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Phylogeny and taxonomy of *Circinotrichum*, *Gyrothrix*, *Vermiculariopsiella* and other setose hyphomycetes

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Key words

Microdochiaceae
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Xylariales

Abstract *Circinotrichum*, *Gyrothrix* and *Vermiculariopsiella* represent a complex of dematiaceous, setose, saprobic hyphomycetes that are commonly collected on plant litters in tropical, subtropical to temperate climates. Multi-locus analysis (ITS, LSU, *rpb2*) and morphological studies revealed that *Gyrothrix* and *Circinotrichum* are polyphyletic and species belong to 10 genera grouping in three different clades within *Xylariales*, named *Coniocessiaceae* (*Circinotrichum* and *Pirozynskiomyces* gen. nov.), *Microdochiaceae* (*Selenodriella* and the resurrected genus *Peglionia*) and the new family *Gyrothricaceae* (*Gyrothrix*, *Xenoanthostomella*, *Neogyrothrix* gen. nov., *Pseudocircinotrichum* gen. nov., and *Pseudoceratocladium* gen. nov.). *Vermiculariopsiella* (*Vermiculariopsiellales*, *Vermiculariopsiellaceae*) is emended for species with setose sporodochia with simple setae (*V. dichapetali*, *V. eucalypticola*, *V. immersa*, *V. pini*, *V. spiralis*, *V. australiensis* sp. nov.) while *Vermiculariopsis* is resurrected and includes setose fungi with branched setae (*Vs. dunni*, *Vs. eucalypti*, *Vs. eucalyptigena*, *Vs. lauracearum*, *Vs. microsperma*, *Vs. pediculata* and *Vs. castanedae* sp. nov.).

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INTRODUCTION

Circinotrichum, *Gyrothrix* and *Vermiculariopsiella* are dematiaceous, setose hyphomycetes producing hyaline, aseptate conidia in a mucoid mass. They occur as saprobes on leaf and twig litter in tropical, subtropical to temperate climates worldwide. Species of these genera have commonly been confused in the past, resulting in a complex taxonomy in literature. *Circinotrichum* and *Gyrothrix* are characterised by polyblastic conidiogenous cells, whereas *Vermiculariopsiella* is characterised by phialidic conidiogenous cells. *Circinotrichum* has simple setae, *Gyrothrix* has branched setae and *Vermiculariopsiella* has both simple and branched setae.

Despite these differences, their taxonomy has been subjected to many changes over time. *Circinotrichum* is the older genus in this complex, with *C. maculiforme* as type species (Nees 1817). It is characterised by erect, brown, simple, verrucose, circinate setae, with gregarious conidiogenous cells at the base of the setae producing simple, aseptate, hyaline conidia. *Gyrothrix* was first introduced as a new section in the genus *Campsotrichum* (Corda 1839) with *G. podosperma* as type. It was later raised to genus level by Corda (1842), but only validly published by Rabenhorst (1844). Corda (1839) also described *Ceratocladium*, based on *Ceratocladium microspermum*, for fungi similar to *Campsotrichum*, with branched setae in which the conidiophores are supported by setae.

Gyrotrichum (1827) has been considered a synonym of *Circinotrichum* (1816) by Linnaeus (Pirozynski 1962), whereas *C. maculiforme* is the earliest name for *Helicosporium obscurum* by Corda (1831), *Psilonia maculiformis* by Fries (1832), *Fusisporium circinatum* by Wallroth (1833), and *Gyrothrix podosperma* by Saccardo (1878, 1881). Weese (1925) also pointed out that what Saccardo (1881) described and illustrated as *H. obscurum* was *C. maculiforme*, and what Saccardo (1878) described and illustrated as *C. maculiforme* was *G. podosperma*.

Hughes (1958) retained *Circinotrichum* for fungi producing unbranched setae and maintained *Gyrothrix* for fungi with constantly branched setae. Although Kendrick (1980) pointed out that *Gyrothrix* and *Ceratocladium* should be considered synonyms of *Circinotrichum*, Pirozynski (1962) retained them as separate genera in his monograph following Hughes, and this concept was generally accepted by subsequent mycologists (Pirozynski & Patil 1970, Hughes & Pirozynski 1971, Castañeda-Ruiz & Kendrick 1990, 1991, Seifert et al. 2011, Crous et al. 2014, 2015, 2019a, c, 2020a).

Other asexual genera with dark setae resembling *Circinotrichum*, *Ceratocladium* and *Gyrothrix* are *Selenodriella*, *Vermiculariopsiella* and *Vermiculariopsis*. *Selenodriella* was established based on *S. fertilis* (Castañeda-Ruiz & Kendrick 1990), which was based on *Circinotrichum fertile* (Pirozynski & Hodges 1973), and initially described with setae. However, Castañeda-Ruiz & Kendrick (1990) described *Selenodriella* with setiform conidiophores with polyblastic, sympodial, inconspicuously denticulated conidiogenous cells grouped along the conidiophores. *Vermiculariopsiella* (Bender 1932), however, includes setose sporodochia or mononematous fungi with simple or branched setae and phialidic conidiogenous cells (Seifert et

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al. 2011). Some *Circinotrichum* and *Gyrothrix* species have been transferred to *Vermiculariopsiella*, i.e., *Circinotrichum microspermum*, *Gyrothrix cornuta* and *G. pediculata* (Nawawi & Kuthubutheen 1990, Castañeda-Ruiz & Kendrick 1991, Hernández-Restrepo et al. 2013). *Vermiculariopsis* (Torrend 1912) a monotypic genus with branched setae very similar to some species of *Vermiculariopsiella* was suggested as an older name for *Vermiculariopsiella* (Crous et al. 2018), but no formal changes were proposed.

Recent phylogenetic studies showed that *Circinotrichum*, *Gyrothrix* and *Ceratocladium* were polyphyletic, clustering in different clades of *Xylariales* (Crous et al. 2014, 2016, 2017, 2018, Becerra-Hernández et al. 2016, Hernández-Restrepo et al. 2017), while *Vermiculariopsiella* was shown as a different lineage in *Vermiculariopsiellales* (Hernández-Restrepo et al. 2017). In spite of these data, however, their generic boundaries remained unclear.

The aim of this study was to assess the systematic placement of several *Circinotrichum*, *Gyrothrix* and *Vermiculariopsiella* species. We based our study on morphological and phylogenetic analyses incorporating ITS, LSU and *rpb2* sequence data of isolates from different culture collections and taxa previously identified in these genera.

MATERIALS AND METHODS

Fungal isolates and fungarium specimens

Specimens were collected from Australia, The Netherlands, South Africa and the USA (Puerto Rico). Plant material was placed in paper bags, transferred to the laboratory, placed in moisture chambers, and treated according to Castañeda-Ruiz et al. (2016). Single spore isolates were obtained from fungal colonies sporulating on dead twigs and leaves. Cultures and fungarium specimens were obtained from the Westerdijk Fungal Biodiversity Institute, Utrecht, the Netherlands (CBS), the Canadian National Mycological Herbarium, Ottawa, Canada (DAOM) and the BCCM/MUCL Agro-food & Environmental Fungal Collection, Louvain, Belgium (MUCL). Reference strains and specimens of the studied fungi are maintained in the culture collection and fungarium of the Westerdijk Fungal Biodiversity Institute (WI), Utrecht, the Netherlands.

Morphological observations

Morphological observations were made from fungi growing on the natural substrate and/or growth media. Culture media was prepared according to Crous et al. (2019b). Strains were inoculated on malt extract agar (MEA) and oatmeal agar (OA). Descriptions of colonies are based on 2-, 4- and 6-wk-old cultures grown in darkness at 23 °C. Cornmeal agar (CMA) supplemented with *Urtica dioica* stems, and synthetic nutrient-poor agar (SNA) supplemented with sterile pine needles were selected to stimulate sporulation, growing under uv-light at 23 °C. Colony colours (surface and reverse) were scored using the colour charts of Rayner (1970). Taxonomic novelties were deposited in MycoBank (www.MycoBank.org; Crous et al. 2004).

Molecular and phylogenetic analyses

Genomic DNA was extracted from fungal colonies growing on MEA using the UltraCleanTM Microbial DNA Isolation Kit (MoBio Laboratories, Inc., Solana Beach, CA, USA) according to the manufacturer's protocol. The primers V9G, ITS5, ITS4 (White et al. 1990, De Hoog & Gerrits van den Ende 1998) and LROR/LR5 (Vilgalys & 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. Part of the second largest component of RNA polymerases II (*rpb2*), was amplified using the primers RPB2-5F2 and RPB2-7CR (Liu et al. 1999, Sung et al. 2007).

Sequences were assembled using Geneious Prime v. 2022.0.1 and deposited in GenBank (Table 1), and the alignments in TreeBASE (www.treebase.org; study number 29491). Individual alignments for each locus were performed with MAFFT online (Katoh et al. 2019) and the combined dataset was created in SequenceMatrix v. 1.8 (Vaidya et al. 2011).

The Maximum Likelihood (ML) analysis was conducted with IQ-TREE v. 2 (Minh et al. 2020). The best nucleotide substitution models under the Akaike Information Criterion (AIC) were selected using IQ-TREE v. 2. Nodal support was determined by non-parametric bootstrapping (BS) with 1 000 replicates. Bayesian Inference (BI) analysis was performed in a likelihood framework as implemented in MrBayes v. 3.2.7 (Ronquist & Huelsenbeck 2003). Two Bayesian searches were performed using default parameters. The BMCMCMC (Bayesian-Metropolis-coupled Markov chain Monte Carlo) analyses lasted until the average standard deviation of split frequencies was below 0.01 with trees saved every 1 000 generations with burn-in 25 %. The BI and ML phylogenetic trees were compared visually for topological conflict among supported clades.

RESULTS

Phylogenetic analysis

Eighty-five isolates belonging to *Circinotrichum*, *Gyrothrix*, *Selenodriella* and *Vermiculariopsiella* were studied (Table 1). From the analysed plant samples, we recovered eight specimens in culture, and 71 additional strains were retrieved from CBS, DAOM and MUCL.

Phylogenetic relationships were inferred based on the analysis of ITS, LSU, and *rpb2* sequences of members of the *Xylariales* and *Vermiculariopsiellales* (Fig. 1). The concatenated dataset of three loci contained 169 taxa (sequence per loci: ITS = 163, LSU = 162 and *rpb2* = 110) and *Kionochaeta ramifera* was used as outgroup. Phylogenetic reconstructions were performed using BI and ML. It consisted of 2 847 characters including gaps (ITS = 1 067 characters; LSU = 900; *rpb2* = 880) with 1 232 parsimony-informative and 1 299 invariable sites. The phylogenetic trees generated by BI and ML analyses were largely congruent; the nodes with support values of ≥ 95 % ML BS and ≥ 0.95 BI posterior probabilities were considered well-supported. The ML tree is shown in Fig. 1. The order *Xylariales* includes 37 well-supported lineages that represent families or natural groups of species. Analysed species of *Circinotrichum*, *Gyrothrix* and *Ceratocladium* were shown to be polyphyletic, and distributed in three major groups in *Coniocessiaceae*, *Microdochiaceae* and the new family *Gyrothricaceae*. Unfortunately, none of the genera have ex-type strains available to confirm their phylogenetic position, and therefore an epitype and neotype strains for *C. maculiforme* and *P. verticiclada*, respectively and a reference strain is designated here for *G. podosperma*. Within *Xylariales*, strains identified as *C. maculiforme*, *C. sinense*, *G. circinata*, and '*Ce. microspermum*' clustered in the same clade, together with *Coniocessia* spp. in the *Coniocessiaceae*. *Circinotrichum maculiforme*, the generic type clade, includes four strains. The *G. circinata* clade includes 11 strains and is shown to be congeneric with *C. maculiforme*, and a new combination for the former is proposed. Unfortunately, strain CBS 488.77 identified as *Ce. microspermum* was sterile, and the placement of this species remains uncertain until further collections are made and an epitype can be designated. Additionally, a new genus, *Pirozynskiomyces*, is designated to

Table 1 Strain information and GenBank accession numbers of newly generated sequences.

Taxa		Strain number	Status[1]	Country	Substrate	GenBank accession number[2]		
New name*	Received as					ITS	LSU	*rpb2*
'*Ceratocladium microspermum*'	*Ceratocladium microspermum*	CBS 488.77		Slovakia	*Quercus* sp., branch	ON400740	ON400793	ON399324
Circinotrichum australiense		CBS 148706, CPC 41017	T	Australia	Unknown substrate	ON400741	ON400794	ON399325
Circinotrichum circinatum	*Circinotrichum* sp.	CPC 26309		Reunion	*Erica* sp.	ON400742	ON400795	ON399326
	Gyrothrix circinata	CBS 148326, KAS 1093		Australia	Dead leaf	ON400743	ON400796	ON399328
	Gyrothrix circinata	CBS 148327, KAS 1164		Australia	*Hakea* sp., seeds on ground	ON400744	ON400797	ON399327
	Gyrothrix circinata	CBS 148325, MHR 18024		USA	Dead leaf	ON400745	ON400798	ON399329
	Gyrothrix sp.	CBS 140235, MUCL 41072		Brazil	Rotten leaf	ON400746	ON400799	ON399336
	Gyrothrix circinata	CBS 140217, MUCL 33100		Malawi	Dead twig	ON400747	ON400800	ON399330
	Gyrothrix circinata	CBS 140218, MUCL 33101		Malawi	Dead twig	ON400748	ON400801	ON399331
	Gyrothrix circinata	CBS 140219, MUCL 33102		Malawi	Dead twig	ON400749	ON400802	ON399332
	Gyrothrix circinata	CBS 140220, MUCL 33103		Malawi	Dead twig	ON400750	ON400803	ON399333
	Gyrothrix circinata	CBS 140229, MUCL 50435		Zimbabwe	Dead twig	ON400751	ON400804	ON399335
	Gyrothrix circinata	CBS 140230, MUCL 50442		Zimbabwe	Dead twig	ON400752	ON400805	ON399334
Circinotrichum maculiforme	*Circinotrichum maculiforme*	CBS 122758, FMR 9645		Spain	Plant debris	KR611875.1	KR611896.1	ON399337
	Circinotrichum maculiforme	CBS 140225, MUCL 39929		Cuba	Rotten leaf	ON400753	ON400806	ON399339
	Circinotrichum sp.	CBS 140016, CPC 24566	ET	Czech Republic	*Loranthus europaeus*, twigs	KR611874.1	KR611895.1	ON399338
	Circinotrichum sp.	CPC 29975		France	*Cornus sanguinea*	ON400754	ON400807	ON399340
Gyrothrix encephalarti	*Gyrothrix citricola*	CBS 114517, CPC 16945		South Africa	*Elegia equisetacea*	ON400755	ON400808	ON399314
	Gyrothrix grisea	CBS 114515, SL 914		South Africa	*Thamnochortus spicigerus*	–	ON400809	ON399315
	Gyrothrix encephalarti	CBS 146684, CPC 35966	T	South Africa	*Encephalartos* sp., leaves	NR_170834.1	MT373358.1	ON399342
Gyrothrix eucalypti	*Gyrothrix eucalypti*	CBS 146022, CPC 35992		South Africa	*Eucalyptus dunnii*	MN562110.1	MN567618.1	ON399345
	Gyrothrix eucalypti	CBS 146023, CPC 36066	T	South Africa	*Eucalyptus* sp., leaf	MN562109.1	MN567617.1	ON399346
Gyrothrix podosperma		CBS 148804, CPC 42063	REF	Netherlands	*Juncus inflexus*, leaf	ON400756	ON400810	ON399343
	Gyrothrix sp.	CBS 148705, CPC 29981		South Africa	*Podocarpus falcatus*	ON400757	ON400811	ON399344
Gyrothrix sp.	*Gyrothrix* sp.	KAS 1687		Australia	*Brachychiton discolor*, leaves on ground	–	–	ON399316
	Gyrothrix sp.	CBS 140237, MUCL 41882		Cuba	Rotten leaf	ON400758	ON400812	ON399317
Gyrothrix verticillata		CBS 148806, CPC 39951		Netherlands	*Astragalus* sp.	ON400759	ON400813	ON399318
		CBS 148805, CPC 39953		Netherlands	*Astragalus* sp.	ON400760	ON400814	ON399319
	Circinotrichum sp.	CBS 148704, CPC 28776		Mexico	*Agapanthus*	ON400761	–	–
	Gyrothrix sp.	CBS 148701, CPC 27527		unknown	*Pinus patula*	ON400762	–	–
Neogyrothrix oleae	*Gyrothrix oleae*	CBS 146069, CPC 37069	T	South Africa	*Olea capensis* subsp. *macrocarpa*	MN562136.1	MN567643.1	–
Neogyrothrix oleae	*Gyrothrix oleae*	CBS 146068, CPC 37063		South Africa	*Diospyros whyteana*	MN562137.1	MN567644.1	–
Peglionia verticiclada	*Gyrothrix verticiclada*	CBS 127654	ET	Italy	*Smilax aspera* litter	ON400763	ON400815	ON399352
	Gyrothrix verticiclada	CBS 140226, MUCL 41150		Venezuela	Rotten leaf	ON400764	ON400816	ON399354
	Gyrothix verticiclada	CBS 148329, KAS 846		Australia	*Eucalyptus* sp., leaves on ground	ON400765	ON400817	ON399353
	Gyrothrix hughesii	CBS 101171, INIFAT C98/3-1		Venezuela	Leaf litter	ON400766	ON400818	ON399355
Pirozynkiomyces brasiliensis	*Gyrothrix circinata*	CBS 112314, INIFAT CO2/88	T	Brazil	Rotten leaf	ON400767	ON400819	ON399341
Pseudoceratocladium polysetosum	*Ceratocladium microspermum*	CBS 126092		Spain	Plant debris	MH864077.1	MH875534.1	ON399347
	Ceratocladium polysetosum	CBS 129023, FMR 10750	T	Spain	Bark	NR_154849.1	NG_059024.1	ON399348
Pseudocircinotrichum papakurae	*Circinotrichum papakurae*	CBS 101373, INIFAT C98/17-8		Brazil	Rotten leaf	KR611876.1	KR611897.1	–
	Circinotrichum papakurae	CBS 140221, MUCL 39023		Cuba	*Theobromae cacao*, leaf	ON400768	ON400820	ON399349
Selenodriella brasiliana	*Circinotrichum australiense*	CBS 140227, MUCL 41176	T	Brazil	Rotten leaf	ON400769	ON400821	ON399356
	Circinotrichum sp.	CBS 140236, MUCL 41175		Brazil	Rotten leaf	ON400770	ON400822	ON399357

Table 1 (cont.)

Taxa		Strain number	Status[1]	Country	Substrate	GenBank accession number[2]		
New name	Received as					ITS	LSU	*rpb2*
Selenodriella cubensis		CBS 683.96, INIFAT C96/30	T	Cuba	Unknown substrate	KP859053.1	KP858990.1	–
Selenodriella fertilis	*Vermiculariopsiella* sp.	CPC 16273		South Africa	*Eucalyptus* sp.	ON400771	ON400823	ON399358
	Circinotrichum rigidum	CBS 148328, KAS 1114		Australia	*Callistemon vininalis*, leaves on ground	ON400772	ON400824	ON399359
		CBS 144589		Australia	*Eucalyptus* sp., leaf litter	MK442624.1	MK442560.1	–
		CBS 772.83		Australia	*Hakea baxteri*, dead leaf	KP859055.1	KP858992.1	–
Vermiculariopsiella australienesis	*Vermiculariopsiella* sp.	CBS 141498, CPC 25482		Australia	*Grevillea* sp., leaves	KX306771.1	ON400825	ON399360
	Vermiculariopsiella dichapetali	CBS 141499, CPC 29196	T	Australia	*Grevillea* sp., leaves	KX306772.1	KX306797.1	ON399361
	Vermiculariopsiella dichapetali	CBS 141500, CPC 29232		Australia	*Acacia glaucoptera*, leaves	KX306773.1	KX306798.1	
	Vermiculariopsiella dichapetali	CBS 143424, CPC 32057		Australia	*Melaleuca* sp., leaves	MH107923.1	MH107969.1	ON399362
	Vermiculariopsiella dichapetali	CBS 143440, CPC 32544		Australia	*Eucalyptus regnans*, leaves	MH107924.1	MH107970.1	–
	Vermiculariopsiella dichapetali	CBS 141498, CPC 25482		Australia	*Grevillea* sp., leaves	KX306771.1	KX306796.1	–
Vermiculariopsiella dichapetali	*Vermiculariopsiella dichapetali*	CBS 137977, CPC 22463	T	Botswana	*Dichapetalum rhodesicum*	KJ869129.1	KJ869186.1	–
Vermiculariopsiella eucalypticola	*Vermiculariopsiella eucalypticola*	CBS 143442, CPC 32506	T	Australia	*Eucalyptus dalrympleana*, leaves	MG386070.1	MG386123.1	ON399368
Vermiculariopsiella eucalyptigena	*Vermiculariospsiella eucalyptigena*	CBS 146091, CPC 36373	T	Australia	*Eucalyptus* sp., leaves	NR_170067.1	MT223939.1	ON399369
Vermiculariopsiella immersa	*Vermiculariopsiella immersa*	CBS 140223, MUCL 39135		Spain	Rotten leaf	KY853476.1	KY85354.1	ON399363
	Vermiculariopsiella immersa	CBS 112026, INIFAT CO2/71		Brazil	Decaying leaf	ON400773	ON400826	ON399364
Vermiculariopsiella pini	*Vermiculariopsiella pini*	CBS 146009, CPC 36727	T	Malaysia	*Pinus tecunumanii*, needles	MN562128.1	MN567635.1	ON399367
Vermiculariopsiella spiralis	*Vermiculariopsiella spiralis*	CBS 110672, CPC 555		South Africa	*Syzygium cordatum*, leaf litter	ON400774	ON400827	ON399365
	Vermiculariopsiella acaciae	CBS 141289, CPC 26291	T	France	*Acacia heterophylla*, leaves	KX228263.1	KX228314.1	ON399366
	Vermiculariopsiella immersa var. *spiralis*	CBS 523.93	T	South Africa	*Syzygium cordatum*, leaf litter	MH862440.1	–	–
Vermiculariopsis castanadae	*Vermiculariopsiella pediculata*	CBS 132484, FMR 12187	T	Portugal	Leaf	MH866028.1	ON400828	ON399323
Vermiculariopsis dunnii	*Circinotrichum* sp.	CBS 148330, KAS 819		Australia	*Eucalyptus fastigata*, bark	ON400775	ON400829	ON399370
	Vermiculariopsiella dunnii	CBS 145538, CPC 35649	T	Australia	*Eucalyptus dunnii*, leaves	MK876412.1	MK876452.1	ON399371
Vermiculariopsis eucalypti	*Gyrothrix* sp.	CBS 141281, CPC 25525	T	Australia	*Eucalyptus* sp., leaves	NR_154637.1	NG_066169.1	
Vermiculariopsis lauracearum	*Vermiculariopsis*-like sp.	CPC 17086		Australia	Unknown substrate	ON400776	ON400830	ON399320
	Vermiculariopsiella	CBS 112582, INIFAT CO2/94-2a		Brazil	Decaying leaf	ON400777	ON400831	ON399321
		CBS 136534, CMW 18375		South Africa	*Sideroxylon inerme*, twigs	ON400778	ON400832	ON399322
	Vermiculariopsiella lauracearum	CBS 145055, CPC 33591	T	Spain	*Laurus novocanariensis*, leaf litter	MK047436.1	MK047487.1	–
Vermiculariopsis pediculata	*Gyrothrix pediculata*	CBS 579.74, ATCC 22290	T	USA	*Robinia pseudo-acacia*, leaf	ON400779	ON400833	ON399372
	Vermiculariopsiella microsperma	CBS 100153, FMR 6199		Cuba	Dead leaves from rain forest	ON400780	ON400834	ON399376
	Vermiculariopsiella microsperma	CBS 101172, INIFAT C98/36-3		Brazil	Leaf litter	KY853477.1	ON400835	ON399380
	Gyrothrix microsperma	CBS 140232, MUCL 51899		Japan	*Castanopsis* sp., dead leaf	–	ON400836	ON399374
	Gyrothrix pediculata	CBS 140228, MUCL 47125		France	Dead leaf unidentified angiosperma	ON400781	ON400837	ON399377
	Gyrothrix sp.	CBS 140234, MUCL 40392		French Guiana	Dead leave	ON400782	ON400838	ON399378
	Vermiculariopsiella microsperma	CBS 140231, MUCL 50517		French Guiana	Dead leave	KY853478.1	ON400839	ON399375
	Gyrothrix pediculata	CBS 148331, KAS 1111		Australia	*Callistemon vininalis*, leaves	ON400783	ON400840	ON399379
	Vermiculariopsiella microsperma	CBS 499.92, INIFAT C91/88		Cuba	*Stigmaphyllon sagraeanum*	–	-	ON399373
Xenoanthostomella chromolaenae	*Circinotrichum*	CBS 148702, CPC 27556		Malaysia	*Albizia falcataria*, petioles	ON400784	ON400841	–
	Circinotrichum	CBS 148703, CPC 27560		Malaysia	*Falcataria moluccana*, seed pods	ON400785	ON400842	–
Xenoanthostomella cycadis	*Circinotrichum cycadis*	CBS 137969, CPC 17285	T	Australia	*Cycada* sp.	KJ869121.1	KJ869178.1	ON399350
	Gyrothrix sp.	CPC 25749		South Africa	*Kniphofia roeperi*, leaf spots	ON400786	ON400843	–
Xenoanthostomella olivacea	*Circinotrichum olivaceum*	CBS 101185, INIFAT C98/17-6		Brazil	Leaf litter	ON400787	ON400844	ON399351

* BoldItalic names represent taxonomic novelties

[1] T indicate ex-type strains, ET ex-epitype strains, and REF reference strain.

[2] ITS: internal transcribed spacers and intervening 5.8S nrDNA; LSU: partial large subunit (28S) of the nrRNA gene operon; *rpb2*: partial RNA polymerase II largest subunit gene.

