No highly similar sequences were obtained with a megablast search using the *rpb1* and *tef1* sequences.

Phragmotrichum Kunze, *Mykologische Hefte* (Leipzig) 2: 84. 1823.

Classification: Melanommataceae, Pleosporales, Pleosporomycetidae, Dothideomycetes.

Conidiomata stromatic to cupulate, immersed to erumpent, solitary to gregarious, dark brown, wall of *textura angularis*. *Conidiophores* hyaline, branched at base, septate, smooth, cylindrical, formed from inner layer of conidioma. *Conidiogenous cells* thallic, integrated, hyaline, smooth, cylindrical, producing unbranched, basipetal chains of conidia. *Conidia* brown, muriformly septate, with transverse and longitudinal septa, truncate at both ends, straight to curved, fusoid to ellipsoid, smooth-walled.

Type species: *Phragmotrichum chailletii* Kunze

Phragmotrichum chailletii Kunze, *Mykologische Hefte* (Leipzig) 2: 84. 1823. Fig. 13.

Synonym: *Gymnosporangium chailletii* (Kunze) Spreng., *Systema Vegetabilium* edit. 16, 4(1): 562. 1827.

Conidiomata 350–600 µm diam, stromatic to cupulate, immersed to erumpent, solitary to gregarious, dark brown, wall of *textura angularis*, up to 80 µm diam. *Conidiophores* hyaline, branched at base, 1–3-septate, smooth, cylindrical, formed from inner layer of conidioma, 15–30 × 3–4 µm. *Conidiogenous cells* thallic, integrated, hyaline, smooth, cylindrical, producing unbranched basipetal chains of conidia, 10–12 × 3–4 µm. *Conidia* brown, muriformly septate, with 4–5 transverse septa, and 2–3 longitudinal septa, truncate at both ends, straight to curved, fusoid to ellipsoid, smooth-walled, (25–)35–45(–50) × (18–)20–23(–25) µm (based on CPC 33263).

Culture characteristics: Colonies erumpent, spreading, covering the dish in 2 wk at 25 °C with moderate aerial mycelium and smooth, even margins. On MEA surface vinaceous buff with patches of dirty white, reverse brown vinaceous; on PDA surface dark mouse grey with patches of olivaceous grey; on OA surface sepia with patches of purplish grey.

Typus: **Switzerland**, near Neuchâtel (“Neuenburg”), on fallen cones of “*Pinus abies*” (*Pinaceae*), 1823 or before, J.F. de Chaillet. Specimen not mentioned, and not located. **Switzerland**, Hindelbank, “Crajholz”, fallen cones of *Picea abies* (*Pinaceae*), 7 Mar. 2017, J. Gilgen & R.K. Schumacher, RKS 77 = HPC 2016 (**neotype** designated here CBS H-24090, MBT388216, cultures ex-neotype CPC 33263 = CBS 144994, CPC 33264).

Additional material examined: **Switzerland**, Hindelbank, “Crajholz”, fallen cones of *Picea abies*, 7 Mar. 2017, J. Gilgen & R.K. Schumacher, RKS 74 = HPC 2014, cultures CPC 33341, CPC 33342.

