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Cladosporium species in indoor environments

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Abstract: As part of a worldwide survey of the indoor mycobiota about 520 new *Cladosporium* isolates from indoor environments mainly collected in China, Europe, New Zealand, North America and South Africa were investigated by using a polyphasic approach to determine their species identity. All *Cladosporium* species occurring in indoor environments are fully described and illustrated. Fourty-six *Cladosporium* species are treated of which 16 species are introduced as new. A key for the most common *Cladosporium* species isolated from indoor environments is provided. *Cladosporium halotolerans* proved to be the most frequently isolated *Cladosporium* species indoors.

Key words: Indoor molds, New species, Phylogeny, Taxonomy, 16 new taxa.

Taxonomic novelties: New species: *Cladosporium aerium* Bensch & Samson, *C. coloradense* Bensch & Samson, *C. domesticum* Bensch & Samson, *C. europaeum* Bensch & Samson, *C. needhamense* Bensch & Samson, *C. neerlandicum* Bensch & Samson, *C. neolangeronii* Bensch & Samson, *C. parahalotolerans* Bensch & Samson, *C. parasubtilissimum* Bensch & Samson, *C. pulvericola* Bensch & Samson, *C. sinense* Bensch & Samson, *C. sloanii* Bensch & Samson, *C. uwebraunianum* Bensch & Samson, *C. vicinum* Bensch & Samson, *C. westerdijkiae* Bensch & Samson, *C. wyomingense* Bensch & Samson.

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INTRODUCTION

The monophyletic genus *Cladosporium* residing in the *Cladosporiaceae* (*Dothideomycetes*) is well circumscribed by having a unique coronate structure of its conidiogenous loci and conidial hila, consisting of a central convex dome surrounded by a raised periclinal rim (David 1997, Braun *et al.* 2003). It has been intensively studied in the last two decades to separate it from cladosporium-like genera (Seifert *et al.* 2004, Heuchert *et al.* 2005, Crous *et al.* 2006, Crous *et al.* 2007b, Schubert *et al.* 2007a, Braun *et al.* 2008, Bezerra *et al.* 2017, Crous *et al.* 2017). Three major species complexes are recognised within the genus, mainly based on morphology, and used for practical purposes, viz. the *C. herbarum*, *C. sphaerospermum* and *C. cladosporioides* species complexes. Morphological features describing the three species complexes have been summarised in Bensch *et al.* (2012, 2015) and Marin-Felix *et al.* (2017). Most of the *Cladosporium* species can be referred to one of the three species complexes based on their morphology. The genus previously encompassed more than 772 names (Dugan *et al.* 2004) of which only 170 were recognized as true *Cladosporium* species in a monographic treatment (Bensch *et al.* 2012). Due to continuous isolations from a range of substrates, collected on continents, this number has increased up to 218 species (Crous *et al.* 2014, Bensch *et al.* 2015, Braun *et al.* 2015, Razafinarivo *et al.* 2016, Marin-Felix *et al.* 2017), including several new species isolated from clinical samples in the United States (Sandoval-Denis *et al.* 2016) and from soil samples in China (Ma *et al.* 2017).

However, little is known about which *Cladosporium* species occur in indoor environments. Besides *Aspergillus*, *Penicillium* and *Talaromyces* (*Trichocomaceae*, *Eurotiomycetes*) *Cladosporium* is considered among the commonest genera found indoors (Flannigan 2001, Visagie *et al.* 2014), with some species being predominate under ambient conditions.

Cladosporium species are among the most abundant fungi in outdoor and indoor air (Fradkin *et al.* 1987, Flannigan 2001, Horner *et al.* 2004). In fact, *C. cladosporioides* was reported to be the most predominant fungus in houses in Ontario and Atlanta (Fradkin *et al.* 1987, Horner *et al.* 2004) and the most abundant fungus in outdoor air (Fradkin *et al.* 1987). As the composition of indoor species reflects the composition of outdoor species one would expect to find *C. cladosporioides* as dominant indoors.

In the present study a multilocus DNA sequence typing approach, employing three loci [the internal transcribed spacers of the rDNA genes (ITS), and partial actin and translation elongation factor 1-alpha gene sequences], as well as morphological examinations and cultural charactersitics were used for the identification and delimitation of more than 500 isolates from indoor environments belonging to the genus *Cladosporium*.

MATERIAL AND METHODS

Isolates

Isolates included in this study were obtained from the culture collection of the Westerdijk Fungal Biodiversity Institute (former

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CBS-KNAW Fungal Biodiversity Centre; CBS), Utrecht, the Netherlands, from the working collection of Pedro Crous (CPC) and from the working collection of the Applied and Industrial Mycology department (DTO), both housed at the Westerdijk Institute. Isolates were inoculated onto 2 % potato-dextrose agar (PDA), synthetic nutrient-poor agar (SNA), 2 % malt extract agar (MEA), oatmeal agar (OA) (Crous *et al.* 2009), as well as dichloran 18 % glycerol agar (DG18) and Malt extract + 20 % sucrose (for *Cladosporium sloanii* sp. nov.) (Samson *et al.* 2010), and incubated under continuous near-ultraviolet light at 25 °C to promote sporulation. All cultures in this study are maintained at the Westerdijk Institute (Table 1). Nomenclatural novelties and descriptions were deposited in MycoBank (www. mycobank.org; Crous *et al.* 2004).

DNA isolation, amplification and sequence analysis

Fungal colonies were established on agar plates, and genomic DNA was isolated as described in Groenewald *et al.* (2013). DNA amplification of the internal transcribed spacer regions and intervening 5.8S rRNA gene (ITS) of the nrDNA cistron, partial actin (*act*) and translation elongation factor 1-alpha (*tef1*) genes followed Groenewald *et al.* (2005, 2013). The ITS was not included in the multigene phylogenetic analyses as this locus has limited resolution below genus level.

Novel sequences generated in this study were added to draft alignments representing the *C. cladosporioides*, *C. herbarum* and *C. sphaerospermum* species complexes and containing sequences from several studies (Zalar *et al.* 2007, Schubert *et al.* 2007b, 2009, Bensch *et al.* 2010, 2012, 2015, Segers *et al.* 2015, Sandoval-Denis *et al.* 2016, Ma *et al.* 2017). Based on draft phylogenetic trees, these alignments were subsequently trimmed back to include representatives of previously published sequences and species rather than all available sequences. Preference was also given to the inclusion of sequences from indoor environments where possible.

Phylogenetic analyses consisted of maximum parsimony (MP), maximum likelihood (ML) and Bayesian (BI) analyses of the trimmed combined *act*/*tef1* alignments representing the *C. cladosporioides*, *C. herbarum* and *C. sphaerospermum* species complexes. In addition, a phylogenetic analysis was performed using only the available ITS sequences. The phylogenetic analyses were performed as described by Wang *et al.* (2016) with the following modifications: for the MP analyses 100 random taxon additions were used and for the BI analyses trees were sampled every 100 generations and the heating parameter was set to 0.15 for the *C. cladosporioides* and *C. herbarum* and *C. sphaerospermum* species complexes. Novel sequences were deposited in NCBI's GenBank nucleotide database (Table 1) and the alignments and trees in TreeBASE (study accession number 21415).

Morphology

Light microscopy (LM): Microscopic observations of isolates were made from colonies cultivated for 7 d under continuous near ultraviolet light at 25 °C on SNA. Preparations were mounted in Shear's solution (Crous *et al.* 2009). To study conidial development and branching patterns of conidial chains, squares of transparent adhesive tape (Titan Ultra Clear Tape, Conglom Inc., Toronto, Canada) were placed on conidiophores growing in the zone between the colony margin and 2 cm inwards, and mounted between two drops of Shear's solution under a glass cover slip. Conidial terminology follows Schubert *et al.* (2007b). Wherever possible, 50 measurements (×1 000 magnification, differential interference contrast microscopy, Zeiss Axioscope 2 PLUS) were made of conidia with outliers given in parentheses. For culture characteristics colonies were cultivated on PDA, OA and MEA for 14 d at 25 °C in the dark, after which surface and reverse colours were rated using the charts of Rayner (1970). Photographs of characteristic structures were captured with a Zeiss Axio Imager A2 microscope equipped with a Nikon DS-Ri2 high-definition colour camera head using differential interference contrast (DIC) optics and the Nikon software NIS-elements D v. 4.50.

Low-temperature scanning electron microscopy (SEM): Isolates of *Cladosporium* spp. were grown on SNA with 30 g agar/L for 3–7 d at room temperature under black light. Relevant parts of the small colonies with conidiophores and conidia were selected carefully under a dissecting microscope, excised with a surgical blade as small agar (3 × 3 mm) blocks, and transferred into a copper cup for snap-freezing in nitrogen slush. Agar blocks were glued to the copper surface with frozen tissue medium (KP-Cryoblock, Klinipath, Duiven, The Netherlands). To ensure preservation of the very delicate spatial structure of the conidiophore Scotch tape was placed loosely on the cup. This prevented that the liquid nitrogen damaged the conidiophores. During freezing the tape was disconnected from the cup. Samples were examined in a JEOL 5600LV scanning electron microscope (JEOL, Tokyo, Japan) equipped with an Oxford CT1500 Cryostation for cryo-scanning electron microscopy (cryoSEM). Electron micrographs were acquired from uncoated frozen samples, or after sputter-coating by means of a goldtarget for several (typically 3, but dependent on the density of the gold layer) times during 30 s. Micrographs of uncoated samples were taken at an acceleration voltage of 2,5 kV, and consisted out of 30 averaged fast scans (SCAN 2 mode), and at 5 kV in case of the coated samples (SCAN 4 mode).

RESULTS

DNA phylogeny

Three phylogenetic analyses were performed on each of the combined *act*/*tef1* alignments, representing the *C. cladosporioides*, *C. herbarum* and *C. sphaerospermum* species complexes. Core statistics for the different analyses are shown in Table 2. Additional details on the phylogenetic trees are provided in the species notes where necessary. Overall, the phylogenies presented in Figs 1–3 are highly similar in terms of the terminal clades irrespective of whether the phylogenetic trees were obtained from the maximum parsimony, Bayesian or maximum-likelihood analyses (data not shown, trees deposited in TreeBASE).

The *C. cladosporioides* species complex phylogeny presented in Fig. 1 delimits 66 species clades. The position of clades changes between the different analyses, as can be observed by the low or absent support values on the backbone of the tree. In general, the BI phylogeny contained more polytomies for species clades and therefore the MP phylogeny is presented in Fig. 1. In

Table 1. *Cladosporium* isolates treated in the species phylogeny with their Genbank and culture collection accession numbers.