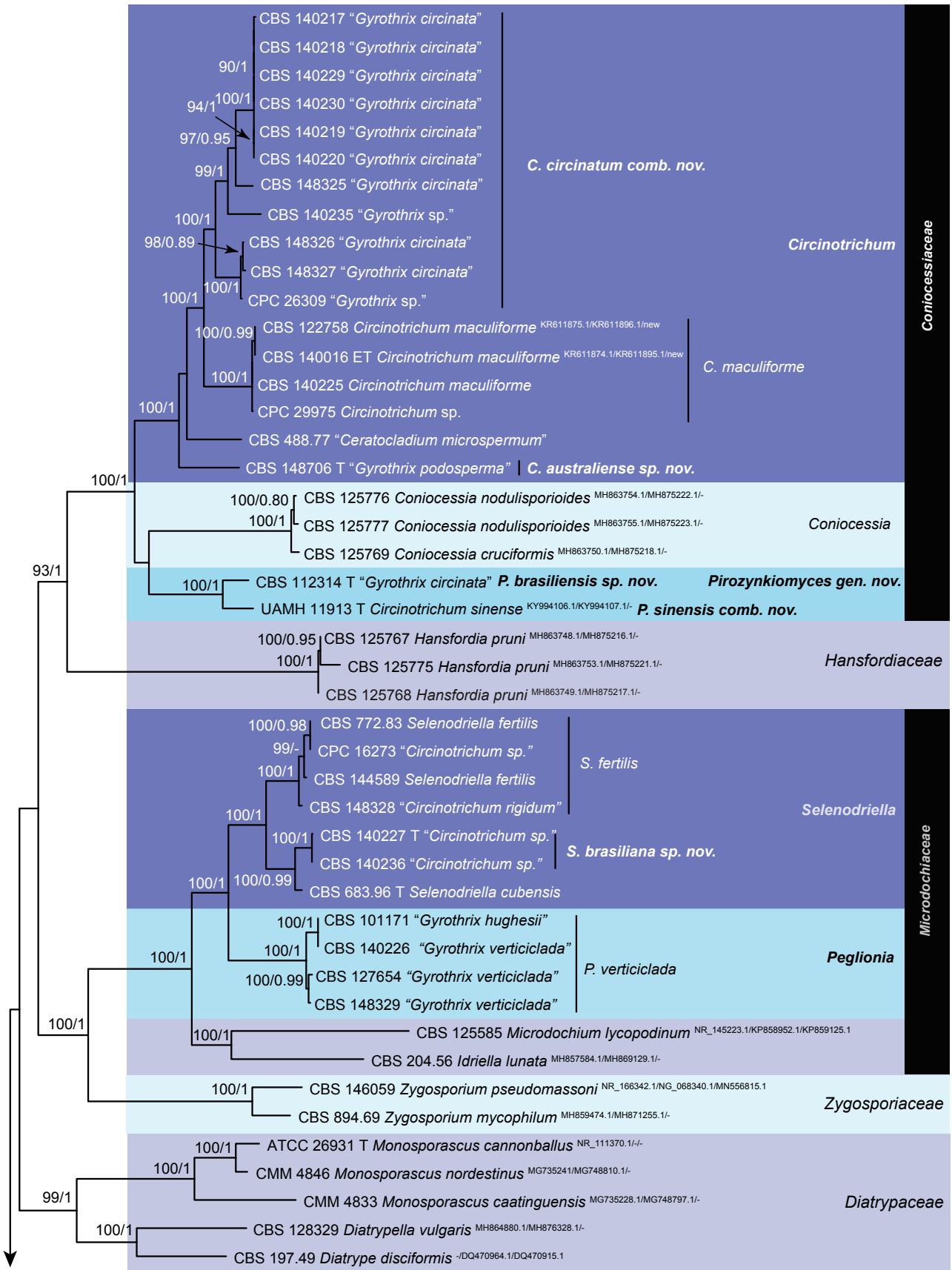

Fig. 1 ML phylogram obtained from the combined ITS, LSU, and *rpb2* sequences of *Xylariales* and *Vermiculariopsiellales* members. The tree was rooted to *Kionochaeta ramifera* (CBS 102618). Taxonomic novelties described in this study are shown in **bold**. Bootstrap support (BS) values ≥ 95 % and Bayesian posterior probability (PP) scores ≥ 0.95 are shown at the nodes. ET, NT, and T indicates ex-epitype, ex-neotype and ex-type.

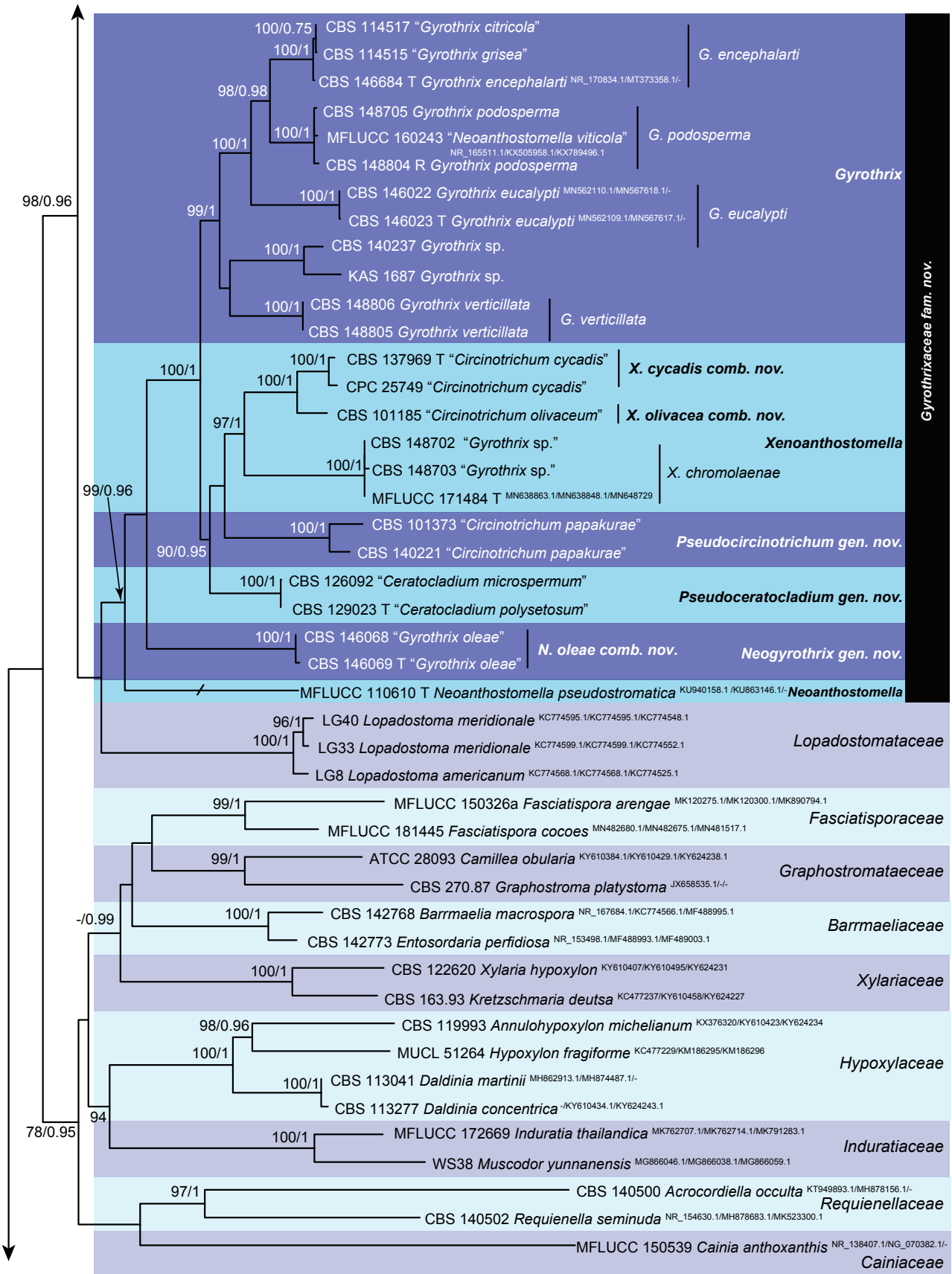
100/0.75
CBS 114517 "Gyrothrix citricola"
100/1
CBS 114515 "Gyrothrix grisea"
G. encephalarti
CBS 146684 T Gyrothrix encephalarti NR_170834.1/MT373358.1/-
98/0.98
CBS 148705 Gyrothrix podosperma
100/1
MFLUCC 160243 "Neoanthostomella viticola"
G. podosperma
NR_165511.1/KX505958.1/KX789496.1
100/1
CBS 148804 R Gyrothrix podosperma
Gyrothrix
98/0.96
100/1
CBS 146022 Gyrothrix eucalypti MN562110.1/MN567618.1/-
99/1
CBS 146023 T Gyrothrix eucalypti MN562109.1/MN567617.1/-
G. eucalypti
100/1
CBS 140237 Gyrothrix sp.
KAS 1687 Gyrothrix sp.
100/1
CBS 148806 Gyrothrix verticillata
CBS 148805 Gyrothrix verticillata
G. verticillata
Gyrothrixaceae fam. nov.
100/1
100/1
CBS 137969 T "Circinotrichum cycadis"
X. cycadis comb. nov.
100/1
CPC 25749 "Circinotrichum cycadis"
CBS 101185 "Circinotrichum olivaceum"
X. olivacea comb. nov.
97/1
CBS 148702 "Gyrothrix sp."
Xenoanthostomella
100/1
CBS 148703 "Gyrothrix sp."
X. chromolaenae
99/0.96
MFLUCC 171484 T MN638863.1/MN638848.1/MN648729
100/1
CBS 101373 "Circinotrichum papakurae"
Pseudocircinotrichum gen. nov.
90/0.95
CBS 140221 "Circinotrichum papakurae"
100/1
CBS 126092 "Ceratocladium microspermum"
Pseudoceratocladium gen. nov.
CBS 129023 T "Ceratocladium polysetosum"
100/1
CBS 146068 "Gyrothrix oleae"
N. oleae comb. nov.
Neogyrothrix gen. nov.
CBS 146069 T "Gyrothrix oleae"
MFLUCC 110610 T Neoanthostomella pseudostromatica KU940158.1 /KU863146.1/-
Neoanthostomella
96/1
LG40 Lopadostoma meridionale KC774595.1/KC774595.1/KC774548.1
100/1
LG33 Lopadostoma meridionale KC774599.1/KC774599.1/KC774552.1
Lopadostomataceae
LG8 Lopadostoma americanum KC774568.1/KC774568.1/KC774525.1
99/1
MFLUCC 150326a Fasciatispora arengae MK120275.1/MK120300.1/MK890794.1
MFLUCC 181445 Fasciatispora cocoes MN482680.1/MN482675.1/MN481517.1
Fasciatisporaceae
99/1
ATCC 28093 Camillea obularia KY610384.1/KY610429.1/KY624238.1
CBS 270.87 Graphostroma platystoma JX658535.1/-/-
Graphostromataceae
-/0.99
100/1
CBS 142768 Barrmaelia macrospora NR_167684.1/KC774566.1/MF488995.1
CBS 142773 Entosordaria perfidiosa NR_153498.1/MF488993.1/MF489003.1
Barrmaeliaceae
100/1
CBS 122620 Xylaria hypoxylon KY610407/KY610495/KY624231
CBS 163.93 Kretzschmaria deutsa KC477237/KY610458/KY624227
Xylariaceae
98/0.96
CBS 119993 Annulohypoxylon michelianum KX376320/KY610423/KY624234
100/1
MUCL 51264 Hypoxylon fragiforme KC477229/KM186295/KM186296
Hypoxylaceae
100/1
CBS 113041 Daldinia martinii MH862913.1/MH874487.1/-
CBS 113277 Daldinia concentrica -/KY610434.1/KY624243.1
94
78/0.95
100/1
MFLUCC 172669 Induratia thailandica MK762707.1/MK762714.1/MK791283.1
WS38 Muscodor yunnanensis MG866046.1/MG866038.1/MG866059.1
Induratiaceae
97/1
CBS 140500 Acrocordiella occulta KT949893.1/MH878156.1/-
CBS 140502 Requienella seminuda NR_154630.1/MH878683.1/MK523300.1
Requienellaceae
MFLUCC 150539 Cainia anthoxanthis NR_138407.1/NG_070382.1/-
Cainiaceae

Fig. 1 (cont.)

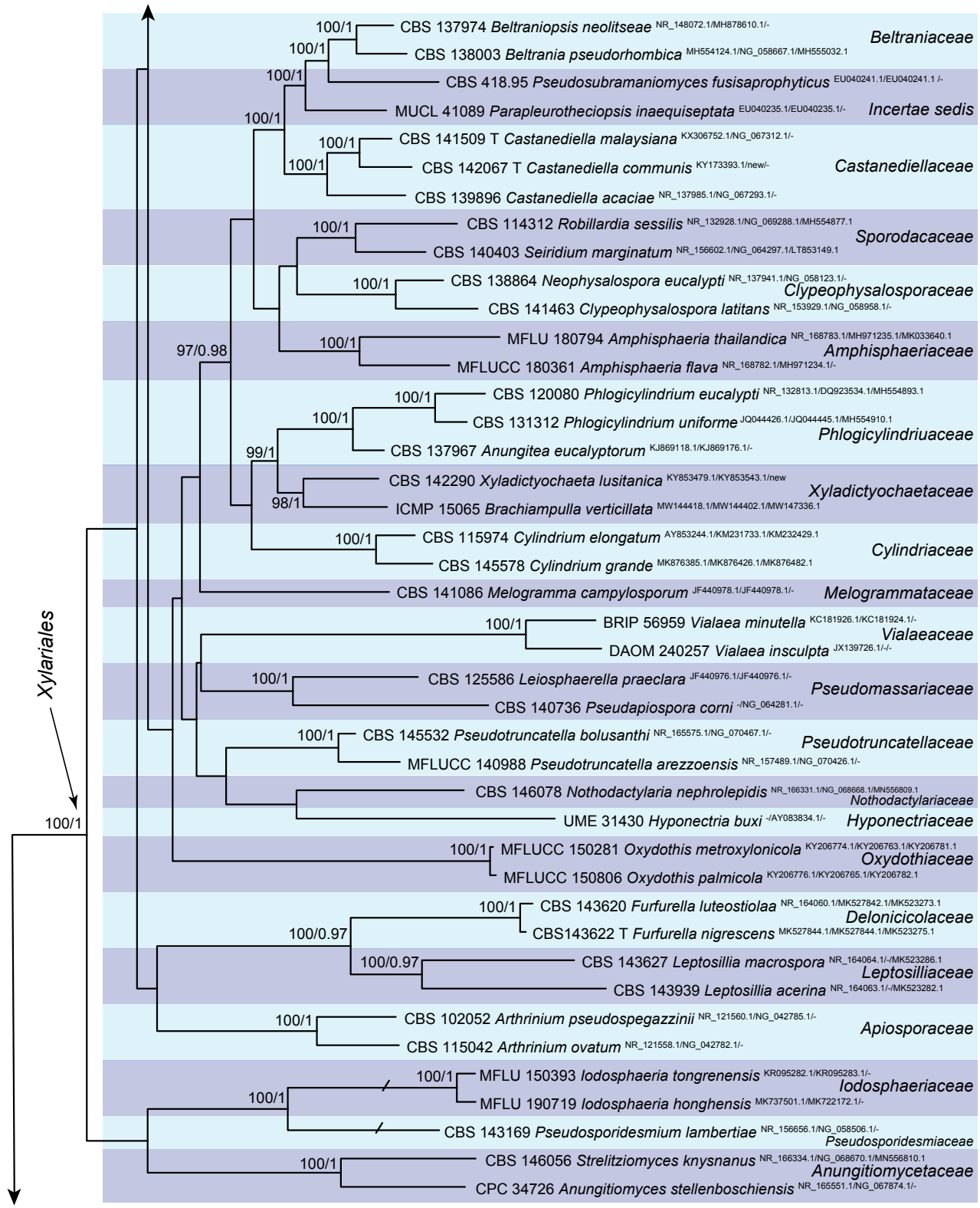

Fig. 1 (cont.)

include *C. sinensis* (UAMH 11913) and a new species *P. brasiliensis* (CBS 112314), previously identified as *G. circinata*. Furthermore, strains identified as *C. rigidum* (CBS 148328) and *Circinotrichum* sp. (CBS 140227 and CBS 140236) are shown to be related to *Selenodriella fertilis* and *S. cubensis*, respectively, in the *Microdochiaceae*. *Gyrothrix verticiclada* (CBS 127654 epitype, CBS 140226 and CBS 148329) and *G. hughesii* (CBS 101171) are also related to *Selenodriella*, but clustered in a separate clade and are interpreted as a distinct genus, for which *Peglionia* is resurrected. Other *Gyrothrix* and *Circinotrichum* species are placed in an *incertae sedis* clade related to *Neoanthostomella* and *Xenoanthostomella*, for which a new family is proposed, *Gyrothricaceae. Gyrothrix* is confined to *G. podosperma*, *G. encephalarti*, *G. eucalypti*, *G. verticillata*, and *Gyrothrix* sp. (CBS 140237 and KAS 1687). *Neoanthostomella viticola* (MFLUCC 160243), which is distant to the type species *N. pseudostromatica* (MFLUCC 110610), is shown as conspecific to *G. podosperma* (CBS 148804 and CBS 148705) and is here consider as synonym. Furthermore, the strains CBS

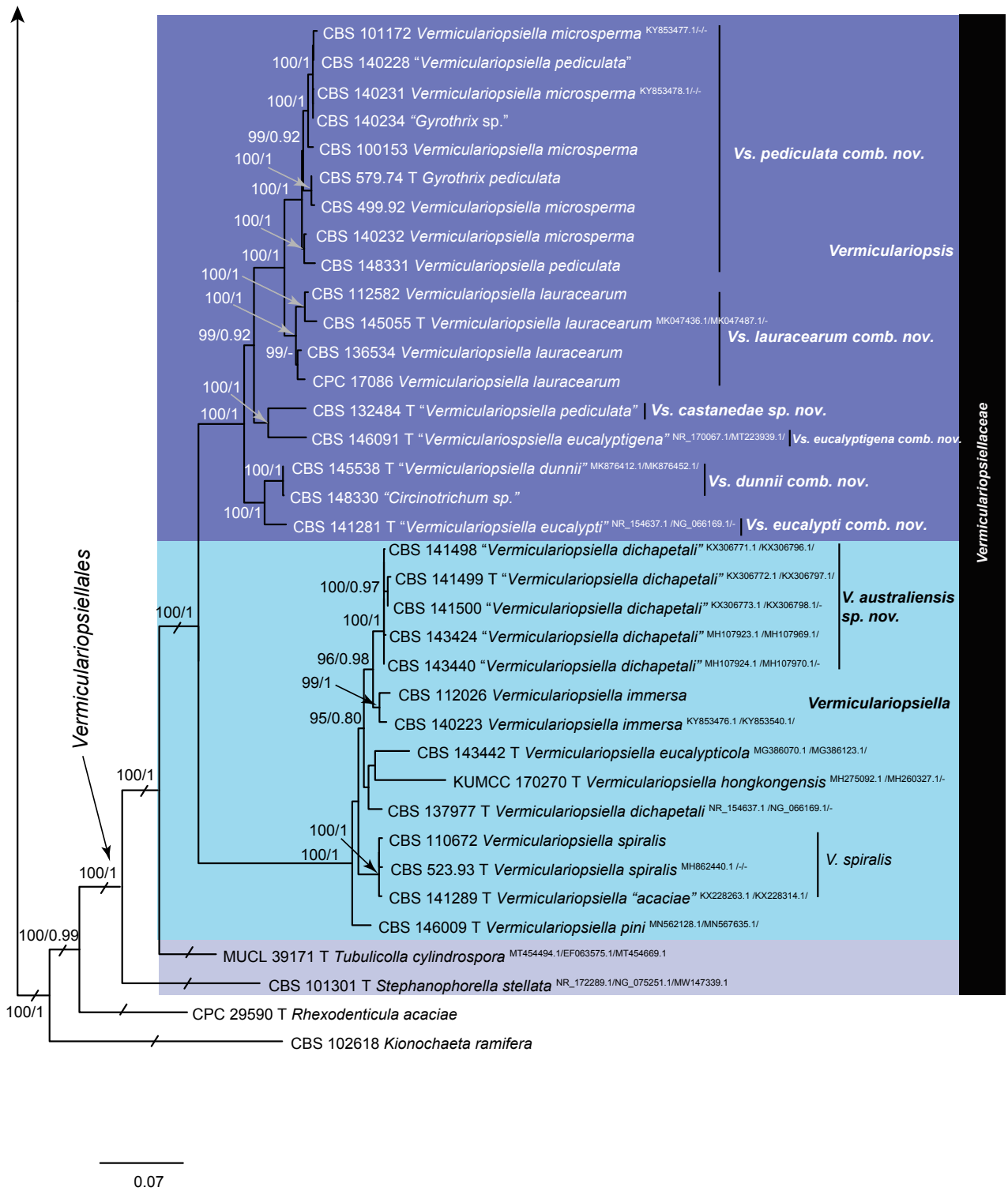

Fig. 1 (cont.)

114517 and CBS 114515, identified respectively as *C. citricola* and *C. griseum*, are conspecific to *G. encephalarti* (CBS 148804). The *Xenoanthostomella* clade includes *Xenoanthostomella chromolaenae* (MFLUCC 171484 type, CBS 148702 and CBS 148703), *C. cycadis* (CBS 137969 and CPC 25749) and *C. olivaceum* (CBS 101185), for which the two new combinations are introduced. Moreover, *C. papakurae* (CBS 101373 and CBS 140221, not ex-type strains), *Ce. polysetosum* (CBS 129023 and CBS 126092 identified as *Ce. microspermum*) and *G. oleae* (CBS 146068 and CBS 146069) formed three different subclades and are described here as three new genera, *Pseudocircinotrichum*, *Pseudoceratocladium* and *Neogyrothrix*, respectively.

Additionally, other strains previously identified to genus level as *Circinotrichum* sp. and *Gyrothrix* sp. are placed in the *Vermiculariopsiellales*. *Vermiculariopsiella* is divided in two different clades. A clade including the type of the genus, *V. immersa*, together with *V. dichapetali* s.lat., *V. hongkongensis*, *V. eucalypticola*, *V. spiralis* and *V. pini*, is here considered *Vermiculariopsiella* s.lat. Another clade that consists of *V. microsperma*, *V. pediculata*, *V. lauracearum*, *V. eucalyptigena*, *V. dunnii*, *V. eucalypti*, CBS 148330 (as *Circinotrichum* sp.) and CBS 140234 (as *Gyrothrix* sp.), are assigned to *Vermiculariopsis* and new combinations proposed.

TAXONOMY

Xylariales, Coniocessiaceae

Circinotrichum Nees, Syst. Pilze (Wurzburg): 18. 1817

Synonyms. *Gyrotrichum* Spreng., Syst. Veg. 4(1): 554. 1827.
Gyrocerus Corda, Icon. Fungorum (Corda) 1: 9. 1837.
Dephilippia Rambelli, Mycopathol. Mycol. Appl. 11: 137. 1959.

Type species. Circinotrichum maculiforme Nees

Emended description. *Colonies* on the natural substrate punctiform or effuse, hairy, blackish brown to black. *Mycelium* composed of branched, smooth-walled, septate, hyaline to pale brown hyphae. *Setae* simple or branched, erect, straight or circinate, thick-walled, initially smooth becoming verrucose, dark brown near the base, paler above, gradually tapering. *Conidiogenous cells* born laterally on the superficial hyphae, polyblastic, obclavate to lageniform, thin-walled, pale brown to subhyaline. *Conidia* aggregated into a dry whitish layer at the base of the setae, cylindrical to fusoid, straight or slightly curved, with the base subulate and the apex bluntly corniform, hyaline. *Sexual morph* not observed.

Accepted species. *C. australiense*, *C. circinatum*, *C. maculiforme*.

Circinotrichum australiense Hern.-Restr. & Crous, *sp. nov.* — MycoBank MB 844007; Fig. 2

Etymology. Named after Australia, the country where the holotype was collected.

Typus. Australia, Canberra, Mt Stromlo, Blue Gums, leaf litter of *Eucalyptus* sp., 16 Jan. 2021, coll. *A. Wells & L.A. Mound*, isol. *P.W. Crous*, HPC 3568 (holotype designated here CBS H-24932, culture ex-type CBS 148706 = CPC 41017).

Mycelium composed of branched and anastomosing, smooth-walled, septate, hyaline to brown hyphae, 1–3 µm wide, bearing setae and conidiogenous cells. *Setae* irregularly branched, in clusters, with L- or T-basal cell giving rise to a network of aggregated conidiogenous cells, main stipe dark brown, thick-walled, initially smooth, becoming verruculose towards the apex, branches and upper part circinate, 125–230 × 3.5–5 µm. *Conidiogenous cells* aggregated in tight clusters around the base of setae, pale to medium brown, smooth, subcylindrical to lageniform, 10–16 × 2.5–5 µm. *Conidia* aggregated in clusters at the apices of conidiogenous cells, hyaline, smooth, multiguttulate, cylindrical to fusoid, straight to slightly curved, apex subobtuse, 12–19 × 1.5–2 µm.

Culture characteristics — On OA colonies zonate, velvety to cottony, fawn to dark brick, vinaceous buff to the periphery, margin effuse, reverse with the centre dark brick to vinaceous, to the periphery rosy buff to buff. Abundant sporulation.

Notes — *Circinotrichum australiense* is represented only by the ex-type strain and clusters as a separate branch in the *Circinotrichum* clade. Morphologically, it resembles *G. podosperma* and *G. macroseta*. However, it can be distinguished from *G. podosperma* by having longer, less branched setae and slightly thinner conidia, and from *G. macroseta* by having smaller setae and longer conidia (*G. macroseta*: setae 250–430 × 5–8 µm, conidia 13–16 × 1.5 µm, Pirozynski 1962).

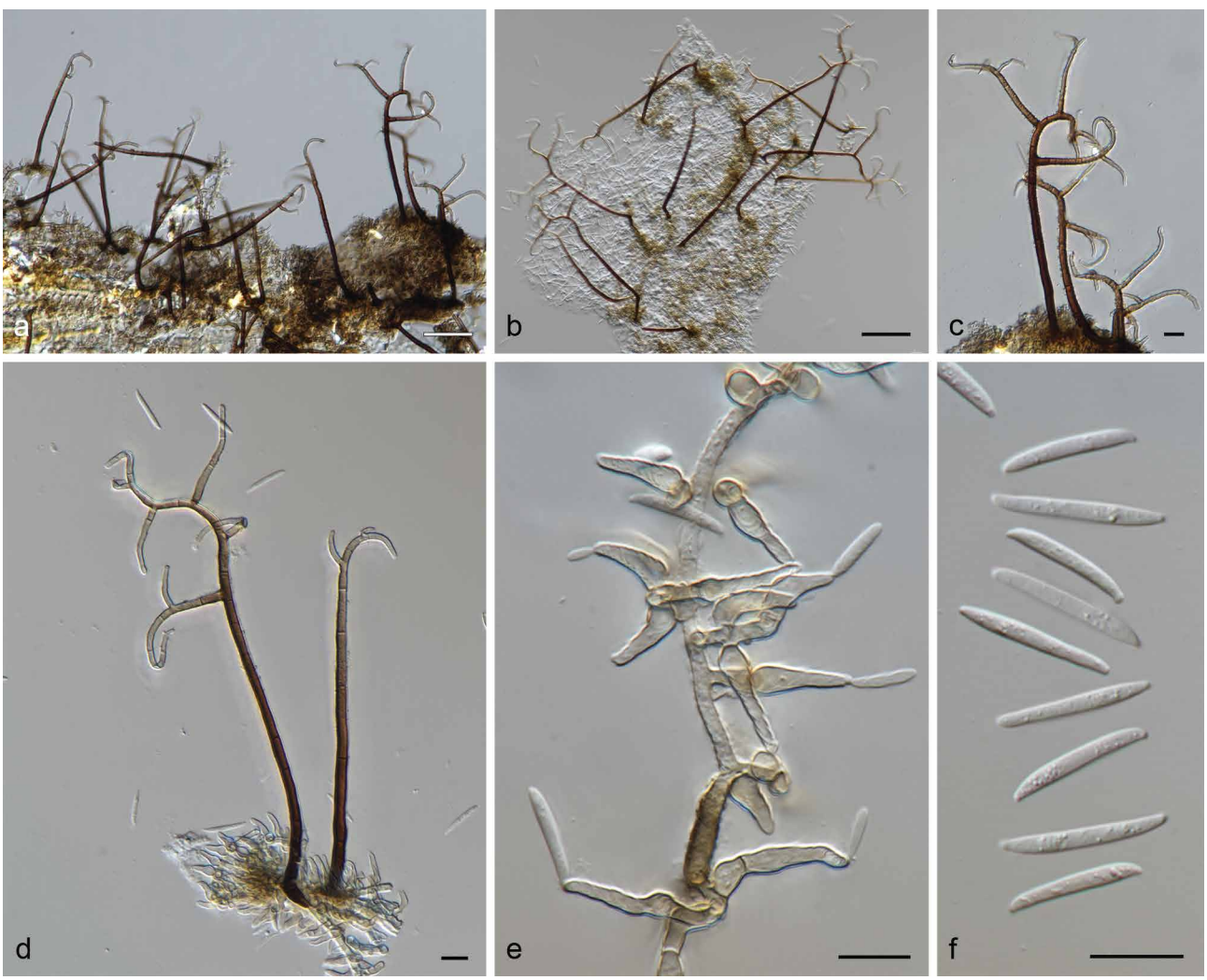

Fig. 2 *Circinotrichum australiense* sp. nov. (CPC 41017). a–d. Setae; e. conidiogenous cells with conidia; f. conidia. — Scale bars: a–b = 50 µm; c–f = 10 µm.

