The forgotten *Calonectria* collection: Pouring old wine into new bags

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Abstract: The genus *Calonectria* with its *Cylindrocladium* asexual morphs has been subject to several taxonomic revisions in the past. These have resulted in the recognition of 116 species, of which all but two species (*C. hederae* and *C. pyrochroa*) are supported by ex-type cultures and supplemented with DNA barcodes. The present study is based on a large collection of unidentified *Calonectria* isolates that have been collected over a period of 20 years from various substrates worldwide, which has remained unstudied in the basement of the CBS-KNAW Fungal Biodiversity Centre. Employing a polyphasic approach, the identities of these isolates were resolved and shown to represent many new phylogenetic species. Of these, 24 are newly described, while *C. uniseptata* is reinstated at species level. We now recognise 141 species that include some of the most important plant pathogens globally.

Key words: *Cylindrocladium*, Cryptic species, Phylogeny, Taxonomy.

Taxonomic novelties: New species: *Calonectria amazonica* L. Lombard & Crous, *C. amazoniensis* L. Lombard & Crous, *C. brasiliana* L. Lombard & Crous, *C. brassicicola* L. Lombard & Crous, *C. brevistipitata* L. Lombard & Crous, *C. cliffordiicola* L. Lombard & Crous, *C. ericae* L. Lombard & Crous, *C. indonesiana* L. Lombard & Crous, *C. lageniformis* L. Lombard & Crous, *C. machaerinae* L. Lombard & Crous, *C. multilateralis* L. Lombard & Crous, *C. paracolhounii* L. Lombard & Crous, *C. parva* L. Lombard & Crous, *C. plurilateralis* L. Lombard & Crous, *C. pseudoecuadoriae* L. Lombard & Crous, *C. pseudouxmalensis* L. Lombard & Crous, *C. putriramosa* L. Lombard & Crous, *C. stipitata* L. Lombard & Crous, *C. syzygiicola* L. Lombard & Crous, *C. tereticornis* L. Lombard & Crous, *C. terricola* L. Lombard & Crous, *C. tropicalis* L. Lombard & Crous, *C. uxmalensis* L. Lombard & Crous, *C. venezuelana* L. Lombard Crous.

INTRODUCTION

The genus *Calonectria*, first introduced in 1867 (Rossman 1979), has been the subject of numerous taxonomic studies since the 1990s (Crous & Wingfield 1994, Crous 2002, Lombard *et al.* 2010b, 2015a, Alfenas *et al.* 2015). These studies have resulted in the recognition of 116 species, of which all but two (*C. hederae* and *C. pyrochroa*) are supported by ex-type cultures and supplemented by DNA barcodes (Crous 2002, Lechat *et al.* 2010, Lombard *et al.* 2010b). This large number of species has arisen mainly due to the introduction of DNA sequence data and subsequent phylogenetic inference enabling delimitation of numerous previously unrecognised cryptic taxa. These species often share the same plant hosts, informing knowledge of the epidemiology and fungicide resistance (Graça *et al.* 2009, Vitale *et al.* 2013, Gehesquière *et al.* 2016).

Calonectria spp. are characterised by sexual morphs that have yellow to dark red perithecia, with scaly to warty ascocarp walls, and *Cylindrocladium* asexual morphs in which the cylindrical and septate conidia are produced from phialides clustered below and surrounding a stipe extention terminating in variously shaped vesicles (Rossman 1993, Crous 2002, Lombard *et al.* 2010b,c). For many years these fungi were best known by their *Cylindrocladium* names associated with important plant diseases (Crous & Wingfield 1994, Crous 2002, Lombard *et al.* 2010c). Following convention that only one scientific name should be used for a fungal species (Hawksworth 2011, 2012, Hawksworth *et al.* 2011, McNeill *et al.* 2012), *Calonectria* has been chosen (Rossman *et al.* 2013). This newly adopted convention should resolve confusion regarding their names (Wingfield *et al.* 2011). However, it is important to recognise that the asexual *Cylindrocladium* morph represents the life phase most commonly found in nature and many species are known only in this form, which also plays a major role in the dissemination of *Calonectria* spp.

Calonectria spp. cause important diseases in numerous plant hosts worldwide. This includes leaf blight, cutting rot, damping-off and root rot (Crous 2002, Lombard *et al.* 2010c, 2015a, Vitale *et al.* 2013, Alfenas *et al.* 2015). The majority of the diseases caused by *Calonectria* spp. are associated with forestry-related plants (see Lombard *et al.* 2010c), where Calonectria leaf blight (CLB) is an important constraint to plantation productivity in South America (Rodas *et al.* 2005, Alfenas *et al.* 2015) and Southeast Asia (Crous & Kang 2001, Old *et al.* 2003, Chen *et al.* 2011, Lombard *et al.* 2015a). In other regions, such as southern Africa and Australia, *Calonectria* spp. appear mostly to be limited to forestry nurseries (Crous 2002, Lombard *et al.* 2009, 2010a,b,c). In agricultural and horticultural crops, *Calonectria* spp. have chiefly been reported only from South America and the Northern Hemisphere, where they are mostly associated with nursery diseases (Lombard *et al.* 2010c, Vitale *et al.* 2013), Cylindrocladium black rot of peanut (Bell & Sobers 1966, Beute & Rowe 1973, Hollowell *et al.* 1998) and box blight of *Buxus* spp. (Henricot *et al.* 2000, Crepel & Inghelbrecht 2003, Brand 2005, Saracchi *et al.* 2008, Saurat *et al.* 2012, Mirabolfathy *et al.* 2013, Gehesquière *et al.* 2016).

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The present study is based on a large collection of unidentified *Calonectria* isolates that were collected over a period of 20 years from various substrates worldwide. This collection of isolates, deposited in the CBS-KNAW culture collection in 2002 has remained unstudied in the basement of the institute and hence, the title of this study “the forgotten basement collection”. The large majority of these isolates were initially identified based solely on morphology and at a time when robust and multigene DNA sequence data were not commonly available. This implied that cryptic species could not be resolved (Lombard *et al.* 2010b, 2015a, Alfenas *et al.* 2015). The aim of the present study was to employ a polyphasic approach to identify these isolates.

MATERIALS AND METHODS

Isolates

Calonectria strains were obtained from the culture collection of the CBS-KNAW Fungal Biodiversity Centre (CBS), Utrecht, The Netherlands and the working collection of the senior author (CPC) housed at the CBS (Table 1).

Phylogeny

Total genomic DNA was extracted from 7-d-old axenic cultures, grown on MEA at room temperature, using the UltraClean™ Microbial DNA isolation kit (Mo Bio Laboratories, Inc., California, USA) following the protocols provided by the manufacturer. Based on previous studies (Lombard *et al.* 2010b, 2015b, Alfenas *et al.* 2015), partial gene sequences were determined for β-tubulin (*tub2*), calmodulin (*cmdA*), and the translation elongation factor 1-alpha (*tef1*) regions as these regions provided the best phylogenetic signal at species level for the genus *Calonectria*. Therefore, the primers and protocols described by Lombard *et al.* (2015b) were used to determine these regions.

To ensure the integrity of the sequences, the amplicons were sequenced in both directions using the same primers used for amplification. Consensus sequences for each locus were assembled in MEGA v. 7 (Kumar *et al.* 2016) and compared with representative sequences from Alfenas *et al.* (2013a,b, 2015), Chen *et al.* (2011) and Lombard *et al.* (2010a,b, 2011, 2015a). Subsequent alignments for each locus were generated in MAFFT v. 7.110 (Katoh & Standley 2013) and the ambiguously aligned regions of both ends were truncated. Congruency of the three loci was tested using the 70 % reciprocal bootstrap criterion (Mason-Gamer & Kellogg 1996) following the protocols of Lombard *et al.* (2015b).

Phylogenetic analyses of the individual gene regions and the combined dataset were based on Bayesian inference (BI), Maximum Likelihood (ML) and Maximum Parsimony (MP). For BI and ML, the best evolutionary models for each locus were determined using MrModeltest (Nylander 2004) and incorporated into the analyses. MrBayes v. 3.2.1 (Ronquist & Huelsenbeck 2003) was used for BI to generate phylogenetic trees under optimal criteria for each locus. A Markov Chain Monte Carlo (MCMC) algorithm of four chains was initiated in parallel from a random tree topology with the heating parameter set at 0.3. The MCMC analysis lasted until the average standard deviation of split frequencies was below 0.01 with trees saved every 1 000 generations. The first 25 % of saved trees were discarded as the “burn-in” phase and posterior probabilities (PP) were determined from the remaining trees.

The ML analyses were preformed 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 another 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.

For MP, analyses were done using PAUP (Phylogenetic Analysis Using Parsimony, v. 4.0b10; Swofford 2003) with phylogenetic relationships estimated by heuristic searches with 1 000 random addition sequences. Tree-bisection-reconnection was used, with branch swapping option set on “best trees” only. All characters were weighted equally and alignment gaps treated as fifth state. Measures calculated for parsimony included tree length (TL), consistency index (CI), retention index (RI) and rescaled consistence index (RC). Bootstrap analyses (Hillis & Bull 1993) were based on 1 000 replications. All new sequences generated in this study were deposited in GenBank (Table 1) and alignments and trees in TreeBASE.

Taxonomy

Axenic cultures were transferred to synthetic nutrient-poor agar (SNA; Nirenburg 1981) and incubated at room temperature for 7 d. Gross morphological characteristics were studied by mounting the fungal structures in 85 % lactic acid and 30 measurements were made at ×1 000 magnification for all taxonomically informative characters 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. For all other fungal structures measured, only the extremes are provided. Colony colour was assessed using 7-d-old cultures on MEA incubated at room temperature and the colour charts of Rayner (1970). All descriptions, illustrations and nomenclatural data were deposited in MycoBank (Crous *et al.* 2004a).

RESULTS

Phylogenetic analyses

Approximately 500−550 bases were determined for the three gene regions included in this study. The congruency analyses revealed no conflicts in tree topologies, with only minor differences in branch support. Therefore, the sequences of the three loci determined here were combined in a single dataset for analyses. For the BI and ML analyses, a HKY+I+G model was selected for all three gene regions and incorporated into the analyses. The ML tree topology confirmed the tree topologies obtained from the BI and MP analyses, and therefore, only the ML tree is presented.

The combined *cmdA*, *tef1* and *tub2* sequences dataset included 278 ingroup taxa and *Curvicladiella cignea* (CBS 109167) as outgroup taxon. This dataset consisted of 1 680

Table 1. *Calonectria* spp. used in phylogenetic analyses.

Species	Isolate nr.[1]	Substrate	Locality	GenBank accession no.[2]		
				tub2	*cmdA*	*tef1*
Calonectria acicola	**CBS 114812**	*Phoenix canariensis*	New Zealand	DQ190590	GQ267359	GQ267291
	CBS 114813	*P. canariensis*	New Zealand	DQ190591	GQ267360	GQ267292
C. aconidialis	**CBS 136086**; CMW 35174; CERC 1850	Soil in *Eucalyptus* plantation	Hainan, China	–	KJ463017	KJ462785
	CBS 136091; CMW 35384; CERC1886	Soil in *Eucalyptus* plantation	Hainan, China	–	–	KJ462786
C. amazonica	CBS 115486; CPC 3894	*E. tereticornis*	Brazil	*KX784611*	*KX784554*	*KX784681*
	CBS 116250; CPC 3534	*E. tereticornis*	Brazil	*KX784612*	*KX784555*	*KX784682*
C. amazoniensis	CBS 115438; CPC 3890	*E. tereticornis*	Brazil	*KX784613*	*KX784556*	*KX784683*
	CBS 115439; CPC 3889	*E. tereticornis*	Brazil	*KX784614*	*KX784557*	*KX784684*
	CBS 115440; CPC 3885	*E. tereticornis*	Brazil	*KX784615*	*KX784558*	*KX784685*
C. angustata	**CBS 109065**; CPC 2347	*Tillandsia capitata*	USA	AF207543	GQ267361	*FJ918551*
	CBS 112133; CPC 3152	*T. capitata*	USA	DQ190593	GQ267362	*FJ918552*
C. arbusta	**CBS 136079**; CMW 31370; CERC1705	Soil in *Eucalyptus* plantation	Guangxi, China	KJ462904	KJ463018	KJ462787
	CBS 136098; CPC 23519; CMW37981; CERC 1944	Soil in *Eucalyptus* plantation	Guangxi, China	–	KJ463019	KJ462788
C. asiatica	CBS 112711; CPC 3898	Leaf litter	Thailand	AY725613	AY725738	AY725702
	CBS 114073; CPC 3900	Leaf litter	Thailand	AY725616	AY725741	AY725705
C. australiensis	**CBS 112954**	*Ficus pleurocarpa*	Australia	DQ190596	GQ267363	GQ267293
C. blephiliae	**CBS 136425**; CPC 21859	*Blephilia cliata*	USA	KF777246	–	KF777243
C. brachiatica	**CBS 123700**; CMW 25298	*Pinus maximinoi*	Buga, Colombia	FJ696388	GQ267366	GQ267296
	CBS134665; LPF305	Soil in *Eucalyptus* plantation	Monte Dourado, Pará, Brazil	KM395933	KM396020	KM395846
C. brasiliana	**CBS 111484**; CPC 1924	Soil	Brazil	*KX784616*	*KX784559*	*KX784686*
	CBS 111485; CPC 1929	Soil	Brazil	*KX784617*	*KX784560*	*KX784687*
C. brasiliensis	**CBS 230.51**; CPC 2390	*Anacardium* sp.	Brazil	GQ267241	GQ267421	GQ267328
	CBS 114257; CPC 1944	*Eucalyptus* leaf	Brazil	GQ267242	GQ267422	GQ267329
C. brassiana	**CBS 134855**	Soil	Teresina, Piauí, Brazil	KM395969	KM396056	KM395882
	CBS 134856	Soil	Teresina, Piauí, Brazil	KM395970	KM396057	KM395883
C. brassicae	CBS 111478; CPC 1921	Soil	Brazil	DQ190611	GQ267383	FJ918568
	CBS 111869; CPC 2409	*Argyeia splendens*	Indonesia	AF232857	GQ267382	FJ918567
C. brassicicola	CBS 112756; CPC 4502	*Brassica* sp.	Indonesia	*KX784618*	–	*KX784688*
	CBS 112841; CPC 4552	*Brassica* sp.	Indonesia	*KX784619*	*KX784561*	*KX784689*
	CBS 112947; CPC 4668		New Zealand	*KX784620*	*KX784562*	*KX784690*
C. brevistipitata	CBS 110837; CPC 913	Soil	Mexico	*KX784621*	*KX784563*	*KX784691*
	CBS 110928; CPC 951	Soil	Mexico	*KX784622*	*KX784564*	*KX784692*
	CBS 115671; CPC 949	Soil	Mexico	*KX784623*	*KX784565*	*KX784693*
C. canadania	**CBS 110817**; CPC 499		Canada	AF348212	AY725743	GQ267297
C. candelabrum	CPC 1675	*Eucalyptus* sp.	Amazonas, Brazil	FJ972426	GQ267367	FJ972525
	CMW 31001	*Eucalyptus* sp.	Amazonas, Brazil	GQ421779	GQ267368	GQ267298
C. cerciana	**CBS 123693**; CMW 25309	*Eucalyptus* cutting	Zhanjiang, China	FJ918510	GQ267369	FJ918559
	CBS 123695; CMW 25290	*Eucalyptus* cutting	Zhanjiang, China	FJ918511	GQ267370	FJ918560
C. chinensis	CBS 112744; CPC 4104	Soil	Hong Kong, China	AY725618	AY725746	AY725709
	CBS 114827; CPC 4101	Soil	Hong Kong, China	AY725619	AY725747	AY725710
C. clavata	**CBS 114557**; ATCC 66389; CPC 2536	*Callistemon viminalis*	USA	AF333396	GQ267377	GQ267305
	CBS 114666; CMW 30994; CPC 2537	Root debris in peat	USA	DQ190549	GQ267378	GQ267306
C. cliffordiicola	**CBS 111812**; CPC 2631	*Cliffordia feruginea*	South Africa	*KX784624*	*KX784566*	*KX784694*
	CBS 111814; CPC 2617	*Prunus avium*	South Africa	*KX784625*	*KX784567*	*KX784695*
	CBS 111819; CPC 2604	*P. avium*	South Africa	*KX784626*	*KX784568*	*KX784696*

(*continued on next page*)

Table 1. (Continued).

Species	Isolate nr.[1]	Substrate	Locality	GenBank accession no.[2]		
				tub2	***cmdA***	***tef1***
C. colhounii	**CBS 293.79**	*Camellia sinensis*	Bandung, Indonesia	DQ190564	GQ267373	GQ267301
	CBS 114704	*Arachis pintoi*	Australia	DQ190563	GQ267372	GQ267300
Ca. colombiana	**CBS 115127**; CPC 1160	Soil	La Selva, Colombia	FJ972423	GQ267455	FJ972492
	CBS 115638; CPC 1161	Soil	La Selva, Colombia	FJ972422	GQ267456	FJ972491
C. colombiensis	**CBS 112220**; CPC 723	Soil	La Selva, Colombia	GQ267207	AY725748	AY725711
	CBS 112221; CPC 724	*Eucalyptus grandis*	La Selva, Colombia	AY725620	AY725749	AY725712
C. crousiana	**CBS 127198**; CMW 27249	*E. grandis*	Fujian, China	HQ285794	–	HQ285822
	CBS 127199; CMW 27253	*E. grandis*	Fujian, China	HQ285795	–	HQ285823
C. cylindrospora	CBS 110666; CPC 496		USA	FJ918509	GQ267423	FJ918557
	CBS 119670; CPC 12766	*Pistacia lentiscus*	Italy	DQ521600	–	GQ421797
C. densa	CBS 125249; CMW 31184	Soil	Las Golondrinas, Pichincha, Ecuador	GQ267230	GQ267442	GQ267350
	CBS 125261; CMW 31182	Soil	Las Golondrinas, Pichincha, Ecuador	GQ267232	GQ267444	GQ267352
C. duoramosa	**CBS 134656**; LPF434	Soil	Monte Dourado, Pará, Brazil	KM395940	KM396027	KM395853
	LPF453	Soil in *Eucalyptus* plantation	Monte Dourado, Pará, Brazil	KM395941	KM396028	KM395854
C. ecuadoriae	**CBS 111406**; CPC 1635	Soil	Ecuador	DQ190600	GQ267375	GQ267303
	CBS 111394; CPC 1628	Soil	Ecuador	DQ190599	GQ267376	GQ267304
C. ericae	CBS 114456; CPC 1984	*Erica* sp.	USA	*KX784627*	*KX784569*	*KX784697*
	CBS 114457; CPC 1985	*Erica* sp.	USA	*KX784628*	*KX784570*	*KX784698*
	CBS 114458; CPC 2019	*Erica* sp.	USA	*KX784629*	*KX784571*	*KX784699*
C. eucalypti	CBS 125273; CMW 14890	*E. grandis*	Indonesia	GQ267217	GQ267429	GQ267337
	CBS 125275; CMW 18444	*E. grandis*	Indonesia	GQ267218	GQ267430	GQ267338
C. eucalypticola	CBS 134846	*Eucalyptus* leaf	Eunápolis, Bahia, Brazil	KM395963	KM396050	KM395876
	CBS 134847	*Eucalyptus* seedling	Santa Bárbara, Minas Gerais, Brazil	KM395964	KM396051	KM395877
C. expansa	CBS 136078; CMW 31441; CERC 1776	Soil in *Eucalyptus* plantation	Guangdong, China	KJ462913	KJ463028	KJ462797
	CBS 136247; CMW 31392; CERC 1727	Soil in *Eucalyptus* plantation	Guangxi, China	KJ462914	KJ463029	KJ462798
C. foliicola	**CBS 136641**; CMW 31393; CERC 1728	*E. urophylla* × *E. grandis* clone leaf	Guangxi, China	KJ462916	KJ463031	KJ462800
	CMW 31394; CERC 1729	*E. urophylla* × *E. grandis* clone leaf	Guangxi, China	KJ462917	KJ463032	KJ462801
C. fujianensis	CBS 127200; CMW 27254	*E. grandis*	Fujian, China	HQ285791	–	HQ285819
	CBS 127201; CMW 27257	*E. grandis*	Fujian, China	HQ285792	–	HQ285820
C. glaeboicola	**CBS 134852**	Soil	Martinho Campos, Minas Gerais, Brazil	KM395966	KM396053	KM395879
	CBS 134853	Soil	Bico do Papagaio, Tocantins, Brazil	KM395967	KM396054	KM395880
C. gordoniae	**CBS 112142**; CPC 3136; ATCC 201837	*Gordonia liasanthus*	USA	AF449449	GQ267381	GQ267309
C. gracilipes	**CBS 111141**	Soil	La Selva, Colombia	DQ190566	GQ267385	GQ267311
	CBS 115674	Soil	La Selva, Colombia	AF333406	GQ267384	GQ267310
C. gracilis	CBS 111284	Soil	Brazil	DQ190567	GQ267408	GQ267324
	CBS 111807	*Manilkara zapota*	Belém, Pará, Brazil	AF232858	GQ267407	GQ267323
C. guangxiensis	**CBS 136092**; CMW 35409; CERC 1900	Soil in *Eucalyptus* plantation	Guangxi, China	KJ462919	KJ463034	KJ462803
	CBS 136094; CMW 35411; CERC 1902	Soil in *Eucalyptus* plantation	Guangxi, China	KJ462920	KJ463035	KJ462804
C. hainanensis	**CBS 136248**; CMW 35187; CERC 1863	Soil in *Eucalyptus* plantation	Hainan, China	–	KJ463036	KJ462805

Table 1. (Continued).

Species	**Isolate nr.**[1]	**Substrate**	**Locality**	**GenBank accession no.**[2]		
				tub2	***cmdA***	***tef1***
C. hawksworthii	**CBS 111870**; CPC 2405; MUCL 30866	*Nelumbo nucifera*	Mauritius	AF333407	GQ267386	FJ918558
C. henricotiae	CB041	*Buxus sempervirens*	Belgium	KF815129	KF815156	–
	CBS 138102; CB045	*B. sempervirens*	Belgium	JX535308	KF815157	–
C. hodgesii	**CBS 133609**; LPF 245	*Anadenanthera peregrina*	Viçosa, Brazil	KC491228	KC491222	KC491225
	CBS 133610; LPF 261	*Azadirachta indica*	Viçosa, Brazil	KC491229	KC491223	KC491226
C. hongkongensis	CBS 114711; CPC 686	Soil	Hong Kong, China	AY725621	AY725754	AY725716
	CBS 114828; CPC 4670	Soil	Hong Kong, China	AY725622	AY725755	AY725717
C. humicola	**CBS 125251**	Soil	Las Golondrinas, Pichincha, Ecuador	GQ267233	GQ267445	GQ267353
	CBS 125269	Soil	Las Golondrinas, Pichincha, Ecuador	GQ267235	GQ267447	GQ267355
C. hurae	CBS 114182; CPC 1714	*Rumohra adiantiformis*	Brazil	DQ190618	–	–
	CBS 114551; CPC 2344	*R. adiantiformis*	USA	AF333408	GQ267387	FJ918548
C. ilicicola	**CBS 190.50**; CMW 30998; IMI 299389	*Solanum tuberosum*	Bogor, Indonesia	AY725631	AY725764	AY725726
	CBS 115897; CPC 493; UFV 108	*Anacardium* sp.	Brazil	AY725647	GQ267403	AY725729
C. indonesiae	**CBS 112823**; CPC 4508	Soil	Warambunga, Indonesia	AY725623	AY725756	AY725718
	CBS 112840; CPC 4554	*Syzygium aromaticum*	Indonesia	AY725625	AY725758	AY725720
C. indonesiana	CBS 112826; CPC 4519		Indonesia	*KX784630*	*KX784572*	*KX784700*
	CBS 112936; CPC 4504		Indonesia	*KX784631*	*KX784573*	*KX784701*
C. indusiata	**CBS 144.36**	*Camellia sinensis*	Sri lanka	GQ267239	GQ267453	GQ267332
	CBS 114684	*Rhododendron* sp.	USA	AF232862	GQ267454	GQ267333
C. insularis	**CBS 114558**; CPC 768	Soil	Tamatave, Madagascar	AF210861	GQ267389	FJ918556
	CBS 114559; CPC 954	Soil	Tamatave, Madagascar	AF210862	GQ267390	FJ918555
C. kyotensis	**CBS 114525**; CPC 2367; ATCC 18834	*Acacia dealbata*	Japan			
	CBS 114542; CPC 2352	Soil	China	*KX784649*	–	*KX784720*
	CBS 114550; CPC 2351	Soil	China	*KX784650*	*KX784587*	*KX784721*
	CBS 114692; CPC 2478; ATCC 18882	*Prunus* sp.	USA	*KX784651*	*KX784588*	*KX784722*
C. lageniformis	**CBS 111324**; CPC 1473	*Eucalyptus* sp.	Mauritius	*KX784632*	*KX784574*	*KX784702*
	CBS 112685; CPC 3418	*Eucalyptus sp.*	Brazil	*KX784633*	*KX784575*	*KX784703*
C. lateralis	**CBS 136629**; CMW 31412; CERC 1747	Soil in *Eucalyptus* plantation	Fangchenggang, Guangxi, China	KJ462955	KJ463070	KJ462840
C. lauri	**CBS 749.70**	*Ilex aquifolium*	Netherlands	GQ267210	GQ267388	GQ267312
C. leucothoes	**CBS 109166**; CPC 2385; ATCC 64824	*Leucothoe axillaris*	Gainsville, Florida, USA	FJ918508	GQ267392	FJ918553
C. machaerinae	CBS 123183; CPC 15378	*Machaerina sinclairii*	New Zealand	*KX784636*	–	*KX784706*
C. madagascariensis	CBS 114571; CPC 2253	Soil	Madagascar	DQ190571	GQ267395	GQ267315
	CBS 114572; CPC 2252	Soil	Madagascar	DQ190572	GQ267394	GQ267314
C. macroconidialis	**CBS 114880**; CPC 307	*E. grandis*	South Africa	AF232855	GQ267393	GQ267313
C. magnispora	**CBS 136249**; CMW 35184; CERC 1860	Soil in *Eucalyptus* plantation	Guangxi, China	KJ462956	KJ463071	KJ462841
C. malesiana	CBS 112710; CPC 3899	Leaf litter	Thailand	AY725626	AY725759	AY725721
	CBS 112752; CPC 4223	Soil	Sumatra, Indonesia	AY725627	AY725760	AY725722
C. maranhensis	**CBS 134811**	*Eucalyptus* sp.	Açailândia, Maranhão, Brazil	KM395948	KM396035	KM395861
	CBS 134812	*Eucalyptus* sp.	Açailândia, Maranhão, Brazil	KM395949	KM396036	KM395862
C. metrosideri	**CBS 133603**; LPF101	*Metrosideros polymorpha*	Viçosa, Brazil	KC294313	KC294304	KC294310
	CBS 133604; LPF 103	*M. polymorpha*	Viçosa, Brazil	KC294314	KC294305	KC294311

(*continued on next page*)

Table 1. (Continued).