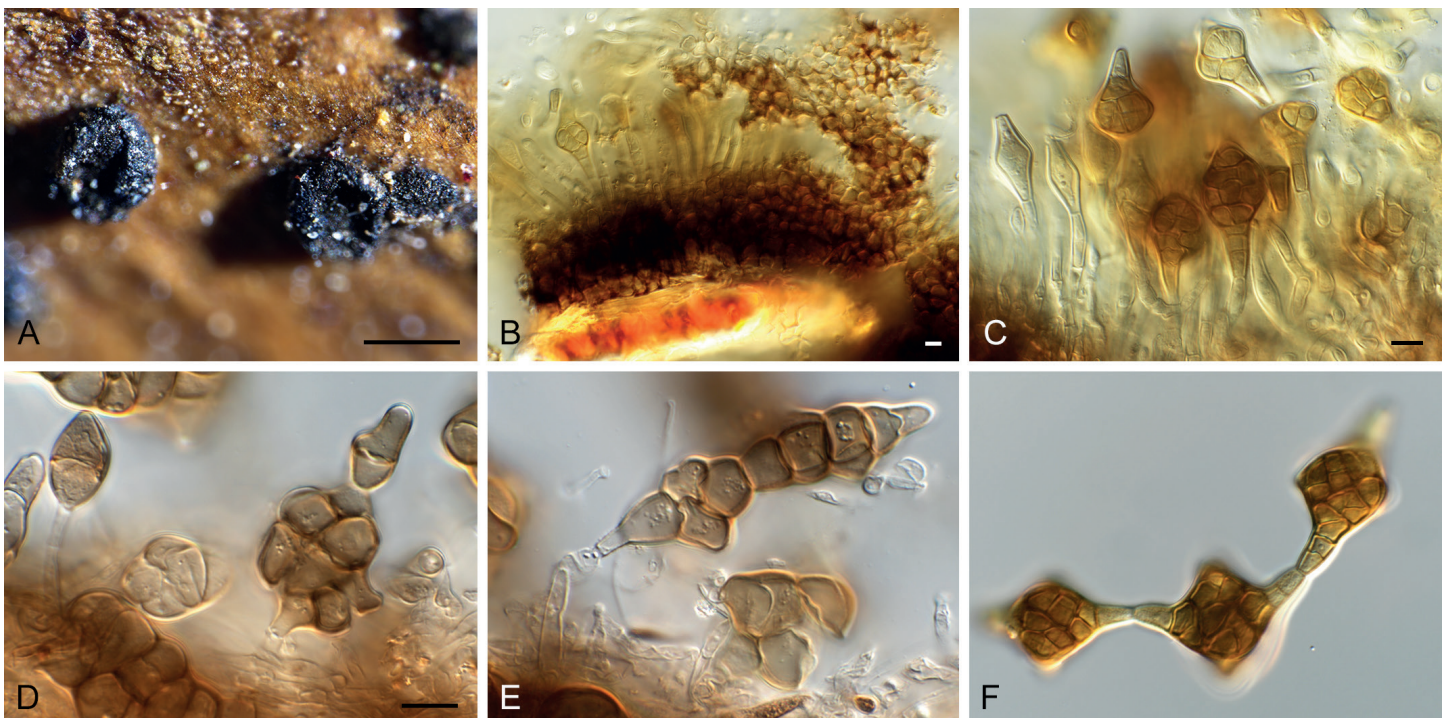


Fig. 13. *Phragmotrichum chailletii* (CPC 33263). **A.** Cupulate conidiomata on host tissue. **B.** Section through conidioma. **C.** Conidiogenous cells giving rise to conidia. **D–F.** Conidial chains. Scale bars: A = 350 µm, all others = 10 µm, and D applies to E, F.

Notes: The holotype grew on fallen cones of “*Pinus abies*” collected in Switzerland, but could not be traced in this study, (Kunze’s herbarium at LZ was destroyed during World War II), and thus a neotype is designated. The old substrate name is a synonym of *Abies alba* and *Picea abies*. Colonies of the neotype sporulated in culture. The species is shown here to belong to *Melanommataceae* (Fig. 1).

Pseudomelanconium Crous & R.K. Schumach., **gen. nov.** MycoBank MB832088.

Classification: *incertae sedis*, *Pezizomycotina*.

Etymology: Name reflects its morphological similarity to the genus *Melanconium*.

Conidiomata pycnidial, immersed to subepidermal, solitary or gregarious, occasionally confluent, unilocular, globose to subglobose, black; wall multi-layered, outer layer thick, composed of brown *textura angularis*, inner layer thin, hyaline to pale brown. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, short, indeterminate, discrete, cylindrical, hyaline to dark brown, smooth-walled. *Conidia* globose, aseptate, base truncate, dark brown, thick and smooth-walled.

Type species: *Pseudomelanconium spartii* (Wijayaw. et al.) Crous & R.K. Schumach. (\equiv *Neomelanconium spartii* Wijayaw. et al.)

Pseudomelanconium spartii (Wijayaw. et al.) Crous & R.K. Schumach., **comb. nov.** MB832089.

Basionym: *Neomelanconium spartii* Wijayaw. et al., *Fungal Diversity* **77**: 182. 2016.

Description and illustration: Wijayawardene et al. (2016).