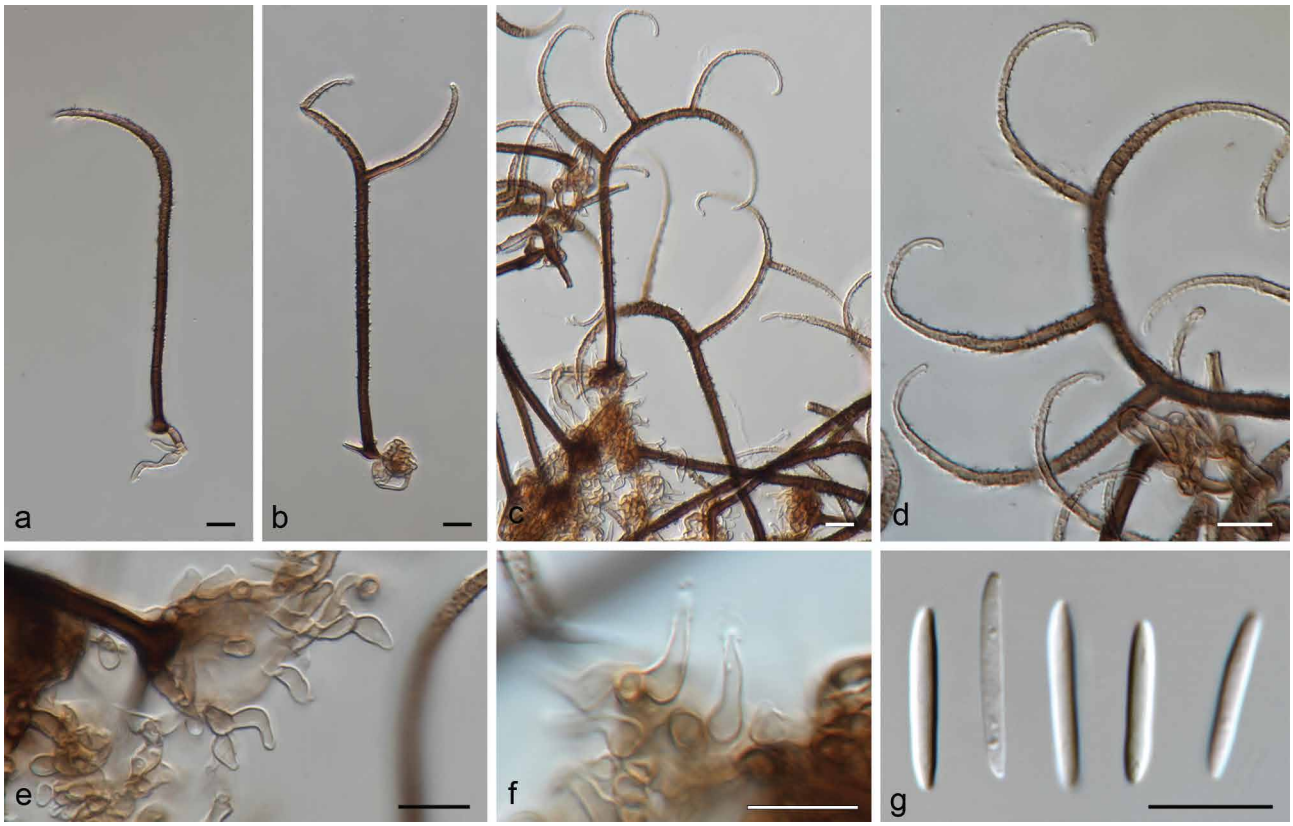

Fig. 3 *Circinotrichum circinatum* (CBS 148325). a–d. Setae; e–f. conidiogenous cells; g. conidia. — Scale bars: a–f = 10 µm.

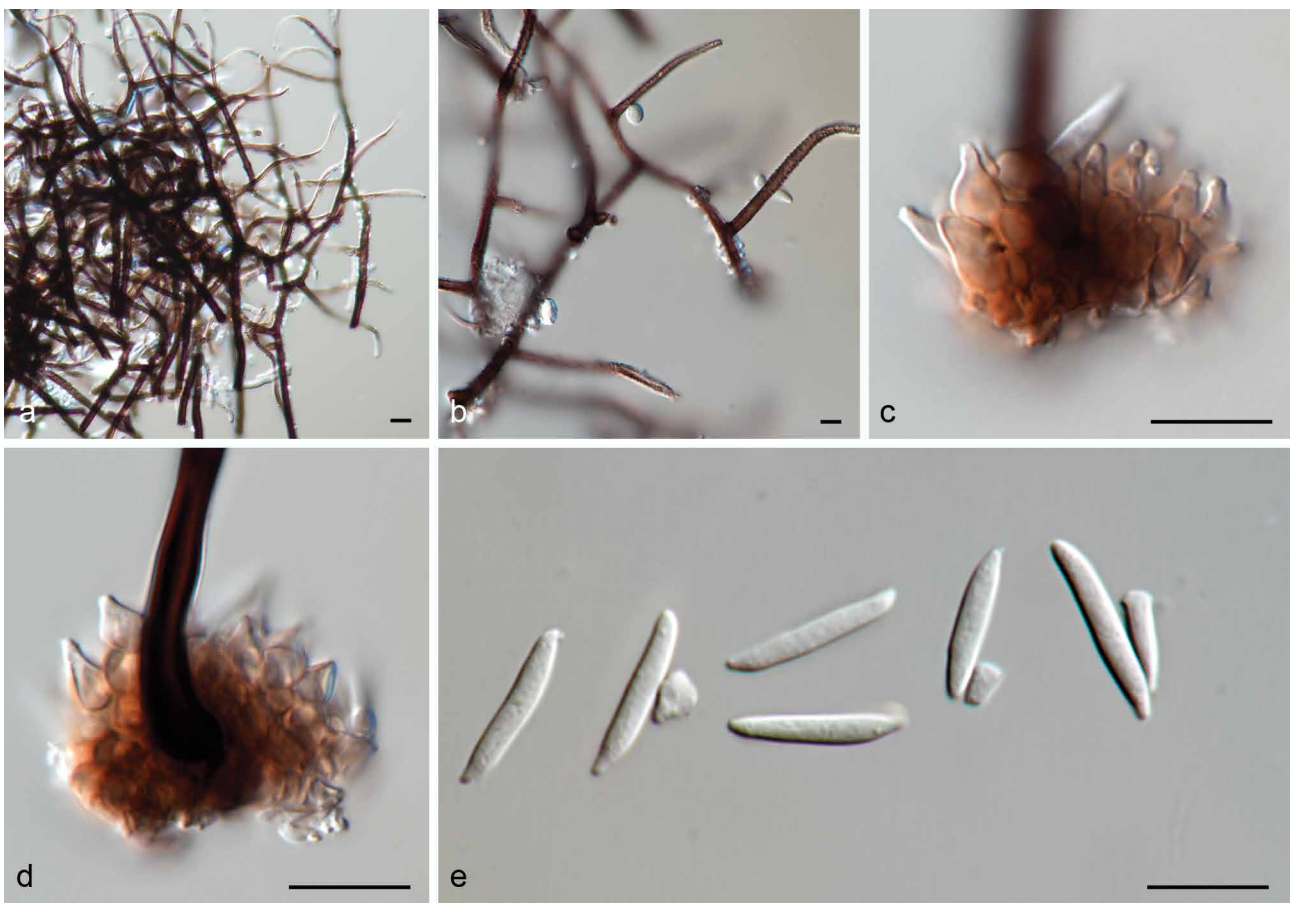

Fig. 4 *Circinotrichum circinatum* (CBS H-13170). a–b. Setae; c–d. conidiogenous cells; e. conidia. — Scale bars: a–e = 10 µm.

Circinotrichum circinatum (Berk. & M.A. Curtis) Hern.-Restr. & Crous, *comb. nov*. — MycoBank MB 844008; Fig. 3–6

Basionym. Campsotrichum circinatum Berk. & M.A. Curtis, Grevillea 3(28): 146. 1875.

Synonym. Gyrothrix circinata (Berk. & M.A. Curtis) S. Hughes, Canad. J. Bot. 36: 771. 1958.

Typus. USA, South Carolina, on leaves of *Magnolia grandiflora*, M.J. Berkeley, 1374, type (83903). Isotype IMI 37262.

Colonies on the natural substrate effuse, velvety, dark brown to black. *Mycelium* composed of branched and anastomosing, smooth-walled, septate, subhyaline to orange-brown hyphae, 1–2.5 µm wide, bearing setae and conidiogenous cells. *Setae* abundant, intertwined, erect, thick-wall, verrucose, circinate, subdichotomously branched, base dark brown, apex pale brown, 76–156 × (2–)3–4 µm. *Conidiogenous cells* born laterally on the superficial hyphae at the base of the setae, obclavate to lageniform, curved, pale brown, 4–11.5 × 2–4 µm, 1–1.5 µm at the apex. *Conidia* aggregated into a whitish layer at the base of the setae, cylindrical to fusoid, straight or slightly curved, base subulate, apex bluntly corniform, hyaline, 11.5–18 × 1.5–2 µm.

Culture characteristics — After 2 wk at 25 °C, on OA cottony to velvety, buff to honey, with radial folds, margin lobate, reverse luteous. On MEA velvety to cottony, zonate, with radial folds that open inside out, centre buff, white and cinnamon, with fawn to greyish sepia zones, periphery pale luteous, margin lobulate, reverse dark brick in the centre, luteous to cinnamon to the periphery.

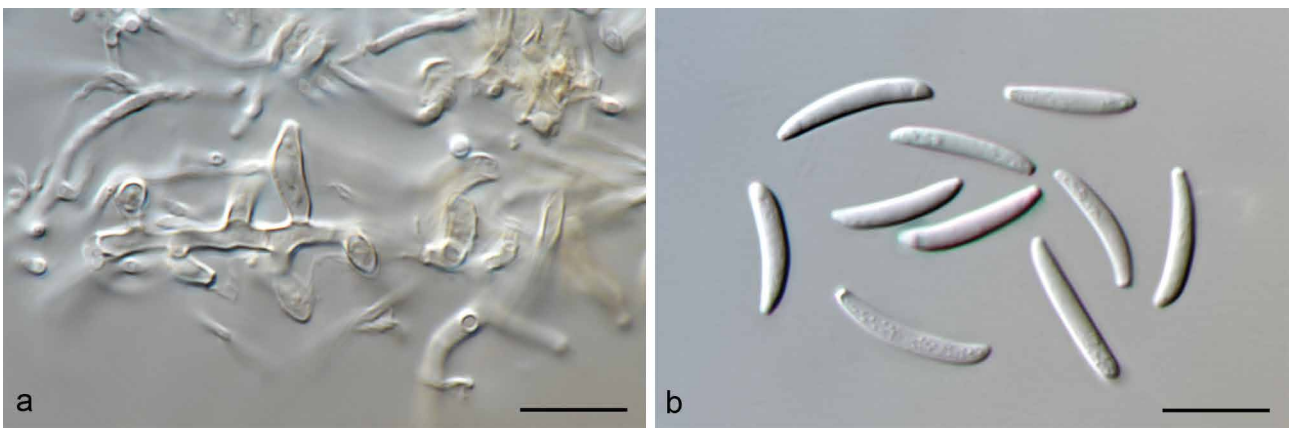

Fig. 5 *Circinotrichum circinatum* (CBS 140235). a. Conidiogenous cells; b. conidia. — Scale bars: a–b = 10 µm.

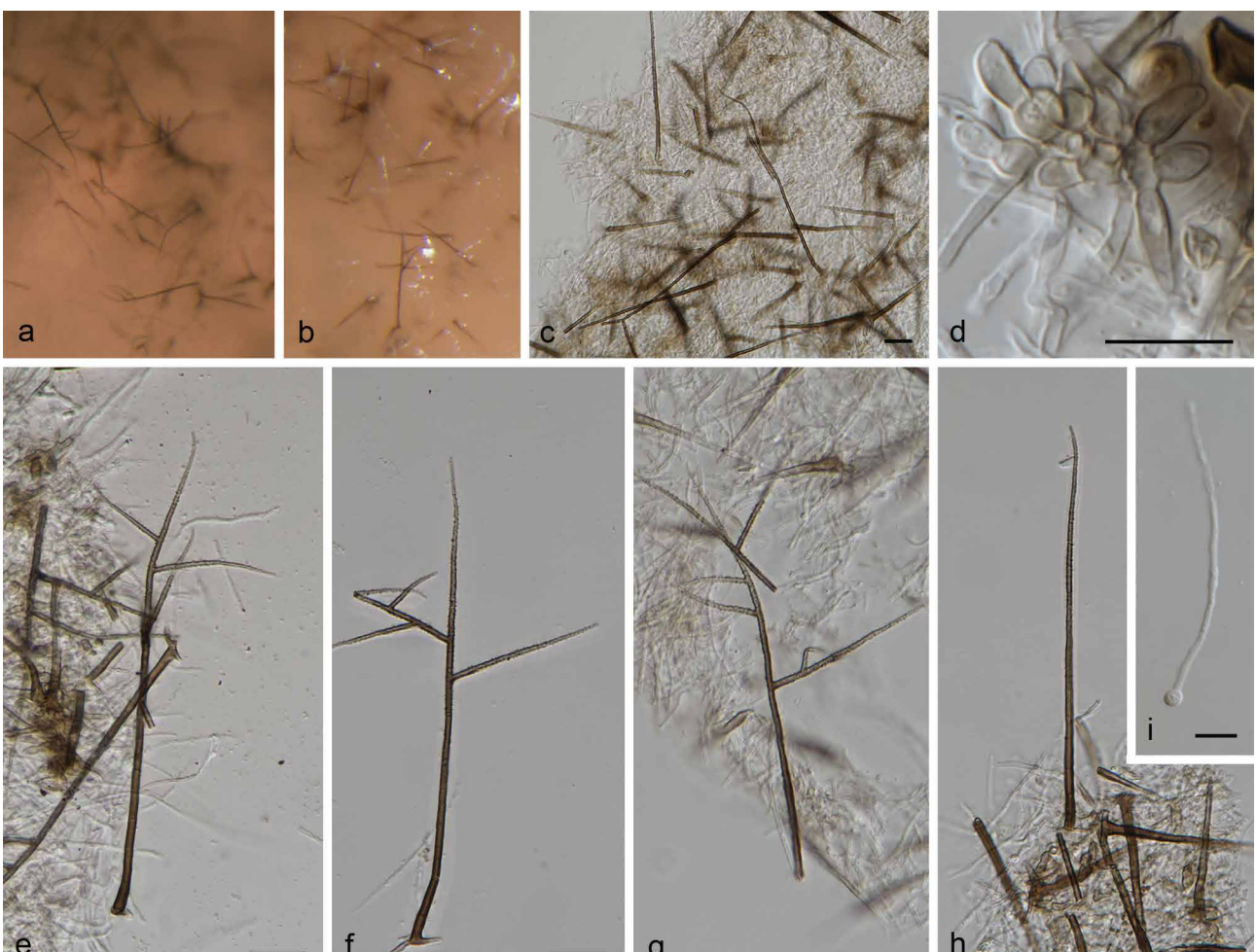

Fig. 6 *Circinotrichum circinatum* (CBS 148326). a–b. Setae on agar; c, e–h. setae; d. conidiogenous cells; i. germinating cell. — Scale bars: c, e–h = 20 µm; d, i = 10 µm.

Additional materials examined. Australia, New South Wales, Yarramulong, Nunkeri Native Flowers, S33°16.3' E151°23.1', 285 ft., on dead leaf, isolated from damp chamber, 23 Aug. 1999, *K.A. Seifert*, DAOMC 226942 = KAS 1093 = CBS 148326; ibid., on *Hakea* seeds on ground, 23 Aug. 1999, *K.A. Seifert*, KAS 1164 = CBS 148327. – Brazil, rotten leaf, Sept. 1997, *R.F. Castañeda-Ruiz*, MUCL 41072 = CBS 140235. – France, Reunion, on *Erica* sp., *P.W. Crous HPC 283*, CPC 26309. – Malawi, Zomba, University of Malawi campus, dead twig, Apr. 1991, coll. *G. Hennebert*, isol. *C. Decock*, MUCL 33100 = CBS 140217; ibid., MUCL 33101 = CBS 140218; ibid., MUCL 33102 = CBS 140219; ibid., MUCL 33103 = CBS 140220. – USA, Puerto Rico, on dead leaves, 19 July 2018, *M. Hernández-Restrepo*, MHR 18024 = CBS 148325. – Zimbabwe, Manicaland, Chipinge, Chirinda forest botanical Reserve, dead twig, Jan. 1996, *C. Decock & V. Robert*, MUCL 50435 = CBS 140229; ibid., MUCL 50442 = CBS 140230.

Notes — This species was firstly introduced as *Campsotrichum circinatum* (Berkeley 1875) on leaves of *Magnolia grandiflora* from the USA and later transferred to *Gyrothrix* (Hughes 1958). However, in our study it is related to *Circinotrichum* (Fig. 1). Based on sequence data, four lineages can be distinguished among isolates previously identified as '*Gyrothrix circinata*'. One monophyletic lineage is the clade with six strains from twigs from Malawi and Zimbabwe, two independent lineages each represented by one strain from leaves collected in Puerto Rico (USA) and Brazil, respectively, and the fourth lineage represented by a clade with strains from Australia and La Reunion (France). Unfortunately, the ex-type strain of this species is not available and most of the strains from this clade did not sporulate well in culture. Fresh material collected in Puerto Rico (CBS 148325; Fig. 3) sporulated well in culture and morphologically corresponds with Pirozynski's description (setae 80–140 × 4 µm, conidiogenous cells up to 8 × 3–4 µm, and conidia 12–15 × 1.5–1.8 µm; Pirozynski 1962). On the other hand, CBS 140235 (Fig. 5) only produced conidiogenous cells and conidia, which were slightly wider (9–15 × 2–2.5 µm). CBS 148326 (Fig. 6) produced setae, which were irregularly branched (not circinate), but no conidia under the conditions studied. Additionally, CBS 112314 from Brazil identified as '*Gyrothrix circinata*' had poorly developed setae, conidiogenous cells and conidia in culture, and was related to *Pirozynskiomyces sinensis* (Fig. 1, 9).

Circinotrichum maculiforme Nees, Syst. Pilze (Würzburg): 19. 1816 (1817) — Fig. 7, 8

Synonym. *Psilonia maculiformis* (Nees) Fr., Syst. Mycol. 3(2): 452. 1832. Additional synonyms listed in Pirozynski (1962).

Fig. 7 *Circinotrichum maculiforme* (a–c. CBS 122758; d–f. CBS 140016). a–c. Setae; d–e. setae and conidiogenous cells; f. conidia. — Scale bars: 10 µm.

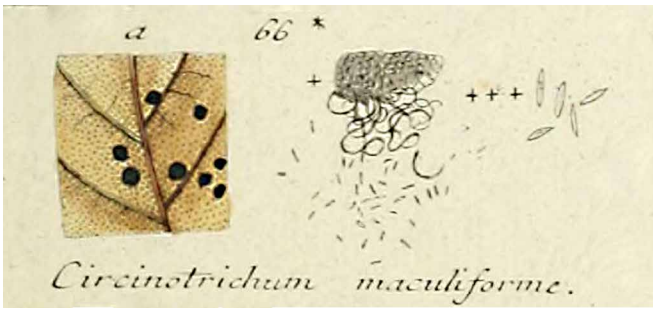

Fig. 8 *Circinotrichum maculiforme*. Original drawing of *Circinotrichum maculiforme* (reproduced from Nees 1817).

Typus. Lectotype designated here, f. 66* in taf. V, tafle der Byben, Das system der pilze und schwämme. Ein versuch (plates), Würzburg, Nees, 1816. MBT 10007055. Epitype designated here, Czech Republic, near Brno, Pouzdrany steppe, on twig of *Loranthus europaeus* (*Loranthaceae*), growing on twigs of *Quercus* sp. (*Fagaceae*), 26 Mar. 2014, coll. *R. Gebauer*, isol. *P.W. Crous* (epitype CBS H-22253, MBT 10007056, culture ex-epitype CPC 24566 = CBS 140016).

Description — See Crous et al. (2015).

Culture characteristics — Colonies reaching 30–50 mm diam after 1 mo at 25 °C, with sparse aerial mycelium and feathery margins. On MEA surface dirty white, reverse sienna. On OA surface honey. On PDA surface and reverse buff.

Additional materials examined. Cuba, on rotten leaf, July 1996, coll. *R.F. Castañeda-Ruiz*, MUCL 39929 = CBS 140225. – France, Cote-d'Or, on *Cornus sanguinea*, 1 Feb. 2016, coll. *unknown*, CPC 29975. – Spain, Zamora, plant debris, Nov. 2007, coll. *J. Capilla*, *R.F. Castañeda-Ruiz & C. Silvera*, FMR 9645 = CBS 122758.

Notes — The type material of *C. maculiforme* is not available, and therefore the illustration included in the protologue (Nees 1817) is selected as lectotype. In addition, to fix the interpretation of this name, CBS 140016 is here designated as ex-epitype culture. Morphological features of the epitype (Crous et al. 2015) fit well with the description of *C. maculiforme* (Saccardo 1878, Pirozynski 1962). Despite all attempts to induce sporulation, only strain CBS 122758 produced setae and conidiogenous cells, whereas the other strains included in this study remain sterile in culture.

Circinotrichum maculiforme, the type species of the genus clusters in a well-supported clade in the phylogenetic tree, represented by four strains from different localities, i.e., Cuba, Czech Republic, France and Spain.

Pirozynskiomyces Hern.-Restr. & Crous, *gen. nov*. — MycoBank MB 844011

Etymology. Named for Kris A. Pirozynski, recognizing his contribution to our knowledge of *Circinotrichum* and *Gyrothrix.*

Type species. *Pirozynskiomyces brasiliensis* Hern.-Restr. & Crous

Colonies on the natural substrate effuse, hairy, blackish brown to black. *Mycelium* partial immersed and partially superficial, composed of hyaline to pale brown, smooth to verrucose, branched, septate hyphae. *Setae* simple or branched, erect, straight or flexuous, thick-walled, verrucose, septate, dark brown. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* polyblastic, ampulliform to lageniform, hyaline to pale brown, thin-walled, smooth, solitary or gregarious at the base of setae. *Conidia* aggregated in white dry masses, curved or falcate, hyaline, smooth, obtuse at the base and abruptly attenuate with a cellular appendage at the apex. *Sexual morph* not observed.

Accepted species. *P. brasiliensis*, *P. sinensis*.

Notes — *Pirozynskiomyces* is proposed to include species with simple or branched setae that produce falcate conidia with one appendage at the apex. Phylogenetically it is related to the *Coniocessiaceae* as *Circinotrichum*, but clusters in a different clade.

Pirozynskiomyces brasiliensis Hern.-Restr. & Crous, *sp. nov.* — MycoBank MB 844012; Fig. 9

Etymology. Named after Brazil, the country where the holotype was collected.

Typus. Brazil, Pista Claudio Coutiño near Pao de Açucar, on rotten leaf, unknown date, coll. *A. Stchigel & J. Guarro*, INIFAT CO2/88 (holotype designated here CBS H-19584, ex-type culture CBS 112314).

Mycelium partial immersed and partially superficial, composed of hyaline to pale brown, smooth to verrucose, branched, septate hyphae. *Setae* simple or branched, erect, flexuous, thick-walled, verrucose, septate, dark brown to orange-brown, 105 × 4 µm. *Conidiogenous cells* ampulliform to lageniform, pale brown, thin-walled, smooth, solitary or gregarious at the base of setae, 8.5–10.5 × 2–4 µm. *Conidia* falcate, hyaline, smooth, 17–22 × 1.5–2 µm, obtuse at the base and abruptly attenuate with a cellular appendage at the apex, 0.5–1.8 µm. *Sexual morph* not observed.

Culture characteristics — Colonies reaching 20–40 mm diam after 2 wk at 25 °C, with sparse aerial mycelium and feathery margins. On MEA surface dirty white, reverse sienna. On OA surface honey. On PDA surface and reverse buff.

Notes — *Pirozynskiomyces brasiliensis* was deposited in the CBS collection as '*G. circinata*'. Morphologically, *P. brasiliensis* can be distinguished from *C. circinatum* by having falcate conidia with one appendage at the apex. It is distinguished from the other species in the genus, *P. sinensis*, by having branched and shorter setae (up to 260 µm) and slightly longer conidia (12–18.5 × 1.5–2.5 µm; Li et al. 2017). On the natural substrate, *P. brasiliensis* has simple and branched setae, but only a few simple setae were observed in culture.

Pirozynskiomyces sinensis (D.W. Li et al.) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844014

Basionym. *Circinotrichum sinense* D.W. Li et al., Botany 95: 1103. 2017.

Typus. China, Hubei, Zhushan county, Guangdu, Bailihe village, Yingzuiyan, Duheyuan National Nature Reserve (N31°52'17.81" E110°08'56.27"), dead foliage of *Camellia cuspidata*, 22 Sept. 2016, coll. *J.-Y. Chen & Y.-X. Wang* (holotype NHES L1703; culture ex-type UAMH 11913).

Description — See Li et al. (2017).

Notes — This species was formerly described as *Circinotrichum* because of the presence of simple setae (Li et al. 2017), however conidia are falcate with one appendage at the apex different from *Circinotrichum* that have conidia cylindrical to fusoid with the apex bluntly corniform. Furthermore, phylogenetically it clustered in a different clade.

XYLARIALES

Gyrothricaceae Hern.-Restr. & Crous, *fam. nov.* — MycoBank MB 844015

Type genus. *Gyrothrix* (Corda) Corda 1842.