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
Cercospora beticola	outgroup	CBS 116456; CPC 11557	*Beta vulgaris*	Italy	V. Rossi	AY840527	AY840494	AY840458
Cladosporium acalyphae	cladosporioides	CBS 125982*; CPC 11625	*Acalypha australis*	South Korea	H.D. Shin	HM147994	HM148235	HM148481
C. aciculare	sphaerospermum	CBS 140488*; CPC 16547	*Syzygium corynanthum*	Australia	P.W. Crous	KT600411	KT600509	KT600607
C. aerium sp. nov.	herbarum	CBS 143356*; DTO 323-B4	Indoor air	China	—	MF472897	MF473324	MF473747
		DTO 323-G6	Indoor air	China	—	MF472898	MF473325	MF473748
		DTO 323-G7	Indoor air	China	—	MF472899	MF473326	MF473749
C. aggregatocicatricatum	herbarum	CBS 113751	Grape berry	USA: WA	F.M. Dugan lab	KT600449	KT600548	KT600646
		CBS 140493*; CPC 14709; ICMP 170869	Culture contaminant	New Zealand	C.F. Hill	KT600448	KT600547	KT600645
		CBS 284.84	Tempeh	Netherlands	—	KT600450	KT600549	KT600647
C. alboflavescens	cladosporioides	CBS 140690*; UTHSC DI-13-225; FMR 13338	Animal, bronchoalveolar lavage fluid	USA: CA	—	LN834420	LN834516	LN834604
C. allicinum	herbarum	CBS 110024	Industrial water	Germany	—	EF679343	EF679417	EF679495
		CBS 115683; ATCC 66670; CPC 5101	CCA-treated Douglas-fir pole	USA: NY	—	AY361959	EF679418	AY752193
		CBS 121624*; CPC 12211	*Hordeum vulgare*	Belgium	J.Z. Groenewald	EF679350	EF679425	EF679502
		CBS 139578; DTO 109-I5	Indoor environment	Denmark	B. Andersen	KP701921	KP701798	KP702044
		CBS 134.31; ATCC 11283; IMI 049632; NCPF 2564	—	Germany	—	EF679335	EF679406	EF679485
		CBS 157.82	*Quercus robur*, leaf spot	Belgium	—	EF679336	EF679407	EF679486
		CBS 159.54; ATCC 36948	Man, skin of hand	Netherlands	—	EF679337	EF679408	EF679487
		CBS 161.55	Man, sputum	Netherlands	—	EF679338	EF679409	EF679488
		CBS 177.71; JCM 11500	Thuja tincture	Netherlands	—	EF679339	EF679410	EF679489
		CBS 188.54; ATCC 11290; IMI 049638; STE-U 3686	—	—	—	AY251077	EF679411	EF679490
		CBS 366.80	Man, skin of hand	Netherlands	St. Barbara Ziekenhuis Geleen	EF679340	EF679412	EF679491
		CBS 399.80	Man, skin of foot	Netherlands	St. Barbara Ziekenhuis Geleen	AJ244227	EF679413	EF679492
		CBS 521.68	Air	Netherlands	—	EF679341	EF679414	EF679493
		CBS 572.78; VKM F-405	*Polyporus radiatus*	Russia	—	DQ289799	EF679415	DQ289866
		CBS 813.71	*Polygonatum odoratum*, leaf	Czech Republic	—	EF679342	EF679416	EF679494
		CPC 11386	*Tilia cordata*, leaves	Germany	K. Schubert	EF679344	EF679419	EF679496
		CPC 11840	*Ourisia macrophylla*			EF679345	EF679420	EF679497
		CPC 12042; EXF-389	Hypersaline water, salterns (reserve pond)	Slovenia	P. Zalar	EF679346	EF679421	EF679498
		CPC 12045; EXF-594	Hypersaline water, salterns (crystallisation pond)	Spain	New Zealand	A. Blouin	EF679422	EF679499
		CPC 12046; EXF-680	Air conditioning system	Slovenia	M. Butala	EF679348	EF679423	EF679500
		CPC 12139	*Hordeum vulgare*	Netherlands	P.W. Crous	EF679349	EF679424	EF679501
		CPC 12212	*Hordeum vulgare*	Belgium	J.Z. Groenewald	EF679351	EF679426	EF679503

(*continued on next page*)

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CPC 12921	*Eucalyptus stellulata*, leaves	Australia	B.A. Summerell	EF679352	EF679427	EF679504
		CPC 22268; EMSL 1726	Indoor air sample	USA: MN	Ž. Jurjević	MF472900	MF473327	MF473750
		CPC 22312; EMSL 1808	Indoor air sample	USA: NJ	Ž. Jurjević	MF472901	MF473328	MF473751
		CPC 22313; EMSL 1809	Indoor air sample	USA: NJ	Ž. Jurjević	MF472902	MF473329	MF473752
		CPC 22343; EMSL 1856	Indoor air sample, bedroom	USA: NY	Ž. Jurjević	MF472903	MF473330	MF473753
		CPC 22349; EMSL 1862	Indoor air sample, bedroom	USA: CA	Ž. Jurjević	MF472904	MF473331	MF473754
		CPC 22358; EMSL 1871	Indoor air sample	UK: England	Ž. Jurjević	MF472905	MF473332	MF473755
		CPC 22377; EMSL 1890	Indoor air sample, bedroom	USA: NY	Ž. Jurjević	MF472906	MF473333	MF473756
		DTO 005-E8	Indoor environment	Germany	G. Fischer	MF472907	MF473334	MF473757
		DTO 084-F3	Indoor environment	Germany	LGA	KP701883	KP701760	KP702006
		DTO 086-D5	Swab sample, archive	Netherlands	M. Meijer	KP701888	KP701765	KP702011
		DTO 089-B9	Air sample, kitchen	Netherlands	M. Meijer	KP701891	KP701768	KP702014
		DTO 089-G4	Air sample, bedroom	Netherlands	J. Houbraken	KP701894	KP701771	KP702017
		DTO 089-G6	Air sample, bedroom	Netherlands	J. Houbraken	KP701895	KP701772	KP702018
		DTO 089-H3	Air sample, bathroom	Netherlands	J. Houbraken	KP701896	KP701773	KP702019
		DTO 090-D3	Swab sample, archive	Netherlands	M. Meijer	KP701900	KP701777	KP702023
		DTO 090-H4	Swab sample, archive	Netherlands	M. Meijer	MF472908	MF473335	MF473758
		DTO 101-A1	Indoor environment, wet wall	Netherlands	J. Houbraken	KP701903	KP701780	KP702026
		DTO 101-I8	Floor under curtain	Hungary	—	MF472909	MF473336	MF473759
		DTO 106-C2	Indoor air, crocodile area of zoo	Netherlands	B. Dictus	KP701906	KP701783	KP702029
		DTO 108-F9	Indoor environment	France	J. Dijksterhuis	MF472910	MF473337	MF473760
		DTO 109-E5; BA 1905	Indoor environment	Denmark	B. Andersen	MF472911	MF473338	MF473761
		DTO 109-E6; BA 1906	Indoor environment	Denmark	B. Andersen	KP701912	KP701789	KP702035
		DTO 109-F3; BA 1918	Indoor environment	Denmark	B. Andersen	KP701916	KP701793	KP702039
		DTO 109-F5; BA 1920	Indoor environment	Denmark	B. Andersen	KP701918	KP701795	KP702041
		DTO 109-I3; BA 1897	Indoor environment	Denmark	B. Andersen	MF472912	MF473339	MF473762
		DTO 110-B7	Wall of basement	Denmark	B. Andersen	KP701923	KP701800	KP702046
		DTO 111-A5	Air sample, bedroom	Denmark	U. Thrane	KP701924	KP701801	KP702047
		DTO 127-E4; AR377	Air sample, bakery	USA: GA	—	MF472913	MF473340	MF473763
		DTO 147-I6	Indoor environment	Hungary	—	MF472914	MF473341	MF473764
		DTO 323-C3	Indoor air	China	—	MF472915	MF473342	MF473765
		DTO 323-E1	Indoor air	China	—	MF472916	MF473343	MF473766
		DTO 323-G5	Indoor air	China	—	MF472917	MF473344	MF473767
C. allii	herbarum	CBS 101.81; ATCC 200948; PD 80/165	*Allium porrum*, velvet spots	Netherlands	—	JN906977	JN906983	JN906996
C. angulosum	cladosporioides	CBS 140692*; UTHSC DI-13-235; FMR 13348	Man, bronchoalveolar lavage fluid	USA: TX	D.A. Sutton	LN834425	LN834521	LN834609
		CPC 11526	*Acacia mangium*	Thailand	W. Himaman	HM148127	HM148371	HM148616
		CPC 14566	*Corymbia foelscheana*	Australia	B.A. Summerell	HM148147	HM148391	HM148636
		CPC 22271; EMSL 1741	Indoor air sample	USA: SC	Ž. Jurjević	MF472918	MF473345	MF473768
C. angustiherbarum	herbarum	CBS 140479*; CPC 17814	*Pinus ponderosa*	USA: UT	W. Quaedvlieg	KT600378	KT600475	KT600574

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
C. angustisporum	cladosporioides	CBS 125983*; CPC 12437	*Alloxylon wickhamii*	Australia	B.A. Summerell	HM147995	HM148236	HM148482
		CPC 22345; EMSL 1858	Outside air sample	USA: AL	Ž. Jurjević	MF472919	MF473346	MF473769
		CPC 22371; EMSL 1884	Indoor air sample, office	USA: FL	Ž. Jurjević	MF472920	MF473347	MF473770
		DTO 127-E6; AR387	Air sample, bakery	USA: WI	—	KP701935	KP701812	KP702057
C. angustiterminale	cladosporioides	CBS 140480*; CPC 15564	*Banksia grandis*	Australia	A.R. Wood	KT600379	KT600476	KT600575
C. antarcticum	herbarum	CBS 690.92*	*Caloplaca regalis*	Antarctica	C. Moller	EF679334	EF679405	EF679484
C. anthropophilum	cladosporioides	CBS 117483; CPC 11684	—	USA	M. Blackwell	HM148007	HM148248	HM148494
		CBS 122130; ATCC 38012; IFO 6539; JCM 10684; NBRC 6539	Bamboo slats	Japan	—	HM148008	HM148249	HM148495
		CBS 140685*; FMR 13382; UTHSC DI-13-269	Man, bronchoalveolar lavage fluid	USA: MN	D.A. Sutton	LN834437	LN834533	LN834621
		CBS 132.29	—	—	—	HM148010	HM148251	HM148497
		CBS 674.82; ATCC 200936; ATCC 38026; CBS 320.87; IMI 126640	*Gossypium* sp., seed	Israel	—	HM148014	HM148255	HM148501
		CPC 10142	*Chenopodium ficifolium*	South Korea	H.D. Shin	HM148015	HM148256	HM148502
		CPC 11119	*Ricinus communis*	South Korea	H.D. Shin	HM148016	HM148257	HM148503
		CPC 11122	*Phytolacca americana*	South Korea	H.D. Shin	HM148019	HM148260	HM148506
		CPC 11123	*Vigna unguiculata* (= *V. sinensis*)	South Korea	H.D. Shin	HM148020	HM148261	HM148507
		CPC 11131	*Dalbergia* sp.	India	W. Gams	HM148021	HM148262	HM148508
		CPC 11406	*Plectranthus* sp.	South Korea	H.D. Shin	HM148026	HM148267	HM148513
		CPC 12852	Pruned wood	USA: LA	K. Seifert	HM148032	HM148273	HM148519
		CPC 13235	*Eucalyptus* sp.	Australia	P.W. Crous	HM148033	HM148274	HM148520
		CPC 13734	*Areca* sp.	Thailand	I. Hidayat	HM148036	HM148277	HM148523
		CPC 14009; MRC 10150	*Triticum aestivum*	South Africa	—	HM148037	HM148278	HM148524
		CPC 14356; BA 1676	Food, coffee leaf	Uganda	J.L. Sørensen	HM148049	HM148290	HM148536
		CPC 14705	*Fraxinus chinensis* subsp. *rhynchophylla*	South Korea	H.D. Shin	HM148050	HM148291	HM148537
		CPC 15038	*Eucalyptus* sp., endophyte spots	Indonesia	M.J. Wingfield	HM148051	HM148292	HM148538
		CPC 22272; EMSL 1722	Indoor air sample, ship	USA: CA	Ž. Jurjević	MF574171	MF574173	MF574175
		CPC 22315; EMSL 1818	Indoor air sample, living room	USA: GA	Ž. Jurjević	MF472921	MF473348	MF473771
		CPC 22393; EMSL 1908	Indoor air sample, hospital	USA: AZ	Ž. Jurjević	MF472922	MF473349	MF473772
		DTO 127-E9; AR409	Air sample, bakery	USA: GA	—	MF472923	MF473350	MF473773
		DTO 317-I7	Indoor air	China	—	MF472924	MF473351	MF473774
		DTO 318-E3	Indoor air	China	—	MF472925	MF473352	MF473775
		DTO 323-C2	Indoor air	China	—	MF472926	MF473353	MF473776
		DTO 323-C6	Indoor air	China	—	MF472927	MF473354	MF473777
		DTO 323-C7	Indoor air	China	—	MF472928	MF473355	MF473778
		DTO 323-D2	Indoor air	China	—	MF472929	MF473356	MF473779
		DTO 323-D8	Indoor air	China	—	MF472930	MF473357	MF473780