Typus: **Italy**, Arezzo, AR Province, Montalone, Pieve Santo Stefano, on dead branch of *Spartium junceum* (*Fabaceae*), 6 Jun. 2012, E. Camporesi, IT 404 (**holotype** MFLU 15-3453, **isotype** HKAS 92541).

Notes: *Pseudomelanconium* is morphologically distinct from *Neomelanconium gelatosporum*, lacking persistent mucoid sheaths on its conidia. Whether *P. spartii* is congeneric with *N. deightonii*, can only be resolved once DNA data become available.

Rutola J.L. Crane & Schokn., *Canad. J. Bot.* **55**: 3015. 1978 (1977).

Classification: *Torulaceae*, *Pleosporales*, *Pleosporomycetidae*, *Dothideomycetes*.

Colonies oval, powdery, dry, black. *Conidiophores* appressed to substrate, micronematous, branched, septate, pale brown. *Conidiogenous cells* integrated, terminal or intercalary, monoblastic, pale brown. *Conidia* phragmosporous, composed of long, simple to branched chains of brown, verruculose acrogenous cells, constricted at septa, fragmenting into segments, 0–multiseptate.

Type species: *Rutola graminis* (Desm.) J.L. Crane & Schokn.

Rutola graminis (Desm. ex Fr.) J.L. Crane & Schokn., *Canad. J. Bot.* **55**: 3015. 1978 (1977). Fig. 14.

Basionym: *Torula graminis* Desm., *Pl. Crypt. Nord. Fr.*, fasc. 4 no. 169. 1826. [: *Fr.*, *Syst. mycol.* (Lundae) **3**(2): 502. 1832].

Synonym: *Torula tritici* Corda, *Icon. fung.* (Prague) **1**: 8. 1837 (see Braun & Kirk 2019).

Colonies on stubble oval, powdery, dark brown, 0.5–2 × 0.1–0.5 mm. *Mycelium* consisting of branched, septate, subhyaline to pale brown, smooth, immersed to superficial, 1.5–2 μ m diam hyphae. *Conidiophores* appressed to substrate, branched, pale brown, smooth. *Conidiogenous cells* integrated, terminal or intercalary, monoblastic, pale brown, smooth, 4–9 × 3–3.5 μ m. *Conidia* phragmosporous, composed of long (13–20 conidia), simple to branched acrogenous chains, attached by narrow isthmus, constricted at septa, fragmenting into segments with one to several septa. Conidial segments dark brown, semi-spherical, broader than long, thick-walled (1–1.5 μ m diam), verruculose, (3–)4–5(–6) × 4–6(–8) μ m.

Culture characteristics: Colonies reaching 30 mm diam after 2 wk, with sparse to moderate aerial mycelium and smooth, lobate margins. On PDA surface pale olivaceous grey, reverse grey olivaceous; on OA surface olivaceous grey with patches of pale olivaceous grey, margins frequently olivaceous black.

Typus: **France**, north France, on dead leaf of an unnamed grass (family unknown), Apr. 1826 or before, J. Desmazières (**isotype**, L 910.267-926 = L0054599 ex Plantes cryptogames du nord de la France 1826, edit. 1, fasc. 4, nr. 169, as “*Torula graminis* Desm.”, selected here as **lectotype**, MBT388217). **Isolectotypes:** Desm., Plantes cryptogames du nord de la France 169 (e.g., BM, FH, G, ILLS841, NY). **Germany**, near Berlin, on dead and still attached leaf of *Typha* sp. (*Typhaceae*), 1 Apr. 2017, R.K. Schumacher, HPC 2021 = RKS 80 (**epitype** designated here CBS H-24078, MBT388218, cultures ex-epitype CPC 33267 = CBS 145906, CPC 33268).

Additional materials examined: **Germany**, near Berlin, on dead and still attached leaf of *Scirpus sylvaticus* (*Cyperaceae*), 3 May 2017, R.K. Schumacher, HPC 2112 = RKS 103, cultures CPC 33714, CPC 33715. **Norway**, Akershus, Skedsmo, Lahaug, on *Scirpus sylvaticus*, 3 May 2017, K. Homble, HPC 2115, culture CPC 33695.