Asexual morph: *Colonies* effused, thin, velvety, mouse grey to black. *Mycelium* partly superficial, partly immersed in the substratum, composed by septate, subhyaline to olivaceous hyphae. *Setae* erect, straight or flexuous, simple or branched, pale brown to brown, septate, smooth to verrucose. *Conidio-*

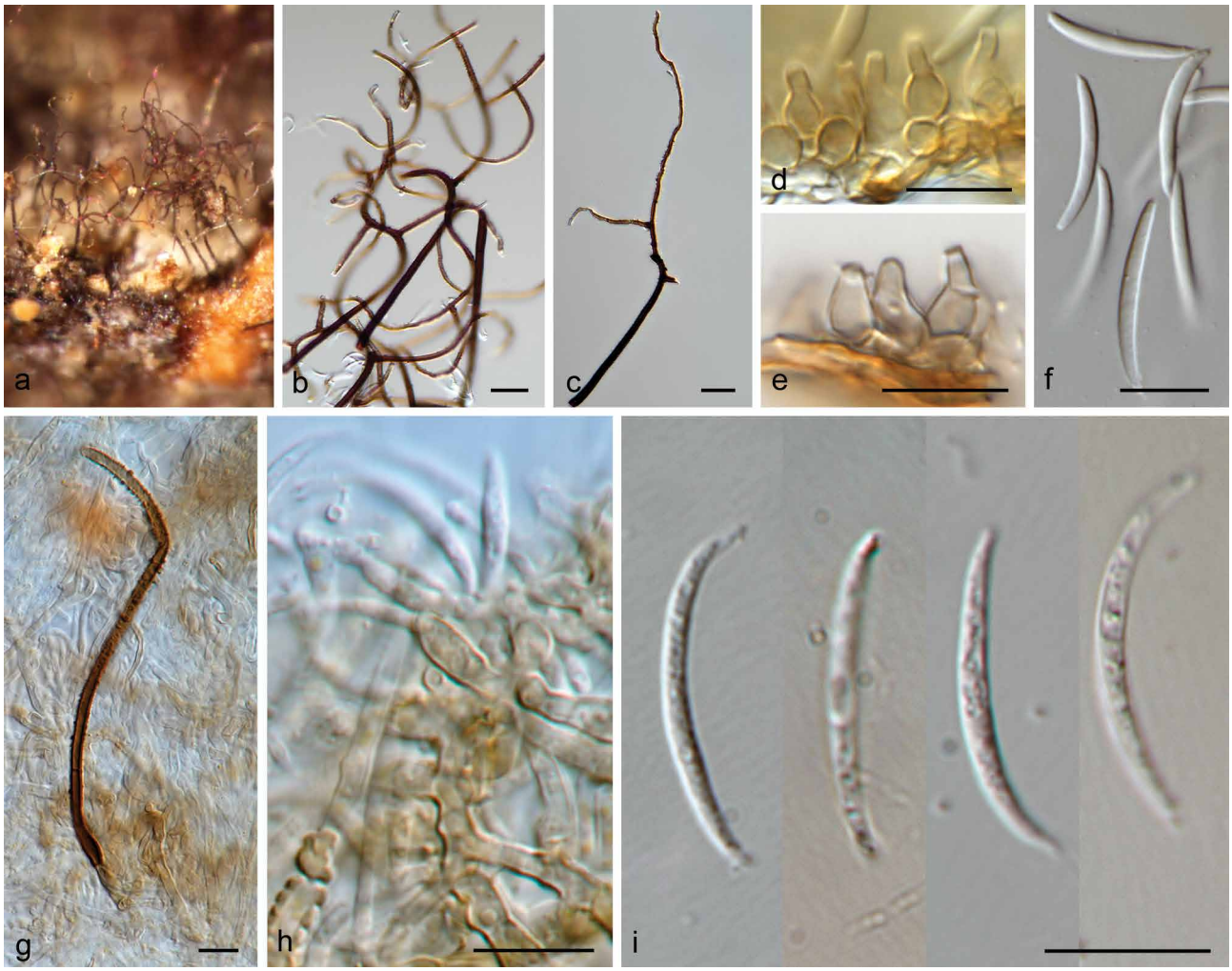

Fig. 9 *Pirozynskiomyces brasiliensis* sp. nov. (a–f. natural substrate, CBS H-19584; g–i. CBS 112314 on OA). a. Colony on the leaf; b–c. branched setae; d–e, h. conidiogenous cells; f, i. conidia; g. simple setae. — Scale bars: b–i = 10 µm.

genous cells born laterally on the superficial hyphae, polyblastic, obclavate to lageniform, hyaline to subhyaline, thin-walled. *Conidia* adherent, dry, aggregated into a thick whitish layer at the base of the setae, cylindrical to fusiform, straight or somewhat curved, with ends bluntly corniform, the free end more obtuse than the attached end, hyaline. *Sexual morph*: *Ascomata* immersed, black, coriaceous, clustered, rarely solitary, globose in cross section, with wide ostiolar neck; *ostiole* papillate with a central periphysate canal; *peridium* with two to multiple cell layers, pale brown cells of *textura irregularis*; *paraphyses* slightly longer than the asci, numerous, filamentous, septate. *Asci* 8-spores, unitunicate, cylindrical, with discoid, apical ring, J+ in Melzer's reagent. *Ascospores* uni- to biseriate, ellipsoidal, unicellular, pale brown to dark brown, smooth-walled, sometimes with mucilaginous sheath, sigmoid to straight germ slit.

Gyrothrix (Corda) Corda, Anleit. Stud. Mykol., Prag: LXIII, 49. 1842

Type species. *Gyrothrix podosperma* (Corda) Rabenh.

Emended description. *Asexual morph*: *Colonies* on the natural substrate effused, thin, velvety, mouse grey to black. *Mycelium* partly superficial, partly immersed in the substratum, composed of a network of branched and anastomosing, septate, subhyaline to olivaceous hyphae. *Setae* erect, straight or flexuous, subdichotomously, verticillate to irregularly branched, pale brown to brown, septate, smooth to verrucose. *Conidiogenous cells* born laterally on the superficial hyphae, polyblastic, obclavate to lageniform, hyaline to subhyaline, thin-walled. *Conidia* adherent, aggregated into a thick whitish layer at the base of the setae, cylindrical to fusiform, straight or somewhat curved, with ends bluntly corniform, the free end more obtuse than the attached end, hyaline. *Sexual morph*: *Ascomata* immersed, black, coriaceous, clustered, rarely solitary, in cross section globose, with wide ostiolar neck; *ostiole* papillate with a central periphysate canal; *peridium* with two cell layers, outwardly comprising thick-walled, compressed, pale brown cells of *textura irregularis* and inwardly comprising thick-walled, several layers of hyaline cells of *textura angularis*; *paraphyses* slightly longer than the asci, numerous, filamentous, septate. *Asci* 8-spores, unitunicate, cylindrical, long pedicellate, with discoid, apical ring, J+ in Melzer's reagent. *Ascospores* uniseriate, ellipsoidal, with pointed ends, pale brown, smooth-walled, sigmoid germ slit.

Accepted species. *G. eucalypti*, *G. encephalarti*, *G. podosperma*, *G. verticillata*.

Gyrothrix eucalypti Crous, Persoonia 43: 261. 2019

Typus. South Africa, Limpopo Province, on leaf of *Eucalyptus* sp., 22 June 2018, *P.W. Crous*, HPC 2472 (holotype CBS H-24163, culture ex-type CPC 36066 = CBS 146023).

Description — See Crous et al. (2019c).

Additional material examined. South Africa, Limpopo Province, on *Eucalyptus dunnii*, 22 July 2018, coll. *P.W. Crous*, CPC 35992.

Notes — Recently described by Crous et al. (2019c). It is only known from South Africa occurring on *Eucalyptus*.

Gyrothrix encephalarti Crous, Persoonia 44: 343. 2020

Typus. South Africa, Northern Province, Tzaneen, on leaves of *Encephalartos* sp. (*Zamiaceae*), 2015, *P.W. Crous*, HPC 2486 (holotype CBS H-24364, culture ex-type CPC 35966 = CBS 146684).

Description — See Crous et al. (2020a).

Additional materials examined. South Africa, Kirstenbosch National Botanical Garden, on *Thamnochortus spicigerus*, 3 Dec. 2001, coll. *S. Lee*, CBS 114515 (as *Gyrothrix grisea*); Kirstenbosch National Botanical Garden, on *Elegia equisetacea*, 3 Dec. 2001, coll. *S. Lee*, CBS 114517 (as *Gyrothrix citricola*).

Notes — G*yrothrix encephalarti* is phylogenetically related to CBS 114515 and CBS 114517, identified in the database as *G. citricola* and *G. grisea*, respectively. Unfortunately, both strains remained sterile and their identity could not be confirmed. *Gyrothrix citricola* was described from Sudan on dead twigs of *Citrus sinensis*, while *G. grisea* was described from India on leaves. Morphologically, both species are very similar (Pirozynski 1962), branching imperfectly dichotomously, with overlapping size of conidiogenous cells and conidia (in *G. grisea* conidiogenous cells 6–10 × 3.5 µm, conidia 10–18 × 1–1.5 µm vs *G. citricola* conidiogenous cells 6 × 3 µm, conidia 8–14 × 1.5–2 µm); only the setae are longer in *G. grisea* (150–200 µm vs 100–160 µm). However, *G. encephalarti* has shorter setae (80–130 µm) and wider conidia ((7–)10–12(–14) × 3(–3.5) µm), but conidiogenous cells of similar size (6–10 × 3–4 µm). Until more strains are available for *G. grisea* and *G. citricola*, we include these strains under *G. encephalarti*.

Gyrothrix podosperma (Corda) Rabenh., Deutschl. Krypt.-Fl. 1: 72. 1844 — Fig. 10, 11

Basionym. *Campsotrichum podospermum* Corda, Pracht-Fl. Eur. Schimmelbild.: 25. 1839.

Synonym. *Neoanthostomella viticola* Daranag. et al., Cryptog. Mycol. 37: 524. 2016.

Typus. Lectotype designated here f. 2, taf. XII, as *Campsotrichum (Gyrothrix) podosperma*, Pracht-flora Europaeischer Schimmelbildungen, Leipzig; Dresden: Fleischer (Corda 1839), MBT 10007061.

Fig. 10 *Gyrothrix podosperma* (a–f natural substrate CBS H-24934; g–i CBS 148804 on OA). a. Colonies on natural substrate; b–c, g. setae; d–e, h. conidiogenous cells; f, i. conidia. — Scale bars: 10 µm.

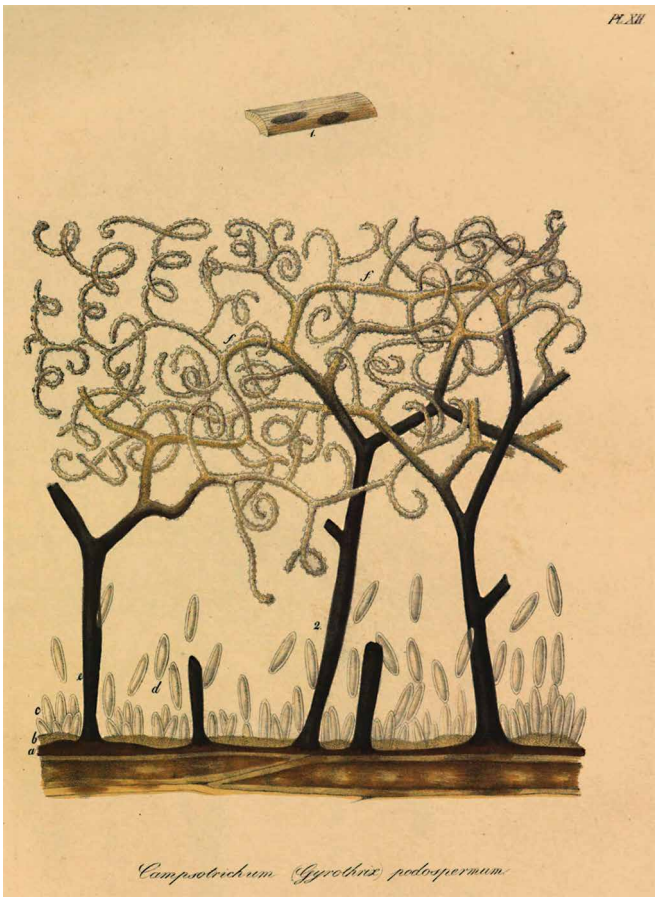

Fig. 11 *Gyrothrix podosperma.* Original drawing of *Campsotrichum* (*Gyrothrix) podosperma* (reproduced from Corda 1839).

Mycelium consisting of hyaline, smooth, septate, branched, 1–2 µm diam hyphae. *Setae* 70–175 × 2.5–5.5 µm, 2–4 times subdichotomously to irregularly branched, brown, numerous, intertwined, erect, septate, thick-walled, initially smooth-walled becoming verrucose; branches paler in colour, smooth, circinate. *Conidiogenous cells* borne laterally on the superficial hyphae, ampulliform to lageniform, subhyaline to pale brown, smooth, 6–13.5 × 2.5–5 µm. *Conidia* adherent, aggregated into a whitish layer at the bases of the setae, cylindrical to fusoid, straight or slightly curved, with the free end bluntly corniform and attached end subulate, hyaline, 11–20 × 2–3 µm. *Sexual morph* see Daranagama et al. (2016).

Culture characteristics — Colonies on OA cottony, zonate, white, buff, vinaceous buff to brown vinaceous with some exudates, margin effuse, reverse rosy buff with dark brick zones. On MEA cottony, white to buff, margin effuse, reverse luteous to rosy buff.

Additional materials examined. Netherlands, Flevoland, Horsterwold, on leaf of *Juncus inflexus*, Apr. 2021, coll. *E.R. Osiek*, isol. *Hernández-Restrepo M.* HPC 3631, CBS H-24934, CBS 148804 = CPC 42063. – South Africa, Western Cape, on *Podocarpus falcatus*, date unknown, *P.W. Crous*, CBS 148705 = CPC 29981.

Notes — In our study, two strains identified as *G. podosperma* from The Netherlands and South Africa were placed in the same clade with *N. viticola* from Italy and are considered here conspecific. The morphology of the isolates from CBS 148804 and CBS 148705 included in our study fit well with the description of *G. podosperma* (Corda 1839, Pirozynski 1962), but The Netherlands and South Africa are localities distant from the type locality (Czech Republic).

Morphologically, *G. podosperma* is similar to *G. macroseta*, which has setae up to 400 × 5–8 µm thick at the base, and branching subdichotomously, nearly monopodial (Pirozynski 1962), while *G. podosperma* has setae up to 260 × 3.5–5 µm.

This is the first time that a sexual morph is linked to *Gyrothrix* and is based on phylogenetic relationships. *Neoanthostomella viticola* was described as a sexual morph with a phialidic asexual morph (Daranagama et al. 2016), but this kind of asexual morph was not observed in our study.

Gyrothrix verticillata Piroz., Mycol. Pap. 84: 23. 1962 — Fig. 12

Typus. UK, Middlesex, Osterley Park, on *Urtica dioica*, 28 Sept. 1948, *P.D. Hewett* (holotype IMI 31406).

Colonies effused, thin, velvety, mouse grey, irregular, up to 5 mm diam, scattered or coalescing. *Mycelium* partly superficial, partly immersed in the substratum, composed of a network of branched and anastomosing, smooth-walled, septate, subhyaline to olivaceous hyphae. Superficial mycelium bears conidiogenous cells and setae, becomes thickened and darker in colour at the point of origin of the setae. *Setae* erect, straight, olivaceous to pale brown, translucent, septate, smooth-wall, simple at first, becoming sparingly branched, 150–300 × 3–4 µm, tapering to a width of less than 0.5 µm at the extremities. Branches in 1–2 whorls of 3 or 4 arising more or less at right angles to the vertical axis, long and slender, straight, more or less horizontal. *Conidiogenous cells* born laterally on the superficial hyphae, polyblastic, crowded obclavate, to lageniform, hyaline or subhyaline, thin-walled, 8–14 × 3.5–4.5 µm, apex 1 µm. *Conidia* adherent, aggregated into a thick whitish layer at the base of the setae, cylindrical to fusiform, straight or somewhat curved, with ends bluntly corniform, the free end more obtuse than the attached end, hyaline, 10–15 × 1.5–2 µm. Adapted from Pirozynski (1962). *Sexual morph* not observed.

Culture characteristics — Colonies on OA velvety with scarce aerial mycelium, fawn to vinaceous buff, reverse rust. Diffusible pigment sienna to scarlet. On MEA funiculate to velvety, elevated with radial folds and cracks, reverse rust to chestnut. Diffusible pigment orange.

Additional materials examined. Mexico, Mexico City, unknown substrate, 22 July 2015, *P.W. Crous*, CPC 28776 = CBS 148704. – The Netherlands, Limburg Province, Wahlwiller, Kruisberg, on *Astragalus* sp., 20 Sept. 2020, coll. *A. van Iperen*, isol. *P.W. Crous* CPC 39953 = CBS 148805; ibid., CPC 39951 = CBS 148806.

Notes — *Gyrothrix verticillata* was described from England and Sierra Leona with setae that become verticillately branched in 1–2 whorls of 3–4 branches arising more or less horizontally. In our study setae have up to 4 whorls with 2–3 branched that can be circinate at the apex of both vertical setae and horizontal branches, and conidia were slightly longer (12–18 × 1.5–2.5 µm).

Gyrothrix sp.

Materials examined. Australia, New South Wales Sydney, Royal Botanic Garden, S33°51'5-.34" E151°13'28.43", on *Brachychiton discolor* leaves on ground,1 Feb. 2003, *K.A. Seifert*, KAS 1687. – Cuba, Camagüey Prov. Hoyo de Bonet, on rotten leaf, Feb. 1999, *R.F. Castañeda-Ruiz*, CBS 140237 = MUCL 41882 = INIFAT C99-37.

Notes — Isolates CBS 140237 and KAS 1687 clustered together in a separate clade with some phylogenetic differences. Unfortunately, both strains remained sterile under the studied conditions.

Neogyrothrix Hern.-Restr. & Crous, *gen. nov.* — MycoBank MB 844016

Etymology. Name refers to the morphological similarity with *Gyrothrix*.

Type species. Neogyrothrix oleae (Crous) Hern.-Restr. & Crous

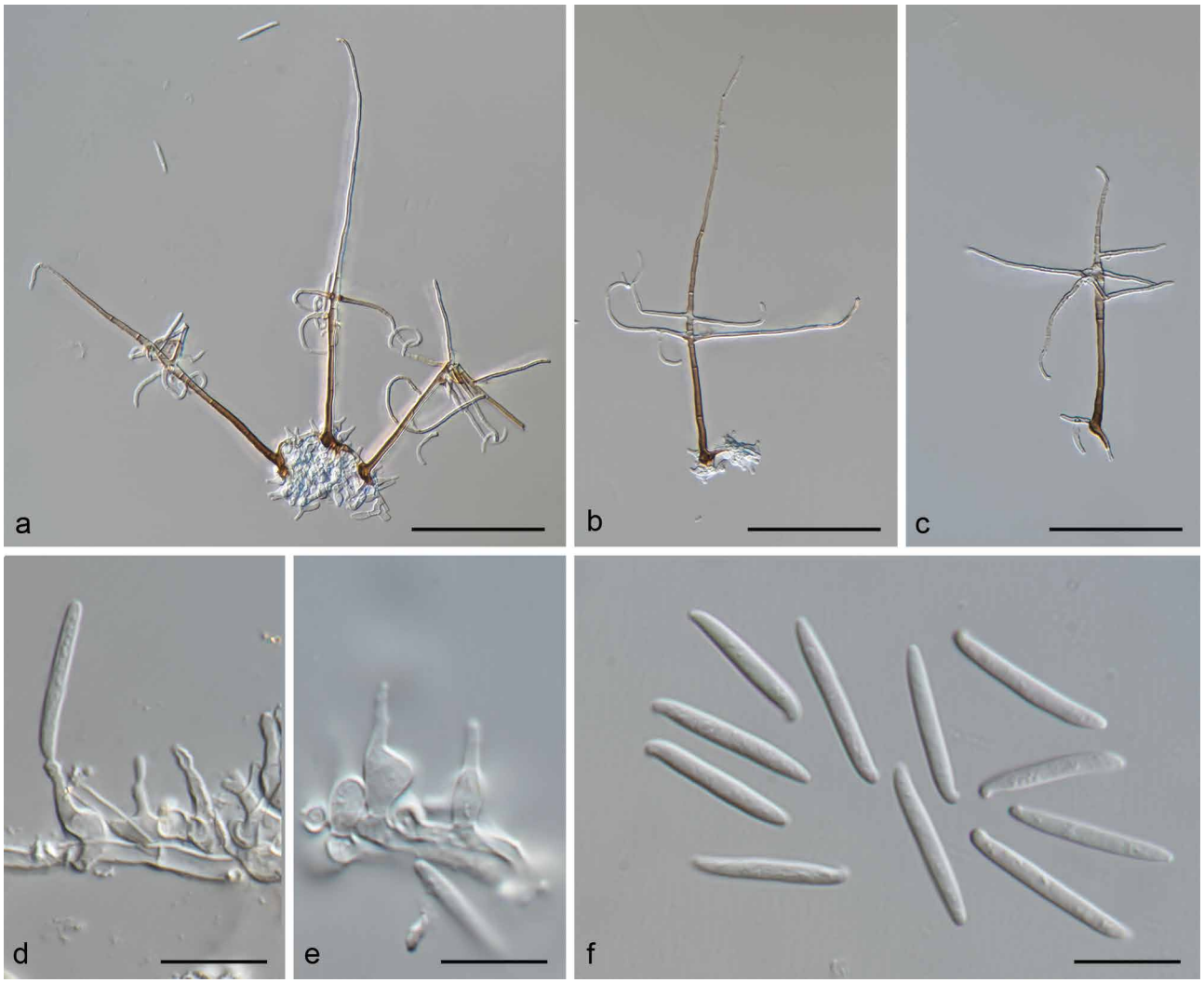

Fig. 12 *Gyrothrix verticillata* (CBS 148806, CBS 148805). a–c. Setae; d–e. conidiogenous cells; f. conidia. — Scale bars: a–c = 50 µm; d–f = 10 µm.

Mycelium consisting of hyaline, smooth, branched, septate, hyphae. *Setae* erect, brown, multiseptate, thick-walled, verruculose to warty, subcylindrical with apical taper, base bulbous, apex spirally curved, apical region frequently with curved lateral branches. *Conidiogenous cells* arranged around the base of setae, polyblastic, subcylindrical to ampulliform, hyaline to subhyaline, smooth, percurrently extended. *Conidia* hyaline, smooth, aseptate, fusoid, inequilateral, inner plane flat, outer plane convex, apex subobtuse, tapering toward inner plane, base with eccentric, truncate hilum, tapering towards inner plane.

Notes — This is a monotypic new genus morphologically very similar to *Gyrothrix* but phylogenetically distinct.

Neogyrothrix oleae (Crous) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844017

Basionym. *Gyrothrix oleae* Crous et al., Persoonia 43: 305. 2019.

Typus. South Africa, Western Cape Province, Knysna, Knysna area, on leaves of *Olea capensis* subsp. *macrocarpa* (*Oleaceae*), 22 Nov. 2018, *F. Roets* (holotype CBS H-24184, culture ex-type CPC 37069 = CBS 146069, as *Gyrothrix olea*).

Description — See Crous et al. (2019c).

Additional materials examined. South Africa, Western Cape Province, Knysna, Knysna area, on leaves of *Olea capensis* subsp. *macrocarpa* (*Oleaceae*), 22 Nov. 2018, *F. Roets*, HPC 2728 (CPC 37069 = CBS 146069); ibid., on *Diospyros whyteana* (*Ebenaceae*), 22 Nov. 2018, *F. Roets*, HPC 2720 (CPC 37063 = CBS 146068).

Notes — This species was firstly described in *Gyrothrix* (Crous et al. 2019c) because of its branched setae. However, our phylogenetic analysis placed this species in a basal clade, distinct from *Gyrothrix*, *Neoanthostomella*, *Xenoanthostomella*, *Pseudocircinotrichum* and *Pseudoceratocladium* (Fig. 1).

Pseudoceratocladium Hern.-Restr. & Crous, *gen. nov.* — MycoBank MB 844018

Etymology. Name refers to the fact that it is morphologically similar to *Ceratocladium*.

Type species. *Pseudoceratocladium polysetosum* (J. Mena et al.) Hern.-Restr. & Crous

Colonies on the natural substrate effuse, velvety, greyish brown to olive brown. *Mycelium* partly superficial, partly immersed in the substratum, composed by septate, olivaceous to pale olivaceous brown, smooth hyphae. Fertile hyphae of superficial mycelium climbing primary setae and producing secondary setae and conidiogenous cells. *Primary setae* arising from the superficial hyphae, simple, erect, straight to slightly flexuous, septate, brown, paler toward the ends, smooth, verrucose at the tip. *Secondary setae* originating from the climbing fertile hyphae and projected more or less at right-angles along primary setae, simple, septate, brown, paler toward the ends, smooth, verrucose at the tip. *Conidiogenous cells* discrete, lateral from fertile hyphae, polyblastic, sympodial and percurrent, ampulliform or lageniform, subhyaline to pale brown, smooth. *Conidia* solitary, dry, forming clusters around the apex of the conidiogenous cells,

0-septate, cylindrical or fusiform with rounded ends, mostly straight or slightly curved, usually with a prominent basal scar, hyaline, smooth. Adapted from Mena-Portales et al. (2011). *Sexual morph* not observed.

Notes — This monotypic genus is erected for *Ce. polysetosum*, a species previously included in *Ceratocladium* because of the presence of fertile and ascending hyphae on the simple setae, but different from other species of the genus by the presence of primary and secondary setae (Mena-Portales et al. 2011). Nevertheless, the phylogenetic tree shows that *Ce. polysetosum* is placed in a different clade related to *Gyrothrix*, *Xenoanthostomella* and *Pci. papakurae.* Unfortunately, the placement of *Ceratocladium* is still unknown, and during this study, it was impossible to propose an epitype for *Ce. microspermum,* the generic type. The strain CBS 488.77, deposited as *Ceratocladium microspermum*, is distantly related in the *Circinotrichum* clade. Unfortunately, strain CBS 488.77 did not sporulate in culture, making it difficult to confirm its identity.

Pseudoceratocladium polysetosum (J. Mena et al.) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844019; Fig. 13

Basionym. *Ceratocladium polysetosum* J. Mena et al., Mycol. Progr. 10(4): 494. 2011.

Typus. Spain, Aragon, Escuaín, Ordesa y Monte Perdido National Park, on bark of an unidentified tree, June 2009, coll. *M. Hernández-Restrepo*, *J. Mena & J. Cano* (holotype IMI 398790, culture ex-type CBS 129023 = FMR 10750).

Description — See Mena-Portales et al. (2011).

Additional material examined. Spain, Aragon, Escuaín, Ordesa y Monte Perdido National Park, on plant debris, June 2009, coll. *M. Hernández-Restrepo*, *J. Mena & J. Cano*, FMR 10749 = CBS 126092 (as *Ceratocladium microspermum*).

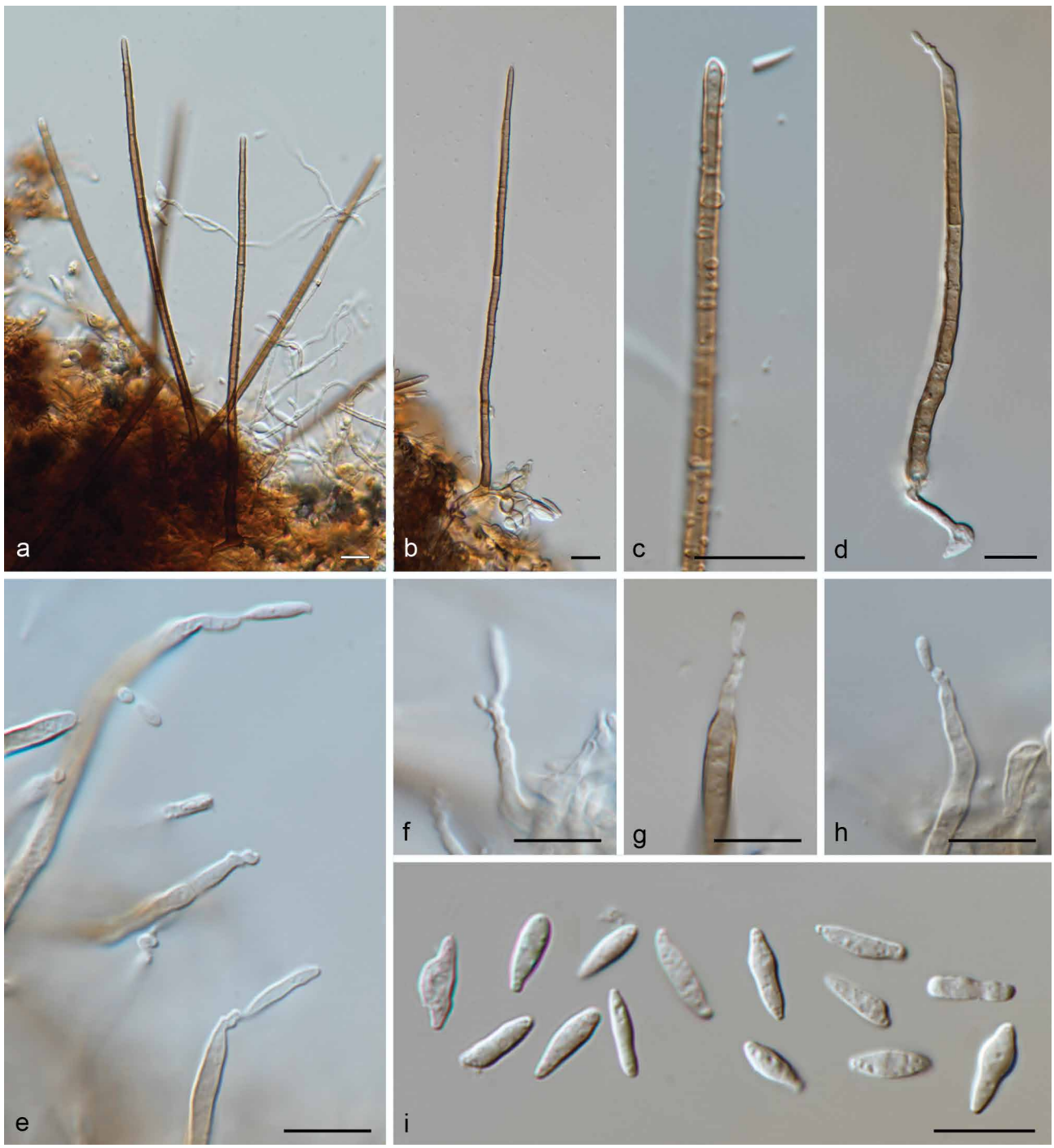

Fig. 13 *Pseudoceratocladium polysetosum* (CBS 129023). a–c. Setae; d. setiform conidiophore; e–h. conidiogenous cells with conidia; i. conidia. — Scale bars: 10 µm.