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Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 323-D9	Indoor air	China	—	MF472931	MF473358	MF473781
		DTO 324-C4	Indoor air	China	—	MF472932	MF473359	MF473782
		DTO 324-D3	Indoor air	China	—	MF472933	MF473360	MF473783
		UTHSC DI-13-207; FMR 13320	Man, cerebrospinal fluid	USA: TX	D.A. Sutton	LN834413	LN834509	LN834597
		UTHSC DI-13-226; FMR 13339	Man, bronchoalveolar lavage fluid	USA: TX	D.A. Sutton	LN834421	LN834517	LN834605
C. aphidis	sphaerospermum	CBS 132182**; CPC 13204	Unidentified aphid	Germany	N. Ale-Agha	JN906978	JN906984	JN906997
C. arthropodii	herbarum	CBS 124043**; CPC 16160	*Arthropodium cirratum*	New Zealand	C.F. Hill	JN906979	JN906985	JN906998
C. asperulatum	cladosporioides	CBS 126339; CPC 11158	*Eucalyptus* leaf litter	India	W. Gams	HM147997	HM148238	HM148484
		CBS 126340*; CPC 14040	*Protea susannae*	Portugal	—	HM147998	HM148239	HM148485
		CPC 22364; EMSL 1877	Indoor air sample, bathroom	USA: CA	Ž. Jurjević	MF472934	MF473361	MF473784
C. australiense	cladosporioides	CBS 125984*; CPC 13226	*Eucalyptus moluccana*	Australia	B.A. Summerell	HM147999	HM148240	HM148486
C. austroafricanum	cladosporioides	CBS 140481*; CPC 16763	Leaf litter	South Africa	M. Gryzenhout	KT600381	KT600478	KT600577
C. austrohemisphaericum	sphaerospermum	CBS 140482*; CPC 12068	*Lagunaria patersonia,* black mould on fruit surface	New Zealand	C.F. Hill	KT600382	KT600479	KT600578
		CPC 16250	*Cussonia thyrsiflora*	South Africa	P.W. Crous	KT600383	KT600480	—
		CPC 17029	*Musa* sp.	Australia	P.W. Crous	KT600384	KT600481	KT600579
		DTO 305-E8; TA05NZ-351A	House dust	New Zealand	T. Atkinson	MF472935	MF473362	MF473785
C. basiinflatum	herbarum	CBS 822.84*	*Hordeum vulgare*	Germany	—	HM148000	HM148241	HM148487
C. chalastosporoides	cladosporioides	CBS 125985*; CPC 13864	Fruiting bodies of *Teratosphaeria proteae-arboreae* on leaves of *Protea nitida*	South Africa	P.W. Crous	HM148001	HM148242	HM148488
C. chubutense	cladosporioides	CBS 124457*; CPC 13979; CIEFAP 321	*Pinus ponderosa*	Argentina	A. Greslebin	FJ936158	FJ936161	FJ936165
C. cladosporioides	cladosporioides	CBS 101367; IMI 379759	Soil	Brazil	—	HM148002	HM148243	HM148489
		CBS 112388*; DTO 039-G6	Air, indoor environment	Germany	Ch. Trautmann	HM148003	HM148244	HM148490
		CBS 113738	Grape bud	USA: WA	F.M. Dugan lab	HM148004	HM148245	HM148491
		CBS 113739	Culm node of crested wheat grass	USA: WA	F.M. Dugan lab	HM148005	HM148246	HM148492
		CBS 113740	Grape berry	USA: WA	F.M. Dugan lab	HM148006	HM148247	HM148493
		CBS 126341; CPC 12763	*Spinacia oleracea*, seed	USA: WA	L. du Toit	HM148009	HM148250	HM148496
		CBS 143.35; MUCL 10090	*Pisum sativum*	South Africa	B.J. Dippenaar	HM148011	HM148252	HM148498
		CBS 144.35; ATCC 11284; IFO 6371; IMI 049627	*Pisum sativum*	USA: CA	—	HM148012	HM148253	HM148499
		CBS 145.35; MUCL 926	*Pisum sativum*	Germany	—	HM148013	HM148254	HM148500
		CPC 11120	*Viola mandshurica*	South Korea	H.D. Shin	HM148017	HM148258	HM148504
		CPC 11121	*Celosia cristata*	South Korea	H.D. Shin	HM148018	HM148259	HM148505

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CPC 11161	*Eucalyptus* sp.	India	W. Gams	HM148022	HM148263	HM148509
		CPC 11393	*Valeriana officinalis*	South Korea	H.D. Shin	HM148023	HM148264	HM148510
		CPC 11398	*Phragmidium griseum* on *Rubus crataegifolius*	South Korea	H.D. Shin	HM148024	HM148265	HM148511
		CPC 11404	*Rubus coreanus*	South Korea	H.D. Shin	HM148025	HM148266	HM148512
		CPC 12187	*Stellaria aquatica*, leaves	South Korea	H.D. Shin	HM148027	HM148268	HM148514
		CPC 12214	*Morus rubra*, leaves	Germany	N. Ale-Agha	HM148028	HM148269	HM148515
		CPC 12760	*Spinacia oleracea*, seed	USA: WA	L. du Toit	HM148029	HM148270	HM148516
		CPC 12762	*Spinacia oleracea*, seed	USA: WA	L. du Toit	HM148030	HM148271	HM148517
		CPC 12764	*Spinacia oleracea*, seed	USA: WA	L. du Toit	HM148031	HM148272	HM148518
		CPC 13667	*Eucalyptus robertsonii* subsp. *hemisphaerica*	Australia	B.A. Summerell	HM148034	HM148275	HM148521
		CPC 13669	*Eucalyptus robertsonii* subsp. *hemisphaerica*	Australia	B.A. Summerell	HM148035	HM148276	HM148522
		CPC 14015; MRC 10260	*Triticum aestivum*	South Africa	—	HM148038	HM148279	HM148525
		CPC 14017; MRC 10809	*Triticum aestivum*	South Africa	—	HM148039	HM148280	HM148526
		CPC 14018; MRC 10810	*Triticum aestivum*	South Africa	—	HM148040	HM148281	HM148527
		CPC 14019; MRC 10813	*Triticum aestivum*	South Africa	—	HM148041	HM148282	HM148528
		CPC 14021; MRC 10827	*Triticum aestivum*	South Africa	—	HM148042	HM148283	HM148529
		CPC 14024; MRC 11280	*Asimina* sp.	South Africa	—	HM148043	HM148284	HM148530
		CPC 14244	*Magnolia* sp.	USA: LA	P.W. Crous	HM148044	HM148285	HM148531
		CPC 14271	Twigs of an unidentified tree	France	P.W. Crous	HM148045	HM148286	HM148532
		CPC 14292; BA 1691	Soil, pea field	Denmark	B. Andersen	HM148046	HM148287	HM148533
		CPC 14293; BA 1692	Cellulose powder, paint manufacturer	Denmark	B. Andersen	HM148047	HM148288	HM148534
		CPC 14355; BA 1676	Food, mouldy pea	USA: WY	J.L. Sørensen	HM148048	HM148289	HM148535
		CPC 15167; HJS 1069	Living mite inhabiting a strawberry leaf	Slovenia	—	HM148052	HM148293	HM148539
		CPC 18230	*Phaenocoma prolifera*, leaf bracts	South Africa	K.L. Crous & P.W. Crous	JF499834	JF499872	JF499878
		CPC 22264; EMSL 1722	Indoor air sample	USA: GA	Ž. Jurjević	MF472936	MF473363	MF473786
		CPC 22265; EMSL 1723	Indoor air sample	USA: MN	Ž. Jurjević	MF472937	MF473364	MF473787
		CPC 22347; EMSL 1860	Indoor air sample, bedroom	USA: MI	Ž. Jurjević	MF472938	MF473365	MF473788
		CPC 22348; EMSL 1861	Indoor air sample, kitchen	USA: FL	Ž. Jurjević	MF472939	MF473366	MF473789
		CPC 22365; EMSL 1878	Indoor air sample, bedroom	USA: VT	Ž. Jurjević	MF472940	MF473367	MF473790
		CPC 22367; EMSL 1880	Indoor air sample, living room	USA: VA	Ž. Jurjević	MF472941	MF473368	MF473791
		CPC 22380; EMSL 1893	Indoor air sample, bedroom	USA: AZ	Ž. Jurjević	MF472942	MF473369	MF473792
		DTO 082-F1	Indoor air sample, living room	Netherlands	B. Favié	KP701879	KP701756	KP702002
		DTO 090-C6	Swab sample, archive	Netherlands	M. Meijer	KP701898	KP701775	KP702021
		DTO 101-G2	Indoor environment, table	Hungary	—	MF472943	MF473370	MF473793
		DTO 101-H7	Floor under curtain	Hungary	—	MF472944	MF473371	MF473794
		DTO 102-A4	Bathroom	Hungary	van Mil	KP701905	KP701782	KP702028

(*continued on next page*)

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 109-I4; BA 1898	Indoor environment	Denmark	B. Andersen	KP701920	KP701797	KP702043
		DTO 109-I6; BA 1900	Indoor environment	Denmark	B. Andersen	KP701922	KP701799	KP702045
		DTO 127-D8; AR362	Air sample, bakery	Netherlands	—	KP701933	KP701810	KP702055
		DTO 147-A9	Indoor environment	Hungary	—	KP701941	KP701818	KP702063
C. colocasiae	cladosporioides	CBS 115191; CPC 4323; Lynfield 436	*Colocasia esculenta* (=*C. antiquorum*)	Fiji	C.F. Hill	AY251075	HM148308	HM148553
		CBS 119542; CPC 12726; JCM 13264	*Colocasia esculenta* (=*C. antiquorum*)	Japan	—	HM148066	HM148309	HM148554
		CBS 386.64*; ATCC 200944; MUCL 10084	*Colocasia esculenta* (=*C. antiquorum*)	Taiwan	K. Sawada	HM148067	HM148310	HM148555
		CPC 5124	*Apium graveolens*	New Zealand	C.F. Hill	AY251076	HM148311	HM148556
C. colombiae	cladosporioides	CBS 274.80B*	*Cortaderia* sp.	Colombia	W. Gams	FJ936159	FJ936163	FJ936166
C. coloradense sp. nov.	sphaerospermum	CBS 143357*; CPC 22238; EMSL 1685	Air sample, bedroom	USA: CO	Ž. Jurjević	MF472945	MF473372	MF473795
C. crousii	cladosporioides	CBS 140686*; UTHSC DI-13-247; FMR 13360	Man, bronchoalveolar lavage fluid	USA: SC	D.A. Sutton	LN834431	LN834527	LN834615
C. cucumerinum	cladosporioides	CBS 158.51; ATCC 11279; IFO 6370; IMI 049628; VKM F-817	*Cucumis sativus*	Netherlands	—	HM148071	HM148315	HM148560
		CBS 171.52*; MUCL 10092	*Cucumis sativus*	Netherlands	—	HM148072	HM148316	HM148561
		CBS 172.54	*Cucumis sativus*	Netherlands	G.W. van der Helm	HM148073	HM148317	HM148562
C. cycadicola	sphaerospermum	CBS 137970*; CPC 17251	*Cycas media*, leaves	Australia	P.W. Crous & R.G. Shivas	KJ869122	KJ869236	KJ869227
C. delicatulum	cladosporioides	CBS 126342; CPC 14287; BA 1681	Indoor air	Denmark	B. Andersen	HM148079	HM148323	HM148568
		CBS 126343; CPC 14299; BA 1698	Building material	Denmark	B. Andersen	HM148080	HM148324	HM148569
		CBS 126344*; CPC 11389	*Tilia cordata*, leaves	Germany	K. Schubert	HM148081	HM148325	HM148570
		CBS 139574; DTO 082-F3	Indoor air, living room	Netherlands	B. Favié	KP701880	KP701757	KP702003
		CPC 14285; BA 1679	Indoor air	Denmark	B. Andersen	HM148083	HM148327	HM148572
		CPC 14286; BA 1680	Indoor air	Denmark	B. Andersen	HM148084	HM148328	HM148573
		CPC 14289; BA 1683	Door frame	Denmark	B. Andersen	HM148085	HM148329	HM148574
		CPC 14360; BA 1718	Indoor air	Denmark	B. Andersen	HM148087	HM148331	HM148576
		CPC 14363; BA 1724	Indoor air	Denmark	B. Andersen	HM148088	HM148332	HM148577
		CPC 14372; BA 1740	Dust, school	Denmark	B. Andersen	HM148089	HM148333	HM148578
		DTO 090-F4	Swab sample, archive	Netherlands	M. Meijer	MF472946	MF473373	MF473796
		DTO 134-D3; DR22	Indoor environment	Algeria	L. Belhoucine	KP701939	KP701816	KP702061
		DTO 134-D4	Indoor environment, apartment building	Algeria	L. Belhoucine	MF472947	MF473374	MF473797
		DTO 134-D5; O200	Indoor environment, apartment building	Algeria	L. Belhoucine	MF472948	MF473375	MF473798
		DTO 134-D6; BT27	Indoor environment	Algeria	L. Belhoucine	MF472949	MF473376	MF473799
		DTO 134-D7; BT91	Indoor environment	Algeria	L. Belhoucine	MF472950	MF473377	MF473800
		DTO 134-D8; BT92	Indoor environment	Algeria	L. Belhoucine	MF472951	MF473378	MF473801

