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Generic concepts in *Nectriaceae*

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Abstract: The ascomycete family *Nectriaceae* (*Hypocreales*) includes numerous important plant and human pathogens, as well as several species used extensively in industrial and commercial applications as biodegraders and biocontrol agents. Members of the family are unified by phenotypic characters such as uniloculate ascomata that are yellow, orange-red to purple, and with phialidic asexual morphs. The generic concepts in *Nectriaceae* are poorly defined, since DNA sequence data have not been available for many of these genera. To address this issue we performed a multi-gene phylogenetic analysis using partial sequences for the 28S large subunit (LSU) nrDNA, the internal transcribed spacer region and intervening 5.8S nrRNA gene (ITS), the large subunit of the ATP citrate lyase (*acl1*), the RNA polymerase II largest subunit (*rpb1*), RNA polymerase II second largest subunit (*rpb2*), α-actin (*act*), β-tubulin (*tub2*), calmodulin (*cmdA*), histone H3 (*his3*), and translation elongation factor 1-alpha (*tef1*) gene regions for available type and authentic strains representing known genera in *Nectriaceae*, including several genera for which no sequence data were previously available. Supported by morphological observations, the data resolved 47 genera in the *Nectriaceae*. We re-evaluated the status of several genera, which resulted in the introduction of six new genera to accommodate species that were initially classified based solely on morphological characters. Several generic names are proposed for synonymy based on the abolishment of dual nomenclature. Additionally, a new family is introduced for two genera that were previously accommodated in the *Nectriaceae*.

Key words: Generic concepts, *Nectriaceae*, Phylogeny, Taxonomy.

Taxonomic novelties: New family: *Tilachlidiaceae* L. Lombard & Crous; **New genera:** *Aquanectria* L. Lombard & Crous, *Bisifusarium* L. Lombard, Crous & W. Gams, *Coccinonectria* L. Lombard & Crous, *Paracremonium* L. Lombard & Crous, *Rectifusarium* L. Lombard, Crous & W. Gams, *Xenoacremonium* L. Lombard & Crous; **New species:** *Mariannaea humicola* L. Lombard & Crous, *Neocosmospora rubicola* L. Lombard & Crous, *Paracremonium inflatum* L. Lombard & Crous, *P. contagium* L. Lombard & Crous, *Pseudonectria foliicola* L. Lombard & Crous, *Rectifusarium robinianum* L. Lombard & Crous, *Xenoacremonium falcatus* L. Lombard & Crous, *Xenogliocladiopsis cypellocarpa* L. Lombard & Crous; **New combinations:** *Aquanectria penicillioides* (Ingold) L. Lombard & Crous, *A. submerse* (H.J. Huds.) L. Lombard & Crous, *Bisifusarium biseptatum* (Schroers, Summerbell & O'Donnell) L. Lombard & Crous, *B. delphinoides* (Schroers, Summerbell, O'Donnell & Lampr.) L. Lombard & Crous, *B. dimerum* (Penz.) L. Lombard & Crous, *B. domesticum* (Fr.) L. Lombard & Crous, *B. lunatum* (Ellis & Everh.) L. Lombard & Crous, *B. nectrioides* (Wollenw.) L. Lombard & Crous, *B. penzigii* (Schroers, Summerbell & O'Donnell) L. Lombard & Crous, *Calonectria candelabra* (Viégas) Rossman, L. Lombard & Crous, *C. cylindrospora* (Ellis & Everh.) Rossman, L. Lombard & Crous, *Clonostachys apocyni* (Peck) Rossman, L. Lombard & Crous, *C. aurantia* (Penz. & Sacc.) Rossman, L. Lombard & Crous, *C. blumenaviae* (Rehm) Rossman, L. Lombard & Crous, *C. gibberosa* (Schroers) Rossman, L. Lombard & Crous, *C. manihotis* (Rick) Rossman, L. Lombard & Crous, *C. parva* (Schroers) Rossman, L. Lombard & Crous, *C. tonduzii* (Speg.) Rossman, L. Lombard & Crous, *C. tornata* (Höhn.) Rossman, L. Lombard & Crous, *Coccinonectria pachysandricola* (B.O. Dodge) L. Lombard & Crous, *C. rusci* (Lechat, Gardiennet & J. Fourn.) L. Lombard & Crous, *Hydropisphaera fusigera* (Berk. & Broome) Rossman, L. Lombard & Crous, *Ilyonectria destructans* (Zinssm.) Rossman, L. Lombard & Crous, *I. macroconidialis* (Brayford & Samuels) Rossman, L. Lombard & Crous, *Mariannaea catenulatae* (Samuels) L. Lombard & Crous, *Nectriopsis rexiana* (Sacc.) Rossman, L. Lombard & Crous, *Neocosmospora ambrosia* (Gadd & Loos) L. Lombard & Crous, *N. falciformis* (Carrión) L. Lombard & Crous, *N. illudens* (Berk.) L. Lombard & Crous, *N. ipomoeae* (Halst.) L. Lombard & Crous, *N. monilifera* (Berk. & Broome) L. Lombard & Crous, *N. phaseoli* (Burkh.) L. Lombard & Crous, *N. plagianthi* (Dingley) L. Lombard & Crous, *N. ramosa* (Bat. & H. Maia) L. Lombard & Crous, *N. solani* (Mart.) L. Lombard & Crous, *N. termitum* (Höhn.) L. Lombard & Crous, *N. tucumaniae* (T. Aoki, O'Donnell, Yos. Homma & Lattanzi) L. Lombard & Crous, *N. virguliformis* (O'Donnell & T. Aoki) L. Lombard & Crous, *Neonectria candida* (Ehrenb.) Rossman, L. Lombard & Crous, *Penicillifer diparietisporus* (J.H. Miller, Giddens & A.A. Foster) Rossman, L. Lombard & Crous, *Rectifusarium ventricosum* (Appel & Wollenw.) L. Lombard & Crous, *Sarcopodium flavolanatum* (Berk. & Broome) L. Lombard & Crous, *S. mammiforme* (Chardón) L. Lombard & Crous, *S. oblongisporum* (Y. Nong & W.Y. Zhuang) L. Lombard & Crous, *S. raripilum* (Penz. & Sacc.) L. Lombard & Crous, *Sphaerostilbella penicillioides* (Corda) Rossman, L. Lombard & Crous, *S. aurifila* (W.R. Gerard) Rossman, L. Lombard & Crous, *Volutella asiana* (J. Luo, X.M. Zhang & W.Y. Zhuang) L. Lombard & Crous, *Xenoacremonium recifei* (Leão & Lôbo) L. Lombard & Crous; **New name:** *Mariannaea pinicola* L. Lombard & Crous; **Typification: Epitypification (basionyms):** *Rectifusarium ventricosum* Appel & Wollenw., *Xenogliocladiopsis eucalyptorum* Crous & W.B. Kendr..

INTRODUCTION

The order *Hypocreales* (*Hypocreomycetidae*, *Sordariomycetes*, *Pezizomycotina*, *Ascomycota*) includes approximately 2 700 fungal species from 240 genera, which are divided over eight families (Kirk *et al.* 2008, Crous *et al.* 2014), with some genera still classified as *incertae sedis* (Lumbsch & Huhndorf 2007). Members of this order are globally found in various environments and are of great importance to agriculture and medicine. They have been extensively exploited in industrial and commercial applications (Rossman 1996). These fungi are generally characterised by the production of lightly to brightly coloured, ostiolate, perithecial ascomata, containing unitunicate asci with hyaline ascospores; asexual morphs, the form most frequently encountered in nature, are moniliaceous and phialidic (Rogerson 1970, Samuels & Seifert 1987, Rossman 1996, 2000, Rossman

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et al. 1999). The taxonomic importance of these asexual morphs has only been recognised relatively recently (Rossman 2000, Seifert & Samuels 2000). The morphology of asexual forms is often crucial for the morphological identification of these fungi.

The family *Nectriaceae* is characterised by uniloculate ascomata that are white, yellow, orange-red or purple. These ascomata change colour in KOH, and are not immersed in a well-developed stroma. They are associated with phialidic asexual morphs producing amerosporous to phragmosporous conidia (Rossman *et al.* 1999, Rossman 2000). This family includes around 55 genera that were originally based on asexual or sexual morphs. The genera include approximately 900 species (www.mycobank.org; www.indexfungorum.org). The majority of these species are soil-borne saprobes or weak to virulent, facultative or obligate plant pathogens, while some are facultatively fungicolous or insecticolous (Rossman *et al.* 1999, Rossman 2000, Chaverri *et al.* 2011, Gräfenhan *et al.* 2011, Schroers *et al.* 2011). Several species have also been reported as important opportunistic pathogens of humans (Chang *et al.* 2006, de Hoog *et al.* 2011, Guarro 2013) while others produce mycotoxins of medical concern (Rossman 1996).

Prior to the advent of DNA sequencing studies, most sexual morph genera recognised in the *Nectriaceae* were placed in *Nectria sensu lato* (Rehner & Samuels 1995, Rossman *et al.* 1999). The genus *Nectria s. str.*, however, is restricted to the type species *N. cinnabarina* with tubercularia-like asexual morphs (Rossman 2000, Hirooka *et al.* 2012). Recently, several studies have treated taxonomic concepts within *Nectriaceae* based on multi-gene phylogenetic inference (Lombard *et al.* 2010a, b, 2012, 2014a, b, Lombard & Crous 2012, Chaverri *et al.* 2011, Gräfenhan *et al.* 2011, Schroers *et al.* 2011, Hirooka *et al.* 2012). In these studies, well-known and important plant and human pathogenic genera have been segregated into several new genera, with some older generic names resurrected (Chaverri *et al.* 2011, Gräfenhan *et al.* 2011, Schroers *et al.* 2011, Hirooka *et al.* 2011, 2012). This has resulted in debates (Geiser *et al.* 2013, O'Donnell *et al.* 2013, Aoki *et al.* 2014) about the prospects for continued use of certain well-known generic names, such as *Fusarium*, for species of agricultural and medical importance. Several genera traditionally classified in the *Nectriaceae* have been excluded from these studies. In the present study, the phylogenetic relationships of most of the genera known from culture and traditionally classified as *Nectriaceae* are evaluated based on DNA sequences of 10 loci. The goal is to provide a phylogenetic backbone for the family *Nectriaceae*. Nomenclatural changes due to the implementation of the new International Code of Nomenclature for algae, fungi and plants (ICN; McNiell *et al.* 2012), are also considered in this study. The taxonomy of some genera is re-evaluated.

MATERIALS AND METHODS

Isolates

Fungal strains were obtained from the culture collection of the CBS-KNAW Fungal Biodiversity Centre (CBS), Utrecht, The Netherlands and the working collection of Pedro W. Crous housed at the CBS (Table 1).

DNA isolation, amplification and analyses

Total genomic DNA was extracted from 7-d-old single-conidial cultures growing on 2 % (w/v) malt extract agar (MEA) using the method of Damm *et al.* (2008). Partial gene sequences were determined for the 28S large subunit (LSU) nrDNA, the internal transcribed spacer region and intervening 5.8S nrRNA gene (ITS), the large subunit of the ATP citrate lyase (*acl1*), the RNA polymerase II largest subunit (*rpb1*), RNA polymerase II second largest subunit (*rpb2*), β-tubulin (*tub2*), histone H3 (*his3*), translation elongation factor 1-alpha (*tef1*), calmodulin (*cmdA*) and α-actin (*act*) using the primers and PCR protocols listed in Table 2. Integrity of the sequences was ensured by sequencing the amplicons in both directions using the same primer pairs as were used for amplification. A consensus sequence for each locus was assembled in MEGA v. 6 (Tamura *et al.* 2013) and additional sequences were obtained from GenBank (Table 1). Subsequent alignments for each locus were generated in MAFFT v. 7 (Katoh & Standley 2013) and manually corrected where necessary. Phylogenetic congruency of the 10 loci was tested using a 70 % reciprocal bootstrap criterion (Mason-Gamer & Kellogg 1996).

Phylogenetic analyses were based on Bayesian inference (BI) and Maximum Likelihood (ML). For both analyses, the evolutionary model for each partition was determined using MrModeltest (Nylander 2004) and incorporated into the analyses. For the BI analysis, the software package BEAST v. 8.0 (Drummond *et al.* 2012) was used. The phylogenetic relationships were estimated by performing six independent repetitions of 100 M generations each, with sampling at every 1 000th generation. The Yule speciation algorithm with GTR substitution model and a lognormal uncorrelated relaxed clock were selected for the data. LogCombiner v. 8.0 (from the BEAST package) was used to combine the outputs of six independent runs. The resulting trees were summarised using Tree Annotator v. 1.8.0 (from the BEAST package) using the maximum clade credibility option. FigTree v. 1.4 was used to visualise the final tree.

The ML analysis was performed using RAxML v. 8.0.9 (randomised accelerated (sic) maximum likelihood for high performance computing; Stamatakis 2014) through the CIPRES website (http://www.phylo.org) to obtain a second measure of branch support. The robustness of the analysis was evaluated by bootstrap support (BS) with the number of bootstrap replicates automatically determined by the software. All novel sequences generated in this study were deposited in GenBank (Table 1) and the alignment(s) and tree(s) in TreeBASE.

Morphology

For morphological characterisation, single-conidial isolates were grown on synthetic nutrient-poor agar (SNA, Nirenberg 1981) with sterile toothpicks, filter paper or carnation leaves placed on the surface of the agar. Alternatively, isolates were also plated onto potato dextrose agar (2 % w/v, PDA), oatmeal agar (OA) and malt extract agar (2 % w/v, MEA) (recipes in Crous *et al.* 2009) to induce sporulation when this failed on SNA. Plates were incubated at room temperature (22–25 °C) under ambient light conditions. Some isolates were incubated at 12 h / 12 h fluorescent light and darkness at 25 °C. Gross morphological characters of the asexual morphs were examined after 7–10 d by mounting fungal structures in clear lactic acid and

Table 1. Details of strains included in the phylogenetic analyses. GenBank accessions numbers in italics were newly generated in this study.

Species	Isolate nr.[1]	Substrate	Collector/ Depositor	Locality	GenBank Accession No.[2]									
					acl1	*act*	*cmdA*	*his3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
"*Acremonium* cf. *curvulum*"	CBS 100551	*Olea europaea*	S. Frisullo	Italy	*KM231057*	*KM231223*	*KM231400*	*KM231552*	*KM231818*	HQ232031	*KM232244*	*KM232385*	*KM231949*	*KM232088*
Albonectria rigidiuscula	CBS 315.73; ATCC 24367; IMI 137397	*Theobroma cacao*	P.S. Liu	Malaysia	*KM231012*	*KM231206*	*KM231383*	*KM231534*	*KM231809*	*KM231677*	*KM232229*	*KM232378*	*KM231938*	*KM232071*
	CBS 122570; GJS 01-170	Bark	G.J. Samuels	Cameroon	HQ897896	*KM231205*	*KM231382*	*KM231533*	HQ897815	*KM231676*	*KM232228*	HQ897760	*KM231937*	*KM232070*
Allantonectria miltina	CBS 474.69; MUCL 14535	*Agave americana*	H.A. van der Aa	Spain	*KM231080*	*KM231246*	*KM231430*	*KM231592*	*KM231835*	*KM231716*	*KM232269*	*KM232408*	*KM231973*	–
	CBS 121121; AR 4391	*Agave americana*	G. Cacialli	Italy	*KM231081*	HM484514	*KM231431*	*KM231593*	HM484547	HM484572	HM484587	*KM232409*	HM484524	HM484609
	CBS 125499; TG 2008-02	*Yucca elata*	T. Gräfenhan	USA	–	*KM231247*	*KM231432*	–	*KM231836*	*KM231717*	*KM232270*	HQ897730	*KM231974*	*KM232107*
Aquanectria penicillioides	CBS 257.54; ATCC 16261	*Acer* sp.	F.V. Ranzoni	USA	*KM230954*	*KM231110*	*KM231275*	–	*KM231743*	*KM231613*	*KM232135*	*KM232299*	*KM231865*	*KM232000*
A. submersus	CBS 394.62^{T}	Unknown	H.J. Hudson	UK	HQ897845	*KM231109*	–	*KM231458*	HQ897796	*KM231612*	*KM232134*	HQ897728	–	*KM231999*
Atractium crassum	CBS 180.31^{T}; NRRL 20894	Water tap	H.W. Wollenweber	Germany	HQ897859	*KM231183*	*KM231356*	*KM231508*	*KM231790*	U88110	*KM232205*	HQ897722	*KM231919*	*KM232049*
A. stilbaster	CBS 410.67^{T}	Decaying bark	W. Gams	Germany	*KM230990*	*KM231184*	*KM231357*	*KM231509*	*KM231791*	*KM231654*	*KM232206*	–	*KM231920*	*KM232050*
	CBS 783.85; KAS 385a	Stump	K.A. Seifert & G. Andersson	Sweden	*KM230991*	*KM231185*	*KM231358*	*KM231510*	*KM231792*	*KM231655*	*KM232207*	–	*KM231921*	*KM232051*
Bisifusarium delphinoides	CBS 120718^{T}; CPC 13041	*Hoodia gordonii*	S.C. Lamprecht	South Africa	*KM230994*	*KM231188*	*KM231363*	*KM231515*	EU926229	*KM231660*	*KM232210*	–	EU926296	*KM232056*
B. dimerum	CBS 108944^{T}; NRRL 36140	*Homo sapiens*	H. Ph. Endtz	The Netherlands	*KM230996*	*KM231190*	*KM231365*	*KM231517*	JQ434586	JQ434514	*KM232212*	*KM232363*	EU926334	EU926400
B. domesticum	CBS 116517; NRRL 29976	Cheese	K. O'Donnell	Switzerland	*KM230997*	*KM231191*	*KM231366*	*KM231518*	EU926219	JQ434512	*KM232213*	HQ897694	EU926286	JQ434531
B. lunatum	CBS 632.76^{T}; BBA 63199; NRRL 20690	*Gymnocalcium damsii*	I. Rummland	Germany	HQ897902	*KM231192*	*KM231367*	*KM231519*	HQ897819	*KM231662*	*KM232214*	HQ897766	EU926291	*KM232057*
B. nectrioides	CBS 176.31^{T}; NRRL 20689	Soil	H.W. Wollenweber	Honduras	*KM230993*	*KM231187*	*KM231362*	*KM231514*	EU926245	*KM231659*	*KM232209*	HQ897721	EU926312	*KM232055*
B. penzigii	CBS 317.34^{T}; NRRL 22109	*Fagus sylvatica*	J. Ehrlich	UK	*KM230995*	*KM231189*	*KM231364*	*KM231516*	*KM231795*	*KM231661*	*KM232211*	*KM232362*	EU926324	EU926390
Calonectria brassicae	CBS 111869; CPC 2409; PC 551197	*Argyreia* sp.			*KM230965*	GQ280454	GQ267382	DQ190720	GQ280576	GQ280698	*KM232181*	*KM232308*	FJ918567	AF232857
C. ilicicola	CBS 190.50^{T}; CPC 2482; IMI 299389	*Solanum tuberosum*	K.B. Boedjin & J. Reitsma	Java	*KM230964*	GQ280483	AY725764	AY725676	GQ280605	GQ280727	*KM232180*	*KM232307*	AY725726	AY725631

(*continued on next page*)

Table 1. (Continued)

Species	Isolate nr.[1]	Substrate	Collector/ Depositor	Locality	GenBank Accession No.[2]									
					acl1	*act*	*cmdA*	*his3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
C. naviculata	CBS 101121^{T}; CMW 30974	Leaf litter	R.F. Castañeda	Brazil	*KM230966*	GQ280478	GQ267399	GQ267252	GQ280600	GQ280722	*KM232182*	*KM232309*	GQ267317	GQ267211
Calostilbe striispora	CBS 133491		C. Lechat	French Guiana	–	*KM231182*	*KM231355*	–	*KM231789*	*KM231653*	*KM232204*	*KM232361*	*KM231918*	*KM232048*
"*C. striispora*"	CBS 122.39	*Erythrina glauca*	R.E.D. Baker	Trinidad and Tobago	*KM231102*	–	–	–	*KM231855*	*KM231735*	*KM232290*	*KM232431*	*KM231991*	*KM232125*
Campylocarpon fasciculare	CBS 112613^{T}; CPC 3970	*Vitis* sp.	F. Halleen	South Africa	*KM231026*	HM352881	*KM231297*	JF735502	AY677301	HM364313	HM364331	*KM232322*	JF735691	AY677221
C. pseudofasciculare	CBS 112679^{T}; CPC 5472	*Vitis vinifera*	F. Halleen	South Africa	*KM231027*	HM352882	*KM231298*	JF735503	AY677306	HM364314	HM364332	*KM232323*	JF735692	AY677214
Chaetopsina acutispora	CBS 667.92^{T}	Forest litter	A. Rambeli	Africa	*KM230976*	*KM231164*	*KM231337*	*KM231494*	*KM231771*	*KM231636*	*KM232187*	–	*KM231901*	*KM232029*
C. chaetopsinae-penicillatae	CBS 608.92^{T}; GJS 77-21; ATCC 56205	*Beilschmiedia tawa*	G.J. Samuels	New Zealand	HQ897847	–	–	–	HQ897798	*KM231638*	–	HQ897709	*KM231903*	*KM232031*
C. fulva	CBS 142.56^{T}; IMI 062199	*Cedrus deodara*	A. Rambeli	Italy	*KM230977*	*KM231165*	*KM231338*	*KM231495*	*KM231772*	*KM231637*	*KM232188*	–	*KM231902*	*KM232030*
Ciliciopodium brevipes	CBS 691.83	*Fagus sylvatica*	G.S. de Hoog	The Netherlands	–	*KM231266*	*KM231451*	–	*KM231856*	*KM231736*	*KM232291*	*KM232432*	*KM231992*	*KM232126*
C. hyalinum	CBS 106.13^{T}	Soil	W. Daszewska	Switzerland	*KM231103*	*KM231267*	–	*KM231606*	*KM231857*	*KM231737*	*KM232292*	*KM232433*	*KM231993*	–
Coccinonectria pachysandricola	CBS 501.63; BBA 808; CCT 4699	*Pachysandra terminalis*	R. Schneider	Germany	*KM230979*	*KM231167*	*KM231340*	*KM231497*	*KM231774*	*KM231640*	*KM232190*	*KM232350*	*KM231905*	*KM232033*
	CBS 476.92; PD 92/1036	*Pachysandra terminalis*		The Netherlands	*KM230980*	*KM231168*	–	*KM231498*	*KM231775*	*KM231641*	*KM232191*	–	*KM231906*	*KM232034*
	CBS 128674; AR 4592	*Pachysandra terminalis*	P. Brown	USA	*KM230981*	JF832512	*KM231341*	*KM231499*	JF832658	JF832715	JF832791	*KM232351*	JF832544	JF832909
C. rusci	CBS 126108^{T}	*Ruscus aculeatus*	C. Lechat	France	*KM230978*	*KM231166*	*KM231339*	*KM231496*	*KM231773*	*KM231639*	*KM232189*	*KM232349*	*KM231904*	*KM232032*
Corallomycetella elegans	CBS 275.60	*Musa sapientum*		Zaire	–	*KM231237*	–	*KM231567*	*KM231828*	*KM231710*	–	*KM232393*	*KM231963*	*KM232100*
C. repens	CBS 358.49	*Carica papaya*	K.B. Boedjin & J. Reitsma	Java	*KM231063*	KC479740	–	*KM231565*	KC479756	*KM231708*	*KM232258*	*KM232391*	*KM231961*	KC479785
	CBS 118.84; IMI 101072	Soil	O.S. Peries	Sri Lanka	*KM231064*	KC479738	–	*KM231566*	KC479755	*KM231709*	*KM232259*	*KM232392*	*KM231962*	KC479784
Corallonectria jatrophae	CBS 913.96^{T}; GJS 96-18	Unknown tree	G.J. Samuels	Puerto Rico	*KM230951*	KC479744	*KM231273*	*KM231457*	KC479758	*KM231611*	*KM232132*	*KM232298*	*KM231863*	KC479787
Cosmospora arxii	CBS 748.69^{T}	*Hypoxylon* sp.	W. Gams	Germany	HQ897725	*KM231224*	*KM231401*	*KM231553*	KM231819	*KM231694*	*KM232245*	HQ897862	*KM231950*	*KM232089*
C. coccinea	CBS 341.70^{T}	*Inonotus nodulosus*	W. Gams	Germany	HQ897913	*KM231221*	*KM231398*	*KM231550*	HQ897827	*KM231692*	*KM232242*	HQ897777	*KM231947*	*KM232086*
C. cymosa	CBS 762.69^{T}	*Inonotus radiatus*	W. Gams	Germany	HQ897914	*KM231222*	*KM231399*	*KM231551*	HQ897828	*KM231693*	*KM232243*	HQ897778	*KM231948*	*KM232087*

Table 1. (Continued)

Species	Isolate nr.[1]	Substrate	Collector/ Depositor	Locality	GenBank Accession No.[2]									
					acl1	*act*	*cmdA*	*his3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
Cosmospora sp.	CBS 101915; GJS 83-159	Lichen	G.J. Samuels	New Zealand	*KM231058*	*KM231225*	*KM231402*	*KM231554*	*KM231820*	*KM231695*	*KM232246*	*KM232386*	*KM231951*	*KM232090*
Curvicladiella cignea	CBS 101411; MUCL 40268	Decaying seed	C. Decock	French Guiana	*KM230967*	*KM231120*	*KM231285*	*KM231459*	*KM231744*	JQ666075	*KM232141*	*KM232310*	*KM231866*	*KM232001*
	CBS 109167^{T}; CPC 1595; MUCL 40269	Leaf litter	C. Decock	French Guiana	*KM230969*	*KM231122*	*KM231287*	*KM231461*	AF220973	AY793431	*KM232142*	*KM232311*	*KM231867*	*KM232002*
	CBS 109168; CPC 1594; MUCL 40268	Decaying seed	C. Decock	French Guiana	*KM230968*	*KM231121*	*KM231286*	*KM231460*	*KM231745*	JQ666074	*KM232143*	*KM232312*	*KM231868*	*KM232003*
Cyanonectria buxi	CBS 130.97	*Buxus sempervirens*	H.-J. Schroers	France	HM626622	*KM231210*	*KM231388*	*KM231539*	*KM231811*	*KM231679*	*KM232233*	HM626690	HQ728150	*KM232075*
	CBS 125551^{T}; HJS 1398	*Buxus sempervirens*	H.-J. Schroers	Slovenia	HM626630	–	–	–	HM626661	HM626673	–	HM626689	HM626648	–
C. cyanostoma	CBS 101734^{T}; GJS 98-127	*Buxus sempervirens*	G.J. Samuels & F. Candoussau	France	HQ897895	GQ505961	*KM231387*	*KM231538*	FJ474076	HM626671	GQ506017	HQ897759	HM484611	HM484535
Cylindrium aeruginosum	CBS 693.83	*Fagus sylvatica*	G.S. de Hoog	The Netherlands	–	*KM231265*	*KM231450*	–	*KM231854*	*KM231734*	–	*KM232430*	*KM231990*	*KM232124*
C. elongatum	CBS 685.83A	*Fagus* sp.	G.S. de Hoog	The Netherlands	–	*KM231264*	*KM231448*	–	*KM231852*	*KM231732*	–	*KM232428*	*KM231988*	*KM232122*
	CBS 115974		G. Verkley	The Netherlands	*KM231101*	–	*KM231449*	*KM231605*	*KM231853*	*KM231733*	*KM232289*	*KM232429*	*KM231989*	*KM232123*
Cylindrocarpostylus gregarius	CBS 101072^{T}	*Hylurgops palliatus*	R. Kirschner	Germany	*KM231021*	*KM231127*	*KM231292*	–	*KM231747*	JQ666084	*KM232144*	*KM232317*	*KM231870*	*KM232005*
	CBS 101073	*Pinus sylvestris*	R. Kirschner	Germany	*KM231022*	*KM231128*	*KM231293*	*KM231465*	*KM231748*	JQ666083	–	*KM232318*	*KM231871*	*KM232006*
	CBS 101074	*Picea abies*	R. Kirschner	Germany	*KM231020*	*KM231126*	*KM231291*	–	*KM231746*	*KM231614*	–	*KM232316*	*KM231869*	*KM232004*
Cylindrocladiella camelliae	CPC 234^{T}; PPRI 3990; IMI 346845	*Eucalyptus grandis*	P.W. Crous	South Africa	*KM230959*	*KM231115*	*KM231280*	AY793509	AF220952	JN099249	*KM232139*	*KM232304*	JN099087	AY793471
C. lageniformis	CBS 340.92^{T}; PPRI 4449; UFV 115	*Eucalyptus* sp.	A.C. Alfenas	Brazil	*KM230958*	*KM231114*	*KM231279*	AY793520	AF220959	JN099165	JN989491	*KM232303*	JN099003	AY793481
C. parva	CBS 114524^{T}; ATCC 28272; CPC 2370	*Telopea speciosissima*	H.J. Boesewinkel	New Zealand	*KM230960*	*KM231116*	*KM231281*	AY793526	AF220964	JN099171	*KM232140*	–	JN099009	AY793486
Cylindrodendrum album	CBS 301.83^{T}; ATCC 46842; IMI 255534	*Fucus distichus*	R.C. Summerbell	Canada	*KM231046*	*KM231152*	*KM231322*	*KM231484*	*KM231764*	*KM231626*	*KM232162*	*KM232339*	*KM231889*	*KM232021*
	CBS 110655	Soil	F.X. Prenafeta-Boldú	The Netherland	*KM231047*	*KM231153*	*KM231323*	*KM231485*	*KM231765*	*KM231627*	*KM232340*	*KM232340*	*KM231890*	*KM232022*
C. hubeiense	CBS 129.97	*Viscum album*	W. Gams	France	*KM231048*	*KM231154*	*KM231324*	*KM231486*	*KM231766*	*KM231628*	*KM232164*	*KM232341*	*KM231891*	*KM232023*
Dactylonectria alcacerensis	CBS 129087^{T}; CPC 19172	*Vitis vinifera*	A. Cabral & H. Oliveira	Portugal	*KM231054*	*KM231158*	*KM231330*	JF735630	JF735333	*KM231629*	*KM232176*	–	JF735819	AM419111
D. estremocensis	CBS 129085^{T}; CPC 19170	*Vitis vinifera*	C. Rego & T. Nascimento	Portugal	*KM231052*	*KM231156*	*KM231328*	JF735617	JF735320	*KM231630*	*KM232174*	*KM232345*	JF735807	JF735448

(*continued on next page*)

Table 1. (Continued)

Species	Isolate nr.[1]	Substrate	Collector/ Depositor	Locality	GenBank Accession No.[2]									
					acl1	***act***	***cmdA***	***his3***	**ITS**	**LSU**	***rpb1***	***rpb2***	***tef1***	***tub2***
D. macrodidyma	CBS 112615^{T}; CPC 3976	*Vitis vinifera*	F. Halleen	South Africa	*KM231055*	HM352883	*KM231331*	JF735647	AY677290	HM364315	HM364333	JF268710	JF268750	AY677233
D. novozelandica	CBS 113552^{T}; CPC 5713	*Vitis vinifera*	R. Bonfiglioli	New Zealand	*KM231053*	*KM231157*	*KM231329*	JF735633	JF735334	–	*KM232175*	*KM232346*	JF735822	AY677237
D. torresensis	CBS 129086^{T}; CPC 19171	*Vitis vinifera*	A. Cabral	Portugal	*KM231056*	*KM231159*	*KM231332*	JF735681	JF735362	*KM231631*	*KM232177*	*KM232347*	JF735870	JF735492
Dialonectria episphaeria	CBS 125494; TG 2006-11	Unknown Ascomycete	T. Gräfenhan	Canada	HQ897892	*KM231227*	*KM231404*	*KM231556*	HQ897811	*KM231697*	*KM232248*	HQ897756	*KM231953*	*KM232092*
D. ullevolea	CBS 125493; TG 2007-56	Unknown Ascomycete	T. Gräfenhan	USA	HQ897918	*KM231226*	*KM231403*	*KM231555*	*KM231821*	*KM231696*	*KM232247*	HQ897782	*KM231952*	*KM232091*
Dematiocladium celtidis	CBS 115994^{T}	*Celtis tala*	N. Allegrucci	Argentina	*KM230952*	*KM231108*	*KM231274*	–	AY793430	AY793438	*KM232133*	–	*KM231864*	–
Falcocladium multivesiculatum	CBS 120386^{T}; PREM 51541; CPC 13207	Leaf litter	S.F. Silveira	Brazil	*KM231099*	*KM231262*	–	–	JF831936	JF831932	*KM232287*	–	–	–
F. sphaeropedunculatum	CBS 111292^{T}; CPC 1448	Leaf litter	P.W. Crous	Brazil	–	*KM231260*	–	–	JF831938	JF831933	*KM232285*	–	–	–
F. thailandicum	CBS 121717^{T}; CPC 13489	*Eucalyptus camaldulensis*	W. Himaman	Thailand	*KM231098*	*KM231261*	–	–	JF831939	JF831934	*KM232286*	–	–	–
Fusarium circinatum	CBS 405.97^{T}; BBA 69720; DAOM 225113; MRC 7541; NRRL 25331	*Pinus radiata*	J. Correll	USA	*KM231017*	*KM231215*	*KM231393*	*KM231544*	U61677	AY249397	JX171510	JX171623	*KM231943*	*KM232080*
F. proliferatum	CBS 189.38; IMI 035108; MUCL 1129		B.L. Chona	India	*KM231019*	*KM231217*	*KM231395*	*KM231546*	*KM231816*	*KM231685*	*KM232238*	*KM232384*	–	*KM232082*
	CBS 263.54; ATCC 10052; IMI 058292; NRRL 2374; QM 1224	*Avena sativa*	T.S. Ramakrishnan	India	*KM231018*	*KM231216*	*KM231394*	*KM231545*	*KM231815*	*KM231684*	*KM232237*	*KM232383*	–	*KM232081*
F. sambucinum	CBS 146.95; BBA 64226	*Solanum tuberosum*	H.I. Nirenberg	UK	*KM231015*	*KM231213*	*KM231391*	*KM231542*	*KM231813*	*KM231682*	*KM232235*	*KM232381*	*KM231941*	*KM232078*
F. subluratum	CBS 189.34^{T}; BBA 62431; NRRL 13384	Soil	O.A. Reinking	Costa Rica	HQ897916	*KM231211*	*KM231389*	*KM231540*	HQ897830	*KM231680*	HQ897780	*KM232380*	–	*KM232076*
F. venenatum	CBS 458.93^{T}; BBA 64537; NRRL 26228	Winter wheat	H.I. Nirenberg	Austria	*KM231016*	*KM231214*	*KM231392*	*KM231543*	*KM231814*	*KM231683*	*KM232236*	*KM232382*	*KM231942*	*KM232079*
F. verrucosa	CBS 102163; GJS 84-426	Bamboo	G.J. Samuels	Venezuela	HQ897920	*KM231212*	*KM231390*	*KM231541*	*KM231812*	*KM231681*	*KM232234*	HQ897784	*KM231940*	*KM232077*
Fusicolla aquaeductuum	CBS 837.85; BBA 64559; NRRL 20865	Plug in water tap	H.I. Nirenberg	Germany	HQ897880	–	*KM231406*	–	*KM231823*	*KM231699*	*KM232250*	HQ897744	*KM231955*	*KM232094*

Table 1. (Continued)

Species	**Isolate nr.**[1]	**Substrate**	**Collector/ Depositor**	**Locality**	**GenBank Accession No.**[2]									
					acl1	***act***	***cmdA***	***his3***	**ITS**	**LSU**	***rpb1***	***rpb2***	***tef1***	***tub2***
F. matuoi	CBS 581.78; ATCC 18694; NRRL 20427	*Albizzia julibrissin*	T. Matuo	Japan	HQ897858	*KM231228*	*KM231405*	*KM231557*	*KM231822*	*KM231698*	*KM232249*	HQ897720	*KM231954*	*KM232093*
F. violacea	CBS 634.76^{T}; BBA 62461; NRRL 20896	*Quadraspidiotus perniciosus*	W. Gerlach	Iran	*KM231059*	*KM231229*	*KM231407*	*KM231558*	*KM231824*	*KM231700*	*KM232251*	HQ897696	*KM231956*	*KM232095*
Geejayessia celtidicola	CBS 125502^{T}; TG 2008-32	*Celtis occidentalis*	T. Gräfenhan	Canada	HM626625	*KM231209*	*KM231386*	*KM231537*	HM626657	HM626669	*KM232232*	HM626685	HM626638	*KM232074*
G. cicatricum	CBS 125549^{T}; HJS 1372	*Buxus sempervirens*	H.-J. Schroers	Slovenia	HM626636	*KM231208*	*KM231385*	*KM231536*	*KM231810*	*KM231678*	*KM232231*	HM626679	HM626643	*KM232073*
G. desmazieri	CBS 125507; TG 2007-87	*Buxus sempervirens*	T. Gräfenhan	Spain	HM626633	*KM231207*	*KM231384*	*KM231535*	HM626651	HM626663	*KM232230*	HM626675	HQ728146	*KM232072*
Gliocephalotrichum bulbilium	CBS 242.62^{T}; ATCC 22228; IFO 9325; IMI 096357; MUCL 18575; NRRL 2899; QM 9007	Soil	L.J. Wickerham	USA	*KM230962*	*KM231118*	*KM231283*	KF513326	DQ377831	AY489732	AY489664	EF469114	*KM231892*	DQ377831
G. cylindrosporum	CBS 902.70^{T}; ATCC 22229; IFO 9326; IMI 155704; MUCL 18576; QM 9009	Soil	C. Klinsukont	Thailand	*KM230963*	*KM231119*	*KM231284*	KF513353	DQ366705	JQ666077	*KM232179*	*KM232306*	KF513408	DQ377841
G. longibrachium	CBS 126571^{T}; MUCL 46693	Leaf litter	C. Decock & V. Robert	French Guiana	*KM230961*	*KM231117*	*KM231282*	KF513367	DQ278422	*KM231686*	*KM232178*	*KM232305*	KF513435	DQ377835
Gliocladiopsis irregularis	CBS 755.97^{T}; CPC 718	Soil	A.C. Alfenas	Indonesia	*KM230957*	*KM231113*	*KM231278*	JQ666023	AF220977	JQ666082	*KM232138*	*KM232302*	KF513449	JQ666133
G. pseudotenuis	CBS 116074^{T}; CPC 706	Soil	M.J. Wingfield	China	*KM230956*	*KM231112*	*KM231277*	JQ666030	AF220981	JQ666080	*KM232137*	*KM232301*	JQ666099	JQ666140
G. sagariensis	CBS 199.55^{T}	Soil	S.B. Saksena	India	*KM230955*	*KM231111*	*KM231276*	JQ666031	JQ666063	JQ666078	*KM232136*	*KM232300*	JQ666106	JQ666141
Hyaloseta nolinae	CBS 109837^{T}	*Nolina micrantha*	A.W. Ramaley	USA	*KM231092*	*KM231255*	*KM231442*	*KM231600*	*KM231846*	*KM231726*	*KM232279*	*KM232422*	JQ666107	–
Ilyonectria capensis	CBS 132815^{T}	*Protea* sp.	K. Bezuidenhout	South Africa	–	–	*KM231319*	JX231135	JX231151	KM515908	*KM232171*	*KM232336*	JX231119	JX231103
I. coprosmae	CBS 119606; GJS 85-39	*Metrosideros* sp.	G.J. Samuels	New Zealand	–	*KM231151*	*KM231321*	JF735505	JF735260	KM515910	*KM232173*	*KM232338*	JF735694	JF735373
I. destructans	CBS 264.65	*Cyclamen persicum*	L. Nilsson	Sweden	–	*KM231148*	*KM231317*	JF735506	AY677273	KM515927	*KM232169*	*KM232334*	JF735695	AY677256
I. leucospermi	CBS 132809	*Leucospermum* sp.	K. Bezuidenhout	South Africa	–	*KM231150*	*KM231320*	JX231145	JX231161	KM515917	*KM232172*	*KM232337*	JX231129	JX231113
I. liriodendri	CBS 117527	*Vitis vinifera*	C. Rego	Portugal	–	*KM231149*	*KM231318*	JF735509	DQ178165	KM515922	*KM232170*	*KM232335*	JF735698	DQ178172
Lectera colletotrichoides	CBS 109728	*Medicago sativa*	C. Eken	Turkey	*KM231100*	*KM231263*	*KM231447*	*KM231604*	KM231851	*KM231731*	*KM232288*	*KM232427*	*KM231987*	*KM232121*
Macroconia leptosphaeria	CBS 717.74	Stroma of Pyrenomycete	W. Gams	France	*KM231062*	*KM231236*	*KM231414*	*KM231564*	KM231827	*KM231707*	*KM232257*	*KM232390*	JF735695	*KM232099*
	CBS 100001	*Urtica dioica*	L. Rommelaars	The Netherlands	HQ897891	*KM231234*	*KM231412*	*KM231562*	HQ897810	*KM231705*	*KM232255*	HQ897755	*KM231959*	*KM232097*
	CBS 112770	*Cucurbitaria laburni*	W. Gams	Austria	*KM231061*	*KM231235*	*KM231413*	*KM231563*	KM231826	*KM231706*	*KM232256*	KM232389	*KM231960*	*KM232098*

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Table 1. (Continued)