Notes — Mena-Portales et al. (2011) described this species from the natural substrate with primary and secondary setae in which conidiogenous cells were present. However, in the present study after culturing the ex-type strain CBS 129023 on different media, only a few simple setae were observed, some of which were fertile at the apex, but the conidial shape was irregular.

Pseudocircinotrichum Hern.-Restr. & Crous, *gen. nov.* — MycoBank MB 844020

Etymology. Name refers to the fact that it is morphologically similar but phylogenetically distant from *Circinotrichum*.

Type species. *Pseudocircinotrichum papakurae* (S. Hughes & Piroz.) Hern.-Restr. & Crous

Colonies on the natural substrate amphigenous, but predominantly hypophyllous, widely effused, brown when sterile, greyish brown and often blueish tinge when profusely sporulating. *Mycelium* partly superficial, partly immersed in the substrate, smooth-wall, septate, subhyaline to pale olivaceous, hyphae bearing setae and conidiogenous cells. *Setae* arising from swollen, thick-walled, and dark brown cells of the superficial mycelium, simple, erect, straight, smooth, thick-wall, and dark brown near the base, paler above. *Conidiogenous cells* polyblastic, relatively few, scattered, arising laterally from the superficial hyphae, obclavate to lageniform, thin-walled, subhyaline. *Conidia* dry, adhering together, to form a whitish pellicle at the base of setae, cylindrical to fusoid, straight or slightly curved, with the base subulate and apex bluntly corniform, hyaline. Adapted from Hughes & Pirozynski (1971).

Notes — This new genus is characterised by simple, smooth-walled setae gradually tapering to an acutely pointed apex.

Pseudocircinotrichum papakurae (S. Hughes & Piroz.) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844021

Basionym. *Circinotrichum papakurae* S. Hughes & Piroz., New Zealand J. Bot. 9: 40. 1971.

Typus. New Zealand, on decaying leaves of *Beilschmiedia taraire*, PDD 28495 (holotype).

Colonies on natural substrate amphigenous, but predominantly hypophyllous, widely effused, velvety, brown when sterile, greyish brown and often blueish tinge when profusely sporulating. *Mycelium* partly superficial, partly immersed in the substrate. Superficial mycelium composed of a network of branched and anastomosed, smooth-wall, septate, subhyaline to pale olivaceous hyphae bearing setae and conidiogenous cells. *Setae* arising from swollen, thick-walled, and dark brown cells of the superficial mycelium, simple, erect, straight, smooth, thick-wall, and dark brown near the base, paler above, up to 150 µm long, 2.5–4 µm wide, gradually tapering to an acutely pointed apex less than 1 µm wide. *Conidiogenous cells* relatively few, scattered, arising laterally from the superficial hyphae, obclavate to lageniform, thin-wall, subhyaline, 5–10 × 3.5–5 µm, narrowed above. *Conidia* adhering together to form a whitish pellicle at the base of setae, cylindrical to fusoid, straight or slightly curved, base subulate and apex bluntly corniform, hyaline, 11–17 × 1.5–2 µm. Adapted from Hughes & Pirozynski (1971). *Sexual morph* not observed.

Culture characteristics — Colonies reaching up to 10 mm diam after 2 wk at 22 °C, spreading, erumpent, with sparse aerial mycelium and feathery margins. On PDA surface and reverse olivaceous-grey. On OA surface iron-grey. On MEA dirty white, with sienna margin, reverse umber.

Additional materials examined. Brazil, Paraiba, Joao Pessoa, on rotten leaf, Sept. 1997, *R.F. Castañeda-Ruiz*, INIFAT C98/17-8 = CBS 101373. – Cuba, on leaf of *Theobromae cacao*, Mar. 1994, *R.F. Castañeda-Ruiz*, MUCL 39023 = CBS 140221.

Notes — *Pseudocircinotrichum papakurae* was initially described on decaying leaves of *Beilschmiedia tarairi* in New Zealand as *Circinotrichum papakurae* (Hughes & Pirozynski 1971). Unfortunately, no ex-type strain is available and none of the strains studied here are suitable for epitypification, since they originate from different geographical regions. In the phylogenetic tree this species is represented by two sterile strains from Brazil and Cuba with some genetic differences, and it formed a basal clade related to *Xenoantosthomella* with low support.

Xenoanthostomella Mapook & K.D. Hyde, Fungal Diversity 100: 235. 2020

Type species. *Xenoanthostomella chromolaenae* Mapook & K.D. Hyde

Asexual morph: *Colonies* on the natural substrate punctiform or effused, dark brown when sterile, greyish brown when copious dried spores are present, scattered. *Mycelium* predominantly superficial, but occasionally penetrating into a substomatal cavity. Superficial mycelium composed of a network of branched anastomosing, smooth-walled, septate, subhyaline to olivaceous hyphae. *Setae* originating from enlarged, dark brown cells of the superficial mycelium, simple, erect, dark brown near the base becoming paler towards the apex, which is circinate or spirally coiled, thick-walled, verrucose. *Conidiogenous cells* arising laterally on the superficial mycelium, polyblastic, obclavate to lageniform, subhyaline. *Conidia* adhering together in large masses and persisting at the bases of setae in the form of a whitish pellicle, cylindrical to fusoid, straight or slightly curved, with the base somewhat corniform or truncate, apex more obtuse than the base, hyaline. *Sexual morph*: *Stromata* superficial, solitary or rarely aggregated, in cross-section subglobose to mammiform, with conspicuous ascomatal mounds, base somewhat applanate, carbonaceous, dark brown to black. *Ascomata* in cross-section globose to subglobose; *ostioles* centric, surrounding area slightly flattened, shiny black, conspicuous, ostiolar canal periphysate; *paraphyses* cylindrical, septate, smooth-walled. *Asci* 8-spored, unitunicate, cylindrical, short pedicellate, with a discoid, apical ring, J+ in Melzer's reagent, apex rounded. *Ascospores* uniseriate, hyaline when immature becoming brown to dark olivaceous brown when mature, guttulate, oblong to narrowly ellipsoid, symmetrical to slightly inequilateral, slightly curved, aseptate, with a spiral germ slit along the entire spore length. Adapted from Hyde et al. (2020).

Accepted species. *X. chromolaenae*, *X. cycadis*, *X. olivaceae*.

Notes — *Xenoanthostomella* is a monotypic genus, known from Thailand and isolated from dead stems of *Chromolaena odorata* and *Nephrolepis* sp. In this study two additional species previously identified as *Circinotrichum* are transferred to this genus.

Xenoanthostomella chromolaenae Mapook & K.D. Hyde, Fungal Diversity 100: 235. 2020 — Fig. 14

Typus. Thailand, on dead stem of *Chromolaena odorata*, MFLU 20-0048 (holotype).

Description — See Hyde et al. (2020).

Additional materials examined. Malaysia, on petioles of *Albizia falcataria*, unknown date, coll. *M.J. Wingfield*, isol. *P.W. Crous*, HPC 487, CBS 148702 = CPC 27556; seed pods of *Falcataria moluccana*, 5 Jan. 2015, coll. *M.J. Wingfield*, isol. *P.W. Crous*, HPC 489, CBS 148703 = CPC 27560.

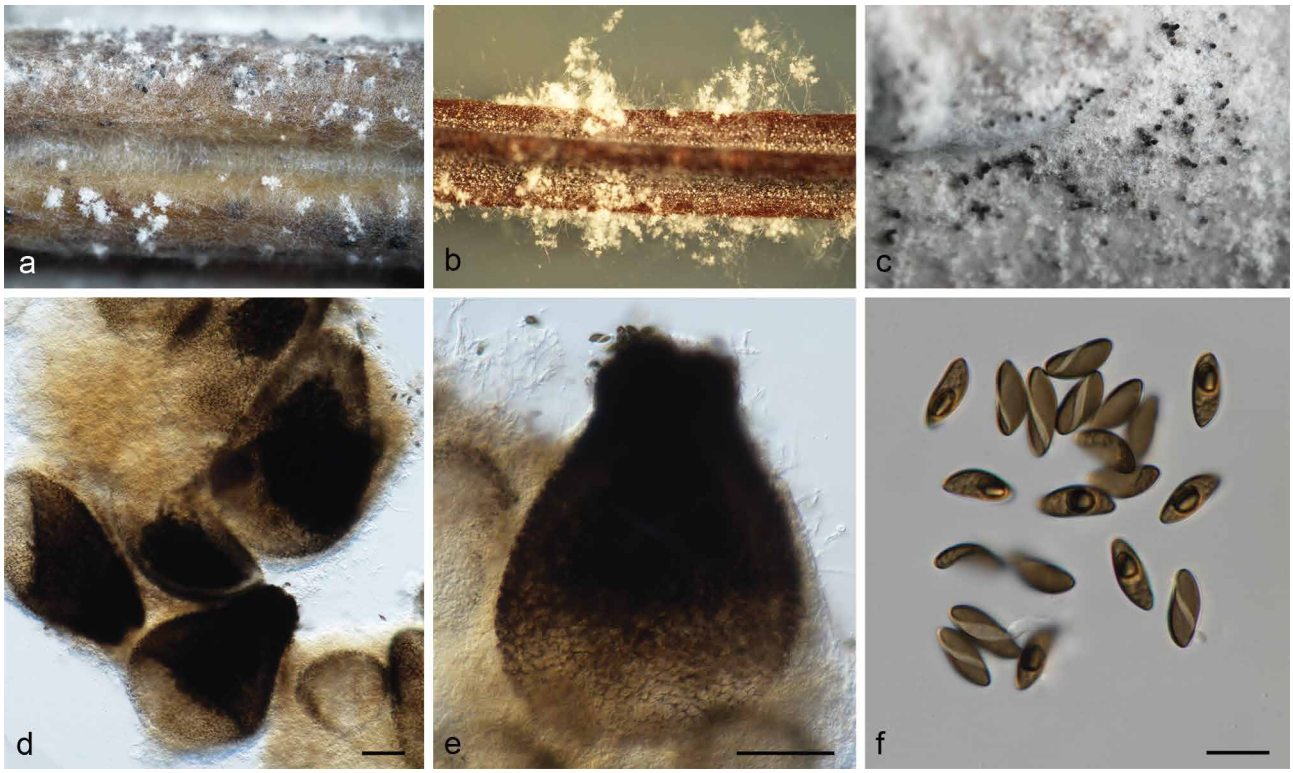

Fig. 14 *Xenoanthostomella chromolaenae* (CBS 148702). a. Colonies on CMA + *Urtica dioica*; b. colonies on SNA + Pine needles; c. colonies on OA; d–e. ascomata; f. ascospores. — Scale bars: d–e = 50 µm; f = 10 µm.

Notes — In our study, two strains originating from Malaysia, isolated from petioles of *Albizia falcataria* and seed pods of *Falcataria moluccana*, were related to *X. chromolaenae*. Both strains were isolated from the natural substrate as *Circinotrichum* sp. However, in culture it only produced the sexual morph, similar to that previously described (ascomata 175–262 × 130–175.5 µm, ascospores 10–16 × 4–5 µm).

Xenoanthostomella cycadis (Crous & R.G. Shivas) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844022

Basionym. *Circinotrichum cycadis* Crous & R.G. Shivas, Persoonia 32: 201. 2014.

Typus. Australia, Queensland, Brisbane Forest Park, on leaves of *Cycas* sp., 15 July 2009, coll. *P.W Crous & R.G Shivas* (holotype CBS H-21680, ex-type culture CBS 137969 = CPC 17285).

Description — See Crous et al. (2014).

Additional material examined. South Africa, on leaf spots of *Kniphofia roeperi*, 12 Jan. 2014, coll. *M.J. Wingfield*, CPC 25749.

Notes — These strains were previously identified as *Circinotrichum* because of the presence of simple setae (Crous et al. 2014). However, based on the phylogenetic analysis this species is better accommodated in *Xenoanthostomella* (Fig. 1). Both isolates included in the analysis were isolated from leaves of different plants (*Cycas* sp. and *Kniphofia roeperi*) from Australia and South Africa. *Xenoanthostomella cycadis* formed a subclade with *C. olivaceum*, which is also morphologically similar and is thus transferred to *Xenoanthostomella*. However, *X. cycadis* has shorter setae and slightly tinner conidia (25–40 µm long, 8–13 × 2–2.5 µm in *X. cycadis* vs 35–75 µm long, 8.5–13 × 1.3–1.6 µm in *X. olivaceum*).

Xenoanthostomella olivacea (Speg.) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844023

Basionym. *Helicotrichum olivaceum* Speg., Bol. Acad. Nac. Ci. Córdoba 11(4): 613. 1889.

Synonym. *Circinotrichum olivaceum* (Speg.) Piroz., Mycol. Pap. 84: 6. 1962.

Typus. Brazil, São Paulo, Apiahy, on rotten leaves of *Drimys* sp., Aug. 1889, *J. Puiggari* 1540, holotype LPS 29433, isotype IMI 87169.

Colonies punctiform or effused, dark brown when sterile, greyish brown when copious dried spores are present, scattered, on leaves, hypophyllous, or on twigs, small, not exceeding 2 mm diam. *Mycelium* predominantly superficial, but occasionally penetrating into a substomatal cavity. Superficial mycelium composed of a network of branched anastomosing, smooth-wall, septate, subhyaline to olivaceous hyphae. *Setae* originating from enlarged, dark brown cells of the superficial mycelium, simple, erect dark brown, and opaque near the base becoming paler towards the apex which is circinate or spirally coiled, thick-walled, 35–75 × 2.5–3.5 µm. *Conidiogenous cells* not crowded, arising laterally on the superficial mycelium, obclavate to lageniform, subhyaline, 5–8 × 2–4 µm. *Conidia* adhering together in large masses and persisting at the bases of setae in the form of a whitish pellicle, cylindrical to fusoid, straight or slightly curved, with end somewhat corniform, the free end more obtuse than the attached one, hyaline, 8.5–13 × 1.3–1.6 µm. Adapted from Pirozynski (1962). *Sexual morph* not observed.

Culture characteristics — Colonies reaching up to 5 mm diam after 2 wk at 25 °C, spreading, erumpent, with sparse aerial mycelium and feathery margins. On PDA surface and reverse olivaceous-grey. On OA surface iron-grey. On MEA dirty white, with sienna margin, reverse umber.

Additional material examined. Brazil, Mata Atlantica, Joao Pessoa, on leaf litter, Sept. 1997, *R.F. Castañeda-Ruiz*, INIFAT C98/17-6 = CBS 101185.

Notes — *Xenoanthostomella olivacea* was first described as *Helicotrichum olivaceum* (Spegazzini 1889), and later transferred to *Circinotrichum* (Pirozynski 1962). This species

has a widespread distribution and has been recorded on fallen leaves of *Cocos nucifera*, *Drymis* sp., *Persea americana*, *Pinus longifolia*, *Rhopalostylis sapida* and dead stems of *Bignonia magnifica* in Australia, Brazil, Ghana, Malaysia, Pakistan and Sierra Leone (Pirozynski 1962, Hughes & Pirozynski 1971).

In our study, only one strain of *X. olivacea* was available, originating from Brazil, the country from where it was originally described. However, this strain remained sterile, and thus we prefer to not designate it as epitype. For morphological comparison see comments under *X. cycadis*.

XYLARIALES, MICRODOCHIACEAE

Peglionia Goid., Malpighia 33: 6. 1934

Type species. *Peglionia verticiclada* Goid.

Emended description. *Colonies* on the natural substrate scattered, velvety, black when sterile and whitish when sporulating profusely. *Mycelium* partly superficial, partly immersed in the substrate, subhyaline to dark brown hyphae, bearing a pseudoparenchymatous tissue. *Setae* scattered or crowded, erect, straight, smooth and thick-walled, dark brown to almost opaque, septate, bulbous base, septate, usually simple branches, dark brown at their base and tapering to rounded, subhyaline to pale brown apex, the apex of the branches is often fractured

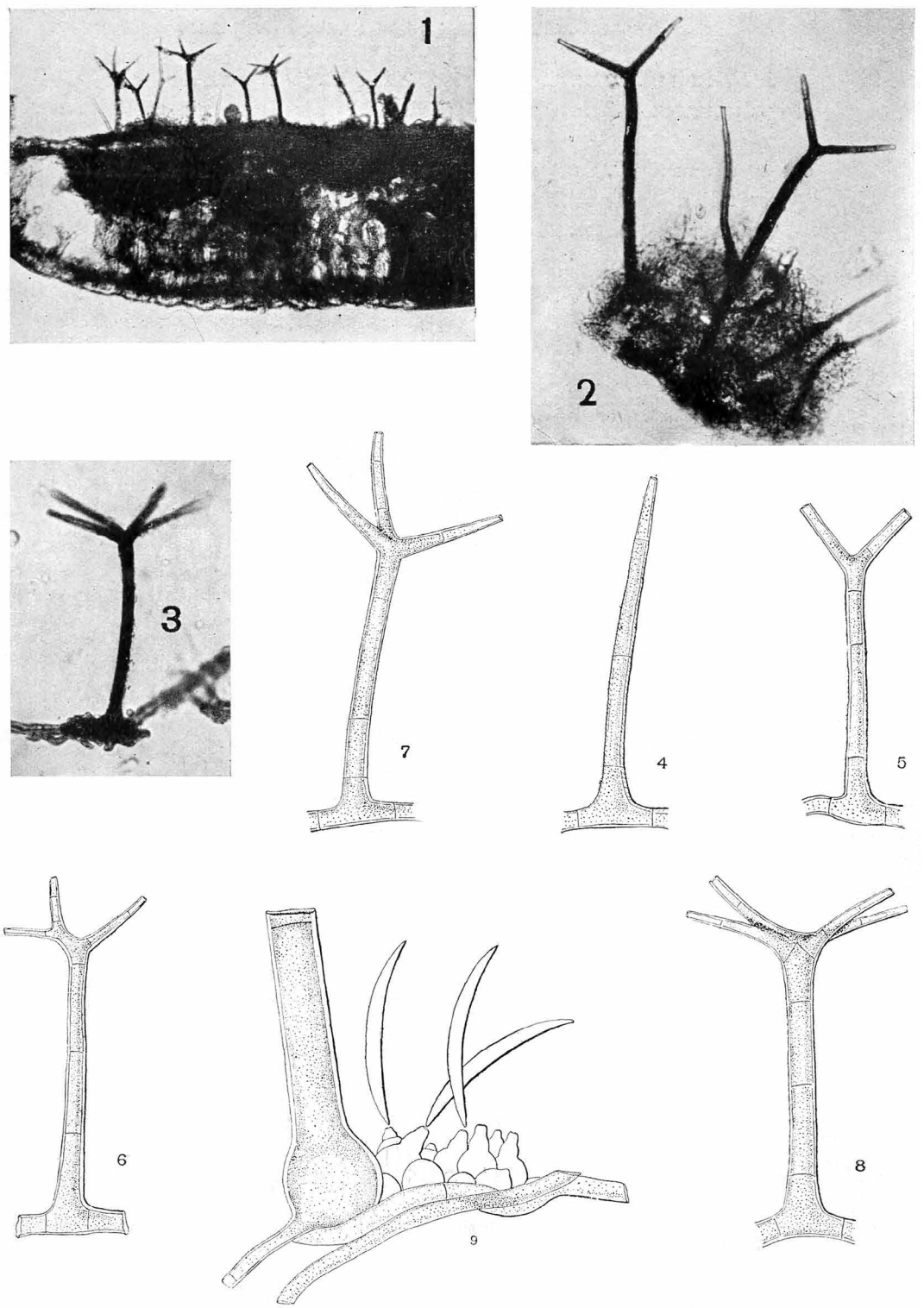

Fig. 15 *Peglonia verticiclada*. Original illustration of *Peglonia verticiclada* (reproduced from Goidanich 1934).

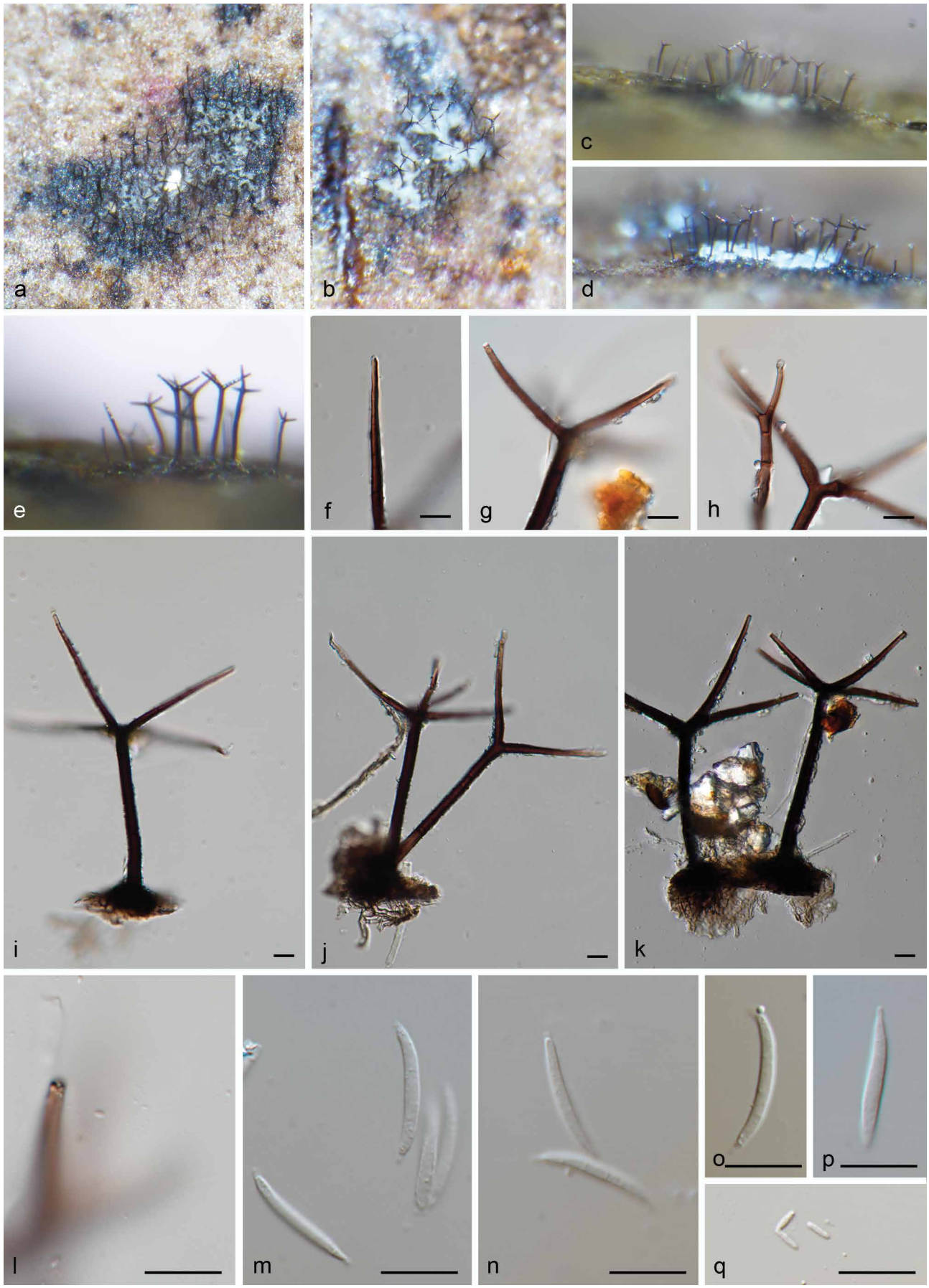

Fig. 16 *Peglonia verticiclada* (CBS H-20475). a–e. Colonies on natural substrate; f–h, l. setae apex; i–k. setae; m–p. conidia; q. microconidia. — Scale bars: f–q = 10 µm.

Fig. 17 *Peglonia verticiclada* (CBS 127654). a–d. Setae; e. chlamydospores; f. conidia; g–j. conidiogenous cells. — Scale bars: 10 µm.

and appears flattened. Occasionally when a seta bears only two apical branches, one or both can be once forked. *Conidiogenous cells* polyblastic, obclavate to lageniform, hyaline to subhyaline. *Conidia* adherent in a continuous white layer on the conidiogenous cells, dry falcate, non-septate, hyaline. *Chlamydospores* (in culture) in chains, subglobose to irregularly shaped, subhyaline to brown. *Sexual morph* not observed.

Notes — *Peglionia* is distinguished from *Circinotrichum* and *Gyrothrix* by the branching pattern of the setae, which is verticillate at the apex.

Peglionia verticiclada Goid., Malpighia 33: 7. 1934 — Fig. 15–17

Synonym. *Gyrothrix verticiclada* (Goid.) S. Hughes & Piroz., Canad. J. Bot. 9: 42. 1971.

Typus. Lectotype designated here, tav. I, (Goidanich 1934), MBT 10007063. Neotype designated here, Italy, Prov. Viterbo, Farnese, selva di Lamona, litter of *Smilax aspera*, 9 Mar. 2010, *W. Gams & M. Réblová*, CBS H-20475, CBS 127654 (as *Gyrothrix verticiclada*). MBT 10007064.

Colonies hypophyllous, scattered, up to 1 mm wide, occasionally larger by confluence, velvety, black when sterile and whitish within when sporulating profusely. *Mycelium* partly superficial,

partly immersed in the substrate. Superficial mycelium at first a network of smooth-walled subhyaline to dark brown hyphae 2–3.5 µm wide, finally bearing a pseudoparenchymatous tissue, 2–5 cells thick, the cells being hyaline to subhyaline and 3–3.5 µm wide. Brown stromatic cellular plugs within the stomal openings connect to superficial mycelium to a brown substomatal pseudoparenchymatous stroma up to 150 µm wide with the cells up to 16 µm diam. Epidermal cells of the host may become occupied by brown cells trough invasion from the internal stroma and rarely by penetration by the superficial hyphae, large dark brown cells of the superficial hyphae extend into setae and the exposed hyaline to subhyaline cells of the superficial tissue bear one or two conidiogenous cells in a palisade. *Setae* scattered or crowded, erect, straight smooth, thick-walled, dark brown to almost opaque, septate, 65–110 × 6.5–7.5 µm, bulbous base, tapering to 2 µm at the apex which bears 2–4 straight, septate, usually simple branches up to 72 µm long, 4.5–5.5 µm wide and dark brown at their base and tapering to 2–3 µm wide at the rounded, subhyaline to pale brown apex, the apex of the branches is often fractured and appears flattened. Occasionally when a seta bears only two apical branches, one or both can be once forked. *Conidiogenous cells* obclavate to lageniform, hyaline to subhyaline, distally with a somewhat irregular contour, 7.2–14.5 × 3–5 µm. *Conidia* adherent in a continuous white layer on the conidiogenous cells, falcate, non-septate, hyaline, 17–22 × 2 µm. *Chlamydospores* (in culture) in chains, subglobose to irregularly shaped, subhyaline to brown, 5.5–9.5 µm diam. *Sexual morph* not observed.

Culture characteristics — Colonies on OA, CMA and MEA after 8 d, 20–25 mm diam, scarce aerial mycelium, dark brown, white to the periphery, margin entire, reverse dark brown.