Notes: Although *Rutola* was treated by Crane & Schoknecht (1977), and recently by Crous et al. (2015), the type species was not known from culture or DNA sequence data, and thus had to be recollected. As shown here, *Rutola* is morphologically and phylogenetically distinct from *Torula*, but both genera reside in the *Torulaceae* (Fig. 1), and *T. herbarum* (Fig. 15) can frequently co-occur on the same material.

Trullula Ces., in Rabenh., *Klotzschii Herbarium Vivum Mycologicum*, cent. 17, nr. 1660. 1852, also in *Bot. Ztg.* **10**: 287. 1852.

Classification: *incertae sedis*, *Pezizomycotina*.

Conidiomata eustromatic, immersed, becoming erumpent, globose, cupulate, unilocular, pale brown; wall of 3–6 layers of *textura angularis*. *Conidiophores* unbranched, septate, hyaline to subhyaline, cylindrical. *Conidiogenous cells* phialidic,

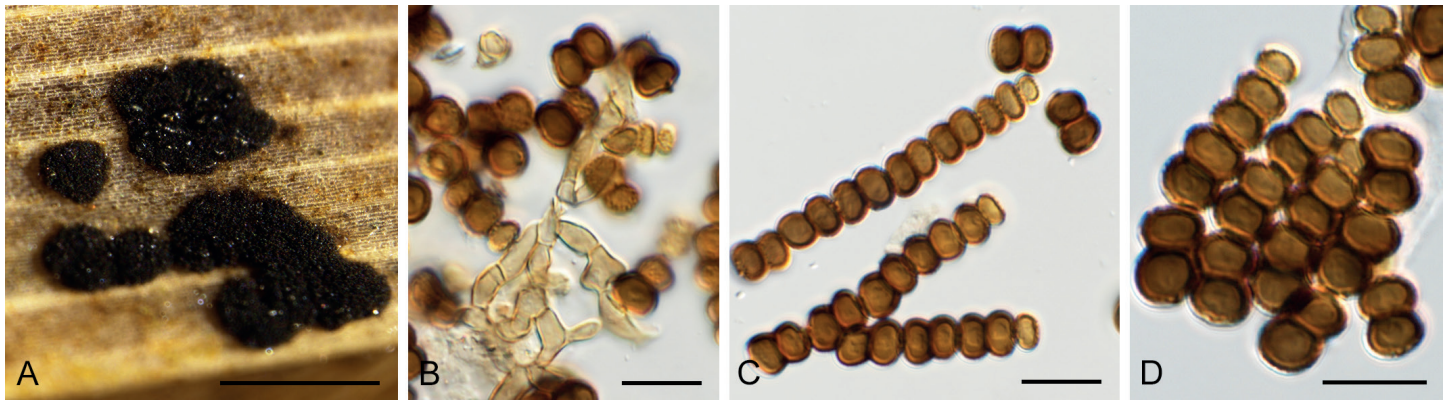


Fig. 14. *Rutola graminis* (CPC 33267). **A.** Sporodochia on host tissue. **B.** Conidiogenous cells giving rise to conidia. **C, D.** Conidial chains. Scale bars: A = 5 mm, all others = 10 µm.