Species	Isolate nr.[1]	Substrate	Collector/ Depositor	Locality	GenBank Accession No.[2]									
					acl1	*act*	*cmdA*	*his3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
M. papilionacearum	CBS 125495; DAOM 238119; TG 2007-03	Black ascomycete on *Fabaceae*	T. Gräfenhan	USA	HQ897912	*KM231233*	*KM231411*	*KM231561*	HQ897826	*KM231704*	*KM232254*	HQ897776	*KM231958*	*KM232096*
Mariannaea camptospora	CBS 209.73^{T}; IMI 186965	Soil	E. Jansen	The Netherlands	*KM231032*	*KM231134*	*KM231303*	*KM231473*	AY624202	–	*KM232147*	*KM232326*	*KM231875*	AY624245
	CBS 120801	Decaying wood	W. Gams	Germany	*KM231031*	*KM231133*	*KM231302*	*KM231472*	*KM231753*	*KM231618*	*KM232151*	*KM232325*	*KM231878*	*KM232010*
M. catenulatae	CBS 491.92^{T}; ATCC 56204	Wood	G.J. Samuels	Venezuela	*KM231030*	*KM231132*	*KM231301*	*KM231471*	*KM231752*	*KM231617*	*KM232150*	–	*KM231877*	*KM232009*
M. humicola	CBS 740.95^{T}; CCT 4534	Soil	S. Baldini	Brazil	*KM231034*	*KM231136*	*KM231305*	*KM231475*	*KM231755*	*KM231619*	*KM232153*	*KM232328*	*KM231880*	*KM232012*
	CBS 102628; INIFAT C99/130-2	Decaying wood	R.F. Castañeda	Spain	*KM231035*	*KM231137*	*KM231306*	*KM231476*	*KM231756*	*KM231620*	*KM232154*	*KM232329*	*KM231881*	*KM232013*
M. pinicola	CBS 745.88^{T}; CTR 71-199	*Pinus* sp.	C.T. Rogerson	Venezuela	*KM231033*	*KM231135*	*KM231304*	*KM231474*	*KM231754*	AY554242	*KM232152*	*KM232327*	*KM231879*	*KM232011*
M. punicea	CBS 239.56^{T}	Soil	J. Meyer	Zaire	*KM231028*	–	*KM231299*	*KM231469*	AY624201	JF415981	*KM232148*	JF416001	*KM231876*	AY624244
	CBS 105.66	Soil	J.H. van Emden	The Netherlands	*KM231029*	*KM231131*	*KM231300*	*KM231470*	*KM231751*	*KM231616*	*KM232149*	*KM232324*	JF416021	*KM232008*
M. samuelsii	CBS 746.88; CTR 71-13	Bark	C.T. Rogerson	Jamaica	*KM231036*	*KM231138*	*KM231307*	*KM231477*	*KM231757*	*KM231621*	*KM232155*	*KM232330*	*KM231882*	*KM232014*
	CBS 125515^{T}; DAOM 235814; KAS 1307	Soil	J. Bissett	Guatamala	HQ897888	*KM231139*	*KM231308*	*KM231478*	HQ843767	HQ843766	*KM232156*	HQ897752	*KM231883*	*KM232015*
Microcera coccophila	CBS 310.34; NRRL 13962	Scale insect	H.W. Wollenweber	Italy	HQ897843	*KM231232*	*KM231410*	*KM231560*	HQ897794	*KM231703*	JX171462	HQ897705	JF740692	–
M. larvarum	CBS 738.79; BBA 62239; MUCL 19033; NRRL 20473	*Quadrapidiotus perniciosus*	W. Gerlach	Iran	*KM231060*	*KM231230*	*KM231408*	*KM231559*	*KM231825*	*KM231701*	*KM232252*	*KM232387*	*KM231957*	–
M. rubra	CBS 638.76^{T}; BBA 62460; NRRL 20475	*Quadrapidiotus perniciosus*	W. Gerlach & D. Ershad	Iran	HQ897903	*KM231231*	*KM231409*	EU860073	HQ897820	*KM231702*	*KM232253*	HQ897767	JF740696	EU860019
Nalanthamala psidii	CBS 116952^{T}; AR 4095	*Psidium guajava*	Y-F. Yen	Taiwan	*KM231073*	*KM231245*	*KM231423*	*KM231576*	AY864836	AY864837	*KM232268*	KM232401	*KM231972*	AY864838
N. vermoesenii	CBS 230.48; ATCC 10522; IMI 040231; MUCL 7584; NRRL 1752	*Citrus medica*	H.S. Fawcett	Spain	*KM231071*	*KM231243*	*KM231421*	*KM231574*	AY554212	AY554263	*KM232266*	*KM232399*	*KM231970*	AY554231
	CBS 110893^{T}; MUCL 9504	*Areca* sp.	P. Biourge		*KM231072*	*KM231244*	*KM231422*	*KM231575*	AY554214	AY554246	*KM232267*	*KM232400*	*KM231971*	AY554233
Nectria balansae	CBS 123351; AR 4446	*Coronila* sp.	C. Lechat	France	*KM231079*	GQ505977	*KM231429*	*KM231582*	HM484552	GQ505996	GQ506026	*KM232407*	HM484525	HM484607
	CBS 125119; GJS 86-117	Woody vine	G.J. Samuels	French Guiana	*KM231078*	JF832486	*KM231428*	*KM231581*	HM484857	HM484868	HM484871	*KM232406*	HM484848	HM484874
	CBS 129349; AR 4635	Twigs	W.Y. Zhuang & X.M. Zhang	China	*KM231077*	JF832485	*KM231427*	*KM231580*	JF832653	JF832711	JF832790	*KM232405*	JF832522	JF832908

Table 1. (Continued)

Species	Isolate nr.[1]	Substrate	Collector/ Depositor	Locality	GenBank Accession No.[2]									
					acl1	***act***	***cmdA***	***his3***	**ITS**	**LSU**	***rpb1***	***rpb2***	***tef1***	***tub2***
N. cinnabarina	CBS 125165^{T}; AR 4477; CLL 7152	*Aesculus* sp.	C. Lechat	France	*KM231074*	HM484503	*KM231424*	*KM231577*	HM484548	HM484562	HM484577	*KM232402*	HM484527	HM484606
"*N. dacryocarpa*"	CBS 121.87; GJS 85-185	Tree fern	G.J. Samuels	Sulawesi	*KM231097*	*KM231259*	–	*KM231587*	*KM231850*	*KM231730*	*KM232284*	–	*KM231986*	*KM232120*
	CBS 113532	*Pithya cupressina*	S. Ryman & O. Constantinescu	Sweden	*KM231094*	*KM231257*	*KM231444*	*KM231601*	*KM231848*	*KM231728*	*KM232281*	*KM232424*	*KM231984*	*KM232118*
N. mariae	CBS 125294^{T}; CLL 7187	*Buxus sempervirens*	C. Lechat	France	*KM231076*	JF832499	*KM231426*	*KM231579*	JF832629	JF832684	JF832789	*KM232404*	JF832542	JF832899
N. nigrescens	CBS 125148^{T}; AR 4211	Wood	A.Y. Rossman	USA	*KM231075*	HM484618	*KM231425*	*KM231578*	HM484707	HM484720	HM484781	*KM232403*	HM484672	HM484806
Neocosmospora ambrosia	CBS 571.94; BBA 65390	*Camellia sinensis*	H.I. Nirenberg	India	*KM231003*	*KM231198*	*KM231373*	–	*KM231801*	*KM231668*	*KM232220*	*KM232368*	*KM231929*	*KM232063*
N. haematococca	CBS 101573	*Passiflora edulis*	C.F. Hill	New Zealand	*KM231000*	*KM231195*	*KM231370*	*KM231522*	*KM231798*	*KM231665*	*KM232217*	*KM232365*	*KM231927*	*KM232060*
	CBS 119600^{T}; GJS 02-90	Dying tree	G.J. Samuels	Sri Lanka	*KM230999*	*KM231194*	*KM231369*	*KM231521*	*KM231797*	*KM231664*	*KM232216*	–	*KM231926*	*KM232059*
	CBS 123669; NRRL 45880				*KM230998*	*KM231193*	*KM231368*	*KM231520*	*KM231796*	*KM231663*	*KM232215*	*KM232364*	*KM231925*	*KM232058*
N. illudens	CBS 119605; GJS 85-37	*Metrosideros sp.*	G.J. Samuels	New Zealand	*KM231009*	*KM231202*	*KM231379*	*KM231530*	*KM231806*	*KM231673*	*KM232225*	*KM232374*	*KM231935*	*KM232068*
	CBS 126406; GJS 85-67	Bark	G.J. Samuels	New Zealand	*KM231008*	JF832443	*KM231378*	*KM231529*	JF832660	JF832762	JF832837	*KM232373*	*KM231934*	JF832841
N. phaseoli	CBS 265.50	*Phaseolus* sp.	W.C. Snyder	USA	*KM231010*	*KM231203*	*KM231380*	*KM231531*	*KM231807*	*KM231674*	*KM232226*	*KM232375*	HE647964	HE648035
	CBS 102429; HJS 0332	Bark	G.J. Samuels	Australia	*KM231011*	*KM231204*	*KM231381*	*KM231532*	*KM231808*	*KM231675*	*KM232227*	*KM232376*	*KM231936*	*KM232069*
N. ramosa	CBS 509.63^{T}; IMUR 410; MUCL 8050	Air	A.C. Batista	Brazil	*KM231004*	*KM231199*	*KM231374*	*KM231525*	*KM231802*	*KM231669*	*KM232221*	*KM232369*	*KM231930*	*KM232064*
N. rubicola	CBS 320.73; ATCC 24395; IMI 131652; NRRL 22107	Soil	M.M. Musa	Sudan	*KM231001*	*KM231196*	*KM231371*	*KM231523*	*KM231799*	*KM231666*	*KM232218*	*KM232366*	DQ247551	*KM232061*
	CBS 101018^{T}	*Rubus idaeus*	A. Zazzerini	Italy	*KM231002*	*KM231197*	*KM231372*	*KM231524*	*KM231800*	*KM231667*	*KM232219*	*KM232367*	*KM231928*	*KM232062*
N. vasinfecta	CBS 325.54; ATCC 16238; IFO 7591	Soil	H.J. Swart	South Africa	*KM231005*	*KM231200*	*KM231375*	*KM231526*	*KM231803*	*KM231670*	*KM232222*	*KM232370*	*KM231931*	*KM232065*
	CBS 562.70; ATCC 32363; IMI 251387	*Arachis hypogaea*	M.A. de Freitas Barbosa	Guinea	*KM231007*	–	*KM231377*	*KM231528*	*KM231805*	*KM231672*	*KM232224*	*KM232372*	*KM231933*	*KM232067*
	CBS 517.71; IMI 302626	Soil	P. Rama Rao	India	*KM231006*	*KM231201*	*KM231376*	*KM231527*	*KM231804*	*KM231671*	*KM232223*	*KM232371*	*KM231932*	*KM232066*
Neonectria candida	CBS 151.29; IMI 113894; MUCL 28083	*Malus sylvestris*	H.W. Wollenweber	UK	*KM231044*	*KM231146*	*KM231315*	JF735602	AY677291	HM042436	*KM232168*	DQ789792	DQ789723	DQ789863

(*continued on next page*)

Table 1. (Continued)

Species	**Isolate nr.**[1]	**Substrate**	**Collector/ Depositor**	**Locality**	**GenBank Accession No.**[2]									
					acl1	***act***	***cmdA***	***his3***	**ITS**	**LSU**	***rpb1***	***rpb2***	***tef1***	***tub2***
N. lugdunensis	CBS 125485; DAOM 235831; TG 2008-07	*Populus fremontii*	T. Gräfenhan	USA	HQ897867	*KM231145*	*KM231314*	*KM231482*	*KM231762*	*KM231625*	*KM232160*	HQ897731	*KM231887*	*KM232019*
N. neomacrospora	CBS 324.61; DSM 62489	*Abies concolor*	J.A. von Arx	The Netherlands	*KM231042*	*KM231144*	*KM231313*	JF735599	JF735312	HM364318	HM364335	DQ789803	HM364335	DQ789875
	CBS 198.62; BBA 9628; IMI 113890	*Abies concolor*	W. Gerlach	Germany	*KM231041*	*KM231143*	*KM231312*	*KM231481*	AJ009255	HM364316	*KM232167*	DQ789795	JF735788	DQ789866
N. tsugae	CBS 788.69^{T}	*Tsuga heterophylla*	J.E. Bier	Canada	HQ897865	*KM231147*	*KM231316*	*KM231483*	*KM231763*	HQ232146	*KM232161*	HQ897728	DQ789720	*KM232020*
Ophionectria trichospora	CBS 314.75^{T}; ATCC 28509; DAOM 139482; IMI 166077	Dead wood	R.P. Korf	Jamaica	–	*KM231181*	*KM231354*	–	*KM231788*	*KM231652*	*KM232203*	–	–	*KM232047*
	CBS 109876; GJS 01-155		G.J. Samuels	Cameroon	–	–	*KM231442*	–	–	AF543790	AY489669	DQ522457	AF543779	DQ522520
Paracremonium contagium	CBS 110348^{T}; UAMH 10141	*Homo sapiens*	S. Mohan	Canada	*KM231067*	*KM231240*	*KM231417*	*KM231570*	*KM231831*	HQ232118	*KM232262*	*KM232396*	*KM231966*	*KM232103*
P. inflatum	CBS 485.77^{T}; CDC 77-043179	*Homo sapiens*	A.A. Padhye	India	*KM231065*	*KM231238*	*KM231415*	*KM231568*	*KM231829*	HQ232113	*KM232260*	*KM232394*	*KM231964*	*KM232101*
	CBS 482.78	Soil	O. Rangel	Colombia	*KM231066*	*KM231239*	*KM231416*	*KM231569*	*KM231830*	*KM231711*	*KM232261*	*KM232395*	*KM231965*	*KM232102*
Penicillifer bipapillatus	CBS 420.88^{T}	Bark	C.T. Rogerson	Venezuela	*KM230948*	*KM231105*	*KM231270*	*KM231454*	*KM231740*	*KM231608*	*KM232129*	*KM232295*	*KM231860*	*KM231996*
P. diparietisporus	CBS 376.59^{T}; ATCC 13214; IMI 100713; QM 7720	Soil	A.A. Foster	USA	*KM230949*	*KM231106*	*KM231271*	*KM231455*	*KM231741*	*KM231609*	*KM232130*	*KM232296*	*KM231861*	*KM231997*
P. penicilliferi	CBS 423.88^{T}; GJS 87-48B	Unknown	G.J. Samuels	Guyana	*KM230947*	*KM231104*	*KM231269*	*KM231453*	*KM231739*	*KM231607*	*KM232128*	*KM232294*	*KM231859*	*KM231995*
P. pulcher	CBS 560.67^{T}; ATCC 18931; MUCL 11607	Soil	J.H. van Emden	The Netherlands	*KM230950*	*KM231107*	*KM231272*	*KM231456*	*KM231742*	*KM231610*	*KM232131*	*KM232297*	*KM231862*	*KM231998*
Pochonia sp.	CBS 401.70; NRRL 26536	Myxomycete	W. Gams	The Netherlands	*KM231089*	*KM231252*	*KM231439*	*KM231598*	*KM231843*	AF339518	*KM232276*	*KM232419*	*KM231980*	*KM232114*
	CBS 892.72	*Arcyria* sp.	W. Gams	The Netherlands	*KM231090*	*KM231253*	*KM231440*	*KM231599*	*KM231844*	*KM231724*	*KM232277*	*KM232420*	*KM231981*	*KM232115*
	CBS 634.75	Myxomycete	W. Gams	The Netherlands	*KM231091*	*KM231254*	*KM231441*	–	*KM231845*	*KM231725*	*KM232278*	*KM232421*	*KM231982*	*KM232116*
Pseudonectria buxi	CBS 324.53	*Buxus sempervirens*	J.A. von Arx	The Netherlands	*KM230984*	*KM231171*	*KM231344*	*KM231502*	*KM231778*	*KM231644*	*KM232194*	*KM232353*	*KM231909*	*KM232037*
	CBS 114049; AR 2716	*Buxus sempervirens*	R. Lowen	Spain	*KM230985*	*KM231172*	*KM231345*	*KM231503*	*KM231779*	U17416	AY489670	*KM232354*	*KM231910*	*KM232038*
"*P. coronata*"	CBS 696.93	*Buxus sempervirens*	F. Candoussau	France	*KM231086*	–	*KM231437*	–	*KM231840*	*KM231721*	*KM232273*	*KM232416*	*KM231977*	*KM232111*
P. foliicola	CBS 122566; AR 2709	*Buxus sempervirens*	A.Y. Rossman	USA	*KM230983*	*KM231170*	*KM231343*	*KM231501*	*KM231777*	*KM231643*	*KM232193*	–	*KM231908*	*KM232036*
	CBS 123190^{T}; CPC 15385	*Buxus sempervirens*	S. Trower	New Zealand	*KM230982*	*KM231169*	*KM231342*	*KM231500*	*KM231776*	*KM231642*	*KM232192*	*KM232352*	*KM231907*	*KM232035*

Table 1. (Continued)

Species	Isolate nr.[1]	Substrate	Collector/ Depositor	Locality	GenBank Accession No.[2]									
					acl1	***act***	***cmdA***	***his3***	**ITS**	**LSU**	***rpb1***	***rpb2***	***tef1***	***tub2***
Rectifusarium robinianum	CBS 830.85; BBA 64246; NRRL 13953	*Solanum tuberosum*	H. Nirenberg	Germany	*KM230992*	–	*KM231359*	*KM231511*	*KM231793*	*KM231656*	JX171461	JX171575	*KM231922*	*KM232052*
	CBS 430.91^{T}; NRRL 25729	*Robinia pseudoacacia*	U. Kuchenbäcker	Germany	HQ897907	–	*KM231360*	*KM231512*	*KM231794*	KM231657	JX171520	HQ897771	*KM231923*	*KM232053*
R. ventricosum	CBS 748.79^{T}; BBA 62452; NRRL 20846; NRRL 22113	Soil	W. Gams	Germany	HQ897897	*KM231186*	*KM231361*	*KM231513*	HQ897816	*KM231658*	*KM232208*	HQ897761	*KM231924*	*KM232054*
Rodentomyces reticulatus	CBS 128675^{T}; AR 4677; DSM 23301	Rodent dung	F. Doveri	Italy	*KM231096*	JF832480	*KM231446*	*KM231603*	JF832659	JF832717	*KM232283*	*KM232426*	JF832543	JF832910
Rugonectria neobalansae	CBS 125120; GJS 85-219	Dead tree	G.J. Samuels	Indonesia	*KM231023*	*KM231129*	*KM231294*	*KM231466*	*KM231750*	HM364322	*KM232146*	*KM232321*	*KM231874*	HM352869
R. rugulosa	CBS 126565; GJS 09-1245	Dead tree	Y. Hirooka	Venezuela	*KM231024*	*KM231130*	*KM231296*	*KM231468*	*KM231749*	*KM231615*	*KM232145*	*KM232320*	*KM231873*	*KM232007*
	CBS 129158		Y. Hirooka	USA	*KM231025*	JF832515	*KM231295*	*KM231467*	JF832661	JF832761	JF832836	*KM232319*	*KM231872*	JF832911
Sarcopodium circinatum	CBS 587.92; CCT 5383	Soil	G. Weber	Costa Rica	–	*KM231180*	*KM231353*	–	*KM231787*	*KM231651*	*KM232202*	*KM232360*	JF832545	*KM232046*
	CBS 100998; INIFAT C98/9	Leaf litter	R.F. Castañeda	Brazil	–	*KM231179*	*KM231352*	*KM231507*	*KM231786*	*KM231650*	*KM232201*	*KM232359*	*KM231917*	*KM232045*
S. circinosetiferum	CBS 100251; FMR 6354	Soil	A.M. Stchigel & M. Calduch	Argentina	*KM230988*	*KM231175*	*KM231348*	*KM231590*	*KM231782*	*KM231646*	*KM232197*	*KM232356*	*KM231913*	*KM232041*
	CBS 100252; FMR 6355	Soil	A.M. Stchigel & M. Calduch	Argentina	*KM230987*	*KM231174*	*KM231347*	*KM231589*	*KM231781*	*KM231645*	*KM232196*	*KM232355*	*KM231912*	*KM232040*
S. flavolanatum	CBS 112283	*Theobroma gileri*	H.C. Evans & R.H. Reeder	Ecuador	–	*KM231178*	*KM231351*	*KM231506*	*KM231785*	*KM231649*	*KM232200*	*KM232358*	*KM231916*	*KM232044*
	CBS 128370	Decaying wood	W.Y. Zhuang & N. Ye	China	*KM230989*	*KM231177*	*KM231350*	*KM231505*	*KM231784*	*KM231648*	*KM232199*	*KM232357*	*KM231915*	*KM232043*
S. macalpinei	CBS 115296; HKUCC 8395	*Viburnum odoratissimum*	K.D. Hyde	Hong Kong	–	*KM231176*	*KM231349*	*KM231591*	*KM231783*	*KM231647*	*KM232198*	–	*KM231914*	*KM232042*
S. vanillae	CBS 100582; PD 98/8/459-1	*Anthurium* sp.	J.W. Veenbaas-Rijks	Ecuador	*KM230986*	*KM231173*	*KM231346*	*KM231504*	*KM231780*	HQ232174	*KM232195*	–	*KM231911*	*KM232039*
Sarocladium kiliense	CBS 400.52	*Ficus carica*	J.M. Waterston	UK	*KM231095*	*KM231258*	*KM231445*	*KM231602*	*KM231849*	*KM231729*	*KM232282*	*KM232425*	*KM231985*	*KM232119*
Septofusidium berolinense	CBS 731.70		G.M. Oláh		*KM231087*	*KM231250*	–	*KM231584*	*KM231841*	*KM231722*	*KM232274*	*KM232417*	*KM231978*	*KM232112*
S. herbarum	CBS 265.58^{T}; IMI 053581	*Urtica dioica*	C. Booth	UK	*KM231088*	*KM231251*	*KM231438*	*KM231585*	*KM231842*	*KM231723*	*KM232275*	*KM232418*	*KM231979*	*KM232113*
Stachybotrys chartarum	CBS 129.13		H.A. Dale		–	*KM231268*	*KM231452*	*KM231588*	*KM231858*	*KM231738*	*KM232293*	*KM232434*	*KM231994*	*KM232127*

(*continued on next page*)

Table 1. (Continued)

Species	Isolate nr.[1]	Substrate	Collector/ Depositor	Locality	GenBank Accession No.[2]									
					acl1	***act***	***cmdA***	***his3***	**ITS**	**LSU**	***rpb1***	***rpb2***	***tef1***	***tub2***
Stylonectria applanata	CBS 125489; TG 2008-24	*Betula* sp.	T. Gräfenhan	Canada	HQ897873	*KM231218*	–	*KM231547*	HQ897803	*KM231689*	*KM232239*	HQ897739	*KM231944*	*KM232083*
S. wegeliniana	CBS 125490; TG 2009-03	*Hapalycystis bicaudata*	H. Voglmayr	Austria	HQ897890	*KM231219*	*KM231396*	*KM231548*	KM231817	*KM231690*	*KM232240*	HQ897754	*KM231945*	*KM232084*
Stylonectria sp.	CBS 125491; TG 2007-21	Unknown Ascomycete	T. Gräfenhan	Germany	HQ897915	*KM231220*	*KM231397*	*KM231549*	HQ897829	*KM231691*	*KM232241*	HQ897779	*KM231946*	*KM232085*
Thelonectria discophora	CBS 125153; AR 4324	*Pinus radiata*	A.Y. Rossman	New Zealand	*KM231049*	HM352875	*KM231327*	*KM231489*	HM364294	HM364307	HM364326	*KM232344*	*KM231897*	HM352860
T. olida	CBS 215.67^{T}; ATCC 16548; DSM 62520; IMI 116873	*Asparagus officinalis*	W. Gerlach	Germany	*KM231050*	HM352884	*KM231325*	*KM231487*	AY677293	HM364317	HM364334	*KM232342*	HM364345	*KM232024*
T. trachosa	CBS 112467^{T}; GJS 92-45; IMI 352560	Bark	D. Bradford & G.J. Samuels	Scotland	*KM231051*	*KM231155*	*KM231326*	*KM231488*	AY677297	HM364312	HM364339	*KM232343*	*KM231896*	AY677258
Thyronectria lamyi	CBS 417.89	*Berberis vulgaris*	H. Schmid	Germany	*KM231083*	JF832516	*KM231434*	*KM231597*	*KM231837*	*KM231718*	JF832830	*KM232413*	JF832580	*KM232108*
T. pyrrhochlora	CBS 125131; AR 2786	*Acer campestre*	A.Y. Rossman	Austria	–	HM484512	–	*KM231594*	HM484545	HM484570	HM484584	*KM232410*	HM484519	HM484598
T. quercicola	CBS 128976^{T}; AR 3805	*Quercus ilex*	J. Checa	Spain	–	JF832450	*KM231433*	*KM231595*	JF832624	JF832743	JF832831	*KM232411*	JF832581	JF832880
T. sinopica	CBS 462.83	*Hedera helix*	H.A. van der Aa	The Netherlands	*KM231082*	GQ505973	–	*KM231596*	HM484542	GQ506001	GQ506031	*KM232412*	HM484531	HM484595
Tilachlidium brachiatum	CBS 505.67	*Hypholoma fasciculare*	W. Gams	Poland	*KM231085*	*KM231249*	*KM231436*	–	*KM231839*	*KM231720*	*KM232272*	*KM232415*	*KM231976*	*KM232110*
	CBS 363.97	*Agaricus* sp.	W. Gams	France	*KM231084*	*KM231248*	*KM231435*	*KM231583*	*KM231838*	*KM231719*	*KM232271*	*KM232414*	*KM231975*	*KM232109*
Trichosphaerella ceratophora	CBS 130.82	*Carpinus betulus*	E. Müller	Switzerland	*KM231093*	*KM231256*	*KM231443*	*KM231586*	*KM231847*	*KM231727*	*KM232280*	*KM232423*	*KM231983*	*KM232117*
Volutella ciliata	CBS 483.61; CCT 5396; MUCL 9859	Soil	G.L. Baron	Canada	*KM230975*	*KM231163*	*KM231336*	*KM231493*	*KM231770*	*KM231635*	*KM232186*	–	HM364356	*KM232028*
V. consors	CBS 139.79; PD 78/836	Decaying orchid bulb	G.H. Boerema	The Netherlands	HQ897853	*KM231161*	*KM231334*	*KM231491*	*KM231768*	*KM231633*	*KM232184*	HQ897715	*KM231899*	*KM232026*
V. minima	CBS 122767	Soil	W. Gams	The Netherlands	*KM230973*	*KM231160*	*KM231333*	*KM231490*	*KM231767*	*KM231632*	*KM232183*		*KM231898*	*KM232025*
V. rosea	CBS 128258	Soil	P.A. Orpurt & J.T. Curtis	USA	*KM230974*	*KM231162*	*KM231335*	*KM231492*	*KM231769*	*KM231634*	*KM232185*	*KM232348*	*KM231900*	*KM232027*
Xenoacremonium falcatus	CBS 400.85^{T}	*Pinus radiata*	J. Reid	New Zealand	*KM231068*	–	*KM231418*	*KM231571*	*KM231832*	HQ232025	*KM232263*	–	*KM231967*	*KM232104*
X. recifei	CBS 137.35^{T}; IHEM 4405; MUCL 9696	*Homo sapiens*	A.E. de Arêa Leão	Brazil	*KM231069*	*KM231241*	*KM231419*	*KM231572*	*KM231833*	HQ232106	*KM232264*	*KM232397*	*KM231968*	*KM232105*
	CBS 541.89	Soil	L. Pfenning	Brazil	*KM231070*	*KM231242*	*KM231420*	*KM231573*	*KM231834*	HQ232114	*KM232265*	*KM232398*	*KM231969*	*KM232106*
Xenocylindrocladium guianense	CBS 112179^{T}; CPC 3496; MUCL 41975	Plant litter	C. Decock	French Guiana	*KM230971*	*KM231124*	*KM231289*	*KM231463*	AF317348	JQ666073	*KM232166*	*KM232314*	*KM231895*	AF320197

Table 1. (Continued)

Species	Isolate nr.[1]	Substrate	Collector/ Depositor	Locality	GenBank Accession No.[2]									
					acl1	*act*	*cmdA*	*his3*	ITS	LSU	*rpb1*	*rpb2*	*tef1*	*tub2*
X. serpens	CBS 128439^{T}; MUCL 39315	Bark	G.L. Hennebert	Ecuador	*KM230972*	*KM231125*	*KM231290*	*KM231464*	AF220982	*KM231688*	*KM232165*	–	*KM231894*	AF320196
X. subverticillatum	CBS 113660T; CPC 3397; MUCL 41834	Plant litter	C. Decock & O. Laurence	Singapore	*KM230970*	*KM231123*	*KM231288*	*KM231462*	AF317347	*KM231687*	–	*KM232313*	*KM231893*	AF320196
Xenogliocladiopsis cypellocarpa	CBS 133814; CPC 19417	*Eucalyptus cypellocarpa*	P.W. Crous	Australia	*KM231039*	*KM231141*	*KM231310*	*KM231479*	*KM231760*	*KM231623*	*KM232158*	*KM232332*	*KM231885*	*KM232017*
	CPC 17153	*Eucalyptus* sp.	P.W. Crous	Australia	*KM231040*	*KM231142*	*KM231311*	*KM231480*	*KM231761*	*KM231624*	*KM232159*	*KM232333*	*KM231886*	*KM232018*
X. eucalyptorum	CBS 138758^{T}; CPC 16271	*Eucalyptus* sp.	P.W. Crous	South Africa	*KM231038*	*KM231140*	*KM231309*	–	*KM231759*	*KM231622*	*KM232157*	*KM232331*	*KM231884*	*KM232016*

^{T} Ex-type and ex-epitype cultures.

[1] AR: Collection of A.Y. Rossman; ATCC: American Type Culture Collection, U.S.A.; BBA: Biologische Bundesanstalt für Land- und Forstwirtschaft, Berlin-Dahlem, Germany; CBS: CBS-KNAW Fungal Biodiversity Centre, Utrecht, The Netherlands; CMW: Forestry and Agricultural Biotechnology Institute, University of Pretoria, Pretoria, South Africa; CCT: Colecao de Culturas Tropical, Fundacao Tropical de Pesquisas e Technologia “André Tosello”, Campinas-SP, Brazil; CDC: Centers for Disease Control and Prevention, Atlanta, GA, USA; CLL: C. Lechat collection; CPC: P.W. Crous collection; CTR: C.T. Rogerson collection; DAOM: Agriculture and Agri-Food Canada National Mycological Herbarium, Canada; DSM: Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH, Braunschweig, Germany; FMR: Facultad de Medicina, Reus, Tarragona, Spain; GJS: Gary J. Samuels collection; HJS: Hans-Josef Schroers collection; HKUCC: University of Hong Kong Culture Collection, Department of Ecology and Biodiversity, Hong Kong, China; IFO: Institute for Fermentation, Osaka, Yodogawa-ku, Osaka, Japan; IHEM: Institute of Hygiene and Epidemiology-Mycology Laboratory, Brussels, Belguim; IMI: International Mycological Institute, CABI-Bioscience, Egham, Bakeham Lane, U.K.; IMUR: Institute of Mycology, University of Recife, Recife, Brazil; INIFAT: INIFAT Fungus Collection, Ministerio de Agricultura Habana; KAS: K.A. Seifert collection; MRC: National Research Institute for Nutritional Diseases, Tygerberg, South Africa; MUCL: Mycothèque de l’Université Catholique de Louvain, Belgium; NBRC: NITE Biological Resource Center, Japan; NRRL: Agricultural Research Service Culture Collection, USA; PD: Collection of the Dutch National Plant Protection Organization (NPPO-NL), Wageningen, The Netherlands; PPRI: Plant Protection Research Institute, Pretoria, South Africa; PREM: National collection of Fungi, Agriculture Department, Pretoria, South Africa; QM: Quatermaster Research and Development Center, US Army, Natick, MA, USA; TG: T. Gräfenhan collection; UAMH: University of Alberta Mold Herbarium and Culture collection, Edmonton, Canada; UFV: Universidade Federal de Viçosa, Brazil.

[2] *acl1*: large subunit of the ATP citrate lyase; *act*: α-actin; *cmdA*: calmodulin; *his3*: histone H3; ITS: the internal transcribed spacer region and intervening 5.8S nrRNA; LSU: 28S large subunit; *rpb1*: RNA polymerase II largest subunit; *rpb2*: RNA polymerase II second largest subunit; *tef1*: translation elongation factor 1-alpha; *tub2*: β-tubulin.

Table 2. Information on loci used in the phylogenetic analyses.

Locus[1]	Primers	Nucleotide substitution models	Included sites (# excluded sites)	Phylogenetically informative sites (%)	Uninformative polymorphic sites	Invariable sites
acl1	acl1-230up, acl1-1220low (Gräfenhan *et al.* 2011)	HKY+I+G	1620 (1103)	1281 (79 %)	235	104
act	ACT-512F (Carbone & Kohn 1999), ACT1Rd (Groenewald *et al.* 2013)	GTR+I+G	985 (476)	551 (56 %)	114	320
cmdA	CAL-228F (Carbone & Kohn 1999), CAL2Rd (Groenewald *et al.* 2013)	GTR+I+G	1209 (846)	919 (76 %)	103	187
his3	CYLH3F, CYLH3R (Crous *et al.* 2004b)	GTR+I+G	788 (431)	530 (67 %)	97	161
ITS	ITS5, ITS4 (White *et al.* 1990)	GTR+I+G	1008 (572)	619 (61 %)	184	205
LSU	LR0R (Rehner & Samuels 1994), LR5 (Vilgalys & Hester 1990)	GTR+I+G	874 (6)	316 (36 %)	101	457
rpb1	RPB1-Ac, RPB1-Cr (Matheny *et al.* 2002)	GTR+I+G	1489 (879)	1264 (85 %)	202	23
rpb2	RPB2-5F2, RPB2-7cR (O'Donnell *et al.* 2007)	GTR+I+G	1366 (557)	919 (67 %)	399	48
tef1	EF1-728F (Carbone & Kohn 1999), EF2 (O'Donnell *et al.* 1998)	GTR+I+G	1049 (850)	854 (81 %)	101	94
tub2	T1 (O'Donnell & Cigelnik 1997), CYLTUB1R (Crous *et al.* 2004b)	GTR+I+G	898 (561)	650 (72 %)	72	176

[1] *acl1*: large subunit of the ATP citrate lyase; *act*: α-actin; *cmdA*: calmodulin; *his3*: histone H3; ITS: the internal transcribed spacer region and intervening 5.8S nrRNA; LSU: 28S large subunit; *rpb1*: RNA polymerase II largest subunit; *rpb2*: RNA polymerase II second largest subunit; *tef1*: translation elongation factor 1-alpha; *tub2*: β-tubulin.

measurements were made at ×1 000 magnification using a Zeiss Axioscope 2 microscope with differential interference contrast (DIC) illumination. The 95 % confidence levels were determined for the conidial measurements with extremes given in parentheses while only extremes are provided for other structures. Colony morphology was assessed using 7-d-old cultures on MEA, OA and/or PDA and the colour charts of Rayner (1970). All descriptions, illustrations and nomenclatural data were deposited in MycoBank (Crous *et al.* 2004a).

RESULTS

Phylogenetic relationships

The multi-gene alignment length was 11 286 bases including gaps, for the 10 gene regions. The phylogenetic analyses included 206 ingroup taxa, with *Stachybotrys chartarum* (CBS 129.13) as an outgroup taxon. The congruence analyses detected one conflict for the placement of *Rodentomyces reticulatus* (CBS 128675) and *Sarocladium kiliense* (CBS 400.52), which could not be resolved without excluding both from the analyses. However, as these conflicts only involved the placement of single species, this was ignored and all partitions were combined following the argument of Cunningham (1997) that combining incongruent partitions could increase phylogenetic accuracy. All ambiguously aligned regions were excluded from the analyses (Table 2). The number of polymorphic and parsimony informative sites, and evolutionary model selected for each gene region are indicated in Table 2.

The Bayesian consensus tree confirmed the tree topology obtained from the ML analysis, and therefore only the ML consensus tree with bootstrap support values (BS) and posterior probability values (PP) are indicated for well-supported clades in Figs 1 and 2. Both Figs 1 and 2 represent the same underlying phylogenetic analyses, but are two different representations of the obtained phylogenetic tree with Fig. 1 providing a collapsed leaf overview of the genera and families, and Fig. 2 providing details at strain level. In Fig. 1, 44 well-supported clades (BS $\geq$ 75 %; PP $\geq$ 0.95) were resolved in the super-clade representing the *Nectriaceae*. Of these, 33 clades represent established genera with the remaining 11 clades representing possible new genera. Three separate single lineages were also resolved within the *Nectriaceae* super-clade, representing *Corallonectria jatrophae* (CBS 913.96), *Calostilbe striispora* (CBS 133491) and *Dematiocladium celtidis* (CBS 115994).

Several clades, representing genera traditionally classified in the *Nectriaceae*, resolved in well-supported sister clades (BS $\geq$ 75 %; PP $\geq$ 0.95) of the *Nectriaceae* super-clade. Isolates representing the species in the genera *Tilachlidium* (CBS 363. 97 & CBS 505. 67) and *Septofusidium* (CBS 265.58 & CBS 731.70), along with an isolate listed as "*Pseudonectria coronata*" (CBS 696.93), formed a well-supported clade (BS $\geq$ 75 %; PP $\geq$ 0.95) basal to the *Nectriaceae* super-clade. Representatives of the genera *Aphanocladium* (CBS 401.70, CBS 634.75 & CBS 892.72; BS = 100 %, PP = 1.0), *Ciliciopodium* (CBS 106.13 & CBS 691.83; BS $\geq$ 75 %, PP $\geq$ 0.95), *Cylindrium* (CBS 685.83A, CBS 693.83 & CBS 115974; BS = 100 %, PP = 1.0) and *Falcocladium* (CBS 111292, CBS 121717 & CBS 120386; BS $\geq$ 75 %, PP $\geq$ 0.95), each formed separate clades outside the *Nectriaceae* super-clade.

Treatment of genera (Fig. 2)

Based on phylogenetic inference supported by morphological observations, several novel taxa were identified in this study. Recognised clades, as well as novel families, genera and species are described and discussed below. Only generic circumscriptions are provided for known taxa where the descriptions are available in MycoBank, or in recently published scientific papers.

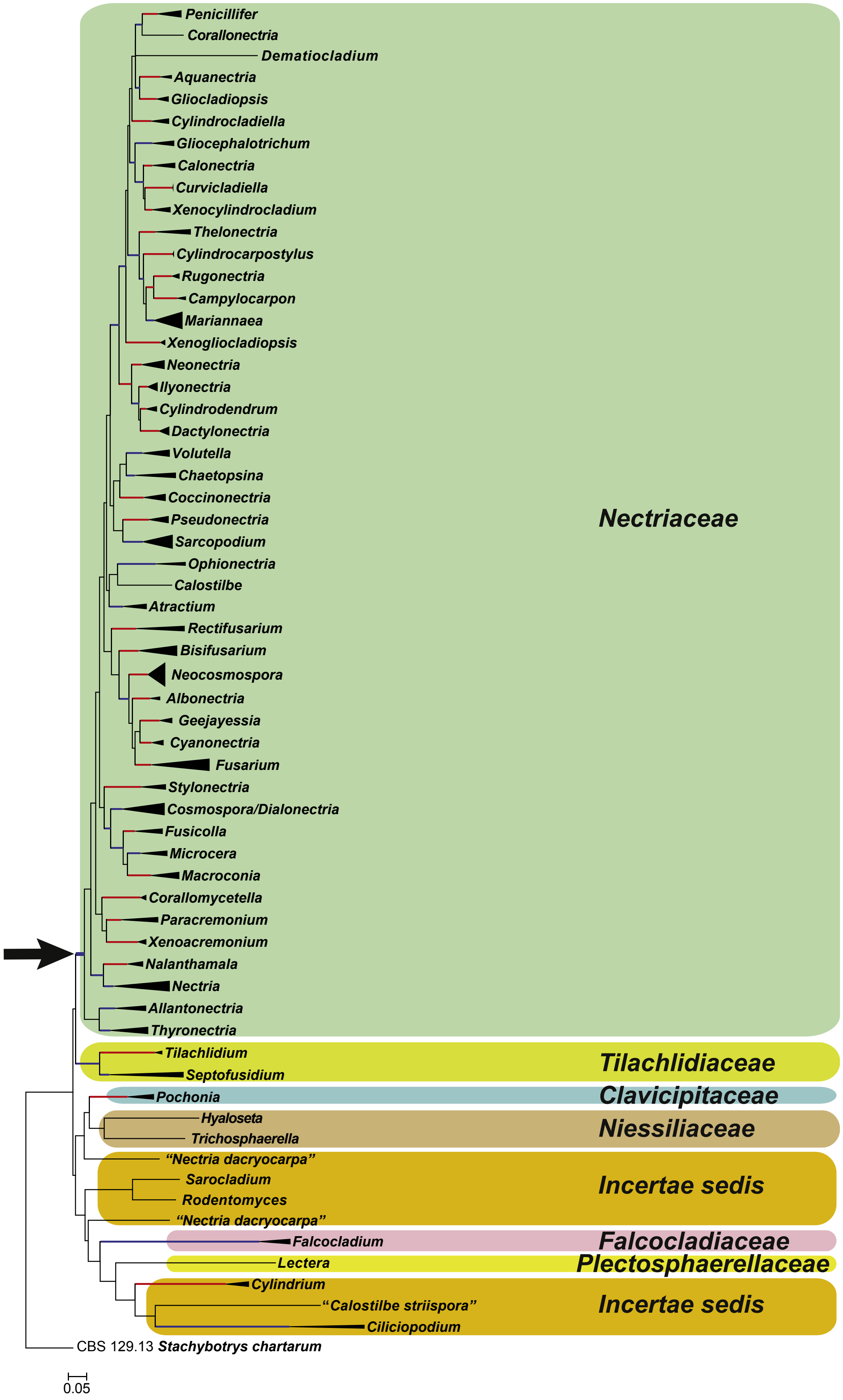

Fig. 1. Maximum Likelihood (ML) consensus tree inferred from the combined 10 genes sequence data set providing a collapsed leaf overview of the genera and families. Thickened branches indicate branches present in both the ML and Bayesian consensus trees. Branches with BS = 100 % and PP = 1.0 are in red. Branches with BS ≥ 75 % and PP ≥ 0.95 are in blue. The tree is rooted to *Stachybotrys chartarum* (CBS 129.13). The arrow indicates the most basal node representing *Nectriaceae*.