Additional materials examined. Australia, New South Wales Blue Mountain National Park Mt Tomah Botanical Garden S33°32.4' E150°25.4', 3591 ft., on dead leaves of *Eucalyptus* sp., 17 Aug. 1999, *K.A. Seifert* DAOMC 226646 = KAS 846 = CBS 148329 (as *Gyrothrix verticiclada*). – Venezuela, Aragua, Rancho grande, Parque Nacional Henry Pittie, on rotten leaf, Nov. 1997, *R.F. Castañeda-Ruiz*, MUCL 41150 = CBS 140226 (as *Gyrothrix verticiclada*); ibid., INIFAT C98/3-1 = CBS 101171 (as *Gyrothrix hughesii*).

Notes — In our study this species is represented by three strains identified previously as *G. verticiclada* and one as *G. hughesii*. All isolates clustered in a clade distant from *Gyrothrix* and related to *Selenodriella* in *Microdochiaceae*. Here, we resurrect the genus *Peglionia* proposed by Goidanich (1934), from Italy. The specimen CBS H-20475 (ex-type strain CBS 127654) collected in Italy fits well with the description of *P. verticiclada* (Hughes & Pirozynski 1971) and is designated here as epitype. Unfortunately, the other three strains, including the one identified as *G. hughesii*, did not sporulate in culture.

Becerra-Hernández et al. (2016) described *P. verticiclada* (as *Gyrothrix*) to have an idriella-like synasexual morph. In their

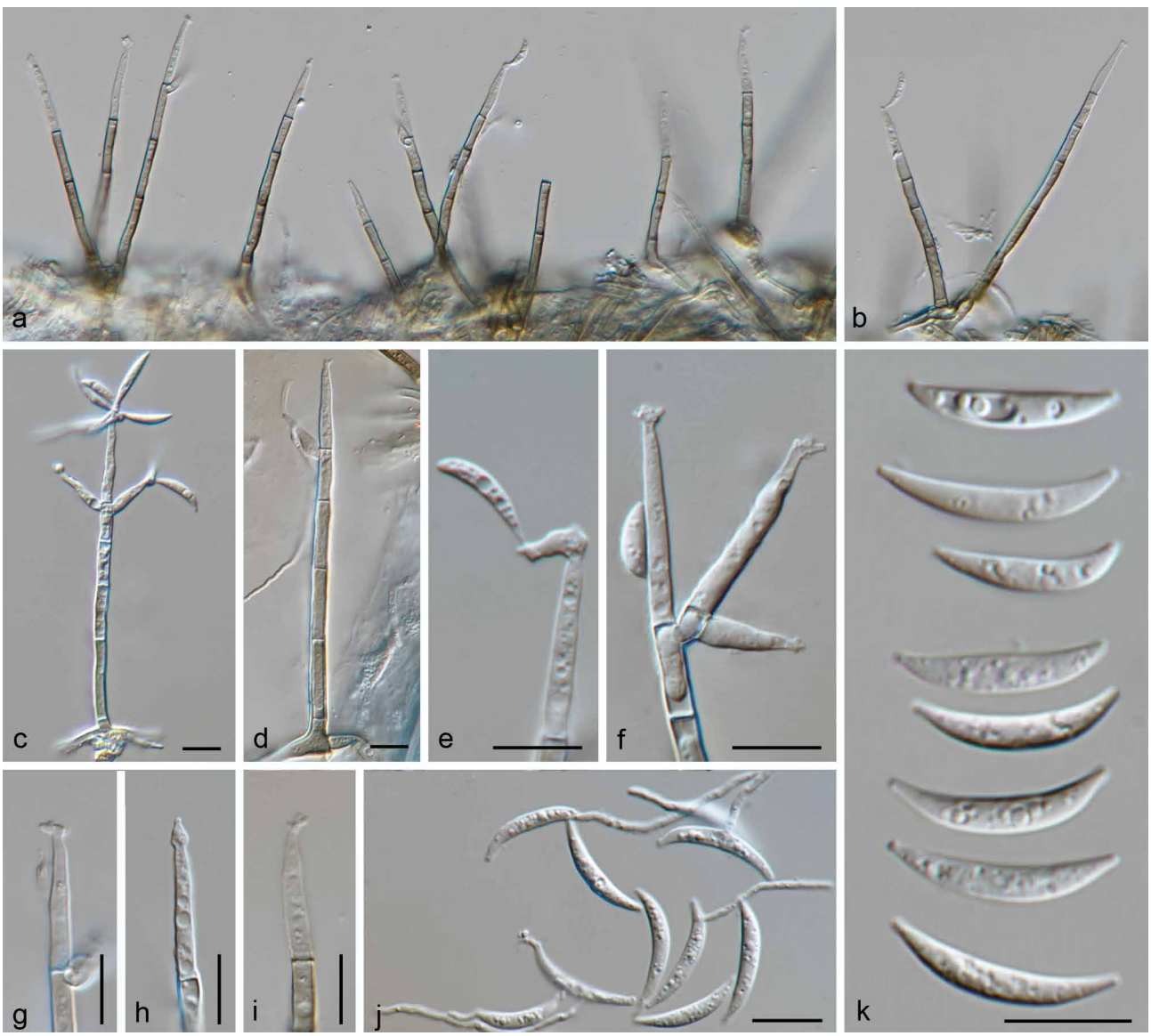

Fig. 18 *Selenodriella brasiliana* sp. nov. (CBS 140227). a–d. Conidiophores with conidia; e–i. conidiogenous cells, and conidia; j. germinating conidia; k. conidia. — Scale bars: c–k = 10 µm.

phylogenetic analyses more strains were included, showing that this species is genetically diverse, and more studies are needed to clarify their phylogeny.

Selenodriella R.F. Castañeda & W.B. Kendr., Univ. Waterloo Biol. Ser. 33: 34. 1990

Type species. *Selenodriella fertilis* (Piroz. & Hodges) R.F. Castañeda & W.B. Kendr.

Mycelium immersed and superficial, hyphae hyaline to pale brown, branched, septate, smooth. *Conidiophores* erect, setiform, branched at the apex, brown at the base, becoming hyaline at the apex. *Conidiogenous cells* cylindrical to lageniform, sympodial, polyblastic denticulate, terminal, in whorls at the apex or solitary on the mycelial hyphae, hyaline to subhyaline. *Conidia* lunate, asymmetrical, unicellular, hyaline, smooth-walled, guttulate. *Sexual morph* not observed.

Accepted species. *S. brasiliana*, *S. cubensis*, *S. fertilis*.

Selenodriella brasiliana Hern.-Restr. & Crous, *sp. nov.* — MycoBank MB 844024; Fig. 18, 19

Etymology. Named after Brazil, the country where the holotype was collected.

Typus. Brazil, Mata Atlantica, Joao Pessoa, on rotten leaf, Nov. 1997, *R.F. Castañeda-Ruiz* (holotype designated here CBS H-24935, culture ex-type MUCL 41176 = KAS 1752 = CBS 140227).

Mycelium immersed and superficial, hyphae hyaline to pale brown, branched, septate, smooth. *Conidiophores* erect, setiform, in groups, branched at the apex, brown at the base, becoming hyaline at the apex, 45–100 × 3–4 µm. *Conidiogenous cells* terminal, in whorls at the apex or solitary on the mycelial hyphae, subcylindrical to lageniform, polyblastic, sympodial, denticulate, denticles 0.5–1.5 × 0.5–0.8 µm, hyaline to subhyaline, 12–26 × 2.5–3.5 µm, 1–1.5 µm at the apex. *Conidia* unicellular, lunate, asymmetrical, 12.5–18.5 × 2.5–3.5 µm, hyaline, smooth-walled, guttulate. *Chlamydospores* not observed. *Sexual morph* not observed.

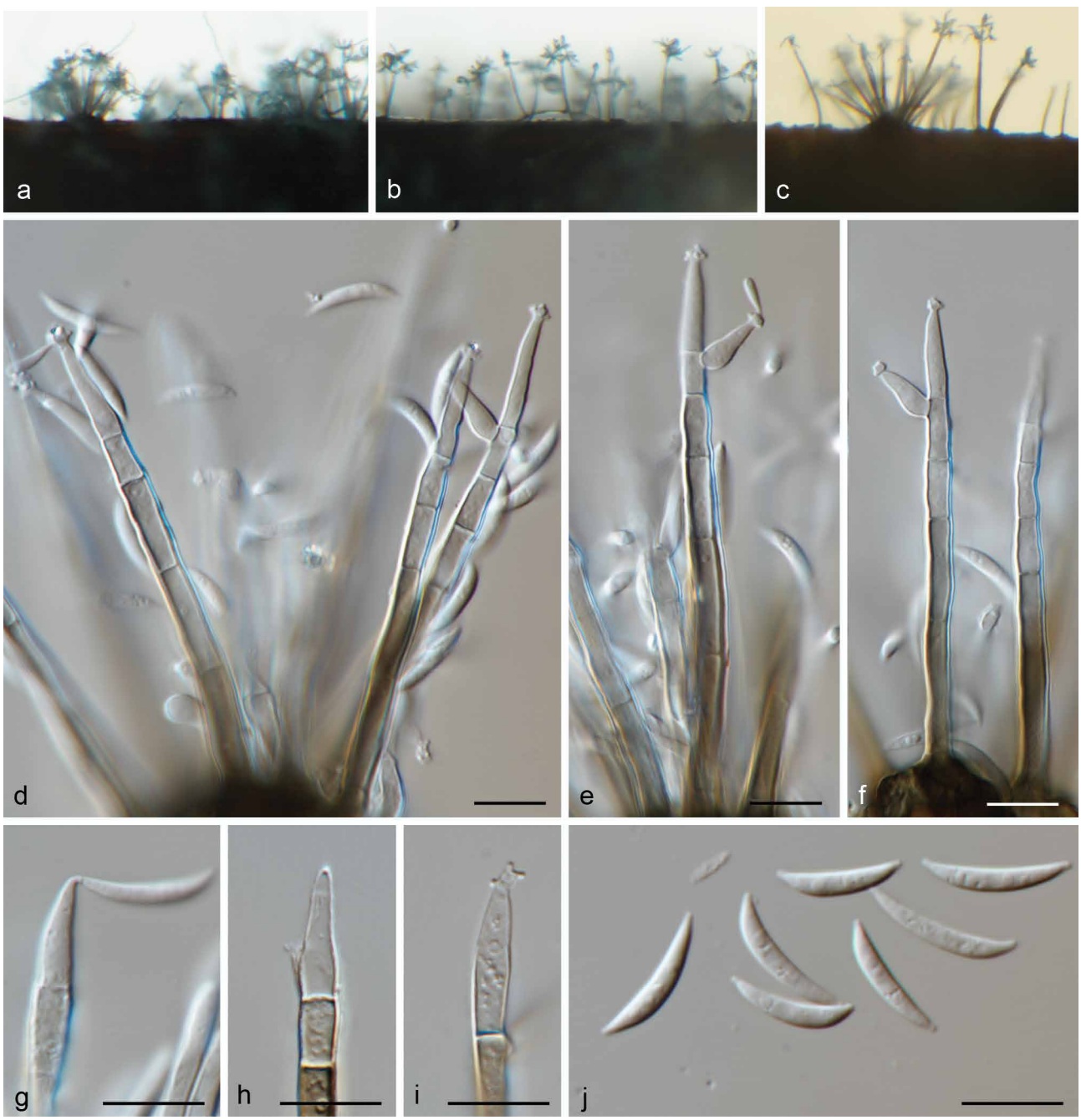

Fig. 19 *Selenodriella brasiliana* sp. nov. (CBS 140236). a–c. Conidiophores with conidia; d–f. conidiophores, conidiogenous cells, and conidia; g–i. conidiogenous cells; j. conidia. — Scale bars: d–j = 10 µm.

Culture characteristics — Colonies on OA 20–25 mm diam after 1 wk at 25 °C. Zonate, centre cottony, white to grey in the centre; sparse aerial mycelium, hazel to rosy buff towards the periphery; margin entire; reverse umber to rosy buff.

Additional material examined. Brazil, Mata Atlantica, Joao Pessoa, on rotten leaf, Nov. 1997, *R.F. Castañeda-Ruiz*, MUCL 41175 = CBS 140236 (as *Circinotrichum* sp.).

Notes — *Selenodriella brasiliana* is morphologically very similar to *S. cubensis* (Hernández-Restrepo et al. 2016), but phylogenetically distinct. Both strains included in this study are from Brazil and previously identified as *Circinotrichum* sp., suggesting that this species may produce simple setae on natural substrates. However, no setae were observed in culture.

Selenodriella cubensis Hern.-Restr. & Crous, Persoonia 36: 75. 2015 '2016'

Typus. Cuba, unknown substrate, June 1996, *R.F. Castañeda-Ruiz* (holotype INIFAT C96/30, isotype CBS H-22143, living culture ex-type CBS 683.96).

Description — See Hernández-Restrepo et al. (2016).

Selenodriella fertilis (Piroz. & Hodges) R.F. Castañeda & W.B. Kendr. 1990 — Fig. 20

Basionym. *Circinotrichum fertile* Piroz. & Hodges, Canad. J. Bot. 51: 160. 1973.

Synonym. *Idriella fertilis* (Piroz. & Hodges) Matsush., Icon. Microfung. Matsush. Lect. (Kobe): 86. 1975.

Typus. USA, South Carolina, on fallen leaves of *Persea borbonia*, 24 Oct. 1971, *C.S. Hodges* (holotype DAOM 137850, isotype IMI 165969).

Description — See Pirozynski & Hodges (1973).

Additional materials examined. Australia, New South Wales Yarramulong, Nunkeri Native Flowers S33°16.3' E151°23.1', 285 ft., on dead leaves of *Callistemon vininalis*, 23 Aug. 1999, *K.A. Seifert*, DAOMC 227007 = KAS1114 = CBS 148328 (as *Circinotrichum rigidum*); Victoria, Nowa Nowa, on leaf litter of *Eucalyptus* sp., 30 Nov. 2016, *P.W. Crous*, CBS 144589; Western Australia, Perth, Kings Park, on dead leaf of *Hakea baxteri*, 1 Aug. 1983, *W. Gams & K. Dixon*, CBS 772.83. – South Africa, on *Eucalyptus* sp., 2009 Oct. 1, *P.W. Crous*, CPC 16273 (as *Circinotrichum* sp.).

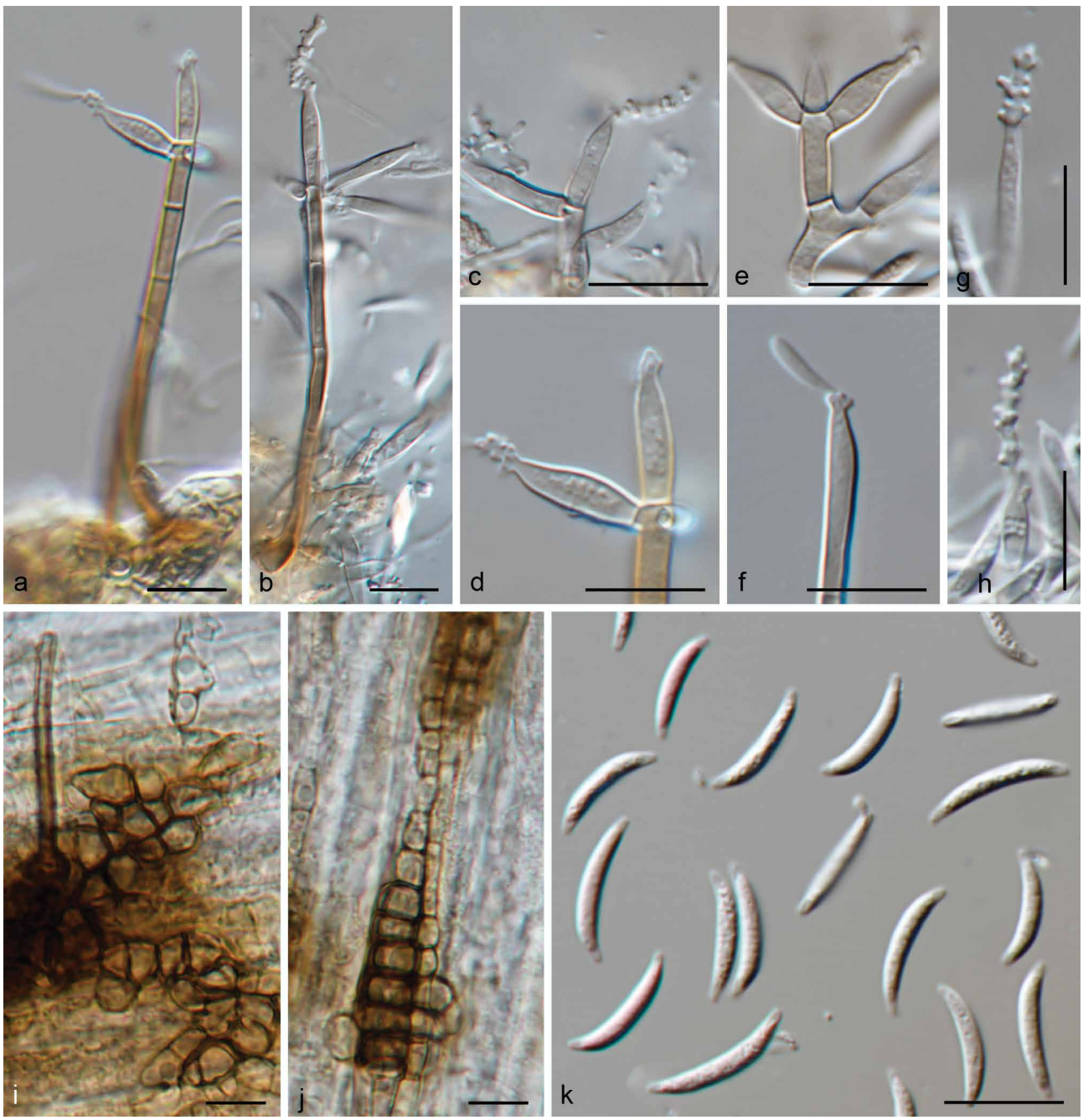

Fig. 20 *Selenodriella fertilis* (CBS 148328). a–b. Conidiophores with conidia; c–h. conidiogenous cells; i–j. chlamydospores; k. conidia. — Scale bars: 10 µm.

Notes — *Selenodriella fertilis* was originally described as *Circinotrichum* from the USA on *Persea boronia* (Pirozynski & Hodges 1973). This species is characterised by climbing conidiogenous cells on the setiforme conidiophores. In our study, it is represented by strains from Australia and South Africa growing on leaves of different hosts. One of the strains was previously identified as *C. rigidum* and another as *Circinotrichum* sp. Unfortunately, neither the ex-type strains of *S. fertilis* nor *C. rigidum* were available for molecular comparison.

VERMICULARIOPSIELLALES, VERMICULARIOPSIELLACEAE

Vermiculariopsiella Bender, Mycologia 24: 412. 1932

Type species. *Vermiculariopsiella immersa* (Desm.) Bender

Conidiomata sporodochial, scattered, solitary, discrete, superficial, setose, black with an overlying white mass of conidia. *Setae* dark brown, thick-walled, mainly simple, erect, straight to slightly curved, tapering gradually to the apices, smooth, septate. *Conidiophores* compacted in the sporodochium, sparingly branched, short, hyaline to pale brown, cylindrical. *Conidiogenous cells* arranged in compact columns, phialidic, subcylindrical to lageniform, hyaline to subhyaline, thin-walled, smooth, narrowing to a recurved cylindrical neck. *Conidia* produced in mucoid mass, hyaline, smooth, aseptate, sparsely guttulate, straight, cylindrical, apex slightly curved and pointed, base obtuse to rounded with a pointed to subacute protuberance on one side indicating the point of attachment. *Sexual morph* unknown.

Accepted species. *V. australiensis*, *V. dichapetali*, *V. eucalypticola*, *V. immersa*, *V. pini*, *V. spiralis*.

Vermiculariopsiella australiensis Hern.-Restr. & Crous, *sp. nov.* — MycoBank MB 844025; Fig. 21

Etymology. Named after Australia, the country where the holotype was collected.

Typus. Australia, Western, Perth, Bedfordale, on leaves of *Grevillea* sp., 29 Sept. 2015, *P.W. Crous* (holotype preserved in a metabolically inactive state and ex-type CBS 141499).

Sporodochia setose, pale brown and whitish conidial masses. *Setae* unbranched, thick-walled, straight to flexuous, dispersed throughout the sporodochium, brown, tapering to an obtuse apex that is medium brown, and thinner walled than the stipe, (20–)100–400 × 3.5–6 µm. *Conidiophores* subcylindrical, hyaline, 20–70 × 2–4 µm. *Conidiogenous cells* terminal, subcylindrical, hyaline, smooth, frequently curved in upper part, apex 1–1.5 µm diam, with cylindrical collarette, 18–35 × 2–4 µm. *Conidia* hyaline, guttulate, straight to slightly curved, inequilateral with inner plane straight and outer plane convex, apex subobtusely rounded, curved, base truncate with a subacute lateral protuberance, 18–26 × 2.5–3 µm.

Culture characteristics — Colonies flat, spreading, with sparse aerial mycelium, folded surface, and even, lobate margin, reaching 25 mm diam after 2 wk at 25 °C. On MEA surface pale mouse grey, reverse mouse grey. On PDA surface sepia, reverse brown vinaceous. On OA surface mouse grey.

Additional materials examined. Australia, New South Wales, Barron Grounds Nature Reserve, on leaves of *Melaleuca* sp., 26 Nov. 2016, *P.W. Crous*, CPC 32057 = CBS 143424 (as *V. dichapetali*); Melbourne, leaves of *Grevillea* sp., 7 July 2014, *P.W. Crous*, CPC 25482 = CBS 141498 (as *V. dichapetali*); Victoria, La Trobe State Forest, leaves of *Eucalyptus regnans*, 30 Nov. 2016, *P.W. Crous*, CPC 32544 = CBS 143440 (as *V. dichapetali*); Western Australia, on leaves of *Acacia glaucoptera*, 22 Sept. 2015, *P.W. Crous*, CPC 29232 = CBS 141500 (as *V. dichapetali*).

Notes — This species is represented by strains formerly identified as *V. dichapetali*, all of them coming from Australia growing

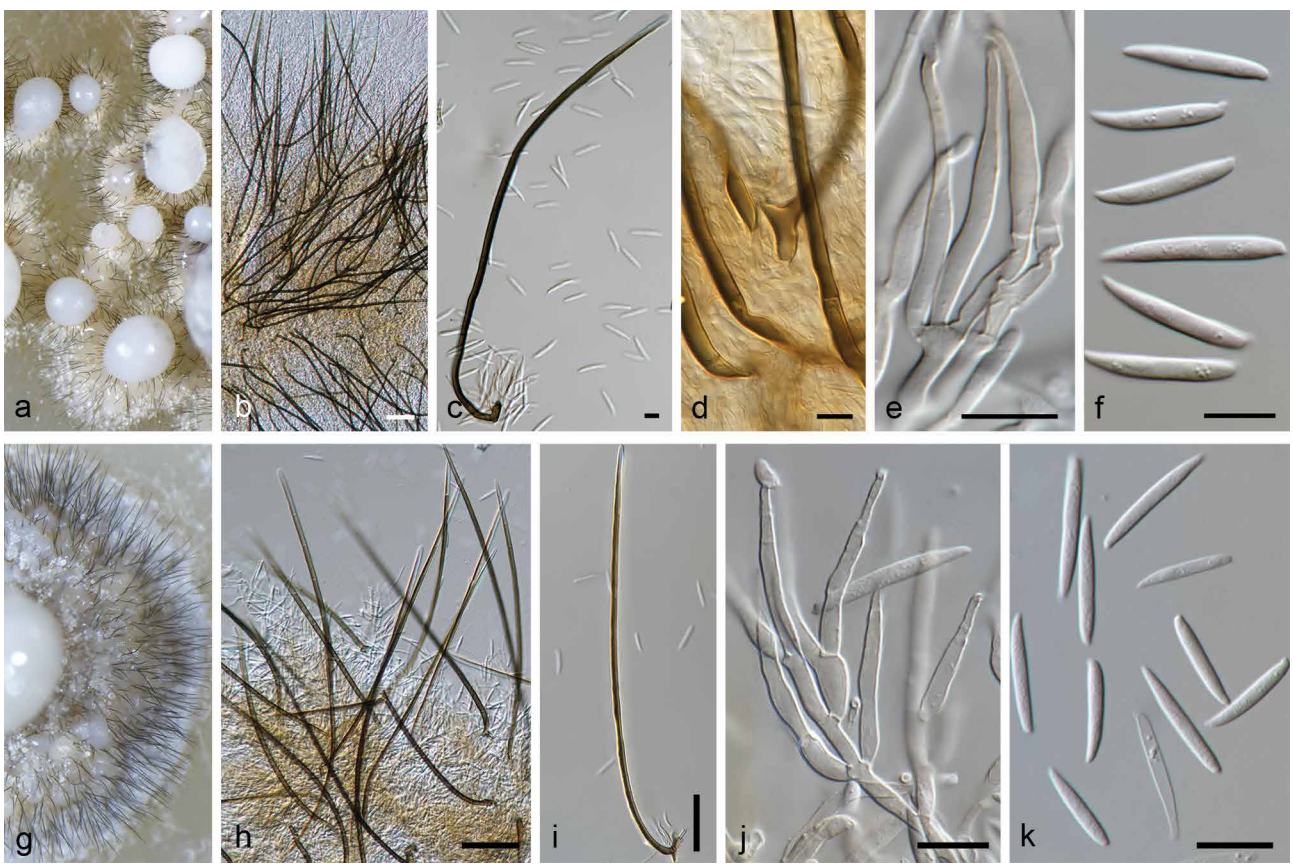

Fig. 21 *Vermiculariopsiella australiensis* sp. nov. (a–f. CBS 141499; g–k. CBS 141500). a, g. Colonies on OA; b–c, h–i. setae and conidia; d. setae base; e, j. conidiophores and conidiogenous cells; f, k. conidia. — Scale bars: b–f, h–k = 10 µm.

on several hosts (*Acacia*, *Eucalyptus*, *Grevillea*, *Melaleuca*). Although the conidiomata and conidial morphology is very similar to *V. dichapetali*, they are distinct based on their DNA data.

Vermiculariopsiella dichapetali Crous, Persoonia 32: 213. 2014

Typus. Botswana, on *Dichapetalum rhodesicum* (*Dichapetalaceae*), 17 Feb. 2013, *M. van der Bank* (holotype CBS H-21689, culture ex-type CPC 22463 = CBS 137977).

Description — See Crous et al. (2014).

Notes — *Vermiculariopsiella dichapetali* is represented only by the ex-type strain in a subclade related to *V. eucalypticola* and *V. hongkongensis*. Some strains formerly identified as *V. dichapetali* originating from Australia formed a separate clade described here as *V. australiensis*. Under the conditions studied here no morphological differences could be found between *V. australiensis* and *V. dichapetali*.

Vermiculariopsiella eucalypticola Crous, Persoonia 39: 433. 2017 — Fig. 22

Typus. Australia, New South Wales, South East Forests National Park, on leaves of *Eucalyptus dalrympleana*, 28 Nov. 2016, *P.W. Crous* (holotype CBS H-23313, culture ex-type CPC 32506 = CBS 143442).

Description — See Crous et al. (2017).

Vermiculariopsiella immersa (Desm.) Bender, Mycologia 24: 412. 1932 — Fig. 23

Basionym. *Excipula immersa* Desm., Bull. Soc. Bot. France 4: 911. 1857.
Synonyms. *Dinemasporium immersum* (Desm.) Sacc., Syll. Fung. 10: 439. 1892.
Vermiculariopsis immersa (Desm.) Höhn., Ber. Deusch. Bot. Ges. 36(7): 317. 1918.

Typus. France, on *Quercus* spp. and *Prunus lusitanica*, Desmazières, Plantes cryptogames de France, Ed. 2, Series 2, 268 (lectotype designated here BPI 954396), MBT 10007069.