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 145-C4	Indoor environment	Germany	—	KP701940	KP701817	KP702062
		DTO 167-H5	Indoor air, poultry houses	Poland	K. Plewa	KP701964	KP701841	KP702086
		DTO 168-F8	Indoor air, poultry houses	Poland	K. Plewa	MF472952	MF473379	MF473802
		DTO 305-H7; TA05NZ-346	House dust	New Zealand	T. Atkinson	MF472953	MF473380	MF473803
		DTO 305-I9; TA05NZ-340	House dust	New Zealand	T. Atkinson	MF472954	MF473381	MF473804
C. domesticum sp. nov.	sphaerospermum	CBS 143358*; CPC 22307; EMSL 1803	Indoor air sample	USA: NJ	Ž. Jurjević	MF472955	MF473382	MF473805
		CPC 22225; EMSL 1658	Indoor air sample, air conditioner	USA: PA	Ž. Jurjević	MF472956	MF473383	MF473806
		CPC 22226; EMSL 1659	Indoor air sample, living room	USA: PA	Ž. Jurjević	MF472957	MF473384	MF473807
		CPC 22318; EMSL 1821	Indoor air sample	USA: FL	Ž. Jurjević	MF472958	MF473385	MF473808
		CPC 22402; EMSL 1930	Indoor air sample, classroom	USA: TX	Ž. Jurjević	MF472959	MF473386	MF473809
		CPC 22408; EMSL 1936	Indoor air sample	USA: NJ	Ž. Jurjević	MF472960	MF473387	MF473810
		CPC 22413; EMSL 1962	Attic, wood roofing sample	USA: PA	Ž. Jurjević	MF472961	MF473388	MF473811
		DTO 305-H2; AA03US-480	House dust, basement HVAC room	USA: CA	A. Amend	MF472962	MF473389	MF473812
		DTO 306-B6; AA03US-525	House dust, basement HVAC room	USA: CA	A. Amend	MF472963	MF473390	MF473813
		DTO 307-E8; AA03US-368	House dust, basement HVAC room	USA: CA	A. Amend	MF472964	MF473391	MF473814
		DTO 307-H3; AA03US-402	House dust, basement HVAC room	USA: CA	A. Amend	MF472965	MF473392	MF473815
		DTO 308-B1; AA03US-387	House dust, basement HVAC room	USA: CA	A. Amend	MF472966	MF473393	MF473816
C. dominicanum	sphaerospermum	CBS 119415*; EXF-732; dH 16386	Hypersaline water, salt lake	Dominican Republic	N. Gunde-Cimerman	DQ780353	JN906986	KJ596641
		CPC 11683	*Citrus* sp., fruit	Iran	—	DQ780357	—	EF101369
		CPC 15932	*Dracaena fragrans*	Philippines	C.J.R. Cumagun	KT600390	KT600487	KT600585
		CPC 20109	Unknown vine	Taiwan	P.W. Crous	KT600391	KT600488	KT600586
		CPC 22240; EMSL 1687	Outside air sample	USA: CO	Ž. Jurjević	MF472967	MF473394	MF473817
		CPC 22241; EMSL 1688	Outside air sample	USA: CO	Ž. Jurjević	MF472968	MF473395	MF473818
		CPC 22244; EMSL 1697	Air sample, hospital	Aruba	Ž. Jurjević	MF472969	MF473396	MF473819
		CPC 22319; EMSL 1822	Indoor air sample	Bermuda	Ž. Jurjević	MF472970	MF473397	MF473820
		EXF-696	Hypersaline water, saltern	Dominican Republic	N. Gunde-Cimerman	EF101367	—	EF101367
		EXF-718	Hypersaline water, salt lake	Dominican Republic	N. Gunde-Cimerman	DQ780356	KJ596581	EF101370
		EXF-720	Hypersaline water, saltern	Dominican Republic	N. Gunde-Cimerman	DQ780355	KJ596579	KJ596643
		EXF-727	Hypersaline water, saltern	Dominican Republic	N. Gunde-Cimerman	DQ780354	KJ596580	—
C. echinulatum	herbarum	CBS 123191; CPC 15386; reference	*Dianthus barbatus*	New Zealand	C.F. Hill	JN906980	JN906987	JN906999
C. europaeum sp. nov.	cladosporioides	CBS 116744; dH 14053	*Acer pseudoplatanus*, leaves	Germany	L. Pehl	HM148053	HM148294	HM148540
		CBS 134914*; CPC 14296; BA1695	Indoor building material, school	Denmark	B. Andersen	HM148056	HM148298	HM148543

(*continued on next page*)

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CBS 125.80	*Cirsium vulgare*, seadcoat	Netherlands	—	DQ780941	HM148295	EF101351
		CPC 13220	Lichens on leaves of *Acer platanoides*	Germany	B. Heuchert	HM148054	HM148296	HM148541
		CPC 14238	*Sambucus nigra, fruit*	Netherlands	P.W. Crous	HM148055	HM148297	HM148542
		DTO 056-H7	Swab sample, house	Netherlands	M. Meijer	KP701871	KP701748	KP701994
		DTO 072-E4	Indoor air, archive	Netherlands	M. Meijer	KP701875	KP701752	KP701998
		DTO 086-B3	Swab sample, archive	Netherlands	M. Meijer	KP701886	KP701763	KP702009
		DTO 109-E7; BA 1907	Indoor environment	Denmark	B. Andersen	KP701913	KP701790	KP702036
		DTO 151-H5	Indoor environment	Portugal	—	MF472971	MF473398	MF473821
C. exasperatum	cladosporioides	CBS 125986*; CPC 14638	*Eucalyptus tintinnans*	Australia	B.A. Summerell	HM148090	HM148334	HM148579
C. exile	cladosporioides	CBS 125987*; CPC 11828	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus avellana*	USA: WA	D. Glawe	HM148091	HM148335	HM148580
C. flabelliforme	cladosporioides	CBS 126345*; CPC 14523	*Melaleuca cajuputi*	Australia	B.A. Summerell	HM148092	HM148336	HM148581
C. flavovirens	cladosporioides	CBS 140462*; FMR 13386; UTHSC DI-13-273	Man, toenail	USA: FL	D.A. Sutton	LN834440	LN834536	LN834624
C. floccosum	herbarum	CBS 140463*; FMR 13325; UTHSC DI-13-212	Man, ethmoid sinus	USA: MN	D.A. Sutton	LN834416	LN834512	LN834600
		CPC 15522	*Allium sativum*	Ukraine	A. Akulov	MF472972	MF473399	MF473822
		CPC 17802	Pine needles	Mexico	M. de Jesús Yáñez-Morales	MF472973	MF473400	MF473823
		CPC 22260; EMSL 1715	Indoor air sample	USA: MN	Ž. Jurjević	MF472974	MF473401	MF473824
		CPC 22309; EMSL 1805	Indoor air sample	USA: TN	Ž. Jurjević	MF472975	MF473402	MF473825
		CPC 22354; EMSL 1867	Indoor air sample, living room	USA: CO	Ž. Jurjević	MF472976	MF473403	MF473826
		CPC 22399; EMSL 1927	Indoor air sample, bedroom	USA: MO	Ž. Jurjević	MF472977	MF473404	MF473827
		CPC 22968; EMSL 2033	Indoor air sample, basement	USA: UT	Ž. Jurjević	MF472978	MF473405	MF473828
		DTO 323-H6	Indoor air	China	—	MF472979	MF473406	MF473829
C. funiculosum	cladosporioides	CBS 122128; ATCC 16160; IFO 6536; JCM 10682; NBRC 6536	*Ficus carica*	Japan	—	HM148093	HM148337	HM148582
		CBS 122129*; ATCC 38010; IFO 6537; JCM 10683; NBRC 6537	*Vigna umbellata*	Japan	—	HM148094	HM148338	HM148583
		CPC 22247; EMSL 1705	Air sample, hospital	USA: AL	Ž. Jurjević	MF472980	MF473407	MF473830
		CPC 22282; EMSL 1756	Indoor air sample	USA: NJ	Ž. Jurjević	MF472981	MF473408	—
		CPC 22298; EMSL 1782	Indoor air sample, office	USA: MA	Ž. Jurjević	MF472982	MF473409	MF473831
		CPC 22391; EMSL 1906	Indoor air sample, bedroom	USA: NJ	Ž. Jurjević	MF472983	MF473410	MF473832
		DTO 127-E7; AR405	Air sample, bakery	USA	—	MF472984	MF473411	MF473833
C. fusiforme	sphaerospermum	CBS 119414*; EXF-449	Hypersaline water, saltern	Slovenia	L. Butinar	DQ780388	JN906988	KJ596640
		CBS 452.71	Chicken food	Canada	—	DQ780390	MF473412	EF101371
		EXF-397	Hypersaline water, saltern	Slovenia	—	DQ780389	KJ596595	EF101373
C. gamsianum	cladosporioides	CBS 125989*; CPC 11807	*Strelitzia* sp.	South Africa	W. Gams	HM148095	HM148339	HM148584