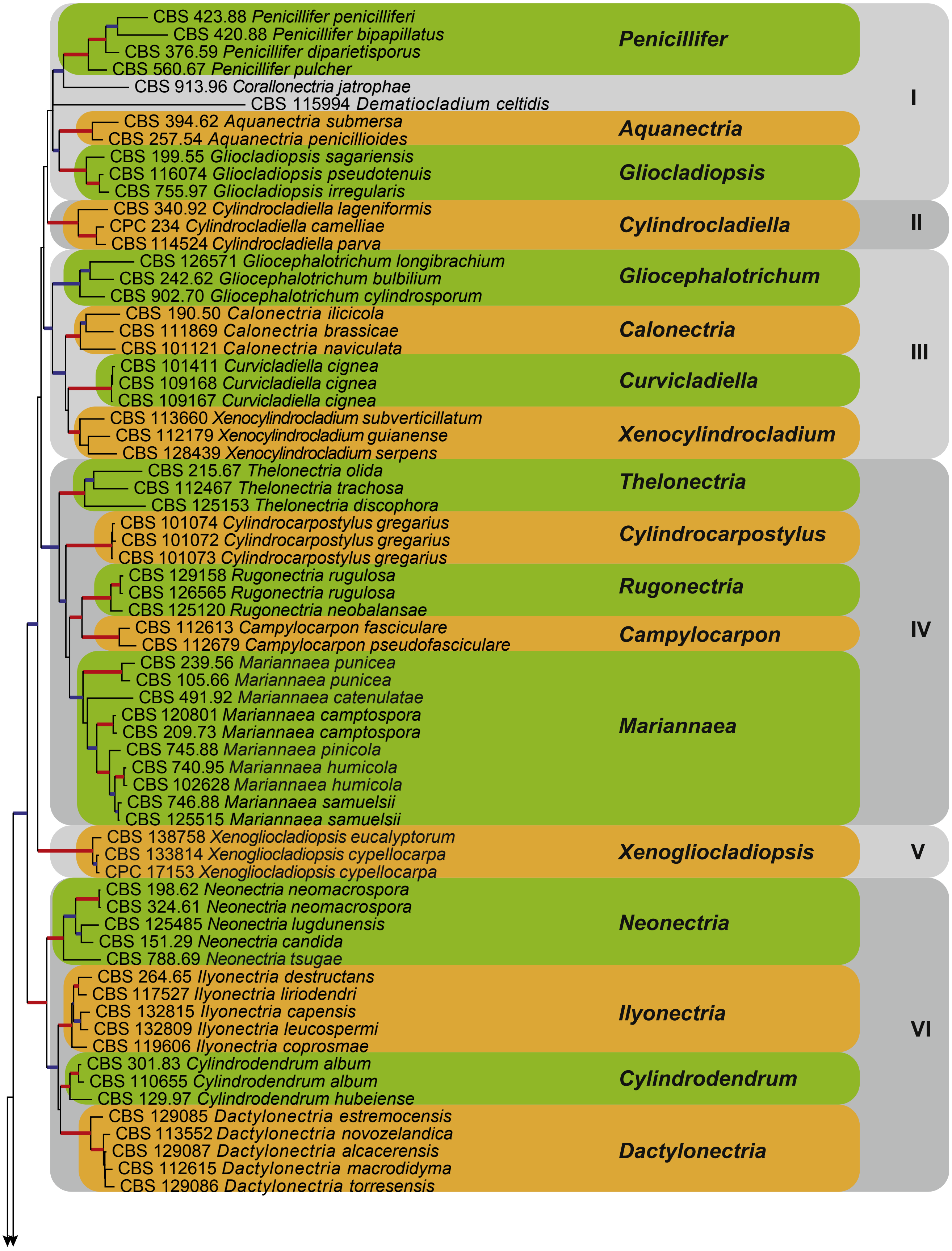

Fig. 2. The ML consensus tree inferred from the combined 10 genes sequence data set. Thickened branches indicate branches present in both the ML and Bayesian consensus trees. Branches with BS = 100 % and PP = 1.0 are in red. Branches with BS ≥ 75 % and PP ≥ 0.95 are in blue. The tree is rooted to *Stachybotrys chartarum* (CBS 129.13). Clade numbers are provided to the right of the tree and these are used for reference in the Treatment of Genera section. Coloured blocks represent the accepted genera.

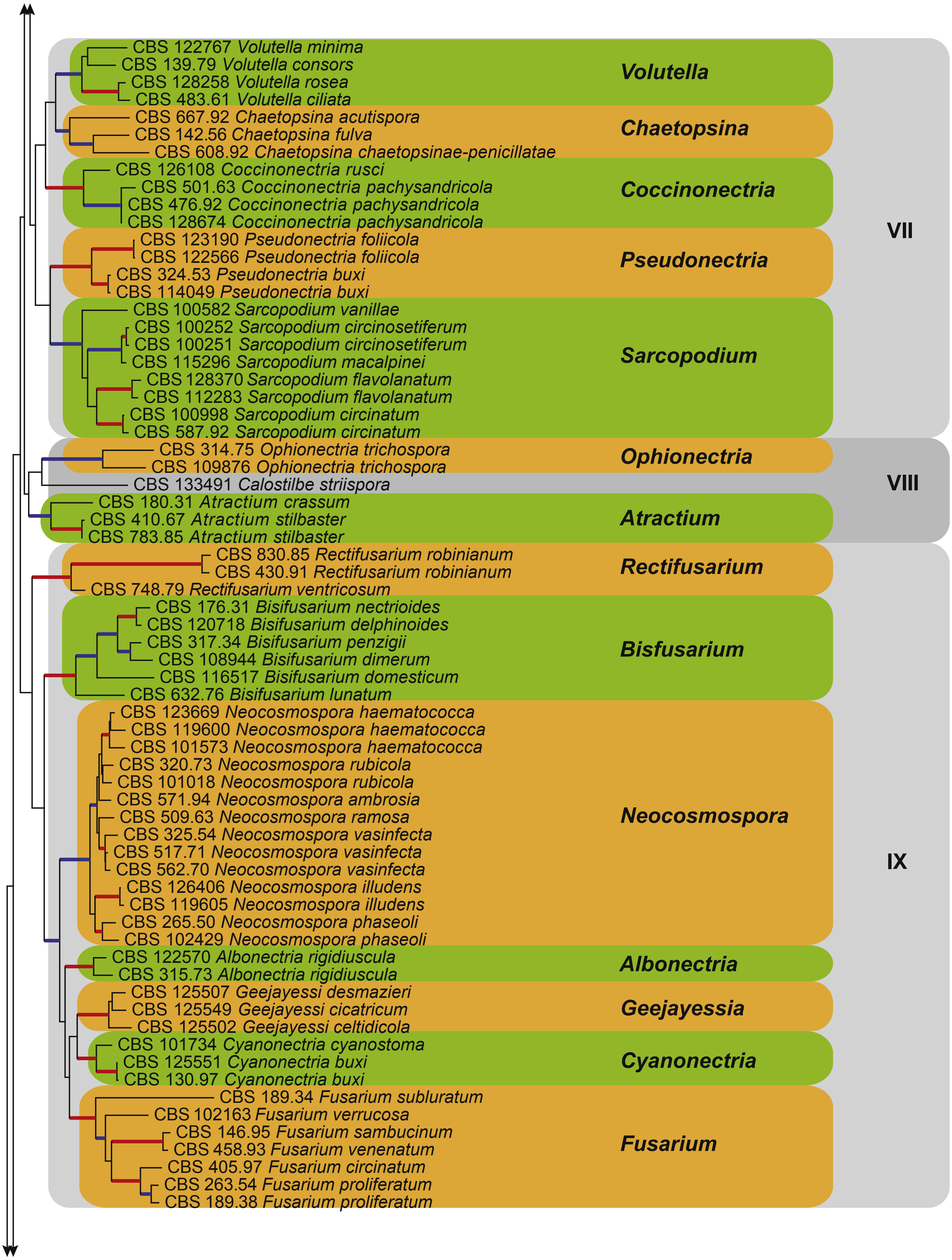

Fig. 2. (Continued).

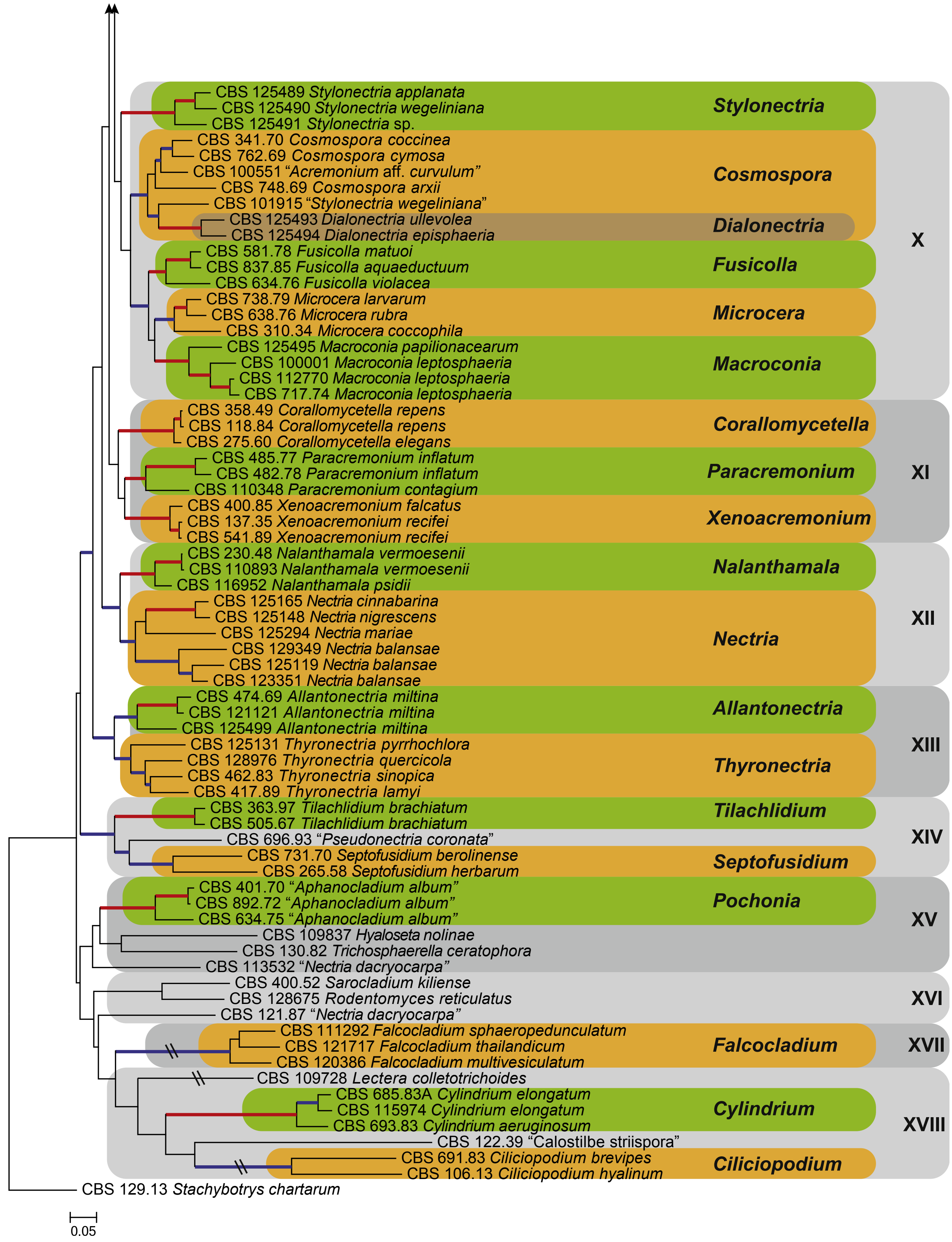

Fig. 2. (Continued).

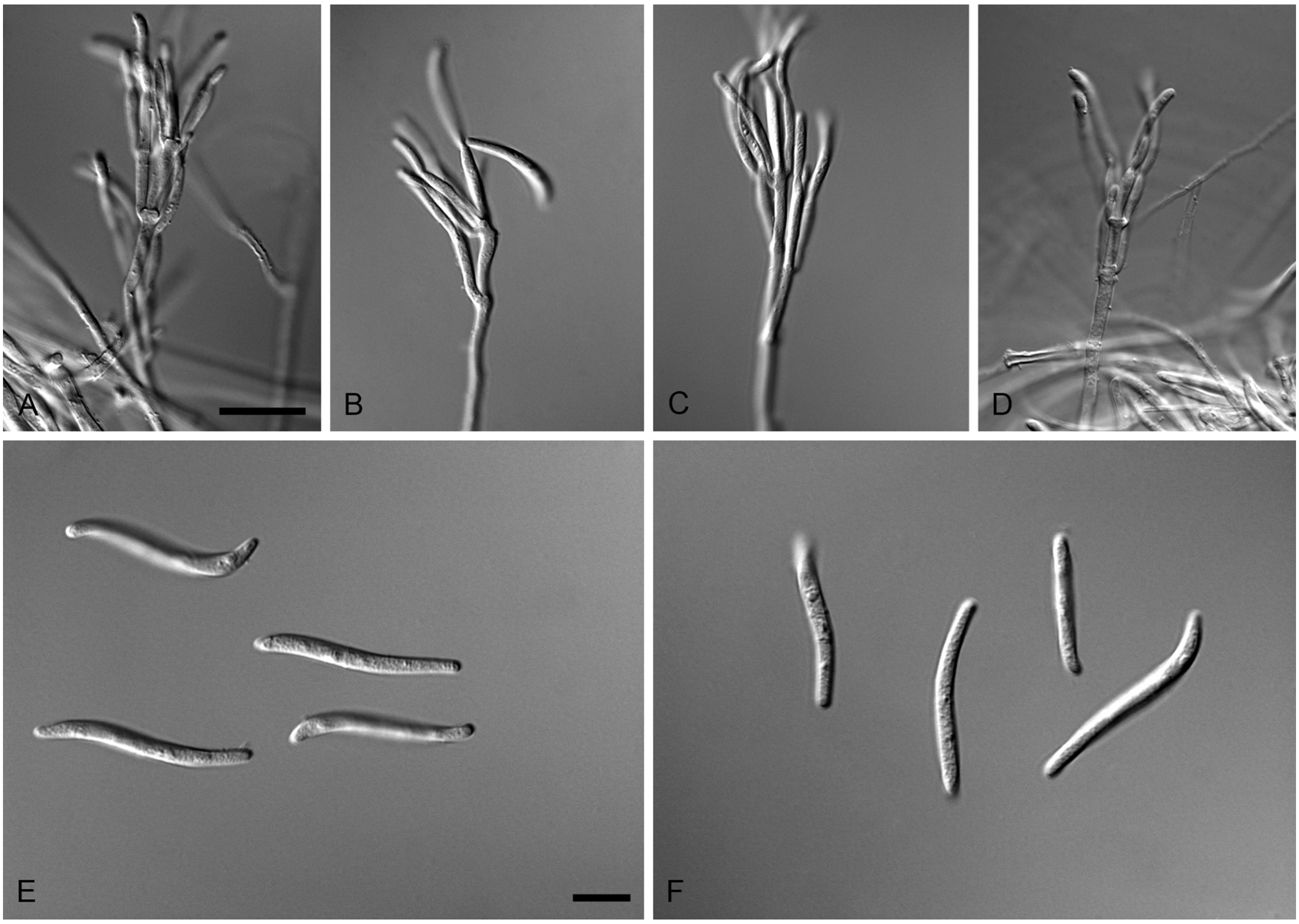

Fig. 3. *Aquanectria penicillioides* (CBS 257.54). A–D. Conidiophores. E–F. Conidia. Scale bars: A = 20 µm (apply to B–D); E = 10 µm (apply to F).

Clade I

Aquanectria L. Lombard & Crous, **gen. nov.** MycoBank MB810949.

Etymology: Name refers to the aquatic niche of these fungi.

Ascomata perithecial, superficial, scattered or aggregated in groups, ovate to subglobose, collapsing laterally when old, brown-orange to orange-red, with papillate ostiolar region. *Asci* cylindrical to clavate, 8-spored. *Ascospores* ellipsoid to fusiform, hyaline, 1-septate, with a slight constriction at the septum. *Conidiophores* in aquatic environment erect, solitary, septate, hyaline, branched, with verticillate penicillus with 1–4 phialides. *Phialides* cylindrical, tip with periclinal thickening, collarette often tubular, not flared. *Conidia* filiform, curved to slightly sigmoid, aseptate to 1-septate, hyaline, smooth. *Chlamydospores* formed intercalary, pale to dark brown, containing a large oil guttule, aggregating to form sclerotia (adapted from Ingold 1942 and Ranzoni 1956).

Type species: *Aquanectria penicillioides* (Ingold) L. Lombard & Crous.

Notes: The aquatic genus *Aquanectria* is established here to accommodate two fungal species previously treated as members of the genera *Flagellospora* and *Heliscus* (Ingold 1942, Ranzoni 1956, Hudson 1961). Recent studies (Baschien *et al.* 2013, Duarte *et al.* 2015) showed that species in the aquatic genus *Flagellospora* belongs to the *Helotiales* based on the type species, *F. curvula*. Furthermore, Lombard *et al.* (2014b) synonymised the genus *Heliscus*, based on the type species *H. lugdunensis*, under the genus *Neonectria*. In this study, CBS 257.54 (= *F. penicillioides*) clustered with the ex-type strain (CBS 394.62) of *Heliscus submersus* in a well-supported clade (BS = 100, PP = 1.0) sister to the clade representing the genus *Gliocladiopsis*. Therefore, new combinations are required to accommodate these fungi in the genus *Aquanectria* with *A. penicillioides* as type.

Aquanectria penicillioides (Ingold) L. Lombard & Crous, **comb. nov.** MycoBank MB810950. Fig. 3.

Basionym: *Flagellospora penicillioides* Ingold, Trans. Brit. Mycol. Soc. 27: 44. 1942.

= *Nectria penicillioides* Ranzoni, Amer. J. Bot. 43: 17. 1956.

Material examined: **USA**, California, Napa County, Green Valley Falls, on decaying leaves of *Acer* sp. submerged in a stream, Dec. 1954, F.V. Ranzoni, culture CBS 257.54.

Descriptions and illustrations: Ingold (1942), Ranzoni (1956).

Aquanectria submersa (H.J. Huds.) L. Lombard & Crous, **comb. nov.** MycoBank MB810162.

Basionym: *Heliscus submersus* H.J. Huds., Trans. Brit. Mycol. Soc. 44: 91. 1961.

Material examined: **Jamaica**, St. Andrew, Hardwar Gap, on decaying leaves submerged in a stream, 1960, H.J. Hudson, (**holotype** IMI 76792 (not seen), culture ex-type CBS 394.62, sterile).

Description and illustration: Hudson (1961).

Notes: Based on the description provided by Hudson (1961), the fungus formerly known as *Heliscus submersus* belongs to the genus *Aquanectria* supported by phylogenetic inference in this study. Hudson (1961) placed this fungus in the aquatic fungal genus *Heliscus*, as the conidia formed two conical arms at the apex. Other members of the genus *Heliscus*, however, are known to produce three or more conical arms at the apex (Saccardo 1880, Ingold 1942, Webster 1959). The two conical arms of *A. submersa* could either represent an atypical character for this species or the initiation of germination tubes at the apex of the conidia. The morphology of *A. submersa* could not be confirmed, as the ex-type strain could not be induced to sporulate by the addition of sterile water, carnation leaf pieces and/or toothpicks to the culture surface.

Corallonectria C. Herrera & P. Chaverri, Mycosystema 32: 539. 2013. MycoBank MB803108.

Ascomata perithecial, seated on short red stalks, in clusters of two or more, ovoid to obpyriform, not collapsing or collapsing when pinched laterally, orange-red to scarlet, with white to yellow furfuraceous coating below apex, apex acute, smooth, scarlet. *Asci* clavate, apex simple, 8-spored arranged biseriately. *Ascospores* smooth, fusiform-ellipsoid, sometimes reniform, 1-septate, often slightly constricted at septum, pale brown when discharged. Synnemata and rhizomorphs formed in culture. *Synnemata* cylindrical, slender to robust, straight to curved, rarely branching, appearing furfuraceous with loose, white hyphae, with a terminal cupulate capitulum, pale luteous. *Rhizomorphs* dichotomously branched, immersed in agar. *Conidiophores* unbranched or once simple monochasial or monoverticillate. *Phialides* cylindrical and hyaline. Conidial mass forming inside cupulate capitula, flame-shaped, luteous. *Conidia* fusarium-like, long-fusiform, slightly curved at the apical and basal ends, apical cell acute, basal cell pedicellate, hyaline, 3–4(–5)-septate (adapted from Herrera *et al.* 2013a).

Type species: *Corallonectria jatrophae* (A. Møller) C. Herrera & P. Chaverri, Mycosystema 32: 539. 2013. MycoBank MB803109.
≡ *Corallomyces jatrophae* A. Møller, Bot. Mitt. Trop. 9: 295. 1901, nom. illeg., Art. 53.
≡ *Nectria jatrophae* (A. Møller) Wollenw., Handb. Pflanzenkrank.: 560. 1931.
≡ *Corallomycetella jatrophae* (A. Møller) Rossman & Samuels, Stud. Mycol. 42: 114. 1999.
= *Nectria madeirensis* Henn., Hedwigia 43: 244. 1904.
= *Macbridella amazonensis* Bat., J.L. Bezerra & C.R. Almeida, Anais XIV Congr. Soc. Bot. Brasil: 118. 1964.
≡ *Nectria amazonensis* (Bat., J.L. Bezerra & C.R. Almeida) Samuels, Canad. J. Bot. 51: 1278. 1973.

Description and illustrations: Herrera *et al.* (2013b).

Notes: *Corallonectria* is a monotypic genus with *C. jatrophae* as type species. Our phylogeny placed the ex-type isolate (CBS 913.96) of *C. jatrophae* basal to the clade representing *Penicillifer* (= *Viridispora*).

Dematiocladium Allegr. *et al.*, Mycol. Res. 109: 836. 2005. MycoBank MB28939.

Ascomatal state not known. *Setae* arising from pseudoparenchymatous cells in a basal stroma, adjacent to cells that give rise to conidiophore stipe, extending beyond the conidiophores; setae unbranched, straight to flexuous, brown, verruculose, thick-walled with basal cell initially smooth, becoming brown with age, tapering from a base which is either rounded and well-defined, or cylindrical and continuous with the cells in the pseudoparenchymatous stroma, to an acutely or subobtusely rounded apex, which is pale brown, thin-walled towards the apex; apical cell sometimes becoming fertile with age, forming an apical penicillate conidiophore. *Conidiophores* consist of a stipe, a penicillate arrangement of fertile branches, and rarely, an extension of the stipe, signifying continued growth and eventual branching of stipe and secondary penicillate conidiophores. *Stipe* septate, hyaline, smooth, brown at the base, arising from tightly arranged pale to medium brown pseudoparenchymous cells in a basal stroma, frequently terminating in a swollen, globose apical cell, giving rise to 1–6 primary branches. *Conidiogenous apparatus* branched (–4), hyaline, smooth, with terminal branches producing 1–6 phialides. *Phialides* elongate doliiform to reniform or subcylindrical, straight to slightly curved, aseptate; apex with minute periclinal thickening and inconspicuous collarette. *Conidia* cylindrical, rounded at both ends, straight, hyaline, 1(–2)-septate, lacking a visible abscission scar, held in parallel clusters by colourless slime. *Chlamydospores* globose, thick-walled, brown, in intercalary chains (adapted from Crous *et al.* 2005).

Type species: *Dematiocladium celtidis* Allegr. *et al.*, Mycol. Res. 109: 836. 2005. MycoBank MB344508.

Description and illustrations: Crous *et al.* (2005).

Notes: *Dematiocladium celtidis* (ex-type CBS 115994) formed a single lineage basal to the clade representing the genus *Penicillifer* and the single lineage representing *Corallonectria jatrophae*. Recently, Crous *et al.* (2014) introduced a second species in this genus, *D. celtidicola* from China, which was not available for this study at the time.

Gliocladiopsis S.B. Saksena, Mycologia 46: 662. 1954. MycoBank MB8341.

= *Glionectria* Crous & C. L. Schoch, Stud. Mycol. 45: 58. 2000.

Ascomata perithecial, superficial, densely gregarious, seated on a thin basal stroma, obovoid to broadly obpyriform, collapsing laterally when drying, warted, red-brown with a dark red stromatic base, changing to dark red in KOH. *Asci* unitunicate, 8-spored, cylindrical, sessile, with a flattened apex, and a refractive apical apparatus. *Ascospores* uniseriate, overlapping, hyaline, ellipsoidal, smooth, medianly 1-septate. *Conidiomata* sporodochial, consisting of numerous aggregated penicillate conidiophores, or reduced to separate penicillate or subverticillate conidiophores. *Conidiophores* monomorphic, penicillate, consisting of a stipe and a penicillate arrangement of fertile branches, rarely dimorphic, penicillate and subverticillate. *Stipe* septate, hyaline, smooth. *Conidiogenous apparatus* with several series of aseptate or 1-septate branches, each terminal branch producing 2–6(–7) phialides. *Phialides* doliiform to cymbiform to cylindrical, hyaline, aseptate, apex with minute periclinal thickening and inconspicuous collarette. *Conidia* cylindrical, rounded at both ends, straight to curved, (0–)1-septate, lacking visible abscission scars, but frequently with a flattened base, held in fascicles by colourless slime (adapted from Saksena 1954 and Lombard & Crous 2012).

Type species: *Gliocladiopsis sagariensis* S.B. Saksena, Mycologia 46: 663. 1954. MycoBank MB297822.

Descriptions and illustrations: Saksena (1954), Crous (2002), Lombard & Crous (2012).

Notes: Representative strains of the genus *Gliocladiopsis* formed a monophyletic clade (BS = 100 %, PP = 1.0) sister to the clade representing the aquatic genus *Aquanectria*. Interestingly, these two genera clustered together in a larger clade (BS $\geq$ 75 %, PP $\geq$ 0.95), even though they do not share the same ecological niche. *Gliocladiopsis* species are characteristically soil-borne (Lombard & Crous 2012). The genera do, however, share similar conidiophore morphology.

Penicillifer Emden, Acta Bot. Neerl. 17: 54. 1968. MycoBank MB9256.
= *Viridispora* Samuels & Rossman, Stud. Mycol. 42: 166. 1999.

Ascomata non-stromatic, superficial, solitary, globose to pyriform, red, orange-brown, tan, or brown, not reacting or changing to red in KOH, coarsely warted or glabrous. *Asci* clavate, apex simple. *Ascospores* green, 1-septate and smooth. *Conidiophores* erect, solitary, septate, hyaline, unbranched and monophialidic, or with a biverticillate penicillus. *Phialides* cylindrical, tip with periclinal thickening, collarette often tubular, not flared. *Conidia* cylindrical to slightly naviculate, 1-septate, hyaline, smooth, with blunt papilla at one or both ends (adapted from Samuels 1989 and Rossman *et al.* 1999).

Type species: *Penicillifer pulcher* Emden, Acta Bot. Neerl. 17: 54. 1968. MycoBank MB335703.

Descriptions and illustrations: Samuels (1989), Polishook *et al.* (1991), Rossman *et al.* (1999).

Notes: The sexual genus *Viridispora* was established by Rossman *et al.* (1999) to accommodate species in the genera *Nectria* (Samuels 1989, Watanabe 1990) and *Neocosmospora* (Polishook *et al.* 1991) that had *Penicillifer* asexual morphs. *Penicillifer* was introduced by Emden (1968), typified by *P. pulcher*, for a fungus isolated from soil in the Netherlands. At present, the genus *Viridispora* accommodates four species, *V. alata* (= *P. bipapillatus*), *V. diparietispora* (= *P. furcatus*), *V. fragariae* (= *P. fragariae*) and *V. penicilliferi* (= *P. macrosporus*), each with its own *Penicillifer* asexual morphs (Samuels 1989, Watanabe 1990, Polishook *et al.* 1991, Rossman *et al.* 1999). So far, only *P. japonicus* (Matsushima 1985) has no associated sexual morph. Because the generic name *Penicillifer* (1968) is older than *Viridispora* (1999) for this monophyletic group of fungi (BS = 100 %, PP = 1.0), we propose that the sexual morph, *Viridispora*, be suppressed in favour of the asexual morph, *Penicillifer*. A new combination is, however, required for *P. furcatus*, as the epithet *Pseudonectria diparietispora* (1957) pre-dates that of *Penicillifer furcatus* (1991) and is provided below.

Penicillifer diparietisporus (J.H. Miller, Giddens & A.A. Foster) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810951.
Basionym: *Pseudonectria diparietispora* J.H. Miller, Giddens & A.A. Foster, Mycologia 49: 793. 1957 (1958, as '*diparietospora*').
≡ *Neocosmospora diparietispora* (J.H. Miller, Giddens & A.A. Foster) Rossman, Samuels & Lowen, Mycologia 85: 699. 1993.
≡ *Viridispora diparietispora* (J.H. Miller, Giddens & A.A. Foster) Samuels & Rossman, Stud. Mycol. 42: 167. 1999.
= *Neocosmospora arxii* Udagawa, Horie & P. Cannon, Sydowia 41: 353. 1989.
= *Neocosmospora endophytica* Polishook, Bills & Rossman, Mycologia 83: 798. 1991.
= *Penicillifer furcatus* Polishook, Bills & Rossman, Mycologia 83: 798. 1991.

Clade II

Cylindrocladiella Boesew., Canad. J. Bot. 60: 2289. 1982. MycoBank MB7869.
= *Nectricladiella* Crous & C. L. Schoch, Stud. Mycol. 45: 54. 2000.

Ascomata perithecial, superficial, solitary, basal stroma absent, globose to obpyriform, collapsing laterally when dry, smooth, with several minute, brown setae arising from the perithecial wall surface, red, changing colour in KOH, ostiole consisting of clavate cells, lined with inconspicuous periphyses. *Asci* unitunicate, 8-spored, cylindrical, sessile, thin-walled, with a flattened apex, and a refractive apical apparatus. *Ascospores* uniseriate, overlapping, hyaline, ellipsoid to fusoid with obtuse ends, smooth, 1-septate. *Conidiophores* monomorphic, penicillate, or dimorphic (penicillate and subverticillate), mononematous, hyaline. Penicillate conidiophores consist of a stipe, a penicillate arrangement of fertile branches, a stipe extension, and a terminal vesicle. Subverticillate conidiophores consist of a stipe, and one or two series of phialides. *Stipe* septate, hyaline, smooth. *Stipe extensions* aseptate, straight, thick-walled, with one basal septum, terminating in a thin-walled vesicle of characteristic shape. *Conidiogenous apparatus* with primary branches aseptate to 1-septate, secondary branches aseptate, terminating in 2–4 phialides. *Phialides* cylindrical, straight or doliiform to reniform to cymbiform, hyaline, aseptate, apex with minute periclinal thickening and collarette. *Conidia* cylindrical, rounded at both ends, straight, (0–)1(–3)-septate, frequently slightly flattened at the base, held in asymmetrical clusters by colourless slime. *Chlamydospores* brown, thick-walled, more frequently arranged in chains than clusters (adapted from Boesewinkel 1982 and Lombard *et al.* 2012).

Type species: *Cylindrocladiella parva* (P.J. Anderson) Boesew., Canad. J. Bot. 60: 2289. 1982.
≡ *Cylindrocladium parvum* P.J. Anderson, Mass. Agric. Exp. Sta. Bull. 183: 37. 1919.

Descriptions and illustrations: Boesewinkel (1982), Lombard *et al.* (2012).

Note: Representatives strains of the genus *Cylindrocladiella* formed a monophyletic clade (BS = 100 %, PP = 1.0), sister to the members of Clade I.

Clade III

Calonectria De Not., Comment. Soc. Crittog. Ital. 2: 477. 1867. MycoBank MB746.

= *Cylindrocladium* Morgan, Bot. Gaz. 17: 191. 1892.
= *Candelospora* Rea & Hawley, Proc. Roy. Irish Acad., B. 13: 11. 1912.

Ascomata perithecial, solitary or in groups, globose to subglobose to ovoid, yellow to orange to red or red-brown to brown, turning darker red to red-brown in KOH, rough-walled; perithecial apex consisting of flattened, thick-walled hyphal elements with rounded tips forming a palisade, discontinuous with warty wall, gradually becoming thinner towards the ostiolar canal, and merging with outer periphyses; perithecial base consisting of dark brown-red, angular cells, merging with a erumpent stroma, cells of the outer wall layer continuing into the pseudoparenchymatous cells of the erumpent stroma. *Asci* 8-spored, clavate, tapering to a long thin stalk. *Ascospores* aggregated in the upper third of the ascus, hyaline, smooth, fusoid with rounded ends, straight to sinuous, unconstricted, or constricted at the septa. *Megaconidiophores* if present, borne on the agar surface or immersed in the agar; stipe extensions mostly absent; conidiophores unbranched, terminating in 1–3 phialides, or sometimes with a single subterminal phialide; phialides straight to curved, cylindrical, seemingly producing a single conidium; periclinal thickening and an inconspicuous, divergent collarette rarely visible. *Megaconidia* hyaline, smooth, frequently remaining attached to the phialide, multi-septate, widest in the middle, bent or curved, with a truncated base and rounded apical cell. *Macroconidiophores* consist of a stipe, a penicillate arrangement of fertile branches, a stipe extension, and a terminal vesicle; stipe septate, hyaline or slightly pigmented at the base, smooth or finely verruculose; stipe extensions septate, straight to flexuous, mostly thin-walled, terminating in a thin-walled vesicle of characteristic shape. *Conidiogenous apparatus* with 0–1-septate primary branches; up to eight additional branches, mostly aseptate, each terminal branch producing 1–6 phialides; phialides cylindrical to allantoid, straight to curved, or doliiform to reniform, hyaline, aseptate, apex with minute periclinal thickening and inconspicuous divergent collarette. *Macroconidia* cylindrical, rounded at both ends, straight or curved, widest at the base, middle, or first basal septum, 1- to multi-septate, lacking visible abscission scars, held in parallel cylindrical clusters by colourless slime. *Microconidiophores* consist of a stipe and a penicillate or subverticillate arrangement of fertile branches. Primary branches 0–1-septate, subcylindrical; secondary branches 0–1-septate, terminating in 1–4 phialides; phialides cylindrical, straight to slightly curved, apex with minute periclinal thickening and marginal frill. *Microconidia* cylindrical, straight to curved, rounded at apex, flattened at base, 1(–3)-septate, held in asymmetrical clusters by colourless slime (adapted from Crous 2002).

Type species: *Calonectria pyrochroa* (Desm.) Sacc., Michelia 1: 308. 1878.
≡ *Nectria pyrochroa* Desm., Bull. Soc. Bot. France 4: 998. 1857.
= *Calonectria daldiniana* De Not., Comment. Soc. Crittog. Ital. 2: 477. 1867.
= *Ophionectria puiggarii* Speg., Bol. Acad. Nac. Ci. 11: 532. 1889.
= *Nectria abnormis* Henn., Hedwigia 36: 219. 1897.
= *Cylindrocladium ilicicola* (Hawley) Boedijn & Reitsma, Reinwardtia 1: 57. 1950.
≡ *Candelospora ilicicola* Hawley, Proc. Roy. Irish Acad., B. 31: 11. 1912.

Descriptions and illustrations: Rossman *et al.* (1999), Crous (2002), Lombard *et al.* (2010b).

Notes: Representative strains of the genus *Calonectria* formed a monophyletic clade (BS = 100 %, PP = 1.0) closely related to the clades representing *Curvicladiella* and *Xenocylindrocladium*, respectively. Based on the ICN for algae, fungi and plants, new combinations are required for *C. morganii* and *C. scoparia* as there are older epithets available for both species.

Calonectria candelabra (Viégas) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810952.

Basionym: *Cylindrocladium candelabrum* Viégas, Bragantia 6: 370. 1946.
= *Calonectria scoparia* Ribeiro & Matsuoka, *In*: Ribeiro, M.Sc. Thesis, Heterotalismo em *C. scoparium* Morgan: 28. 1978 (nom. inval., Art. 29).
≡ *Calonectria scoparia* Peerally, Mycotaxon 40: 341. 1991.

Calonectria cylindrospora (Ellis & Everh.) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810953.

Basionym: *Diplocladium cylindrosporum* Ellis & Everh., Bull. Torrey Bot. Club 27: 58. 1900.
= *Cylindrocladium scoparium* Morgan, Bot. Gaz. 17: 191. 1892.
= *Cylindrocladium pithecolobii* Petch, Ann. Roy. Bot. Gard. (Peradeniya) 6: 244. 1917.
= *Cylindrocladium ellipticum* Alfieri, C.P. Seym. & Sobers, Phytopathology 60: 1213. 1970.
= *Calonectria morganii* Crous, Alfenas & M.J. Wingf. Mycol. Res. 97: 706. 1993.

Curvicladiella Decock & Crous, Stud. Mycol. 55: 225. 2006. MycoBank MB500866.

Ascomatal state unknown. *Conidiomata* sporodochial or synnematal, consisting of numerous penicillate conidiophores arising from a stroma of brown, thick-walled chlamydospores. *Conidiophores* consist of a thick-walled, smooth to finely verruculose, septate, pale brown to brown basal stipe, a conidiogenous apparatus and several sterile stipe extensions that have 1(–2) apical and one basal septum; stipe extensions avesiculate; apical cell thick-walled, verruculose, pale brown, prominently curved, tapering towards a bluntly rounded acute apex. *Conidiogenous apparatus* with several hyaline, smooth, subcylindrical, straight to slightly curved conidiophore branches; phialides hyaline, smooth, doliiform to reniform or subcylindrical, apex with minute periclinal thickening, and inconspicuous, flared collarette. *Conidia* cylindrical, septate, lacking a visible abscission scar, held in heads of colourless slime. *Chlamydospores* arranged intercalarily, often aggregating to form microsclerotia (adapted from Decock & Crous 1998 and Crous *et al.* 2006).

Type species: *Curvicladiella cignea* Decock & Crous, Stud. Mycol. 55: 225. 2006.

Descriptions and illustrations: Decock & Crous (1998), Crous *et al.* (2006)

Note: The monotypic genus *Curvicladiella* formed a well-supported clade (BS = 100 %, PP = 1.0) closely related to the genera *Calonectria* and *Xenocylindrocladium*.

Gliocephalotrichum J.J. Ellis & Hesselt., Bull. Torrey Bot. Club 89: 21. 1962. MycoBank MB8340.

Ascomata perithecial, superficial, globose to subglobose, scarlet, turning purple in KOH, with a white to pale luteous amorphous coating and hyphal stromatic base. *Asci* unitunicate, narrowly clavate, 8-spored, with flattened apex and a minute refractive ring. *Ascospores* hyaline, ellipsoidal, smooth, aseptate.

Fig. 4. *Xenocylindrocladium serpens* (ex-type CBS 128439). A–C. Conidiophores. D–G. Conidiogenous apparatus with doliiform to reniform phialides. H–I. Avesiculate stipe extensions. J. Conidia. K. Chlamydospores. Scale bars: A = 50 μm (apply to B–C); D = 10 μm (apply to E–G); H = 10 μm (apply to I–K).

Conidiophores consisting of a septate, hyaline, pale luteous to pale brown stipe and a penicillate arrangement of fertile branches subtended by septate stipe extensions. *Stipe extensions* hyaline, septate, terminating in narrowly to broadly clavate vesicles. *Conidiogenous apparatus* with a series of aseptate, hyaline to pale brown branches, each terminating in 2–8 phialides. *Phialides* clavate to cylindrical, hyaline, aseptate, constricted at the apex, with minute periclinal thickening. *Conidia* cylindrical to ellipsoidal, straight to slightly curved, aseptate, accumulating in a white to luteous mucoid mass above the phialides (adapted from Rossman *et al.* 1993 and Lombard *et al.* 2014a).

Type species: *Gliocephalotrichum bulbilium* J.J. Ellis & Hesselt., Bull. Torrey Bot. Club 89: 21. 1962.

Descriptions and illustrations: Rossman *et al.* (1993), Lombard *et al.* (2014a).

Notes: Species of *Gliocephalotrichum* are soil-borne fungi generally associated with post-harvest fruit spoilage of several important tropical fruit crops (Lombard *et al.* 2014a). Representatives of *Gliocephalotrichum* clustered in a monophyletic clade (BS $\geq$ 75 %, PP $\geq$ 0.95), basal to the clades representing *Calonectria*, *Curvicladiella* and *Xenocylindrocladium*.

Xenocylindrocladium Decock *et al.*, Mycol. Res. 101: 788. 1997. MycoBank MB27788. Fig. 4.
= *Xenocalonectria* Crous & C.L. Schoch, Stud. Mycol. 45: 50. 2000.

Ascomata perithecial, superficial, solitary or aggregated, globose to subglobose, warted, yellow to red and with a dark red stromatic base; ostiolar periphyses hyaline, tubular with rounded ends. *Asci* unitunicate, 8-spored, cylindrical, with long basal stalks, a flattened apex, and a refractive apical apparatus. *Ascospores* aggregate in the upper third of the ascus, hyaline, broadly to narrowly ellipsoidal, smooth, medianly 1-septate.

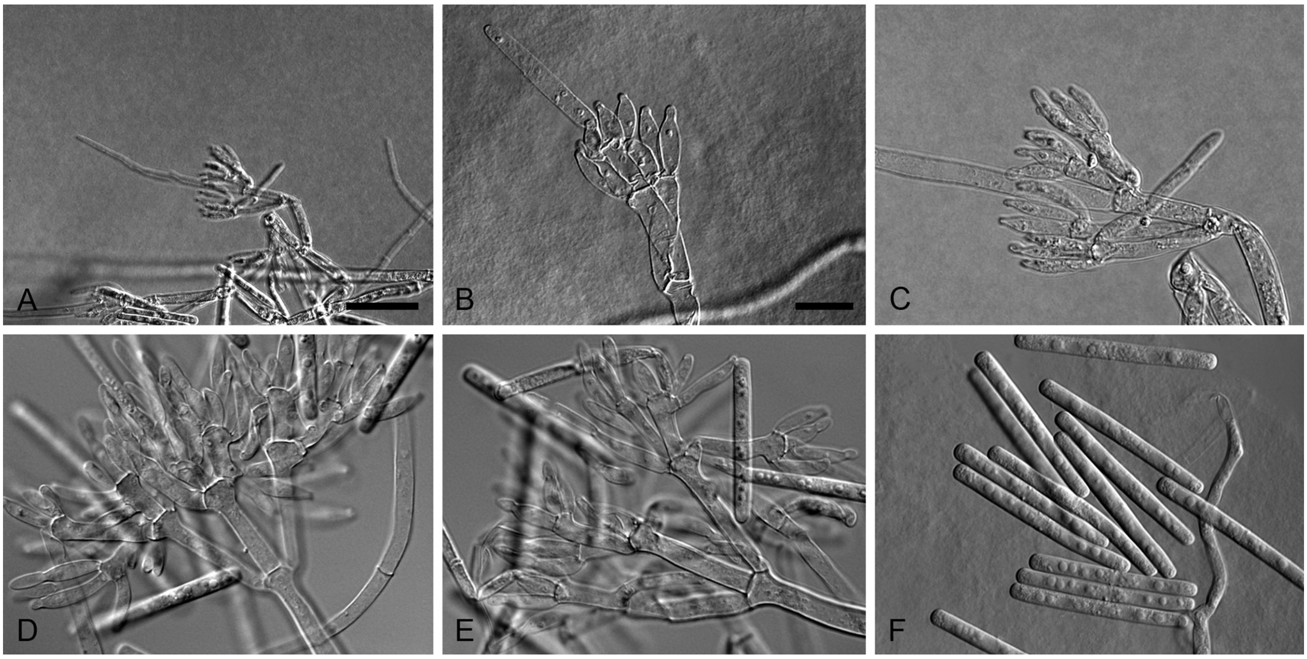

Fig. 5. *Cylindrocarpostylus gregarius* (ex-type CBS 101072). A–C. Conidiophores. D–E. Conidiogenous apparatus with cylindrical to allantoid phialides. F. Conidia. Scale bars: A = 50 µm; B = 10 µm (apply to C–F).