Conidiomata sporodochial, scattered, solitary, discrete, superficial, setose, 245–1105 µm diam, black with an overlying white mass of conidia. Basal stroma of *textura angularis*, brown, from

Fig. 22 *Vermiculariopsiella eucalypticola* (CBS 143442). a. Colonies on OA; b–c. setae; d. setae base and conidiogenous cells; e. conidia. — Scale bars: b–e = 10 µm.

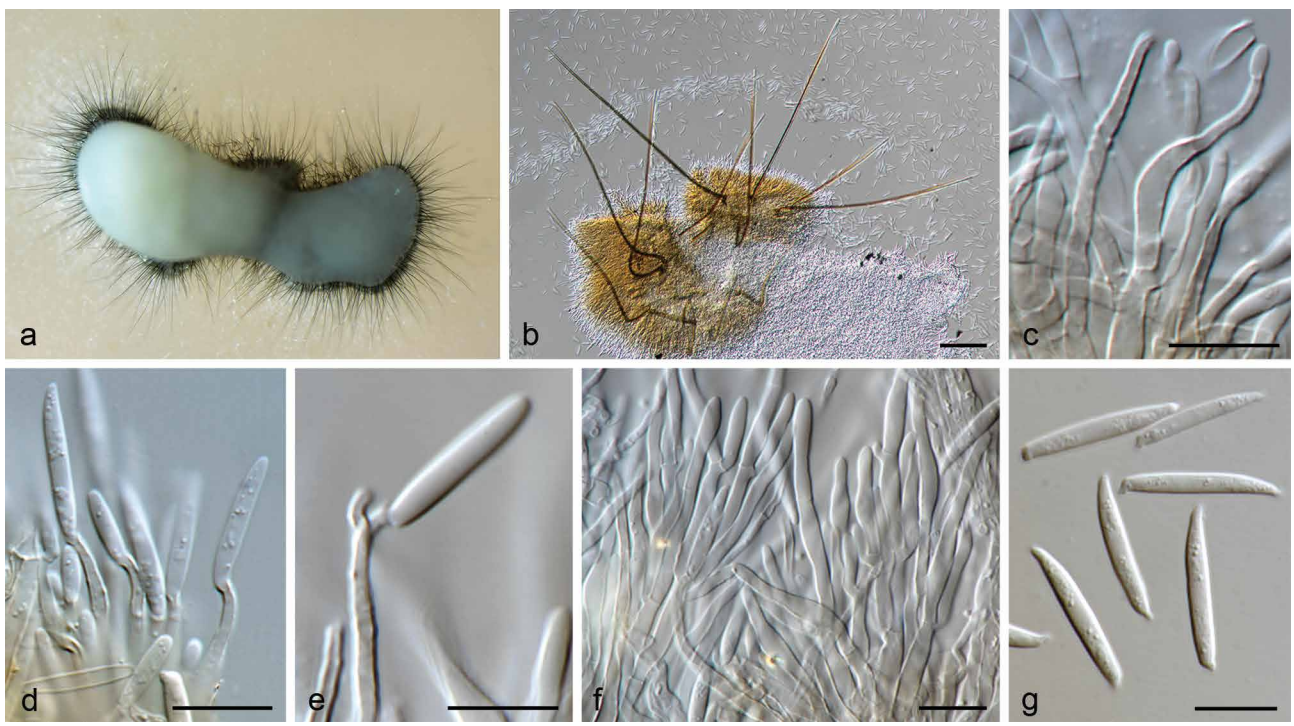

Fig. 23 *Vermiculariopsiella immersa* (CBS 112026). a. Setose sporodochia on OA; b. sporodochia with setae, conidiogenous cells and conidia; c–f. conidiogenous cells; g. conidia. — Scale bars: a = 50 µm; b–f = 10 µm.

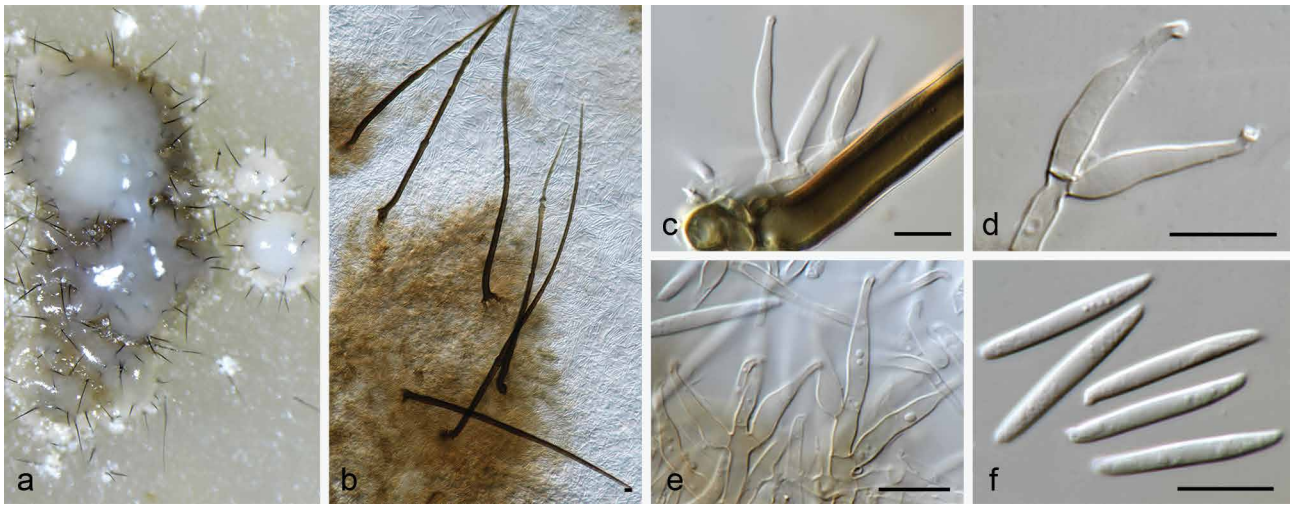

Fig. 24 *Vermiculariopsiella pini* (CBS 146009). a. Colonies on OA; b. setae; c–e. conidiogenous cells; f. conidia. — Scale bars: b–f = 10 µm.

which the setae arise and merging into the conidiogenous region. *Setae* abundant, 8–21 per sporodochium, rigid, erect, straight to slightly curved, unbranched, tapering gradually to the apices, septate, dark brown, paler above, thick-walled, smooth, 570–1325 µm long inflated at the base, 8.5–12 µm wide at the first septum, narrowing to 4–6 µm at the subobtuse to acute apices. *Conidiophores* compacted in the sporodochium, sparingly branched, short, pale brown, cylindrical, 15–30 × 2–3 µm. *Conidiogenous cells* arranged in compact columns, subcylindrical to lageniform, hyaline to subhyaline, thin-walled, smooth, 11–15 × 2–3 µm, narrowing to a recurved cylindrical neck and ending in a distinct flared collarette and channel 0.5–1 µm wide. *Conidia* produced in mass, hyaline, smooth, normally aseptate, sparsely guttulate, straight, cylindrical, apex slightly curved and pointed, base obtuse to rounded with a pointed to subacute protuberance on one side indicating the point of attachment, 13–23 × 1.5–2.5 µm. Adapted from Nawawi & Kuthubutheen (1990). *Sexual morph* unknown.

Additional materials examined. Brazil, Corcovado, on decaying leaf, unknown date, *A. Stchigel & J. Guarro*, CBS 112026. – Spain, Canary Islands, on rotten leaf, Jan. 1995, *R.F. Castañeda-Ruiz*, MUCL 39135 = CBS 140223.

Notes — *Vermiculariopsiella immersa* is represented by two strains from Brazil and Spain, respectively, with some molecular differences. Unfortunately, the ex-type strain of the species is not available for comparison.

Vermiculariopsiella pini Crous, Persoonia 43: 291. 2019 — Fig. 24

Typus. Malaysia, on needles of *Pinus tecunumanii*, 1 Oct. 2018, *M.J. Wingfield*, HPC 2657 (holotype CBS H-24174, culture ex-type CPC 36727 = CBS 146009).

Description — See Crous et al. (2019c).

Vermiculariopsiella spiralis Crous, M.J. Wingf. & W.B. Kendr., Canad. J. Bot. 73(2): 233. 1995 — Fig. 25

Synonym. Vermiculariopsiella acaciae Crous & M.J. Wingf., Persoonia 36: 345. 2016.

Typus. South Africa, Mpumalanga Province, Barberton, on leaf litter of *Syzygium cordatum*, Nov. 1992, *M.J. Wingfield* (holotype PREM 51693, culture CPC 555 = CBS 523.93).

Mycelium immersed, composed of brown, smooth, septate hyphae, 2–4 µm diam, giving rise to conidiophores and setae. *Conidiomata* sporodochial, scattered, solitary, discrete, setose, with conidia aggregated in slimy masses. *Setae* abundant, erect, curved to flexuous, septate, unbranched, circinate to spirally twisted in the upper half, thick-walled, dark brown, smooth, (180–)500–1200 × (4–)7–10 µm wide at the first basal septum, tapering to a rounded apex 1–1.5 µm wide. *Conidiophores* aggregated in stroma, subcylindrical, 1–2-septate, simple or branched, 25–40 × 2.5–4 µm. *Conidiogenous cells* subcylindrical to lageniform, hyaline, thin-walled, smooth, 10–27 × 2–3 µm, narrowing to recurved, cylindrical necks with apices 1–1.5 µm, ending in flared collarettes 1–2 µm long. *Conidia* hyaline, aseptate, straight, cylindrical, apex slightly curved and pointed, base obtuse to rounded with a subacute lateral protuberance, (9.5–)15–22(–25) × 1.5–3 µm. *Microconidia* (on SNA) ellipsoid, straight, hyaline, smooth, guttulate conidia, apex subobtusely rounded, base truncate, 4–7 × 2–2.5 µm. Adapted from Crous et al. (1995, 2016). *Sexual morph* unknown.

Culture characteristics — Colonies reaching up to 40 mm diam after 2 wk at 25 °C, with spreading, flat surface; margins smooth, lobate, and sparse aerial mycelium. On MEA surface pale luteous, reverse luteous. On OA surface dirty white to pale luteous. On PDA surface and reverse dirty white.

Additional materials examined. France, La Réunion, on leaves of *Acacia heterophylla*, 3 July 2015, *P.W. Crous* & *M.J. Wingfield*, CPC 26291 = CBS 141289 (ex-type of *V. acaciae*). – South Africa, Mpumalanga Province, Barberton, on leaf litter of *Syzygium cordatum*, 1 Nov. 1992, *M.J. Wingfield*, CBS 110672.

Notes — *Vermiculariopsiella acaciae* is synonymized with *V. spiralis*. Although there are some morphological differences in setae (spirally twisted vs straight) among the descriptions of *V. acaciae* (Crous et al. 2016) and *V. spiralis* (Crous et al. 1995), molecular data show them to be conspecific. During our study, only the strain CBS 110672 sporulated in culture, showing irregular conidiomata formation, some of them with long setae pointed at the apex, and others with short, thick-walled setae, and conidial dimensions of 9.5–15 × 2–3 µm. Another unique characteristic described in the protologue is that it produces microconidia in culture (Crous et al. 2016).

Vermiculariopsis Torrend, Brotéria, Sér. Bot. 10: 41. 1912

Type species. Vermiculariopsis circinotricha Torrend

Emended description. *Colonies* hypophyllous, punctiform to effuse, thin, velvety, mouse grey, scattered. *Mycelium* superficial, composed of branched and anastomosing, smooth-walled, septate, subhyaline or olivaceous hyphae bearing conidiogenous cells and setae, becoming thickened and dark brown at the point of origin of the setae. *Setae* erect, distinctly septate, with

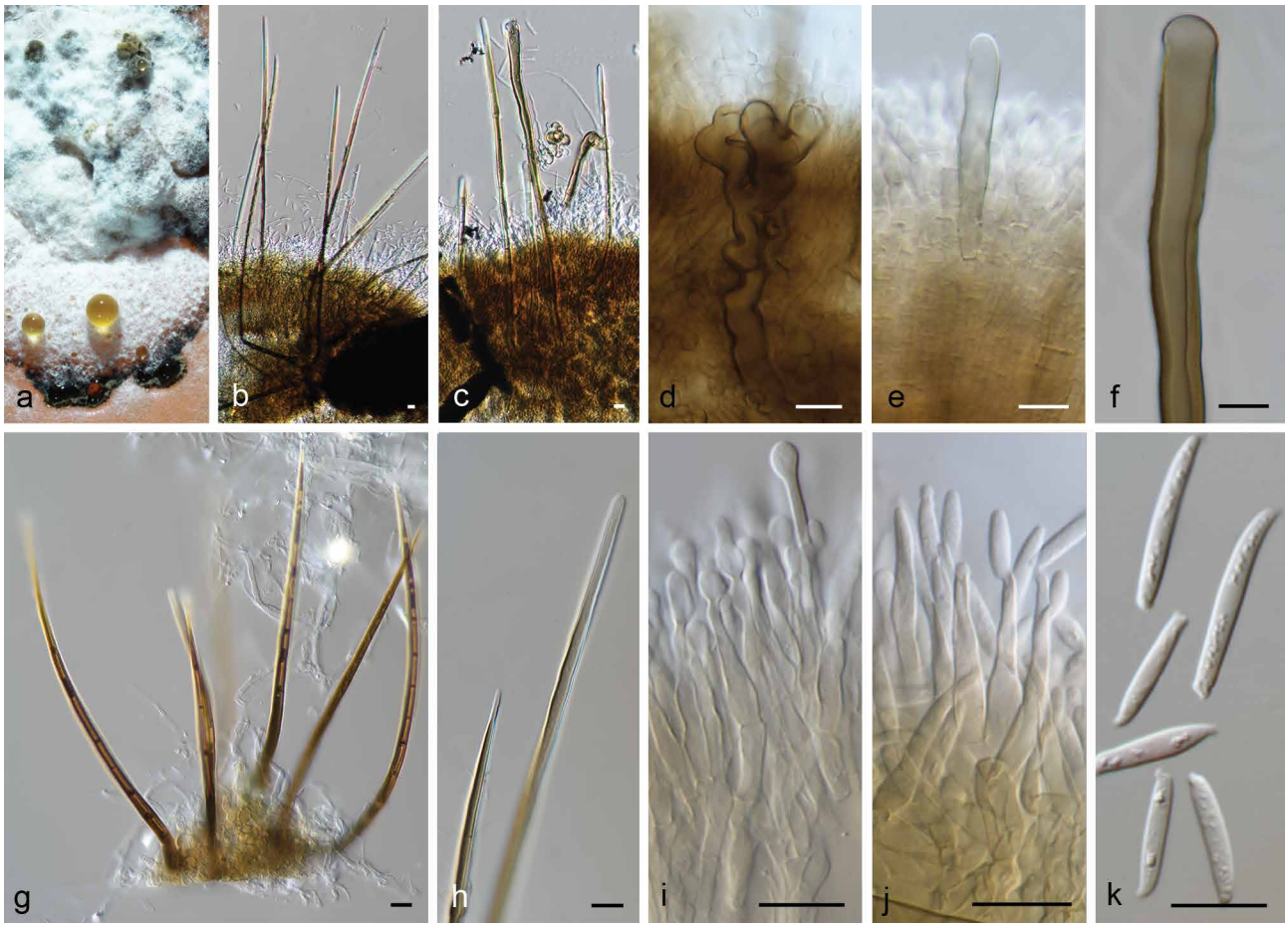

Fig. 25 *Vermiculariopsiella spiralis* (CBS 110672). a. Colonies on OA; b–c, g. setose sporodochia; d–f. thick wall setae; h. pointed setae; i. capitate setae; j. conidiogenous cells; k. conidia. — Scale bars: b–k = 10 µm.

a branched upper part, coiled or spiralled twisted, thin-walled, pale brown to brown, darker near the base, smooth, base bulbous swelling; branching imperfectly dichotomous, extremities spirally coiled, intertwined. *Conidiogenous cells* phialidic, borne laterally on the superficial hyphae or swollen bases of setae, obclavate to lageniform, subhyaline. *Conidia* adhering together to form a whitish pellicle at the base of setae, mucoid, asymmetrical, oblong, attenuate, somewhat apiculate, curved at the apex, eccentrically and inconspicuously fimbrillate at the base, straight or slightly curved, guttulate, hyaline, produced seriately and obliquely from the conidiogenous loci, forming a white cirrhus or pseudo chains. *Sexual morph* not observed.

Accepted species. *Vs. castanedae*, *Vs. circinotricha*, *Vs. dunnii*, *Vs. eucalypti*, *Vs. eucalyptigena*, *Vs. lauracearum*, *Vs. microsperma*, *Vs. pediculata*.

Vermiculariopsis castanedae Hern.-Restr. & Crous, *sp. nov.* — MycoBank MB 844026; Fig. 26

Etymology. Named for Rafael F. Castañeda-Ruiz, in recognition of his significant contribution to our knowledge of hyphomycetous fungi.

Typus. Portugal, Minho province, Lagoas de Bertiandos, N41°46' W8°38', FMR 12187, on rotten leaf of unidentified plant, 9 Nov. 2011, *R.F. Castañeda*, *M. Hernández-Restrepo*, *J. Gené & J. Mariné-Gené* (holotype designated here HAL 2447 F, culture ex-type CBS 132484).

Description — See Hernández-Restrepo et al. (2013).

Additional material examined. Portugal, Minho Prov., Lagoas de Bertiandos, on unidentified leaf, Nov. 2011, *R.F. Castañeda-Ruiz*, *M. Hernández-Restrepo*, *J. Gené & J. Mariné-Gené*, FMR 12187 = CBS 132484 (as *V. pediculata*).

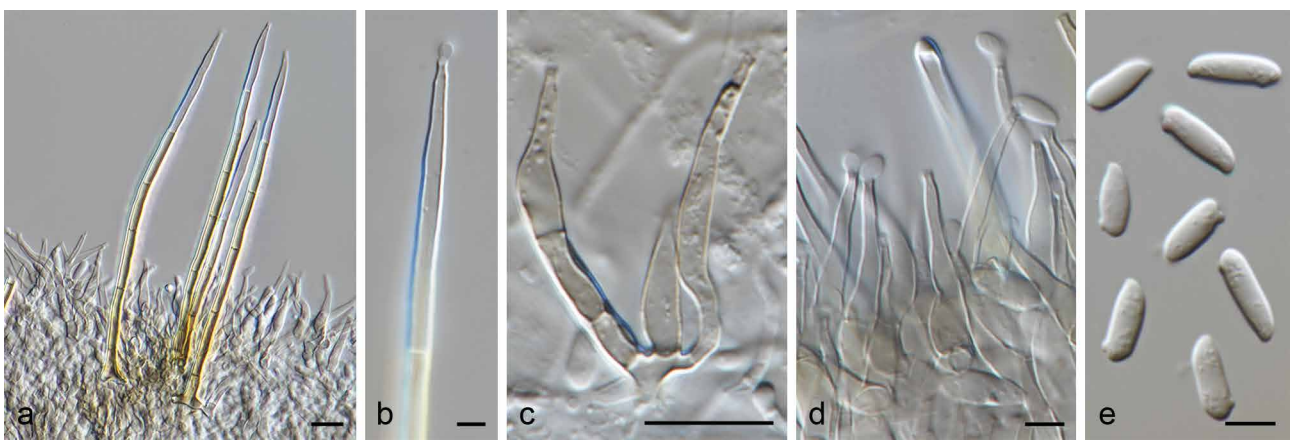

Fig. 26 *Vermiculariopsis castanedae* sp. nov. (CBS 132484). a. Setae simple; b. setiforme conidiophore; c–d. conidiogenous cells; e. conidia. — Scale bars: 10 µm.

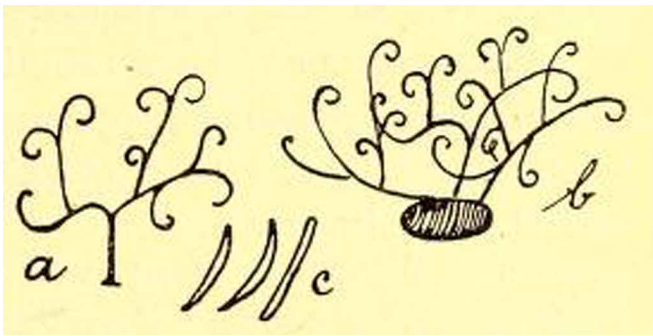

Fig. 27 *Vermiculariopsis circinotricha*. Original drawing of *Vermiculariopsis circinotricha* (reproduced from Torrend 1912).

Notes — This strain was previously identified as *V. pediculata* based on morphological characteristics (Hernández-Restrepo et al. 2013). At the time of collection, sporulation was very similar in culture to that observed on the natural substrate. However, during our study sporulation on the media tested was poor, and only a few simple, and sometimes fertile setae were observed. Conidia were also slightly larger than previously observed (5–11 × 2–3 µm). Phylogenetically, this species is related to *Vs. eucalyptigena*, but can be distinguished by its slightly smaller conidia ((6–)10–12 × (2.5–)3(–4) µm vs 5–11 × 2–3 µm).

Vermiculariopsis circinotricha Torrend, Brotéria, Sér. Bot. 10: 41. 1912 — Fig. 27

Typus. Lectotype designated here, f. 1, Deuxième contribution pour l'étude des champignons de l'ile de Madère, (Torrend 1912), MBT 10007072.

Setae 300–500 × 4–8 µm, branched, circinate, brown, paler at the apex. Conidia cylindrical to fusoid, slightly curved, hyaline, 14–19 × 1–1.5 µm. Adapted from Torrend (1912).

Notes — This species is only known from the type collection in Madeira, Portugal (Torrend 1912). The holotype material is not available and the illustration from Torrend (1912) is here designated as lectotype.

Vermiculariopsis dunnii (Crous & Carnegie) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844029; Fig. 28

Basionym. *Vermiculariopsiella dunnii* Crous & Carnegie, Persoonia 42: 313. 2019.

Typus. Australia, New South Wales, Yabbra State Forest, Boomi Creek plantation, on leaves of *Eucalyptus dunnii*, 19 Apr. 2016, *A.J. Carnegie*, isol. *P.W. Crous* (holotype CBS H-23938, culture ex-type CBS 145538).

Description — Crous et al. (2019a).

Additional material examined. Australia, New South Wales, Blue Mountain National Park, Mt Tomah Botanical Garden, S33°32.4' E150°25.4', 3591 ft., on *Eucalyptus fastigata* bark, 17 Aug. 1999, *K.A. Seifert*, KAS 819 = CBS 148330 (as *Circinotrichum* sp.).

Notes — This species was recently described from Australia (Crous et al. 2019a). In our study, a second isolate was identified as *Vs. dunnii*, also originating from Australia and on *Eucalyptus fastigata*.

Vermiculariopsis eucalypti (Crous et al.) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844027

Basionym. *Vermiculariopsiella eucalypti* Crous et al., Persoonia 36: 325. 2016.

Typus. Australia, Victoria, Toolangi State Forest, S37°33'25.3" E145°31' 55.9", on leaves of *Eucalyptus regnans*, 9 Nov. 2014, *P.W. Crous*, *J. Edwards & P.W.J. Taylor* (holotype CBS H-22590, culture ex-type CPC 25525 = CBS 141281).

Description — See Crous et al. (2016).

Notes — This species was previously described as *V. eucalypti*, and is only known from the type locality in Australia. Phylogenetically it is related to *Vs. dunnii*, which is also from Australia occurring on *Eucalyptus*.

Vermiculariopsis eucalyptigena (Crous) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844028

Basionym. *Vermiculariopsiella eucalyptigena* Crous, Fung. Syst. Evol. 6: 226. 2020.

Typus. Australia, New South Wales, Royal National Park, Winifred Falls, fire trail, on leaves of *Eucalyptus* sp., 1 June 2016, *A.J. Carnegie*, HPC 2542 (holotype CBS H-24252, culture ex-type CPC 36373 = CBS 146091).

Description — See Crous et al. (2020b).

Notes — This species is only known from the type locality in Australia (Crous et al. 2020b). Phylogenetically it is related to *Vs. castanedae*.

Vermiculariopsis lauracearum (Crous) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844030; Fig. 29

Basionym. *Vermiculariopsiella lauracearum* Crous, Persoonia 41: 279. 2018.

Typus. Spain, La Gomera, on leaf litter of *Laurus novocanariensis*, 30 Mar. 2017, *A. van Iperen*, isol. *P.W. Crous*, HPC 2058 (holotype CBS H-23755, culture ex-type CBS 145055).

Description — See Crous et al. (2018).

Additional materials examined. Australia, unknown substrate, 7 Nov. 2009, *P.W. Crous*, CPC 17086. – Brazil, Pista Claudio Coutiño near Pao de Açucar, decaying leaf, unknown date, *A. Stchigel & J. Guarro*, INIFAT

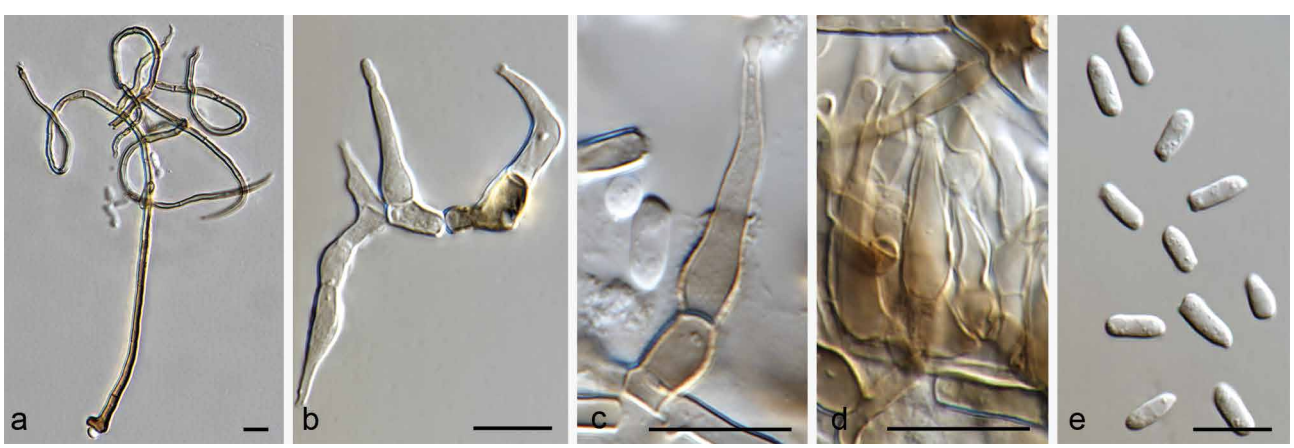

Fig. 28 *Vermiculariopsis dunnii* (CBS 148330). a. Setae; b–d. conidiogenous cells; e. conidia. — Scale bars: 10 µm.