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
C. globisporum	cladosporioides	CBS 812.96*	Meat stamp	Sweden	M. Olsen	HM148096	HM148340	HM148585
		CPC 19124; BA 2038	Indoor environment, window frame	Denmark	B. Andersen	MF472985	MF473413	MF473834
C. grevilleae	cladosporioides	CBS 114271*; CPC 2913; JT 974	*Grevillea* sp., leaves	Australia	P.W. Crous & B.A. Summerell	JF770450	JF770472	JF770473
C. halotolerans	sphaerospermum	CBS 114065; DTO 036-G3	Air	Germany	U. Weidner	MF472986	MF473414	MF473835
		CBS 119416*; EXF-572; FMR 13493	Hypersaline water, salterns	Namibia	N. Gunde-Cimerman	DQ780364	JN906989	KJ596633
		CBS 139583; DTO 147-B9	Indoor environment	Hungary	—	KP701942	KP701819	KP702064
		CPC 22275; EMSL 1745	Indoor air sample	USA: SC	Ž. Jurjević	MF472987	MF473415	MF473836
		CPC 22278; EMSL 1749	Indoor air sample, pineapple storage room	USA: DE	Ž. Jurjević	MF472988	MF473416	MF473837
		CPC 22281; EMSL 1755	Indoor air sample, pineapple storage room	USA: DE	Ž. Jurjević	MF472989	MF473417	MF473838
		CPC 22293; EMSL 1774	Indoor air sample, living room	USA: NJ	Ž. Jurjević	MF472990	MF473418	MF473839
		CPC 22308; EMSL 1804	Indoor air sample	USA: NJ	Ž. Jurjević	MF472991	MF473419	MF473840
		CPC 22335; EMSL 1848	Indoor air sample, bedroom	USA: NJ	Ž. Jurjević	MF472992	MF473420	MF473841
		CPC 22337; EMSL 1850	Indoor air sample, 11th floor	USA: NY	Ž. Jurjević	MF472993	MF473421	MF473842
		CPC 22360; EMSL 1873	Indoor air sample, 19th floor	USA: NY	Ž. Jurjević	MF472994	—	MF473843
		CPC 22366; EMSL 1879	Indoor air sample, living room	USA: NJ	Ž. Jurjević	MF472995	MF473422	MF473844
		CPC 22372; EMSL 1885	Indoor air sample, hospital	USA: NY	Ž. Jurjević	MF472996	MF473423	MF473845
		CPC 22381; EMSL 1894	Indoor air sample, bathroom	USA: WI	Ž. Jurjević	MF472997	MF473424	MF473846
		CPC 22390; EMSL 1905	Indoor air sample, bedroom	USA: NJ	Ž. Jurjević	MF472998	MF473425	MF473847
		CPC 22397; EMSL 1925	Indoor air sample, classroom	USA: TX	Ž. Jurjević	MF472999	MF473426	MF473848
		CPC 22401; EMSL 1929	Indoor air sample, living room	USA: NJ	Ž. Jurjević	MF473000	MF473427	MF473849
		CPC 22411; EMSL 1960	Attic, wood roofing sample	USA: PA	Ž. Jurjević	MF473001	MF473428	MF473850
		CPC 22412; EMSL 1961	Attic, wood roofing sample	USA: PA	Ž. Jurjević	MF473002	MF473429	MF473851
		CPC 22414; EMSL 1963	Attic, wood roofing sample	USA: PA	Ž. Jurjević	MF473003	MF473430	MF473852
		dH12862	Culture contaminant	Brazil	—	DQ780371	EF101400	—
		DTO 049-E7	Swab sample, house	Netherlands	J. Houbraken	MF473004	MF473431	MF473853
		DTO 049-E8	Swab sample, house	Netherlands	J. Houbraken	MF473005	MF473432	MF473854
		DTO 102-A1	Bathroom	Hungary	van Mil	KP701904	KP701781	KP702027
		DTO 102-A3	Bathroom	Hungary	van Mil	MF473006	MF473433	MF473855
		DTO 108-F7	Indoor environment	France	J. Dijksterhuis	MF473007	MF473434	MF473856
		DTO 109-D1	Bathroom wall	Thailand	P. Noonim	MF473008	MF473435	MF473857
		DTO 109-D3	Indoor air, open Petri-dish	Thailand	P. Noonim	KP701911	KP701788	KP702034
		DTO 114-H7	Swab sample, indoor environment	Netherlands	P. Noonim	KP701925	KP701802	KP702048
		DTO 114-I3	Swab sample, indoor environment	Netherlands	P. Noonim	KP701926	KP701803	KP702049
		DTO 117-H3; HM2 RS5	Indoor environment of house	Netherlands	M. Meijer & O. Terhoeven	KP701929	KP701806	KP702052

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Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 127-E3; AR373	Air sample, bakery	USA: GA	—	MF473009	MF473436	MF473858
		DTO 127-E8; AR407	Air sample, bakery	USA: GA	—	KP701936	KP701813	KP702058
		DTO 130-C9	Swab sample, food plant	Netherlands	M. Meijer	MF473010	MF473437	MF473859
		DTO 147-B3	Indoor environment	Hungary	—	MF473011	MF473438	MF473860
		DTO 147-B8	Indoor environment	Hungary	—	MF473012	MF473439	MF473861
		DTO 153-C3	Bathroom	Netherlands	F. Hagen	KP701952	KP701829	KP702074
		DTO 153-C5	Bathroom	Netherlands	F. Hagen	MF473013	MF473440	MF473862
		DTO 160-I2	Fungal growth in living room	Netherlands	J. Najafzadeh	MF473014	MF473441	MF473863
		DTO 160-I3	Fungal growth in living room	Netherlands	J. Najafzadeh	MF473015	MF473442	MF473864
		DTO 160-I5	Black spots in bathroom	Netherlands	J. Najafzadeh	MF473016	MF473443	MF473865
		DTO 161-D5	Swab sample, wooden window frame in apartment	Netherlands	J. Houbraken	KP701957	KP701834	KP702079
		DTO 305-E4; AA03US-390	House dust, basement HVAC room	USA: CA	A. Amend	MF473017	MF473444	MF473866
		DTO 305-E5; AA03US-412	House dust, basement HVAC room	USA: CA	A. Amend	MF473018	MF473445	MF473867
		DTO 305-E6; KJ03SA-372	House dust, small apartment	South Africa	K. Jacobs	MF473019	MF473446	MF473868
		DTO 305-E7; KJ03SA-381	House dust, small apartment	South Africa	K. Jacobs	MF473020	MF473447	MF473869
		DTO 305-E9; AA01MX-246	House dust, rental studio	Mexico	A. Amend	MF473021	MF473448	MF473870
		DTO 305-F1; AA03US-378	House dust, basement HVAC room	USA: CA	A. Amend	MF473022	MF473449	MF473871
		DTO 305-F2; PN08TH-553	House dust from four rooms	Thailand	P. Noonim	MF473023	MF473450	MF473872
		DTO 305-F3; AA03US-528	House dust, basement HVAC room	USA: CA	A. Amend	MF473024	MF473451	MF473873
		DTO 305-F4; AA03US-385	House dust, basement HVAC room	USA: CA	A. Amend	MF473025	MF473452	MF473874
		DTO 305-F6; AA07MX-882	House dust, in a hotel	Mexico	A. Amend	MF473026	MF473453	MF473875
		DTO 305-F9; MB02UK-43	House dust, living room, bedroom	UK: England	M. Bidartondo	MF473027	MF473454	MF473876
		DTO 305-G1; MB02UK-62	House dust, living room, bedroom	UK: England	M. Bidartondo	MF473028	MF473455	MF473877
		DTO 305-G2; MB02UK-41	House dust, living room, bedroom	UK: England	M. Bidartondo	MF473029	MF473456	MF473878
		DTO 305-G5; PN09TH-863	House dust, in meeting hall	Thailand	P. Noonim	MF473030	MF473457	MF473879
		DTO 305-G6; AA03US-493	House dust, basement HVAC room	USA: CA	A. Amend	MF473031	MF473458	MF473880
		DTO 305-G7; AA03US-498	House dust, basement HVAC room	USA: CA	A. Amend	MF473032	MF473459	MF473881
		DTO 305-G8; KJ03SA-398	House dust, small apartment	South Africa	K. Jacobs	MF473033	MF473460	MF473882
		DTO 305-G9; AA07MX-872	House dust, in a hotel	Mexico	A. Amend	MF473034	MF473461	MF473883
		DTO 305-H3; AA03US-410	House dust, basement HVAC room	USA: CA	A. Amend	MF473035	MF473462	MF473884

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 305-H6; AA03US-437	House dust, basement HVAC room	USA: CA	A. Amend	MF473036	MF473463	MF473885
		DTO 305-I3; MB02UK-55	House dust, living room, bedroom	UK: England	M. Bidartondo	MF473037	MF473464	MF473886
		DTO 305-I4; AA03US-442	House dust, basement HVAC room	USA: CA	A. Amend	MF473038	MF473465	MF473887
		DTO 305-I6; AA07MX-944	House dust, in a hotel	Mexico	A. Amend	MF473039	MF473466	MF473888
		DTO 305-I8; KJ10SA-43	House dust	South Africa	K. Jacobs	MF473040	MF473467	MF473889
		DTO 306-A2; AA03US-441	House dust, basement HVAC room	USA: CA	A. Amend	MF473041	MF473468	MF473890
		DTO 306-A4; AA03US-523	House dust, basement HVAC room	USA: CA	A. Amend	MF473042	MF473469	MF473891
		DTO 306-A9; AA03US-499	House dust, basement HVAC room	USA: CA	A. Amend	MF473043	MF473470	MF473892
		DTO 306-B1; AA03US-501	House dust, basement HVAC room	USA: CA	A. Amend	MF473044	MF473471	MF473893
		DTO 306-B3; AA03US-471	House dust, basement HVAC room	USA: CA	A. Amend	MF473045	MF473472	MF473894
		DTO 306-B4; AA03US-508	House dust, basement HVAC room	USA: CA	A. Amend	MF473046	MF473473	MF473895
		DTO 306-B5; AA03US-452	House dust, basement HVAC room	USA: CA	A. Amend	MF473047	MF473474	MF473896
		DTO 306-B8; AA03US-558	House dust, basement HVAC room	USA: CA	A. Amend	MF473048	MF473475	MF473897
		DTO 306-B9; AA03US-416	House dust, basement HVAC room	USA: CA	A. Amend	MF473049	MF473476	MF473898
		DTO 306-C2; AA07MX-817	House dust, in a hotel	Mexico	A. Amend	MF473050	MF473477	MF473899
		DTO 306-C5; AA03US-370	House dust, basement HVAC room	USA: CA	A. Amend	MF473051	MF473478	MF473900
		DTO 306-C6; AA03US-369	House dust, basement HVAC room	USA: CA	A. Amend	MF473052	MF473479	MF473901
		DTO 306-C7; AA03US-383	House dust, basement HVAC room	USA: CA	A. Amend	MF473053	MF473480	MF473902
		DTO 306-C8; AA03US-552	House dust, basement HVAC room	USA: CA	A. Amend	MF473054	MF473481	MF473903
		DTO 306-C9; MB02UK-63	House dust, living room, bedroom	UK: England	M. Bidartondo	MF473055	MF473482	MF473904
		DTO 306-D3; AA03US-463	House dust, basement HVAC room	USA: CA	A. Amend	MF473056	MF473483	MF473905
		DTO 306-D4; AA03US-377	House dust, basement HVAC room	USA: CA	A. Amend	MF473057	MF473484	MF473906
		DTO 306-D5; 7050035.81-631	House dust	Canada	Health Canada	MF473058	MF473485	MF473907

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Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 306-D6; AA03US-538	House dust, basement HVAC room	USA: CA	A. Amend	MF473059	MF473486	MF473908
		DTO 306-D7; KJ03SA-370	House dust, small apartment	South Africa	K. Jacobs	MF473060	MF473487	MF473909
		DTO 306-D9; KJ10SA-8	House dust	South Africa	K. Jacobs	MF473061	MF473488	MF473910
		DTO 306-E1; AA03US-425	House dust, basement HVAC room	USA: CA	A. Amend	MF473062	MF473489	MF473911
		DTO 306-E2; AA03US-519	House dust, basement HVAC room	USA: CA	A. Amend	MF473063	MF473490	MF473912
		DTO 306-E5; KJ03SA-382	House dust, small apartment	South Africa	K. Jacobs	MF473064	MF473491	MF473913
		DTO 306-E6; AA03US-564	House dust, basement HVAC room	USA: CA	A. Amend	MF473065	MF473492	MF473914
		DTO 306-E8; AA03US-554	House dust, basement HVAC room	USA: CA	A. Amend	MF473066	MF473493	MF473915
		DTO 306-E9; KJ03SA-364	House dust, small apartment	South Africa	K. Jacobs	MF473067	MF473494	MF473916
		DTO 306-F1; MB02UK-39	House dust, living room, bedroom	UK: England	M. Bidartondo	MF473068	MF473495	MF473917
		DTO 306-F2; KJ09SA-132	House dust	South Africa	K. Jacobs	MF473069	MF473496	MF473918
		DTO 306-F3; AA03US-510	House dust, basement HVAC room	USA: CA	A. Amend	MF473070	MF473497	MF473919
		DTO 306-F4; Arg-26	House dust	Argentina	G. Reppchen	MF473071	MF473498	MF473920
		DTO 307-E9; KJ03SA-393	House dust, small apartment	South Africa	K. Jacobs	MF473072	MF473499	MF473921
		DTO 307-F4; MB02UK-66	House dust, living room, bedroom	UK: England	M. Bidartondo	MF473073	MF473500	MF473922
		DTO 307-F6; KJ10SA-48	House dust	South Africa	K. Jacobs	MF473074	MF473501	MF473923
		DTO 307-F7; AA03US-430	House dust, basement HVAC room	USA: CA	A. Amend	MF473075	MF473502	MF473924
		DTO 307-F8; AA03US-454	House dust, basement HVAC room	USA: CA	A. Amend	MF473076	MF473503	MF473925
		DTO 307-F9; KJ10SA-37	House dust	South Africa	K. Jacobs	MF473077	MF473504	MF473926
		DTO 307-G1; AA03US-426	House dust, basement HVAC room	USA: CA	A. Amend	MF473078	MF473505	MF473927
		DTO 307-G2; TA10NZ-207A	House dust	New Zealand	T. Atkinson	MF473079	MF473506	MF473928
		DTO 307-G3; AA03US-448	House dust, basement HVAC room	USA: CA	A. Amend	MF473080	MF473507	MF473929
		DTO 307-G4; MB02UK-49	House dust, living room, bedroom	UK: England	M. Bidartondo	MF473081	MF473508	MF473930
		DTO 307-G5; AA03US-429	House dust, basement HVAC room	USA: CA	A. Amend	MF473082	MF473509	MF473931
		DTO 307-G7; AA03US-420	House dust, basement HVAC room	USA: CA	A. Amend	MF473083	MF473510	MF473932
		DTO 307-G8; AA03US-515	House dust, basement HVAC room	USA: CA	A. Amend	MF473084	MF473511	MF473933