Species	Isolate nr.[1]	Substrate	Locality	GenBank accession no.[2]		
				tub2	*cmdA*	*tef1*
C. mexicana	**CBS 110918**; CPC 927	Soil	Mexico	AF210863	GQ267396	FJ972526
C. microconidialis	CBS 136636; CMW 31475; CERC 1810	*E. urophylla* × *E. grandis* clone seedling leaf	CERC Nursery, Zhanjiang, Guangdong, China	KJ462959	KJ463074	KJ462844
	CBS 136638; CMW 31487; CERC 1822	*E. urophylla* × *E. grandis* clone seedling leaf	CERC Nursery, Zhanjiang, Guangdong, China	KJ462960	KJ463075	KJ462845
C. monticola	**CBS 140645**; CPC 28835	Soil	Thailand	KT964769	KT964771	KT964773
	CPC 28836	Soil	Thailand	KT964770	KT964772	KT964774
C. mossambicensis	**CBS 137243**; CMW 36327	*E. grandis* × *E. camaldulensis* cutting	Mozambique	–	JX570722	JX570718
C. multilateralis	CBS 110926: CPC 947	Soil	Mexico	*KX784639*	*KX784578*	*KX784709*
	CBS 110927; CPC 948	Soil	Mexico	*KX784640*	*KX784579*	*KX784710*
	CBS 110931; CPC 956	Soil	Mexico	*KX784641*	–	*KX784711*
	CBS 110932; CPC 957	Soil	Mexico	*KX784642*	*KX784580*	*KX784712*
	CBS 115606					
	CBS 115615; CPC 915	Soil	Mexico	*KX784643*	*KX784581*	*KX784713*
C. multinaviculata	**CBS 134858**; LPF233	Soil in *Eucalyptus* plantation	Mucuri, Bahia, Brazil	KM395985	KM396072	KM395898
	CBS 134859; LPF418	Soil in *Eucalyptus* plantation	Monte Dourado, Pará, Brazil	KM395986	KM396073	KM395899
C. multiphialidica	**CBS 112678**	Soil	Cameroon	AY725628	AY725761	AY725723
C. multiseptata	**CBS 112682**	*Eucalyptus* sp.	Indonesia	DQ190573	GQ267397	FJ918535
C. naviculata	**CBS 101121**	Leaf litter	João Pessoa, Brazil	GQ267211	GQ267399	GQ267317
	CBS 116080	Soil	Amazonas, Brazil	AF333409	GQ267398	GQ267316
C. nemicola	**CBS 134837**	Soil	Araponga, Minas Gerais, Brazil	KM395979	KM396066	KM395892
	CBS 134838	Soil	Araponga, Minas Gerais, Brazil	KM395980	KM396067	KM395893
C. orientalis	CBS 125259	Soil	Teso East, Indonesia	GQ267237	GQ267449	GQ267357
	CBS 125260	Soil	Lagan, Indonesia	GQ267236	GQ267448	GQ267356
C. ovata	CBS 111299	*E. tereticornis*	Tucuruí, Pará, Brazil	GQ267212	GQ267400	GQ267318
	CBS 111307	*E. tereticornis*	Tucuruí, Pará, Brazil	AF210868	GQ267401	GQ267319
C. pacifica	**CBS 109063**; CPC 2534; IMI 354528	*Araucaria heterophylla*	Hawaii, USA	GQ267213	AY725762	AY725724
	CBS 114038; CPC 10717	*Ipomoea aquatica*	Auckland, New Zealand	AY725630	GQ267402	GQ267320
C. papillata	CBS 136096; CMW 37972; CERC 1935	Soil in *Eucalyptus* plantation	Guangdong, China	KJ462963	KJ463078	KJ462848
	CBS 136097; CMW 37976; CERC 1939	Soil in *Eucalyptus* plantation	Guangdong, China	KJ462964	KJ463079	KJ462849
C. paracolhounii	**CBS 114679**; CPC 2445		USA	*KX784644*	*KX784582*	*KX784714*
	CBS 114705; CPC 2423		USA	*KX784645*	–	*KX784715*
C. paraensis	**CBS 134669**; LPF430	Soil in *Eucalyptus* plantation	Monte Dourado, Pará, Brazil	KM395924	KM396011	KM395837
	LPF306	Soil in *Eucalyptus* plantation	Monte Dourado, Pará, Brazil	KM395925	KM396012	KM395838
C. parakyotensis	**CBS 136085**; CMW 35169; CERC 1845	Soil in *Eucalyptus* plantation	Guangdong, China	–	KJ463081	KJ462851
	CBS 136095; CMW 35413; CERC 1904	Soil in *Eucalyptus* plantation	Guangxi, China	–	KJ463082	KJ462852
C. parva	**CBS 110798**; CPC 410	Soil	South Africa	*KX784646*	*KX784583*	*KX784716*
C. pauciramosa	**CBS 138824**; CMW 5683	*E. grandis*	South Africa	FJ918514	GQ267405	FJ918565
	CMW 30823	*E. grandis*	South Africa	FJ918515	GQ280404	FJ918566
C. penicilloides	**CBS 174.55**; IMI 299375	*Prunus* sp.	Japan	AF333414	GQ267406	GQ267322
C. pentaseptata	CBS 136087; CMW 35177; CERC 1853	*Eucalyptus* leaf	Hainan, China	KJ462966	KJ463083	KJ462853
	CBS 136089; CMW 35377; CERC 1879	*Eucalyptus* leaf	Hainan, China	KJ462967	KJ463084	KJ462854

Table 1. (Continued).

Species	**Isolate nr.**[1]	**Substrate**	**Locality**	**GenBank accession no.**[2]		
				tub2	***cmdA***	***tef1***
C. piauiensis	CBS 134849	Soil	Serra das Confusões, Piauí	KM395972	KM396059	KM395885
	CBS 134850	Soil	Teresina, Piauí, Brazil	KM395973	KM396060	KM395886
C. pini	**CBS 123698**	*Pinus patula*	Buga, Colombia	GQ267224	GQ267436	GQ267344
	CBS 125253	*P. patula*	Buga, Colombia	GQ267225	GQ267437	GQ267345
C. polizzi	CBS 125270; CMW 7804	*Callistemon citrinus*	Messina, Sicily, Italy	FJ972417	GQ267461	FJ972486
	CBS 125271; CMW 10151	*Arbustus unedo*	Catania, Sicily, Italy	FJ972418	GQ267462	FJ972487
C. plurilateralis	**CBS 111401**; CPC 1637		Ecuador	*KX784648*	*KX784586*	*KX784719*
C. pluriramosa	**CBS 136976**; CMW 31440; CERC 1774	Soil in *Eucalyptus* plantation	Fangchenggang, Guangxi, China	KJ462995	KJ463112	KJ462882
C. propaginicola	**CBS 134815**; LPF220	*Eucalyptus* sp.	Santana, Pará, Brazil	KM395953	KM396040	KM395866
	CBS 134816; LPF222	*Eucalyptus* sp.	Santana, Pará, Brazil	KM395954	KM396041	KM395867
C. pseudobrassicae	CBS 134661; LPF260	Soil in *Eucalyptus* plantation	Santana, Pará, Brazil	KM395935	KM396022	KM395848
	CBS 134662; LPF280	Soil in *Eucalyptus* plantation	Santana, Pará, Brazil	KM395936	KM396023	KM395849
C. pseudocerciana	CBS 134823	*Eucalyptus* sp.	Santana, Pará, Brazil	KM395961	KM396048	KM395874
	CBS 134824	*Eucalyptus* seedling	Santana, Pará, Brazil	KM395962	KM396049	KM395875
C. pseudocolhounii	**CBS 127195**; CMW 27209	*E. dunnii*	Fujian, China	HQ285788	–	HQ285816
	CBS 127196; CMW 27213	*E. dunnii*	Fujian, China	HQ285789	–	HQ285817
C. pseudoecuadoriae	**CBS 111402**; CPC 1639		Ecuador	*KX784652*	*KX784589*	*KX784723*
	CBS 111412; CPC 1648	Soil	Ecuador	DQ190601	*KX784590*	*KX784724*
C. pseudohodgesii	**CBS 134818**	*Azadirachta indica*	Viçosa, Minas Gerais, Brazil	KM395905	KM395991	KM395817
	CBS 134819	*A. indica*	Viçosa, Minas Gerais, Brazil	KM395906	KM395992	KM395818
C. pseudokyotensis	**CBS 137332**; CMW 31439; CERC 1774	Soil in *Eucalyptus* plantation	Fangchenggang, Guangxi, China	KJ462994	KJ463111	KJ462881
C. pseudometrosideri	CBS 134844	*Eucalyptus* sp.	Açailândia, Maranhão, Brazil	KM395908	KM395994	KM395820
	CBS 134845	Soil	Maceió, Alagoas, Brazil	KM395909	KM395995	KM395821
C. pseudomexicana	**CBS 130354**	*Callistemon* sp.	Tunisia	JN607281	–	JN607496
	CBS 130355	*Callistemon* sp.	Tunisia	JN607282	–	JN607497
Ca. pseudonaviculata	**CBS 114417**; CPC 10926	*Buxus sempervirens*	West Auckland, New Zealand	GQ267214	GQ267409	GQ267325
	CBS 116251; CPC 3399	*B. sempervirens*	New Zealand	AF449455	KM396000	KM395826
C. pseudopteridis	**CBS 163.28**; IMI 299579	*Washingtonia robusta*	USA	–	KM396076	KM395902
C. pseudoreteaudii	**CBS 123694**; CMW 25310	*Eucalyptus* hybrid cutting	Guangdong, China	FJ918504	GQ267411	FJ918541
	CBS 123696; CMW 25292	*Eucalyptus* hybrid cutting	Guangdong, China	FJ918505	GQ267410	FJ918542
C. pseudoscoparia	CBS 125255; CMW 15216	*E. grandis*	Pichincha, Ecuador	GQ267227	GQ267439	GQ267347
	CBS 125256; CMW 15216	*E. grandis*	Pichincha, Ecuador	GQ267228	GQ267440	GQ267348
C. pseudospathiphylli	**CBS 109165**; CPC 1623	Soil	Ecuador	FJ918513	GQ267412	FJ918562
C. pseudospathulata	CBS 134840	Soil	Araponga, Minas Gerais, Brazil	KM395982	KM396069	KM395895
	CBS 134841	Soil	Araponga, Minas Gerais, Brazil	KM395983	KM396070	KM395896
C. pseudouxmalensis	CBS 110923; CPC 941	Soil	Mexico	*KX784653*	–	*KX784725*
	CBS 110924; CPC 942	Soil	Mexico	*KX784654*	–	*KX784726*
	CBS 115677; CPC 943	Soil	Mexico	*KX784655*	–	*KX784727*
C. pseudovata	CBS 134674; LPF267	Soil in *Eucalyptus* plantation	Santana, Pará, Brazil	KM395945	KM396032	KM395858
	CBS 134675; LPF285	Soil in *Eucalyptus* plantation	Santana, Pará, Brazil	KM395946	KM396033	KM395859
C. pteridis	**CBS 111793**; ATCC 34395; CPC 2372	*Arachnoides adiantiformis*	USA	DQ190578	GQ267413	FJ918563
	CBS 111871; CPC 2443	*Pinus* sp.	Spain	DQ190579	GQ267414	FJ918564
C. putriramosa	**CBS 111449**; CPC 1951	*Eucalyptus* cutting	Brazil	*KX784656*	*KX784591*	*KX784728*
	CBS 111470; CPC 1940	Soil	Brazil	*KX784657*	*KX784592*	*KX784729*
	CBS 111477; CPC 1928	Soil	Brazil	*KX784658*	*KX784593*	*KX784730*
	CBS 116076; CPC 604	*Eucalyptus* cutting	Brazil	GQ421776	–	GQ421792

(*continued on next page*)

Table 1. (Continued).

Species	Isolate nr.[1]	Substrate	Locality	GenBank accession no.[2]		
				tub2	***cmdA***	***tef1***
C. queenslandica	**CBS 112146**; CPC 3213	*E. urophylla*	Australia	AF389835	GQ267415	FJ918543
	CBS 112155; CPC 3210	*E. pellita*	Australia	AF389834	GQ267416	FJ918544
C. quinqueramosa	**CBS 134654**; LPF065	Soil in *Eucalyptus* plantation	Monte Dourado, Pará, Brazil	KM395942	KM396029	KM395855
	CBS 134655; LPF281	Soil in *Eucalyptus* plantation	Santana, Pará, Brazil	KM395943	KM396030	KM395856
C. reteaudii	CBS 112143; CPC 3200	*E. camaldulensis*	Vietnam	GQ240642	GQ267418	FJ918536
	CBS 112144; CPC 3201	*E. camaldulensis*	Vietnam	AF389833	GQ267417	FJ918537
C. robigophila	**CBS 134652**	*Eucalyptus* sp.	Açailândia, Maranhão, Brazil	KM395937	KM396024	KM395850
	CBS 134653	*Eucalyptus* sp.	Açailândia, Maranhão, Brazil	KM395938	KM396025	KM395851
C. rumohrae	CBS 109062; CPC 1603	*Adianthum* sp.	Netherlands	AF232873	GQ267420	FJ918550
	CBS 111431; CPC 1716	*R. adiantiformis*	Brazil	AF232871	GQ267419	FJ918549
C. seminaria	CBS 136631; CMW 31449; CERC 1784	*E. urophylla* × *E. grandis* clone seedling leaf	CERC Nursery, Zhanjiang, Guangdong, China	KJ462997	KJ463114	KJ462884
	CBS 136632; CMW 31450; CERC 1785	*E. urophylla* × *E. grandis* clone seedling leaf	CERC Nursery, Zhanjiang, Guangdong, China	KJ462998	KJ463115	KJ462885
C. silvicola	CBS 134836	Soil	Araponga, Minas Gerais, Brazil	KM395975	KM396062	KM395888
	CBS 135237	Soil	Araponga, Minas Gerais, Brazil	KM395978	KM396065	KM395891
C. spathulata	**CBS 555.92**	*E. viminalis*	Brazil	AF308463	GQ267426	FJ918554
	CBS 115639; CPC 1148		Colombia	*KX784659*	*KX784594*	*KX784732*
	CBS 115644; CPC 1071	*E. grandis*	Colombia	*KX784660*	*KX784595*	*KX784733*
C. spathiphylli	CBS 114540; ATCC 44730; CPC 2378	*Spathiphyllum* sp.	USA	AF348214	GQ267424	GQ267330
	CBS 116168; CPC 789	*Spathiphyllum* sp.	Switzerland	FJ918512	GQ267425	FJ918561
C. sphaeropendunculata	**CBS 136081**; CMW 31390; CERC 1725	Soil in *Eucalyptus* plantation	Guangxi, China	KJ463003	KJ463120	KJ462890
C. stipitata	**CBS 112513**; CPC 3851	*Eucalyptus* sp.	Colombia	*KX784661*	*KX784596*	*KX784734*
C. sulawesiensis	CBS 125253; CMW 14879	*Eucalyptus* sp.	Sulawesi, Indonesia	GQ267220	GQ267432	GQ267340
	CBS 125277	*Eucalyptus* sp.	Sulawesi, Indonesia	GQ267222	GQ267434	GQ267342
C. sumatrensis	**CBS 112829**; CPC 4518	Soil	Sumatra, Indonesia	AY725649	AY725771	AY725733
	CBS 112934; CPC 4516	Soil	Indonesia	AY725651	AY725773	AY725735
C. syzygiicola	CBS 112827; CPC 4512	*S. aromaticum*	Indonesia	*KX784662*	*KX784597*	*KX784735*
	CBS 112831; CPC 4511	*S. aromaticum*	Indonesia	*KX784663*	–	*KX784736*
C. telluricola	CBS 134663; LPF214	Soil	Salinas, Minas Gerais, Brazil	KM395929	KM396016	KM395842
	CBS 134664; LPF217	Soil	Mucuri, Bahia, Brazil	KM395930	KM396017	KM395843
C. tereticornis	**CBS 111301**; CPC 1429	*E. tereticornis*	Brazil	*KX784664*	–	*KX784737*
C. terrae-reginae	**CBS 112151**; CPC 3202	*E. urophylla*	Queensland, Australia	FJ918506	GQ267451	FJ918545
	CBS 112634; CPC 4233	*Xanthorrhoea australis*	Victoria, Australia	FJ918507	GQ267452	FJ918546
C. terrestris	**CBS 136642**; CMW 35180; CERC 1856	Soil in *Eucalyptus* plantation	Guangdong, China	KJ463004	KJ463121	KJ462891
	CBS 136643; CMW 35364; CERC 1868	Soil in *Eucalyptus* plantation	Guangdong, China	KJ463005	KJ463122	KJ462892
C. terricola	**CBS 116247**; CPC 3583	Soil in *Eucalyptus* plantation	Brazil	*KX784665*	–	*KX784738*
	CBS 116248; CPC 3536	Soil in *Eucalyptus* plantation	Brazil	*KX784666*	–	*KX784739*
C. tetraramosa	**CBS 136635**; CMW 31474; CERC 1809	*E. urophylla* × *E. grandis* clone seedling leaf	CERC Nursery, Zhanjiang, Guangdong, China	KJ463011	KJ463128	KJ462898
	CBS 136637; CMW 31476; CERC 1811	*E. urophylla* × *E. grandis* clone seedling leaf	CERC Nursery, Zhanjiang, Guangdong, China	KJ463012	KJ463129	KJ462899
C. tropicalis	CBS 116242; CPC 3543	*Eucalyptus* sp.	Brazil	*KX784668*	–	*KX784741*
	CBS 116271; CPC 3559	*Eucalyptus* sp.	Brazil	*KX784669*	*KX784599*	*KX784742*

Table 1. (Continued).

Species	Isolate nr.[1]	Substrate	Locality	GenBank accession no.[2]		
				tub2	***cmdA***	***tef1***
C. turangicola	**CBS 136077**; CMW 31411; CERC 1746	Soil in *Eucalyptus* plantation	Fangchenggang, Guangxi, China	KJ463013	–	KJ462900
	CBS 136093; CMW 35410; CERC 1901	Soil in *Eucalyptus* plantation	Guangxi, China	KJ463014	KJ463130	KJ462901
C. tunisiana	CBS 130356	*Callistemon* sp.	Tunisia	JN607277	–	JN607292
	CBS 130357	*C. laevis*	Tunisia	JN607276	–	JN607291
C. uniseptata	**CBS 413.67**; CPC 2391; IMI 299577	*Paphiopedilum callosum*	Celle, Germany	GQ267208	GQ267379	GQ267307
	CBS 170.77; IMI 299388	*Idesia polycarpa*	Auckland, New Zealand	GQ267209	GQ267380	GQ267308
C. uxmalensis	CBS 110919; CPC 928	Soil	Mexico	*KX784637*	–	*KX784707*
	CBS 110925; CPC 945	Soil	Mexico	*KX784638*	–	*KX784708*
C. variabilis	CBS 112691; CPC 2506	*Theobroma grandiflorum*	Brazil	GQ267240	GQ267458	GQ267335
	CBS 114677; CPC 2436	*Schefflera morotoni*	Brazil	AF333424	GQ267457	GQ267334
C. venezuelana	**CBS 111052**; CPC 1183		Venezuela	*KX784671*	*KX784601*	*KX784744*
Ca. zuluensis	**CBS 125268**	*E. grandis*	South Africa	FJ972414	GQ267459	FJ972483
	CBS 125272	*E. grandis*	South Africa	FJ972415	GQ267460	FJ972484
Calonectria sp.	CBS 111423; CPC 1650		Ecuador	*KX784673*	*KX784603*	*KX784746*
	CBS 111465; CPC 1902	Soil	Brazil	DQ190607	*KX784584*	*KX784717*
	CBS 111706; CPC 1636		Ecuador	*KX784674*	*KX784604*	*KX784747*
	CBS 112152; CPC 3203	*E. camaldulensis*	Vietnam	*KX784672*	*KX784602*	*KX784745*
	CBS 112753; CPC 4225		Indonesia	*KX784667*	*KX784598*	*KX784740*
	CBS 113496; CPC 3155			*KX784675*	*KX784605*	*KX784748*
	CBS 113627; CPC 3232			*KX784676*	*KX784606*	*KX784749*
	CBS 114164; CPC 1634		Ecuador	*KX784677*	*KX784607*	*KX784750*
	CBS 114691; CPC 2472; AR 2574		Canada	*KX784678*	*KX784608*	*KX784751*
	CBS 114755; CPC 1403	*E. tereticornis*	Brazil	*KX784670*	*KX784600*	*KX784743*
	CBS 116108; CPC 726	Soil	Colombia	*KX784647*	*KX784585*	*KX784718*
	CBS 116249; CPC 3533	*Eucalyptus* sp.	Brazil	*KX784679*	*KX784609*	*KX784752*
	CBS 116265; CPC 3552	*Eucalyptus* sp.	Brazil	*KX784680*	*KX784610*	*KX784753*
	CBS 116305; CPC 3890	*Eucalytus* sp.	Brazil	*KX784634*	*KX784576*	*KX784704*
	CBS 116319; CPC 3761	*Eucalytus* sp.	Brazil	*KX784635*	*KX784577*	*KX784705*
Curvicladiella cignea	**CBS 109167**; CPC 1595; MUCL 40269	Leaf litter	French Guiana	KM232002	KM231287	KM231867

[1] AR: Amy Y. Rossman working collection; ATCC: American Type Culture Collection, Virginia, USA; CBS: Centraalbureau voor Schimmelcultures, Utrecht, The Netherlands; CERC: China Eucalypt Research Centre, Zhanjiang, Guangdong Province, China; CMW: culture collection of the Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria, South Africa; CPC: Pedro Crous working collection housed at CBS; IMI: International Mycological Institute, CABI-Bioscience, Egham, Bakeham Lane, UK; LPF: Laboratório de Patologia Florestal, Universidade Federal de Viçosa, Viçosa, Brazil; MUCL: Mycothèque, Laboratoire de Mycologie Systématique st Appliqée, l'Université, Louvian-la-Neuve, Belgium; UFV: Universidade Federal de Viçosa, Viçosa, Brazil. Isolates obtained during the survey indicated in grey blocks.

[2] *tub2* = β-tubulin, *cmdA* = calmodulin, *tef1* = translation elongation factor 1-alpha. Ex-type isolates indicated in **bold**. Sequences generated in this study indicated in *italics*.

characters, of which 507 were constant, 198 parsimony-uninformative and 975 parsimony-informative. The MP analysis yielded 1 000 trees (TL = 6 998; CI = 0.344; RI = 0.867; RC = 0.298) and a single best ML tree with −lnL = −32198.651254 which is presented in Fig. 1. The BI lasted for 10 M generations, and the consensus tree, with posterior probabilities, was calculated from 15 002 trees left after 5 000 trees were discarded as the 'burn-in' phase. In the phylogenetic tree (Fig. 1) the previously unnamed *Calonectria* species resolved in 21 distinct clades that were either well or strongly supported and 17 single lineages, each representing probable novel phylogenetic taxa.

Taxonomy

Based on phylogenetic inference supported by morphological observations, numerous *Calonectria* isolates included in this study represent novel species. No sexual morphs were observed for any of the novel taxa described below, even after 6 wk of incubation at room temperature. Fifteen of the lineages (CBS 111423, CBS 111468, CBS 111706, CBS 112152, CBS 112753, CBS 113496, CBS 113627, CBS 114164, CBS 114691, CBS 114755, CBS 116108, CBS 116249, CBS 116265, CBS 116305, CBS 116319) identified based on phylogenetic inference are not provided with names because they form part of a separate study

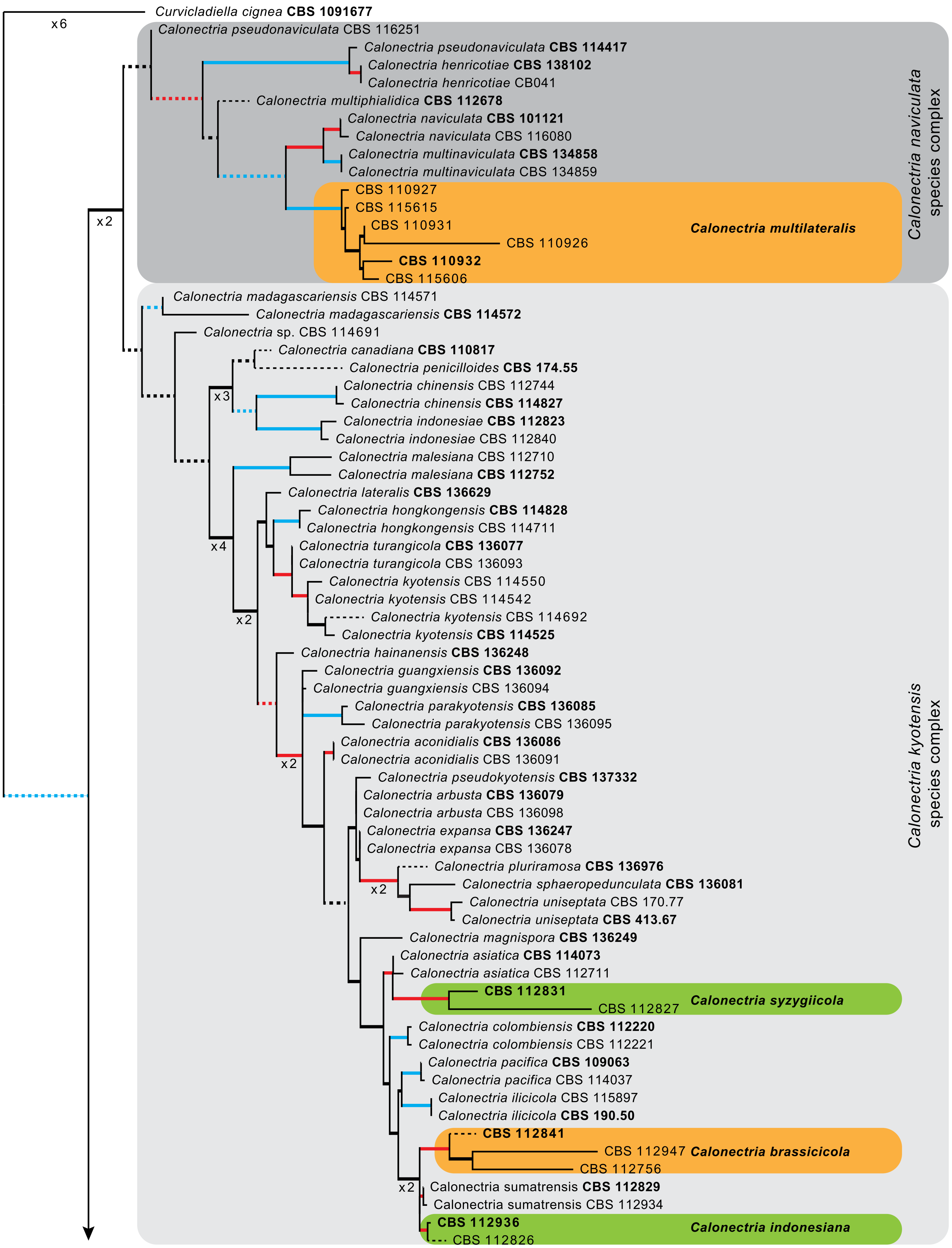

Fig. 1. The ML consensus tree inferred from the combined *cmdA*, *tef1* and *tub2* sequence alignments. Thickened lines indicate branches present in the ML, MP and Bayesian consensus trees. Branches with ML-BS & MP-BS = 100 % and PP = 1.00 are in blue. Branches with ML-BS & MP-BS $\geq$ 75 % and PP $\geq$ 0.95 are in red. Dashed lines indicate branches shortened ×10. The scale bar indicates 0.09 expected changes per site. The tree is rooted to *Curvicladiella cignea* (CBS 109167). Epi- and ex-type strains are indicated in **bold**.