Conidiophores consisting of a stipe, a penicillate arrangement of fertile branches, and an avesiculate stipe extension. *Stipe* septate, hyaline, smooth; stipe extensions septate, straight to flexuous or sinuous. *Conidiogenous apparatus* with aseptate or 1-septate primary branches; aseptate secondary, tertiary and quaternary branches, each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, apex with minute periclinal thickening and inconspicuous collarette. *Conidia* cylindrical, rounded at both ends, straight or curved, septate, lacking visible abscission scars, held in parallel cylindrical clusters by slime (adapted from Decock *et al.* 1997).

Type species: *Xenocylindrocladium serpens* Decock *et al.*, Mycol. Res. 101: 788. 1997.

Notes: The genus *Xenocylindrocladium* includes three species described from the tropics, isolated from plant debris (Decock *et al.* 1997, Crous *et al.* 2001). At the same time, Decock *et al.* (1997) introduced the sexual morph of *X. serpens* as *Nectria serpens*, which was later transferred to the genus *Xenocalonectria* by Schoch *et al.* (2000). Given the name changes required if the genus name *Xenocalonectria* was used, we propose that the generic name *Xenocalonectria* be suppressed in favour of *Xenocylindrocladium*, which also has priority by date and therefore no new combinations are required. Representatives of the genus *Xenocylindrocladium* formed a monophyletic clade (BS = 100 %, PP = 1.0), closely related to the genera *Curvicladiella* and *Calonectria*.

Clade IV

Campylocarpon Halleen *et al.*, Stud. Mycol. 50: 448. 2004. MycoBank MB28858.

Ascomatal state unknown. Asexual state cylindrocarpon-like. *Conidiophores* arise laterally from single or fasciculate aerial hyphae, carried singularly or aggregated, consisting of a stipe bearing several phialides or a penicillus of irregular branches with terminal branches bearing one or several phialides. *Phialides* cylindrical or narrowly flask-shaped. *Macroconidia* cylindrical, typically curved, (1–)3–4(–5)-septate, with minute tapering, obtuse ends, sometimes somewhat more strongly tapering at the base; base with or without an obscure hilum. *Microconidia* and *chlamydospores* not observed (adapted from Halleen *et al.* 2004).

Type species: *Campylocarpon fasciculare* Schroers *et al.*, Stud. Mycol. 50: 448. 2004.

Description and illustrations: Halleen *et al.* (2004).

Notes: The monophyletic clade (BS = 100 %, PP = 1.0) representing the asexual genus *Campylocarpon* is closely related but separate from the clade representing the genus *Rugonectria*. Both these genera share several morphological characters, such as having cylindrocarpon-like asexual states. Neither is known to produce chlamydospores in culture.

Cylindrocarpostylus R. Kirschner & Oberw., Mycol. Res. 103: 1155. 1999. MycoBank MB28330. Fig. 5.

Ascomatal state unknown. *Conidiophores* arise from hyphae, consisting of a stipe and penicillate arrangement of fertile branches. *Stipe* septate, smooth, becoming verruculose with age, initially hyaline, turning yellow to brown. *Conidiogenous apparatus* with aseptate primary, secondary, tertiary and quaternary branches, each terminal branch producing 2–4 phialides; phialides cylindrical to allantoid, hyaline, aseptate, apex with minute periclinal thickening and inconspicuous collarette. *Conidia* hyaline, smooth, cylindrical, rounded at both ends, straight or slightly curved, 0–3-septate, lacking visible abscission scars (adapted from Kirschner & Oberwinkler 1999).

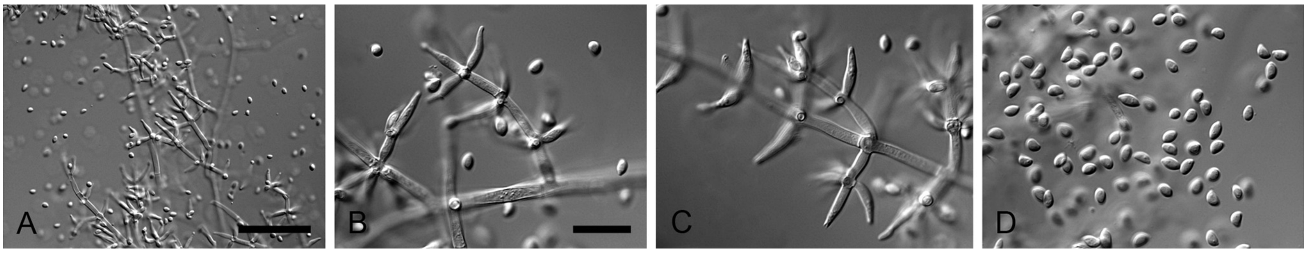

Fig. 6. *Mariannaea humicola* (ex-type CBS 740.95). A–C. Conidiophores with verticillate phialides. D. Conidia. Scale bars: A = 50 µm; B = 10 µm (apply to C–D).

Type species: *Cylindrocarpostylus gregarius* (Bres.) R. Kirschner & Oberw., Mycol. Res. 103: 1155. 1999.

≡ *Diplocladium gregarium* Bres., Ann. Mycol. 1: 127. 1903.
≡ *Cylindrocladium gregarium* (Bres.) de Hoog, Persoonia 10: 75. 1978.

Description and illustrations: Kirschner & Oberwinkler (1999).

Note: Representatives of the monotypic genus *Cylindrocarpostylus* formed a monophyletic clade (BS = 100 %, PP = 1.0), separate from all other members of Clade IV.

Mariannaea G. Arnaud ex Samson, Stud. Mycol. 6: 74. 1974. MycoBank MB8846.

Ascomata perithecial with inconspicuous or absent stroma, solitary, globose with a flat apex, not collapsing or collapsing laterally by pinching when dry, pale yellow, orange or brown, not reacting in KOH. Perithecial wall smooth or finely roughened. *Asci* cylindrical to narrowly clavate, sometimes with an inconspicuous apical ring, 8-spored. *Ascospores* 1-septate, hyaline, smooth to spinulose. *Conidiophores* verticillate to penicillate, hyaline, with phialides arising directly from the stipe or forming whorls of metulae on lower parts of the stipe. Stipe hyaline, becoming yellow-brown at the base. *Phialides* monophialidic, flask-shaped, hyaline, usually with obvious periclinal thickening and inconspicuous collarettes. *Conidia* aseptate, hyaline, in chains that collapse to form slimy heads. *Chlamydospores* globose to ellipsoidal, hyaline, formed in intercalary chains (adapted from Samson 1974).

Type species: *Mariannaea elegans* (Corda) Samson, Stud. Mycol. 6: 75. 1974.

≡ *Penicillium elegans* Corda, Icones Fung. 2: 17. 1838.
≡ *Hormodendron elegans* (Corda) Bonorden, Handb. Allg. Mykol.: 76. 1851.
≡ *Spicaria elegans* (Corda) Harz., Bull. Soc. Imp/Nat. Moscou 44: 238. 1871.
≡ *Paecilomyces elegans* (Corda) Mason & Hughes *apud* Hughes, Mycol. Pap. 45: 27. 1951.

Descriptions and illustration: Samson (1974), Gräfenhan *et al.* (2011).

Note: Unfortunately no culture or sequences of *M. elegans* were available to be included in this phylogenetic study.

Mariannaea catenulatae (Samuels) L. Lombard & Crous, **comb. nov.** MycoBank MB810163.

Basionym: *Chaetopsina catenulata* Samuels, Mycotaxon 22: 28. 1985.

≡ *Nectria chaetopsinae-catenulatae* Samuels, Mycotaxon 22: 28. 1985.
≡ *Cosmospora chaetopsinae-catenulatae* (Samuels) Rossman & Samuels, Stud. Mycol. 42: 119. 1999.
≡ *Chaetopsinectria chaetopsinae-catenulatae* (Samuels) J. Luo & W.Y. Zhuang, Mycologia 102: 979. 2010.

Description and illustration: Samuels (1985).

Notes: Based on phylogenetic inference in this study, the ex-type culture CBS 491.92, previously known as *Chaetopsinectria chaetopsinae-catenulatae* (Samuels 1985, Luo & Zhuang 2010), clustered in the monophyletic clade (BS ≥ 75 %, PP ≥ 0.95) representing the genus *Mariannaea*. Therefore, a new combination is provided in the genus *Mariannaea*. This is the first study to include this ex-type strain in a molecular phylogeny.

Mariannaea pinicola L. Lombard & Crous, **nom. nov.** MycoBank MB810164.

≡ *Nectria mariannaea* Samuels & Seifert, Mycotaxon 110: 101. 2009.
≡ *Nectria mariannaea* Samuels & Seifert, Sydowia 43: 257. 1991. (nom. Inval., Art 23.4).

Etymology: Name derived from the plant host *Pinus* sp., from which it was collected.

Descriptions and illustrations: Samuels & Seifert (1991).

Notes: Gräfenhan *et al.* (2011) refrained from transferring *Nectria mariannaea* to the genus *Mariannaea* based on insufficient taxonomic information available at that time. As the use of the same epithet would create a tautonym (Art. 23.4), we choose to provide this species with a new epithet.

Mariannaea humicola L. Lombard & Crous, **sp. nov.** MycoBank MB810165. Fig. 6.

Etymology: Name refers to the soil substrate from which this fungus was isolated.

Ascomatal state not observed. *Conidiophores* arising from the agar surface from aerial hyphae or fascicles, mostly 80–100 µm long, axis 3–7 µm wide, branching verticillately at 2–3 levels, with a terminal whorl of 1–5 phialides, and 1–2 lower nodes of 1–3 phialides, rarely with single phialides. *Phialides* subulate, sometimes with base slightly swollen, 10–20 µm, 2–4 µm at the broadest part, with periclinal thickening and inconspicuous collarette. *Conidia* fusiform to ellipsoidal to obovoid, hyaline, smooth, (3–)4–6 × 2–3 µm (av. 5 × 3 µm), with a distinct hilum at both or at one end. *Chlamydospores* not seen.

Culture characteristics: Colonies slow growing on MEA, 45–50 mm diam in 14 d at 24 °C. Surface dirty white in the centre becoming tan to sienna towards the margins with dirty white, irregularly distributed tuffs of fascicles; aerial mycelium abundant. Reverse chestnut becoming umber at the margins.

Materials examined: **Brazil**, Sao Paulo, from rhizosphere soil under *Araucaria angustifolia*, Apr. 1995, S. Baldini (**holotype** CBS H-21953, culture ex-type CBS 740.95 = CCT 4534). **Spain**, Canary Islands, La Gomera, on decaying wood of unknown tree, Oct. 1999, R.F. Castañeda, culture CBS 102628 = INIFAT C99/130-2.

Notes: *Mariannaea humicola* is introduced here for two isolates (CBS 740.95 & CBS 102628), which were listed as "*Nectria mariannaea*" (= *M. pinicola*) in the CBS collection. Both isolates clustered together in a clade (BS = 100 %, PP = 1.0) separate from the ex-type culture (CBS 754.88) of *M. pinicola*. The conidia of *M. humicola* [(3–)4–6 × 2–3 µm (av. 5 × 3 µm)] are smaller than those of *M. pinicola* [5–9(–17) × (2–)2.5–4.5 µm; Samuels & Seifert 1991] and no chlamydospores were observed for *M. humicola*, which are readily formed by *M. pinicola* (Samuels & Seifert 1991).

Rugonectria P. Chaverri & Samuels, Stud. Mycol. 68: 73. 2011. MycoBank MB518563.

Ascomata perithecial, formed on or partially immersed within a stroma, globose to subglobose, warted, orange to red, turning dark red in KOH. *Asci* cylindrical to clavate, 8-spored. *Ascospores* 1-septate, ellipsoidal to oblong, hyaline or sometimes yellow. Asexual state cylindrocarpon-like. *Microconidiophores* monophialidic or sparsely branched, terminating in cylindrical phialides. *Microconidia* 0–1-septate, ovoid to cylindrical, with rounded ends, hyaline, lacking a prominent basal hilum. *Macroconidiophores* irregularly branched or in fascicles, terminating in cylindrical phialides. *Macroconidia* (3–)5–7(–9)-septate, fusiform, curved, tapering towards the ends with an inconspicuous basal hilum. *Chlamydospores* absent (adapted from Chaverri *et al.* 2011).

Type species: *Rugonectria rugulosa* (Pat. & Gaillard) Samuels *et al.*, Stud. Mycol. 68: 73. 2011.

≡ *Nectria rugulosa* Pat. & Gaillard, Bull. Soc. Mycol. France 4: 115. 1888.

≡ *Neonectria rugulosa* (Pat. & Gaillard) Mantiri & Samuels, Canad. J. Bot. 79: 339. 2001.

= *Cylindrocarpon rugulosum* Brayford & Samuels, Sydowia 46: 146. 1994.

Description and illustration: Chaverri *et al.* (2011).

Note: Representatives of the genus *Rugonectria* formed a monophyletic clade (BS = 100 %, PP = 1.0), closely related but separate from the clade representing *Campylocarpon*.

Thelonectria P. Chaverri & C. Salgado, Stud. Mycol. 68: 76. 2011. MycoBank MB518567.

Ascomata perithecial formed superficial or seated on an immersed inconspicuous stroma, globose, subglobose, or pyriform to elongated, smooth or warted, with a prominently darkened papilla or darkly pigmented apex. *Asci* cylindrical and 8-spored. *Ascospores* 1-septate, hyaline, ellipsoidal to oblong, becoming pigmented with age. Asexual morph cylindrocarpon-like; microconidiophores and microconidia rare. *Macroconidiophores* irregularly branched or in fascicules, terminating in cylindrical phialides; macroconidia (3–)5–7(–9)-septate, curved, often broadest at upper third, with rounded apical cell and flattened or rounded basal cells with inconspicuous hilum. *Chlamydospores* rare, abundant in one species (adapted from Chaverri *et al.* 2011).

Type species: *Thelonectria discophora* (Mont.) P. Chaverri & C. Salgado, Stud. Mycol. 68: 76. 2011.

≡ *Sphaeria discophora* Mont., Ann. Sci. Nat., Bot. II 3: 353. 1835.

≡ *Neonectria discophora* (Mont.) var. *discophora* Mantiri & Samuels, Canad. J. Bot. 79: 339. 2001.

= *Nectria tasmanica* Berk. in Hooker, Flora Tasmaniae 2: 279. 1860.

= *Nectria mammoidea* W. Phillips & Plowr., Grevillea 3: 126. 1875.

≡ *Creonectria mammoidea* (W. Phillips & Plowr.) Seaver, Mycologia 1: 188. 1909.

= *Nectria nelumbicola* Henn., Verh. Bot. Ver. Prov. Brandenb. 40: 151. 1898.

= *Nectria umbilicata* Henn., Hedwigia 41: 3. 1902.

= *Nectria mammoidea* var. *rugulosa* Weese, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 125: 552. 1916.

= *Cylindrocarpon ianthothele* var. *majus* Wollenw., Z. Parasitenk. 1: 161. 1928.

= *Nectria mammoidea* var. *minor* Reinking, Zentbl. Bakt. Parasitenk., Abt. II, 94: 135. 1936.

= *Cylindrocarpon ianthothele* var. *minus* Reinking, Zentbl. Bakt. Parasitenk., Abt. II, 94: 135. 1936.

= *Creonectria discostiolata* Chardón, Bol. Soc. Venez. Ci. Nat. 5: 341. 1939.

= *Cylindrocarpon ianthothele* var. *rugulosum* C. Booth, Mycol. Pap. 104: 25. 1966.

= *Cylindrocarpon pineum* C. Booth, Mycol. Pap. 104: 26. 1966.

Description and illustration: Chaverri *et al.* (2011).

Note: Representatives of the genus *Thelonectria* formed a monophyletic clade (BS = 100 %, PP = 1.0), distinct from the other member genera in Clade IV even though this genus shares some morphological characters with the genera *Campylocarpon* and *Rugonectria*.

Clade V

Xenogliocladiopsis Crous & W.B. Kendr., Canad. J. Bot. 72: 63. 1994. MycoBank MB27282.

Ascomatal state unknown. *Conidiophores* separate or aggregated in sporodochia, consisting of a stipe, a penicillate arrangement of fertile branches, and an avesiculate stipe extension; stipe septate, hyaline, smooth; stipe extensions septate, straight to flexuous. *Conidiogenous apparatus* with aseptate primary, secondary, tertiary and additional branches, each terminal branch producing 2–6 phialides. *Phialides* cylindrical to cymbiform, hyaline, aseptate; collarette absent. *Conidia* hyaline, aseptate, cylindrical to fusiform with acutely rounded ends (adapted from Crous & Kendrick 1994).

Type species: *Xenogliocladiopsis eucalyptorum* Crous & W.B. Kendr., Canad. J. Bot. 72: 63. 1994. Fig. 7.

Materials examined: **South Africa**, Limpopo Province, Gold River Game Resort, *Eucalyptus* leaf litter, May 1991, P.W. Crous, holotype PREM 51299; Northern Cape Province, Kleinzee, on leaves of *Eucalyptus* sp., 27 Feb. 2009, leg. Z.A. Pretorius, isol. P.W. Crous (**epitype designated here** CBS H-21952, MBT198395, culture ex-epitype CBS 138758 = CPC 16271).

Notes: When Crous & Kendrick (1994) introduced the asexual genus *Xenogliocladiopsis* based on *X. eucalyptorum*, they incorrectly linked it to the *Dothidiomycete* sexual morph *Arnaudiella eucalyptorum*. Phylogenetic inference in the current study clearly shows that the genus *Xenogliocladiopsis* belongs to the *Nectriaceae*, forming a well-supported clade (BS = 100 %, PP = 1.0) basal to Clades I–IV.

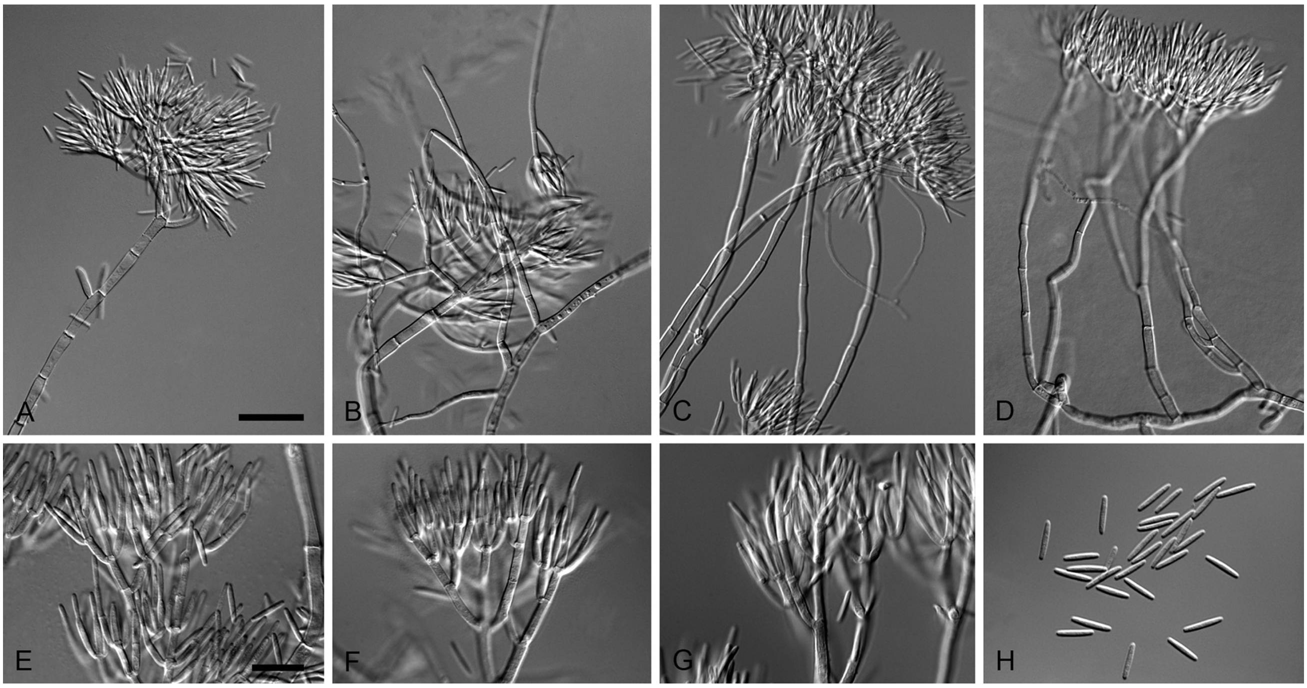

Fig. 7. *Xenogliocladiopsis eucalyptorum* (ex-epitype CBS 138758). A–D. Conidiophores. E–G. Conidiogenous apparatus with cylindrical to cymbiform phialides. F. Conidia. Scale bars: A = 50 μm (apply to B–D); E = 10 μm (apply to F–H).

Xenogliocladiopsis cypellocarpa L. Lombard & Crous, **sp. nov.** MycoBank MB810166. Fig. 8.

Etymology: Name derived from the plant host *Eucalyptus cypellocarpa*, from which it was isolated.

Ascomatal state not observed. *Conidiophores* hyaline, separate or aggregated in sporodochia, consisting of a stipe bearing a penicillate arrangement of fertile branches, and an avesiculate stipe extension; stipe septate, hyaline, smooth, 19–105 × 4–11 μm; stipe extension septate, straight to flexuous, 70–190 μm long, 2–4 μm wide at the apical septum. *Conidiogenous apparatus* 70–115 μm wide, and 65–105 μm long; primary branches aseptate, 15–30 × 3–7 μm; secondary branches aseptate, 10–20 × 2–6 μm; tertiary branches aseptate, 7–22 × 2–5 μm; quaternary branches and additional branches (–8) aseptate, 6–15 × 1–4 μm, each terminal branch producing 2–6 phialides; phialides cylindrical to cymbiform, hyaline, aseptate, 8–11 × 1–3 μm, collarette absent. *Conidia* cylindrical to fusiform, rounded at both ends, straight, 8–10 × 1–2 μm (av. 9 × 1 μm).

Culture characteristics: Colonies moderately fast growing on MEA, 60–80 mm diam after 10 d at 24 °C. Surface white to pale luteous with pale luteous to yellow tuffs of sporodochia forming at the margins; aerial mycelium abundant in the centre becoming immersed towards the margins, with conidiophores forming on the aerial mycelium and on the surface at the margins. Reverse similar in colour.

Material examined: **Australia**, Northern territories, Darwin, Kurralong Height, on leaves of *Eucalyptus cypellocarpa*, 25 Apr. 2011, P.W. Crous (**holotype** CBS H-21951, culture ex-type CBS 133814 = CPC 19417); Queensland, Slaughter Falls, on leaves of *Eucalyptus* sp., 16 Jul. 2009, P.W. Crous, culture CPC 17153.

Notes: *Xenogliocladiopsis cypellocarpa* is introduced here as a new species in the genus *Xenogliocladiopsis*. This species forms shorter stipe extensions (up to 190 μm) than *X. eucalyptorum* (up to 220 μm), and the conidia of *X. cypellocarpa* are also slightly smaller than those of *X. eucalyptorum* (7.5–11 × 1–1.5 μm; Crous & Kendrick 1994).

Clade VI

Cylindrodendrum Bonord., Handb. allg. Mykol.: 98. 1851. MycoBank MB7873.

Ascomatal state unknown. *Conidiophores* initially as lateral phialides on somatic hyphae, sometimes verticillate, hyaline. *Phialides* monophialidic, elongate doliiform to reniform to obpyriform, with the terminal part frequently having a swollen tip, apex with minute periclinal thickening and inconspicuous collarette. *Conidia* cylindrical, rounded at both ends, straight, 0–1-septate, with visible abscission scars (adapted from Lombard *et al.* 2014b).

Type species: *Cylindrodendrum album* Bonord., Handb. Allg. Mykol.: 48. 1851.

Description and illustrations: Lombard *et al.* (2014b).

Notes: Chaverri *et al.* (2011) suggested that the asexual morph-typified genus *Cylindrodendrum* could be considered as a synonym of "*Cylindrocarpon*". Morphologically however, members of *Cylindrodendrum* more closely resemble the asexual morphs of fungal species in the genera *Atractium*, *Cosmospora*, *Dialonectria*, *Fusicolla*, *Macroconia* and *Stylonectria*, with the exception of conidium morphology (Gräfenhan *et al.* 2011). Based on phylogenetic inference, *Cylindrodendrum* isolates included in this study formed a monophyletic clade (BS = 100 %, PP = 1.0), sister to the monophyletic clade representing *Dactylonectria*.

Dactylonectria L. Lombard & Crous, Phytopathol. Medit. 53: 348. 2014. MycoBank MB810142.

Ascomata perithecial, superficial, solitary or aggregated in groups, ovoid to obpyriform, dark red, becoming purple-red in

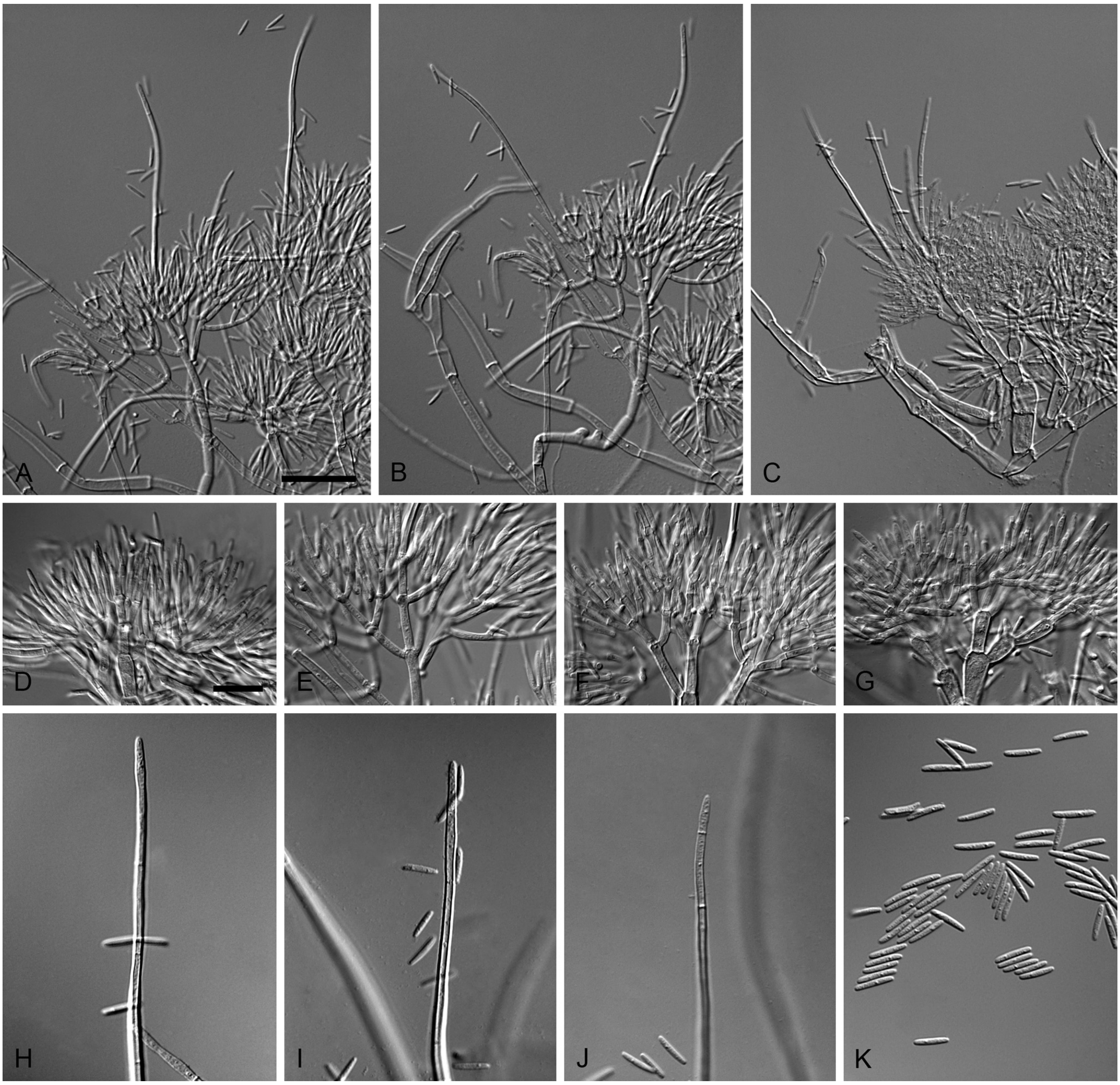

Fig. 8. *Xenogliocladiopsis cypellocarpa* (ex-type CBS 133814). A–C. Conidiophores. D–G. Conidiogenous apparatus with cylindrical to cymbiform phialides. H–J. Avesiculate stipe extensions. K. Conidia. Scale bars: A = 50 µm (apply to B–C); D = 10 µm (apply to E–K).

KOH, smooth to finely warted, with papillate apex; without recognisable stroma. *Asci* clavate to narrowly clavate, 8-spored; apex rounded, with a minutely visible ring. *Ascospores* ellipsoidal to oblong-ellipsoidal, somewhat tapering towards the ends, medianly septate, smooth to finely warted. *Conidiophores* simple or aggregated to form sporodochia; simple conidiophores arising laterally or terminally from aerial mycelium, solitary to loosely aggregated, unbranched or sparsely branched, septate, bearing up to three phialides. *Phialides* monophialidic, more or less cylindrical, tapering slightly in the upper part towards the apex. *Macroconidia* cylindrical, hyaline, straight to slightly curved, 1–4-septate, apex or apical cell typically slightly bent to one side and minutely beaked, base with visible, centrally located or laterally displaced hilum. *Microconidia* ellipsoid to ovoid, hyaline, straight, aseptate to 1-septate, with a minutely or clearly laterally displaced hilum. *Chlamydospores* rarely formed, globose to subglobose, smooth but often appear rough due to deposits, thick-walled, mostly occurring in chains.

Type species: *Dactylonectria macrodidyma* (Halleen, *et al.*) L. Lombard & Crous, Phytopathol. Medit. 53: 352. 2014.

≡ *Neonectria macrodidyma* Halleen *et al.*, Stud. Mycol. 50: 445. 2004.

≡ *Ilyonectria macrodidyma* (Halleen *et al.*) P. Chaverri & C. Salgado, Stud. Mycol. 68: 71. 2011.

= *Cylindrocarpon macrodidymum* Halleen *et al.*, Stud. Mycol. 50: 446. 2004.

Notes: Species in the genus *Dactylonectria* were initially regarded as members of the genus *Ilyonectria*. However, phylogenetic studies (Cabral *et al.* 2012a, Lombard *et al.* 2014b), showed that the genus *Ilyonectria*, as originally conceived, was paraphyletic. This led to the introduction of the genus *Dactylonectria* to accommodate *Ilyonectria* species isolated from grapevines (Cabral *et al.* 2012a, Lombard *et al.* 2014b). The clade representing the genus *Dactylonectria* (BS = 100 %, PP = 1.0) is monophyletic, and is sister to the clade representing *Cylindrodendrum*. Both clades are distinct from *Ilyonectria*.

Ilyonectria P. Chaverri & C. Salgado, Stud. Mycol. 68: 69. 2011. MycoBank MB518558.

Ascomata perithecial, superficial, solitarily or in groups, loosely attached to substrate, red, turning purple-red in KOH, globose to subglobose, or ovoid to obpyriform with a broadly conical papilla or flattened apex, scaly to slightly warted. *Asci* narrowly clavate or cylindrical, 8-spored; apex subtruncate, with a minutely visible ring. *Ascospores* ellipsoidal, 1-septate, smooth hyaline. Asexual morph cylindrocarpon-like. *Conidiophores* simple or complex or sporodochial. Simple conidiophores arising laterally or terminally from aerial mycelium, solitary or loosely aggregated, unbranched or sparsely branched, bearing up to three phialides. Complex conidiophores solitary or aggregated in small sporodochia, repeatedly and irregularly branched. *Phialides* cylindrical, tapering towards the apex. *Microconidia* 0–1-septate, oval to ovoid to fusiform to ellipsoid, with a minutely or clearly laterally displaced hilum, formed in heads on solitary conidiophores or as masses on sporodochia. *Macroconidia* straight, cylindrical, 1–3(–4)-septate, with both ends obtusely rounded, base sometimes with a visible, centrally located to laterally displaced hilum, forming flat domes of slimy masses. *Chlamydospores* globose to subglobose, thick-walled, intercalary or solitary, initially hyaline, becoming brown with age (adapted from Chaverri *et al.* 2011).

Type species: *Ilyonectria destructans* (Zinssm.) Rossman, L. Lombard & Crous.

Description and illustration: Chaverri *et al.* (2011).

Notes: Representatives of the genus *Ilyonectria* clustered together in a well-supported clade (BS = 100 %, PP = 1.0), distinct from the clades representing *Cylindrodendrum* and *Dactylonectria*. Chaverri *et al.* (2011) applied the epithet '*radicicola*' (1963) to the type of this genus, whereas the older epithet '*destructans*' (1918) is available. Therefore, a new combination is provided below for the type species of *Ilyonectria*. Furthermore, a new combination is provided for *Neonectria macroconidialis*, which Cabral *et al.* (2012a) showed to belong to this genus.

Ilyonectria destructans (Zinssm.) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810954.

Basionym: *Ramularia destructans* Zinssm., Phytopathology 8: 570. 1918.

≡ *Cylindrocarpon destructans* (Zinssm.) Scholten, Netherl. J. Plant Path. 70 suppl. (2): 9. 1964.

= *Cylindrocarpon radicicola* Wollenw., Fus. Autogr. Del. 2: 651. 1924.

= *Nectria radicicola* Gerlach & L. Nilsson, Phytopathol. Z. 48: 225. 1963.

≡ *Neonectria radicicola* (Gerlach & L. Nilsson) Mantiri & Samuels, Canad. J. Bot. 79: 339. 2001.

≡ *Ilyonectria radicicola* (Gerlach & L. Nilsson) P. Chaverri & C. Salgado, Stud. Mycol. 68: 71. 2011.

Ilyonectria macroconidialis (Brayford & Samuels) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810955.

Basionym: *Cylindrocarpon macroconidialis* Brayford & Samuels, Mycol. Res. 94: 440. 1990.

≡ *Nectria radicicola* var. *macroconidialis* Samuels & Brayford, Mycol. Res. 94: 440. 1990.

≡ *Neonectria macroconidialis* (Samuels & Brayford) Seifert, Phytopathology 93: 1541. 2003.

Neonectria Wollenw., Ann. Mycol. 15: 52. 1917. MycoBank MB3469.

= *Chitinonectria* Morelet, Bull. Soc. Sci. Nat. Archéol. Toulon & Var 178: 6. 1969.

= *Heliscus* Sacc., Michelia 2: 35. 1880.

Ascomata perithecial, solitary or in groups, seated on an erumpent stroma, red, turning dark red in KOH, smooth to scruffy, subglobose to broadly obpyriform, with a blunt or acute apex. *Asci* narrowly clavate to cylindrical, 8-spored. *Ascospores* ellipsoidal, smooth or finely verruculose, 1-septate, hyaline becoming pale brown with age. *Paraphyses* septate when present, slightly constricted at each septum. *Conidiophores* simple or complex forming sporodochia. Simple conidiophores solitary or loosely aggregated, unbranched or sparsely branched. Complex conidiophores irregularly branched, solitary or aggregated to form sporodochia. *Phialides* cylindrical, tapering towards the apex. *Microconidia* formed by simple conidiophores, hyaline, smooth, ellipsoidal to oblong, 0–1-septate. *Macroconidia* mostly formed by complex conidiophores, hyaline, smooth, straight or slightly curved towards the ends, 3–7(–9)-septate, lacking a scar or basal hilum. *Chlamydospores* globose to subglobose, hyaline (adapted from Chaverri *et al.* 2011).

Type species: *Neonectria candida* (Ehrenb.) Rossman, L. Lombard & Crous.

Description and illustration: Chaverri *et al.* (2011).

Notes: The genus *Neonectria* is monophyletic, forming a well-supported clade (BS = 100 %, PP = 1.0), distinct from the genera included in Clade VI. A new combination is required for *N. ramulariae* (1917) as there is an older epithet *Fusarium candidum* (1818), available for this species.

Neonectria candida (Ehrenb.) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810956.

Basionym: *Fusarium candidum* Ehrenb., Syl. Mycol. Berol: 24. 1818.

≡ *Ramularia candida* (Ehrenb.) Wollenw., Phytopatology 1: 220. 1913.

≡ *Cylindrocarpon ehrenbergii* Wollenw., Fus. Autogr. Del.: 461. 1916.

= *Fusarium obtusiusculum* Sacc., Michelia 2: 297. 1881.

≡ *Fusarium oxysporum* var. *obtusiusculum* (Sacc.) Cif., Ann. Bot., Roma 16: 221. 1924.

≡ *Cylindrocarpon obtusiusculum* (Sacc.) U. Braun, Cryptog. Bot. 4: 113. 1993.

= *Fusarium eichleri* Bres., Ann. Mycol. 1: 130. 1903.

= *Neonectria ramulariae* Wollenw., Ann. Mycol. 15: 52. 1917.

≡ *Nectria ramulariae* (Wollenw.) E. Müll., Beitr. Kryptogamenfl. Schweiz 11: 634. 1962.

= *Cylindrocarpon magnusianum* Wollenw., Z. Parasitenk. 1: 172. 1928.

Clade VII

Chaetopsina Rambelli, Atti Accad. Sci. Ist. Bologna, Cl. Sci. Fis., Rendiconti: 5. 1956. MycoBank MB7584.

= *Chaetopsinectria* J. Luo & W.Y. Zhuang, Mycologia 102: 979. 2010.

Ascomata perithecial, solitary, non-stromatic, superficial, obpyriform, with an acute apex, red, becoming dark red in KOH, smooth. *Asci* unitunicate, clavate, 8-spored, with a simple apex or an apical ring. *Ascospores* ellipsoid to fusiform, 1-septate, hyaline, smooth to striate. *Conidiophores* erect, setiform, tapering towards acutely rounded apex, mostly flexuous, yellow-brown, turning red-brown in KOH, fertile in mid region, unbranched, verruculose, thick-walled, base bulbous. Fertile region consisting of irregularly branched dense aggregated conidiogenous cells. *Conidiogenous cells* ampulliform to lageniform, hyaline, smooth, mono- to polyphialidic. *Conidia* hyaline, smooth, guttulate, subcylindrical, aseptate, apex and base bluntly rounded, base rarely with flattened hilum (adapted from Rambelli 1956 and Luo & Zhuang 2010).

Type species: *Chaetopsina fulva* Rambelli, Atti Accad. Sci. Ist. Bologna, Cl. Sci. Fis. Rendiconti: 5. 1956.
= *Nectria chaetopsinae* Samuels, Mycotaxon 22: 18. 1985.
≡ *Cosmospora chaetopsinae* (Samuels) Rossman & Samuels, Stud. Mycol. 42: 119. 1999.
≡ *Chaetopsinectria chaetopsinae* (Samuels) J. Luo & W.Y. Zhuang, Mycologia 102: 979. 2010.

Descriptions and illustrations: Rambelli (1956), Samuels (1985), Luo & Zhuang (2010).

Notes: *Chaetopsinectria*, a sexual genus based on *Cosmospora chaetopsinae* (Samuels 1985), was established by Luo & Zhuang (2010) for a group of fungi having *Chaetopsina* asexual morphs. We propose that the sexual genus *Chaetopsinectria* (2010) be suppressed in favour of asexual genus *Chaetopsina* (1956), which has priority by date and would require no new combinations. The clade representing *Chaetopsina* (BS $\geq$ 75 %, PP $\geq$ 0.95), which includes the type species, *C. fulva* (ex-type CBS 142.56), is closely related to but separate from the clade representing the genus *Volutella*. In addition, these two genera do not share any morphological characters.

Coccinonectria L. Lombard & Crous, **gen. nov.** MycoBank MB810176.

Etymology: Name refers to the scarlet ascomata produced by these fungi.

Ascomata perithecial, superficial, solitary or aggregated in groups, developing on old sporodochia of volutella-like asexual morphs, subovoid to subglobose, orange to orange-red to carmine red, becoming pink to purple in KOH, initially rough surface due to short, thick-walled setae, with a short papillate ostiole; perithecial wall consists of two regions; inner region composed of thin-walled, flattened, hyaline cells; outer region composed of thick-walled ellipsoid to elongated cells. *Setae* scattered on surface of the perithecia except at the ostiolar region, hyaline, thick-walled, straight to curved, aseptate, narrowing toward the apex. *Asci* unitunicate, clavate, 8-spored, apex simple, truncate with hyaline, thin-walled moniliform paraphyses between the asci. *Ascospores* narrowly ellipsoid to fusiform, aseptate or medianly septate, slightly constricted at the septum, hyaline, becoming dark yellow with age, finely verrucose. *Conidiophores* sporodochial, ochraceous to amber or light russet, with hyaline to lightly coloured aseptate setae. *Conidia* aseptate, hyaline, guttulate, ellipsoidal to fusiform.

Type species: *Coccinonectria pachysandricola* (B.O. Dodge) L. Lombard & Crous.

Notes: The sexual genus *Coccinonectria* is established here to accommodate fungal species previously incorrectly treated as members of the genus *Pseudonectria* (Rossman *et al.* 1999, Gräfenhan *et al.* 2011). *Coccinonectria* is distinguished from *Pseudonectria* by its orange to scarlet ascomata with short, thick-walled setae extending from the ascomatal surface (Dodge 1944, Rossman *et al.* 1999). The latter genus is characterised by yellow to greyish yellow-green ascomata with longer setae on the ascomatal surface (Rossman *et al.* 1999). Phylogenetic inference also shows that the genus *Coccinonectria* is closely related to the genera *Chaetopsina* and *Volutella*, but clearly distinct from the genus *Pseudonectria*.

Coccinonectria pachysandricola (B.O. Dodge) L. Lombard & Crous, **comb. nov.** MycoBank MB810177.
Basionym: *Pseudonectria pachysandricola* B.O. Dodge, Mycologia 36: 536. 1944.
≡ *Volutella pachysandricola* B.O. Dodge, Mycologia 36: 536. 1944.

Description and illustrations: Dodge (1944).

Coccinonectria rusci (Lechat, Gardiennet & J. Fourn.) L. Lombard & Crous, **comb. nov.** MycoBank MB810179.
Basionym: *Pseudonectria rusci* Lechat *et al.*, Persoonia 32: 297. 2014.

Description and illustrations: Crous *et al.* (2014).

Note: *Coccinonectria rusci* (ex-type CBS 126108) clustered in a monophyletic clade representing the genus *Coccinonectria*, and therefore a new combination is proposed for this species.

Pseudonectria Seaver, Mycologia 1: 48. 1909. MycoBank MB4460. ***emend.*** L. Lombard & Crous.
≡ *Nectriella* Sacc., Michelia 1: 51. 1877.
≡ *Nectriella* subgen. *Notarisiella* Sacc., Syll. Fung. 2: 452. 1883.
≡ *Notarisiella* (Sacc.) Clements & Shear, The genera of Fungi: 280. 1931.