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 307-H5; AA03US-431	House dust, basement HVAC room	USA: CA	A. Amend	MF473085	MF473512	MF473934
		DTO 307-H6; AA03US-428	House dust, basement HVAC room	USA: CA	A. Amend	MF473086	MF473513	MF473935
		DTO 307-H7; AA03US-421	House dust, basement HVAC room	USA: CA	A. Amend	MF473087	MF473514	MF473936
		DTO 307-H8; AA03US-460	House dust, basement HVAC room	USA: CA	A. Amend	MF473088	MF473515	MF473937
		DTO 307-H9; AA03US-484	House dust, basement HVAC room	USA: CA	A. Amend	MF473089	MF473516	MF473938
		DTO 307-I1; AA03US-423	House dust, basement HVAC room	USA: CA	A. Amend	MF473090	MF473517	MF473939
		DTO 307-I4; AA03US-440	House dust, basement HVAC room	USA: CA	A. Amend	MF473091	MF473518	MF473940
		DTO 307-I7; AA03US-511	House dust, basement HVAC room	USA: CA	A. Amend	MF473092	MF473519	MF473941
		DTO 307-I8; AA03US-381	House dust, basement HVAC room	USA: CA	A. Amend	MF473093	MF473520	MF473942
		DTO 308-A1; AA03US-401	House dust, basement HVAC room	USA: CA	A. Amend	MF473094	MF473521	MF473943
		DTO 308-A3; AA03US-422	House dust, basement HVAC room	USA: CA	A. Amend	MF473095	MF473522	MF473944
		DTO 308-A4; AA03US-467	House dust, basement HVAC room	USA: CA	A. Amend	MF473096	MF473523	MF473945
		DTO 308-A5; AA03US-432	House dust, basement HVAC room	USA: CA	A. Amend	MF473097	MF473524	MF473946
		DTO 308-A6; AA03US-411	House dust, basement HVAC room	USA: CA	A. Amend	MF473098	MF473525	MF473947
		DTO 308-A7; AA03US-391	House dust, basement HVAC room	USA: CA	A. Amend	MF473099	MF473526	MF473948
		DTO 308-A8; AA03US-507	House dust, basement HVAC room	USA: CA	A. Amend	MF473100	MF473527	MF473949
		DTO 308-A9; AA03US-400	House dust, basement HVAC room	USA: CA	A. Amend	MF473101	MF473528	MF473950
		DTO 308-B3; AA03US-520	House dust, basement HVAC room	USA: CA	A. Amend	MF473102	MF473529	MF473951
		DTO 308-B4; AA03US-464	House dust, basement HVAC room	USA: CA	A. Amend	MF473103	MF473530	MF473952
		DTO 308-B6; AA03US-408	House dust, basement HVAC room	USA: CA	A. Amend	MF473104	MF473531	MF473953
		DTO 308-B7; AA01MX-245	House dust, rental studio	Mexico	A. Amend	MF473105	MF473532	MF473954

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Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 323-C4	Indoor air	China	—	MF473106	MF473533	MF473955
		DTO 323-F3	Indoor air	China	—	MF473107	MF473534	MF473956
		DTO 323-F6	Indoor air	China	—	MF473108	MF473535	MF473957
		DTO 323-F8	Indoor air	China	—	MF473109	MF473536	MF473958
		DTO 323-F9	Indoor air	China	—	MF473110	MF473537	MF473959
		DTO 323-G9	Indoor air	China	—	MF473111	MF473538	MF473960
		DTO 323-H4	Indoor air	China	—	MF473112	MF473539	MF473961
		DTO 323-I2	Indoor air	China	—	MF473113	MF473540	MF473962
		DTO 323-I3	Indoor air	China	—	MF574172	MF574174	MF574176
		DTO 323-I7	Indoor air	China	—	MF473114	MF473541	MF473963
		DTO 324-B3	Indoor air	China	—	MF473115	MF473542	MF473964
		DTO 324-B4	Indoor air	China	—	MF473116	MF473543	MF473965
		DTO 324-B5	Indoor air	China	—	MF473117	MF473544	MF473966
		DTO 324-B6	Indoor air	China	—	MF473118	MF473545	MF473967
		DTO 324-C1	Indoor air	China	—	MF473119	MF473546	MF473968
C. herbaroides	herbarum	CBS 121626*; CPC 12052; EXF-1733	Hypersaline water, salterns	Israel	P. Zalar	EF679357	EF679432	EF679509
C. herbarum	herbarum	CBS 121621**; ATCC MYA-4682; CPC 12177	*Hordeum vulgare*	Netherlands	P.W. Crous	EF679363	EF679440	EF679516
		CBS 121622; CPC 11600	*Delphinium barbeyi*, stems	USA: CO	A. Ramaley	DQ289800	EF679435	DQ289867
		CBS 111.82; JCM 11532	*Arctostaphylos uva-ursi*	Switzerland	—	AJ238469	EF679433	EF679510
		CBS 300.49	*Biscutella laevigata*	Switzerland	—	EF679358	EF679434	EF679511
		CPC 11601	*Delphinium barbeyi*, stems	USA: CO	A. Ramaley	EF679359	EF679436	EF679512
		CPC 11602	*Delphinium barbeyi*, stems	USA: CO	A. Ramaley	EF679360	EF679437	EF679513
		CPC 11603	*Delphinium barbeyi*, stems	USA: CO	A. Ramaley	EF679361	EF679438	EF679514
		CPC 11604	*Delphinium barbeyi*, stems	USA: CO	A. Ramaley	EF679362	EF679439	EF679515
		CPC 12178	*Hordeum vulgare*	Netherlands	P.W. Crous	EF679364	EF679441	EF679517
		CPC 12179	*Hordeum vulgare*	Netherlands	P.W. Crous	EF679365	EF679442	EF679518
		CPC 12180	*Hordeum vulgare*	Netherlands	P.W. Crous	EF679366	EF679443	EF679519
		CPC 12181	*Hordeum vulgare*	Netherlands	P.W. Crous	EF679367	EF679444	EF679520
		CPC 12183	*Hordeum vulgare*	Netherlands	P.W. Crous	EF679368	EF679445	EF679521
C. hillianum	cladosporioides	CBS 125988*; CPC 15459; C92	*Typha orientalis*, leaf mold	New Zealand	R. Beever	HM148097	HM148341	HM148586
		CPC 15458	*Typha orientalis*, leaf mold	New Zealand	R. Beever	HM148098	HM148342	HM148587
C. inversicolor	cladosporioides	CBS 139573; DTO 072-C9	Indoor air, archive	Netherlands	M. Meijer	KP701874	KP701751	KP701997
		CBS 401.80*; ATCC 200941	*Triticum aestivum*, leaf	Netherlands	—	HM148101	HM148345	HM148590
		CBS 484.80	*Cortaderia* sp.	Colombia	—	HM148103	HM148347	HM148592
		CPC 11818	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus avellana*	USA: WA	D. Glawe	HM148104	HM148348	HM148593
		CPC 14190	Outside air	Netherlands	M. Meijer	HM148106	HM148350	HM148595

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CPC 14191	Outside air	Netherlands	M. Meijer	HM148107	HM148351	HM148596
		CPC 14241	*Sambucus nigra*, fruit	Netherlands	P.W. Crous	HM148108	HM148352	HM148597
		CPC 14368; BA 1735	School dust	Denmark	B. Andersen	HM148109	HM148353	HM148598
		CPC 19108; BA 2015	Indoor air	Denmark	B. Andersen	MF473120	MF473547	MF473969
		CPC 22287; EMSL 1763	Indoor air sample, bedroom	USA: OR	Ž. Jurjević	MF473121	MF473548	MF473970
		CPC 22289; EMSL 1765	Indoor air sample, living room	USA: AK	Ž. Jurjević	MF473122	—	MF473971
		CPC 22300; EMSL 1788	Indoor air sample, living room	USA: OR	Ž. Jurjević	MF473123	MF473549	MF473972
		CPC 22385; EMSL 1900	Indoor air sample, bedroom	USA: WA	Ž. Jurjević	MF473124	MF473550	MF473973
		DTO 108-F8	Indoor environment	France	J. Dijksterhuis	KP701908	KP701785	KP702031
		DTO 109-E9; BA 1909	Indoor environment	Denmark	B. Andersen	MF473125	MF473551	MF473974
C. ipereniae	cladosporioides	CBS 140483*; CPC 16238	*Puya* sp.	Chile	A. van Iperen	KT600394	KT600491	KT600589
		CPC 16855	*Arctostaphylos pallida*	USA: CA	P.W. Crous	KT600395	KT600492	KT600590
C. iranicum	cladosporioides	CBS 126346*; CPC 11554	*Citrus sinensis*, leaf	Iran	W. Gams	HM148110	HM148354	HM148599
C. iridis	herbarum	CBS 107.20	—	—	—	EF679369	EF679446	EF679522
		CBS 138.40**	*Iris* sp., leaves	Netherlands	—	EF679370	EF679447	EF679523
C. langeronii	sphaerospermum	CBS 101880	Moist aluminium school window frame	Belgium	E.S. Hoekstra	DQ780380	MF473552	EF101359
		CBS 139581; DTO 124-D5	Air sample, food plant	Netherlands	M. Meijer	KP701931	KP701808	KP702053
		CBS 189.54*	Man, mycosis	Brazil	Fonseca	DQ780379	JN906990	EF101357
		CBS 601.84	*Picea abies*, wood	Germany	—	DQ780382	MF473553	EF101360
		CPC 19121; BA 2035	Indoor air	Denmark	—	MF473126	MF473554	MF473975
		CPC 22235; EMSL 1681	Indoor air sample, storage room	USA: DE	Ž. Jurjević	MF473127	MF473555	MF473976
		CPC 22261; EMSL 1716	Indoor air sample	USA: MN	Ž. Jurjević	MF473128	MF473556	MF473977
		CPC 22299; EMSL 1783	Indoor air sample	USA: PA	Ž. Jurjević	MF473129	MF473557	MF473978
		CPC 22325; EMSL 1831	Indoor air sample, washroom	Ireland	Ž. Jurjević	MF473130	MF473558	MF473979
		CPC 22326; EMSL 1832	Indoor air sample, washroom	Ireland	Ž. Jurjević	MF473131	MF473559	MF473980
		DTO 004-C3	Swab sample, house	Netherlands	J. Houbraken	MF473132	MF473560	MF473981
		DTO 085-H6	Indoor air, archive	Netherlands	M. Meijer	KP701885	KP701762	KP702008
		DTO 124-D2	Air sample, food plant	Netherlands	M. Meijer	MF473133	MF473561	MF473982
C. lebrasiae	sphaerospermum	CBS 138283*; UBOCC-A-112063	Milk bread	France	M. Le Bras	KJ596568	KJ596583	KJ596631
C. licheniphilum	cladosporioides	CBS 125990*; CPC 13224	Lichen *Phaeophysica orbicularis* and *Physcia* sp. on stems and bark of *Acer platanoides*	Germany	W. von Brackel	HM148111	HM148355	HM148600
C. limoniforme	herbarum	CBS 113737	Grape berry	USA: WA	F.M. Dugan lab	KT600396	KT600493	KT600591
		CBS 140484*; CPC 12039	*Musa acuminata*	Egypt	R.S. Summerbell	KT600397	KT600494	KT600592
		CGMCC 3.18037	*Populus euphratica*, rhizosphere	China	Y. Hao	KX938396	KX938413	KX938379
		CGMCC 3.18038	*Populus euphratica*, rhizosphere	China	—	KX938397	KX938414	KX938380
		CPC 12048; EXF-1060	Hypersaline water	Israel	P. Zalar	KT600398	KT600495	KT600593
		CPC 12049; EXF-1062	Hypersaline water	Israel	P. Zalar	KT600399	KT600496	KT600594