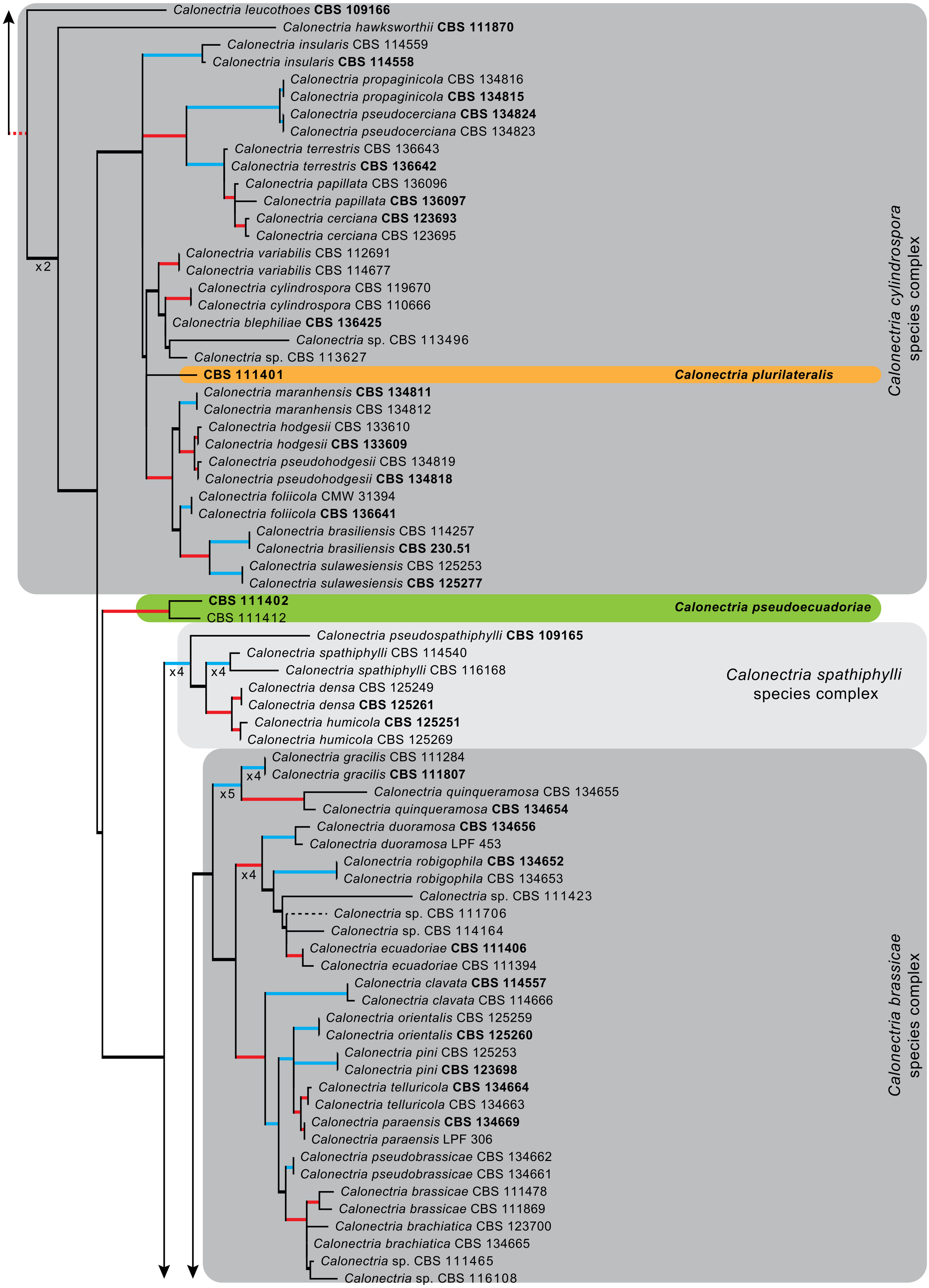

Fig. 1. (Continued).

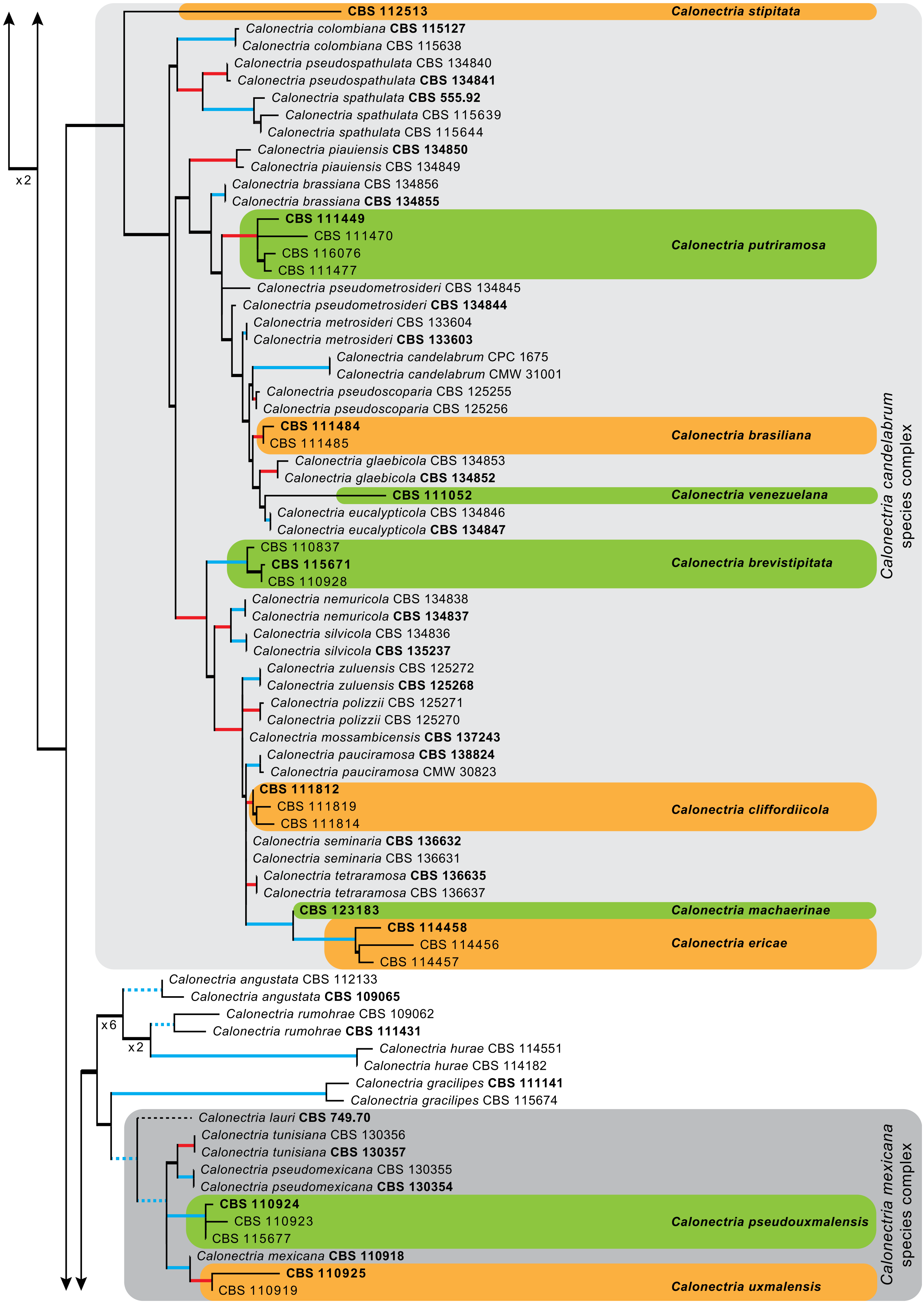

Fig. 1. (Continued).

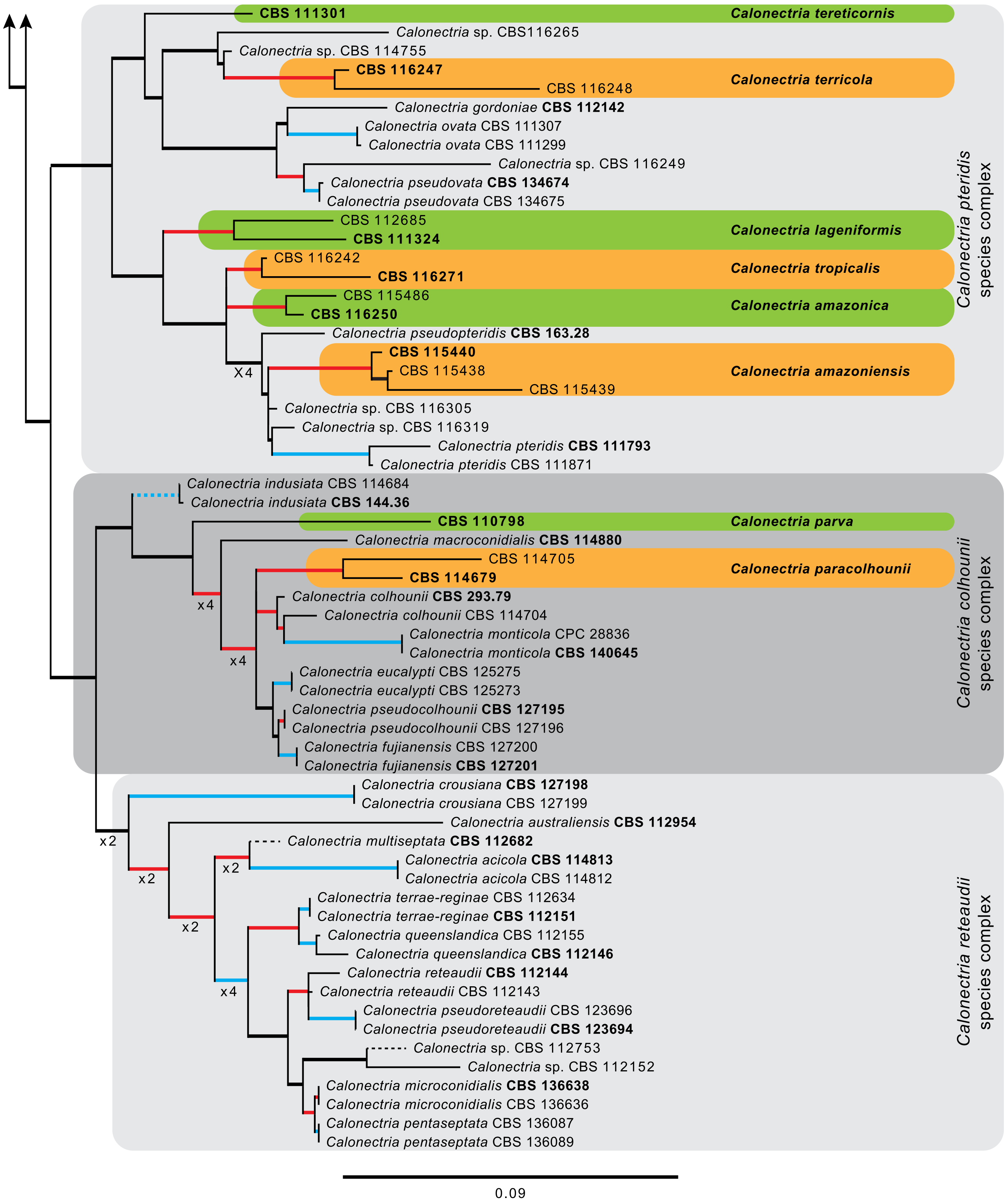

Fig. 1. (Continued).

(Crous *et al. in prep.*) or more taxa are required to resolve their phylogenetic position.

Calonectria amazonica L. Lombard & Crous, **sp. nov.** MycoBank MB818698. Fig. 2.

Etymology: Name refers to the Amazonian region of Brazil where this fungus was collected.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension

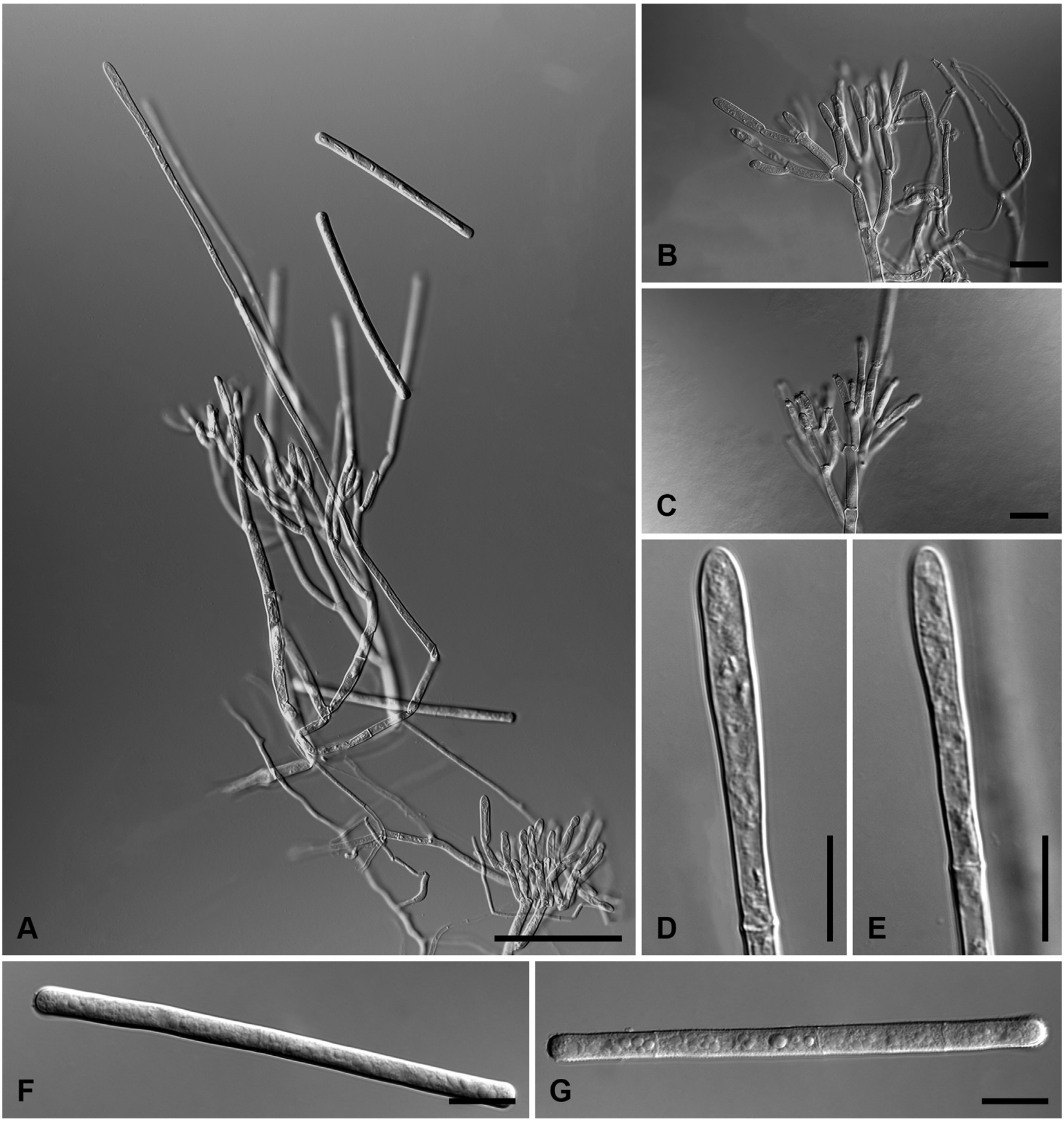

Fig. 2. *Calonectria amazonica* (ex-type CBS 116250). **A.** Macroconidiophore. **B–C.** Conidiogenous apparatus with conidiophore branches and allantoid to elongate doliiform to reniform phialides. **D–E.** Clavate vesicles. **F–G.** Macroconidia. Scale bars: A = 50 µm; B–G = 10 µm.

terminating in a vesicle; stipe septate, hyaline, smooth, 75–190 × 6–8 µm; stipe extension septate, straight to flexuous, 180–270 µm long, 4–5 µm wide at the apical septum, terminating in a clavate vesicle, 5–6 µm diam. *Conidiogenous apparatus* 45–55 µm wide, and 60–80 µm long; primary branches aseptate, 22–32 × 4–6 µm; secondary branches aseptate, 14–24 × 3–5 µm; tertiary branches aseptate, 10–18 × 2–4 µm; quaternary branches aseptate, 10−15 × 3 µm, each terminal branch producing 2–4 phialides; phialides allantoid to elongate doliiform to reniform, hyaline, aseptate, 9–20 × 3–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight to slightly curved, (68–) 74–84(–88) × (4−)4.5−5.5(−6) µm (av. 79 × 5 µm), 1(−3)-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (40−65 mm diam) on MEA after 7 d at room temperature; surface sienna to sepia with moderate white, wooly aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse sienna to sepia with abundant chlamydospores throughout the medium, forming microsclerotia.

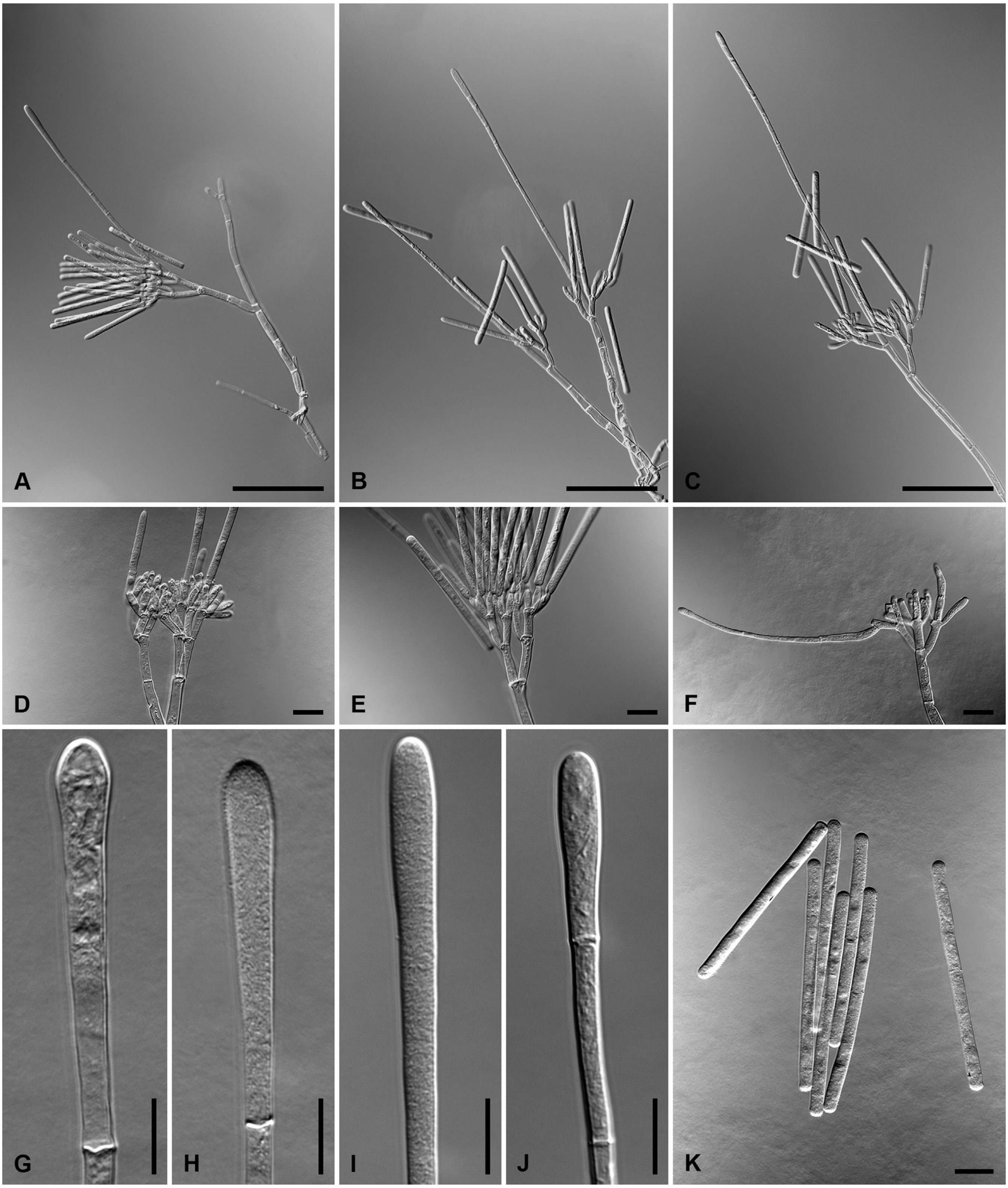

Fig. 3. *Calonectria amazoniensis* (ex-type CBS 115440). **A–C.** Macroconidiophores. **D–E.** Conidiogenous apparatus with conidiophore branches and elongate doliiform to reniform phialides. **F.** Conidiogenous apparatus with lateral stipe extension. **G–J.** Clavate vesicles. **K.** Macroconidia. Scale bars: A–C = 50 μm; D–K = 10 μm.

Specimens examined: **Brazil**, Amazon, from foliar lesion of *Eucalyptus tereticornis*, 1993, P.W. Crous & A.C. Alfenas (**holotype** CBS-H22750, culture ex-type CBS 116250 = CPC 3534); ibid., cultures CBS 115486 = CPC 3894.

Notes: *Calonectria amazonica* resides in the *C. pteridis* complex. The macroconidia of *C. amazonica* [(68–)74–84(–88) × (4–)4.5–5.5(–6) μm (av. 79 × 5 μm)] are slightly smaller than those of *C. pteridis* and *C. pseudopteridis* [(50–)70–100(–130) × (4–)5–6 μm (av. 82 × 5.5 μm); Crous 2002, Alfenas *et al.* 2015], but larger than those of *C. amazoniensis*, *C. lageniformis* and *C. tropicalis* (see below).

Calonectria amazoniensis L. Lombard & Crous, **sp. nov.** MycoBank MB818699. Fig. 3.

Etymology: Name refers to the Amazonian region of Brazil where this fungus was collected.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 45–240 × 6–9 µm; stipe extension septate, straight to flexuous, 140–280 µm long, 4–5 µm wide at the apical septum, terminating in a clavate vesicle, 5–7 µm diam; lateral stipe extensions (90° to main axis) few, 80–95 µm long, 2–4 µm wide at the apical septum, terminating in clavate vesicles, 2–3 µm diam. *Conidiogenous apparatus* 30–110 µm wide, and 30–100 µm long; primary branches aseptate, 15–31 × 4–6 µm; secondary branches aseptate, 10–26 × 3–5 µm; tertiary branches aseptate, 9–31 × 3–5 µm; quaternary branches and additional branches (−5) aseptate, 9–18 × 3–5 µm each terminal branch producing 2–4 phialides; phialides elongate doliiform to reniform, hyaline, aseptate, 7–17 × 3–5 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight to slightly curved, (56–)64–74(–75) × (4–)4.5–5.5(–6) µm (av. 69 × 4 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (40–65 mm diam) on MEA after 7 d at room temperature; surface sienna to amber with moderate white, wooly aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse sienna with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Brazil**, Amazon, from foliar lesion of *Eucalyptus tereticornis*, 1993, P.W. Crous & A.C. Alfenas (**holotype** CBS-H22751 culture ex-type CBS 115440 = CPC 3885); ibid., cultures CBS 115438 = CPC 3890, CBS 115439 = CPC 3889.

Notes: *Calonectria amazoniensis* resides in the *C. pteridis* complex. This species can be distinguished from other species in the *C. pteridis* complex by its greater number (−5) of branches in the conidiogenous apparatus and the presence of lateral stipe extensions (Crous 2002, Alfenas *et al.* 2015).

Calonectria brasiliana L. Lombard & Crous, **sp. nov.** MycoBank MB818700. Fig. 4.

Etymology: Name refers to Brazil, the country where this fungus was collected.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 40–240 × 5–10 µm; stipe extension septate, straight to flexuous, 117–172 µm long, 4–6 µm wide at the apical septum, terminating in an ellipsoid to obpyriform vesicle, 6–9 µm diam. *Conidiogenous apparatus* 45–100 µm wide, and 40–70 µm long; primary branches aseptate, 16–23 × 4–6 µm; secondary branches aseptate, 10–17 × 3–6 µm; tertiary branches aseptate, 7–13 × 3–5 µm; quaternary branches and additional branches (–5) aseptate, 7–14 × 3–4 µm each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 7–12 × 3–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (36–)38–42(–46) × (3–)3.5–4.5(–5) µm (av. 40 × 4 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (30–60 mm diam) on MEA after 7 d at room temperature; surface cinnamon to brick with sparse, felty, white aerial mycelium and abundant sporulation on the aerial mycelium and colony surface; reverse cinnamon to sepia with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Brazil**, from soil, Jun. 1998, A.C. Alfenas (**holotype** CBS-H22752, culture ex-type CBS 111484 = CPC 1924); ibid., culture CBS 111485 = CPC 1929.