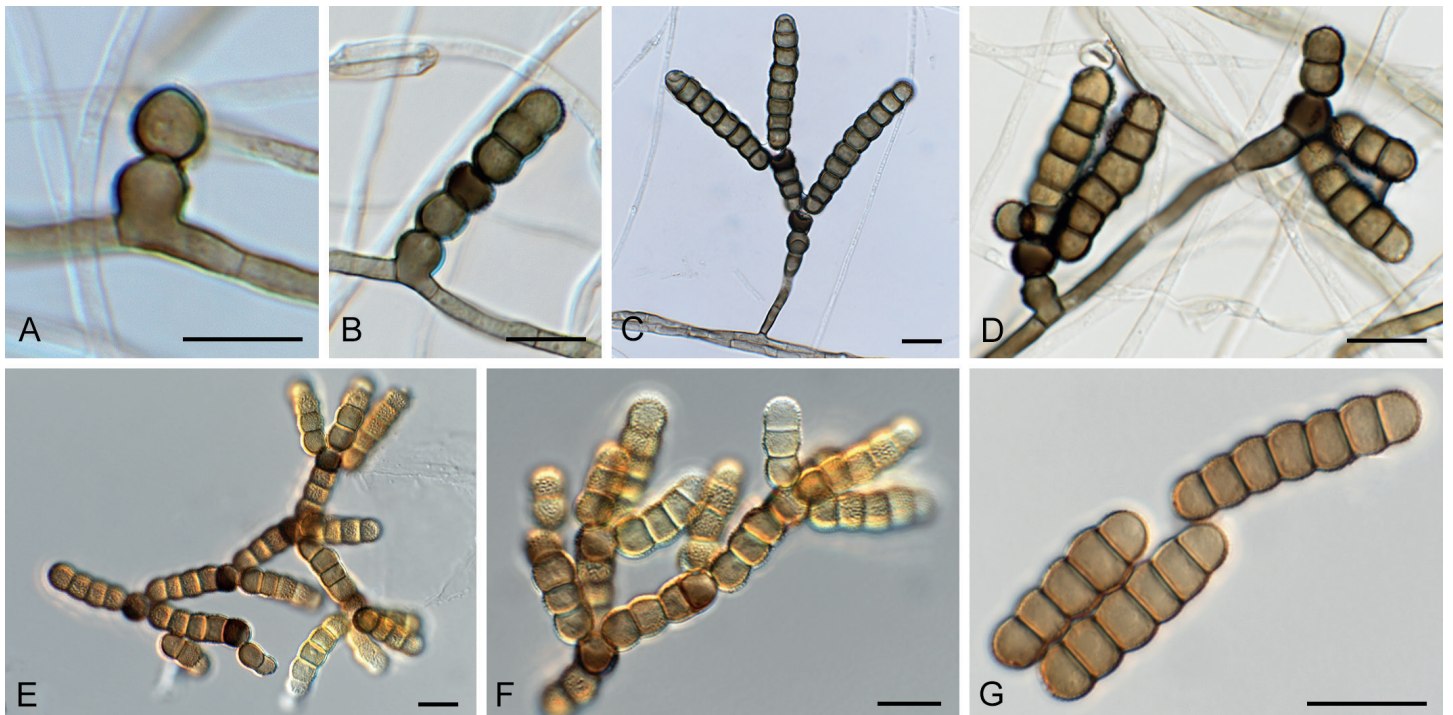


Fig. 15. *Torula herbarum* (CBS 144995). **A–D.** Conidiogenous cells giving rise to conidia. **E–G.** Conidia. Scale bars = 10 µm.

subcylindrical, terminal, determinate, hyaline with minute collarette. *Conidia* aseptate, in unbranched chains, subcylindrical to doliiform, straight, hyaline to subhyaline, thin-walled, apex obtuse, base truncate.

Type species: *Trullula oreoselini* Ces.

Trullula oreoselini Ces. in Rabenh., *Klotzschii Herbarium Vivum Mycologicum*, cent. 17, nr. 1660. 1852. Fig. 16.

Conidiomata eustromatic, immersed, becoming erumpent, globose, 200–350 µm diam, cupulate, unilocular, pale brown to black olive, sometimes white bordered, soft, gelatinous; wall of 3–6 layers of *textura angularis*. *Conidiophores* unbranched, 0–1-septate, hyaline to subhyaline, cylindrical, 5–15 × 2–3 µm. *Conidiogenous cells* phialidic, subcylindrical, terminal, determinate, hyaline with minute collarette, 5–8 × 2–3 µm. *Conidia* aseptate, in unbranched chains, subcylindrical to doliiform, straight, hyaline to subhyaline to olivaceous

(olivaceous in mass), thin-walled, apex obtuse, base truncate, (5–)6–7(–8) × 3(–4) µm.

Typus: **Italy**, Vercelli, on dead stem of *Peucedanum oreoselinum* (*Apiaceae*), winter 1852, *V. de Cesati* (B, s.n., ex Rabenh., Klotzschii herbarium Vivum Mycologicum 1852, Cent. 17, Nr. 1660; selected here as **lectotype**, MBT388219). **Isolectotypes:** Rabenh., Klotzschii herbarium Vivum Mycologicum 1660 (e.g., HAL).