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Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CPC 12050; EXF-1081	Hypersaline water	Israel	P. Zalar	KT600400	KT600497	KT600595
		CPC 13923	*Eucalyptus* sp.	Cyprus	A. van Iperen	KT600401	KT600498	KT600596
		CPC 18086; KSU C1	Tomato	—	—	KT600402	KT600499	KT600597
		CPC 22350; EMSL 1863	Indoor air sample, bedroom	USA: CA	Ž. Jurjević	MF473134	MF473562	MF473983
		CPC 22384; EMSL 1899	Sample from under kitchen sink	USA: CA	Ž. Jurjević	MF473135	MF473563	MF473984
		CPC 22394; EMSL 1909	Indoor air sample, hospital	USA: AZ	Ž. Jurjević	MF473136	MF473564	MF473985
		CPC 22395; EMSL 1910	Indoor air sample, hospital	USA: AZ	Ž. Jurjević	MF473137	MF473565	MF473986
		DTO 082-F2	Indoor air, living room	Netherlands	B. Favié	MF473138	MF473566	MF473987
		DTO 090-H8	Swab sample, archive	Netherlands	M. Meijer	KP701901	KP701778	KP702024
		DTO 305-G4; BH02AU-115	House dust	Australia: Tasmania	B. Horton	MF473139	MF473567	MF473988
C. longicatenatum	cladosporioides	CBS 140485*; CPC 17189	Unknown plant	Australia	P.W. Crous	KT600403	KT600500	KT600598
C. longissimum	sphaerospermum	CBS 300.96*	Soil along coral reef coast	Papua New Guinea	A. Aptroot	DQ780352	EU570259	EF101385
C. lycoperdinum	cladosporioides	CBS 126347; CPC 12102	Galls of *Apiosporina morbosa* on *Prunus* sp.	Canada	K.A. Seifert	HM148112	HM148356	HM148601
		CBS 126348; CPC 11833	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus avellana*	USA: WA	D. Glawe	HM148113	HM148357	HM148602
		CBS 274.80C	*Puya* sp.	Colombia	W. Gams	HM148114	HM148358	HM148603
		CBS 574.78C; VKM F-2759	*Aureobasidium caulivorum*	Russia	—	HM148115	HM148359	HM148604
		CPC 22256; EMSL 1711.b	Outside air sample	USA: MN	Ž. Jurjević	MF473140	MF473568	MF473989
C. macrocarpum	herbarum	CBS 121623*; CPC 12752	*Spinacia oleracea*	USA: WA	L. du Toit	EF679375	EF679453	EF679529
		CBS 121811; CPC 12755	*Spinacia oleracea*	USA: WA	L. du Toit	EF679376	EF679454	EF679530
		CBS 175.82	Water	Romania	—	EF679371	EF679448	EF679524
		CBS 223.31; ATCC 11287; IFO 6379; IMI 049635; JCM 11501	*Mycosphaerella tulasnei*	—	—	AF222830	EF679449	EF679525
		CBS 299.67	*Triticum aestivum*	Turkey	—	EF679372	EF679450	EF679526
		CPC 11817	Cleistothecia of *Phyllactinia guttata* on leaves of *Corylus* sp.	USA: WA	D. Glawe	EF679373	EF679451	EF679527
		CPC 12054; EXF-2287	Hypersaline water, salterns (precrystalisation pond)	Slovenia	P. Zalar	EF679374	EF679452	EF679528
		CPC 12756	*Spinacia oleracea*	USA: WA	L. du Toit	EF679377	EF679455	EF679531
		CPC 12757	*Spinacia oleracea*	USA: WA	L. du Toit	EF679378	EF679456	EF679532
		CPC 12758	*Spinacia oleracea*	USA: WA	L. du Toit	EF679379	EF679457	EF679533
		CPC 12759	*Spinacia oleracea*	USA: WA	L. du Toit	EF679380	EF679458	EF679534
		CPC 14305; BA 1704	Indoor environment, dust, school	Denmark	B. Andersen	MF473141	MF473569	MF473990
C. montecillanum	cladosporioides	CBS 140486*; CPC 17953	Pine needles	Mexico	M. de Jesús Yáñez-Morales	KT600406	KT600504	KT600602
		CPC 15605	*Taraxacum* sp.	Mexico	M. de Jesús Yáñez-Morales	KT600407	KT600505	KT600603
		CPC 17804	Pine needles	Mexico	M. de Jesús Yáñez-Morales	KT600408	KT600506	KT600604

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
C. myrtacearum	cladosporioides	CBS 126349; CPC 13689; NSM 734672	*Eucalyptus placita*	Australia	B.A. Summerell	HM148116	HM148360	HM148605
		CBS 126350*; CPC 14567	*Corymbia foelscheana*	Australia	B.A. Summerell	HM148117	HM148361	HM148606
C. needhamense sp. nov.	cladosporioides	CBS 143359*; CPC 22353; EMSL 1866	Indoor air sample, office	USA: MA	Ž. Jurjević	MF473142	MF473570	MF473991
C. neerlandicum sp. nov.	cladosporioides	CBS 143360*; DTO 086-C5	Swab sample, archive	Netherlands	M. Meijer	KP701887	KP701764	KP702010
C. neolangeronii sp. nov.	sphaerospermum	CBS 109868	Mortar of Muro Farnesiano	Italy	C. Urzi	DQ780377	MF473571	EF101362
		CBS 797.97*	Indoor environment	Netherlands	O. Adan	MF473143	—	MF473992
		CPC 22236; EMSL 1682	Indoor air sample, pineapple storage room	USA: DE	Ž. Jurjević	MF473144	MF473572	MF473993
		CPC 22262; EMSL 1717	Outside air sample	USA: MN	Ž. Jurjević	MF473145	MF473573	MF473994
		CPC 22263; EMSL 1718	Indoor air sample	USA: MN	Ž. Jurjević	MF473146	MF473574	—
		CPC 22266; EMSL 1724	Indoor air sample	USA: MN	Ž. Jurjević	MF473147	MF473575	MF473995
		CPC 22267; EMSL 1725	Indoor air sample	USA: MN	Ž. Jurjević	MF473148	MF473576	MF473996
		CPC 22314; EMSL 1810	Indoor air sample	USA: NJ	Ž. Jurjević	MF473149	—	MF473997
		DTO 162-A4	Wall in a storage room of antiquities with mold growth	Netherlands	J. Houbraken	KP701962	KP701839	KP702084
C. neopsychrotolerans	cladosporioides	CGMCC 3.18031*	*Saussurea involucrata*, rhizosphere soil	China	G. Wang	KX938383	KX938400	KX938366
		CGMCC 3.18032	*Saussurea involucrata*, rhizosphere soil	China	G. Wang	KX938384	KX938401	KX938367
C. ossifragi	herbarum	CBS 842.91*; ATCC 200946	*Narthecium ossifragum*, green leaf	Norway	M. di Menna	EF679381	EF679459	EF679535
		CBS 843.91	*Narthecium ossifragum*, green leaf	Norway	M. di Menna	EF679382	EF679460	EF679536
C. oxysporum	cladosporioides	CBS 125991; CPC 14371; IBT 14868	Soil, near the terracotta army	China	S. Gravesen	HM148118	HM148362	HM148607
		CBS 126351; CPC 14308; IBT 25029	Indoor air	Venezuela	B. Andersen	HM148119	HM148363	HM148608
C. paracladosporioides	cladosporioides	CBS 171.54*; ATCC 11278, 200943; IFO 6369; IMI 049626; MUCL 917; NCTC 4097	—	—	—	HM148120	HM148364	HM148609
C. parahalotolerans sp. nov.	sphaerospermum	CBS 139585*; DTO 161-D3	Swab sample, apartment	Netherlands	J. Houbraken	KP701955	KP701832	KP702077
		CPC 22280; EMSL 1754	Indoor air sample, hotel room	USA: ME	Ž. Jurjević	MF473150	MF473577	MF473998
		CPC 22330; EMSL 1843	Indoor air sample, family room	USA: NH	Ž. Jurjević	MF473151	—	MF473999
		CPC 22336; EMSL 1849	Indoor air sample	USA: NJ	Ž. Jurjević	MF473152	MF473578	MF474000
		CPC 22342; EMSL 1855	Indoor air sample, 18th floor	USA: NY	Ž. Jurjević	MF473153	—	MF474001
		CPC 22373; EMSL 1886	Indoor air sample, hospital	USA: NY	Ž. Jurjević	MF473154	—	MF474002

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Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CPC 22376; EMSL 1889	Indoor air sample, hospital	USA: NY	Ž. Jurjević	MF473155	—	MF474003
		DTO 161-D6	Swab sample, apartment	Netherlands	J. Houbraken	KP701958	KP701835	KP702080
		DTO 305-F7; AA07MX-953	House dust, in a hotel	Mexico	A. Amend	MF473156	MF473579	MF474004
		DTO 305-F8; AA07MX-935	House dust, in a hotel	Mexico	A. Amend	MF473157	MF473580	MF474005
		DTO 305-I5; AA03MX-750	House dust, in a hardware store	Mexico	A. Amend	MF473158	MF473581	MF474006
		DTO 306-C1; AA07MX-836	House dust, in a hotel	Mexico	A. Amend	MF473159	MF473582	MF474007
		DTO 306-E4; AA02MX-573	House dust, in a church	Mexico	A. Amend	MF473160	MF473583	MF474008
		DTO 307-H4; AA03MX-612	House dust, in a hardware store	Mexico	A. Amend	MF473161	MF473584	MF474009
		DTO 323-B8	Indoor air	China	—	MF473162	MF473585	MF474010
		DTO 323-C1	Indoor air	China	—	MF473163	MF473586	MF474011
		DTO 323-C8	Indoor air	China	—	MF473164	MF473587	MF474012
		DTO 323-F4	Indoor air	China	—	MF473165	MF473588	MF474013
		DTO 323-H2	Indoor air	China	—	MF473166	MF473589	MF474014
		DTO 323-H3	Indoor air	China	—	MF473167	MF473590	MF474015
		DTO 324-A7	Indoor air	China	—	MF473168	MF473591	MF474016
		DTO 324-B7	Indoor air	China	—	MF473169	MF473592	MF474017
C. paralimoniforme	herbarum	CGMCC 3.18103*	Meadow soil	China	J. Zhuang	KX938392	KX938409	KX938375
		CGMCC 3.18104	*Thododendron* sp., rhizosphere soil	China	Y. Hao	KX938393	KX938410	KX938376
C. parapenidielloides	cladosporioides	CBS 140487*; CPC 17193	*Eucalyptus* sp.	Australia	P.W. Crous	KT600410	KT600508	KT600606
C. parasubtilissimum sp. nov.	herbarum	CBS 143361*; CPC 22332; EMSL 1845	Indoor air sample, bathroom	USA: NM	Ž. Jurjević	MF473170	MF473593	MF474018
		CPC 22396; EMSL 1924	Indoor air sample, recreational vehicle	USA: CA	Ž. Jurjević	MF473171	MF473594	MF474019
C. penidielloides	sphaerospermum	CBS 140489*; CPC 17674	*Acacia verticillata*	Australia	P.W. Crous	KT600412	KT600510	KT600608
C. perangustum	cladosporioides	CBS 125996*; CPC 13815	*Cussonia* sp.	South Africa	P.W. Crous	HM148121	HM148365	HM148610
		CBS 126365; CPC 11820	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus avellana*	USA: WA	D. Glawe	HM148123	HM148367	HM148612
		CPC 11663	*Oncoba spinosa*	New Zealand	C.F. Hill	HM148128	HM148372	HM148617
		CPC 11815	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus* sp.	USA: WA	D. Glawe	HM148130	HM148374	HM148619
		CPC 11819	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus* sp.	USA: WA	D. Glawe	HM148131	HM148375	HM148620
		CPC 11821	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus* sp.	USA: WA	D. Glawe	HM148132	HM148376	HM148621
		CPC 11831	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus* sp.	USA: WA	D. Glawe	HM148133	HM148377	HM148622
		CPC 12216	*Morus rubra*	Germany	N. Ale-Agha	HM148135	HM148379	HM148624
		CPC 13727	*Teratosphaeria maculiformis*	South Africa	P.W. Crous	HM148139	HM148383	HM148628
		CPC 13730	*Protea caffra*	South Africa	P.W. Crous	HM148140	HM148384	HM148629