Notes: *Calonectria brasiliana* is a new species in the *C. candelabrum* complex (Schoch *et al.* 1999, Lombard *et al.* 2010a,b, 2015a). The macroconidia of *C. brasiliana* [(36–)38–42(–46) × (3–)3.5–4.5(–5) µm (av. 40 × 4 µm)] are smaller than those of its closest phylogenetic neighbours (Fig. 1): *C. candelabrum* [(45–)58–68(–80) × 4–5(–6) µm (av. 60 × 4.5 µm); Crous 2002], *C. eucalypticola* [(43–)49–52(–55) × 3–5 µm (av. 50 × 4 µm); Alfenas *et al.* 2015], *C. glaebicola* [(45–)50–52(–55) × 3–5 µm (av. 50 × 4 µm); Alfenas *et al.* 2015], *C. metrosideri* [(40–)44–46(–51) × 3–5 µm (av. 45 × 4 µm); Alfenas *et al.* 2013a, 2015], *C. pseudometrosideri* [(40–)49–52(–60) × (3–)4.5(–5) µm (av. 51 × 4.5 µm); Alfenas *et al.* 2015] and *C. pseudoscoparia* [(41–)45–51(–52) × 3–5 µm (av. 48 × 4 µm); Lombard *et al.* 2010b].

Calonectria brassicicola L. Lombard & Crous, **sp. nov.** MycoBank MB818701. Fig. 5.

Etymology: Name refers to the host plant, *Brassica*, from which this fungus was isolated.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicles; stipe septate, hyaline, smooth, 30–90 × 6–9 µm; stipe extension septate, straight to flexuous, 90–140 µm long, 4–5 µm wide at the apical septum, terminating in a sphaeropedunculate vesicle, 6–10 µm diam; lateral stipe extensions (90° to main axis) sparse, 30–50 µm long, 2–4 µm wide at the apical septum, terminating in sphaeropedunculate vesicles, 3–5 µm. *Conidiogenous apparatus* 45–80 µm wide, and 35–50 µm long; primary branches aseptate, 12–20 × 4–6 µm; secondary branches aseptate, 8–13 × 3–5 µm; tertiary branches aseptate, 8–12 × 3–6 µm; quaternary branches aseptate, 8–11 × 2–5 µm, each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 7–15 × 3–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (36–)39–45(–48) × (4–)4.5–5.5(–6) µm (av. 42 × 5 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (50–65 mm diam) on MEA after 7 d at room temperature; surface buff with abundant white to buff, wooly aerial mycelium, and moderate sporulation on the colony surface; reverse sienna, chlamydospores not observed.

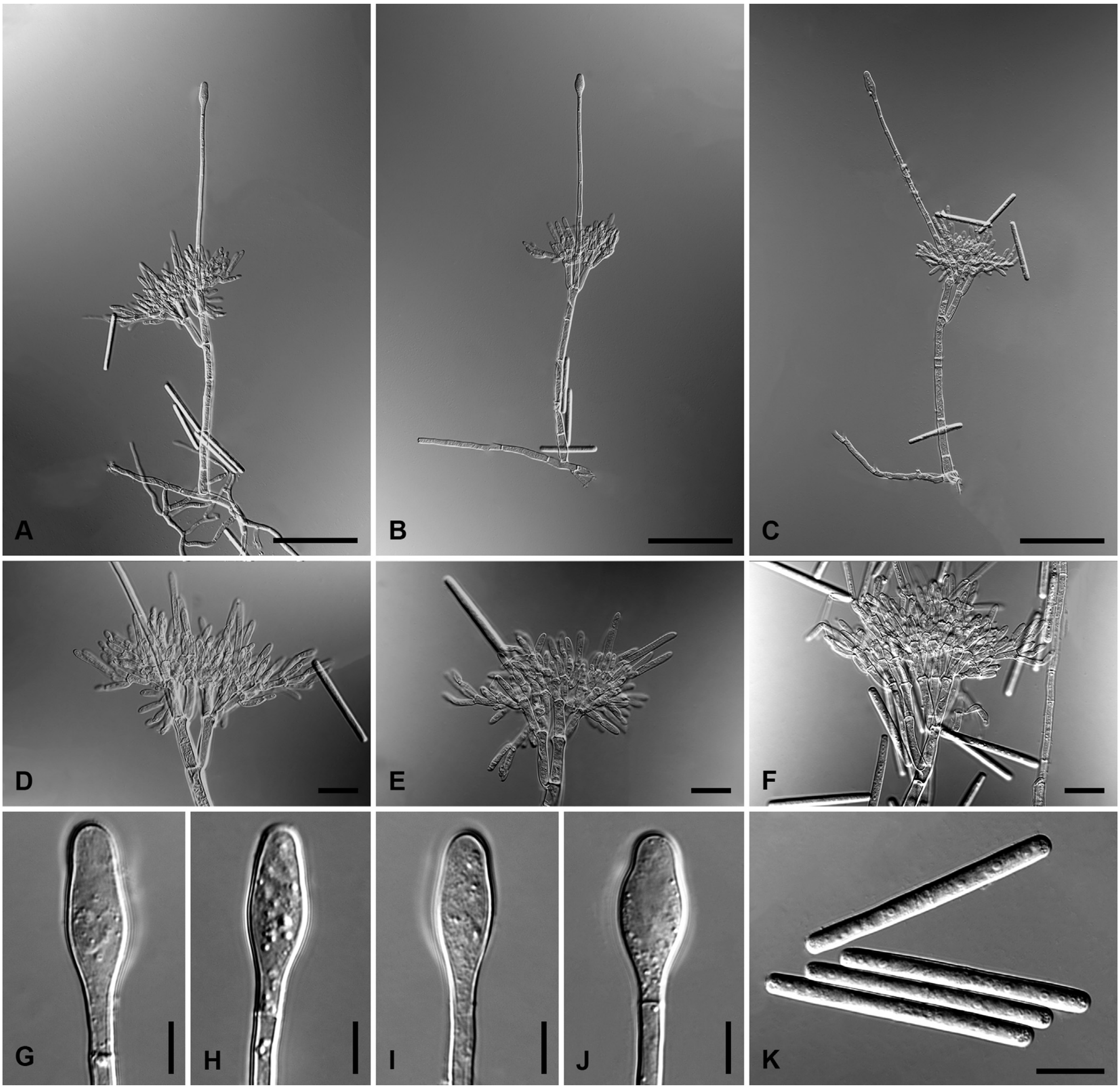

Fig. 4. *Calonectria brasiliana* (ex-type CBS 111484). **A–C.** Macroconidiophores. **D–F.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **G–J.** Ellipsoid to obpyrifom vesicles. **K.** Macroconidia. Scale bars: A–C = 50 μm; D–K = 10 μm.

Specimens examined: **Indonesia**, from soil at *Brassica* sp., 1990s, M.J. Wingfield (**holotype** CBS-H22753, culture ex-type CBS 112841 = CPC 4552); ibid., culture CBS 112756 = CPC 4502. **New Zealand**, substrate unknown, 2001, C.F. Hill, Lynfield 484, culture CBS 112947 = CPC 4668.

Notes: *Calonectria brassicicola* is similar to *C. sumatrensis* in having few lateral stipe extensions (Crous *et al.* 2004b). The macroconidia of *C. brassicicola* [(36–)39–45(–48) × (4–)4.5–5.5(–6) μm (av. 42 × 5 μm)] are smaller than those of *C. sumatrensis* [(45–)55–65(–70) × (4.5–)5(–6) μm (av. 58 × 5 μm); Crous *et al.* 2004b].

Calonectria brevistipitata L. Lombard & Crous, **sp. nov.** MycoBank MB818702. Fig. 6.

Etymology: Name refers to the short stipe extensions of the macroconidiophores in this fungus.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 50–210 × 5–12 μm; stipe extension septate, straight to flexuous, 90–135 μm long, 2–5 μm wide at the apical septum, terminating in an fusiform to obpyriform vesicle, 5–8 μm diam; lateral stipe extensions (90° to main axis) abundant, 60–80 μm long, 2–3 μm wide at the apical septum, terminating in broadly clavate vesicles, 2–3 μm diam. *Conidiogenous apparatus* 45–75 μm wide, and 45–70 μm long; primary branches aseptate, 13–25 × 4–6 μm; secondary branches aseptate, 10–19 × 3–5 μm; tertiary branches aseptate, 8–16 × 3–5 μm; quaternary branches aseptate, 7–11 × 3–4 μm each terminal branch producing 2–6 phialides; phialides elongate doliiform to reniform, hyaline, aseptate, 6–11 × 2–4 μm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia*

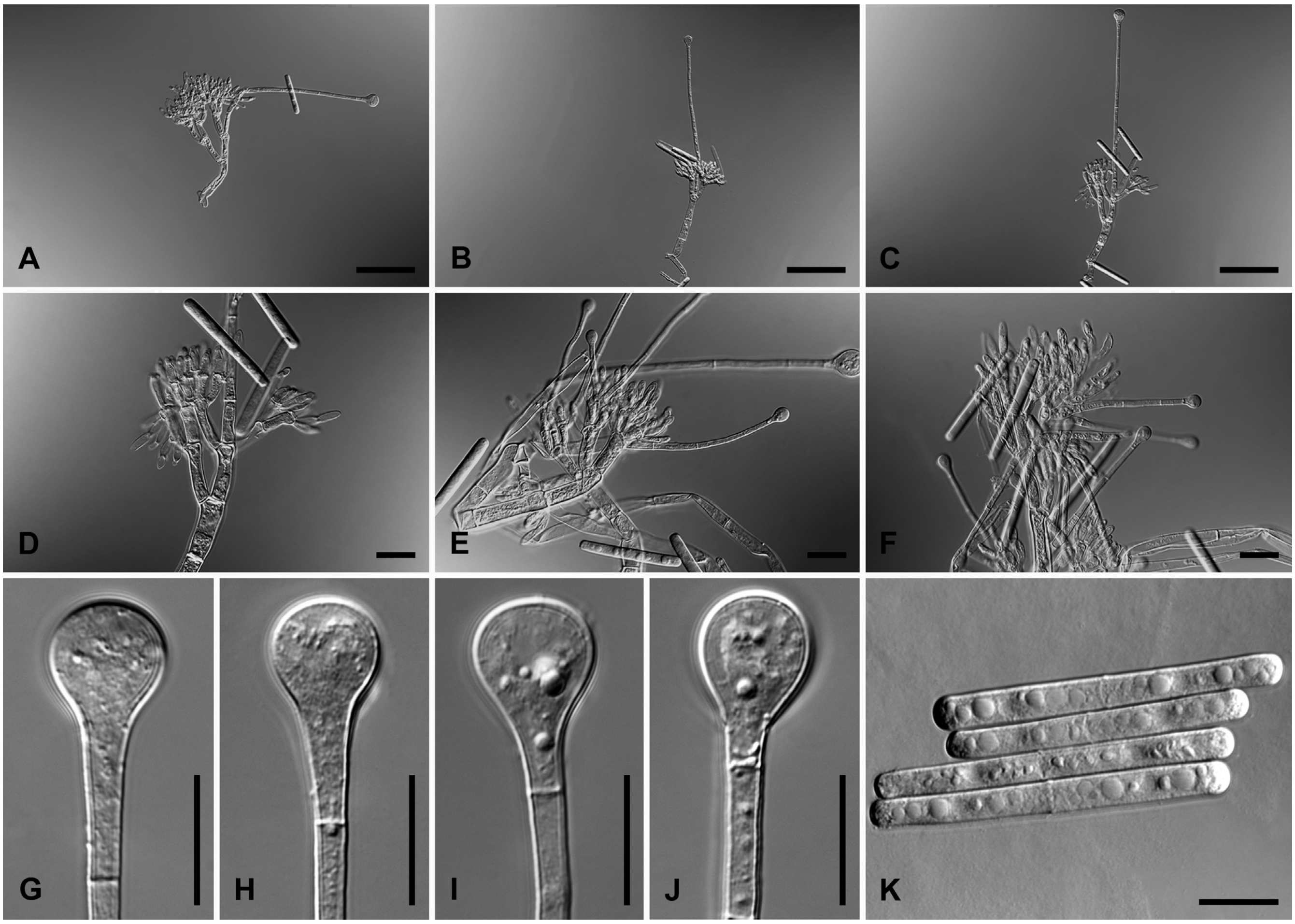

Fig. 5. *Calonectria brassicicola* (ex-type CBS 112841). **A–C.** Macroconidiophores. **D–F.** Conidiogenous apparatus with lateral stipe extensions and doliiform to reniform phialides. **G–J.** Sphaeropedunculate vesicles. **K.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

Fig. 6. *Calonectria brevistipitata* (ex-type CBS 115671). **A–C.** Macroconidiophores. **D–E.** Conidiogenous apparatus with conidiophore branches and elongate doliiform to reniform phialides. **F.** Conidiogenous apparatus with lateral stipe extension. **G–J.** Fusiform to ellipsoid vesicles. **K.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

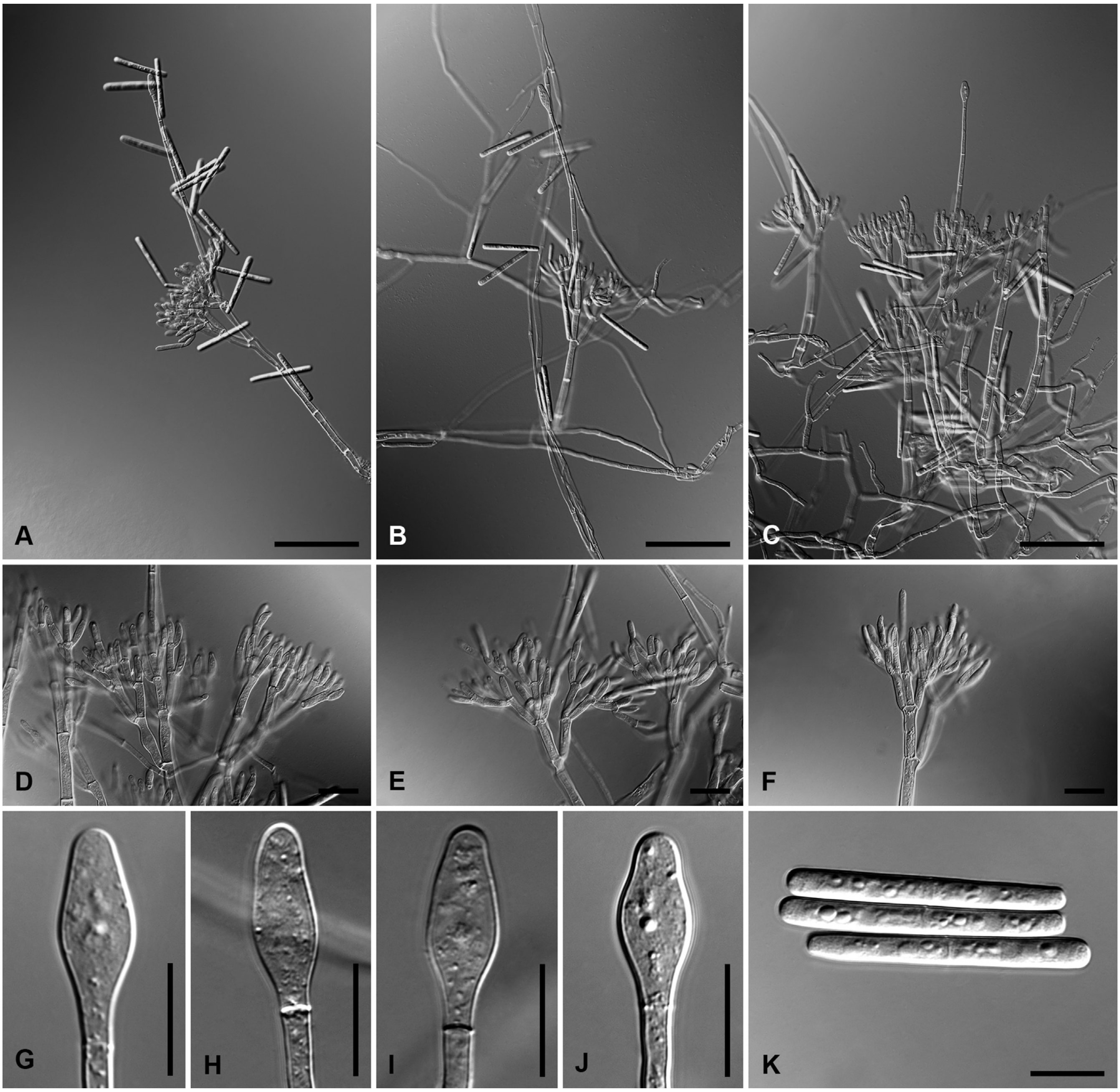

Fig. 7. *Calonectria cliffordiicola* (ex-type CBS 111812). **A–C.** Macroconidiophores. **D–F.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **G–J.** Ellipsoid to obpyrifom vesicles. **K.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

cylindrical, rounded at both ends, straight, 29–33(–35) × 3–4 µm (av. 31 × 3.5 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (40–70 mm diam) on MEA after 7 d at room temperature; surface cinnamon to brick to sienna with abundant, wooly, white to buff aerial mycelium and abundant sporulation on the aerial mycelium and colony surface; reverse cinnamon to sepia with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Mexico**, from soil, Apr. 1994, P.W. Crous (**holotype** CBS-H22754, culture ex-type CBS 115671 = CPC 949); ibid., cultures CBS 110837 = CPC 913, CBS 110928 = CPC 951.

Notes: *Calonectria brevistipitata* is a new species in the *C. candelabrum* complex. The lateral stipe extensions (up to 80 µm long) and macroconidia [29–33(–35) × 3–4 µm (av. 31 × 3.5 µm) of *C. brevistipitata* are shorter than the lateral stipe extensions (up to 125 µm long) and macroconidia [(35–)36–40(–43) × (3–)3.5–4.5(–5) µm (av. 38 × 4 µm)] of *C. machaerinae*, the only other species in the *C. candelabrum* complex to produce lateral stipe extensions.

Calonectria cliffordiicola L. Lombard & Crous, **sp. nov.** MycoBank MB818703. Fig. 7.

Etymology: Name refers to plant host plant genus, *Cliffordia*, from which this fungus was isolated.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 65–130 × 7–10 µm; stipe extension septate, straight to flexuous, 127–180 µm long, 4–6 µm wide at the apical septum, terminating in an ellipsoid to

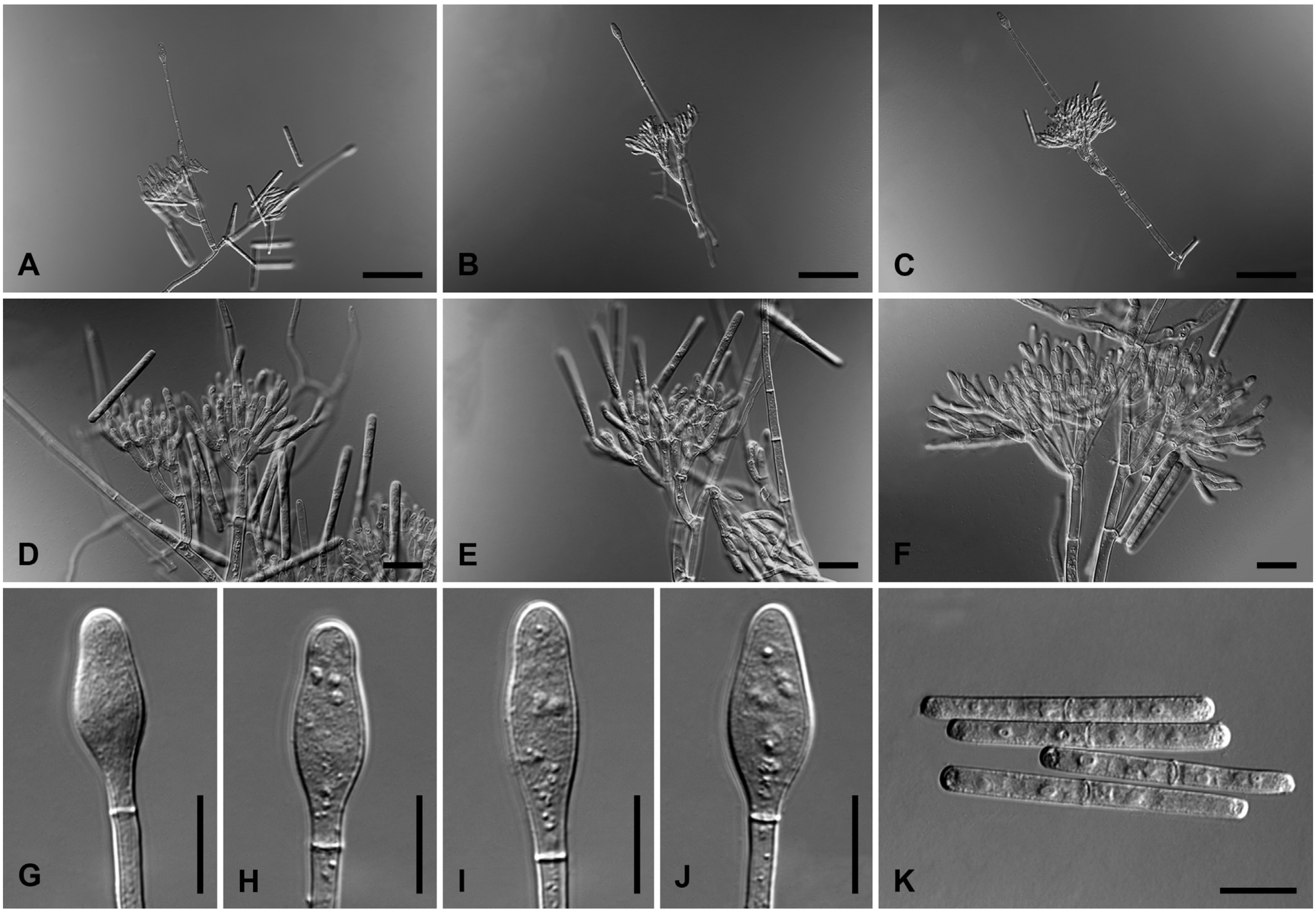

Fig. 8. *Calonectria ericae* (ex-type CBS 114458). **A–C.** Macroconidiophores. **D–F.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **G–J.** Ellipsoid to obpyriform vesicles. **K.** Macroconidia. Scale bars: A–C = 50 μm; D–K = 10 μm.

obpyriform vesicle, 7–9 μm diam. *Conidiogenous apparatus* 57–100 μm wide, and 40–85 μm long; primary branches aseptate, 15–32 × 4–6 μm; secondary branches aseptate, 11–23 × 3–6 μm; tertiary branches aseptate, 7–13 × 3–5 μm; quaternary branches aseptate, 8–13 × 3–4 μm each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 7–11 × 3–4 μm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (35–)38–42(–44) × (3–)3.5–4.5(–6) μm (av. 40 × 4 μm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (35–65 mm diam) on MEA after 7 d at room temperature; surface cinnamon to brick with sparse, felty, white to buff aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse cinnamon to sepia with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **South Africa**, Western Cape Province, George, from *Cliffordia feruginea*, 14 Apr. 1998, P.W. Crous (**holotype** CBS-H22755, culture ex-type CBS 111812 = CPC 2631); Stellenbosch, from *Prunus avium* saplings, 1 May 1999, C. Linde, cultures CBS 111814 = CPC 2617, CBS 111819 = CPC 2604.

Notes: *Calonectria cliffordiicola* is a new species in the *C. candelabrum* complex (Schoch *et al.* 1999, Lombard *et al.* 2010a,b, 2015a). Morphologically, this species shows some overlap with *C. brasiliana*, but can be distinguished by its shorter stipe extensions (up to 180 μm) compared to *C. brasiliana* (up to 240 μm).

Calonectria ericae L. Lombard & Crous, **sp. nov.** MycoBank MB818704. Fig. 8.

Etymology: Name refers to host plant genus, *Erica*, from which this species was isolated.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 40–100 × 6–9 μm; stipe extension septate, straight to flexuous, 105–160 μm long, 3–7 μm wide at the apical septum, terminating in an ellipsoid to obpyriform vesicle, 6–10 μm diam. *Conidiogenous apparatus* 40–75 μm wide, and 35–70 μm long; primary branches aseptate, 15–23 × 3–5 μm; secondary branches aseptate, 10–19 × 2–6 μm; tertiary branches aseptate, 6–16 × 2–5 μm; quaternary branches aseptate, 6–13 × 2–5 μm each terminal branch producing 2–6 phialides; phialides elongate doliiform to reniform, hyaline, aseptate, 6–11 × 2–4 μm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (29–)34–40(–42) × (3–)3.5–4.5(–5) μm (av. 37 × 4 μm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (40–65 mm diam) on MEA after 7 days at room temperature;

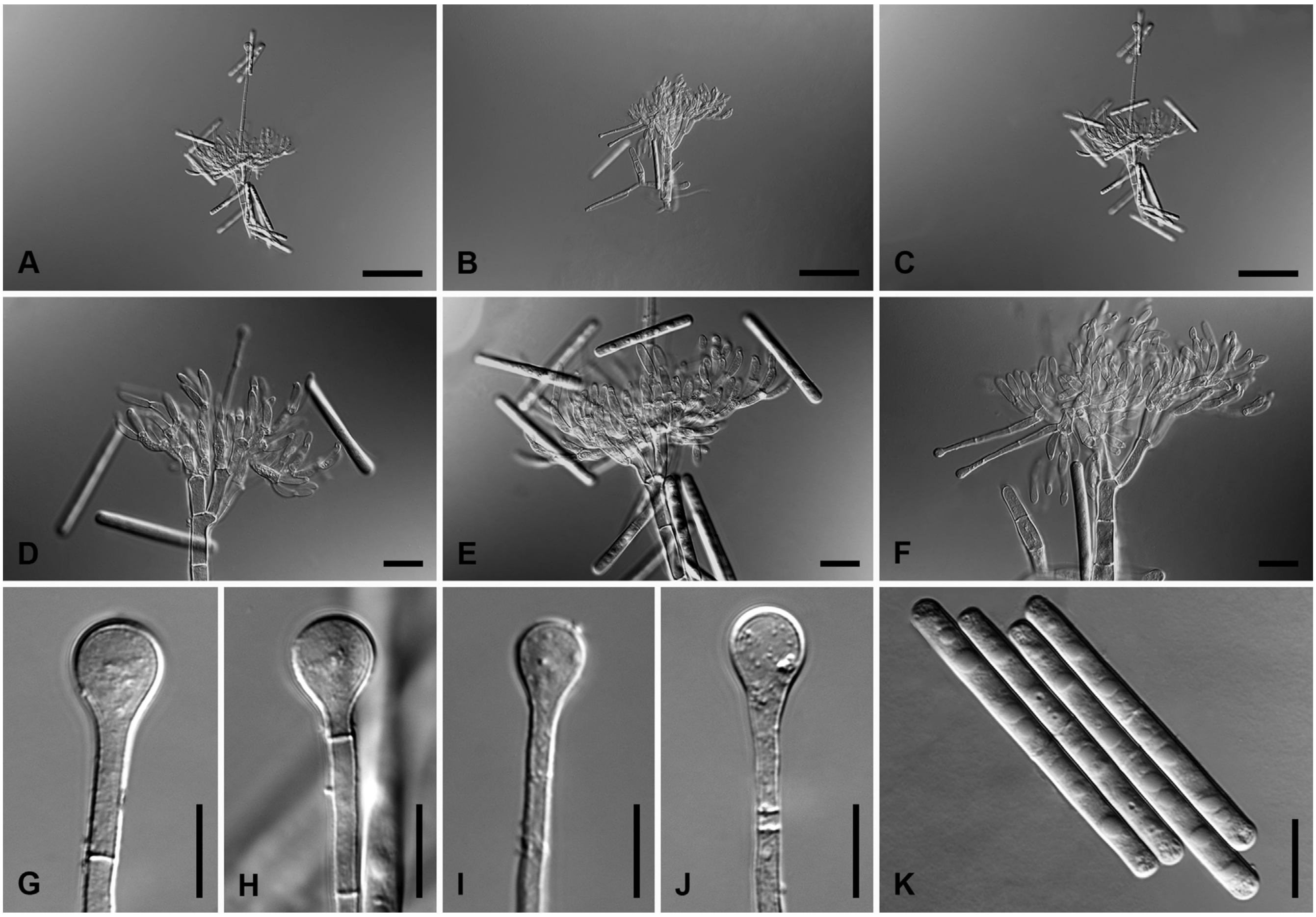

Fig. 9. *Calonectria indonesiana* (ex-type CBS 112936). **A–C.** Macroconidiophores. **D–E.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **F.** Conidiogenous apparatus with lateral stipe extension. **G–J.** Sphaeropedunculate vesicles. **K.** Macroconidia. Scale bars: A–C = 50 μm; D–K = 10 μm.

surface cinnamon to brick with sparse, felty, white aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse cinnamon to umber with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **USA**, California, from *Erica capensis*, Sep. 1998, S.T. Koike (**holotype** CBS-H22756, culture ex-type CBS 114458 = CPC 2019); ibid., cultures CBS 114456 = CPC 1984, CBS 114457 = CPC 1985.