Ascomata perithecial, superficial, solitary, with an inconspicuous basal stroma, globose to pyriform, with a pointed apex, pale yellow to greyish yellow-green, not changing in KOH; ascomatal wall smooth, with or without sparse to numerous hyaline to orange setae; ascomatal surface of cells with irregularly thickened walls and joined by pores. *Asci* cylindrical to narrowly clavate, 8-spored. *Ascospores* aseptate, fusiform to ellipsoidal. *Conidiophores* simple or sporodochial. Simple conidiophores as lateral phialides on somatic hyphae or monochasial or verticillate, hyaline. Sporodochial conidiophores consist of a stipe and a penicillate arrangement of fertile branches. *Conidiogenous apparatus* consists of aseptate primary, secondary and rarely tertiary branches with each terminal branch producing 2–4 phialides. *Phialides* hyaline, cylindrical to allantoid, tapering towards the apex, with obvious periclinal thickening and inconspicuous collarettes. *Conidia* aseptate, hyaline, fusiform to ellipsoidal. *Chlamydospores* hyaline, globose to subglobose, formed intercalarily in chains (adapted from Rossman *et al.* 1993, 1999).

Type species: *Pseudonectria buxi* (DC.) Seifert *et al.*, Stud. Mycol. 68: 107. 2011. Fig. 9.
≡ *Tubercularia buxi* DC., Flore française, Edn. 3 (Paris) 6: 110. 1815.
≡ *Chaetostroma buxi* (DC.) Corda, Icon. Fung. 2: 30. 1838.
≡ *Volutella buxi* (DC.) Berk., Ann. Mag. Nat. Hist. 5: 465. 1850.
≡ *Chaetodochium buxi* (DC.) Höhn., Mitt. Bot. Lab. TH Wien 9: 45. 1932.
= *Psilonia rosea* Berk., The English Flora, Fungi 5-2: 353. 1836.
= *Pseudonectria rousseliana* (Mont.) Clements & Shear, The genera of Fungi: 280. 1931.

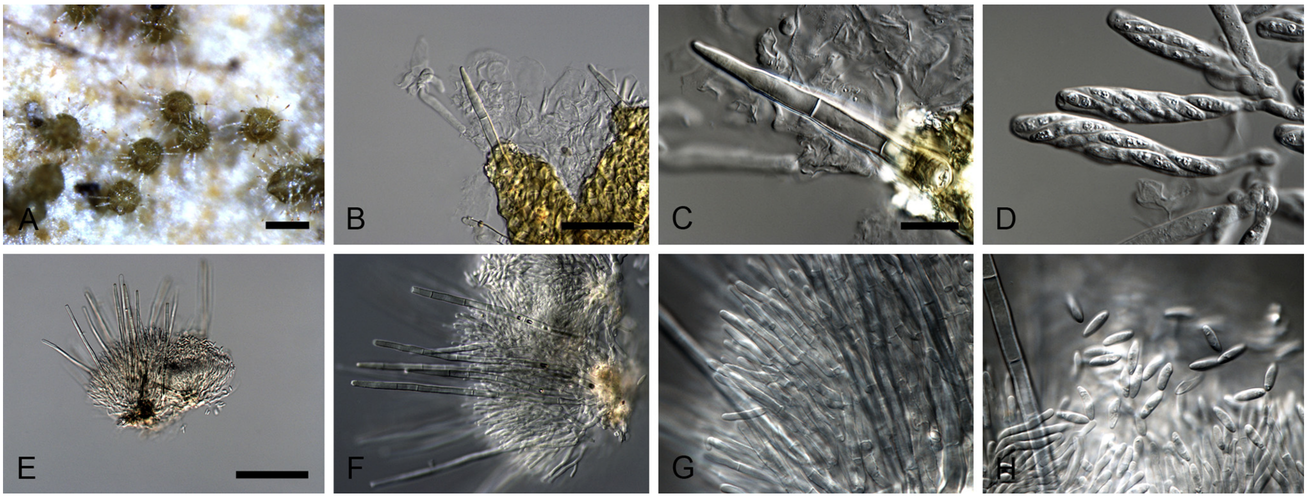

Fig. 9. *Pseudonectria buxi* (CBS 324.53). A. Ascomata on the leaf of *Buxus sempervirens*. B–C. Setae on ascomatal surface. D. Asci with ascospores. E–F. Sporodochial conidiophores. G. Conidiogenous apparatus with cylindrical to allantoid phialides. H. Conidia. Scale bars: A = 500 µm; B = 50 µm (apply to F); C = 10 µm (apply to D, G–H); E = 100 µm.

≡ *Nectria rousseliana* Mont. in Castagne, Cat. Pl. Marseille Suppl.: 44. 1851.
≡ *Stigmatea rousseliana* (Mont.) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23/24: 97. 1870.
≡ *Notarisiella rousseliana* (Mont.) Clements & Shear, The genera of Fungi: 280. 1931.
= *Nectria rousseliana* Mont. var. *viridis* Berk. & Br., Ann. Mag. Nat. Hist. ser. 3, 3: 21. 1859, *fide* Lowen 1991.

Descriptions and illustrations: Rossman *et al.* (1993, 1999).

Note: Representatives of the genus *Pseudonectria* formed a monophyletic clade (BS = 100 %, PP = 1.0), sister to the clade representing the genus *Sarcopodium*.

Pseudonectria foliicola L. Lombard & Crous, **sp. nov.** MycoBank MB810180. Fig. 10.

Etymology: Name refers to the natural habitat of this species, which is a foliar pathogen.

Ascomatal state not observed. *Conidiophores* simple or sporodochial. Simple conidiophores monochasial or verticillate or as lateral phialides on somatic hyphae; phialides aseptate hyaline, cylindrical to allantoid, 12–35 × 2–3 µm. Sporodochial conidiophores without setae, consisting of a stipe and a penicillate arrangement of fertile branches; stipe hyaline, smooth, 0–1-septate, 10–25 × 2–3 µm. *Conidiogenous apparatus* 75–95 µm wide, 85–100 µm long; primary branches aseptate, 25–40 × 2–4 µm, secondary branches aseptate, 15–20 × 2–4 µm, tertiary branches rare, aseptate, 12–15 × 2–3 µm, each terminal branch producing 2–4 phialides; phialides hyaline, cylindrical to allantoid, 9–14 × 2–4 µm, tapering towards the apex, with obvious periclinal thickening and inconspicuous collarettes. *Conidia* hyaline, aseptate, fusiform to ellipsoidal, (5–)6.5–7.5(–8) × 2–3 µm (av. 7 × 3 µm), forming flat domes of pink to salmon slimy masses on the sporodochia. *Chlamydospores* hyaline, globose to subglobose, 35–60 µm diam, formed intercalarily in chains or solitary.

Culture characteristics: Colonies fast growing on MEA, reaching 90 mm in 10 d at 24 °C. Surface white with abundant aerial mycelium, with scattered pink to salmon slimy masses of conidia on sporodochia at the margins. Reverse white.

Material examined: **New Zealand**, South Auckland, Ardmore, on leaves of *Buxus sempervirens*, 1 May 2008, S. Trower (**holotype** CBS H-21950, culture ex-type CBS 123190 = CPC 15385). **USA**, Maryland, Beltsville, Prince George's Co., on leaves of *B. sempervirens*, 10 May 1992, A.Y. Rossman, culture CBS 122566 = AR 2709.

Notes: *Pseudonectria foliicola* can be distinguished from *P. buxi* by the formation of simple conidiophores in the asexual state, something not reported for *P. buxi* (Bezerra 1963, Rossman *et al.* 1993). Also, no setae were observed surrounding the sporodochia of *P. foliicola*, while setae formation is characteristic of *P. buxi* (Bezerra 1963, Rossman *et al.* 1993). The conidia of *P. foliicola* are also smaller than those of *P. buxi*, which are 8–12 × 2.5–3 µm (Bezerra 1963).

Sarcopodium Ehrenb. ex Schlecht., Synop. Pl. Crypt. 2: 101. 1824. MycoBank MB9788.

≡ *Sarcopodium* Ehrenb., Syl. Mycol. Berol. 23. 1818.
= *Tricholeconium* Corda, Icon. Fung. 1: 17. 1837.
= *Cyphina* Sacc., Syll. Fung. 3: 623. 1884.
= *Periolopsis* Maire, Ann. Mycol. 11: 357. 1913.
= *Actinostilbe* Petch, Ann. Roy. Bot. Gard. (Peradeniya) 9: 327. 1925.
= *Kutilakesa* Subram., J. Indian Bot. Soc. 35: 478. 1956.
= *Kutilakesopsis* Agnihoth. & Barua, J. Indian Bot. Soc. 36: 308. 1957.
= *Lanatonectria* Samuels & Rossman, Stud. Mycol. 42: 137. 1999.

Ascomata perithecial, solitary or in groups, superficial on a minute stroma, on an erumpent, previously conidial stroma, or at the base of a synnema, subglobose to broadly obpyriform, red, turning dark red in KOH, non-papillate or with a minute papilla, with hyaline to yellow hyphal hairs; hairs smooth, spinulose, hooked or straight, septate, thin-walled, arising from the surface of the ascomatal wall and forming around the ascomatal base, sometimes forming a tomentum on the ascomatal surface. *Asci* clavate to fusiform, 8-spored, apex simple or with a ring. *Ascospores* ellipsoid to fusiform, 1-septate, hyaline to pale yellow-brown, striate. *Conidiomata* sporodochial, cupulate to synnematal, superficial. *Setae* simple, septate, rarely branched, smooth or verruculose, straight or circinate, brown. *Conidiophores* macronematous, irregularly, verticillately, or penicillately branched, hyaline, smooth. *Phialides* hyaline, smooth, cylindrical or doliiform to reniform. *Conidia* aggregated in slimy masses, straight, cylindrical to ellipsoid, hyaline,

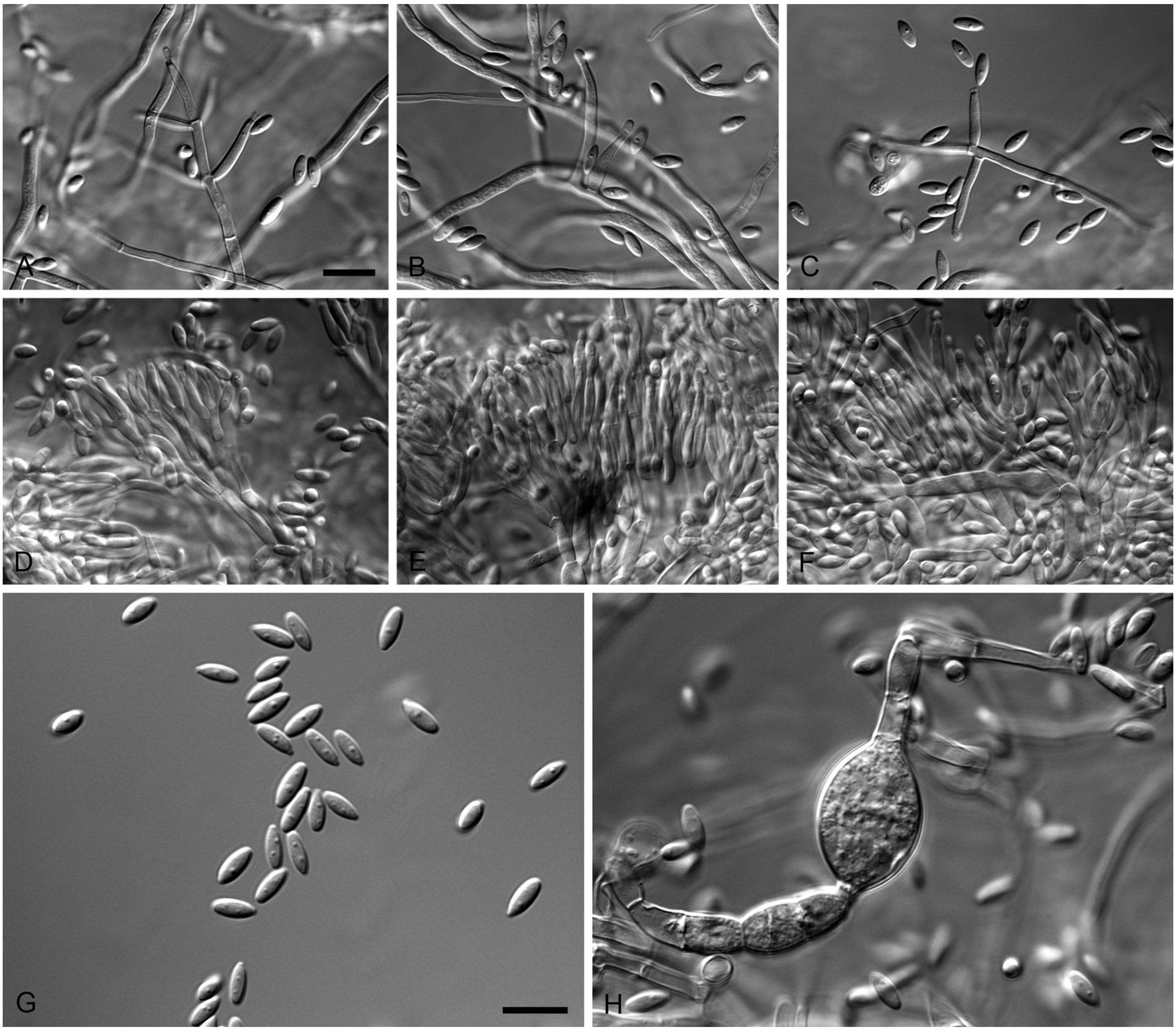

Fig. 10. *Pseudonectria foliicola* (ex-type CBS 123190). A–C. Simple conidiophores. D–F. Sporodochial conidiophores. G. Conidia. H. Chlamydospores. Scale bars: A = 10 µm (apply to B–F); G = 10 µm (apply to H).

0–1-septate (adapted from Sutton 1981 and Rossman *et al.* 1999).

Type species: *Sarcopodium circinatum* Ehrenb. ex Schlecht., Synop. Pl. Crypt. 2: 101. 1824. Fig. 11.

≡ *Sarcopodium circinatum* Ehrenb., Syl. Mycol. Berol. 12 & 23. 1818.
≡ *Thelephora circinata* (Ehrenb.) Fr., Elenchus Fung. 1: 226. 1828.
≡ *Corticium circinatum* (Ehrenb.) Fr., Epi. Syst. Mycol.: 556. 1838.
≡ *Hymenochaete circinata* (Ehrenb.) Lév., Ann. Sci. Nat., Bot. 5: 133. 1846.

Descriptions and illustrations: Sutton (1981), Rossman *et al.* (1999).

Notes: Representatives of the genus *Sarcopodium* formed a monophyletic clade (BS $\geq$ 75 %, PP $\geq$ 0.95), closely related to the genus *Pseudonectria*. Rossman *et al.* (1999) established the sexual genus *Lanatonectria*, based on *L. flocculenta*, for nectriaceous fungi with *Actinostilbe* asexual morphs. Later, Rossman *et al.* (2013) proposed that the genus name *Lanatonectria* be suppressed in favour of *Actinostilbe* based on priority, as per the ICN (McNiell *et al.* 2012). However, Sutton (1981) had already synonymised *Actinostilbe* under the asexual morph genus *Sarcopodium*. Furthermore, Rossman *et al.* (2013) synonymised *L. flocculenta* (= *A. macalpinei*) under *A. flocculenta*. *Actinostilbe flocculenta* should be regarded as a synonym of *S. macalpinei* as proposed by Sutton (1981). Phylogenetic inference in this study clearly supports the findings of Sutton (1981). Therefore, we regard *Actinostilbe* as a synonym of *Sarcopodium* and introduce several new combinations below.

Sarcopodium flavolanatum (Berk. & Broome) L. Lombard & Crous, **comb. nov.** MycoBank MB810181.
Basionym: *Nectria flavolanata* Berk. & Broome, J. Linn. Soc., Bot. 14: 114. 1873.

≡ *Actinostilbe flavolanata* (Berk. & Broome) Rossman, Samuels & Seifert, IMA Fungus 4: 46. 2013.

= *Nectria radians* Penz. & Sacc., Malpighia 11: 510. 1897.
= *Nectria tjibodensis* Penz. & Sacc., Malpighia 11: 512. 1897.
= *Chilonectria javanica* Penz. & Sacc., Malpighia 11: 508. 1897.
= *Calonectria sulphurella* Starbäck, Bih. Kungl. Svenska Vetenskapakad. Handl. 25: 30. 1899.
= *Sphaerostilbe ochracea* Pat., in Duss, Énum. Champ. Guadeloupe: 79. 1903.

Sarcopodium mammiforme (Chardón) L. Lombard & Crous, **comb. nov.** MycoBank MB810182.
Basionym: *Sphaerostilbe mammiformis* Chardón, Sci. Surv. Porto Rico & Virgin Islands 8: 46. 1926.

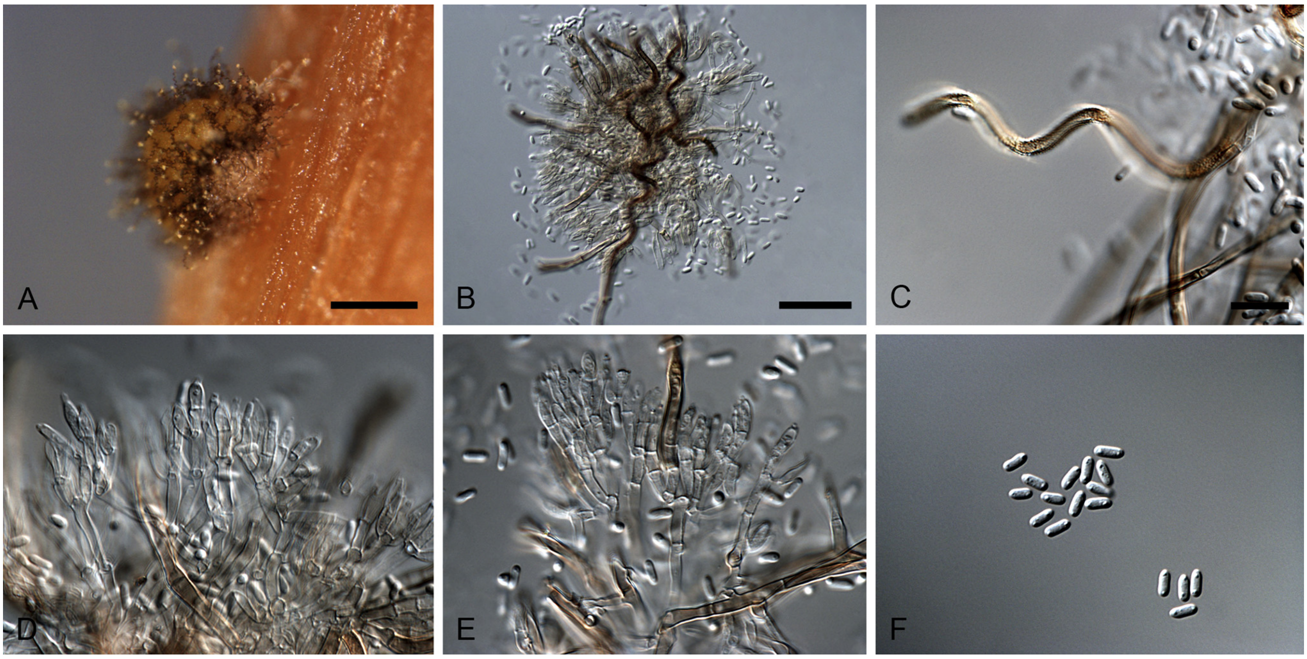

Fig. 11. *Sarcopodium circinatum* (CBS 100998). A–B. Sporodochial conidiomata. C. Circinate setae. D–E. Conidiophores. F. Conidia. Scale bars: A, B = 100 µm; C = 10 µm (apply to D–F).

≡ *Nectria mammiformis* (Chardón) Samuels, Caldasia 13: 393. 1982.
≡ *Lanatonectria mammiformis* (Chardón) Samuels & Rossman, Stud. Mycol. 42: 139. 1999.
= *Actinostilbe mammiformis* (Cif.) Seifert & Samuels, Stud. Mycol. 42: 139. 1999.
≡ *Stromatographium mammiforme* Cif., Sydowia 8: 264. 1954.

Sarcopodium oblongisporum (Y. Nong & W.Y. Zhuang) L. Lombard & Crous, **comb. nov.** MycoBank MB810183.
Basionym: *Lanatonectria oblongispora* Y. Nong & W.Y. Zhuang, Fungal Diversity 19: 98. 2005.
≡ *Actinostilbe oblongispora* (Y. Nong & W.Y. Zhuang) Rossman *et al.*, IMA Fungus 4: 46. 2013.

Sarcopodium raripilum (Penz. & Sacc.) L. Lombard & Crous, **comb. nov.** MycoBank MB810184.
Basionym: *Nectria raripila* Penz. & Sacc., Malpighia 15: 228. 1901.
= *Lanatonectria raripila* (Penz. & Sacc.) Samuels & Rossman, Stud. Mycol. 42: 140. 1999.

Volutella Tode 1790: Fr. 1832. Fungi Mecklenb. Sel. 1: 28. 1790: Syst. Mycol. 3: 458, 466. 1832. MycoBank MB7573.
= *Volutellonectria* J. Luo & W.Y. Zhuang, Phytotaxa 44: 3. 2012.

Ascomata perithecial, solitary, on a thin basal stroma, superficial, obpyriform to pyriform, with an acute apex, orange to red, turning dark red in KOH, smooth or hairy. *Asci* unitunicate, subcylindrical to clavate, 8-spored, with an apical ring. *Ascospores* 1-septate, hyaline, fusiform to biconic, smooth or finely roughened. *Conidiophores* aggregated into sporodochia or synnemata, with an inconspicuous stroma; unbranched, hyaline setae around the margin of conidiomata. *Synnemata* when produced, determinate, pale, composed of a stipe of parallel hyphae and a divergent capitulum of conidiophores giving rise to a slimy conidial mass. *Conidiophore* branching once or twice monochasial, 2-level verticillate, monoverticillate or irregularly biverticillate. *Conidiogenous cells* monophialidic, hyaline, subulate, usually with conspicuous periclinal thickening. *Conidia* aseptate, hyaline, ellipsoidal, ovate or oblong, forming slimy white, yellow, orange or pink masses (adapted from Gräfenhan *et al.* 2011 and Luo & Zhuang 2012).

Type species: *Volutella ciliata* (Alb. & Schw.: Fr.) Fr., Syst. Mycol. 3: 466. 1832. Fig. 12.

Descriptions and illustrations: Gräfenhan *et al.* (2011), Luo & Zhuang (2012).

Notes: Representatives of the genus *Volutella* formed a monophyletic clade (BS $\geq$ 75 %, PP $\geq$ 0.95), distinct from the clades representing *Coccinonectria* and *Pseudonectria*. *Volutella* shares several morphological characters of the asexual morph with these genera.

Volutella asiana (J. Luo, X.M. Zhang & W.Y. Zhuang) L. Lombard & Crous, **comb. nov.** MycoBank MB810185.
Basionym: *Volutellonectria asiana* J. Luo, X.M. Zhang & W.Y. Zhuang, Phytotaxa 44: 5. 2012.

Notes: Luo & Zhuang (2012) established the sexual genus *Volutellonectria* (*Vo.*), with *Vo. consors* as type, and indicated that *Volutella* (*V.*) *minima* represents the asexual morph. However, Gräfenhan *et al.* (2011) synonymised *V. minima* under *Vo. consors*. Additionally, Luo & Zhuang (2012) introduced two more species in the genus *Volutellonectria*, namely *Vo. asiana* as a new species, and *Vo. ciliata* (= *V. ciliata*) as a new combination. Given the obscurity of *Volutellonectria* and the number of name changes that would be required if the use of this name were perpetuated, we propose that the sexual genus *Volutellonectria* be suppressed in favour of the asexual genus *Volutella*, which also has priority by date. Therefore only the single new combination proposed in this study is required.

Clade VIII

Atractium Link: Fr., Mag. Ges. naturf. Freunde, Berlin 3: 10. 1809: Fries, Syst. Mycol. 1: xli. 1821. MycoBank MB7291.

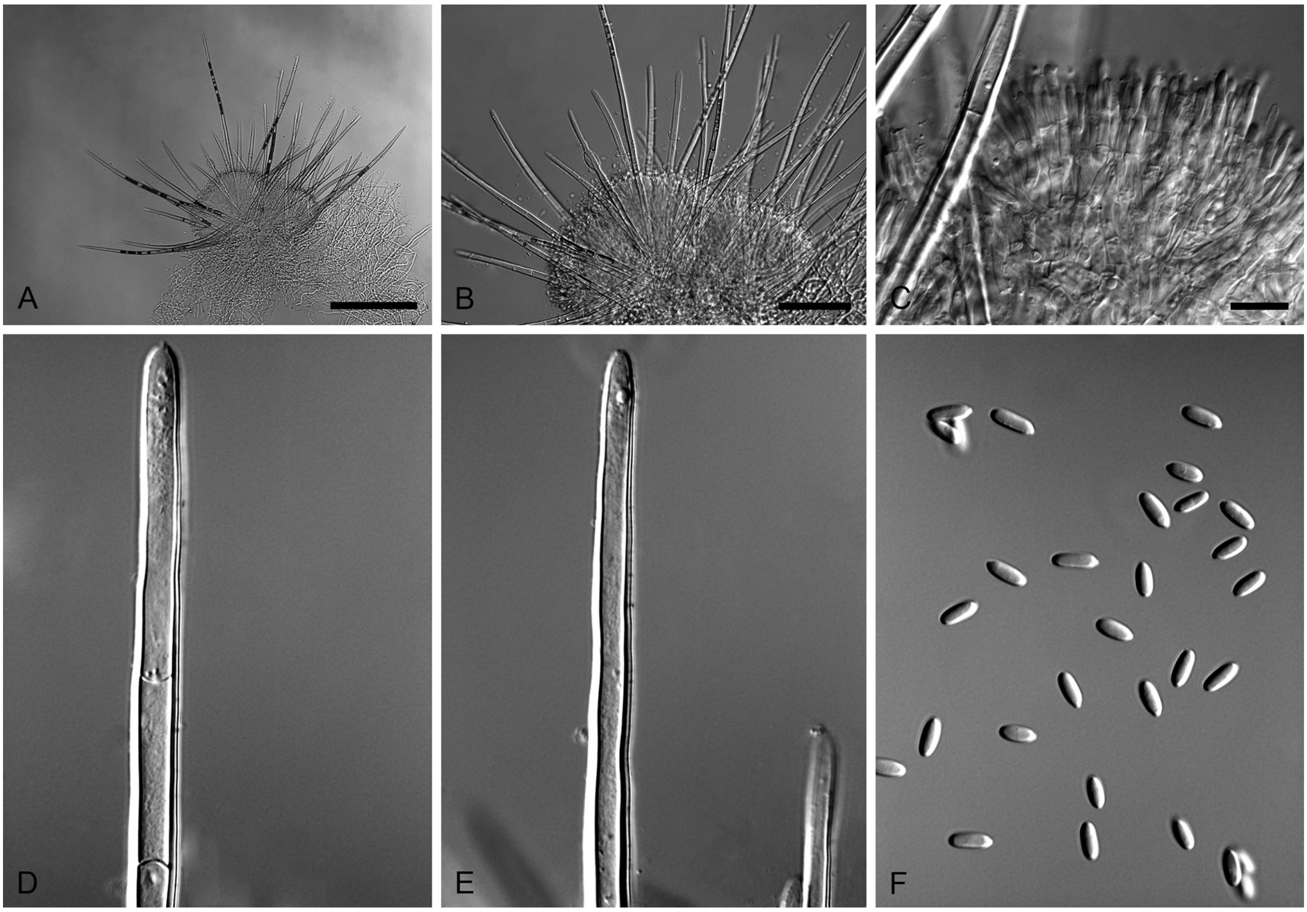

Fig. 12. *Volutella ciliate* (CBS 483.61). A–B. Sporodochial conidiomata. C. Conidiophores. D–E. Setae. F. Conidia. Scale bars: A = 100 μm; B = 50 μm; C = 10 μm (apply to D–F).

Ascomatal state unknown. *Conidiophores* aggregated into sporodochia or synnemata, non-stromatic. *Synnemata* determinate, pale brown, composed of a stipe of parallel hyphae and a divergent capitulum of conidiophores giving rise to a slimy conidial mass. *Conidiophore* branching once or twice monochasial, 2-level verticillate, monoverticillate or irregularly biverticillate. *Conidiogenous cells* monophialidic, hyaline, subulate with conspicuous periclinal thickening. *Conidia* (0–)1–5-septate, clavate, obovoid or gently curved, rarely ellipsoidal, with a rounded apical cell, and somewhat conical basal cell, lacking a differentiated foot, forming yellow to orange masses (adapted from Gräfenhan *et al.* 2011).

Type species: *Atractium stilbaster* Link, Mag. Ges. naturf. Freunde, Berline 3: 10. 1809.

≡ *Fusarium stilbaster* (Link) Link, Caroli Linné Sp. Pl. Ex. Pl. Rite Cogn. Gen. Relat. 6: 106. 1825.
= *Atractium fuscum* Sacc., Syll. Fung. 2: 514. 1883.
≡ *Stilbella fusca* (Sacc.) Seifert, Stud. Mycol. 27: 77. 1985.
= *Atractium flavoviride* Sacc., Syll. Fung. 2: 514. 1883.
= *Stilbum madidum* Peck, Annual Rep. New York St. Mus. Nat. Hist. 46: 35. 1893.
= *Didymostilbe eichleriana* Bres. & Sacc., C. r. Congr. Bot. Palermo: 59. 1902.
= *Didymostilbe capillacea* Bres. & Sacc., Annls Mycol. 1: 28. 1903.
= *Didymostilbe obovoidea* Matsush. Icon. Microfung. Matsush. Lect.: 60. 1975.

Description and illustrations: Gräfenhan *et al.* (2011).

Note: Representatives of the genus *Atractium* formed a monophyletic clade (BS $\geq$ 75 %, PP $\geq$ 0.95), closely related to the genera *Calostilbe* and *Ophionectria*.

Calostilbe Sacc. & Syd., Syll. Fung. 16: 591. 1902. MycoBank MB758.

= *Nectria* subgen. *Phaeonectria* Sacc., Syll. Fung. 11: 359. 1895.
≡ *Phaeonectria* (Sacc.) Sacc. & Trotter, Syll. Fung. 22: 485. 1913.
= *Calostilbella* Höhn., Ber. Deutsch. Bot. Ges. 37: 160. 1919.

Stromata well-developed, originating from a central point, pseudoparenchymatous below the ascomata, giving rise to synnemata, ascomata forming at the base and on rhizoids that arise from the stromata, growing under bark and breaking through at points. *Ascomata* perithecial, superficial, densely aggregated, ovoid, not collapsing or collapsing laterally when dry, orange, turning sienna in KOH, apical region with acute papilla. Ascomata surface prosenchymatous, walls thickened. *Asci* clavate, apex simple, base pointed to pedicellate. *Ascospores* fusiform to ellipsoidal, 1-septate, slightly constricted or not, yellow-brown, coarsely striate, appearing as longitudinal furrows. Asexual morph synnematal, arising throughout the stromata. Hyphae of the synnemata parallel, branched, with the ends of the hyphae at the surface with small “cork screws”, giving the surface a granular-crystalline aspect. *Phialides* formed in a well-defined, hemispherical cluster, with a swollen, often slightly flared apex at the tip and cylindrical base. Sterile elements interspersed with phialides, straight, smooth, thin-walled, septate. *Conidia* ellipsoidal, 1-septate, yellow-brown, thick-walled in the centre becoming hyaline and thin-walled at the ends, held in a solitary, brown drop of liquid at the apex (adapted from Rossman *et al.* 1999).

Type species: *Calostilbe striispora* (Ellis & Everh.) Seaver, Mycologia 20: 248. 1928.

≡ *Nectria striispora* Ellis & Everh., Bull. Iowa Univ. Lab. Nat. Hist. 2: 398. 1893.
≡ *Macbridella striispora* (Ellis & Everh.) Seaver, Mycologia 1: 196. 1909.
≡ *Letendraea striispora* (Ellis & Everh.) Weese, Sitzungsber. Kaiserl. Akad. Wiss., Math.- Naturwiss. Cl., Abt. 1, 125: 514. 1916.
= *Sphaerostilbe longiasca* Möller, Bot. Mitt. Tropen 9: 122. 1901.
≡ *Calostilbe longiasca* (Möller) Sacc. & P. Syd., Syll. Fung. 16: 591. 1902.
≡ *Letendraea longiasca* (Möller) Weese, Sitzungsber. Kaiserl. Akad. Wiss., Math.- Naturwiss. Cl., Abt. 1, 128: 742. 1919.
≡ *Nectria longiasca* (Möller) E. Müll., Beitr. Kryoptogamenfl. Schweiz 11: 636. 1962.
= *Sphaerostilbe musarum* Ashby, Bull. Dept. Agric. Jamaica 2: 118. 1914.
= *Calostilbella calostilbe* Höhn., Ber. Deutsch. Bot. Ges. 37: 160. 1919.
= *Xenostilbum sydowii* Petr., Sydowia 13: 106. 1919.
= *Calostilbe ledermannii* Syd., Engl. Bot. Jahrb. 57: 322. 1922.

Description and illustrations: Rossman *et al.* (1999).

Notes: We recommend that the generic name *Calostilbe* be protected over the generic name *Calostilbella* based on priority. Therefore, *Calostilbella calostilbe* should be regarded as a synonym of *Calostilbe striispora*.

Ophionectria Sacc., Michelia 1: 323. 1878. MycoBank MB3608.
= *Antipodium* Piroz., Canad. J. Bot. 52: 1143. 1974.

Ascomata perithecial, solitary or aggregated in groups, sometimes seated on a white to bright yellow subiculum of thick-walled, minutely warted septate hyphae, each cell swollen at one end, superficial, ovoid to elongate-ovoid to cylindrical, often truncate at the apex, red-orange to scarlet, turning dark red to bay in KOH, covered with conspicuous, concolorous warts of loosely compacted, irregularly globose, pigmented cells; ascomata often naked towards the apex. *Asci* clavate, 8-spored, with simple apex. *Ascospores* long-fusiform, often somewhat bent, vermiform, multiseptate, the proximal end slightly inflated and bluntly rounded, the distal end tapering and narrowly rounded, thick-walled, hyaline, with faint longitudinal striations or smooth. *Conidiophores* arise laterally from hyphae, septate, unbranched, erect, straight, thin-walled, hyaline tapering toward the apex, terminating in a cylindrical phialide. *Conidia* (2–)3–5(–6)-septate, with the two middle cells larger than the end cells, fusiform and not constricted at the septa, or broadly ellipsoidal to ovoid and somewhat constricted at the median septum, initially hyaline turning olive-yellow with age (adapted from Pirozynski 1974 and Rossman *et al.* 1999).

Type species: *Ophionectria trichospora* (Berk. & Broome) Sacc., Michelia 1: 323. 1878.
≡ *Nectria trichospora* Berk & Broome, J. Linn. Soc., Bot. 14: 115. 1875.
≡ *Dialonectria trichospora* (Berk. & Broome) Cooke, Grevillea 12: 111. 1884.
≡ *Tubeufia trichospora* (Berk. & Broome) Petch, Ann. Roy. Gard. Peradeniya 5: 285. 1912.
= *Calonectria ornata* A.L. Smith, J. Linn. Soc., Bot. 35: 8. 1901.
= *Calonectria cinnabarina* P. Henn., Hedwigia 36: 220. 1897.
≡ *Ophionectria cinnabarina* (P. Henn.) P. Henn., Hedwigia 41: 7. 1902.
= *Calonectria theobromae* Pat., in Duss, Énum. Champ. Guadeloupe: 81. 1903.
= *Ophionectria portoricensis* Chardón, Mycologia 13: 285. 1912.
= *Antipodium spectabile* Piroz., Canad. J. Bot. 52: 1143. 1974.

Descriptions and illustrations: Pirozynski (1974), Rossman (1977), Rossman *et al.* (1999).

Notes: *Ophionectria trichospora*, the type of the genus (Rossman 1977), is directly linked to the type of the asexual genus *Antipodium* (Pirozynski 1974), known as *A. spectabile*. Rossman (1977) re-evaluated the generic status of *Ophionectria* and retained only the type species. Later, Rossman (1983) added *O. magniverrucosa* to the genus. A second species isolated from *Arechae catechu*, *A. arechae*, was added to the genus *Antipodium* by Matsushima (1980). However, based on the description and illustrations provided, this species should be considered a member of the genus *Trichothecium* (Summerbell *et al.* 2011). Since the generic name *Ophionectria* (1878) has priority over the generic name *Antipodium* (1974), we recommend that the generic name *Ophionectria* be protected against *Antipodium*.

Clade IX

Albonectria Rossman & Samuels, Stud. Mycol. 42: 105. 1999. MycoBank MB27953.

Ascomata perithecial, solitary to gregarious on a sparse to well-developed stroma, superficial, globose to subglobose to ellipsoidal or ovoid to obovoid, white to pale yellow to pale ochraceous, not changing colour in KOH, warty, with or without a small pointed papilla. Asci narrowly clavate or broadly clavate to ellipsoidal, 4–8-spored. Ascospores ellipsoidal to long-ellipsoidal or fusiform to long-fusiform, multiseptate, hyaline to yellow-brown, smooth to striate. Conidiophores monophialidic, polyphialidic or sporodochial. Microconidia variable in shape, 0–1-septate, hyaline, smooth, with or without a flattened basal papilla, or with or without a poorly developed foot cell. Macroconidia cylindrical to broadly fusiform or long fusiform to clavate, multiseptate, curved, with curved, pointed tip and foot-cell, or distinctly beaked at both ends (adapted from Gerlach & Nirenberg 1982 and Rossman *et al.* 1999).

Type species: *Albonectria rigidiuscula* (Berk. & Broome) Rossman & Samuels, Stud. Mycol. 42: 105. 1999.
≡ *Nectria rigidiuscula* Berk. & Broome, J. Linn. Soc., Bot. 14: 116. 1873.
≡ *Calonectria rigidiuscula* (Berk. & Broome) Sacc., Michelia 1: 313. 1878.
= *Calonectria lichenigena* Speg., Bol. Acad. Nac. Ci. 11: 530. 1889.
= *Calonectria eburnean* Rehm., Hedwigia 37: 196. 1898.
= *Calonectria sulcata* Starbäck, Bih. Kongl. Svenska Vetenskapsakad. Handl. 25: 29.1899.
= *Calonectria meliae* Zimm., Centralbl. Bakteriol. Parasitenk. 7: 106. 1901.
= *Calonectria cremea* Zimm., Centralbl. Bakteriol. Parasitenk. 7: 140. 1901.
= *Calonectria hibiscicola* Henn., Hedwigia 48: 105. 1908.
= *Fusarium decemcellulare* Brick, Jahresber. Vereinigung. Angew. Bot. 6: 277. 1908.
= *Scoleconectria tetraspora* Seaver, North Amer. Flora 3: 27. 1910.
≡ *Calonectria tetraspora* (Seaver) Sacc. & Trotter, Syll. Fung. 22: 487. 1913.

Descriptions and illustrations: Gerlach & Nirenberg (1982), Rossman *et al.* (1999).

Notes: The sexual genus *Albonectria* was introduced by Rossman *et al.* (1999) to accommodate species with white to pale yellow ascomata associated with *Fusarium* asexual morphs. Representatives of this genus formed a monophyletic clade (BS = 100 %, PP = 1.0) closely related but separate from the clades representing *Cyanonectria*, *Geejayessia* and *Fusarium*.

Bisifusarium L. Lombard, Crous & W. Gams, **gen. nov.** MycoBank MB810226. Fig. 13.

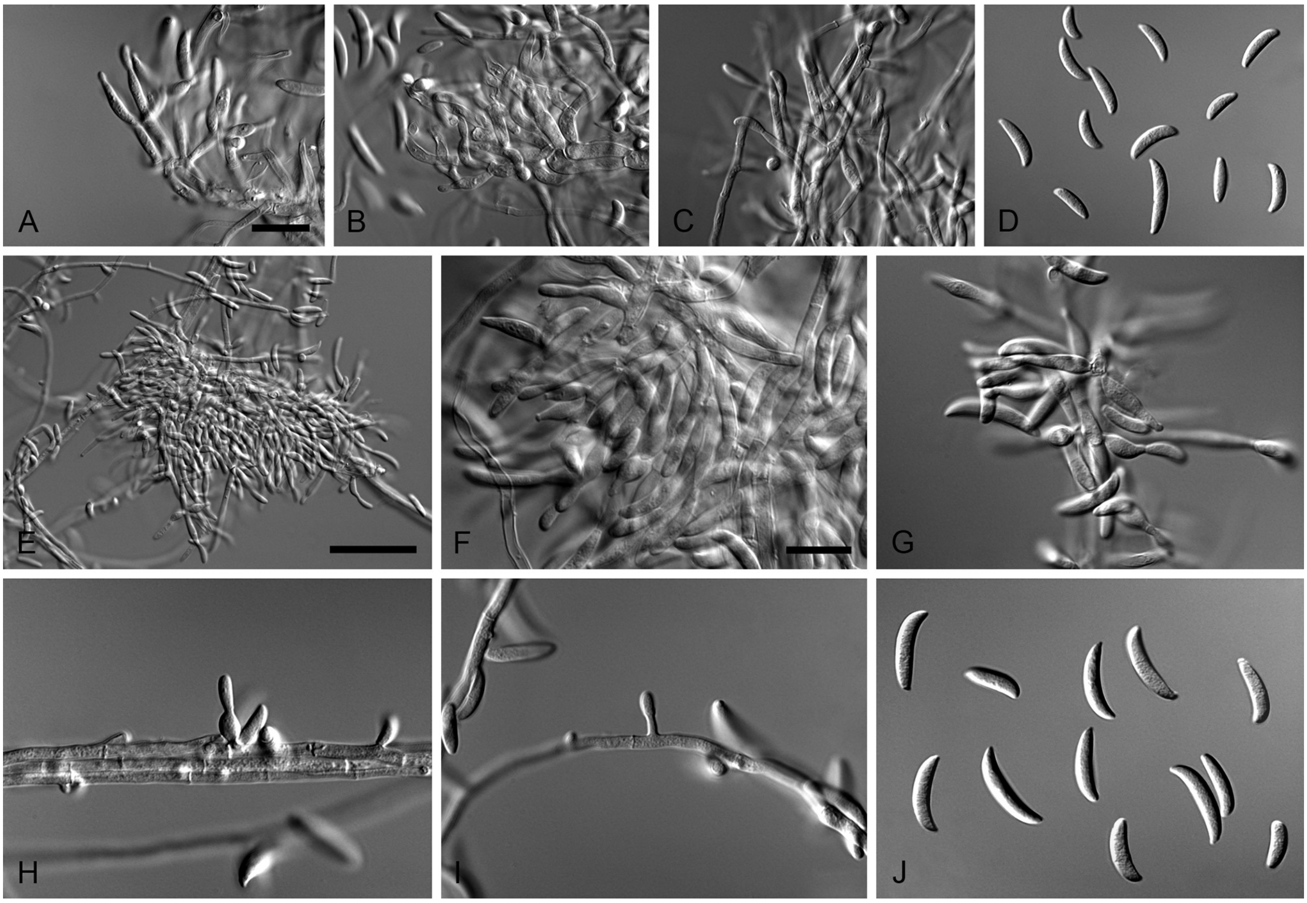

Fig. 13. *Bisifusarium*. A–D. *B. dimerum* (ex-type CBS 108944). A–C. Sporodochia. D. Conidia. E–J. *B. delphinoides* (ex-type CBS 120718). E–G. Sporodochia. H–I. Lateral phialidic pegs. J. Conidia. Scale bars: A = 10 µm (apply to B–D); E = 50 µm; F = 10 µm (apply to G–J).