Notes: In his treatment of *Trullula*, Sutton (1980) indicated that *Trullula oreoselini* was the correct lectotype species of *Trullula*. However, as he did not see the type, he based his interpretation of the genus on *Epidochium melanochlorum* (= *T. melanochlorum*), stating that if the type of *T. oreoselini* was ever found to deviate morphologically from that of *E. melanochlorum*, a new generic name would have to be chosen from among the synonyms he listed for *Trullula* to accommodate *E. melanochlorum*.

Our examination of the type specimen of *T. oreoselini* showed that it is not congeneric with that of *E. melanochlorum*, and that

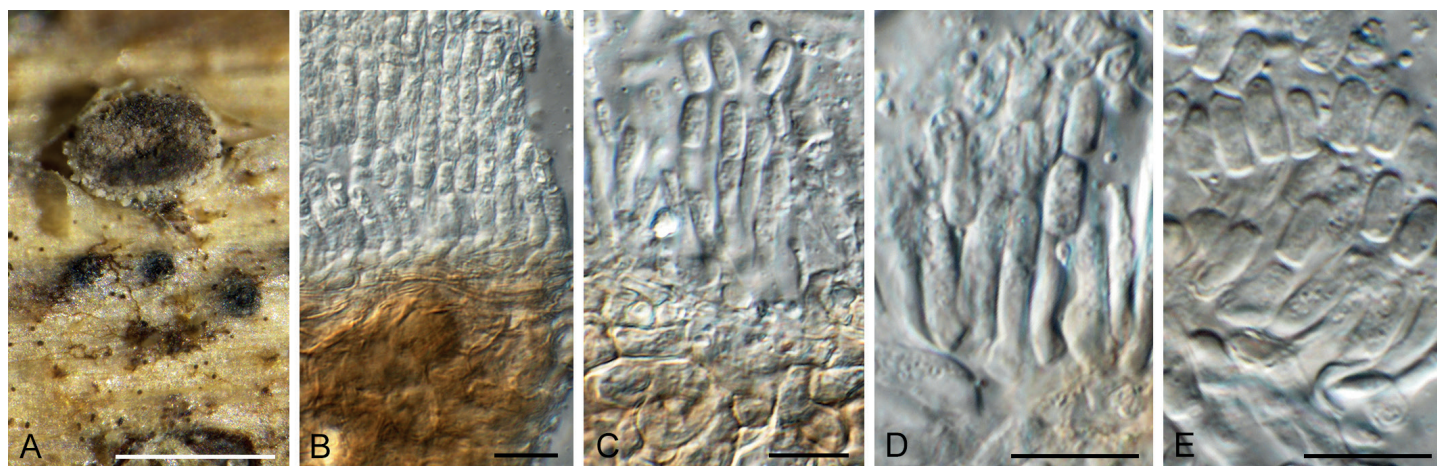


Fig. 16. *Trullula oreoselini* (holotype Herbarium B). **A.** Semi-immersed conidioma on host. **B–E.** Conidiogenous cells giving rise to conidia. Scale bars: A = 350 μ m, all others = 10 μ m.

Trullula s.str., 1852, probably represents an older name for what is now called *Sirexipula* [1907, based on *S. kabatiana* Bubák: **Czech Republic**, Turnov, on dead leaves of *Hosta sieboldiana* (= *Funkia sieboldiana*) (*Asparagaceae*), leg. J.E. Kabat, 12 May 1905, **syntypes** BPI 392537 and 392538, IMI 194246 (Kabat & Bubák, *Fungi imperfect exsiccate* 571, e.g., S-F58940 and WIS-F-00822942, = topotype material collected at 22 May 1905)]. However, as there are no cultures of *Trullula oreoselini* nor *Sirexipula kabatiana*, this matter cannot be pursued further here.

ACKNOWLEDGEMENTS

We are grateful to Arien van Iperen, Diana Vos, Yda Vlug, Trix Merx (cultures), Mieke Starink-Willems (DNA isolation, amplification and sequencing), and Marjan Vermaas (photographic plates) for their technical assistance. We are also grateful to Robert Lucking (B) for sending us a loan of *Trullula oreoselini* for study, and the curators of BR for material of *Lembosia aulographoides*.

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