Notes: *Calonectria ericae* is a new species in the *C. candelabrum* complex. This species produces the smallest macroconidia in the *C. candelabrum* complex. Kioke *et al.* (1999) initially identified these isolates as *C. pauciramosa* based on morphology and mating studies using the *C. pauciramosa* mating tester strains (Schoch *et al.* 1999, Lombard *et al.* 2010a).

Calonectria indonesiana L. Lombard & Crous, **sp. nov.** MycoBank MB818705. Fig. 9.

Etymology: Name refers to Indonesia, the country where this fungus was collected.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicles; stipe septate, hyaline, smooth, 35–115 × 6–9 μm; stipe extension septate, straight to flexuous, 110–130 μm long, 3–5 μm wide at the apical septum, terminating in a sphaeropedunculate vesicle, 8–10 μm diam; lateral stipe extensions (90° to main axis) sparse, 30–50 μm long, 3–4 μm wide at the apical septum, terminating in sphaeropedunculate vesicles, 4–5 μm. *Conidiogenous apparatus* 40–100 μm wide, and 40–70 μm long; primary branches aseptate, 11–20 × 4–6 μm; secondary branches aseptate, 8–17 × 4–7 μm; tertiary branches aseptate, 9–14 × 3–6 μm; quaternary branches and additional branches (−6) aseptate, 7–12 × 3–5 μm, each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 7–14 × 3–5 μm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (38–)40–46(–48) × (3–)4.5–5.5(–6) μm (av. 43 × 5 μm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (50–65 mm diam) on MEA after 7 d at room temperature; surface buff with abundant white to buff, wooly aerial mycelium, and moderate sporulation on the colony surface; reverse sienna, chlamydospores not observed.

Specimens examined: **Indonesia**, north Sumatera, from soil, 1998, M.J. Wingfield (**holotype** CBS-H22757, culture ex-type CBS 112936 = CPC 4504); ibid., culture CBS 112826 = CPC 4519.

Notes: *Calonectria indonesiana* is similar to *C. brassicicola* and *C. sumatrensis* in having few lateral stipe extensions (Crous *et al.* 2004b). *Calonectria indonesiana* (−6) can be distinguished from

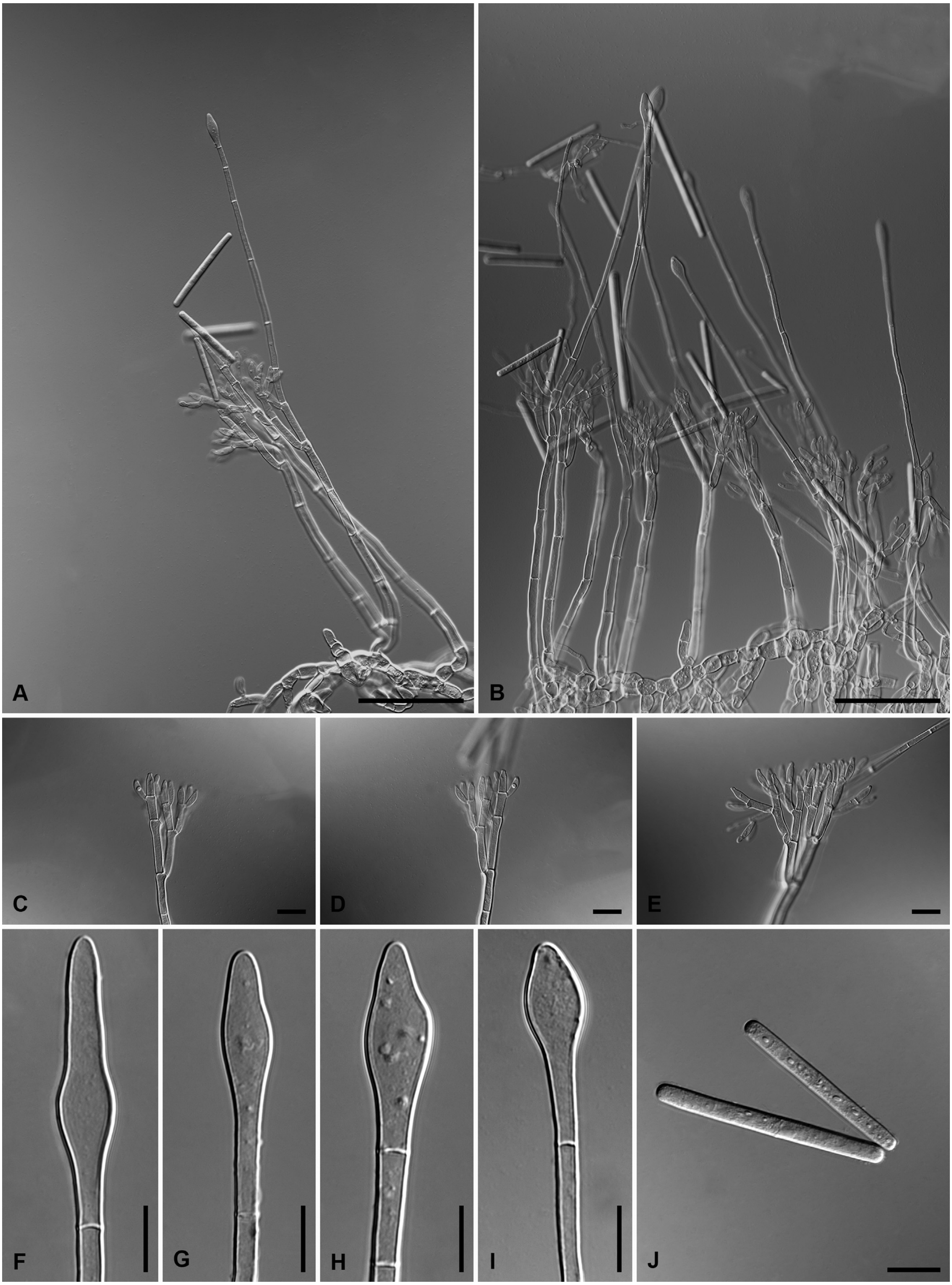

Fig. 10. *Calonectria lageniformis* (ex-type CBS 111324). **A–B.** Macroconidiophores. **C–E.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **F–I.** Lageniformis to ellipsoid vesicles. **J.** Macroconidia. Scale bars: A–B = 50 µm; C–J = 10 µm.

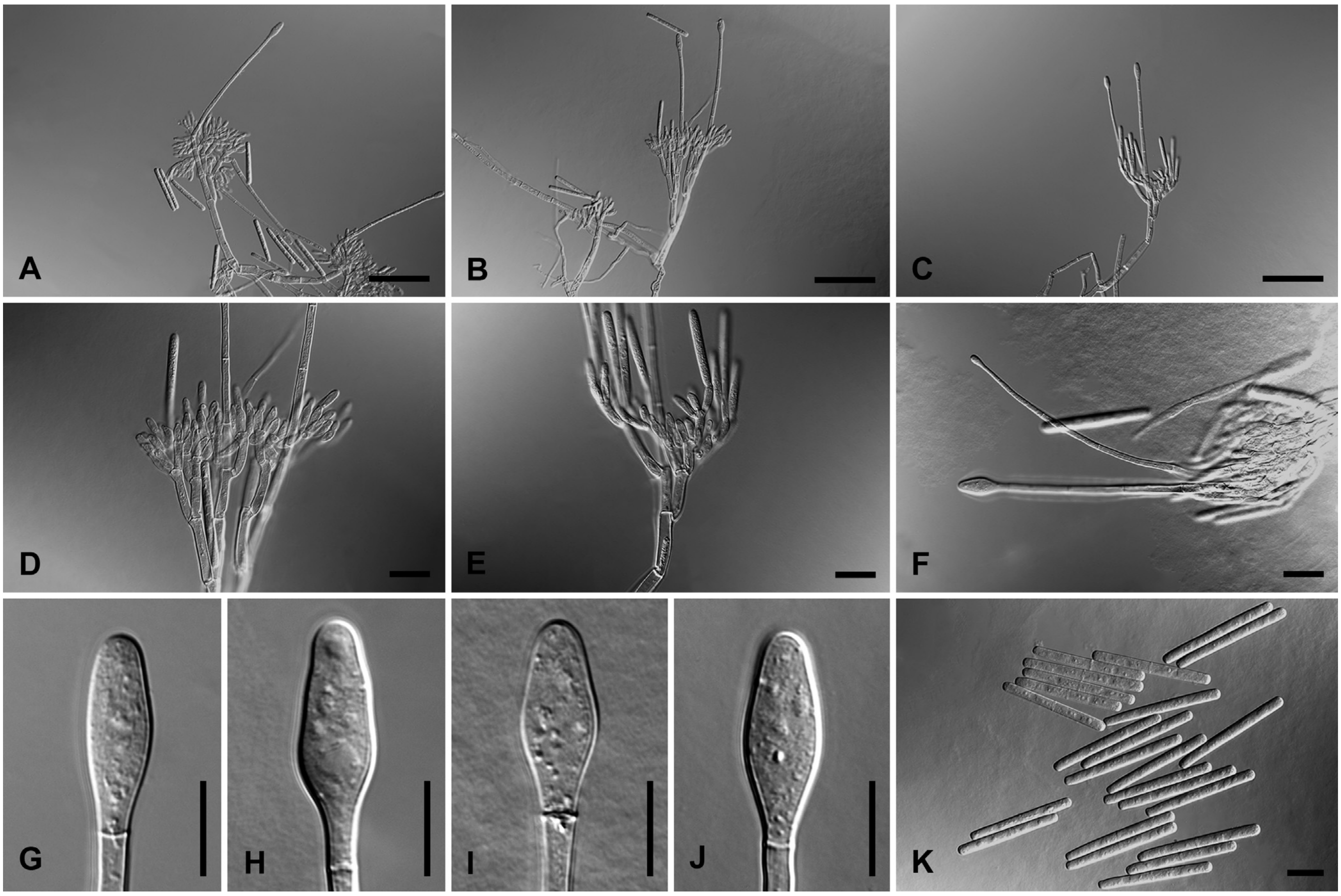

Fig. 11. *Calonectria machaerinae* (ex-type CBS 123183). **A–C.** Macroconidiophores. **D–E.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **F.** Conidiogenous apparatus with lateral stipe extension. **G–J.** Ellipsoid to obpyriform vesicles. **K.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

C. brassicicola (−4) and *C. sumatrensis* (−3) by the number of branches of the conidiogenous apparatus (Crous *et al.* 2004b).

Calonectria lageniformis L. Lombard & Crous, **sp. nov.** MycoBank MB818706. Fig. 10.

Etymology: Name refers to the characteristic lageniform vesicles in this fungus.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 65–220 × 4–9 µm; stipe extension septate, straight to flexuous, 135–185 µm long, 4–6 µm wide at the apical septum, terminating in a lageniform to ellipsoid vesicle, 6–10 µm diam. *Conidiogenous apparatus* 20–80 µm wide, and 35–60 µm long; primary branches aseptate, 16–28 × 4–6 µm; secondary branches aseptate, 10–18 × 3–6 µm; tertiary branches aseptate, 8–13 × 3–6 µm, each terminal branch producing 2–4 phialides; phialides doliiform to reniform, hyaline, aseptate, 7–11 × 3–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (35–)37–43(–45) × (3–)4.5–5.5(–6) µm (av. 40 × 5 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies fast growing (60–90 mm diam) on MEA after 7 d at room temperature; surface sepia with sparse buff, felty aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse sepia with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Brazil**, from leaf lesion on *Eucalyptus* sp., 1993, P.W. Crous & A.C. Alfenas, culture CBS 112685 = CPC 3418. **Mauritius**, Rivière Noire, from foliar lesion on *Eucalyptus* sp., 10 Apr. 1996, H. Smith (**holotype** CBS-H22758 culture ex-type CBS 111324 = CPC 1473).

Note: *Calonectria lageniformis* is the only species that has lageniform vesicles (Crous 2002, Lombard *et al.* 2010b, 2015a, Alfenas *et al.* 2015).

Calonectria machaerinae L. Lombard & Crous, **sp. nov.** MycoBank MB818707. Fig. 11.

Etymology: Name refers to plant host genus, *Machaerina*, from which this species was isolated.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 40–115 × 5–10 µm; stipe extension septate, straight to flexuous, 105–170 µm long, 3–5 µm wide at the apical septum, terminating in an ellipsoid to obpyriform vesicle, 6–9 µm diam; lateral stipe extensions (90° to main axis) few, 80–125 µm long, 3–5 µm wide at the apical septum, terminating in broadly clavate vesicles, 5–6 µm diam. *Conidiogenous apparatus* 40–80 µm wide, and 55–90 µm long; primary branches aseptate, 18–28 × 4–6 µm; secondary branches aseptate, 13–23 × 3–6 µm; tertiary branches aseptate, 8–19 × 3–5 µm; quaternary branches and additional branches

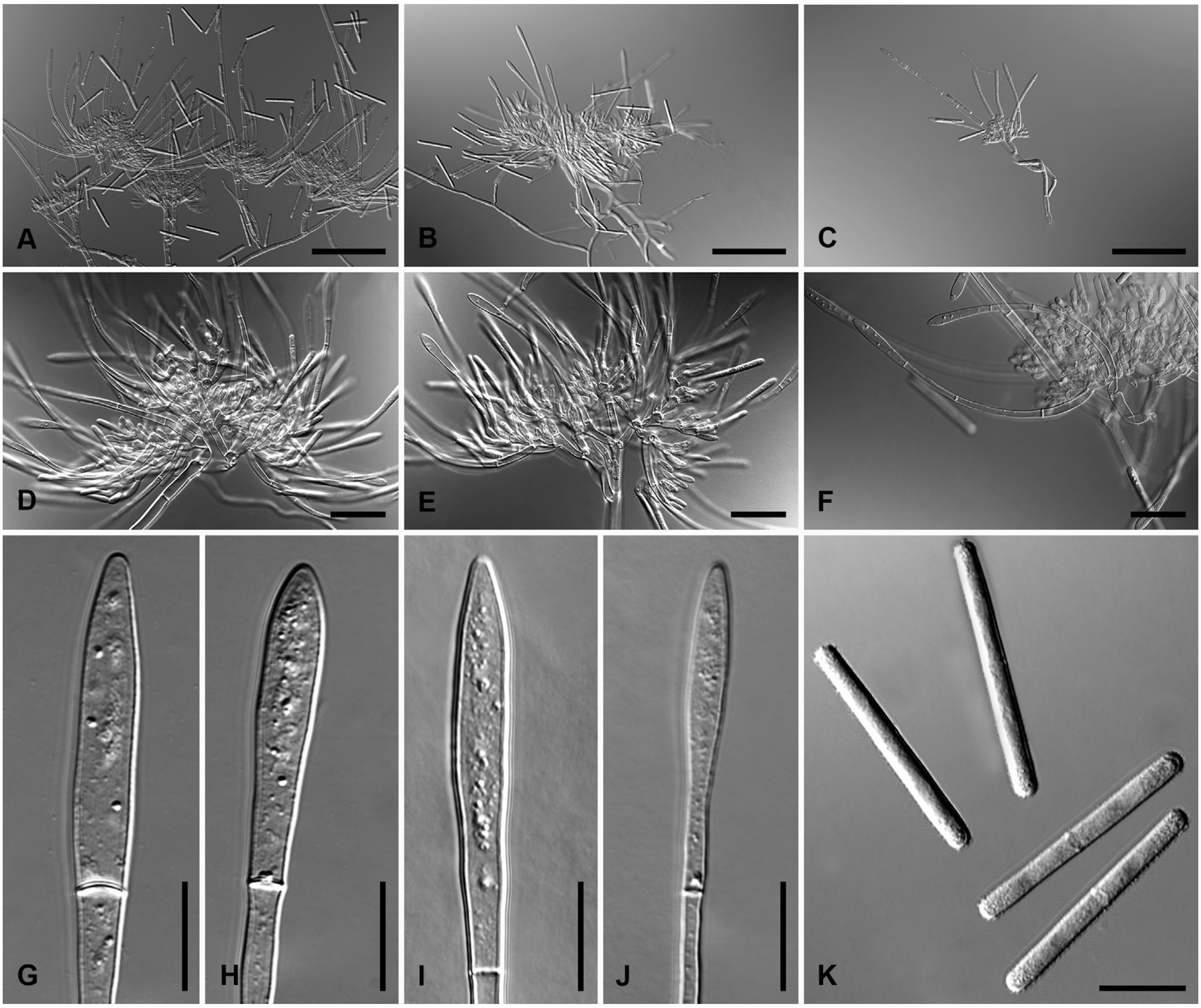

Fig. 12. *Calonectria multilateralis* (ex-type CBS 110932). **A–C.** Macroconidiophores. **D–E.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform to elongate reniform phialides. **F.** Conidiogenous apparatus with lateral stipe extension. **G–J.** Naviculate vesicles. **K.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

(−6) aseptate, 7−15 × 3−5 µm each terminal branch producing 2−6 phialides; phialides doliiform to reniform, hyaline, aseptate, 6−11 × 2−4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (35−)36−40(−43) × (3−)3.5−4.5(−5) µm (av. 38 × 4 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies fast growing (60−85 mm diam) on MEA after 7 d at room temperature; surface cinnamon to brick with sparse, wooly, white aerial mycelium and abundant sporulation on the aerial mycelium and colony surface; reverse cinnamon to umber with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimen examined: **New Zealand**, Auckland, Auckland University Campus, from foliar lesion of *Machaerina sinclairii*, 27 Jan. 2008, C.F. Hill (**holotype** CBS-H22760, culture ex-type CBS 123183 = CPC 15378).

Notes: *Calonectria machaerinae* is a new species in the *C. candelabrum* complex. This species, along with *C. brevistipitata*, are the only two species to produce lateral stipe extensions in the *C. candelabrum* complex (Schoch *et al.* 1999, Lombard *et al.* 2010a,b, 2015a). See note under *C. brevistipitata* for additional distinguishing characters.

Calonectria multilateralis L. Lombard & Crous, **sp. nov.** MycoBank MB818708. Fig. 12.

Etymology: Name refers to the multiple lateral stipe extensions on the macroconidiophores of this species.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicles; stipe septate, hyaline, smooth, 25−130 × 4−8 µm; stipe extension septate, straight to flexuous, 135−375 µm long, 5−6 µm wide at the apical septum, terminating in a naviculate vesicle, 6−11 µm diam; lateral stipe extensions (90° to main axis) numerous, 55−100 µm long, 3−5 µm wide at the apical septum, terminating in naviculate vesicles, 4−8 µm. *Conidiogenous apparatus* 45−95 µm wide, and 30−70 µm long; primary branches aseptate, 10−25 × 3−6 µm; secondary branches aseptate, 6−20 × 3−5 µm; tertiary branches aseptate, 7−15 × 3−5 µm; quaternary branches and additional branches (−7) aseptate, 6−13 × 2−4 µm, each terminal branch

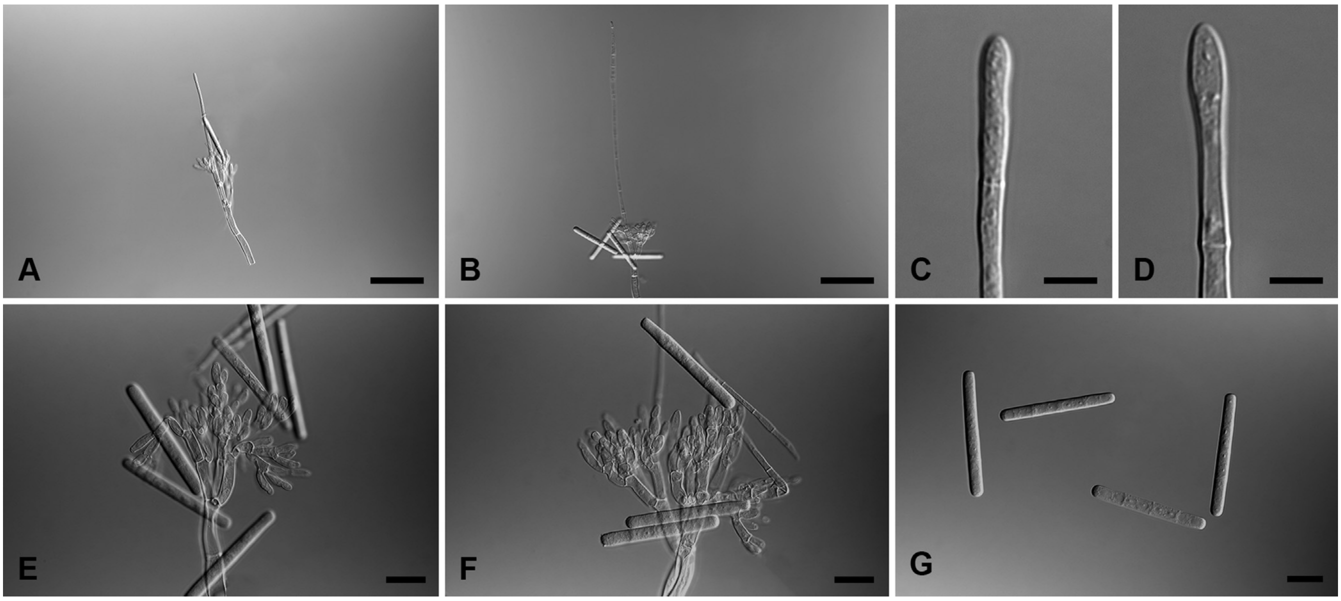

Fig. 13. *Calonectria paracolhounii* (ex-type CBS 114679). **A–B.** Macroconidiophores. **C–D.** Clavate vesicles. **E–F.** Conidiogenous apparatus with conidiophore branches and elongate doliiform to doliiform to reniform phialides. **G.** Macroconidia. Scale bars: A–B = 50 µm; C–G = 10 µm.

producing 2–6 phialides; phialides doliiform to reniform to elongate reniform, hyaline, aseptate, 6–12 × 2–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (27–) 31–35(–38) × 3–4 µm (av. 33 × 3 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies fast growing (55–85 mm diam) on MEA after 7 d at room temperature; surface buff with abundant white, wooly aerial mycelium and abundant sporulation on the colony surface; reverse buff to sienna, chlamydospores not observed.

Specimens examined: **Mexico**, Uxmal, from soil, Apr. 1994, P.W. Crous (**holotype** CBS-H22762, culture ex-type CBS 110932 = CPC 957); ibid., cultures CBS 110926 = CPC 947, CBS 110927 = CPC 948, CBS 110931 = CPC 956, CBS 115615 = CPC 915.

Notes: *Calonectria multilateralis* is a new species in the *C. naviculata* complex (Alfenas *et al.* 2015). The macroconidia of *C. multilateralis* [31–35(–38) × 3–4 µm (av. 33 × 3 µm)] are smaller than those of *C. naviculata* [(40–)42–50 × 3(–4) µm (av. 45 × 3 µm); Crous 2002] and *C. multinaviculata* [(40–) 44–49(–52) × (2.5–)3.5(–4) µm (av. 46 × 3.5 µm); Alfenas *et al.* 2015].

Calonectria paracolhounii L. Lombard & Crous, **sp. nov.** MycoBank MB818709. Fig. 13.

Etymology: Name refers to the fact that this species has an asexual morph that is very similar to that of *C. colhounii*.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 21–75 × 5–9 µm; stipe extension septate, straight to flexuous, 82–178 µm long, 3–5 µm wide at the apical septum, terminating in a narrowly clavate vesicle, 3–5 µm diam. *Conidiogenous apparatus* 31–77 µm wide, and 25–54 µm long; primary branches aseptate, 11–23 × 3–6 µm; secondary branches aseptate, 7–13 × 3–6 µm; tertiary branches aseptate, 7–12 × 2–4 µm, each terminal branch producing 2–6 phialides; phialides elongate doliiform to doliiform to reniform, hyaline, aseptate, 6–12 × 2–5 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (37–) 39–43(–45) × 4–5 µm (av. 41 × 5 µm), 3-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (25–55 mm diam) on MEA after 7 d at room temperature; surface buff to sienna with abundant buff to white, felty to wooly aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse buff to sienna to umber with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **USA**, substrate unknown, 1990s, A.Y. Rossman (**holotype** CBS-H22763 culture ex-type CBS 114679 = CPC 2445). **Australia**, fruit of *Annona reticulata*, 1988, D. Hutton, culture CBS 114705 = CPC 2423.