Etymology: Name refers to the 2-celled macroconidia characteristically formed by these fungi.

Ascomatal state unknown. *Conidiophores* macronematous, lateral phialidic pegs, simple or sporodochial. Later phialidic pegs arising from superficial or submerged hyphae. Simple conidiophores monophialidic, rarely polyphialidic, cylindrical and slightly tapering towards the apex, or flask-shaped, solitary or aggregated when forming terminally or laterally on hyphae. *Sporodochia* pionnotal or hemispherical. Pionnotal sporodochia poorly developed, consisting of densely arranged phialides or short supporting cells with whorls of phialides; whorls arising laterally from hyphae or from irregularly branched conidiophores. Hemispherical sporodochia consisting of a core of angular, uniformly thin-walled, hyaline cells bearing cylindrical phialide-subtending cells or monophialides. *Microconidia* 0(–1)-septate, ellipsoidal and straight or allantoid, broadly lunate to reniform or curved and tapering at both ends, mostly formed by monophialidic conidiophores and lateral phialidic pegs as inconspicuous heads. *Macroconidia* (0–)1–2(–3)-septate, curved to lunate, with a distal end slightly more bent than the proximal end or with both ends equally bent, both ends tapering, the proximal end typically slightly pedicellate, mostly formed as masses on poorly or well-developed sporodochia. *Chlamydospores*, if present, globose to subglobose to ellipsoidal, solitary or in chains, sometimes aggregated into sclerotia (adapted from Schroers *et al.* 2009).

Type species: *Bisifusarium dimerum* (Penz.) L. Lombard & Crous.

Notes: The genus *Bisifusarium* is established here to accommodate fusarium-like species previously classified in the genus *Fusarium*. Species of *Bisifusarium* can be distinguished from species in *Fusarium* by their short, (0–)1–2(–3)-septate macroconidia and the formation of lateral phialidic pegs arising from the hyphae (Gerlach & Nirenberg 1982, Schroers *et al.* 2009), rarely seen in the genus *Fusarium*. Past phylogenetic studies (Schroers *et al.* 2009, O'Donnell *et al.* 2013) showed that species of *Bisifusarium* (as the *Fusarium dimerum* species group; Schroers *et al.* 2009) formed a well-supported monophyletic clade, closely related but separate to "the *Fusarium* terminal clade" (Geiser *et al.* 2013). Phylogenetic inference in this study further supports this observation, with representatives of *Bisifusarium* forming a well-supported clade (BS = 100 %, PP = 1.0) closely related but separate from the clade representing the genus *Fusarium*.

Bisifusarium biseptatum (Schroers, Summerbell & O'Donnell) L. Lombard & Crous, **comb. nov.** MycoBank MB810227.

Basionym: *Fusarium biseptatum* Schroers, Summerbell & O'Donnell, Mycologia 101: 59. 2009. [non *Fusarium biseptatum* Sawada, Special Publ. Coll. Agric. Natl. Taiwan Univ. 8: 228. 1959, nom. inval.]

Description and illustrations: Schroers *et al.* (2009).

Bisifusarium delphinoides (Schroers, Summerbell, O'Donnell & Lampr.) L. Lombard & Crous, **comb. nov.** MycoBank MB810228.

Basionym: *Fusarium delphinoides* Schroers, Summerbell, O'Donnell & Lampr., Mycologia 101: 57. 2009.
? = *Fusarium dimerum* var. *majusculum* Wollenw., Fus. Autogr. Del. 1: 90. 1916.

Description and illustrations: Schroers *et al.* (2009).

Bisifusarium dimerum (Penz.) L. Lombard & Crous, **comb. nov.** MycoBank MB810229.
Basionym: *Fusarium dimerum* Penz., Michelia 2: 484. 1882.
≡ *Fusarium pusillum* Wollenw., Fus. Autogr. Del. 2: 550. 1924.
≡ *Fusarium aquaeductuum* var. *dimerum* (Penz.) Raillo, Fungi of the genus *Fusarium*: 279. 1950.
≡ *Microdochium dimerum* (Penz.) Arx, Trans. Brit. Mycol. Soc. 83: 374. 1984.
? = *Fusarium dimerum* var. *pusillum* Wollenw., Fus. Autogr. Del. 3: 851. 1930.

Descriptions and illustrations: Gerlach & Nirenberg (1982), Schroers *et al.* (2009).

Bisifusarium domesticum (Fr.) L. Lombard & Crous, **comb. nov.** MycoBank MB810230.
Basionym: *Trichothecium domesticum* Fr., Syst. Mycol. 3: 427. 1832.
≡ *Fusarium domesticum* (Fr.) Bachm., LWT – Food Sci. Tech. 38: 405. 2005.

Description and illustrations: Schroers *et al.* (2009).

Bisifusarium lunatum (Ellis & Everh.) L. Lombard & Crous, **comb. nov.** MycoBank MB810231.
Basionym: *Gloeosporium lunatum* Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia. 43: 82. 1891.
≡ *Fusarium lunatum* (Ellis & Everh.) Arx, Verh. Kon. Akad. Wetensch., Afd. Natuurk. 51: 101. 1957.
≡ *Microdochium lunatum* (Ellis & Everh.) Arx, Trans. Brit. Mycol. Soc. 83: 374. 1984.
= *Fusarium dimerum* var. *violaceum* Wollenw., Fus. Autogr. Del. 3: 854. 1930.

Description and illustrations: Schroers *et al.* (2009).

Bisifusarium nectrioides (Wollenw.) L. Lombard & Crous, **comb. et stat. nov.** MycoBank MB810232.
Basionym: *Fusarium dimerum* var. *nectrioides* Wollenw., Fus. Autogr. Del. 3: 855. 1930.
= *Fusarium nectrioides* (Wollenw.) Schroers, Summerbell & O'Donnell, Mycologia 101: 59. 2009.

Description and illustrations: Schroers *et al.* (2009).

Bisifusarium penzigii (Schroers, Summerbell & O'Donnell) L. Lombard & Crous, **comb. nov.** MycoBank MB810233.
Basionym: *Fusarium penzigii* Schroers, Summerbell & O'Donnell, Mycologia 101: 61. 2009.

Description and illustrations: Schroers *et al.* (2009).

Cyanonectria Samuels & Chaverri, Mycol. Progress 8: 56. 2009. MycoBank MB537057.

Ascomata perithecial, gregarious or caespitose, with a reduced or well-developed stroma, smooth, thin-walled, ampulliform to obpyriform or pyriform, dark bluish or red to red-brown, becoming darker in KOH, with darker bluish purple to black apex. *Asci* cylindrical to narrowly clavate, with rounded or flattened apex, with or without refractive ring, 8-spored. *Ascospores* ellipsoidal, 1-septate, not or slightly constricted at the septum, pale yellow-brown, smooth or finely warted. *Conidiophores* monophialidic, polyphialidic or sporodochial. *Macroconidia* (1–)5–7(–8)-septate, long-fusiform, with gently curving ends, pedicellate foot cell, with a hooked apical cell. *Chlamydospores* formed from cells of macroconidia, subglobose, not formed by hyphae.

Type species: *Cyanonectria cyanostoma* (Sacc. & Flageolet) Samuels & Chaverri, Mycol. Progress 8: 56. 2009.
≡ *Nectria cyanostoma* Sacc. & Flageolet, Atti Congr. Bot. Palermo: 53. 1902.
≡ *Fusarium cyanostomum* (Sacc. & Flageolet) O'Donnell & Geiser, Phytopathology 103: 404. 2013.

Description and illustrations: Samuels *et al.* (2009), Schroers *et al.* (2011).

Notes: Samuels *et al.* (2009) introduced the sexual genus *Cyanonectria*, based on *C. cyanostoma*, to accommodate the sexual morphs of an unnamed *Fusarium* sp., characterised by bicoloured perithecia. Later, Schroers *et al.* (2011) synonymised *F. buxicola* under *C. buxi*, recognising that the genus *Cyanonectria* formed a strongly supported clade distinct from other sexual genera associated with *Fusarium* asexual morphs. Phylogenetic inference in this study supports the findings of Samuels *et al.* (2009) and Schroers *et al.* (2011) with representatives of *Cyanonectria* forming a well-supported monophyletic clade (BS = 100 %, PP = 1.0).

Fusarium Link, Mag. Ges. Naturf. Freunde Berlin 3: 10. 1809. MycoBank MB8284.
= *Selenosporium* Corda, Icon. Fungorum H. Cogn. 1: 7. 1837.
= *Pionnotes* Fr., Summa Veg. Scand. 2: 481. 1849.
= *Gibberella* Sacc., Michelia 1: 43. 1877.
= *Sporotrichella* P. Karst., Meddeland. Soc. Fuana Fl. Fenn. 14: 96. 1887.
= *Ustilaginoidella* Essed, Ann. Bot. 25: 351. 1911.
= *Rachisia* Linder, Deutsche Essigind.: 467. 1913.
= *Stagonostroma* Died., Kryptog. Fl. Mark Brandenburg 9: 561. 1914.
= *Discofusarium* Petch, Trans. Brit. Mycol. Soc. 7: 143. 1921.
= *Pseudomicrocera* Petch, Trans. Brit. Mycol. Soc. 7: 164. 1921.
= *Fusidomus* Grove, J. Bot. 67: 201. 1929.
= *Botryocrea* Petr., Sydowia 3: 140. 1949.
= *Bidenticula* Deighton, Trans. Brit. Mycol. Soc. 59: 425. 1972.
= *Pycnofusarium* Punith., Trans. Brit. Mycol. Soc. 61: 63. 1973.

Ascomata perithecial, solitary or aggregated into groups, nonstromatic or on a thin stroma, superficial, globose to subglobose to pyriform, white, yellow, orange, red, bluish purple, bluish black or black, changing colour or not changing colour in KOH, slightly rugose to tuberculate to warted. *Asci* narrowly clavate to clavate to cylindrical, 8-spored, with or without an apical ring. *Ascospores* (0–)1–3-septate, mostly ellipsoidal, hyaline or pale yellow-brown. *Conidiophores* mono- or polyphialidic or sporodochial. *Microconidia* absent or present, 0–1(–2) septate. *Macroconidia* 1–multiseptate, straight or curved, with or without a hooked apical cell. *Chlamydospores* absent or present, globose, subglobose to ellipsoidal, formed terminally or intercalarily in chains or singular, sometime aggregating to form sclerotia (adapted from Gerlach & Nirenberg 1982).

Type species: *Fusarium sambucinum* Fuckel, Hedwigia 2: 135. 1863.

= *Fusarium roseum* Link, Mag. Ges. Naturf. Freunde Berlin 3: 10. 1809.
≡ *Fusidium roseum* (Link) Link, Mag. Ges. Naturf. Freunde Berlin 8: 31. 1816.
= *Sphaeria pulicaris* Kunze, Mykol. Hefte 2: 37. 1823.
≡ *Gibbera pulicaris* (Kunze) Fr., Summa Veg, Scand. 2: 402.
≡ *Botryosphaeria pulicaris* (Kunze) Ces. & De Not. 1963.
≡ *Nectria pulicaris* (Kunze) Tul. & C. Tul. Selec. Fung. Carpol. 3: 63. 1865.
≡ *Cucurbitaria pulicaris* (Kunze) Quél. Mém. Soc. Émul. Montbéliard. 5: 511. 1875.
≡ *Gibberella pulicaris* (Kunze) Sacc., Michelia 1: 43. 1877.

See Wollenweber & Reinking (1935), Booth (1971) and Index Fungorum (www.indexfungorum.org) for more synonymies.

Notes: The genus *Fusarium* as treated here accommodates *Fusarium* spp. belonging to the *Gibberella* clade (O'Donnell *et al.* 2013). This genus includes many important plant pathogenic and medically important species, and includes various *Fusarium* species groups, which could result in the segregation of this genus into more genera. However, a monographic study, which includes a more robust phylogeny, is required to identify and introduce these genera. In this study, representatives of this genus formed a well-supported monophyletic clade (BS = 100 %, PP = 1.0) distinct from the clades representing *Albonectria*, *Cyanonectria* and *Geejayessia*. A new combination is required for *F. sambucinum* (1863), the type species of the genus, as the epithet of *Sphaeria pulicaris* (1823) is older. However, we refrain from doing so here as *F. sambucinum* is extensively used in literature and better known among plant pathologists and other applied biologists.

Description and illustrations: Gerlach & Nirenberg (1982).

Geejayessia Schroers *et al.*, Stud. Mycol. 68: 124. 2011. MycoBank MB519479.

Ascomata perithecial, aggregated into groups of five or more, broadly ampulliform with a short necks, or broadly ellipsoidal, pale orange, brownish to reddish orange, bright red or black, changing colour in KOH if not black. *Asci* cylindrical or clavate, with a broadly rounded or flattened apex, with or without a minute refractive ring, 8-spored. *Ascospores* 1-septate, broadly ellipsoidal to ellipsoidal, slightly constricted at the septum, verruculose, hyaline to pale brown. *Conidiophores* monophialidic, polyphialidic or sporodochial. *Microconidia* usually absent, when present, then oblong ellipsoidal, gently curved. rounded at both ends or with an asymmetrical hilum. *Macroconidia* formed in white to pale yellow slimy masses, gently curved, with pronounced pedicellate foot cell, and more or less inequilaterally fusoid, hooked apical cell (adapted from Schroers *et al.* 2011).

Type species: *Geejayessi cicatricum* (Berk.) Schroers, Stud. Mycol. 68: 124. 2011.

≡ *Sphaeria sanguinea* var. *cicatricum* Berk., Mag. Zool. Bot. 1: 48. 1837.
≡ *Nectria cicatricum* (Berk.) Tul. & C. Tul., Selec. Fung. Carpol. 3: 77. 1865.
≡ *Fusarium cicatricum* (Berk.) O'Donnell & Geiser, Phytopathology 103: 404. 2013.

Description and illustrations: Schroers *et al.* (2011).

Notes: The sexual genus *Geejayessia* was introduced to accommodate fusarium-like species characterised by their broadly ampulliform to broadly ellipsoidal, multicoloured ascomata (Schroers *et al.* 2011), and represents a well-supported monophyletic clade (BS = 100 %, PP = 1.0) distinct from the *Fusarium* clade.

Neocosmospora E.F. Sm., U.S.D.A. Div. Veg. Pathol. Bull. 17: 45. 1899. MycoBank MB3447.

= *Lachnidium* Giard., Compt. Rend. Hebd. des Séances Acad. Sci.: 1520. 1891. (*nom. conf.*)
= *Hyalofloreа* Bat. & H. Maia, Anais Soc. Biol. Pernambuco 13: 154. 1955.
? = *Haematonectria* Samuels & Nirenberg, Stud. Mycol. 42: 134. 1999.

Ascomata perithecial solitary, or aggregated in groups, non-stromatic or with a basal stroma, superficial, globose to pyriform, yellow to orange-brown to red, darkening in KOH, smooth to roughly warted. *Asci* narrowly clavate to cylindrical, simple apex or with a refractive ring, 8-spored. *Ascospores* 0–1-septate, globose to ellipsoidal, hyaline to yellow to yellow-brown, finely striate. *Conidiophores* generally simple, arising laterally from hyphae, rarely polyphialidic or forming poorly developed sporodochia. *Microconidia* 0–1-septate, oval, ellipsoidal to subcylindrical, hyaline, sometimes aggregated in slimy masses. *Macroconidia* subcylindrical, slightly curved with the tips cell slightly hooked, basal cell somewhat pedicellate, multiseptate. *Chlamydospores* when present hyaline to pale yellow, globose to obovoid, terminal or intercalary (adapted from Rossman *et al.* 1999 and Nalim *et al.* 2011).

Type species: *Neocosmospora vasinfecta* E.F. Sm., U.S.D.A. Div. Pathol. Bull. 17: 45. 1899.

≡ *Fusarium neocosmosporiellum* O'Donnell & Geiser, Phytopathology 103: 405. 2013.
= *Neocosmospora vasinfecta* var. *tracheiphila* E.F. Sm., U.S.D.A. Div. Veg. Pathol. Bull. 17: 45. 1899.
= *Neocosmospora vasinfecta* var. *nivea* E.F. Sm., U.S.D.A. Div. Veg. Pathol. Bull. 17: 45. 1899.
= *Pseudonectria ornata* Bat. & Maia, Anais Soc. Biol. Pernambuco 13: 74. 1955.
= *Neocosmospora vasinfecta* var. *major* Rama Rao, Mycopathol. Mycol. Appl. 21: 218. 1963.
= *Neocosmospora vasinfecta* var. *conidiifera* Kamyschko, Novoti Sist. Nizsh. Rast. 2: 115. 1965.
= *Neocosmospora ornamentata* M.A.F. Barbosa, Garcia de Orta, sér. Est. Argon.: 17. 1965.
= *Neocosmospora vasinfecta* var. *africana* (Arx) P.F. Cannon & D. Hawksw., Trans. Brit. Mycol. Soc. 82: 676. 1984.

Descriptions and illustrations: Rossman *et al.* (1999), Nalim *et al.* (2011).

Notes: Three generic names, *Haematonectria* (1999), *Lachnidium* (1891) and *Neocosmospora* (1899) could be applied to this group of fungi (Rossman *et al.* 1999, Summerbell & Schroers 2002). However, the generic name *Lachnidium* is based on a *nomen confusum* (see Madelin 1966 and Kendrick 1974), and can therefore not be used. The genus *Neocosmospora* includes fusarium-like spp. also associated with the sexual genus *Haematonectria*. Rossman *et al.* (1999) could distinguish these genera based on ascomatal morphology and the reduced asexual morph of *Neocosmospora*. O'Donnell (1996) argued that the asexual morphs of *Neocosmospora* are microconidial *Fusarium* spp. that lost the ability to produce macroconidia and septate ascospores. Recent phylogenetic studies (Gräfenhan *et al.* 2011, Nalim *et al.* 2011, O'Donnell *et al.* 2013), which included representatives of both genera, showed that these genera are congeneric. As the generic name *Neocosmospora* (1899) is older than the generic name

Haematonectria (1999), the name *Neocosmospora* takes priority for these fungi. Further support is provided by Nalim *et al.* (2011) whom stabilised the name *Nectria haematococca* through epi-typification and provided a new combination for this species under the genus name *Neocosmopora* (as *Neo. haematococca*). Phylogenetic inference in this study supported these findings with the clade representing the sexual genus *Neocosmospora* being well-supported (BS $\geq$ 75 %, PP $\geq$ 0.95). However, as with the genus *Fusarium*, a monographic study is required to identify all the species belonging to this genus, and therefore only a few new combinations are introduced at this time. The ex-type strain of *Hyalofloreа ramosa* (CBS 509.63), the type species of the genus *Hyalofloreа* (Batista & Maia 1955) clustered within the *Neocosmospora* clade, and therefore this genus is regarded as a synonym of *Neocosmospora* and a new combination is provided. Two isolates listed in the CBS collection as "*F. ventricosum*" (CBS 320.73 and CBS 101018) also clustered within this clade, separate from other known species, and are therefore described here as new.

Neocosmospora ambrosia (Gadd & Loos) L. Lombard & Crous, **comb. nov.** MycoBank MB810957.

Basionym: *Monacrospium ambrosium* Gadd & Loos, Trans. Brit. Mycol. Soc. 30: 13. 1947.

≡ *Fusarium ambrosium* (Gadd & Loos) Agnihothr. & Nirenberg, Stud. Mycol. 32: 98. 1990.

≡ *Dactylella ambrosia* (Gadd & Loos) K.Q. Zhang, X.Z. Liu & L. Cao, Mycosystema 7: 112. 1995.

= *Fusarium bugnicourtii* Brayford, Trans. Brit. Mycol. Soc. 89: 350. 1987.

Neocosmospora falciformis (Carrión) L. Lombard & Crous, comb. nov. MycoBank MB810958.

Basionym: *Cephalosporium falciforme* Carrión, Mycologia 43: 523. 1951.

≡ *Acremonium falciforme* (Carrión) W. Gams, Cephalosporium-artige Schimmelpilze: 139. 1971.

≡ *Fusarium falciforme* (Carrión) Summerb. & Schroers, J. Clin. Microbiol. 40: 2872. 2002.

Neocosmospora illudens (Berk.) L. Lombard & Crous, **comb. nov.** MycoBank MB810959.

Basionym: *Nectria illudens* Berk., in Hooker, Botany of the Antarctic Voyage II. Flora of New Zealand 7: 203. 1855.

≡ *Cucurbitaria illudens* (Berk.) Kuntze, Rev. Gen. Plant. 3: 461. 1898.

≡ *Haematonectria illudens* (Berk.) Samuels & Nirenberg, Stud. Mycol. 42: 136. 1999.

= *Fusarium illudens* C. Booth, The genus *Fusarium*: 53. 1971.

Neocosmospora ipomoeae (Halst.) L. Lombard & Crous, **comb. nov.** MycoBank MB810960.

Basionym: *Nectria ipomoeae* Halst., Rep. New Jersey Agric. Exp. Sta. 12: 281. 1891.

≡ *Cucurbitaria ipomoeae* (Halst.) Kuntze, Rev. Gen. Plant. 3: 461. 1898.

≡ *Creonectria ipomoeae* (Halst.) Seaver, N. Amer. Flora 3: 22. 1910.

≡ *Hypomyces ipomoeae* (Halst.) Wollew., Phytopathology 3: 34. 1913.

≡ *Haematonectria ipomoeae* (Halst.) Samuels & Nirenberg, Stud. Mycol. 42: 136. 1999.

= *Fusarium javanicum* Koord., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. 13: 247. 1907.

= *Hypomyces solani* f. *cucurbitae* W.C. Snyder & H.N. Hansen, Amer. J. Bot. 28: 741. 1941.

Neocosmospora monilifera (Berk. & Broome) L. Lombard & Crous, **comb. nov.** MycoBank MB810961.

Basionym: *Nectria monilifera* Berk. & Broome, J. Linn. Soc., Bot. 14: 114. 1875.

≡ *Nectriella monilifera* (Berk. & Broome) Sacc., Michelia 1: 279. 1878.

≡ *Dialonectria monilifera* (Berk. & Broome) Cooke, Grevillea 12: 110. 1884.

≡ *Neoskofitzia monilifera* (Berk. & Broome) Höhn., Ann. Mycol. 8: 467. 1910.

≡ *Haematonectria monilifera* (Berk. & Broome) Samuels & Rossman, Stud. Mycol. 42: 137. 1999.

Neocosmospora phaseoli (Burkh.) L. Lombard & Crous, **comb. nov.** MycoBank MB810962.

Basionym: *Fusarium martii* f. *phaseoli* Burkh., Mem. Cornell Univ. Agric. Exp. Sta. 26: 1007, 1919.

≡ *Fusarium solani* f. *phaseoli* (Burkh.) W.C. Snyder & H.N. Hansen, Amer. J. Bot. 28: 740. 1941.

≡ *Fusarium phaseoli* (Burkh.) T. Aoki & O'Donnell, Mycologia 95: 671. 2003.

Neocosmospora plagianthi (Dingley) L. Lombard & Crous, **comb. nov.** MycoBank MB810963.

Basionym: *Nectria plagianthi* Dingley, Trans. Roy. Soc. New Zealand 79: 196. 1951.

≡ *Fusarium plagianthi* (Dingley) O'Donnell & Geiser, Phytopathology 103: 404. 2013.

Neocosmospora ramosa (Bat. & H. Maia) L. Lombard & Crous, **comb. nov.** MycoBank MB810242.

Basionym: *Hyalofloreа ramosa* Bat. & H. Maia, Anais Soc. Biol. Pernambuco 13: 155. 1955.

Neocosmospora rubicola L. Lombard & Crous, **sp. nov.** MycoBank MB810243. Fig. 14.

Etymology: Name derived from the plant host *Rubus idaeus*, from which it was collected.

Ascomatal state not observed. *Conidiophores* mononematous, simple, unbranched or aggregated into sporododochia. *Mononematous conidiophores* 13–129 µm long, 3–7 µm at the base, hyaline, aseptate or septate, terminating in a single phialide or a penicillate or verticillate arrangement of 2–4 phialides; single phialides 17–60 × 3–5 µm, cylindrical, tapering towards the apex, with periclinal thickening and slightly flared collarette; penicillate or verticillate phialides, 13–43 × 3–4 µm, cylindrical to allantoid, tapering towards the apex, with periclinal thickening and slightly flared collarette. *Sporodochial conidiophores* irregularly branched, sometimes slightly stipitate; sporodochial phialides cylindrical to allantoid, tapering towards the apex, 11–25 × 3–4 µm, with periclinal thickening, with or without slightly flared collarette. *Microconidia* mostly produced by mononematous conidiophores, 0–1(–2)-septate; 0-septate microconidia ellipsoidal to fusiform or obovoid, (8–)9–13(–19) × (2–)3–4(–5) µm (av. 11 × 4 µm); 1-septate microconidia, ellipsoidal to fusiform, straight to slightly curved, apex acutely rounded, base sometime flattened (13–)15–20(–22) × (3–)4–6 µm (av. 18 × 5 µm); 2-septate microconidia rarely formed, ellipsoidal to fusiform, straight to slightly curved, 20–22(–24) × 4–6 µm (av. 22 × 5 µm). *Macroconidia* 3–5-septate, cylindrical, straight or curving at both ends, beaked at both ends: 3-septate macroconidia (27–)32–44(–47) × 4–6 µm (av. 38 × 5 µm); 4-septate macroconidia (35–)38–48(–53) × 4–6 µm (av. 43 × 5 µm); 5-septate macroconidia (44–)45–49(–51) × 5–6 µm (av. 47 × 5 µm). *Chlamydospores* not observed.

Culture characteristics: Colony on PDA reaching 35–40 mm after 7 d at 24 °C, forming abundant white to pale luteous aerial

Fig. 14. *Neocosmospora rubicola* (ex-type CBS 101018). A–C. Sporodochial conidiophores. D. Conidiogenous apparatus with cylindrical to allantoid phialides. E–H. Simple conidiophores. I. Microconidia. J. Macroconidia. Scale bars: B = 50 µm (apply to C, E–F); D = 10 µm (apply to G–H); I = 10 µm (apply to J).

mycelium, arranged in concentric rings, richly sporulating on the aerial mycelium; reverse concolorous. On SNA with sterile carnation leaf pieces, aerial mycelium absent, mononematous conidiophores arising on the surface of the agar; white sporodochia formed abundantly on the surface of the carnation leaf pieces.

Materials examined: **Italy**, on *Rubus idaeus*, Jun. 1998, A. Zazzerini (**holotype** CBS H-21949, culture ex-type CBS 101018); **Sudan**, isolated form soil, Feb. 1973, M.M. Musa, culture CBS 320.73 = ATCC 24395 = IMI 131652 = NRRL 22107 = NRRL 22122.

Notes: *Neocosmospora rubicola* is described here as a new species in the genus *Neocosmospora*. Sequence comparisons on the FUSARIUM-ID (http://isolate.fusariumdb.org; O'Donnell *et al.* 2010) and *Fusarium* MLST (http://www.cbs.knaw.nl/fusarium; O'Donnell *et al.* 2012) databases were inconclusive, identifying both isolates (CBS 101018 & CBS 320.73) as part of the *F. solani* complex only.

Neocosmospora solani (Mart.) L. Lombard & Crous, **comb. nov.** MycoBank MB810964.

Basionym: *Fusisporium solani* Mart., Die Kartoffel-Epidemie der letzten Jahre oder die Stockfäule und Räude der Kartoffeln: 20. 1842.

≡ *Fusarium solani* (Mart.) Sacc. Michelia 2: 296. 1881.

= *Fusarium martii* Appel & Wollew. Arb. Kaiserl. Biol. Anst. Ld.-u. Forstw. 8: 83. 1910.

= *Nectria cancri* Rutgers, Ann. Jard. Bot. Buitenzorg 2: 59. 1913.

= *Fusarium striatum* Sherb., Mem. Cornell Univ. Agric. Exp. Sta. 6: 255. 1915.

(See Index Fungorum (www.indexfungorum.org) and MycoBank (www.mycobank.org) for more synonyms).

Note: Nalim *et al.* (2011) concluded that *Neocosmospora solani* (= *F. solani*) is not congeneric with *Neo. haematococca* (= *Haematonectria haematococca*) and therefore a new combination is provided here.

Neocosmospora termitum (Höhn.) L. Lombard & Crous, **comb. nov.** MycoBank MB810965.

Basionym: *Neoskofitzia termitum* Höhn., Sitzungsber. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 117: 998. 1908.

≡ *Haematonectria termitum* (Höhn.) Samuels & Rossman, Stud. Mycol. 42: 137. 1999.

Neocosmospora tucumaniae (T. Aoki, O'Donnell, Yos. Homma & Lattanzi) L. Lombard & Crous, **comb. nov.** MycoBank MB810966.

Basionym: *Fusarium tucumaniae* T. Aoki, O'Donnell, Yos. Homma & Lattanzi, Mycologia 95: 664. 2003.

Neocosmospora virguliformis (O'Donnell & T. Aoki) L. Lombard & Crous, **comb. nov.** MycoBank MB810967.

Basionym: *Fusarium virguliforme* O'Donnell & T. Aoki, Mycologia 95: 667. 2003.

Rectifusarium L. Lombard, Crous & W. Gams, **gen. nov.** MycoBank MB810252.

Etymology: Name refers to the erect, acremonium-like conidiophores characteristic of these fungi.

Ascomata perithecial, aggregated in groups, dark red, smooth-walled, globose to subglobose, with a papillate ostiolar region, ringed by a short collar of hyphal tips, smooth. *Asci* clavate, 8-spored, with a rounded apex containing a refractive apical ring. *Ascospores* ellipsoidal, 1-septate, constricted at the septum, verrucose, light brown. *Conidiophores* simple, mononematous, straight to flexuous, hyaline, septate, unbranched or rarely branched, terminating in a single phialide. *Phialides* cylindrical, tapering towards the apex, with periclinal thickening and flared collarettes. *Sporodochia* not formed. *Microconidia* rare, ellipsoidal to fusiform, 0–1-septate, hyaline. *Macroconidia* 3-septate, hyaline, ellipsoidal to fusiform, with both ends slightly curved, sometimes with a basal foot cell, apex acutely rounded. *Chlamydospores* hyaline, forming laterally or terminally, globose to subglobose (adapted from Gerlach & Nirenberg 1982).

Type species: *Rectifusarium ventricosum* (Appel & Wollenw.) L. Lombard & Crous.

Notes: The genus *Rectifusarium* is established here to include the fusarium-like species previously treated as *F. ventricosum*. Wollenweber (1913) established the section *Ventricosum* to accommodate *F. ventricosum*, recognising this *Fusarium* sp. as unique in the genus in having no sporodochia. Phylogenetic inference in this study showed that representatives of this group of fungi formed a distinct well-supported clade (BS = 100 %, PP = 1.0), basal to the other clades included in Clade IX.

Rectifusarium robinianum L. Lombard & Crous, **sp. nov.** MycoBank MB810258. Fig 15.

Etymology: Name derived from the plant host *Robinia pseudoacacia*, from which it was isolated.

Ascomatal state not observed. *Conidiophores* arising laterally from hyphae, simple, unbranched or sparsely branched, mononematous, straight to flexuous, septate, 110–197 × 4–7 µm, terminating in a single phialide; phialides cylindrical, tapering towards the apex, 40–85 × 2–6 µm, with periclinal thickening and slightly flared collarette. *Microconidia* rare, (0–)1-septate, straight and fusiform, or slightly curved and ellipsoidal, 12–16(–17) × 3–4 µm (av. 14 × 3 µm). *Macroconidia* (1–)3-septate, straight or slightly curved, fusiform to ellipsoidal, (22–)25–31(–33) × 5–7 µm (av. 28 × 6 µm), with rounded apex and flattened basal cell. *Chlamydospores* hyaline, verruculose, globose to subglobose, 6–10 µm diam, forming laterally or terminally.

Culture characteristics: Colony on PDA reaching 90 mm after 7 d at 24 °C, forming abundant white to pale luteous aerial mycelium, richly sporulating on the aerial mycelium; reverse concolorous.

Materials examined: **Germany**, Köln, on twig of *Robinia pseudoacacia*, May 1991, U. Kuchenbäcker (**holotype** CBS H-21948, culture ex-type CBS 430.91 = NRRL 25729); Berlin, from *Solanum tuberosum*, Dec. 1985, H. Nirenberg, culture CBS 830.85 = BBA 64246 = NRRL 13953.

Note: *Rectifusarium robinianum* can be distinguished from *R. ventricosum* by its smaller macroconidia and rarely branching acremonium-like conidiophores.

Rectifusarium ventricosum (Appel & Wollenw.) L. Lombard & Crous, **comb. nov.** MycoBank MB810253. Fig. 16.

Basionym: *Fusarium ventricosum* Appel & Wollenw., Phytopathology 3: 32. 1913.

≡ *Fusarium solani* var. *ventricosum* (Appel & Wollenw.) Joffe, Plant and Soil 38: 440. 1973.

= *Fusarium cuneiforme* Sherb., Mem. Cornell Univ. Agric. Exp. Sta. 6: 129. 1915.

Materials examined: **Germany**, Berlin, on tuber of *Solanum tuberosum*, Oct. 1909, H.W. Wollenweber [**holotype** B 700021849 (as *Fusarium argillaceum*)]; (**epitype designated here**: **Germany**, Kiel, from soil in wheat field, Dec. 1979, W. Gerlach, epitype CBS H-21947, MB198380, culture ex-epitype CBS 748.79 = BBA 62452 = NRRL 20846 = NRRL 22113).

Notes: Wollenweber (1917) synonymised *F. ventricosum* and *F. cuneiforme* under *F. argillaceum*. This decision was based on Fuckel's Fungi Rhenani no. 226, which Booth (1971) rejected as a misdetermination of *F. argillaceum* as it did not agree with the description of Fries (1832) for *F. argillaceum*. Comparisons of the type material (B 700021849; as *F. argillaceum*) and Wollenweber's *Fusaria autographice delineate* no. 431 agree with the description and illustrations provided by Booth (1971) for *F. ventricosum* based on the isolate CBS 748.79, and therefore we agree with Booth's argument that *F. ventricosum* is not synonymous with *F. argillaceum*.

Clade X

Cosmospora Rabenh., Hedwigia 2: 59. 1862. MycoBank MB1273.

= *Crysogluten* Briosi & Farneti, Atti Is. Bot. Univ. Lab. Critt. Pavia 8: 117. 1904.

? = *Dialonectria* (Sacc.) Cooke, Grevillea 12: 109. 1884.

≡ *Nectria* subgen. *Dialonectria* Sacc., Syll. Fung. 2: 490. 1883.

Ascomata perithecial, scattered or gregarious, with inconspicuous or absent stroma, obpyriform with an acute or papillate apex, orange red or bright red, turning dark red in KOH, smooth walled. *Asci* narrowly clavate to cylindrical, with an apical ring, 8-spored. *Ascospores* initially hyaline, becoming yellow brown to reddish brown, 1-septate, becoming tuberculate when mature. *Conidiophores* acremonium-like, consisting of lateral phialides on somatic hyphae, or with one or two levels of monochasial branching, or verticillate, hyaline. *Phialides* monophialidic, cylindrical to subulate to subclavate, hyaline. *Microconidia* ellipsoidal, oblong or clavate or slightly allantoid, aseptate, hyaline, forming slimy heads. *Macroconidia* absent or rare, subcylindrical, curved, slightly narrowing towards each end, apical cell often slightly hooked with a more or less pointed tip, basal cell not or scarcely pedicellate, 3–5-septate, hyaline (adapted from Rossman *et al.* 1999 and Gräfenhan *et al.* 2011).

Type species: *Cosmospora coccinea* Rabenh., Hedwigia 2: 59. 1862 [non *Nectria coccinea* (Pers.) Fr. 1849].

= *Nectria cosmariospora* Ces. & De Not., Comment. Soc. Crittog. Ital. 1: 195. 1863.

≡ *Dialonectria cosmariospora* (Ces. & De Not.) Moraves, Česká Mykol. 8: 92. 1954.

= *Verticillium olivaceum* W. Gams, Cephalosporium-artige Schimmelpilze: 129. 1971.

Descriptions and illustrations: Rossman *et al.* (1999), Gräfenhan *et al.* (2011).

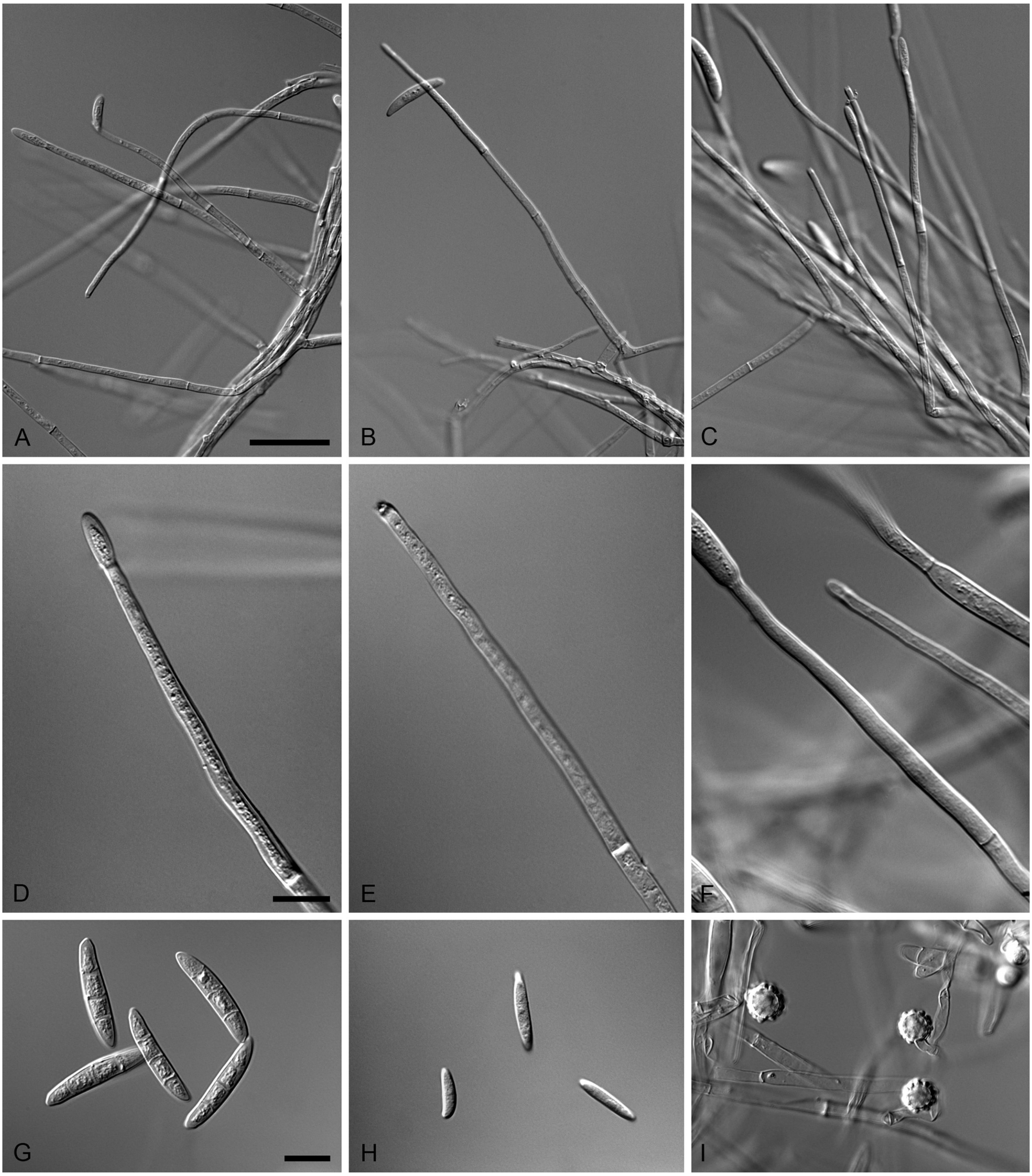

Fig. 15. *Rectifusarium robinianum* (ex-type CBS 430.91). A–F. Conidiophores. G. Macroconidia. H. Microconidia. I. Chlamydospores. Scale bars: A = 50 μm (apply to B–C); D = 10 μm (apply to E–F); G = 10 μm (apply to H–I).

Notes: Representatives of the genus *Cosmospora* formed a well-supported clade (BS $\geq$ 75 %, PP $\geq$ 0.95), which also included representatives of the genus *Dialonectria* (CBS 125493 & CBS 125494; Gräfenhan *et al.* 2011). Samuels *et al.* (1991) revised the genus *Dialonectria* (as *Nectria* subgen. *Dialonectria*) and assigned it to *Cosmospora sensu* Rossman. Gräfenhan *et al.* (2011) later resurrected the genus *Dialonectria* and restricted its generic concept around the type species, *D. episphaeria*, recognising that this species represents a species complex of at least five phylogenetic lineages. Although the phylogenetic inference in this study supports the findings of Samuels *et al.* (1991) that *Dialonectria* should be seen as a synonym of *Cosmospora*, we select not to introduce new combinations at present. A monographic study for both genera is required to stabilise the taxonomy of these genera. Furthermore, isolates listed in the CBS collection as "*Acremonium* cf. *curvulum*" (CBS 100551) and "*Stylonectria wegeliniana*" (CBS 101915) clustered within the *Cosmospora* clade. Both isolates appear to be sterile, and therefore their taxonomic status cannot be determined at present.