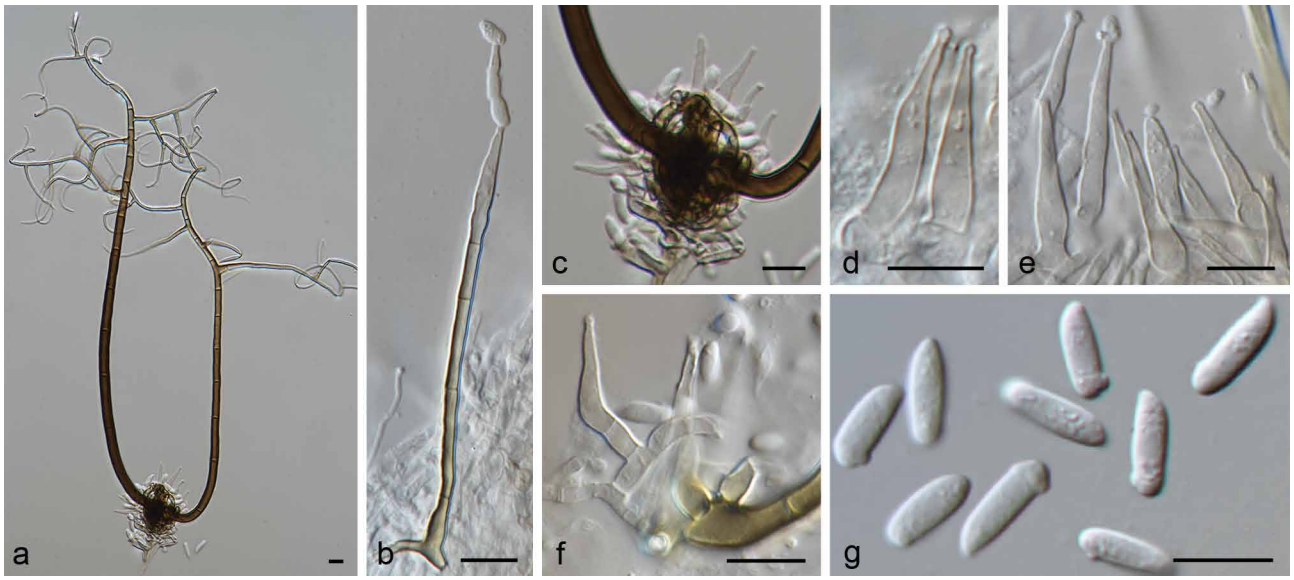

Fig. 29 *Vermiculariopsis lauracearum* (CBS 112582). a. Setae; b. setiforme conidiophore; c–f. conidiogenous cells; g. conidia. — Scale bars: 10 µm.

CO2/94-2a, CBS 112582 (as *Vermiculariopsiella* sp.). – South Africa, Western Cape province, Walker Bay Nature Reserve, on twigs of *Sideroxylon inerme*, 2 Dec. 2002, *S. Marincowitz*, CMW 18375 = CBS 136534.

Notes — Originally described as *V. lauracearum* from the Canary Islands on *Laurus novocanarensis*; this species resembles *Vs. circinotricha* from Madeira on *Laurus canarensis*. However, *Vs. lauracearum* has shorter and wider conidia ((9–)10(–11) × (3–)3.5(–4) µm vs 14–19 × 1–1.5 µm). In our study this species is represented by four strains from different continents and substrates with some genetic differences.

Vermiculariopsis microsperma (Höhn.) Hern.-Restr. & Crous, *comb. nov.* — MycoBank MB 844031

Basionym. *Circinotrichum microspermum* Höhn., Abh. Bayer. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1 118: 411. 1909.
Synonyms. *Gyrothrix microsperma* (Höhn.) Piroz., Mycol. Pap. 84: 14. 1962.
Vermiculariopsiella microsperma (Höhn.) R.F. Castañeda & W.B. Kendr., Univ. Waterloo Biol. Ser. 35: 118. 1991.

Typus. Indonesia, Java, Buitenzorg, on dry leaf, Höhnel, 1528 (holotype FH00284755, isotype IMI 85614).

Description — See Pirozynski (1962).

Notes — Originally described from Java as *Circinotrichum* (Höhnel 1909). It was later transferred to *Gyrothrix* based on the presence of branched setae (Pirozynski 1962), and more recently placed in *Vermiculariopsiella* because of the occurrence of phialidic conidiogenous cells (Castañeda-Ruiz & Kendrick 1991). This species is morphologically similar to *Vs. pediculata*, but has smaller conidia (6–8 × 1.5–1.8 µm vs 4.5–10 × 2–4 µm; Pirozynski 1962, Cunningham 1974). Unfortunately, no ex-type strain can be designated for *Vs. microsperma*. Despite several strains identified as *Vs. microsperma* in the CBS collection, none of them could be confirmed as such and they are considered here as *Vs. pediculata*.

Vermiculariopsis pediculata (J.L. Cunn.) Hern.-Restr & Crous, *comb. nov.* — MycoBank MB 844032; Fig. 30, 31

Basionym. *Gyrothrix pediculata* J.L. Cunn., Mycologia 66: 123. 1974.
Synonym. *Vermiculariopsiella pediculata* (J.L. Cunn.) Hern.-Restr. et al., Mycotaxon 122: 138. 2013.

Typus. USA, Rockville, Maryland, on leaf of *Robinia pseudo-acacia*, May 1970, *J.L. Cunningham* (isotype IMI 177800, culture ex-type ATCC 22290 = CBS 579.74 type of *Gyrothrix pediculata*).

Colonies hypophyllous, effuse, thin, velvety, mouse grey, scattered, up to 1 mm diam. *Mycelium* superficial, composed of branched and anastomosing, smooth-walled, septate, subhyaline or olivaceous hyphae bearing conidiogenous cells and setae, becoming thickened and dark brown at the point of origin of the setae. *Setae* erect, distinctly septate, upper part 2–5 times branched, coiled or spiralled twisted, thin-walled, pale brown to brown, translucent, darker near the base paler toward the apex, smooth, 150–350 × 3–5 µm, base bulbous swelling up to 10 µm, 0.5–1.5 µm at the apex; branching imperfectly dichotomous, extremities spirally coiled, intertwined. *Conidiogenous cells* borne laterally on the superficial hyphae or swollen bases of setae, obclavate to lageniform, subhyaline, 10–24 × 3–5 µm, apex 1–2 µm. *Conidia* adhering together to form a whitish pellicle at the base of setae, oblong to cylindrical, straight or slightly curved, guttulate, hyaline, 4.5–10 × 2–4 µm.

Culture characteristics — Colonies flat, cottony to pulverulent, zonate, with sparse aerial mycelium, effuse margin, reaching 20 mm diam after 2 wk at 25 °C. On MEA surface greyish sepia, periphery velvety, mouse grey, margin lobate to fimbriate, reverse zonate brown vinaceous, fawn. On OA surface vinaceous buff, cinnamon, pale mouse or fawn, reverse dark brick, cinnamon, sienna.

Additional materials examined. Australia, New South Wales Yarramulong, Nunkeri Native Flowers, S33°16.3' E151°23.1', 285 ft., on leaves of *Callistemon vininalis*, 23 Aug. 1999, *K.A. Seifert*, KAS 1111 = CBS 148331 (as *V. pediculata*). – Brazil, Mata Atlantica, Engenho do Rei, Santa Rita, on leaf litter, Sept. 1997, *R.F. Castañeda-Ruiz*, INIFAT C98/36-3 = CBS 101172 (as *Vermiculariopsiella microsperma*). – Cuba, Trinidad, on dead leaves from rain forest, Jan. 1996, *J. Guarro*, FMR 6199 = CBS 100153 (as *Vermiculariopsiella microsperma*); La Estrella, Granma, on leaf of *Stigmaphyllon sagraeanum*, 14 Mar. 1991, *R.F. Castañeda-Ruiz*, INIFAT C 91/88, CBS 499.92 (as *Vermiculariopsiella microsperma*). – France, Martinique, Anses d'arlet, decaying leaf of unidentified angiosperma, Aug. 2005, *C. Lécuru & C. Decock*, MUCL 47125 = CBS 140228 (as *Gyrothrix pediculata*). – French Guiana, Cayenne area, Larimande's forest, dead leaf, 20 Jan. 1997, *C. Decock & V. Robert*, MUCL 40392 = CBS 140234 (as *Gyrothrix* sp.); ibid., Jan. 1997, *C. Decock*, MUCL 50517 = CBS 140231 (as *Vermiculariopsiella microsperma*). – Japan, Onoaida, Yakushima Island, Kagoshima Pref., on dead leaf of *Castanopsis* sp., unknown date, *K. Tubaki*, MUCL 51899 = CBS 140232 (as *Gyrothrix microsperma*).

Notes — This species was originally described from the USA as *Gyrothrix pediculata*, based on the presence of branched setae (Cunningham 1974). It was later placed in *Vermiculariopsiella* because the occurrence of phialidic conidiogenous cells by Hernández-Restrepo et al. (2013), and here we reallocated

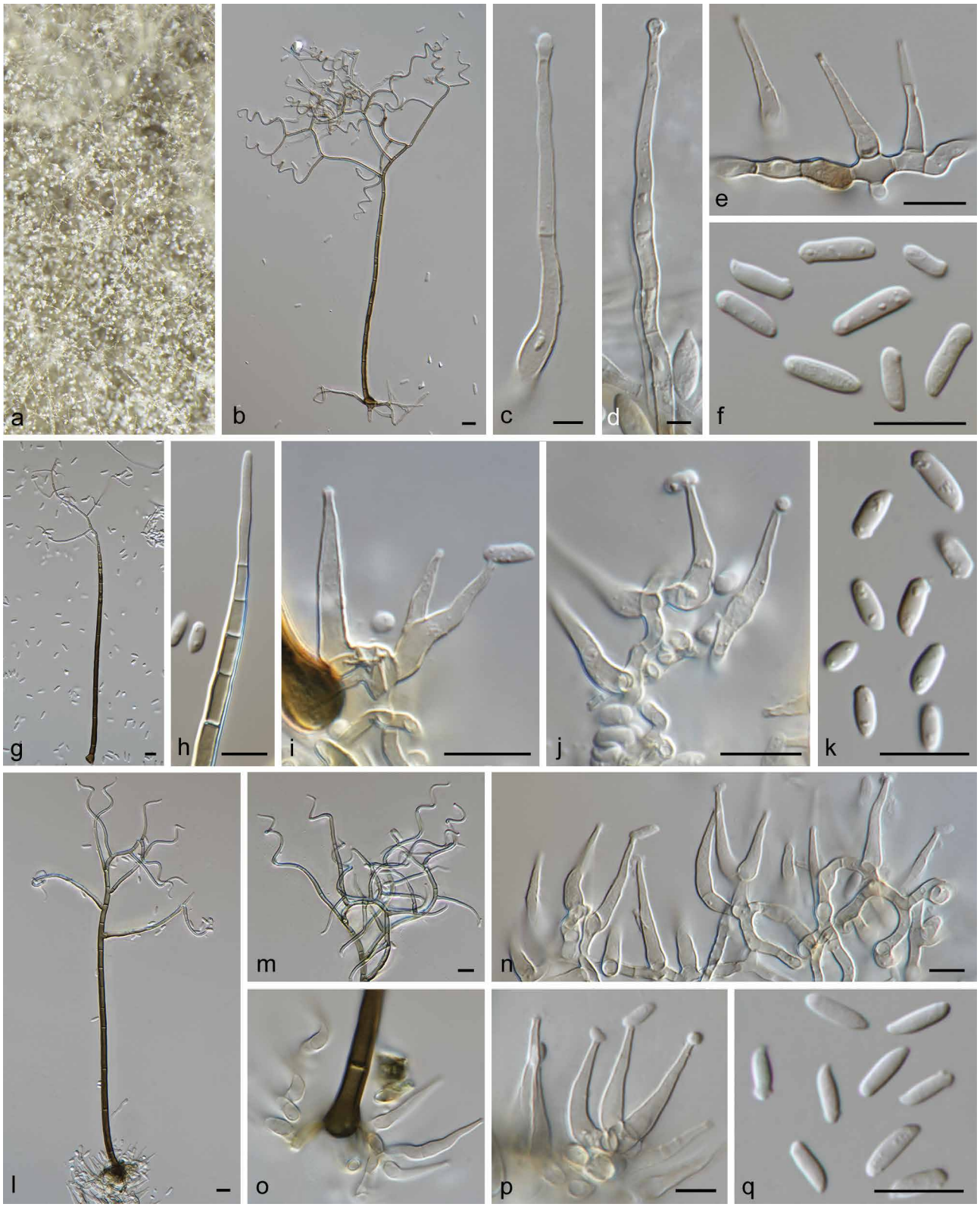

Fig. 30 *Vermiculariopsis pediculata* (a–f. CBS 100153; g–k. CBS 101172; l–q. CBS 140228). a. Colony overview on OA; b, g–h, l–m. setae; c–e, i–j, n–p. conidiogenous cells; f, k, q. conidia. — Scale bars: b–q = 10 µm.

it to *Vermiculariopsis* because of the combination of those two characters. Furthermore, in our study the clade including the ex-type CBS 579.74 and other strains from Australia, Brazil, Cuba, France, French Guiana and Japan represents a genetically diverse group, including some strains previously identified as *V. microsperma* (for morphological comparison see comment in *Vs. microsperma*).

DISCUSSION

Circinotrichum, *Gyrothrix* and *Vermiculariopsiella* are re-evaluated morphologically and molecularly. In total 85 strains were studied from the CBS, CPC, MUCL and DAOM culture collections. *Circinotrichum* and *Gyrothrix* were shown to be polyphyletic, distributed into three different clades in the *Xylariales*, i.e., *Coniocessiaceae*, *Microdochiaceae* and the newly proposed *Gyrothricaceae*, and to a lesser extent *Vermiculariopsiellales* (*Vermiculariopsiellaceae*).

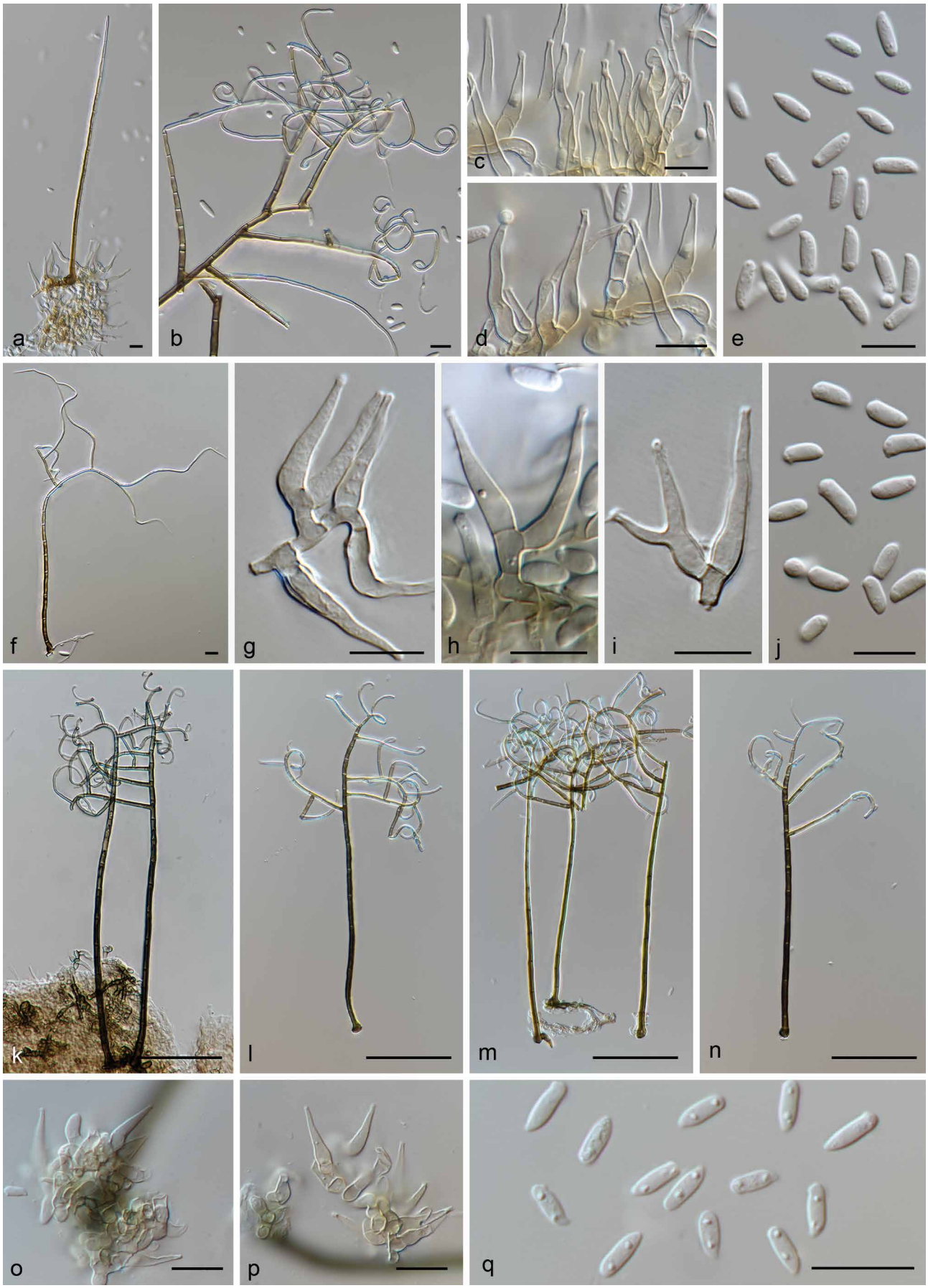

Fig. 31 *Vermiculariopsis pediculata* (a–e. CBS 140231; f–j. CBS 148331; k–q. CBS 499.92). a–b, f, k–n. Setae; c–d, g–i, o–p. conidiogenous cells; e, j, q. conidia. — Scale bars: k–n = 50 µm, others 10 µm.

Although Saccardo (1878) and Kendrick (1980) pointed out the similarity between *Circinotrichum* and *Gyrothrix*, Hughes (1958) and Pirozynski (1962) preferred to retain them as separate genera based on the setal branching pattern, and this concept was followed by many other taxonomists (Castañeda-Ruiz & Kendrick 1990, 1991, Seifert et al. 2011, Crous et al. 2014, 2015). Our study revealed that *Circinotrichum* and *Gyrothrix* are indeed different genera. However, *Circinotrichum* includes species with both simple and branched setae, whereas other genera are chiefly segregated based on their DNA phylogeny. *Circinotrichum* is emended and both a lectotype and epitype are proposed for *C. maculiforme*. Molecular data revealed that *Gyrothrix circinata* is related to *C. maculiforme* in the *Coniocessiaceae*. While *C. sinensis* also has simple setae, it is reclassified in a new genus, *Pirozynskiomyces*. The inclusion of these two genera in *Coniocessiaceae* expand the concept of the asexual morphs from nodulisporium-like taxa to include setose fungi with polyblastic lageniform conidiogenous cells and fusoid conidia.

Gyrothricaceae is proposed for *Gyrothrix* and other circinotrichum-like fungi, including anthostomella-like taxa as the sexual morph, such as *Xenoanthostomella* and *Neoanthostomella*. *Gyrothrix* includes *G. eucalypti*, *G. encephalarti*, *G. verticillata*, and the type species *G. podosperma*. *Neoanthostomella viticola* is synonymised under *G. podosperma* based on molecular evidence. This is also the first time that *Gyrothrix* is linked to a sexual morph. Another interesting relationship revealed during our study is the link between *Xenoanthostomella* (sexual morph) and its circinotrichum-like asexual morph. The phylogenetic

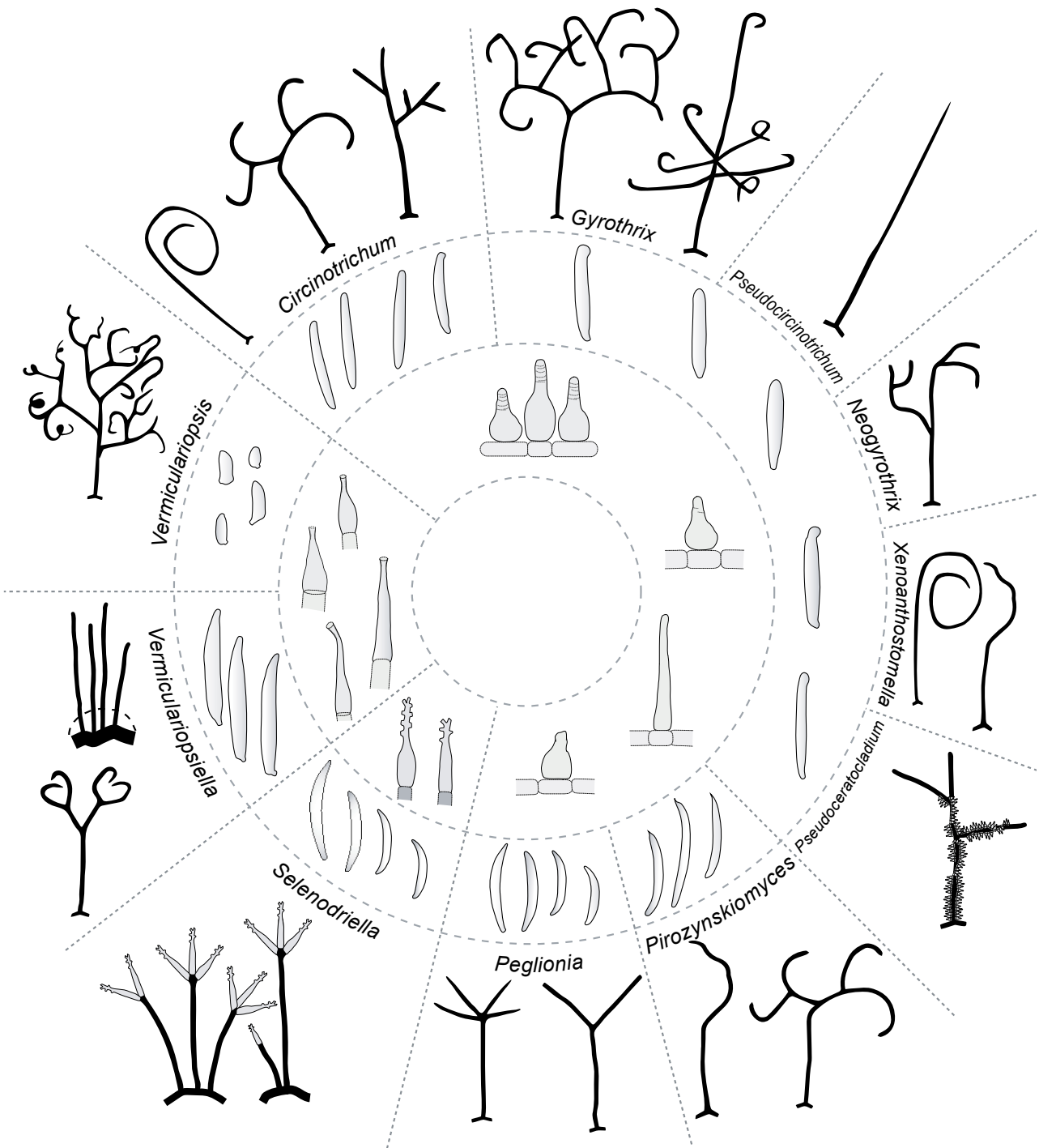

Fig. 32 Morphotypes of *Circinotrichum*, *Gyrothrix*, *Vermiculariopsiella* and similar genera. Conidiogenous cells, conidia and setae are shown in the inner, central, and outer parts of the wheel, respectively.

analysis showed *C. cycadis* and *C. olivaceum* to be congeneric with *X. chromolaenae*, and therefore new combinations are proposed. Other segregated monotypic genera that are included in *Gyrothricaceae* are *Pseudocircinotrichum*, *Neogyrothrix* and *Pseudoceratocladium*.

Morphological identification is challenging for some species and genera, because many characters overlap, and characters such as simple or branched setae are uninformative at genus level. Hence, molecular data are recommended. *Circinotrichum*, *Gyrothrix*, *Neogyrothrix*, *Pirozynskiomyces*, *Pseudicircinotrichum*, *Pseudoceratocladium* and *Xenoanthostomella* have polyblastic conidiogenous cells and fusoid to falcate conidia. *Pseudicircinotrichum* and *Xenoanthostomella* have simple setae, while *Circinotrichum* and *Pirozynkiomyces* have simple or branched setae, and *Gyrothrix* and *Neogyrothrix* have branched setae (Fig. 32).

Microdochiaceae also includes setose fungi with polyblastic conidiogenous cells and fusoid to lunate conidia. Some isolates previously identified as *Circinotrichum* sp. and another as *C. rigidum* nested with *Selenodriella fertilis*, while others formed a clade separate from *S. fertilis* and *S. cubensis* and are here described as *S. brasiliana*. Furthermore, *Peglionia* is here resurrected for *G. verticiclada*, that differs from *Gyrothrix* as discussed by Becerra-Hernández et al. (2016). *Peglionia verticiclada* is characterised by the production of curved conidia and setae with verticillate and straight branches at the apex, and never circinate as in *Circinotrichum*, *Gyrothrix* or other members of *Xylariales* (Fig. 32).

The taxonomy of *Circinotrichum*, *Gyrothrix* and similar fungi has been traditionally based mainly on the presence of simple or branched setae (Pirozynski 1962, Seifert et al. 2011), whereas the conidiogenesis has been controversial. Enteroblastic and holoblastic species were included in the same genus for a long time. Cunningham (1974) described and illustrated the conidiogenesis of *Vs. pediculata* (as *Gyrothrix pediculata*) from cultures on corn meal agar. This ontogenesis was classified as conidial development type 18 (conidium ontogeny holoblastic, delimitation by 1 septum, schizolytic secession, maturation by diffuse wall-building, percurrent and sympodial enteroblastic conidiogenous cell proliferation below the previous locus and delimiting septum, the second and subsequent conidia formed from proliferations, but with no observed reduction in length of the conidiogenous cells). The other genera included in this study have polyblastic conidiogenous cells, with thin walls at the apex, that in old specimens can lead to a misinterpretation as phialidic conidiogenesis. Recently some studies revealed that the phialidic species previously included in *Gyrothrix* belong to *Vermiculariopsiella* (Castañeda-Ruiz & Kendrick 1991, Hernández-Restrepo et al. 2013, 2017). In our study molecular and morphological evidence show that *Vermiculariopsiella* s.lat. represents two different genera, both with phialidic conidiogenous cells. *Vermiculariopsiella* comprises fungi with setose sporodochial conidiomata with simple setae, except for *V. eucalypticola*, and cylindrical conidia. *Vermiculariopsis*, however, is a suitable genus for fungi similar to *Vermiculariopsiella* but with branched setae and smaller, oblong conidia including *Vs. circinotricha* the type species, *Vs. dunnii*, *Vs. eucalypti*, *Vs. eucalyptigena*, *Vs. lauracearum*, *Vs. microsperma*, *Vs. pediculata* and *Vs. castanedae* (Fig. 32).

Despite the use of different culture media and conditions to promote sporulation, many of the strains remained sterile after subculturing, or did not sporulate well in culture, and in several cases, setae were poorly developed. For many taxa no fungarium material was deposited together with the strain, making morphological comparison difficult. The limited availability of ex-type strains proved to be another obstacle in this study. Several species were described more than 100 years ago, and type material proved difficult to track. We propose lectotypes for *C. maculiforme*, *G. podosperma*, *P. verticilada* and *Vs. circinotricha*, an epitype for *C. maculiforme*, and a neotype for *P. verticiclada*. Unfortunately, many species still lack molecular data (i.e., *C. argentinense*, *C. britannicum*, *C. chathamiense*, *C. cochinense*, *C. falcatisporum*, *C. flagelliforme*, *C. flexuosum*, *C. mediterraneum*, *C. metaniger*, *C. obscurum*, *C. palmicola*, *C. ponmudiense*, *C. poonense*, *C. rigidum*, *G. bifurcata*, *G. chimaera*, *G. cubensis*, *G. dichotoma*, *G. flagella*, *G. grisea*, *G. indica*, *G. inops*, *G. kigeliae*, *G. macroseta*, *G. magica*, *G. pupulinii*, *G. ramosa*, *G. thevetiae*, *V. arcicula*, *V. cornuta*, *V. cubensis*, *V. elegans*, *V. endophytica*, *V. falcata*, *V. indica*, *V. papayae*, *V. parva*, *V. parvula* and *V. pteridis*) and fresh materials need to be recollected from type localities to facilitate further molecular study. The identity of some of the strains could not be confirmed morphologically, and for these taxa only molecular data were considered in our analyses (CBS 488.77 '*Ce. microspermum*', CBS 140234 *Vs. microsperma*, CBS 114515 *G. grisea*, CBS 114517 *G. citricola*, CBS 101171 *G. hughesii* and CBS 148328 *C. rigidum*).

During this study we experienced that for most of these genera, isolates rarely sporulated in culture, or quickly ceased to do so upon subculturing. It is therefore recommended that future studies that collect strains from these genera also preserve fungarium specimens, and also investigate alternate conditions and media to induce sporulation in culture, as this will prove crucial for further morphological comparisons.

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