Notes: *Calonectria paracolhounii* is a new species in the *C. colhounii* complex (Lombard *et al.* 2010b, Chen *et al.* 2011). The macroconidia of *C. paracolhounii* [(37–)39–43(–45) × 4–5 µm (av. 41 × 5 µm)] are smaller than those of *C. colhounii* [(45–) 60–70(–80) × (4–)5(–6) µm (av. 65 × 5 µm); Crous 2002], *C. eucalypti* [(66–)69–75(–80) × (5–)–6 µm (av. 72 × 6 µm); Lombard *et al.* 2010b], *C. fujianensis* [(48–)50–55(–60) × (2.5–) 3.5–4.5(–5) µm (av. 52.5 × 4 µm); Chen *et al.* 2011], *C. monticola* 46–51(–56) × 4–5 µm (av. 49 × 5 µm); Crous *et al.* 2015b] and *C. pseudocolhounii* [(49–)55–65(–74) × (3.5–)4–5(–5.5) µm (av. 60 × 4.5 µm); Chen *et al.* 2011]. Hutton & Sanewski (1989) initially identified isolate CBS 114705 as *C. colhounii,* associated with leaf and fruit spots of custard apple (*Annona reticulata*). Their identification was based on morphological comparisons, as no DNA sequence data was available for the genus *Calonectria* at that time.

Calonectria parva L. Lombard & Crous, **sp. nov.** MycoBank MB818710. Fig. 14.

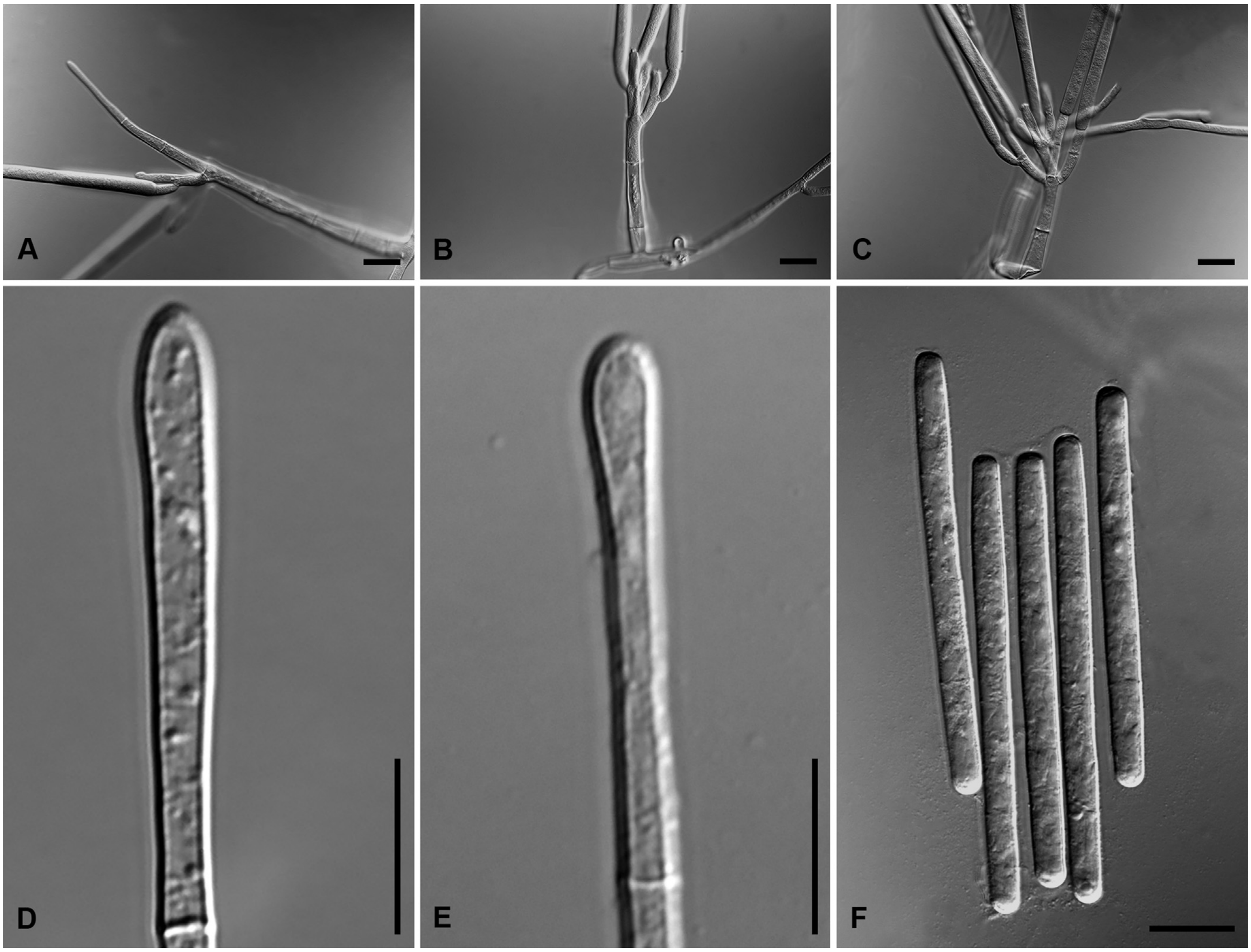

Fig. 14. *Calonectria parva* (ex-type CBS 110798). **A.** Macroconidiophore. **B–C.** Conidiogenous apparatus with conidiophore branches and cylindrical to allantoid phialides. **D–E.** Narrowly clavate vesicles. **F.** Macroconidia. Scale bars = 10 µm.

Etymology: Name refers to the small macroconidiophores in this fungus.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and rarely a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 43–149 × 5–7 µm; stipe extension septate, straight to flexuous, 65–95 µm long, 2–4 µm wide at the apical septum, terminating in a narrowly clavate vesicle, 3–5 µm diam. *Conidiogenous apparatus* 18–33 µm wide, and 24–43 µm long; primary branches aseptate, 11–21 × 3–5 µm; secondary branches aseptate, 11–15 × 3–4 µm, each terminal branch producing 2–4 phialides; phialides cylindrical to allantoid, hyaline, aseptate, 9–19 × 3–5 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (60–)66–78(–83) × 5–7 µm (av. 72 × 6 µm), (1–)3-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies fast growing (55–85 mm diam) on MEA after 7 d at room temperature; surface buff with abundant buff to white, felty aerial mycelium and sparse to moderate sporulation on the aerial mycelium and colony surface; reverse buff; chlamydospores not observed.

Specimen examined: **South Africa**, Mpumalanga, Sabie, D.R. de Wet nursery, from *Eucalyptus grandis* ramets (roots), 11 May 1990, P.W. Crous (**holotype** CBS-H22764, culture ex-type CBS 110798 = CPC 410 = PPRI 4001).

Note: *Calonectria parva* can be distinguished from other species in the genus by its relatively small macroconidiophores, which rarely bear a stipe extension.

Calonectria plurilateralis L. Lombard & Crous, **sp. nov.** MycoBank MB818711. Fig. 15.

Etymology: Name refers to the multiple lateral stipe extensions on the macroconidiophores of this fungus.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and numerous lateral stipe extensions terminating in vesicles, lacking a central stipe extension; stipe septate, hyaline, smooth, 50–130 × 4–7 µm; stipe extension septate, straight to flexuous, 110–180 µm long, 4–7 µm wide at the apical septum, terminating in obpyriform to ellipsoid vesicles, 7–11 µm diam; lateral stipe extensions (90° to main axis) abundant, 75–105 µm long, 3–6 µm wide at the apical septum, terminating in obpyriform to ellipsoid vesicles, 5–7 µm diam. *Conidiogenous apparatus* 25–80 µm wide, and 25–85 µm long; primary branches aseptate, 11–39 × 2–9 µm; secondary branches aseptate, 7–17 × 3–5 µm; tertiary branches

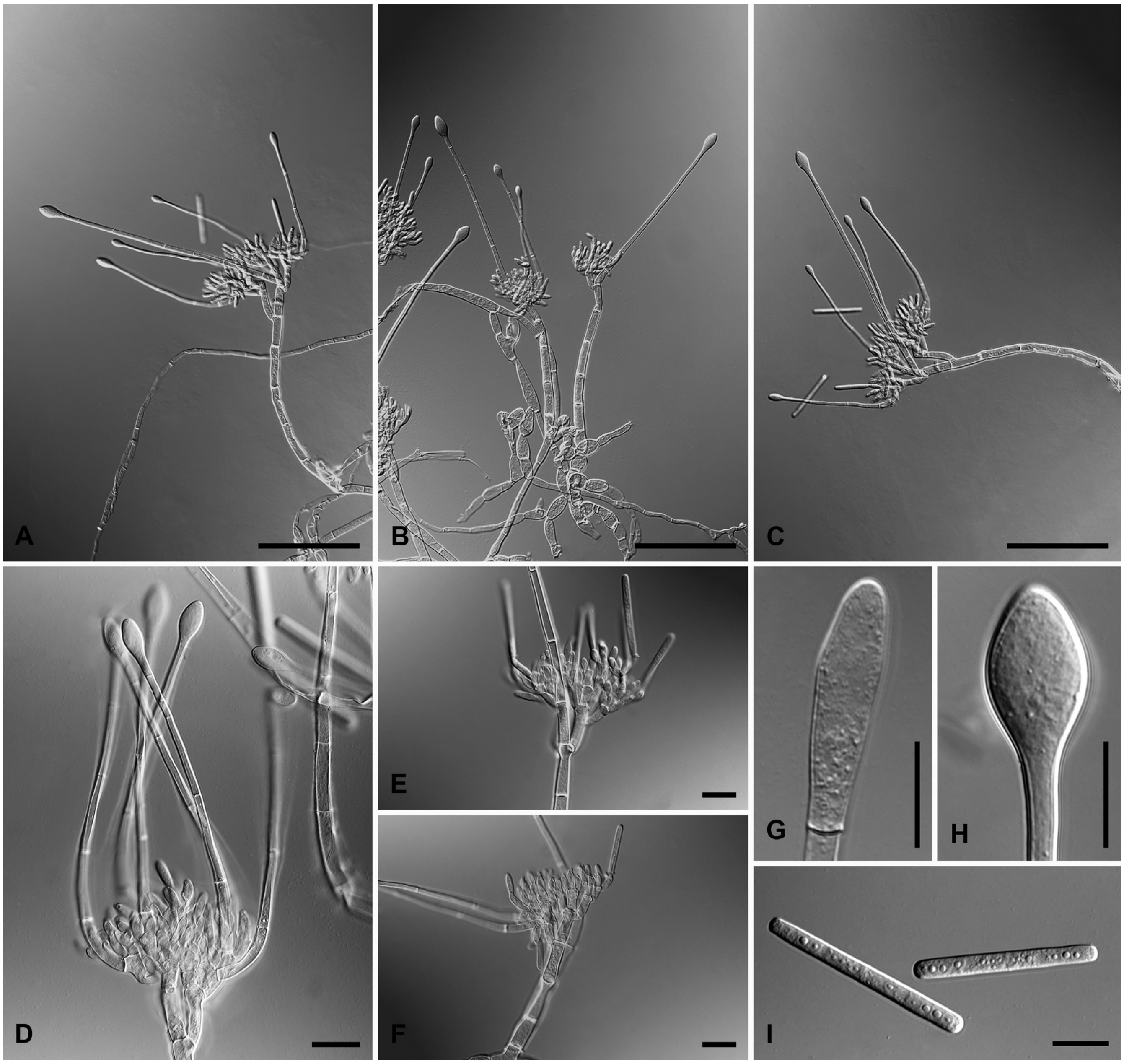

Fig. 15. *Calonectria plurilateralis* (ex-type CBS 111401). **A–C.** Macroconidiophores with lateral stipe extensions. **D.** Conidiogenous apparatus with lateral stipe extensions. **E–F.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **G–H.** Obpyriform to ellipsoidal vesicles. **I.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

aseptate, 6–12 × 3–5 µm; quaternary branches aseptate, 8 × 4 µm, each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 4–11 × 3–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (27–)30–38(–41) × (3–)3.5–4.5(–5) µm (av. 34 × 4 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies fast growing (60–85 mm diam) on MEA after 7 d at room temperature; surface sienna to sepia with moderate white, wooly aerial mycelium and abundant sporulation on the colony surface; reverse sienna to sepia, chlamydospores throughout the medium, forming microsclerotia.

Specimen examined: **Ecuador**, from soil, 20 Jun. 1997, M.J. Wingfield (**holotype** CBS-H22766, culture ex-type CBS 111401 = CPC 1637).

Note: *Calonectria plurilateralis* can be distinguished from other members of the *C. cylindrospora* complex by its numerous lateral stipe extensions.

Calonectria pseudoecuadoriae L. Lombard & Crous, **sp. nov.** MycoBank MB818712. Fig. 16.

Etymology: Name refers to the fact that this species has an asexual morph that is very similar to that of *C. ecuadoriae*.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 40–210 × 7–10 µm; stipe extension septate, straight to flexuous, 160–250 µm long, 4–5 µm wide at the apical septum, terminating in a clavate vesicle, 4–7 µm diam. *Conidiogenous apparatus* 70–105 µm wide, and 50–90 µm long; primary branches aseptate, 18–30 × 5–7 µm; secondary branches

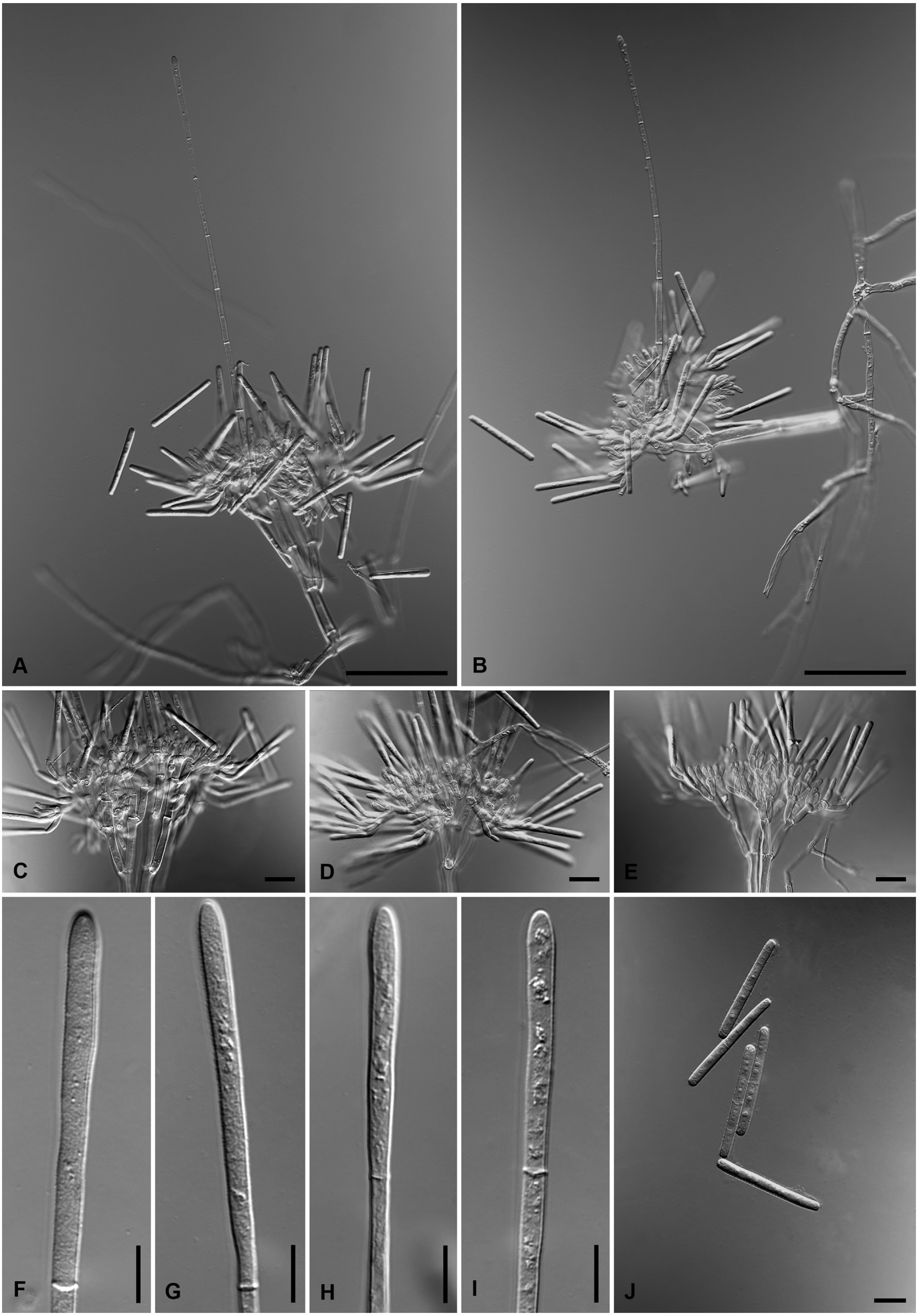

Fig. 16. *Calonectria pseudoecuadoriae* (ex-type CBS 111402). **A–B.** Macroconidiophores. **C–E.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **F–I.** Clavate vesicles. **J.** Macroconidia. Scale bars: A–B = 50 µm; C–J = 10 µm.

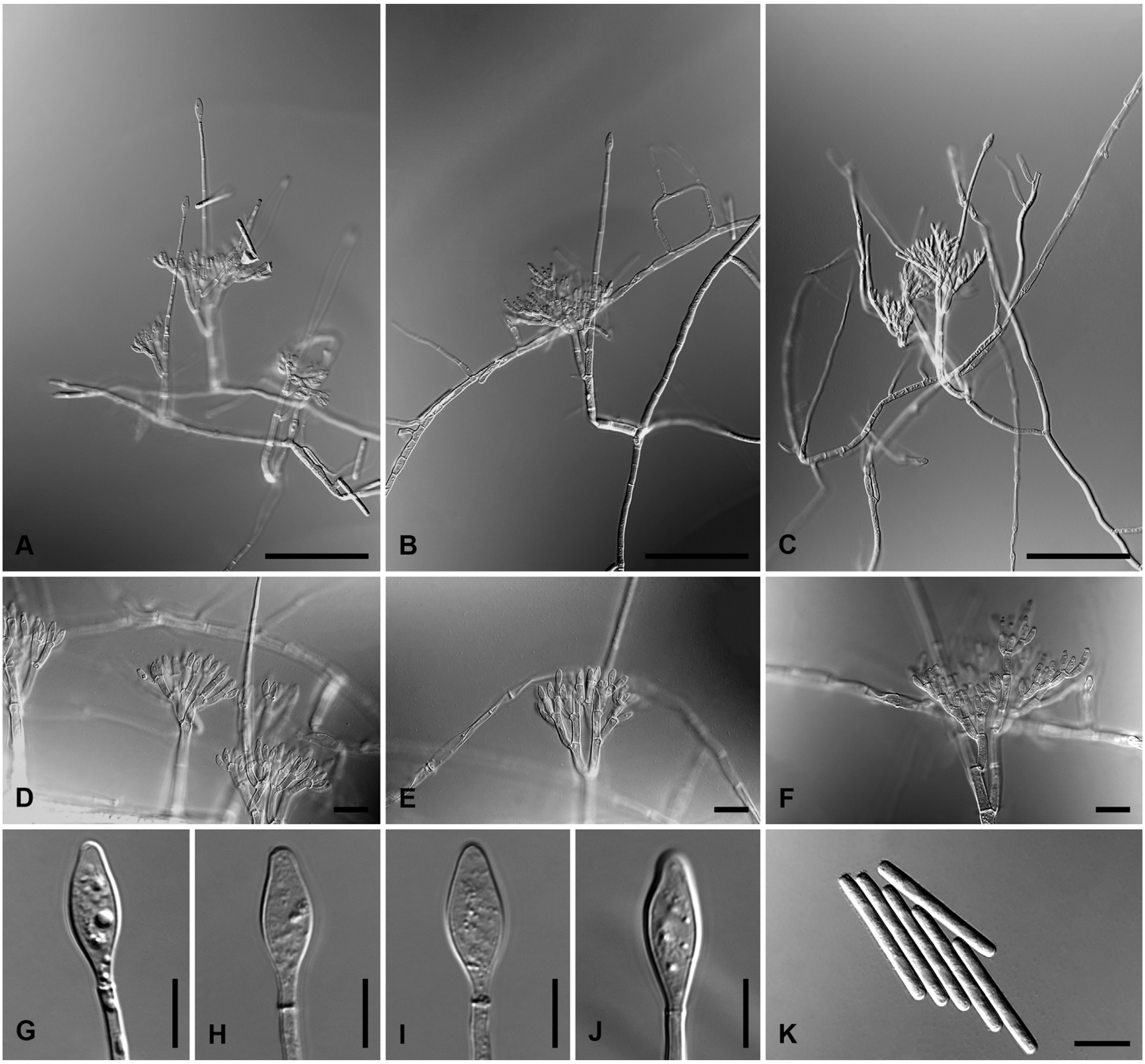

Fig. 17. *Calonectria pseudouxmalensis* (ex-type CBS 110924). **A–C.** Macroconidiophores. **D–F.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **G–J.** Obpyriform to ellipsoidal vesicles. **K.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

aseptate, 9–22 × 3–7 µm; tertiary branches aseptate, 7–17 × 3–5 µm; quaternary branches and additional branches (–6) aseptate, 7–12 × 3–5 µm, each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 8–12 × 3–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (34–)36–40(–43) × 3–4 (–5) µm (av. 38 × 3.5 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega*- and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (30–60 mm diam) on MEA after 7 d at room temperature; surface cinnamon to brick with sparse white, wooly aerial mycelium and abundant sporulation on the aerial mycelium and colony surface; reverse buff to cinnamon with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Ecuador**, soil, 20 Jun. 1997, M.J. Wingfield (**holotype** CBS-H22768, culture ex-type CBS 111402 = CPC 1639); ibid., culture CBS 111412 = CPC 1648.

Notes: *Calonectria pseudoecuadoriae* is morphologically similar to *C. ecuadoriae*. The macroconidia of *C. pseudoecuadoriae* [(34–)36–40(–43) × 3–4 (–5) µm (av. 38 × 3.5 µm)] are smaller than those of *C. ecuadoriae* [(45–)48–55(–65) × (4–)4.5(–5) µm (av. 51 × 4.5 µm); Crous *et al.* 2006]. Furthermore, *C. pseudoecuadoriae* has six tiers of branches in its conidiogenous apparatus in comparison to the seven in *C. ecuadoriae* (Crous *et al.* 2006), although these differences are relatively minor.

Calonectria pseudouxmalensis L. Lombard & Crous, **sp. nov.** MycoBank MB818713. Fig. 17.

Etymology: Name refers to the fact that this species has an asexual morph that is very similar to that of *C. uxmalensis*.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 30–60 × 6–8 µm; stipe extension septate, straight to flexuous, 100–140 µm long, 4–6 µm wide at the apical septum, terminating in a obpyriform to ellipsoidal vesicle sometimes with a papillate apex, 5–9 µm diam. *Conidiogenous apparatus* 25–65 µm wide, and 30–60 µm long; primary branches aseptate, 14–21 × 4–6 µm; secondary branches aseptate, 8–16 × 2–5 µm; tertiary branches aseptate, 5–13 × 2–5 µm; quaternary branches and additional branches (–6) aseptate, 5–9 × 2–4 µm, each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 6–9 × 3–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (26–)28–30(–32) × 3–4 µm (av. 29 × 3 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies fast growing (75–90 mm diam) on MEA after 7 d at room temperature; surface sienna with abundant white, felty to wooly aerial mycelium and abundant sporulation on the aerial mycelium and colony surface; reverse sienna with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Mexico**, from soil, Apr. 1994, P.W. Crous (**holotype** CBS-H22769, culture ex-type CBS 110924 = CPC 942); ibid., cultures CBS 110923 = CPC 941, CBS 115677 = CPC 943.

Notes: *Calonectria pseudouxmalensis* can be distinguished from *C. uxmalensis* by its lack of lateral stipe extensions. The macroconidia of *C. pseudouxmalensis* [(26–)28–30(–32) × 3–4 µm (av. 29 × 3 µm)] are smaller than those of *C. mexicana* [(35–)40–48(–52) × 3–4(–4.5) µm (av. 45 × 3 µm); Schoch *et al.* 1999, Crous 2002], *C. pseudomexicana* [(40–)43–48(–49) × (4–)5–6 µm (av. 45 × 5 µm); Lombard *et al.* 2011] and *C. tunisiana* [(43–)47–51(–53) × 4–6 µm (av. 49 × 5 µm); Lombard *et al.* 2011]. Schoch *et al.* (1999) was able to induce the sexual morph of *C. mexicana* through the heterothallic mating of CBS 110918 (= CPC 927) with CBS 110923 (= CPC 941), which was deposited as the holotype (PREM 55763) of *C. mexicana*. However, phylogenetic inference in this study showed that the one mating tester strain CBS 110923 (Schoch *et al.* 1999) is distinct from the other mating tester strain (CBS 110918; ex-type of *Cylindrocladium mexicanum*). This phenomenon is not new to the genus *Calonectria*, as Neubauer & Zinkernagel (1995) and Overmeyer *et al.* (1996) have shown that fertile perithecia can be induced in some *Calonectria* species when they are cultured in the presence of other species, but where sexual outcrossing has not occurred.

Calonectria putriramosa L. Lombard & Crous, **sp. nov.** MycoBank MB818714. Fig. 18.

Etymology: Name refers to cutting rot, the disease symptoms that are associated with infection by this fungus.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 40–170 × 5–10 µm; stipe extension septate, straight to flexuous, 145–185 µm long, 4–7 µm wide at the apical septum, terminating in an ellipsoid to obpyriform vesicle, 7–9 µm diam. *Conidiogenous apparatus* 45–60 µm wide, and 30–90 µm long; primary branches aseptate, 12–34 × 3–6 µm; secondary branches aseptate, 9–21 × 3–6 µm; tertiary branches aseptate, 9–17 × 3–5 µm; quaternary branches aseptate, 4–13 × 3–5 µm each terminal branch producing 2–6 phialides; phialides elongate reniform to allantoid to cylindrical, hyaline, aseptate, 6–15 × 3–5 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (35–)40–46(–49) × (4–)4.5–5.5(–6) µm (av. 43 × 5 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (35–75 mm diam) on MEA after 7 d at room temperature; surface cinnamon to brick with sparse, wooly, white to buff aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse cinnamon to sepia with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Brazil**, from *Eucalyptus* cuttings, Jun. 1998, A.C. Alfenas (**holotype** CBS-H22770, culture ex-type CBS 111449 = CPC 1951); Bahia do Sol, from *Eucalyptus* cuttings, Apr. 1993, P.W. Crous, culture CBS 116076 = CPC 604; from soil, Jun. 1998, A.C. Alfenas, cultures CBS 111470 = CPC 1940, CBS 111477 = CPC 1928.