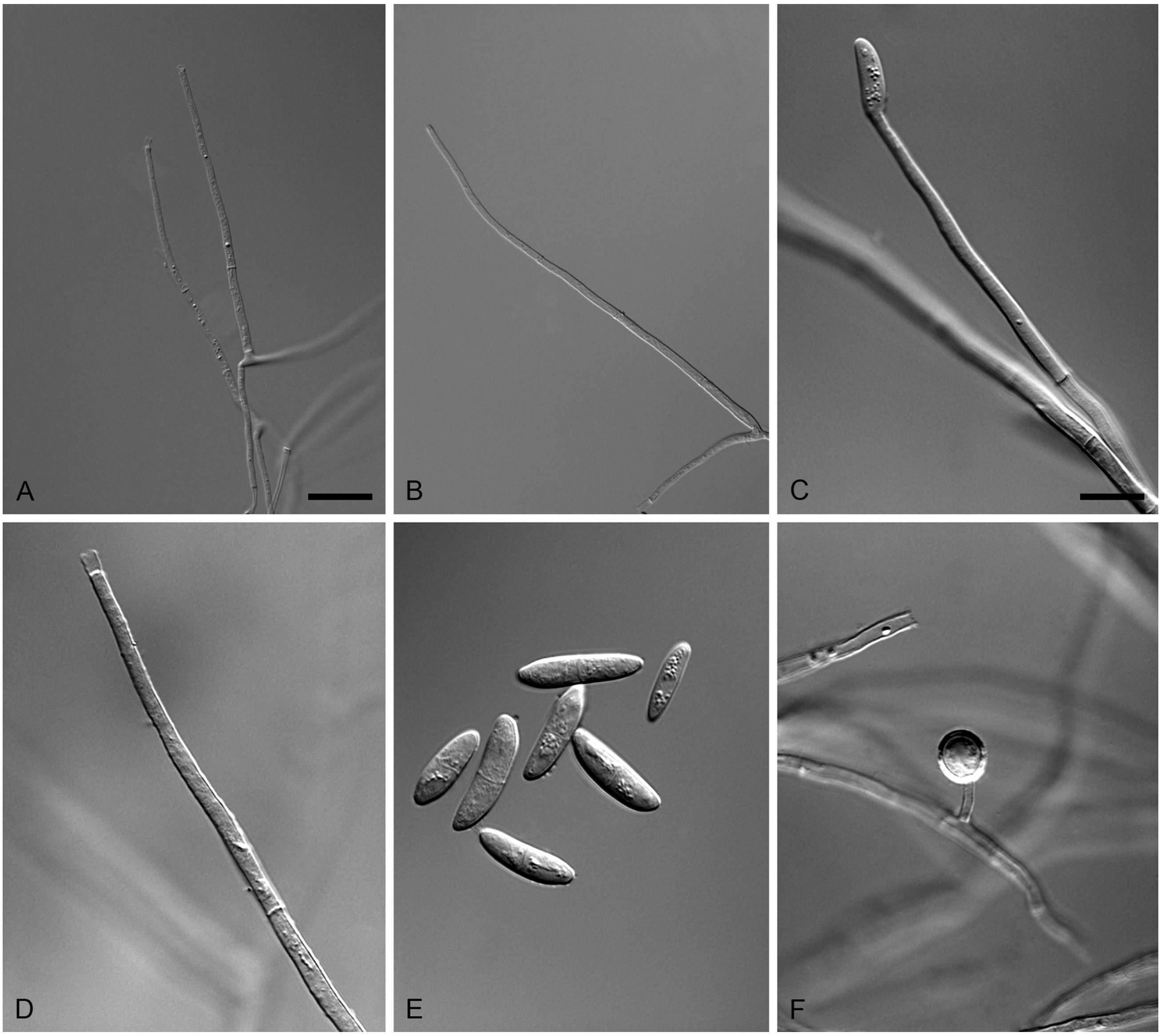

Fig. 16. *Rectifusarium ventricosum* (ex-epitype CBS 748.79). A–D. Conidiophores. E. Macroconidia. F. Chlamydospores. Scale bars: A = 50 µm (apply to B); C = 10 µm (apply to D–F).

Fusicolla Bonord., Handb. Allg. Mykol.: 150. 1851. MycoBank MB8294.

Ascomata perithecial, stroma erumpent, fully or partially immersed in a slimy, pale orange sheet of hyphae over the substrate, scattered to gregarious, or in small groups, globose to pyriform with a short acute or disk-like papilla, yellow, pale buff to orange, not changing in KOH, smooth walled. *Asci* cylindrical to narrowly clavate, with an apical ring, 8-spored. *Ascospores* hyaline to pale brown, 1-septate, smooth or slightly verrucose when mature. *Conidiophores* initially as lateral phialides on somatic hyphae, sometimes monochasial, verticillate or penicillate, hyaline. *Phialides* monophialidic, cylindrical to subulate, hyaline. *Microconidia* absent or sparse, ellipsoidal to allantoid, aseptate, hyaline. *Macroconidia* falcate, straight to curved, narrowing towards the ends, apical cell often hooked with a pointed tip, basal cell slightly pedicellate 1–3-septate or 3–5-septate or up to 10-septate, hyaline. *Chlamydospores* absent to abundant, globose, single, in pairs or chains, sometimes forming in macroconidia (adapted from Gerlach & Nirenberg 1982 and Gräfenhan *et al.* 2011).

Type species: *Fusicolla betae* (Desm.) Bonord. Handb. Allg. Mykol.: 150. 1851.

≡ *Fusisporium betae* Desm., Ann. Sci. Nat., Bot. 19: 436. 1830.
≡ *Fusarium betae* (Desm.) Sacc., Michelia 2: 132. 1880.
≡ *Pionnotes betae* (Desm.) Sacc., Syll. Fung. 4: 726. 1886.
≡ *Pionnotes rhizophila* var. *betae* (Desm.) de Wild. & Durieu, Prodrome de la flore belge 2: 367. 1898.

Descriptions and illustrations: Gerlach & Nirenberg (1982), Gräfenhan *et al.* (2011).

Notes: Representatives of the genus *Fusicolla* formed a monophyletic clade (BS = 100 %, PP = 1.0) closely related to but separate from the clades representing the genera *Macroconia* and *Microcera*. Unfortunately, no cultures or sequences of *F. betae* were available to be included in the present study.

Macroconia (Wollenw.) Gräfenhan *et al.*, Stud. Mycol. 68: 101. 2011. MycoBank MB519441.

≡ *Nectria* sect. *Macroconia* Wollenw., Angew. Bot. 8: 179. 1926.

Ascomata perithecial, stroma inconspicuous or absent, solitary, subglobose with or without a small apical papilla, orange to carmine red, turning dark red to violet in KOH, sometimes with hyphal hairs arising from the outer wall. *Asci* cylindrical to narrowly clavate, with a simple apex, 8-spored. *Ascospores* yellowish, 1-septate, smooth, sometimes becoming striate when mature. *Conidiophores* initially as lateral phialides on somatic hyphae, later monochasial to verticillate, hyaline. *Phialides* monophialidic, cylindrical to subulate, hyaline. *Microconidia* rare or absent, ellipsoidal to allantoid, hyaline. *Macroconidia* subcylindrical to curved, apical cell conical or hooked, basal cell mostly conspicuously pedicellate, 3–7(–14)-septate, hyaline. *Chlamydospores* absent to rare, globose, single, in pairs or chains in hyphae (adapted from Gräfenhan *et al.* 2011).

Type species: *Macroconia leptosphaeriae* (Niessl.) Gräfenhan, & Schroers, Stud. Mycol. 68: 102. 2011.

≡ *Nectria leptosphaeriae* Niessl., Fungi Saxonici Exsiccati. Die Pilze Sachsen's: no. 165. 1886.
≡ *Cucurbitaria leptosphaeriae* (Niessl.) Kuntze, Rev. Gen. Plant. 3: 461. 1898.
≡ *Hypomyces leptosphaeriae* (Niessl.) Wollenw., Fus. Autog. Del. 1: 57. 1916.
≡ *Lasionectria leptosphaeriae* (Niessl.) Petch, Trans. Brit. Mycol. Soc. 21: 268. 1938.
≡ *Cosmospora leptosphaeriae* (Niessl.) Rossman & Samuels, Stud. Mycol. 42: 122. 1999.

Description and illustrations: Gräfenhan *et al.* (2011).

Notes: The genus *Macroconia* was raised from section name to genus level by Gräfenhan *et al.* (2011) for fusarium-like species having large macroconidia and minute perithecia. Phylogenetic inference in this study supports this decision, with representatives of this genus forming a well-supported clade (BS = 100 %, PP = 1.0) closely related to but separate from the genera *Fusicolla* and *Microcera*.

Microcera Desm., Ann. Sci. Nat. Bot. 10: 359. 1848. MycoBank MB8920.

= *Pseudomicrocera* Petch, Trans. Brit. Mycol. Soc. 7: 164. 1921.

Ascomata perithecial with stroma and/or byssus covering host, solitary or in groups, globose, with a blunt papilla, orange to dark red, turning dark red or violet in KOH, finely roughened. *Asci* cylindrical to narrowly clavate, with an apical ring, 8-spored. *Ascospores* hyaline to pale yellow-brown, 1(–3)-septate, smooth, sometimes becoming tuberculate when mature. *Conidiophores* as lateral phialides on somatic hyphae, becoming monochasial, verticillate to penicillate, hyaline, forming discrete sporodochia or synnemata on the host. *Phialides* monophialidic, cylindrical to subulate to subclavate, hyaline. *Macroconidia* pale, orange, pink or bright red in mass, subcylindrical, moderately or conspicuously curved, apical cell often slightly or conspicuously hooked, basal cell scarcely to conspicuously pedicellate, (0–)3–5(–12)-septate, hyaline (adapted from Gräfenhan *et al.* 2011).

Type species: *Microcera coccophila* Desm., Ann. Sci. Nat. Bot. 10: 359. 1848.

≡ *Tubercularia coccophila* (Desm.) Bonord., Abh. Naturf. Ges. Halle 8: 96. 1864.
≡ *Fusarium coccophila* (Desm.) Wollenw. & Reinking, Die Fusarien, ihre Beschreibung, Schadwirkung und Bekämpfung: 34. 1935.
≡ *Fusarium coccophilum* (Desm.) Wollenw. & Reinking, Die Fusarien, ihre Beschreibung, Schadwirkung und Bekämpfung: 34. 1935.
≡ *Nectria episphaeria* f. *coccophila* (Desm.) W.C. Snyder & H.N. Hansen, Amer. J. Bot. 32: 662. 1945.
≡ *Fusarium episphaeria* f. *coccophilum* (Desm.) W.C. Snyder & H.N. Hansen, Amer. J. Bot. 32: 662. 1945.

= *Atractium flammeum* Berk. & Ravenel, Ann. Mag. Nat. Hist. 13: 461. 1854.
= *Microcera pluriseptata* Cooke & Massee, Grevillea 17: 43. 1888.

Description and illustrations: Gräfenhan *et al.* (2011).

Notes: The genus *Microcera* includes fusarium-like species generally regarded as entomogenous fungi associated with scale insects, although they can also be found on other substrates (Gräfenhan *et al.* 2011). Gräfenhan *et al.* (2011) resurrected this genus based on DNA sequence data and its ecological association, after Wollenweber & Reinking (1935) placed all *Microcera* spp. in *Fusarium*. Our phylogenetic inference supports this decision, as representatives of the genus *Microcera* clustered in a well-supported clade (BS $\geq$ 75 %, PP $\geq$ 0.95) distantly related to *Fusarium* but closely related to the genera *Fusicolla* and *Macroconia*.

Stylonectria Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 124: 52. 1915. MycoBank MB5301.

Ascomata perithecial on a thin, white to yellow, hyphal or subiculum-like stroma, gregarious in groups of up to 20, subglobose, pyriform to subcylindrical, with a rounded or broad, circular, flat disc on a venter-like neck, pale yellow, orange-red, orange-brown, or pale to dark red, becoming dark red to purple in KOH, smooth. *Asci* cylindrical to clavate, apex simple or with a ring, 8-spored. *Ascospores* hyaline or yellow to pale brown, 1-septate, cylindrical to allantoid to ellipsoidal, smooth or tuberculate. *Conidiophores* initially formed as unbranched phialides on somatic hyphae, sometimes loosely branched, sometimes forming small sporodochia. *Phialides* monophialidic, cylindrical to subcylindrical, with a distinct collarette. *Microconidia* sparse, allantoid to lunulate, slightly or strongly curved, aseptate, in slimy heads. *Macroconidia* orange in mass, subcylindrical or moderately to strongly curved, falcate, 0–1-septate, apex narrower than base, apical cell blunt or hooked, basal cell not or scarcely pedicellate (adapted from Höhnel 1915 and Gräfenhan *et al.* 2011).

Type species: *Stylonectria applanata* Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Wien, Math.-Naturwiss. Kl., Abt. 1, 124: 52. 1915.

Descriptions and illustration: Höhnel (1915), Weese (1916), Gräfenhan *et al.* (2011).

Notes: Species of *Stylonectria* are host-specific fungicolous fungi, which Rossman *et al.* (1999) considered as a synonym of *Cosmospora*. Phylogenetic inference in this study and Gräfenhan *et al.* (2011) showed that the genus *Stylonectria* formed a well-supported clade (BS = 100 %, PP = 1.0) basal to the other genera included in Clade X.

Clade XI

Corallomycetella Henn., Hedwigia 43: 245. 1904. MycoBank MB1237.

= *Corallomyces* Berk & M.A. Curtis, J. Acad. Nat. Sci. Philadelphia, Ser. 2, 2: 289. 1853 [non Fr. 1849].
= *Rhizostilbella* Wolk, Mykol. Zentralbl. 4: 237. 1914.

Ascomata perithecial, solitary or gregarious, associated with reddish rhizomorphs or synnemata, obpyriform, orange-red to red, changing to purple in KOH, slightly scruffy, smooth around the ostiole. *Asci* clavate to cylindrical, with an apical ring, 8-spored. *Ascospores* ellipsoidal, 1-septate, constricted at the septum, hyaline to yellow-brown, finely striate. Asexual morph synnematous. *Synnemata* solitary or gregarious, 2–5 caespitose, arising laterally or as terminal extension of the rhizomorphs or directly from the substrate, cylindric-capitate, subulate-capitate, cylindrical, slender to robust, straight to curved to sinuous, unbranched or branched, hirsute, pale luteous to luteous, turning red to purple in KOH. Marginal hyphae echinulate to verrucose, pale luteous, turning bright red in KOH, with clavate terminal cells, covering the entire surface of stipe. *Conidiophores* unbranched, or once simple monochasial or monoverticillate. *Phialides* cylindrical, terminal, collarettes not flared, periclinal thickening conspicuous. *Conidia* ellipsoidal, ovoidal with a truncate base, aseptate, smooth, forming white to yellow, subglobose conidial masses (adapted from Rossman *et al.* 1999 and Herrera *et al.* 2013b).

Type species: *Corallomycetella repens* (Berk. & Broome) Rossman & Samuels, Stud. Mycol. 42: 113. 1999.
≡ *Sphaerostilbe repens* Berk. & Broome, J. Linn. Soc., Bot. 14: 114. 1875.
= *Corallomycetella heinsenii* Henn., Hedwigia 43: 245. 1904.
≡ *Corallomyces heinsenii* Henn., Hedwigia 43: 245. 1904.
= *Corallomycetella heinsenii* Henn. Hedwigia 43: 245. 1904.
= *Nectria mauritiicola* Henn., Seifert & Samuels, Stud. Mycol. 27: 161. 1985.
= *Stilbum incarnatum* Wakker, Ziekten van het Suikerriet op Java, Leiden: 197. 1898.
= *Nectria coccinea* (Pers.: Fr.) Fr. var. *platyspora* Rehm, Ann. Mycol. 7: 137. 1900.
≡ *Nectria platyspora* (Rehm) Weese, Ann. Mycol. 8: 464. 1910.
= *Rhizostilbella rubra* Wolk, Mykol. Zentralbl. 4: 237. 1914.
= *Stilbum incarnatum* var. *dioscoreae* Sacc., Bull. Orto Bot. Regia Univ. Napoli 6: 63. 1918.
= *Cephalosporium kashiense* R.Y. Roy & G.N. Singh, Curr. Sci. 37: 535. 1968.
≡ *Acremonium kashiense* (R.Y. Roy & G.N. Singh) W. Gams, Cephalosporium-artige Schimmelpilze: 138. 1971.
= *Rhizostilbella hibisci* (Pat.) Seifert, Stud. Mycol. 27: 162. 1985.
≡ *Stilbum hibisci* Pat., J. Bot. (Morot): 320. 1891.

Description and illustrations: Herrera *et al.* (2013b).

Notes: Species of *Corallomycetella* are tropical fungi characterised by the formation of brightly coloured rhizomorphs of their rhizostilbella-like asexual morphs (Seifert 1985, Rossman *et al.* 1999, Herrera *et al.* 2013b). These fungi are associated with rotting diseases of various woody tropical plant hosts (Rossman *et al.* 1999, Herrera *et al.* 2013b). Phylogenetic inference in this study showed that the species of *Corallomycetella* formed a distinct monophyletic clade (BS = 100 %, PP = 1.0).

Paracremonium L. Lombard & Crous, **gen. nov.** MycoBank MB810267.

Etymology: Name refers to the acremonium-like morphology of these fungi.

Ascomatal morph not observed. *Mycelium* consisting of hyaline, septate, branched hyphae, sometimes forming sterile coils with conidiophores radiating outwards, hyphal septa inconspicuously swollen. *Conidiophores* arising laterally from somatic hyphae, erect, cylindrical to subcylindrical, unbranched or rarely branched, aseptate or septate, smooth, hyaline. *Conidiogenous cell* terminal, monophialidic, hyaline, smooth, elongate-ampulliform or subcylindrical, tapering towards the apex, with periclinal thickening and inconspicuous collarette. *Conidia* aseptate, fusiform to ellipsoidal to cylindrical, straight to slightly or strongly curved, forming slimy heads on the conidiophore.

Type species: *Paracremonium inflatum* L. Lombard & Crous.

Notes: The genus *Paracremonium* is established here for different strains from a group of fungi previously treated as *Acremonium recifei* (Gams 1971; also see *Xenoacremonium* below). Species of *Paracremonium* are distinguished from other acremonium-like genera by the formation of sterile coils from which conidiophores radiate and having inconspicuously swollen septa in the hyphae. All species in *Paracremonium* are associated with human infections (see below). Phylogenetic inference in this study showed that representatives of this genus formed a monophyletic clade (BS = 100 %, PP = 1.0) closely related but separate from the clades representing *Corallomycetella* and *Xenoacremonium*.

Paracremonium inflatum L. Lombard & Crous, **sp. nov.** MycoBank MB810268. Fig. 17.

Etymology: Name refers to the inconspicuous swollen septa of the hyphae formed by this fungus.

Ascomatal state unknown. *Mycelium* consisting of hyaline, septate, branched, 2–4 µm diam hyphae, inconspicuously swollen at the hyphal septa, sometimes forming sterile coils with conidiophores radiating outwards. *Conidiophores* arising laterally from somatic hyphae, erect, subcylindrical, unbranched or rarely branched, 0–1-septate, up to 115 µm tall, 2–3 µm diam, hyaline, smooth, terminating in one or two conidiogenous cells. *Conidiogenous cells* terminal, elongate-ampulliform, tapering towards apex, 20–85 × 2–4 µm, apex 1.5–2 µm diam, with prominent periclinal thickening and inconspicuous collarette, hyaline, smooth. *Conidia* formed in heads at apex of conidiogenous cells, aseptate, ellipsoidal to fusiform, smooth, slightly to strongly curved, 5–6 × 1–2 µm (av. 5 × 2 µm). *Chlamydospores* not seen.

Culture characteristics: Colony on PDA reaching 50–65 mm diam after 7 d at 24 °C; colony consists of semi-immersed aerial mycelium; surface with pink to salmon centre becoming white at the margins; reverse concolorous.

Materials examined: **India**, from a granulomatous lesion on the right hand of a male *Homo sapiens*, Oct. 1977, A.A. Padhye (**holotype** CBS H-21946, culture ex-type CBS 485.77 = CDC 77-043179). **Colombia**, Dep. de Meta, Municipio de Villavicencio, 25 km from road Villavicencio-Acacías, 550°m alt., from soil in maize-field, 18 Feb. 1978, O. Rangel, culture CBS 482.78.

Paracremonium contagium L. Lombard & Crous, **sp. nov.** MycoBank MB810269. Fig. 18.

Etymology: Name refers to the ability of this fungus to cause a subcutaneous infection of humans.

Ascomatal state unknown. *Mycelium* consisting of hyaline, septate, branched, 2–4 µm diam hyphae, sometimes

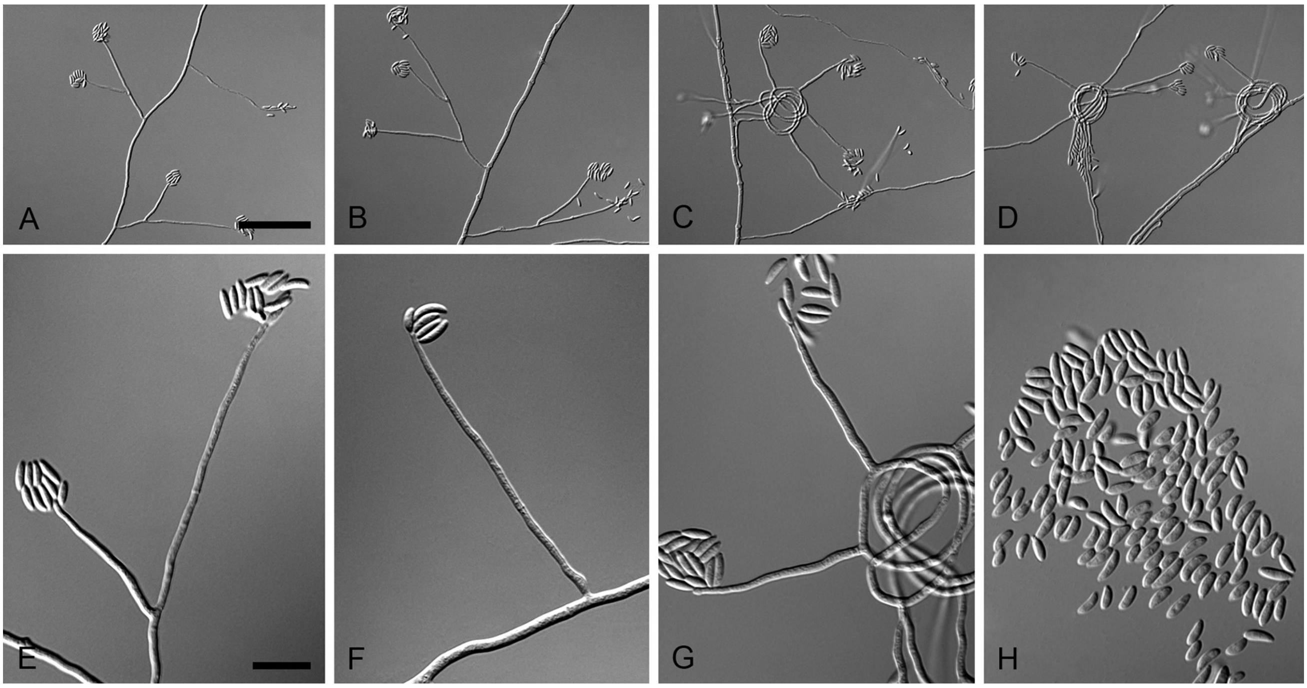

Fig. 17. *Paracremonium inflatum* (ex-type CBS 485.77). A–B, E–F. Conidiophores arising laterally from somatic hyphae with swollen hyphal septa. C–D, G. Conidiophores arising laterally from somatic hyphae in sterile coils. H. Conidia. Scale bars: A = 50 µm (apply to B–D); E = 10 µm (apply to F–H).

inconspicuously swollen at the hyphal septa. *Conidiophores* arising laterally from somatic hyphae, erect, subcylindrical, unbranched or rarely branched, 0–1-septate, up to 75 µm tall, 1–2 µm diam, hyaline, smooth, terminating in one or two conidiogenous cells. *Conidiogenous cells* terminal, elongate-ampulliform, tapering towards apex, 25–50 × 2–3 µm, apex 1.5–2 µm diam, with prominent periclinal thickening and inconspicuous collarette, hyaline, smooth. *Conidia* formed in heads at apex of conidiogenous cells, aseptate, ellipsoidal to fusiform, smooth, slightly to strongly curved, 4–6(–7) × 2–3 µm (av. 5 × 2 µm). *Chlamydospores* not seen.

Culture characteristics: Colony on PDA reaching 45–50 mm diam after 7 d at 24 °C; colony consists of semi-immersed aerial mycelium; surface with pink to salmon centre becoming white at the margins; reverse apricot in centre becoming salmon to pale pink to white towards the margin.

Material examined: **Canada**, Ontario, Toronto, from a subcutaneous lesion in the left thigh of a male *Homo sapiens*, S. Mohan (**holotype** CBS H-21945, culture ex-type CBS 110348 = UAMH 10141).

Note: *Paracremonium contagium* can be distinguished from *P. inflatum* by its shorter conidiophores and the absence of sterile coils from which conidiophores radiate.

Xenoacremonium L. Lombard & Crous, **gen. nov.** MycoBank MB810270.

Etymology: Name refers to the acremonium-like morphology of these fungi.

Ascomatal state not observed. *Mycelium* consisting of hyaline, septate, branched hyphae. *Conidiophores* either as lateral phialidic pegs or arising laterally from somatic hyphae, erect, cylindrical to subcylindrical, unbranched or rarely branched, aseptate or septate, smooth, hyaline. *Conidiogenous cells* terminal, monophialidic, hyaline, smooth, elongate-ampulliform or subcylindrical, tapering towards the apex, with periclinal thickening and inconspicuous collarette. *Conidia* aseptate, fusiform to ellipsoidal to cylindrical, slightly or strongly curved, forming slimy heads on the conidiophore.

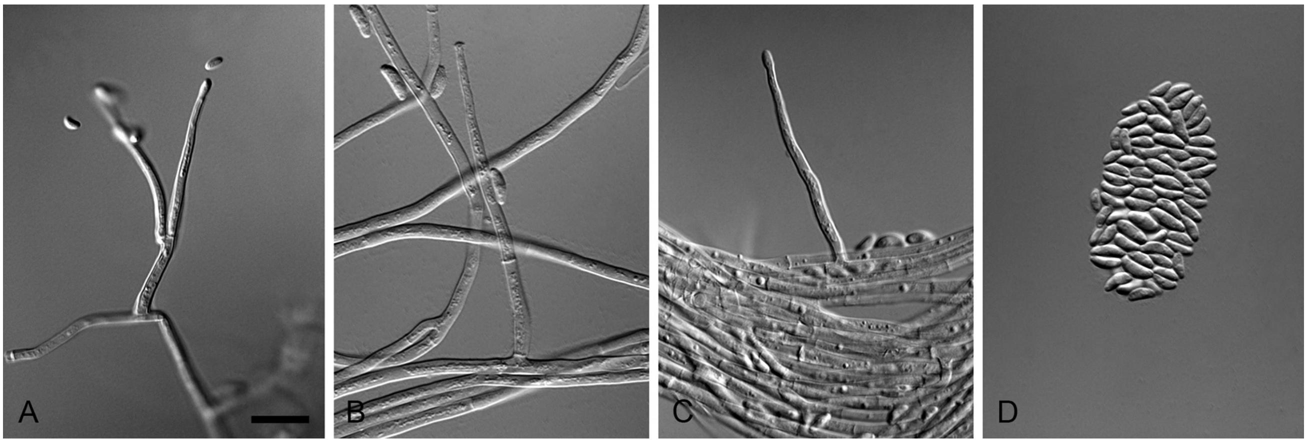

Fig. 18. *Paracremonium contagium* (ex-type CBS 110348). A–C. Conidiophores arising laterally from somatic hyphae. D. Conidia. Scale bar: A = 10 µm (apply to B–D).

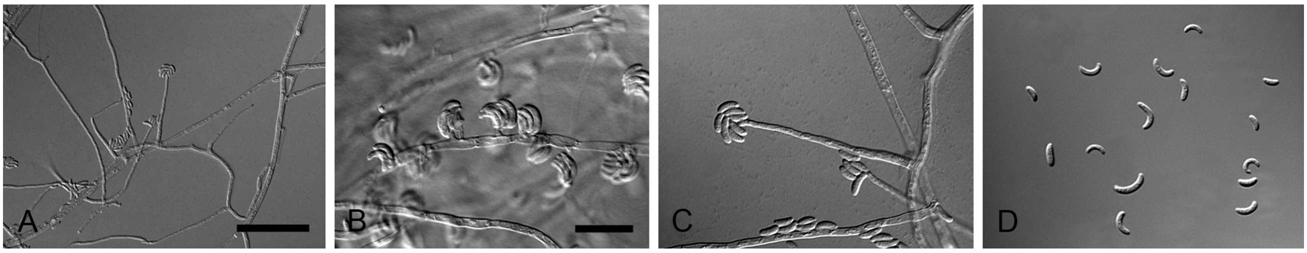

Fig. 19. *Xenoacremonium falcatus* (ex-type CBS 400.85). A, C. Conidiophores arising laterally from somatic hyphae. B. Lateral phialidic pegs. D. Conidia. Scale bars: A = 50 µm; B = 10 µm (apply to C–D).

Type species: *Xenoacremonium recifei* (Leão & Lôbo) L. Lombard & Crous.

Notes: The genus *Xenoacremonium* is established here for a group of fungi previously treated as *Acremonium recifei* (Gams 1971), which includes the ex-type of *A. recifei* (CBS 137.35). Phylogenetic inference in this study showed that representatives of this genus formed a monophyletic clade (BS = 100 %, PP = 1.0) closely related but separate from the clades representing *Corallomycetella* and *Paracremonium*.

Xenoacremonium falcatus L. Lombard & Crous, **sp. nov.** MycoBank MB810271. Fig. 19.

Etymology: Name refers to the strongly curved conidia produced by this fungus.

Ascomatal morph unknown. *Mycelium* consisting of hyaline, septate, branched, 2–3 µm diam hyphae. *Conidiophores* either as lateral phialidic pegs, 2–4 × 1–2 µm, or arising laterally from somatic hyphae, erect, subcylindrical, unbranched or rarely branched, 0–1-septate, up to 80 µm tall, 2–4 µm diam, hyaline, smooth, terminating in one or two conidiogenous cells. *Conidiogenous cells* terminal, elongate-ampulliform, tapering towards apex, 25–80 × 2–3 µm, apex 1–2 µm diam, with prominent periclinal thickening and inconspicuous collarette, hyaline, smooth. *Conidia* formed in heads at apex of conidiogenous cells, aseptate, ellipsoidal to fusiform or reniform, smooth, slightly to strongly curved, 4–8(–10) × 1–2 µm (av. 6 × 2 µm). *Chlamydospores* not seen.

Culture characteristics: Colony on PDA reaching 55–60 mm diam after 7 d 24 °C; colony consists of semi-immersed aerial mycelium; surface with pale luteous to luteous centre becoming white towards the margins; reverse pale luteous with pale luteous or luteous pigment throughout the medium.

Material examined: **New Zealand**, North Island, Woodhill Forest, Compartment 75, on *Pinus radiata*, 14 May 1982, J. Reid (**holotype** CBS H-21944, culture ex-type CBS 400.85).

Notes: The conidia of *Xenoacremonium falcatus* [4–8(–10) × 1–2 µm (av. 6 × 2 µm)] are slightly larger than those of *X. recifei* [4–6(–7.5) × 1–2 µm; Gams 1971]. Furthermore, *X. falcatus* produces lateral phialidic pegs on its somatic hyphae, a feature not observed in this study or reported for *X. recifei* by Gams (1971).

Xenoacremonium recifei (Leão & Lôbo) L. Lombard & Crous, **comb. nov.** MycoBank MB810272. Fig. 20.

Basionym: *Cephalosporium recifei* Leão & Lôbo, C.R. Soc. Biol. R. Janeiro: 205. 1934.

≡ *Hyalopus recifei* (Leão & Lôbo) Leão & M.A.J. Barbosa, Sub. Stud. Parasitol. Genero Hyalopus Corda 1838: 39. 1941.

≡ *Acremonium recifei* (Leão & Lôbo) W. Gams, Cephalosporium-artige Schimmelpilze: 133. 1971.

= *Hyalopus furcatus* Bat. & C. Ram., Atas Inst. Micol. Univ. Recife 4: 290. 1967.

= *Hyalopus furcatum* Bat. & C. Ram., Atas Inst. Micol. Univ. Recife 4: 290. 1967.

Material examined: **Brazil**, from mycetoma on *Homo sapiens*, 1934, A.E. de Area Leão (culture ex-type CBS 137.35).

Clade XII

Nalanthamala Subram., J. Indian Bot. Soc. 35: 478. 1956.

= *Rubrinectria* Rossman & Samuels, Stud. Mycol. 42. 1999.

Ascomata perithecial on an erumpent stroma, aggregated in groups, superficial, globose to broadly ovate or broadly pyriform, with a short, rounded, obtuse papilla, orange-red with orange, rarely green scales, turning dark red in KOH. *Asci* cylindrical, apex simple or with a small, refractive ring, 8-spored. *Ascospores* broadly ellipsoidal to fusiform, 1-septate, slightly constricted at the septum, pale brown to golden-brown, coarsely striate. *Conidiophores* sporodochial or penicillate, stalked, mononematous. *Sporodochia* hyaline, erumpent, hemispherical or flat; cells of well-developed sporodochia angular to globose, forming pseudoparenchymatous tissue, evenly thin-walled. *Phialides* formed singly or in whorls on cylindrical cells that arise from pseudoparenchymatous tissue of sporodochia or in whorls on penicillately branched conidiophores, elongate, widest

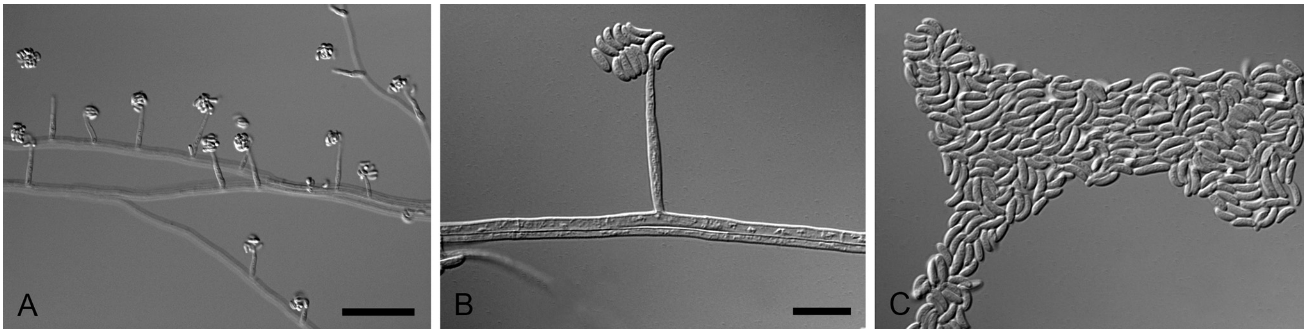

Fig. 20. *Xenoacremonium recifei* (ex-type CBS 137.35). A–B. Conidiophores arising laterally from somatic hyphae. C. Conidia. Scale bars: A = 50 µm; B = 10 µm (apply to C).

at the base or in the lower third, narrowing towards the apex or cylindrical and narrowing below the apex. *Conidia* ovoid, frequently with somewhat truncated ends, hyaline, aseptate, smooth, held in dry chains (adapted from Rossman *et al.* 1999 and Schroers *et al.* 2005).

Type species: *Nalanthamala madreeya* Subram., J. Indian Bot. Soc. 35: 478. 1956.

Descriptions and illustrations: Rossman *et al.* (1999), Schroers *et al.* (2005).

Notes: Species of *Nalanthamala* are tropical fungi associated with wilt and blight diseases of various economically important tropical crops (Schroers *et al.* 2005, Rossman *et al.* 2013). Representatives of this genus formed a monophyletic clade (BS = 100 %, PP = 1.0) closely related to the clade representing the genus *Nectria*. Unfortunately cultures or sequences of *N. madreeya* were not available for the molecular phylogeny.

Nectria (Fr.) Fr., Summa Veg. Scand. 2: 387. 1849. MycoBank MB3431.

≡ *Hypocrea* sect. *Nectria* Fr., Syst. Orbis Veg.: 105. 1825.
= *Ephodrosphaera* Dumort., Commentat. Bot.: 90. 1822.
= *Sphaerostilbe* Tul. & C. Tul., Sel. Fung. Carpol. 1: 130. 1861.
= *Megalonectria* Speg., Anales Soc. Ci. Argent. 12: 217. 1881.
= *Stilbonectria* P. Karst., Hedwigia 28: 194. 1889.
= *Creonectria* Seaver, Mycologia 1: 183. 1909.
= *Rhodothrix* Vain., Ann. Acad. Sci. Fenn. 15: 31. 1921.
= *Styloletendraea* Weese, Mitt. Bot. Inst. Techn. Hochsch. Wien 1: 60. 1924.
= *Ochraceospora* Fiore, Boll. Soc. Naturalisti Napoli 41: 90. 1930.

Ascomata perithecial on or nearly or completely immersed in an erumpent stroma, aggregated in groups, red to bay to sienna, turning bright red to blood red to purple in KOH, subglobose to globose, surface smooth to warted. *Asci* cylindrical to narrowly clavate or clavate, with an inconspicuous ring, 8-spored. *Ascospores* ellipsoidal, oblong, fusiform, pyriform or allantoid, rounded at both ends, smooth or spinulose, hyaline, straight to slightly curved, up to 4-septate. *Conidiophores* pycnidial, sporodochial, lateral phialidic pegs or acropleurogenous. *Microconidia* hyaline, ellipsoid to fusoid, rarely curved, aseptate. *Macroconidia* hyaline, ellipsoidal, oblong, cylindrical to allantoid or subglobose to ellipsoidal, 0–1-septate, smooth, straight to slightly curved, rounded at both ends. *Chlamydospores* rare (adapted from Hirooka *et al.* 2012).

Type species: *Nectria cinnabarina* (Tode: Fr.) Fr., Summa Veg. Scand. 2: 388. 1849.

≡ *Sphaeria cinnabarina* Tode: Fr., Tode, Fungi Mecklenburg. Selecti. 2: 9. 1791: Fries, Syst. Mycol. 2: 412. 1823.
≡ *Cucurbitaria cinnabarina* (Tode: Fr) Grev., Scot. Crypt. Fl. 3: 135. 1825.
= *Sphaeria tremelloides* Weigel, Observ. Bot.: 46. 1772.
= *Tubercularia vulgaris* Tode: Fr., Tode, Fungi Mecklenburg. Selecti. 1: 18. 1790: Fries, Syst. Mycol. 3: 464. 1832.
= *Sphaeria decolorans* Pers.: Fr., Persoon, Neues Mag. Bot. 1: 83. 1794: Fries, Syst. Mycol. 2: 412. 1823.
= *Sphaeria celastri* Fr., Elenchus Fung. 2: 81. 1827.
= *Nectria russellii* Berk. & M.A. Curtis, Grevillea 4: 45. 1875.
= *Nectria offuscata* Berk. & M.A. Curtis, Grevillea 4: 45. 1875.
= *Creonectria purpurea* (L.) Seaver, Mycologia 1: 183. 1909.
≡ *Tremella purpurea* L., Species Pl.: 1158. 1753.

Description and illustration: Hirooka *et al.* (2012).

Notes: Hirooka *et al.* (2012) recently revised *Nectria*, recognising 29 species within the genus. Representatives of this genus included in this study formed a monophyletic clade (BS $\geq$ 75 %, PP $\geq$ 0.95) closely related to the genus *Nalanthamala*.

Clade XIII

Allantonectria Earle, In: Greene, Pl. Baker. 2: 11. 1901. MycoBank MB128.

Ascomata perithecial on a well-developed, erumpent stroma, superficial, scattered to aggregated, subglobose to globose, sometimes with a depressed apical region, bay to scarlet, turning blood-red in KOH, sometimes surface scruffy or scaly, slightly orange. *Asci* narrowly clavate with an inconspicuous ring at the apex, 8-spored. *Ascospores* allantoid to cylindrical with rounded corners, straight to slightly curved, aseptate, hyaline, smooth. *Lateral phialidic pegs* abundant, enteroblastic, monophialidic, flask-shaped. *Conidiophores* abundant, unbranched, sometimes trichoderma-like. *Conidiogenous cells* monophialidic, cylindrical, tapering towards the apex or slightly flask-shaped. *Conidia* oblong or ellipsoidal with strongly constricted centre, hyaline, straight or slightly curved, rounded at both ends (adapted from Hirooka *et al.* 2012).

Type species: *Allantonectria miltina* (Mont.) Weese, Ann. Mycol. 8: 464. 1910.

≡ *Sphaeria miltina* Mont., Explor. Sci. Algérie, Bot. I, 1: 477. 1848.
≡ *Nectria miltina* (Mont.) Mont., Syll. Gen. Sp. Pl. Cryptog.: 225. 1856.
≡ *Nectriella miltina* (Mont.) Sacc., Michelia 1: 278. 1878.
= *Allantonectria yuccae* Earle, In: Greene, Pl. Baker. 2: 11. 1901.
= *Nectriella bacillispora* Traverso & Spessa, Bol. Soc. Brot. 25: 172. 1910.

Description and illustrations: Hirooka *et al.* (2012).

Notes: The genus *Allantonectria* is monotypic based on *A. miltina*, recently resurrected to generic level by Hirooka *et al.* (2012) after Rossman *et al.* (1999) placed the type species in *Nectria*. Isolates of *A. miltina* formed a monophyletic clade (BS $\geq$ 75 %, PP $\geq$ 0.95), distinct from the *Nectria* clade, but closely related to the clade representing the genus *Thyronectria*.

Thyronectria Sacc., Grevillea 4 (no. 29): 21. 1875. MycoBank MB5469.

= *Pleonectria* Sacc., Nuovo Giom. Bot. Ital. 8: 78. 1876.
= *Chilonectria* Sacc., Michelia 1: 279. 1878.
= *Nectria* subgenus *Aponectria* Sacc., Michelia 1: 296. 1878.
≡ *Aponectria* (Sacc.) Sacc., Syll. Fung. 2: 516. 1883.
= *Mattirolia* Berl. & Bres., Annuario Soc. Alpinisti Tridentini 14: 55. 1889.
= *Scoleconectria* Seaver, Mycologia 1: 197. 1909.
= *Thyronectroidea* Seaver, Mycologia 1: 206. 1909.