Notes: *Calonectria putriramosa* is a new species in the *C. candelabrum* complex (Schoch *et al.* 1999, Lombard *et al.* 2010a,b, 2015a). The macroconidia of *C. putriramosa* [(35–)40–46(–49) × (4–)4.5–5.5(–6) µm (av. 43 × 5 µm)] are smaller than those of its closest phylogenetic neighbours (see notes under *C. brasiliana*), but slightly larger than those of *C. brasiliana* [(36–)38–42(–46) × (3–)3.5–4.5(–5) µm (av. 40 × 4 µm)].

Calonectria stipitata L. Lombard & Crous, **sp. nov.** MycoBank MB818715. Fig. 19.

Etymology: Name refers to the lateral stipe extensions produced by this fungus.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 35–85 × 6–9 µm; stipe extension septate, straight to flexuous, 105–195 µm long, 4–6 µm wide at the apical septum, terminating in an ellipsoid to obpyriform vesicle, 7–11 µm diam; lateral stipe extensions (90° to main axis) abundant, 70–135 µm long, 3–6 µm wide at the apical septum, terminating in broadly clavate vesicles, 3–6 µm diam. *Conidiogenous apparatus* 50–120 µm wide, and 40–75 µm long; primary branches aseptate, 15–29 × 4–5 µm; secondary branches aseptate, 9–18 × 3–6 µm; tertiary branches aseptate, 8–19 × 2–5 µm; quaternary branches and additional branches (–6) aseptate, 6–14 × 2–5 µm, each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 7–13 × 2–5 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (27–)29–35(–37) × (3–)3.5–4.5(–6) µm (av.

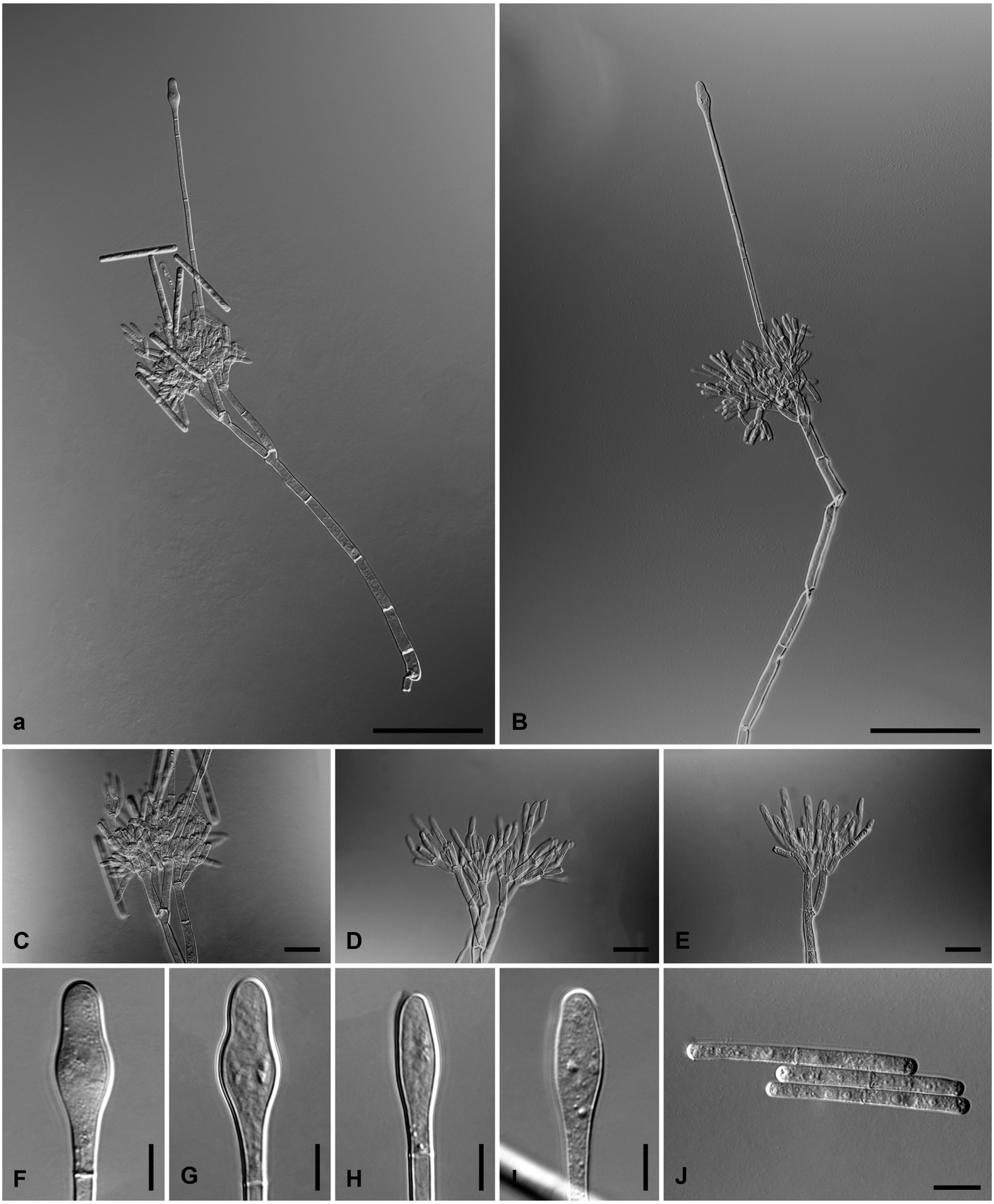

Fig. 18. *Calonectria putriramosa* (ex-type CBS 111449). **A–B.** Macroconidiophores. **C–E.** Conidiogenous apparatus with conidiophore branches and elongate reniform to allantoid to cylindrical phialides. **F–I.** Ellipsoid to obpyrifom vesicles. **J.** Macroconidia. Scale bars: A–B = 50 µm; C–J = 10 µm.

32 × 4 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies fast growing (60−85 mm diam) on MEA after 7 d at room temperature; surface sienna to sepia with abundant wooly, white aerial mycelium and abundant sporulation on the aerial mycelium and colony surface; reverse sienna to sepia with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimen examined: **Colombia**, from *Eucalyptus* sp., 1990s, M.J. Wingfield (**holotype** CBS-H22771, culture ex-type CBS 112513 = CPC 3851).

Notes: *Calonectria stipitata*, like *C. brevistipitata* and *C. machaerinae*, produce lateral stipe extensions, a characteristic

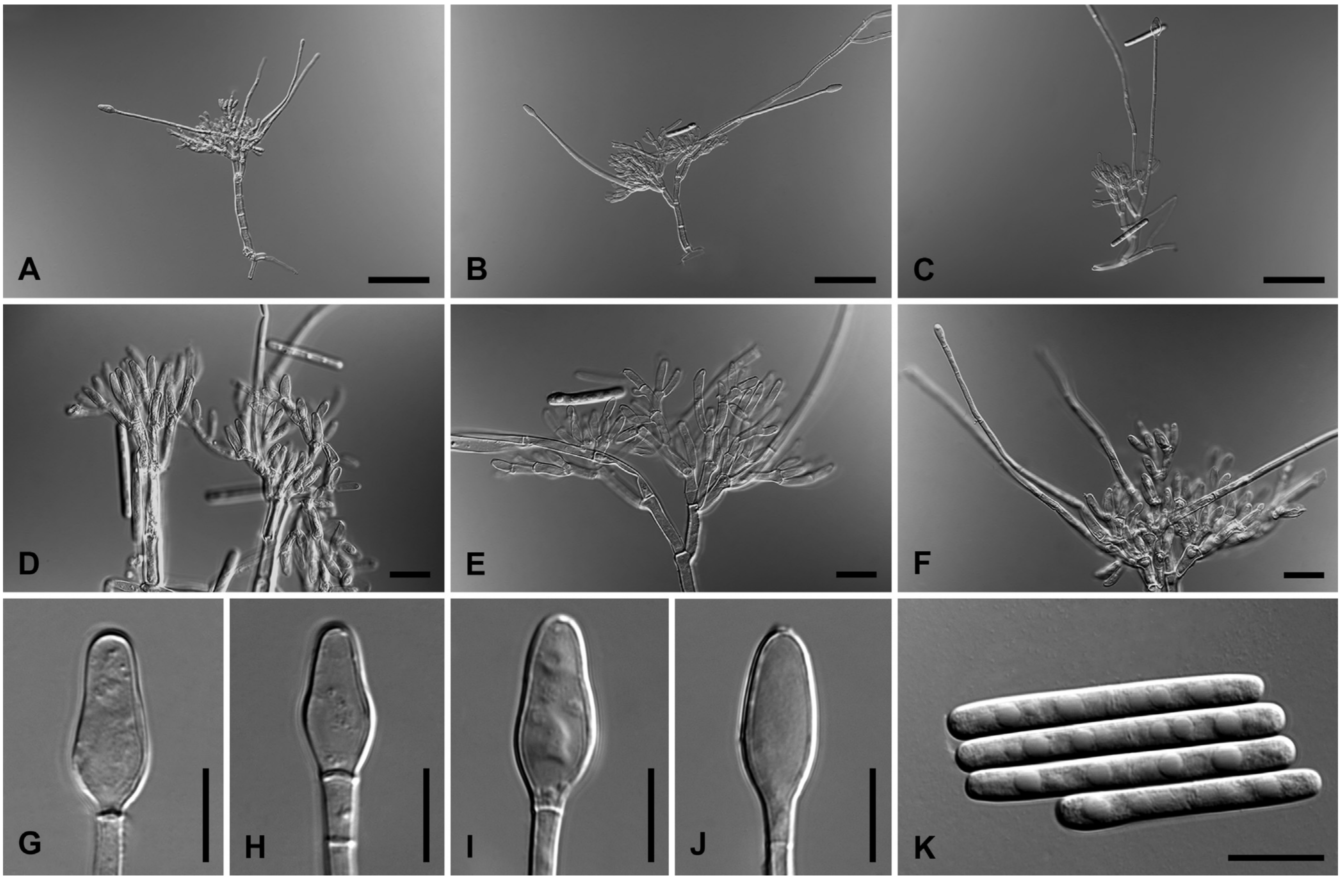

Fig. 19. *Calonectria stipitata* (ex-type CBS 112513). **A–C.** Macroconidiophores. **D–E.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **F.** Conidiogenous apparatus with lateral stipe extension. **G–J.** Ellipsoid to obpyriform vesicles. **K.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

not usually associated with members of the *C. candelabrum* complex (Schoch *et al.* 1999, Lombard *et al.* 2010a,b, 2015a). The lateral stipe extensions of *C. stipitata* (up to 135 µm) are longer than those of *C. brevistipitata* (up to 80 µm) and *C. machaerinae* (up to 125 µm).

Calonectria syzygiicola L. Lombard & Crous, **sp. nov.** MycoBank MB818716. Fig. 20.

Etymology: Name refers to the host plant, *Syzygium aromaticum* from which this fungus was isolated.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 30–170 × 4–8 µm; stipe extension septate, straight to flexuous, 65–105 µm long, 3–4 µm wide at the apical septum, terminating in a sphaeropedunculate vesicle, 4–7 µm diam; lateral stipe extensions (90° to main axis) sparse, 40–50 µm long, 2–3 µm wide at the apical septum, terminating in sphaeropedunculate vesicles, 3–6 µm diam. *Conidiogenous apparatus* 30–70 µm wide, and 30–45 µm long; primary branches aseptate, 12–21 × 4–6 µm; secondary branches aseptate, 8–14 × 3–5 µm; tertiary branches aseptate, 9–12 × 3–5 µm; quaternary branches aseptate, 8–10 × 2–3 µm, each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 7–11 × 2–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (39–)41–49(–56) × (4–)4.5–5.5(–7) µm (av. 45 × 5 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (45–65 mm diam) on MEA after 7 d at room temperature; surface amber to sienna with abundant wooly, white to buff aerial mycelium, and abundant sporulation on the aerial mycelium and colony surface; reverse sienna with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Indonesia**, Sumatra, from soil under *Syzygium aromaticum*, 1998, M.J. Wingfield (**holotype** CBS-H22772, culture ex-type CBS 112831 = CPC 4511), culture CBS 112827 = CPC 4512.

Notes: *Calonectria syzygiicola* is closely related to *C. asiatica* (Fig. 1). However, the macroconidia of *C. syzygiicola* [(39–)41–49(–56) × (4–)4.5–5.5(–7) µm (av. 45 × 5 µm)] are smaller than those of *C. asiatica* [(42–)48–55(–65) × (4–)5(–5.5) µm (av. 53 × 5 µm); Crous *et al.* 2004b].

Calonectria tereticornis L. Lombard & Crous, **sp. nov.** MycoBank MB818717. Fig. 21.

Etymology: Name refers to the host plant, *Eucalyptus tereticornis*, from which this fungus was isolated.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 70–270 × 6–11 µm; stipe extension septate, straight to flexuous, 140–245 µm long, 3–7 µm wide at the apical septum, terminating in a fusiform to ovoid vesicle, 8–14 µm diam. *Conidiogenous apparatus* 35–65 µm wide, and 45–75 µm long; primary branches aseptate, 18–34 × 4–10 µm; secondary branches aseptate, 11–26 × 3–7 µm, each terminal branch

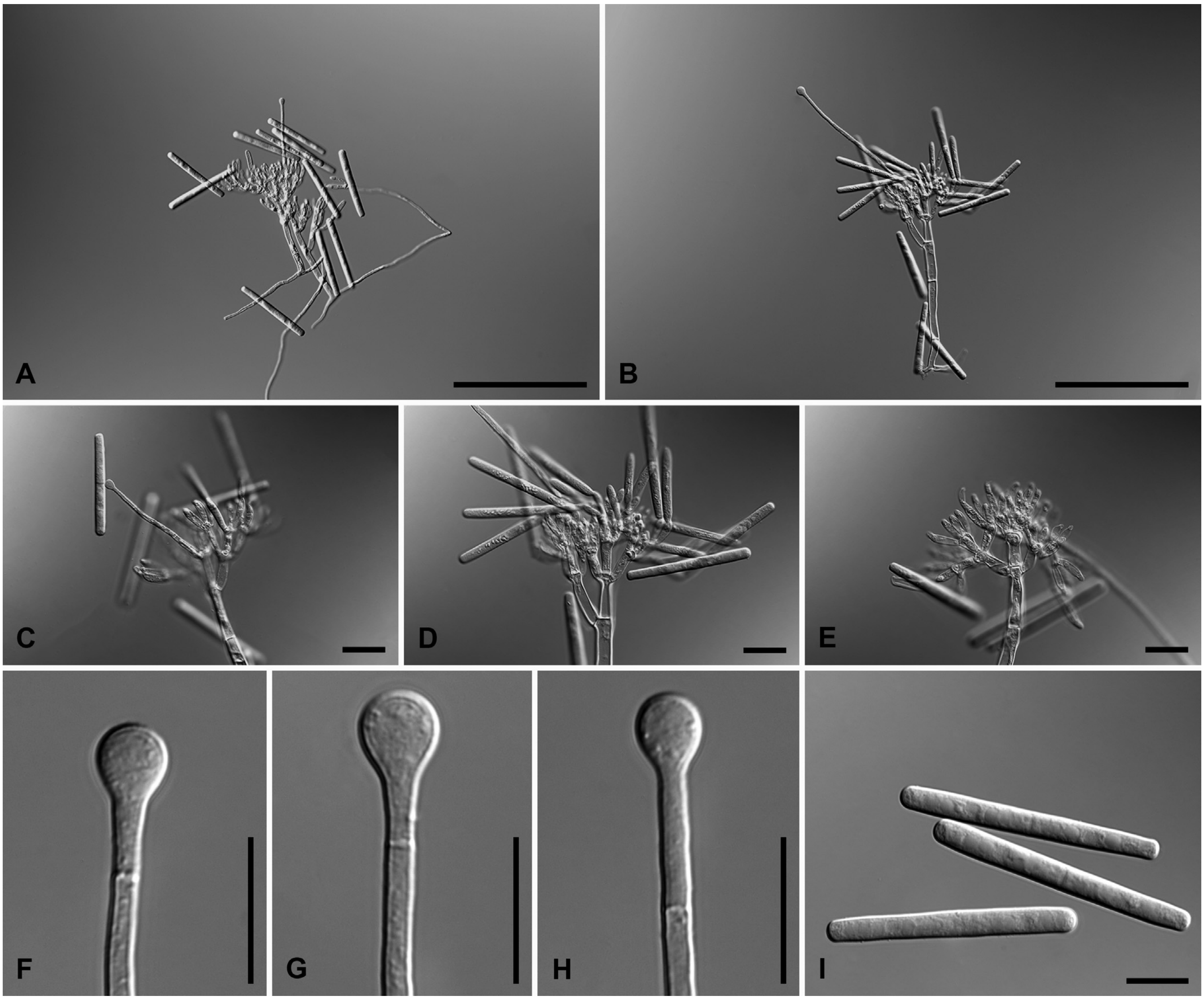

Fig. 20. *Calonectria syzygiicola* (ex-type CBS 112831). **A–B.** Macroconidiophores. **C–E.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **F–H.** Sphaeropedunculate vesicles. **I.** Macroconidia. Scale bars: A–B = 50 µm; C–I = 10 µm.

producing 2–4 phialides; phialides elongate doliiform to allantoid, hyaline, aseptate, 9–15 × 3–5 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (51–)55–63(–71) × (3–)4.5–5.5(–6) µm (av. 59 × 5 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies fast growing (55–75 mm diam) on MEA after 7 d at room temperature; surface cinnamon to sienna with sparse buff to white, wooly aerial mycelium and abundant sporulation on the aerial mycelium and colony surface; reverse sienna to umber with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Brazil**, Tucurui, from leaves of *Eucalyptus tereticornis*, 20 Sep. 1996, P.W. Crous (**holotype** CBS-H22773 culture ex-type CBS 111301 = CPC 1429).

Notes: *Calonectria tereticornis* is closely related to *C. gordoniae* and *C. ovata* (Fig. 1). The macroconidia of *C. tereticornis* [(51–)55–63(–71) × (3–)4.5–5.5(–6) µm (av. 59 × 5 µm)] are smaller than those of *C. gordoniae* [(44–)50–70(–80) × (4–)5–6 µm (av. 65 × 5 µm); Crous 2002] and *C. ovata* [(50–)65–80(–110) × 4–5(–6) µm (av. 70 × 5 µm); Crous 2002].

Calonectria terricola L. Lombard & Crous, **sp. nov.** MycoBank MB818718. Fig. 22.

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

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 30–100 × 5–9 µm; stipe extension septate, straight to flexuous, 135–175 µm long, 4–5 µm wide at the apical septum, terminating in a fusiform to ovoid vesicle, 8–12 µm diam. *Conidiogenous apparatus* 30–100 µm wide, and 45–65 µm long; primary branches aseptate, 14–26 × 3–6 µm; secondary branches aseptate, 13–22 × 2–5 µm; tertiary branches aseptate, 15–18 × 4–5 µm, each terminal branch producing 2–4 phialides; phialides elongate doliiform to reniform, hyaline, aseptate, 9–17 × 3–5 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at

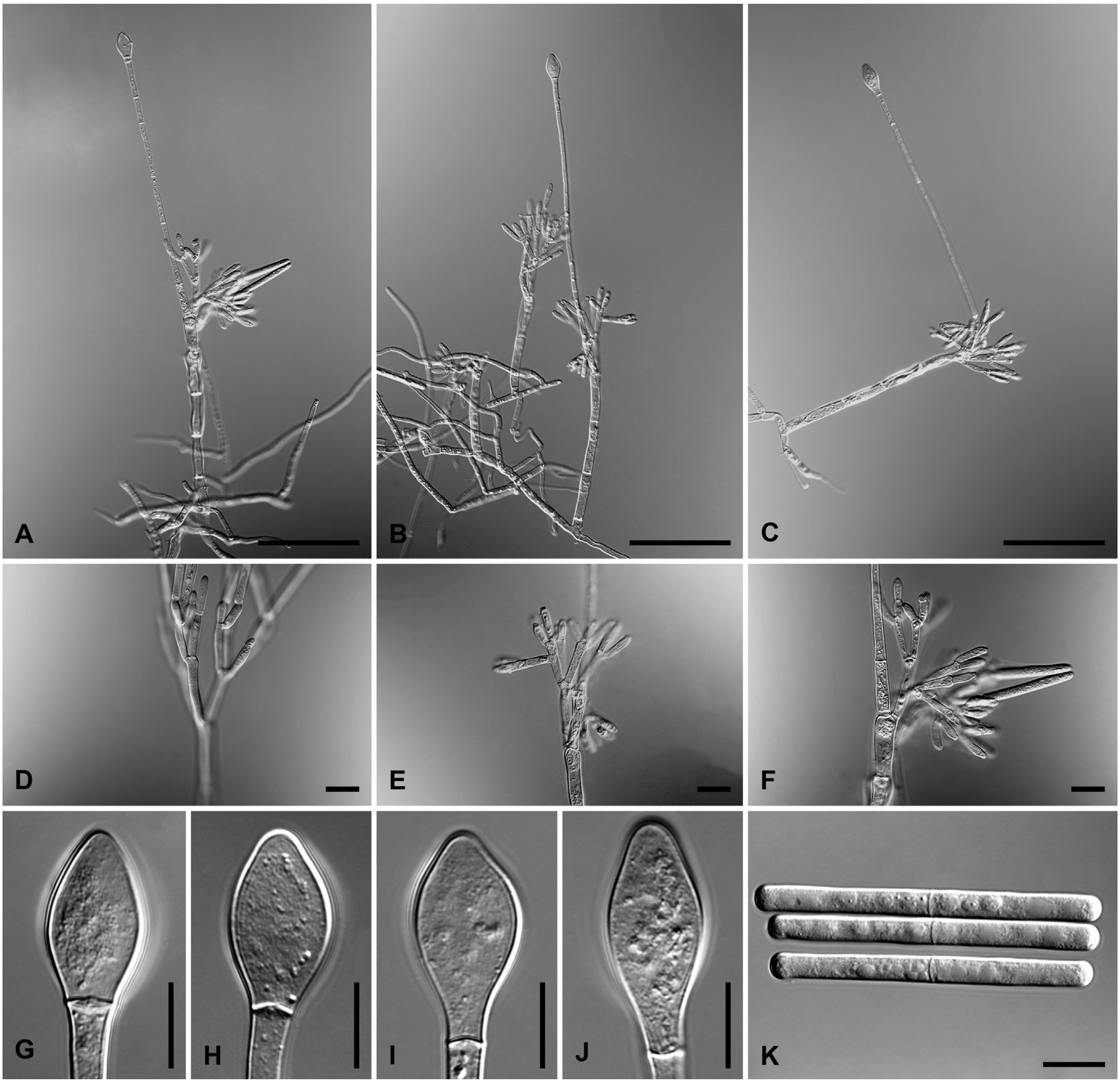

Fig. 21. *Calonectria tereticornis* (ex-type CBS 111301). **A–C.** Macroconidiophores. **D–F.** Conidiogenous apparatus with conidiophore branches and elongate doliiform to reniform phialides. **G–J.** Fusiform to ovoid vesicles. **K.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

both ends, straight, (40–)43–49(–53) × (3–)4–5(–6) µm (av. 46 × 4.5 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega-* and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (45–65 mm diam) on MEA after 7 d at room temperature; surface brick to sienna with sparse, buff to white, wooly aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse sienna with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Brazil**, from soil in *Eucalyptus* plantation, 1996, P.W. Crous (**holotype** CBS-H22774; culture ex-type CBS 116247 = CPC 3583); ibid., culture CBS 116248 = CPC 3536.

Notes: *Calonectria terricola* is a new species in the *C. pteridis* complex. The macroconidia of *C. terricola* [(40–)43–49(–53) × (3–)4–5(–6) µm (av. 46 × 4.5 µm)] are smaller than those of *C. ovata* [(50–)65–80(–110) × 4–5 (–6) µm (av. 70 × 5 µm); Crous 2002], *C. pseudovata* [(55–)67–70(–80) × (4–)5 (–7) µm (av. 69 × 5 µm); Alfenas *et al.* 2015] and *C. tereticornis* [(51–)55–63(–71) × (3–)4.5–5.5(–6) µm (av. 59 × 5 µm)].

Calonectria tropicalis L. Lombard & Crous, **sp. nov.** MycoBank MB818719. Fig. 23.

Etymology: Name refers to the tropical region in Brazil where this fungus was collected.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 120–210 × 7–8 µm; stipe extension septate, straight to flexuous, 190–270 µm long, 4–6 µm wide at the apical septum,

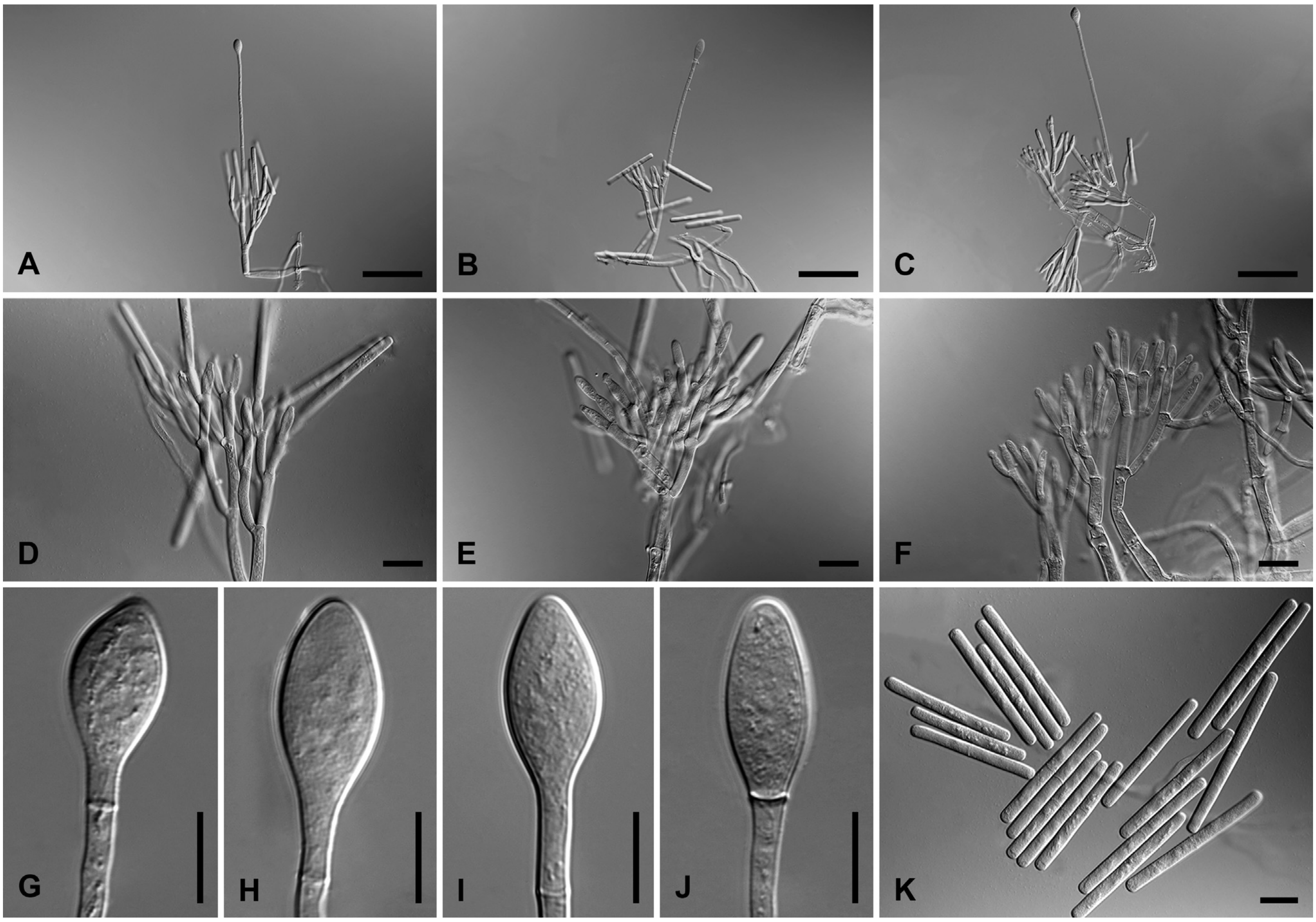

Fig. 22. *Calonectria terricola* (ex-type CBS 116247). **A–C.** Macroconidiophores. **D–F.** Conidiogenous apparatus with conidiophore branches and elongate doliiform to reniform phialides. **G–J.** Fusiform to ovoid vesicles. **K.** Macroconidia. Scale bars: A–C = 50 µm; D–K = 10 µm.

terminating in a clavate vesicle, 5–6 µm diam. *Conidiogenous apparatus* 50–70 µm wide, and 60–90 µm long; primary branches aseptate, 20–32 × 4–6 µm; secondary branches aseptate, 12–29 × 3–6 µm; tertiary branches aseptate, 12–20 × 2–4 µm, each terminal branch producing 2–4 phialides; phialides elongate doliiform to reniform, hyaline, aseptate, 10–16 × 2–5 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight to slightly curved, (69–)74–86(–89) × (4–)4.5–5.5(–6) µm (av. 80 × 5 µm), 1(–3)-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega*- and *microconidia* not observed.

Culture characteristics: Colonies moderately fast growing (45–65 mm diam) on MEA after 7 days at room temperature; surface sienna to sepia with moderate white, wooly aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse sienna to sepia with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Brazil**, Amazon, from foliar lesion of *Eucalyptus* sp., 1993, P.W. Crous & A.C. Alfenas (**holotype** CBS-H22776 culture ex-type CBS 116271 = CPC 3559); ibid., cultures CBS 116242 = CPC 3543.

Notes: *Calonectria tropicalis* resides in the *C. pteridis* complex. This species can be distinguished from other species in the complex by the smaller numbers of fertile branches in its conidiogenous apparatus.

Calonectria uniseptata Gerlach, Phytopathol. Z. 61: 379. 1968. MycoBank MB327268.

Specimen examined: **Germany**, Celle, from root of *Paphiopedilum callosum*, May 1967, W. Gerlach, culture ex-type CBS 413.67 = IMI 299577.

Notes: Sobers (1972) reduced *C. floridana* and *C. uniseptata* to synonymy with *C. kyotensis* based on their similarities in morphology and pathogenicity. Phylogenetic inference in this study showed that the ex-type of *C. uniseptata* (CBS 413.67; Gerlach 1968) is distinct from *C. kyotensis*. Therefore, *C. uniseptata* is reinstated here as a distinct species of *Calonectria*.

Calonectria uxmalensis L. Lombard & Crous, **sp. nov.** MycoBank MB818720. Fig. 24.

Etymology: Name refers to the ancient Maya city Uxmal, Mexico, the locality where this fungus was collected.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 35–155 × 6–8 µm; stipe extension septate, straight to flexuous, 60–140 µm long, 3–6 µm wide at the apical septum, terminating in a obpyriform to ellipsoidal vesicle sometimes with a papillate apex, 5–8 µm diam; lateral stipe extensions (90° to main axis) few, 88–100 µm long, 3–4 µm wide at the apical septum,

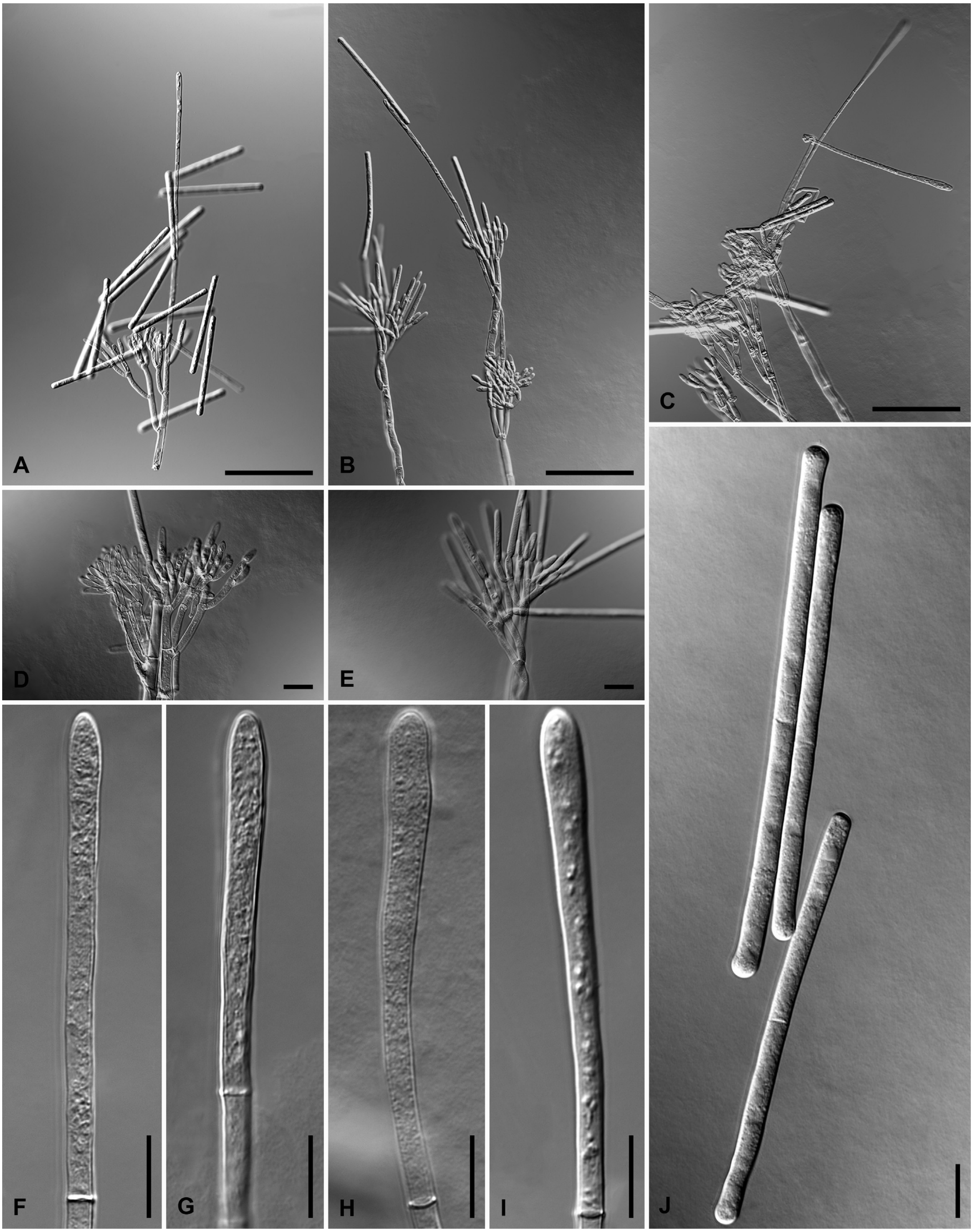

Fig. 23. *Calonectria tropicalis* (ex-type CBS 116271). **A–C.** Macroconidiophores. **D–E.** Conidiogenous apparatus with conidiophore branches and elongate doliiform to reniform phialides. **F–I.** Clavate vesicles. **J.** Macroconidia. Scale bars: A–C = 50 µm; D–J = 10 µm.

terminating in broadly clavate to obpyriform to ellipsoid vesicles, 5–6 µm diam. *Conidiogenous apparatus* 30–90 µm wide, and 35–60 µm long; primary branches aseptate, 14–19 × 3–6 µm; secondary branches aseptate, 10–16 × 3–6 µm; tertiary branches aseptate, 7–11 × 3–5 µm; quaternary branches and additional branches (–6) aseptate, 7–11 × 3–5 µm, each terminal branch producing 2–6 phialides; phialides doliiform to reniform, hyaline, aseptate, 8–11 × 2–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at both ends, straight, (26–)

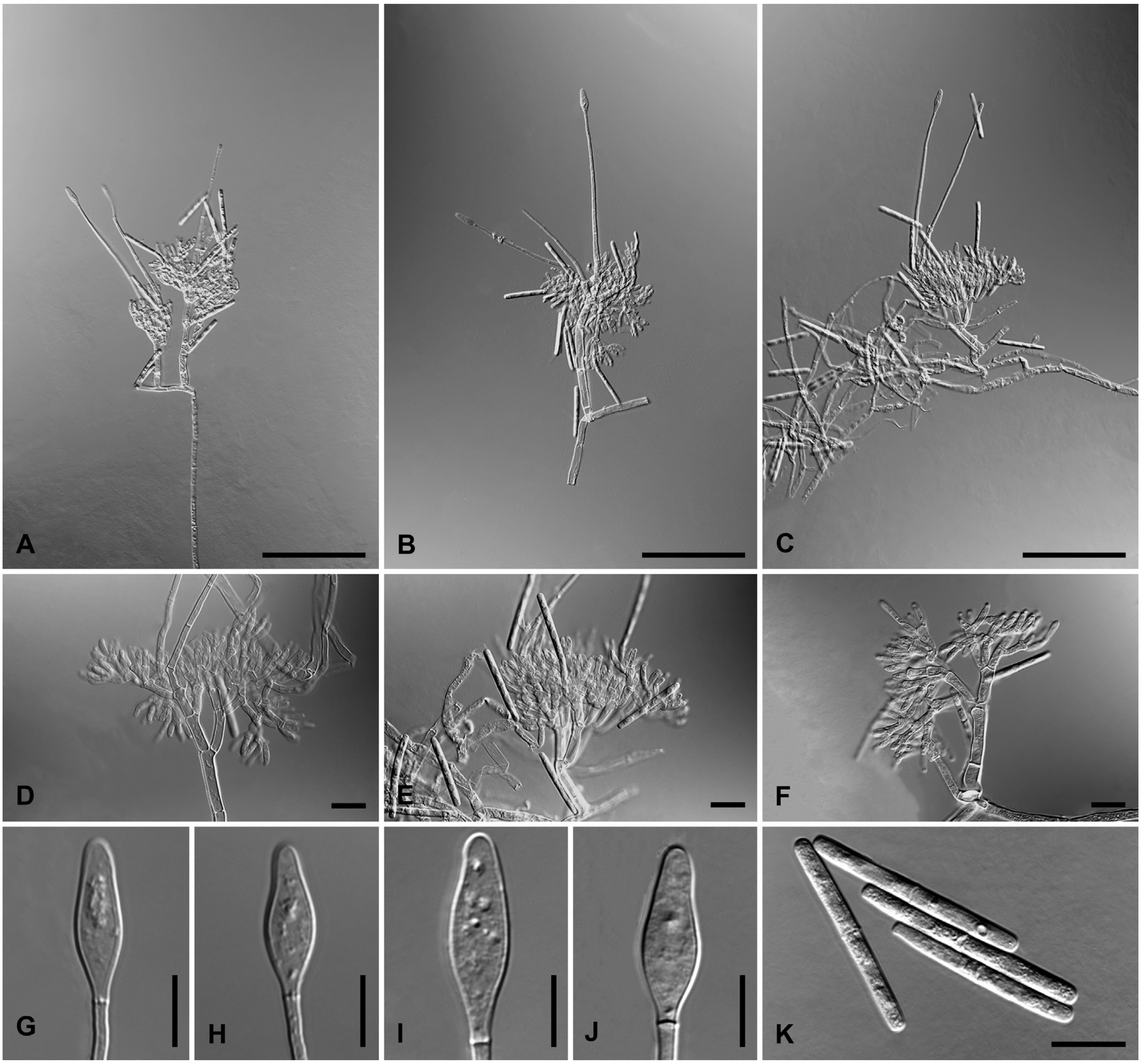

Fig. 24. *Calonectria uxmalensis* (ex-type CBS 110925). **A–C.** Macroconidiophores with lateral stipe extensions. **D–F.** Conidiogenous apparatus with conidiophore branches and doliiform to reniform phialides. **G–J.** Obpyriform to ellipsoidal vesicles. **K.** Macroconidia. Scale bars: A–C = 50 μm; D–K = 10 μm.

27–33(–35) × 3–4 μm (av. 30 × 3 μm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Mega*- and *microconidia* not observed.

Culture characteristics: Colonies fast growing (65–85 mm diam) on MEA after 7 d at room temperature; surface buff to sienna with abundant buff to white, felty to wooly aerial mycelium and moderate sporulation on the aerial mycelium and colony surface; reverse sienna to umber with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimens examined: **Mexico**, Uxmal, from soil, Apr. 1994, P.W. Crous (**holotype** CBS-H22761, culture ex-type CBS 110925 = CPC 945); ibid., culture CBS 110919 = CPC 928.

Notes: *Calonectria uxmalensis* can be distinguished from *C. mexicana*, *C. pseudomexicana* and *C. tunisiana* by its lateral stipe extensions, a characteristic not known for the latter three species (Schoch *et al.* 1999, Crous 2002, Lombard *et al.* 2011).

Calonectria venezuelana L. Lombard & Crous, **sp. nov.** MycoBank MB818721. Fig. 25.

Etymology: Name refers to Venezuela, the country from which this fungus was collected.

Macroconidiophores consist of a stipe bearing a penicillate arrangement of fertile branches, and a stipe extension terminating in a vesicle; stipe septate, hyaline, smooth, 35–100 × 4–8 μm; stipe extension septate, straight to flexuous, 85–190 μm long, 3–6 μm wide at the apical septum, terminating in a fusiform to ovoid to ellipsoid vesicle, 5–9 μm diam. *Conidiogenous apparatus* 25–60 μm wide, and 25–65 μm long; primary branches aseptate, 15–30 × 4–8 μm; secondary branches aseptate, 11–24 × 3–5 μm; tertiary branches aseptate, 8–14 × 3–6 μm, each terminal branch producing 2–4 phialides; phialides elongate doliiform to reniform, hyaline, aseptate, 8–17 × 2–5 μm, apex with minute periclinal thickening and inconspicuous collarette. *Macroconidia* cylindrical, rounded at

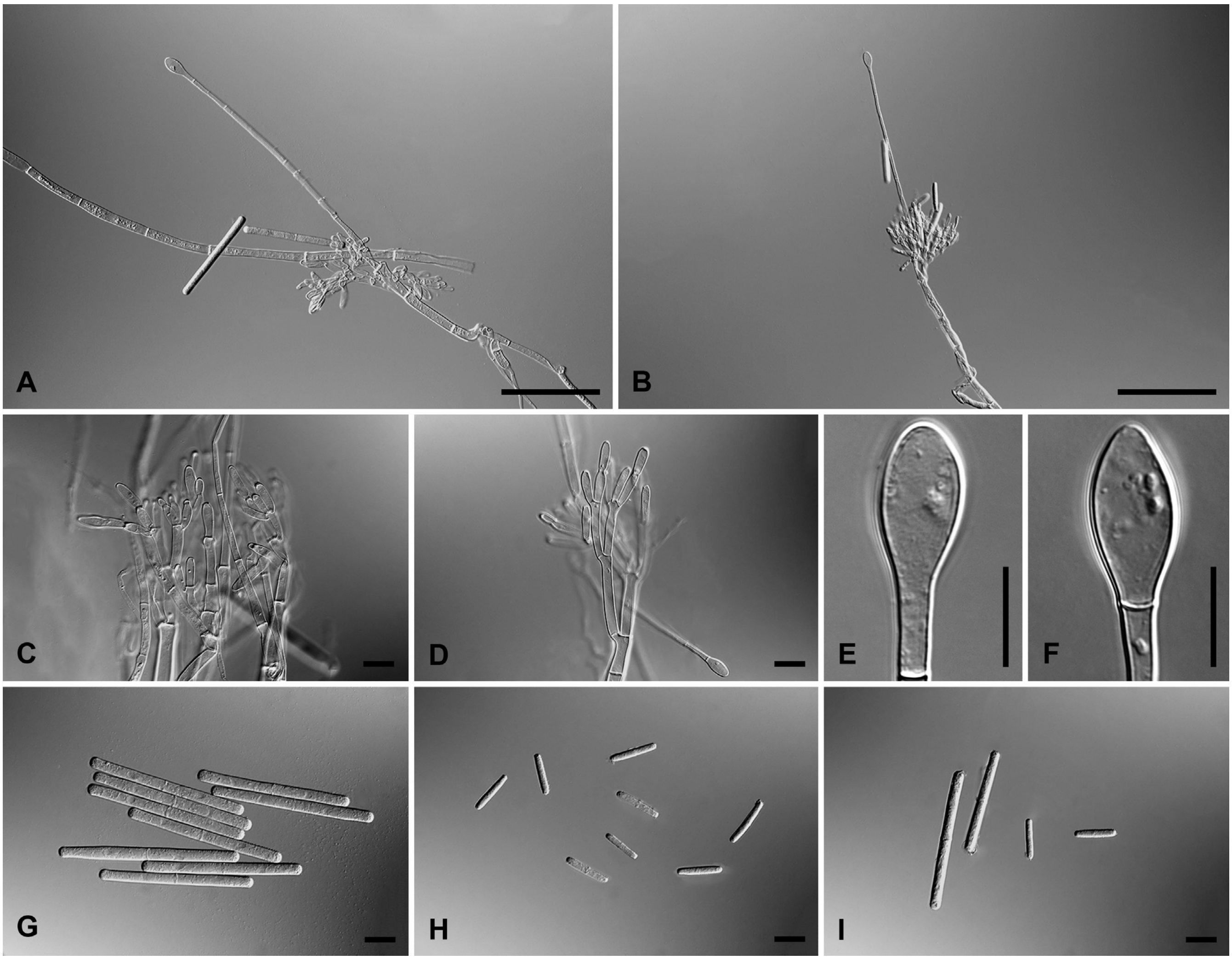

Fig. 25. *Calonectria venezuelana* (ex-type CBS 111052). **A–B.** Macroconidiophores. **C–D.** Conidiogenous apparatus with conidiophore branches and elongate doliiform to reniform phialides. **E–F.** Fusiform to ovoid to ellipsoid vesicles. **G.** Macroconidia. **H.** Microconidia. **I.** Micro- and macroconidia. Scale bars: A–B = 50 µm; C–I = 10 µm.

both ends, straight, (48–)54–62(–65) × (4–)4.5–5.5(–7) µm (av. 58 × 5 µm), 1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Microconidiophores* consists of a stipe and a penicillate or sub-verticillate arrangement of fertile branches; stipe septate, hyaline, smooth, 25–40 × 3–4 µm; primary branches aseptate, 8–12 × 2–4 µm, terminating in 1–4 phialides that are cylindrical, straight to slightly curved, 7–15 × 2–4 µm, apex with minute periclinal thickening and inconspicuous collarette. *Microconidia* cylindrical, straight to slightly curved, rounded at the apex and flattened at the base, 16–20(–22) × (2–)2.5–3.5(–4) µm (av. 18 × 3 µm), (0–)1-septate, lacking a visible abscission scar, held in parallel cylindrical clusters by colourless slime. *Megaconidia* not observed.

Culture characteristics: Colonies fast growing (50–75 mm diam) on MEA after 7 d at room temperature; surface cinnamon to amber with sparse, buff to white, wooly aerial mycelium and abundant sporulation on the aerial mycelium and colony surface; reverse sienna to amber with abundant chlamydospores throughout the medium, forming microsclerotia.

Specimen examined: **Venezuela**, Acarigua, from soil, 27 Jun. 1995, M.J. Wingfield (**holotype** CBS-H22778 culture ex-type CBS 111052 = CPC 1183).

Notes: *Calonectria venezuelana* forms a single lineage closely related to *C. eucalypticola* (Fig. 1). The macroconidia of *C. venezuelana* [(48–)54–62(–65) × (4–)4.5–5.5(–7) µm (av. 58 × 5 µm)] are larger than those of *C. eucalypticola* [(43–)49–52(–55) × 3–5 µm (av. 50 × 4 µm); Alfenas *et al.* 2015].

DISCUSSION

A collection of isolates stored for many years and tentatively identified as species of *Calonectria* based on morphology, were shown to represent 24 new species. At the time that they were collected, it would not have been possible to recognise them as novel taxa and this vividly illustrates the power of the DNA-based sequencing tools that are now available to facilitate accurate species recognition. These species emerging from this study were isolated from various substrates collected globally over a 20 year period, and this study therefore highlights the value of the careful storage and maintenance of cultures for further study when appropriate opportunities arise to do so. This paper also highlights the fact that many undescribed species most likely remain hidden in culture collections, requiring a re-evaluation based on DNA sequence comparisons.

Most of the isolates collected in Brazil formed part of the *C. pteridis* species complex. This is regarded as one of the most prominent species complexes associated with CLB on *Eucalyptus* in that country (Alfenas *et al.* 2004, 2013c, 2015, Graça et al. 2009). *Calonectria amazonica*, *C. amazoniensis*, *C. lageniformis*, *C. tereticornis* and *C. tropicalis* were all isolated from CLB leaf lesions on *Eucalyptus* spp. propagated commercially as non-natives in plantations. Results of this study have raised the number of species known from Brazil to 55 (Alfenas *et al.* 2013a,b, 2015). *Calonectria terricola*, isolated from soil collected in a *Eucalyptus* plantation in Brazil, also formed part of the *C. pteridis* complex in this study.

Calonectria parva, isolated from soil collected in South Africa, formed a basal lineage to the *C. colhounii* species complex. This species can be readily distinguished from other species in the *C. colhounii* species complex by its relatively small macroconidiophores, which rarely bear stipe extensions.

Both *C. uxmalensis* and *C. pseudouxmalensis*, isolated from soil collected in Mexico, are new additions to the *C. mexicana* species complex, which now include five species (Lombard *et al.* 2011). This complex is characterised by the papillate apices of the vesicles terminating the stipe extensions (Lombard *et al.* 2011). *Calonectria uxmalensis* can be distinguished from the other species in this complex by the formation of lateral stipe extensions, whereas macroconidial dimensions can distinguish *C. pseudouxmalensis* from the species in this complex.

Calonectria paracolhounii, collected in the USA and Australia, is a new addition to the *C. colhounii* complex (Crous 2002, Crous *et al.* 2006, Chen *et al.* 2011). This species complex now includes seven species (Crous 2002, Crous *et al.* 2006, 2015b, Chen *et al.* 2011, Xu *et al.* 2012), and is characterised by the formation of unique bright yellow perithecia. Although no perithecia were observed for *C. paracolhounii* in this study, the macroconidia of *C. paracolhounii* were smaller than those of the other species known in this complex.

The *C. candelabrum* species complex (Schoch *et al.* 1999) accommodates the greatest number of species in the genus and includes 27 species (Schoch *et al.* 1999, Crous 2002, Lombard *et al.* 2010a, 2011, 2015a, Crous *et al.* 2013, Alfenas et al. 2015) after the addition of *C. brasiliana* (Brazil), *C. brevistipitata* (Mexico), *C. cliffordiicola* (South Africa), *C. ericae* (USA), *C. machaerinae* (New Zealand), *C. putriramosa* (Brazil), *C. stipitata* (Colombia) and *C. venezuelana* (Venezuela) recognised in this study. Although some unique morphological characters could be identified to distinguish these eight new species, DNA sequence comparisons are required to provide accurate species identification.

Calonectria pseudoecuadoriae and *C. plurilateralis* (Ecuador) are both new additions to the *C. brassicae* and *C. cylindrospora* species complexes, respectively (Crous 2002, Lombard *et al.* 2009, Alfenas *et al.* 2015). *Calonectria pseudoecuadoriae* is morphologically similar to *C. ecuadoriae* (Crous *et al.* 2006) except for the additional branches in the conidiogenous apparatus and smaller macroconidia. *Calonectria plurilateralis* is the only species in the *C. cylindrospora* complex known to produce lateral stipe extensions, distinguishing it from other species in this complex.

Calonectria brassicicola (Indonesia and New Zealand), *C. indonesiana* (Indonesia), and *C. syzygiicola* (Indonesia) are new additions to the *C. kyotensis* species complex (Crous 2002, Crous *et al.* 2004b, Lombard *et al.* 2010b, 2015a). Species in this complex are characterised by their sphaeropedunculate vesicles and the formation of lateral stipe extensions on the conidiogenous apparatus (Crous *et al.* 2004b, Lombard *et al.* 2010b, 2015a). The three new species introduced in this study can be distinguished from their closest phylogenetic neighbours as well as from each other by the number of branches in the conidiogenous apparatus and their macroconidial dimensions.

Calonectria spp. are soil-borne fungi that are able to exist in this substrate for long periods of time due to their abundant production of sclerotia (Crous 2002). This also implies that they can be and most likely have been extensively moved between countries and continents. Given their importance as plant pathogens, it is ironical that very little is known regarding their genetic diversity or pathways of movement globally. This study has shown that there are many more species of *Calonectria* than has been recognised and it likely that many more species have yet to be discovered. Genomes have yet to be sequenced for *Calonectria* spp. and as these emerge, tools will become available to answer questions regarding the global movement of these fungi (Crous *et al.* 2016). They will also contribute to reducing the impact of, for example, tree pathogens that are resulting in serious losses to planted forests (Wingfield *et al.* 2015).

When the 24 species newly described in this study were collected, the genus *Calonectria* had only been peripherally studied. At that time, most species had been described based on their morphological characteristics, which included vesicle shape and macroconidial dimensions and septation (Crous & Wingfield 1994, Crous 2002). However, with a large number of DNA sequences now available from recent taxonomic studies of the genus *Calonectria* (Lombard *et al.* 2010b, 2015a, Alfenas *et al.* 2015), the initial identifications could be either confirmed or corrected. This study, vividly highlights the impact that DNA sequence data have had in providing more accurate identifications of filamentous fungi (Crous *et al.* 2015a, 2016). Identifications at this level are already impacting substantially on agricultural and forestry practices as well as in the trade in food and fibre products (Crous *et al.* 2016).

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