Ascomata perithecial, immersed in a stroma or superficial, densely aggregated, subglobose to globose to flask-shaped, apex obtuse, red to umber, turning slightly purple in KOH. *Asci* oblong or clavate, with undifferentiated apex or with an inconspicuous ring, 8-spored. *Ascospores* ellipsoidal, fusiform, long-cylindrical to filiform, hyaline, (0–)1-septate, multiseptate to muriform, smooth or striate, sometimes budding in the ascus to produce oblong to allantoid, aseptate, hyaline, ascoconidia. On natural substrate asexual morph sometimes pycnidial. *Pycnidia* co-occurring with ascomata, solitary or aggregated in groups, superficial, subglobose to irregularly discoid to cupulate or elongate and erect, rosy, orange, red, violaceous brown to nearly black. *Conidiophores* densely packed, simple, irregularly or verticillately branched. Conidia formed on lateral phialidic pegs or cylindrical to subulate phialides, conidial formation enteroblastic. *Conidia* hyaline, oblong, ellipsoid or allantoid, aseptate. In culture, asexual morph forming verticillate conidiophores or pycnidia. *Conidiophores* unbranched or branched, but sometimes densely branched to form sporodochia. *Conidiogenous cells* monophialidic, cylindrical, slightly curved towards the apex. *Conidia* oblong, ellipsoidal, cylindrical or allantoid, hyaline (0–)1–2-septate, smooth (adapted from Hirooka *et al.* 2012 and Jaklitsch & Voglmayr 2014).

Type species: *Thyronectria rhodochlora* (Mont.) Seeler, J. Arnold Arbor. 21: 455. 1940.

≡ *Sphaeria rhodochlora* Mont., Ann. Sci. Nat., Bot. 1: 307. 1834.
≡ *Mattirolia rhodochlora* (Mont.) Berl. (as "*rhodoclora*"), Atti Congr. Bot. Int., (Genova): 574. 1892.
≡ *Pleosphaeria rhodochlora* (Mont.) Sacc., Syll. Fung. (Abellini) 2: 306. 1883.
≡ *Trichosphaeria rhodochlora* (Mont.) Sacc., Syll. Fung. (Abellini) 1: 454. 1882.
= *Pleosphaeria mutabilis* Sacc., Syll. Fung. 2: 306. 1883.
≡ *Mattirolia mutabilis* (Sacc.) Checa, M.N. Blanco & G. Moreno, Mycotaxon 125: 153. 2013.
≡ *Strickeria mutabilis* (Sacc.) G. Winter, Rabenh. Krypt.-Fl., ed. 2, 1: 288. 1885.
= *Thyronectria patavina* Sacc., Atti Soc. Veneto-Trentino Sci. Nat. 4: 123. 1875.
≡ *Nectria patavina* (Sacc.) Rossman, Mem. New York Bot. Gard. 49: 260. 1989.
≡ *Valsonectria patavina* (Sacc.) Cooke, Grevillea 12: 105. 1884.
= *Nectria pyrrhochlora* Auersw., (as "*pyrrochlora*") in Rabenhorst, Hedwigia 8: 88. 1869.
≡ *Calonectria pyrrhochlora* (Auersw.) Sacc., (as "*pyrrochlora*") Michelia 1: 251. 1878.
≡ *Thyronectria pyrrhochlora* (Auersw.) Sacc., Michelia 2: 325. 1881.
≡ *Valsonectria pyrrochlora* (Auersw.) Cooke, Grevillea 12: 105. 1884.
≡ *Pleonectria pyrrhochlora* (Auersw.) G. Winter, Rabenh. Krypt.-Fl. Ed. 2, 1, II. Abt.: Ascomyc.: Gymnoasceen: 108. 1884.
≡ *Mattirolia pyrrochlora* (Auersw.) Starbäck, Bih. Kungl. Svenska Vetenskapsakad. Handl. 19: 43. 1894.

Descriptions and illustrations: Hirooka *et al.* (2012), Jaklitsch & Voglmayr (2014).

Notes: Recently, Hirooka *et al.* (2012) revised this group of fungi, placing them in the genus *Pleonectria*, with *P. lamyi* as type, stating that this generic name was the oldest available name for these fungi. Jaklitsch & Voglmayr (2014), however, argued that the generic name *Thyronectria* represents the oldest name for these fungi based on phylogenetic inference. Previously, these fungi were incorrectly placed in the fungal family *Thyridiaceae* due to the presence of paraphyses, but have now been shown to belong to the *Nectriaceae* (Jaklitsch & Voglmayr 2014). Phylogenetic inference in the present study supports this conclusion with representatives of *Thyronectria* forming a monophyletic clade (BS $\geq$ 75 %, PP $\geq$ 0.95) closely related to but separate from the clade representing *Allantonectria*.

Clade XIV

Tilachlidiaceae L. Lombard & Crous, **fam. nov.** MycoBank MB810273.

Ascomatal state unknown. *Conidiophores* synnematous or acremonium-like. *Synnemata* terete, simple to branched, cylindrical, narrowing towards the apex, consisting of bundles of parallel longitudinal, closely compacted hyphae with 1–4 scattered phialides terminating the hyphae of the synnema. *Phialides* cymbiform to cylindrical, hyaline, aseptate, with obvious collarettes, narrowing towards the apex. *Conidia* hyaline, fusiform to ellipsoid to subcylindrical, aseptate becoming 1–3-septate in culture, smooth to finely ornamented, with or without mucoid sheath, formed in chains or agglutinating into large spherical or irregular white clumps. Parasitic or saprobic on living or dead foliicolous or entomogenous fungi.

Type genus: *Tilachlidium* Preuss.

Type species: *Tilachlidium brachiatum* (Batsch) Petch.

Notes: The fungal family *Tilachlidiaceae* is introduced here to include species of the synnematous genera *Septofusidium* and *Tilachlidium*. Gams (1971) placed the genus *Septofusidium* in the family *Nectriaceae* based on morphological characters, whereas the genus *Tilachlidium* was classified as *incertae sedis* in the order *Hypocreales* (Gams 1971). No records could be located where *Septofusidium* has been treated in a molecular or phylogenetic analysis and neither are there any DNA sequence records available for this genus on NCBI's GenBank sequence database. Only one record for *T. brachiatum* (CBS 506.67; HQ232177) could be found on GenBank. Therefore, this study represents the first molecular phylogenetic inference to include *Septofusidium*. Representatives of both genera clustered together in a well-supported clade (BS $\geq$ 75 %, PP $\geq$ 0.95) basal to the clades (Clades I–XIII) representing the family *Nectriaceae*, supporting the introduction of the new family *Tilachlidiaceae*.

Tilachlidium Preuss, Linnaea 24: 126. 1851. MycoBank MB10236. Fig. 21.

Ascomatal state unknown. *Synnemata* cylindrical, simple or branched, narrowing towards the apex, consisting of bundles of parallel, longitudinal, usually closely compacted hyphae. *Phialides* scattered, hyaline, subulate, gradually narrowing to an acute apex, usually terminating hyphae of the synnema, or as lateral cells of the hyphae, single or in groups. *Conidia* oblong to ellipsoidal, aseptate, hyaline, smooth, covered by a mucoid layer, aggregating into large spherical or irregular masses.

Type species: *Tilachlidium brachiatum* (Batsch) Petch, Trans. Brit. Mycol. Soc. 21: 66. 1937.

≡ *Clavaria brachiata* Batsch., Elenchus Fung. 1: 233. 1786.
≡ *Isaria brachiata* (Batsch) Schum., Enum. Fl. Saell. 2: 443. 1803.
= *Isaria agaricina* Pers., Disp. Meth. Fung.: 111. 1794.
= *Isaria citrine* Pers., Icon. Descr. Fung. Minus Cognit., Lipsiae: 9. 1798.
= *Isaria intricata* Fr., Syst. Mycol. 3: 278. 1829.
= *Isaria filiformis* Wallr., Fl. Cryptog. German. 2: 307. 1833.
= *Tilachlidium pinnatum* Preuss, Linnaea 24: 127. 1851.
= *Corethropsis epimyces* Massee, J. R. Microbiol. Soc. 5: 759. 1885.
= *Tilachlidium subulatum* A.L. Smith, Trans. Brit. Mycol. Soc. 3: 122. 1908.
= *Hirsutella ramosa* Mains, Mycologia 41: 308. 1949.
= *Tilachlidium ramosum* (Mains) Mains, Mycologia 43: 714. 1952.
= *Tilachlidium setigerum* Malençon, Bull. Soc. Hist. Natr. Afr. N. 44: 148. 1953.

Descriptions and illustrations: Mains (1951), Gams (1971).

Notes: Species of *Tilachlidium* are saprophytic fungi growing on dried fungi or entomogenous on lepidopterous insects (Petch

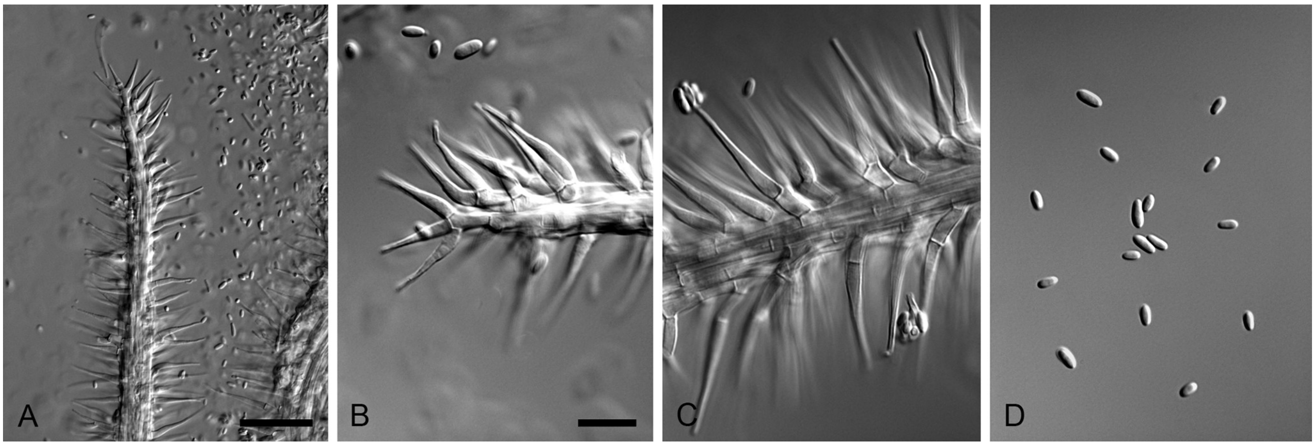

Fig. 21. *Tilachlidium brachiatum* (CBS 505.67). A. Synnema of bundled, parallel, compacted hyphae with lateral and terminal phialides. B. Phialides terminating hyphae of synnema. C. Lateral phialides extending from synnema. D. Conidia. Scale bars: A = 50 μm; B = 10 μm (apply to C–D).

1931, Mains 1951). Representatives of the genus *Tilachlidium* formed a monophyletic clade (BS = 100 %, PP = 1.0) closely related to but separate from the clade representing the genus *Septofusidium*.

Septofusidium W. Gams, Cephalosporium-artige Schimmelpilze: 147. 1971. MycoBank MB9882. Fig. 22.

Ascomatal state unknown. *Conidiophores* basitonously verticillate, arising laterally from submerged hyphae. *Phialides* sometimes integrated in septate branches, cylindrical to allantoid, smooth, becoming verrucose, hyaline to yellow. *Conidia* formed in long divergent chains, cylindrical to fusiform, 0–7-septate, hyaline to yellow, smooth or roughened to verrucose, sometimes with distinct hilum at both ends.

Type species: *Septofusidium elegantulum* (Pidopl.) W. Gams, Cephalosporium-artige Schimmelpilze: 147. 1971.

≡ *Fusidium elegantulum* Pidopl., Mykrobiol. Zh. Kiew 9: 53. 1948.

Descriptions and illustrations: Gams (1971), Samson (1974).

Notes: Species of *Septofusidium* are regarded as parasitic on foliicolous fungi (Gams 1971, Samson 1974). Representatives of this genus formed a monophyletic clade (BS ≥ 75 %, PP ≥ 0.95) within the larger clade representing the new family *Tilachlidiaceae*. Unfortunately sequences or cultures of *S. elegantulum* were not available for study. One isolate (CBS 696.93) listed as "*Pseudonectria coronata*" in the CBS collection also clustered within the *Tilachlidiaceae* clade. However, this isolate was sterile and analyses of the DNA sequences were inconclusive. Therefore this isolate cannot be identified at present and might be a contaminant of the original culture.

Clade XV

This weakly-supported clade includes representatives of the hypocrealean families *Clavicipitaceae* and *Niessliaceae*. The family *Clavicipitaceae* is represented here by isolates previously treated as *Aphanocladium album* (CBS 401.70, CBS 892.72 & CBS 634.75; Gams 1971) which formed a well-supported clade (BS = 100 %, PP = 1.0). Based on the illustration provided by Gams (1971) for CBS 401.70 and confirmed by comparisons of

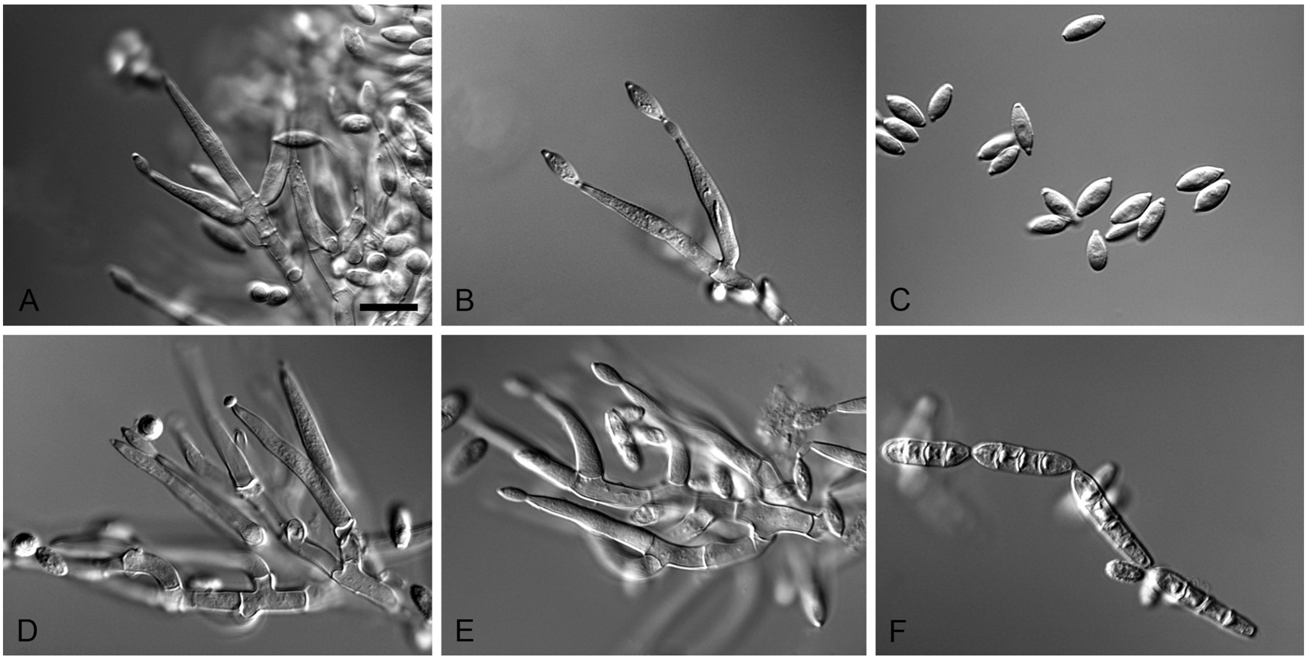

Fig. 22. *Septofusidium*. A–C. *S. herbarum*. A–B. Conidiophores. C. Conidia. D–F. *S. berolinese*. D–E. Conidiophores. F. Conidia. Scale bar: A = 10 μm (apply to B–F).

DNA sequences on NCBI's GenBank sequence database, these isolates represent unknown species in the genus *Pochonia*. Unfortunately, all three isolates appear to be sterile and are therefore tentatively treated as undetermined species of *Pochonia* pending further investigation. The family *Niessliaceae* is represented by *Hyaloseta nolinae* (CBS 109837) and *Trichosphaerella ceratophora* (CBS 130.82). An isolate listed in the CBS collection as "*Nectria dacryocarpa*" (CBS 113532) also clustered within this clade, but is also sterile and no conclusive identification could be made based on DNA sequence comparisons, and is therefore not treated further here.

Clade XVI

This weakly-supported clade includes the ex-type of *Rodentomyces reticulatus* (CBS 128675; Doveri *et al.* 2010) and an authentic strain of *Sarocladium kiliense* (CBS 400.52; Herrera *et al.* 2013b). The monotypic genus *Rodentomyces* was initially placed in the *Nectriaceae* based on ITS and LSU sequence data (Doveri *et al.* 2010). However, this was not supported in the phylogenetic inference in this study. Analyses of the individual gene regions used here clustered both *R. reticulatus* and *S. kiliense* as a weakly-supported clade in the *Nectriaceae* (Clades I–XIII) using the *tub2*, ITS, LSU and *tef1* gene regions (results not shown) basal to the *Nectria* clade (Clade XII). The remaining six genes regions used here, however, placed both these isolates at the basal position represented in Figs 1 and 2. At present, the genus *Sarocladium* is classified as *incertae sedis* in the order *Hypocreales* (Summerbell *et al.* 2011, Giraldo *et al.* 2014), and therefore based on the weak relationship between *R. reticulatus* and *S. kiliense* in this study, both are considered *incertae sedis* pending further investigation. An isolated listed in the CBS collection as "*Nectria dacryocarpa*" (CBS 121.87) also clustered within this clade, but is also sterile and no conclusive identification could be made based on DNA sequence comparisons, and is therefore not treated further here.

Clade XVII

Falcocladium S.F. Silveira *et al.*, Mycotaxon 50: 447. 1994. MycoBank MB25800.

Ascomatal state unknown. *Conidiophores* sporodochial, synnematal, or penicillate when formed on aerial mycelium, hyaline, solitary or aggregated in groups, arising laterally from somatic hyphae, or from a stroma of thick-walled, red-brown chlamydospores. *Stipe extensions* hyaline to pale brown, straight to flexuous, aseptate, thick-walled, originating from any position on a conidiophore branch, or in the position of a phialide, frequently with more than one occurring in the same conidiogenous apparatus, terminating in an ellipsoidal, sphaeropedunculate or turbinate vesicle. *Conidiogenous apparatus* hyaline, aseptate to multi-septate, consisting of up to three series of branches. *Phialides* hyaline, arising from ends of each terminal branch in groups of 2–6, ampulliform or lageniform to subulate, with inconspicuous collarettes. *Conidia* hyaline, 0(–1)-septate, falcate with acute, short apical and basal appendages (adapted from Crous *et al.* 1994).

Type species: *Falcocladium multivesiculatum* S.F. Silveira *et al.*, Mycotaxon 50: 448. 1994.

Descriptions and illustrations: Crous *et al.* (1994, 1997, 2007), Somrithipol *et al.* (2007).

Notes: The family *Falcocladiaceae* was recently introduced for the genus *Falcocladium* (Jones *et al.* 2014), which includes four species, namely *F. multivesiculatum* (Crous *et al.* 1994), *F. sphaeropedunculatum* (Crous *et al.* 1997), *F. thailandicum* (Crous *et al.* 2007) and *F. turbinatum* (Somrithipol *et al.* 2007). Crous *et al.* (2007) judged the genus to be polyphyletic (but allied with the *Hypocreales*) after the ITS sequence of *F. thailandicum* was included in a phylogenetic analysis of this species with *F. multivesiculatum*, *F. sphaeropedunculatum* and other related sequences downloaded from GenBank. Phylogenetic inference in the present study showed that the ex-type of *F. thailandicum* (CBS 121717) clustered within the monophyletic clade (BS $\geq$ 75 %, PP $\geq$ 0.95) representing the genus *Falcocladium*, but distinct from the *Nectriaceae* clade (Clade I–XIII), therefore supporting the introduction of the family *Falcocladiaceae*.

Clade XVIII

This unsupported clade includes *Lectera colletotrichoides* (CBS 109728) of the *Plectosphaerellaceae* (*Hypocreomycetidae, incertae sedis*, *Sordariomycetes*), representatives of the genera *Cylindrium* and *Ciliciopodium*, and a single isolate (CBS 122.39) listed as "*Calostilbe striispora*" in the CBS collection. Both *Cylindrium* and *Ciliciopodium* are classified in the family *Nectriaceae* by Index Fungorum and MycoBank and limited literature is available for both genera. Phylogenetic inference in this study excluded both genera from *Nectriaceae* and they are therefore considered as *incertae sedis*.

Untreated or excluded genera

Bacillispora Sv. Nilsson, Bot. Not. 115: 77. 1962. MycoBank MB7304.

Type species: *Bacillispora aquatica* Sv. Nilsson, Botaniska Notiser 115: 77. 1962.

Descriptions and illustrations: Nilsson (1962), Iqbal & Bhatty (1980).

Notes: *Bacillospora* is an aquatic asexual genus established by Nilsson (1962) with *B. aquatica* as type. Based on the descriptions provided by Nilsson (1962) and Iqbal & Bhatty (1980) (for *B. inflata*), members of this genus closely resemble the asexual morphs of the genera *Neonectria* and *Thelonectria*. However, no cultures were available at this time to determine the phylogenetic position of *Bacillospora* in the *Nectriaceae*.

Peziotrichum (Sacc.) Lindau, In: Engler & Prantl, Natürl. Pflanzenfam. 1(1): 467. 1900. MycoBank MB9285.

≡ *Botryotrichum* subgenus *Peziotrichum* Sacc., Hedwigia 32: 58. 1893.

Type species: *Peziotrichum lachnella* (Sacc.) Lindau, In: Engler & Prantl, Natürl. Pflanzenfam. 1(1): 467. 1900.

≡ *Botryotrichum lachnella* Sacc., Hedwigia 32: 58. 1893.

Description and illustration: Subramanian (1971).

Notes: *Peziotrichum* is an entomogenous asexual genus, based on *P. lachnella,* which was initially linked to *Ophionectria coccorum* (Petch 1927, Subramanian 1971). Rossman (1977) synonymised *O. coccorum* under *Podonectria coccorum*, which belongs to the *Tubeufiaceae* (*Pleosporales*, *Pleosporomycetidae*, *Dothideomycetes*; Rossman 1987), a genus also linked to the asexual genus *Tetracrium* (*Tubeufiaceae, Pleosporales*, *Pleosporomycetidae*, *Dothideomycetes*; Kodsueb *et al.* 2006). Since there are no living cultures available representing *Peziotrichum* that would allow for molecular studies, the link of this genus to *Podonectria* and *Tetracrium* cannot be confirmed. *Peziotrichum* could be considered as a member of the *Tubeufiaceae*, based on the descriptions and illustrations provided by Petch (1927) and Subramanian (1971).

Pleogibberella Sacc., In: Berl. & Voglino, Syll. Fung. Addit. 1–4: 217. 1886. MycoBank MB4211.

Type species: *Pleogibberella calami* (Cooke) Berl. & Voglino, Syll. Fung. Addit. 1–4: 217. 1886 (as "*calamia*").
≡ *Gibberella calami* Cooke, Grevillea 13: 8. 1884.

Description and illustration: Rossman *et al.* (1999).

Notes: Rossman *et al.* (1999) studied the type specimen of *Pleogibberella calami*, the only species in this genus, and concluded that this genus is most similar to members of the genus *Nectria* based on the ascomatal wall structure, well-developed stroma and large, muriform ascospores. The type specimen also did not include asexual structures. No living cultures are available to allow this genus to be included in molecular studies.

Pleurocolla Petr., Ann. Mycol. 22: 15. 1924. MycoBank MB9458.

Type species: *Pleurocolla tiliae* Petr. Ann. Mycol. 22: 15. 1924.

Description and illustration: Diehl (1933).

Notes: No living cultures were available for molecular studies.

Pseudocosmospora C. Herrera & P. Chaverri, Mycologia 105: 1291. 2013. MycoBank MB802432.

Type species: *Pseudocosmospora eutypellae* C. Herrera & P. Chaverri, Mycologia 105: 1293. 2013.

Description and illustration: Herrera *et al.* (2013a).

Notes: Representatives of *Pseudocosmospora* have not been included in this study as no cultures were available to us. Herrera *et al.* (2013a), however, clearly indicated this sexual genus to form a monophyletic lineage sister to *Dialonectria* and *Cosmospora*.

Stalagmites Thiess. & Syd., Ann. Mycol. 12: 189. 1914. MycoBank MB5182.

Type species: *Stalagmites tumefaciens* (Syd. & P. Syd.) Thiess. & Syd., Ann. Mycol. 12: 189. 1914.
≡ *Dothidea tumefaciens* Syd. & P. Syd., Ann. Mycol. 5: 360. 1907.

Description and illustration: Rossman *et al.* (1999).

Notes: This monotypic genus, based on *Stalagmites tumefaciens*, is associated with galls on branches of a *Serjania* sp. Rossman *et al.* (1999) concluded that this genus belongs in the *Nectriaceae* based on morphological similarities to the sexual morphs of *Fusarium* (as *Gibberella*) and *Pleogibberella*. No living cultures were available for molecular studies.

DISCUSSION

To our knowledge, this study represents the largest sampling of nectriaceous fungi subjected to multi-locus sequence analyses to date. It provides a broad phylogenetic backbone and framework for future studies of the *Nectriaceae*. Members of this family are commonly found in various environments, where they play important socio-economic roles in human endeavours in agriculture, industry and medicine. The phylogenetic foundation set in this study will form the basis for further investigation of several genera, and will allow identification of novel taxa in existing and new fungal groups in this family. Although taxonomic issues have been clarified in some genera in this study, it also highlights some taxonomic problems in the *Nectriaceae*.

Members of the *Nectriaceae* are pleomorphic fungi, displaying both asexual and sexual morphs during their life cycles. This originally resulted in the separate naming of each fungal morph, providing a considerable challenge to fungal systematics (Cannon & Kirk 2000). The implementation of The International Code of Nomenclature for algae, fungi and plants (ICN; McNiell *et al.* 2012), stipulating that only one scientific name should be used for a fungal species, resulted in the abolishment of dual nomenclature (ICN Art. 59; McNeill *et al.* 2006, Hawksworth *et al.* 2011) for pleomorphic fungi. Although selecting the correct generic name for a group of fungi should be based on priority of the oldest generic name, several fungal groups are considered exceptions to this principle based on the need for reasonable nomenclatural stability in fungi of economic or health significance (Rossman *et al.* 2013). Therefore, Hawksworth (2011, 2012) proposed several criteria to be applied for determining the status of a generic name. These criteria include (1) the number of name changes required, (2) the clarity of the generic concept, (3) the frequency of use of each generic name and (4) the vote of interested members of the scientific community. Applying these criteria, Rossman *et al.* (2013) proposed the conservation or protection of several generic names in the *Nectriaceae*. Also following this approach, we propose the conservation or protection of the generic names *Penicillifer* (= *Viridispora*), *Sarcopodium* (=*Actinostilbe* = *Lanatonectria*) and *Xenocylindrocladium* (=*Xenocalonectria*) based on priority of the generic name and the number of name changes required if the alternative generic name is applied. However, the implementation of ICN has already sparked intensive debate, especially where well-established generic names in literature, such as *Fusarium s. lat.* (Geiser *et al.* 2013, O'Donnell *et al.* 2013, Aoki *et al.* 2014), have now been segregated into more narrowly defined genera, with newly introduced and older generic names being applied for these newly segregated fungal groups (Gräfenhan *et al.* 2011, Schroers *et al.* 2011).

The generic name *Fusarium* is well-embedded in mycological literature, representing the fourth most commonly published fungal name (see Geiser *et al.* 2013). The segregation of the genus *Fusarium* by Gräfenhan *et al.* (2011) and Schroers *et al.* (2011) was therefore met by strong opposition from the general *Fusarium* working community (Geiser *et al.* 2013, O'Donnell *et al.* 2013, Aoki *et al.* 2014), although the genus *Fusarium s. lat*. clearly has internal phylogenetic structure supporting these divisions. A similar debate within the general plant pathological community surrounded the segregation of *Cylindrocarpon* and *Neonectria* into several genera by Chaverri *et al.* (2011). These changes have ultimately been widely accepted (Cabral *et al.* 2012a, b, c, Lombard *et al.* 2013). We therefore choose to retain the generic names *Albonectria*, *Cyanonectria*, *Geejayessia* and *Neocosmospora* as proposed by Gräfenhan *et al.* (2011), Nalim *et al.* (2011) and Schroers *et al.* (2011) for fungal groups previously treated in the genus *Fusarium*. This approach allows for consistency in the taxonomic treatment of genera in the *Nectriaceae*, as several clades, which include important plant pathogens (e.g. Clade III & IV) are shown here to display a similar genetic structure and ecology (e.g. *Campylocarpon*, *Dactylonectria*, *Ilyonectria* and *Neonectria* on *Vitis vinifera*; Cabral *et al.* 2012a, b, c, Lombard *et al.* 2013, 2014a, b).

In this study, we were able to resolve 47 genera in the *Nectriaceae*, of which three genera, namely *Calostilbe*, *Corallonectria* and *Dematiocladium*, are represented by single lineages due to the paucity of cultures. For several of these genera there has been little or no DNA sequence data available prior to this study. These genera include *Aquanectria, Curvicladiella*, *Cylindrocarpostylus*, *Cylindrodendrum*, *Ophionectria*, *Paracremonium*, *Penicillifer*, *Sarcopodium*, *Septofusidium*, *Tilachlidium*, *Xenoacremonium*, *Xenocylindrocladium*, and *Xenogliocladiopsis*. All these genera were shown to form monophyletic clades. New studies will be needed on these groups, especially since two of them, *Paracremonium* and *Xenoacremonium*, represent important human pathogens (Gams 1971). The remaining genera are for the most part regarded as either foliicolous or entomogenous fungi or endophytes and saprobes of mostly woody plant hosts (Ranzoni 1956, Gams 1971, Crous & Kendrick 1994, Kirschner & Oberwinkler 1999, Rossman *et al.* 1999) which might play an important role in industrial applications in future.

Six new genera, which were previously treated as members of the genera *Acremonium*, *Flagellospora*, *Fusarium* and *Pseudonectria*, are introduced here in the family *Nectriaceae*. Species in the new genus *Coccinonectria* were initially regarded as members of the genus *Pseudonectria* mostly based on plant host association (Rossman *et al.* 1999, Gräfenhan *et al.* 2011, Crous *et al.* 2014). Morphologically, *Coccinonectria* species can be distinguished from *Pseudonectria* by their scarlet ascomata, although their asexual morphs share several morphological features. Phylogenetic inference in this study also supported segregation of *Coccinonectria* from *Pseudonectria*, and therefore two new combinations are made in *Coccinonectria*.

Bisifusarium, Neocosmospora and *Rectifusarium* were previously treated as members of the genus *Fusarium*. Phylogenetic inference in this study showed that these genera are monophyletic and distinct from each other and *Fusarium*. *Bisifusarium* includes fusarium-like species previously treated as the "*Fusarium dimerum* species complex" (Schroers *et al.* 2005, Geiser *et al.* 2013, O'Donnell *et al.* 2013). They are distinguished by the formation of lateral phialidic pegs, which are not commonly found in *Fusarium*, and by producing 1–2-septate macroconidia. These fungi are mostly isolated from clinical samples (Schroers *et al.* 2009). Species of *Rectifusarium* are soil-borne fungi and have been isolated from various agricultural crops, but are not regarded as important pathogens or post-harvest pathogens of these crops (Wollenweber 1913, Gerlach & Nirenberg 1982). This genus is distinguished from *Fusarium* by its simple, erect, almost cylindrocarpon-like conidiophores, and the absence of sporodochia. Members of the new genera *Paracremonium* and *Xenoacremonium* were previously treated as *Acremonium recifei* (Gams 1971, Summerbell *et al.* 2011), which have been shown to be paraphyletic (Summerbell *et al.* 2011). Both genera include important human subcutaneous and opportunistic pathogens (Gams 1971, de Hoog *et al.* 2011). Phylogenetic inference guided the recognition of subtle morphological distinctions between the genera. Species of *Paracremonium* can be distinguished by the formation of sterile coils in culture and their pink to salmon coloured colonies on PDA. *Xenoacremonium* species do not form sterile coils in culture, but readily release a pale luteous to luteous pigment into the growth medium, a phenomenon that is not observed in *Paracremonium*.

A new family, *Tilachlidiaceae*, is introduced here in the order *Hypocreales* for two genera, *Septofusidium* and *Tilachlidium*, previous classified in the family *Nectriaceae*. These genera share several morphological characters and are known to be saprobic or parasitic on other fungi (Petch 1931, Mains 1951, Gams 1971, Samson 1974). Some species of *Tilachlidium* have been shown to produce important antibiotics (Gottshall *et al.* 1951, Roberts 1952) as well as novel compounds that are cytotoxic to leukemia cells (Feng *et al.* 2004), discoveries highlighting the potential for exploitation of these fungi in medical applications.

Comparisons of the phenotypic and ecological characters of genera in the *Nectriaceae* included in this study showed marginal correlations with some of the clades identified in the phylogenetic tree. Genera in Clade I are characterised by their penicillate arrangement of fertile branches but do not all share the same ecological niche. Clade III includes genera that also have a penicillate arrangement of fertile branches but have a sterile stipe extension extending beyond the conidiogenous apparatus and are generally regarded as soil-borne fungi. Clade IV and VI include genera, with the exception of *Cylindrocarpostylus* and *Mariannaea*, having soil-borne cylindrocarpon-like asexual morphs. They are associated with basal rot and canker diseases of their plant hosts. Genera in Clade VII are characterised by their sporodochial asexual morphs with characteristic straight to circinate setae surrounding the sporodochia. They are associated mostly with leaf and stem blight diseases of plant hosts in the *Buxaceae*. Clade X includes genera with fusarium-like asexual morphs. They are generally pathogens of other fungi or of insects.

The ten gene regions used in this study were chosen based on their extensive use in molecular mycology. They have proved suitable to explore phylogenetic relationships within and between genera in the *Nectriaceae* (Chaverri *et al.* 2011, Gräfenhan *et al.* 2011, Hirooka *et al.* 2012, Lombard *et al.* 2010a, b, 2012, 2014a, b, Lombard & Crous 2012, Herrera *et al.* 2013a, b, O'Donnell *et al.* 2013). Although phylogenetic analyses of the individual gene regions (results not shown) were able to resolve all the genera in the *Nectriaceae* with varying statistical support, none of these gene regions can be considered as the "silver bullet" for the *Nectriaceae*. An illustration of the unreliability of individual genes is found in the placement of *Rodentomyces reticulatus* and *Sarocladium kiliense* within the *Nectriaceae* clade by *tub2*, ITS, LSU and *tef1*, but not by the other six genes studied. The best statistical support for each genus was obtained using *rpb1* and *rpb2,* and therefore these loci should be further studied in attempts to determine phylogenetic relationships in the *Nectriaceae*. However, the ability of these two loci to serve as barcodes for species in these genera still needs to be determined for each genus on an individual basis.

The present study, as mentioned previously, should serve as backbone for future taxonomic studies of genera in the *Nectriaceae*. More loci need to be identified and screened with an eye to finding a more robust single locus – a process that might be expedited by using whole genome sequences. Presently there is an under-representation of *Nectriaceae* in the available whole genome sequences (nine genomes; http://genome.jgi.doe.gov). More genomic studies are urgently needed in the *Nectriaceae*. Our study also highlights the importance of maintaining living cultures in public culture collections, as many of the genera included in this study were subjected to molecular analysis for the first time based on cultures collected at various times in history, while, on the other hand, several recently described taxa were unavailable for inclusion.

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APPENDIX

Recently Rossman *et al.* (2013) proposed generic names for acceptance or rejection in the families *Bionectriaceae*, *Hypocreaceae* and *Nectriaceae*. In this treatment, *Clonostachys* was recommended above *Bionectria* in the *Bionectriaceae*. Within the *Hypocreaceae*, *Hypomyces* was recommended over *Cladobotryum*, *Sphaerostilbella* over *Gliocladium*, and *Trichoderma* over *Hypocrea*. In keeping with these proposals and in line with the *International Code of Nomenclature for algae, fungi and plants* (ICN; McNiell *et al.* 2012), new combinations are required in the genera *Clonostachys*, *Hydropisphaera*, *Nectriopsis* (*Bionectriaceae*), and *Sphaerostilbella* (*Hypocreaceae*), which are provided here.

BIONECTRIACEAE

Clonostachys apocyni (Peck) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810968.
Basionym: *Nectria apocyni* Peck, Bull. Buffalo Soc. Nat. Sci. 1: 71. 1873.
≡ *Cucurbitaria apocyni* (Peck) Kuntze, Rev. Gen. Plant. 3: 460. 1898.
≡ *Bionectria apocyni* (Peck) Schroers & Samuels, Z. Mykol. 63: 153, 1997.
= *Nectria rugispora* Pat., Bull. Trimestriel Soc. Mycol. France 8: 133. 1892.
≡ *Cucurbitaria rugispora* (Pat.) Kuntze, Rev. Gen. Plant. 3: 461. 1898.
= *Nectria carneoflavida* Penz. & Sacc., Malpighia 11: 511. 1897.
= *Dendrodochium macrosporum* Sacc. & Ellis, Michelia 2: 580. 1882.
≡ *Clonostachys macrospora* (Sacc. & Ellis) Schroers & W. Gams, Stud. Mycol. 46: 62. 2001.
= *Dendrodochium roseomucosum* Matsush., Matsush. Mycol. Mem. 8: 17. 1995.

Clonostachys aurantia (Penz. & Sacc.) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810969.
Basionym: *Nectriella aurantia* Penz. & Sacc., Malpighia 11: 509. 1897.
≡ *Bionectria aurantia* (Penz. & Sacc.) Rossman, Samuels & Lowen, Mycologia 85: 698. 1993.

Clonostachys blumenaviae (Rehm) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810970.
Basionym: *Nectria blumenaviae* Rehm, Hedwigia 37: 192. 1898.

Clonostachys gibberosa (Schroers) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810971.
Basionym: *Bionectria gibberosa* Schroers, Stud. Mycol. 46: 198. 2001.

Clonostachys manihotis (Rick) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810972.
Basionym: *Nectria manihotis* Rick, Ann. Mycol. 8: 458. 1910.

Clonostachys parva (Schroers) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810973.
Basionym: *Bionectria parva* Schroers, Stud. Mycol. 46: 143. 2001.

Clonostachys tonduzii (Speg.) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810974.
Basionym: *Bionectria tonduzii* Speg., Bol. Acad. Nac. Ci. 579: 563. 1919.
≡ *Nectria tonduzii* (Speg.) Samuels, Mem. New York Bot. Gard. 48: 22. 1988.

Clonostachys tornata (Höhn.) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810975.
Basionym: *Pseudonectria tornata* Höhn., Sitzungsber. Akad. Wiss. Wien, Mat.-Naturwiss. Kl. 118: 1470. 1909.
≡ *Bionectria tornata* (Höhn.) Schroers, Stud. Mycol. 46. 184. 2001.
= *Nectria sesquiphialis* Samuels, Mem. New York Bot. Gard. 49: 276. 1989.
= *Sesquicillium asymmetricum* Samuels, Mem. New York Bot. Gard. 49: 276. 1989.
≡ *Clonostachys asymmetrica* (Samuels) Schroers, Stud. Mycol. 46: 184. 2001.

Note: The sexual-asexual morph connections for these species in *Clonostachys* are based on the monograph of *Bionectria* by Schroers (2001).

Hydropisphaera fusigera (Berk. & Broome) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810976.
Basionym: *Monotospora fusigera* Berk. & Broome, J. Linn. Soc., Bot. 14: 99. 1873.
≡ *Gliomastix fusigera* (Berk. & Broome) C.H. Dickinson, Mycol. Pap. 115: 7. 1968.
≡ *Acremonium fusigera* (Berk. & Broome) W. Gams, *Cephalosporium*-artige Schimmelpilze: 94. 1971.
= *Hydropsisphaera bambusicola* Lechat, Mycotaxon 111: 96. 2010.

Notes: Lechat *et al.* (2010) linked the sexual morph *Hydropisphaera bambusicola* to the asexual morph *Gliomastix fusigera*.

The epithet of *G. fusigera* (≡ *Monotospora fusigera* (1973) is older, therefore takes priority, and the new combination is provided.

Nectriopsis rexiana (Sacc.) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810977.

Basionym: *Verticillium nanum* subsp. *rexianum* Sacc., Michelia 2: 577. 1882.

≡ *Verticillium rexianum* (Sacc.) Sacc., Syll. Fung. 4: 153. 1886.

=*Verticillium niveostratosum* Lindau, Rabenh. Kryptogam.-Fl., Pilze – Fungi imperfecti 1: 316. 1905.

= *Hypomyces exiguus* Pat., Bull. Soc. Mycol. France 18: 180. 1902.

≡ *Nectriopsis exigua* (Pat.) W. Gams, Netherlands J. Pl. Pathol. 88: 73. 1982.

=*Nectria myxomyceticola* Samuels, Mem. New York. Bot. Gard. 48: 48. 1988.

HYPOCREACEAE

Sphaerostilbella aurifila (W.R. Gerard) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810979.

Basionym: *Stilbum aurifilum* W.R. Gerard, Bull. Torrey Bot. Club. 5: 39. 1874.

≡ *Ciliciopodium aurifilum* (W.R. Gerard) Cooke, Grevillea 19: 14. 1890.

≡ *Dendrostilbella aurifilia* (W.R. Gerard) Seifert & J.A. Mackinnon, Mycologia 75: 324. 1983.

= *Sphaerostilbe lutea* Henn., Bot. Jahrb. Syst. 30:40. 1901.

≡ *Sphaerostilbella lutea* (Henn.) Sacc., Syll. Fung. 17: 778. 1905.

= *Stilbum zacalloxanthum* R.T. Moore, Amer. Naturalist 93: 41. 1959.

= *Stilbum mycetophilum* S. Ahmad, Biologia (Lahore) 6: 136. 1961.

Sphaerostilbella penicillioides (Corda) Rossman, L. Lombard & Crous, **comb. nov.** MycoBank MB810978.

Basionym: *Gliocladium penicillioides* Corda, Icon. Fungorum hucusque Cogn. 4: 31. 1840.

= *Hypomyces aureonitens* Tul. & C. Tul., Selecta Fungorum Carpologia: Nectriei-Phacidiei- Pezizei 3: 64. 1865.

≡ *Hypolyssus aureonitens* (Tul. & C. Tul.) Kuntze, Rev. Gen. Plant. 3: 488. 1898.

≡ *Nectriopsis aureonitens* (Tul. & C. Tul.) Maire, Ann. Mycol. 9: 323. 1911.

≡ *Hyphonectria aureonitens* (Tul. & C. Tul.) Petch, J. Bot. 74: 220. 1937.

≡ *Sphaerostilbella aureonitens* (Tul. & C. Tul) Seifert, Samuels & W. Gams, Stud. Mycol. 27: 145. 1985.

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