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CPC 13774	*Protea caffra*	South Africa	P.W. Crous	HM148141	HM148385	HM148630
		CPC 13870	*Teratosphaeria fibrillosa*	South Africa	P.W. Crous	HM148142	HM148386	HM148631
		CPC 14247	*Magnolia* sp.	USA: LA	P.W. Crous	HM148145	HM148389	HM148634
		CPC 15192	*Protea cynaroides*	South Africa	L. Mostert	HM148149	HM148393	HM148638
		CPC 22297; EMSL 1781	Indoor air sample	USA: PA	Ž. Jurjević	MF473172	MF473595	MF474020
		CPC 22327; EMSL 1833	Indoor air sample	USA: ME	Ž. Jurjević	MF473173	—	MF474021
		CPC 22328; EMSL 1834	Indoor air sample	USA: ME	Ž. Jurjević	MF473174	MF473596	MF474022
		CPC 22329; EMSL 1835	Indoor air sample, library	USA: CT	Ž. Jurjević	MF473175	MF473597	MF474023
		CPC 22331; EMSL 1844	Indoor air sample, bedroom closet	USA: CA	Ž. Jurjević	MF473176	MF473598	MF474024
		CPC 22375; EMSL 1888	Indoor air sample, hospital	USA: NY	Ž. Jurjević	MF473177	MF473599	MF474025
		CPC 22378; EMSL 1891	Indoor air sample, bedroom	USA: CA	Ž. Jurjević	MF473178	MF473600	MF474026
		DTO 127-E1; AR368	Air sample, bakery	USA: GA	—	KP701934	KP701811	KP702056
		DTO 127-E2; AR371	Air sample, bakery	USA: GA	—	MF473179	MF473601	MF474027
		DTO 323-E4	Indoor air	China	—	MF473180	MF473602	MF474028
		DTO 323-E8	Indoor air	China	—	MF473181	MF473603	MF474029
		DTO 323-E9	Indoor air	China	—	MF473182	MF473604	MF474030
		DTO 324-A2	Indoor air	China	—	MF473183	MF473605	MF474031
		DTO 324-A6	Indoor air	China	—	MF473184	MF473606	MF474032
		DTO 324-D1	Indoor air	China	—	MF473185	MF473607	MF474033
C. phaenocomae	cladosporioides	CBS 128769*; CPC 18223	*Phaenocoma prolifera*	South Africa	K.L. Crous & P.W. Crous	JF499837	JF499875	JF499881
C. phlei	herbarum	CBS 358.69**	*Phleum pratense*	Germany	—	JN906981	JN906991	JN907000
C. phyllactiniicola	cladosporioides	CBS 126352*; CPC 11836	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus avellana*	USA: WA	D. Glawe	HM148150	HM148394	HM148639
		CBS 126353; CPC 11823	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus avellana*	USA: WA	D. Glawe	HM148151	HM148395	HM148640
C. phyllophilum	cladosporioides	CBS 125992*; CPC 11333	*Taphrina* sp. on *Prunus cerasus*	Germany	K. Schubert	HM148154	HM148398	HM148643
		CPC 13873	*Teratosphaeria proteae-arboreae* on *Protea arborea*	South Africa	P.W. Crous	HM148155	HM148399	HM148644
C. pini-ponderosae	cladosporioides	CBS 124456*; CPC 13980; CIEFAP 322	*Pinus ponderosa*	Argentina	A. Greslebin	FJ936160	FJ936164	FJ936167
C. prolongatum	herbarum	CGMCC 3.18035	*Populus euphratica*, rhizosphere	China	Y. Hao	KX938395	KX938412	KX938378
		CGMCC 3.18036*	*Populus euphratica*, rhizosphere	China	Y. Hao	KX938394	KX938411	KX938377
C. pseudiridis	herbarum	CBS 116463*; LYN 1065	*Iris* sp., large leaf lesions	New Zealand	C.F. Hill	EF679383	EF679461	EF679537
C. pseudochalastosporoides	cladosporioides	CBS 140490*; CPC 17823	Pine needles	Mexico	M. de Jesús Yáñez-Morales	KT600415	KT600513	KT600611
C. pseudocladosporioides	cladosporioides	CBS 117134	Cloud water	—	M. Sancelme	HM148156	HM148400	HM148645

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Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CBS 117153	*Paeonia* sp., living leaves	Germany	R. Kirschner	HM148157	HM148401	HM148646
		CBS 125993*; CPC 14189	Outside air	Netherlands	M. Meijer	HM148158	HM148402	HM148647
		CBS 139575; DTO 084-F1	Indoor environment	Germany	—	KP701881	KP701758	KP702004
		CBS 139580; DTO 121-H1	Bakery	Germany	—	KP701930	KP701807	MF474034
		CBS 149.66; NRRL A-14110	*Triticum aestivum*	USA: IL	—	HM148161	HM148405	HM148650
		CBS 176.82	*Pteridium aquilinum*	Romania	—	HM148162	HM148406	HM148651
		CBS 574.78A; VKM F-422	Mycophilic on unidentified substrate	Russia	—	HM148163	HM148407	HM148652
		CBS 667.80; IHEM 3705	*Malus sylvestris*, leaf	Italy	—	HM148165	HM148409	HM148654
		CBS 673.69	Air	Netherlands	—	EF679353	EF679428	EF679505
		CPC 11605	*Agrimonia pilosa*	South Korea	H.D. Shin	HM148167	HM148411	HM148656
		CPC 12850	Pruned wood	USA: LA	K. Seifert	HM148169	HM148413	HM148658
		CPC 13488	*Vernonia* sp.	Brazil	O. Pereira	HM148171	HM148415	HM148660
		CPC 13992	Kentucky coffee tree, pods	USA: VA	P.W. Crous	HM148174	HM148418	HM148663
		CPC 13998; CAMS 001160	*Aloe dichotoma*	South Africa	—	HM148175	HM148419	HM148664
		CPC 14001; MRC 03240	Oats	South Africa	—	HM148176	HM148420	HM148665
		CPC 14010; MRC 10183	*Sorghum* sp.	South Africa	—	HM148182	HM148426	HM148671
		CPC 14013; MRC 10221	*Triticum aestivum*	South Africa	—	HM148183	HM148427	HM148672
		CPC 14020; MRC 10814	*Triticum aestivum*	South Africa	—	HM148185	HM148429	HM148674
		CPC 14193	Outside air	Netherlands	M. Meijer	HM148186	HM148430	HM148675
		CPC 22237; EMSL 1683	Air sample, car air conditioner	USA: FL	Ž. Jurjević	MF473186	MF473608	MF474035
		CPC 22283; EMSL 1759	Indoor air sample, hotel room	USA: NJ	Ž. Jurjević	MF473187	MF473609	MF474036
		CPC 22284; EMSL 1760	Indoor air sample, hotel room	USA: NJ	Ž. Jurjević	MF473188	MF473610	MF474037
		CPC 22285; EMSL 1761	Indoor air sample, airport - control tower	USA: MA	Ž. Jurjević	MF473189	MF473611	MF474038
		CPC 22292; EMSL 1773	Indoor air sample, living room	USA: NJ	Ž. Jurjević	MF473190	MF473612	MF474039
		CPC 22311; EMSL 1807	Indoor air sample	USA: NJ	Ž. Jurjević	MF473191	MF473613	MF474040
		CPC 22334; EMSL 1847	Indoor air sample, bedroom	USA: OH	Ž. Jurjević	MF473192	MF473614	MF474041
		CPC 22338; EMSL 1851	Indoor air sample	USA: NY	Ž. Jurjević	MF473193	MF473615	MF474042
		CPC 22340; EMSL 1853	Indoor air sample, 27th floor	USA: NY	Ž. Jurjević	MF473194	MF473616	MF474043
		CPC 22341; EMSL 1854	Indoor air sample	USA: NY	Ž. Jurjević	MF473195	MF473617	MF474044
		CPC 22351; EMSL 1864	Indoor air sample, bedroom, 2nd floor	USA: NJ	Ž. Jurjević	MF473196	MF473618	MF474045
		CPC 22356; EMSL 1869	Indoor air sample, bedroom closet	USA: TN	Ž. Jurjević	MF473197	MF473619	MF474046
		CPC 22362; EMSL 1875	Indoor air sample, living room	USA: PA	Ž. Jurjević	MF473198	MF473620	MF474047
		CPC 22368; EMSL 1881	Indoor air sample, office	USA: GA	Ž. Jurjević	MF473199	MF473621	MF474048
		CPC 22369; EMSL 1882	Sumatra dragonfruit sample	USA: NJ	Ž. Jurjević	MF473200	MF473622	MF474049
		CPC 22382; EMSL 1895	Indoor air sample, bathroom	USA: TX	Ž. Jurjević	MF473201	MF473623	MF474050
		CPC 22386; EMSL 1901	Indoor air sample, classroom	USA: RI	Ž. Jurjević	MF473202	MF473624	MF474051
		CPC 22389; EMSL 1904	Indoor air sample, living room	USA: NJ	Ž. Jurjević	MF473203	MF473625	MF474052
		CPC 22392; EMSL 1907	Indoor air sample, hospital	USA: AZ	Ž. Jurjević	MF473204	MF473626	MF474053

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CPC 22966; EMSL 2014	Indoor air sample, office	USA: AZ	Ž. Jurjević	MF473205	MF473627	MF474054
		DTO 079-F4	Wallpaper from a house	Netherlands	J. Hooiveld	KP701877	KP701754	KP702000
		DTO 150-A7	Indoor environment	Portugal	—	MF473206	MF473628	MF474055
		DTO 150-C1	Indoor environment	Portugal	—	KP701943	KP701820	KP702065
		DTO 150-C7	Indoor environment	Portugal	—	MF473207	MF473629	MF474056
		DTO 150-D1	Indoor environment	Portugal	—	MF473208	MF473630	MF474057
		DTO 151-A4	Indoor environment	Portugal	—	MF473209	MF473631	MF474058
		DTO 151-A8	Indoor environment	Portugal	—	MF473210	MF473632	MF474059
		DTO 151-B7	Indoor environment	Portugal	—	MF473211	MF473633	MF474060
		DTO 151-D1	Indoor environment	Portugal	—	KP701946	KP701823	KP702068
		DTO 151-E7	Indoor environment	Portugal	—	MF473212	MF473634	MF474061
		DTO 151-G7	Indoor environment	Portugal	—	KP701949	KP701826	KP702071
		DTO 152-A5	Indoor environment	Portugal	—	MF473213	MF473635	MF474062
		DTO 152-A6	Indoor environment	Portugal	—	MF473214	MF473636	MF474063
		DTO 152-D6	Indoor environment	Portugal	—	MF473215	MF473637	MF474064
		DTO 152-H5	Indoor environment	Portugal	—	MF473216	MF473638	MF474065
		DTO 152-H6	Indoor environment	Portugal	—	MF473217	MF473639	MF474066
		DTO 152-H7	Indoor environment	Portugal	—	MF473218	MF473640	MF474067
		DTO 307-F3; 7330009-34-883	House dust	Canada	Health Canada	MF473219	MF473641	MF474068
		DTO 307-G9; 7050035.81-622	House dust	Canada	Health Canada	MF473220	MF473642	MF474069
		DTO 308-A2; 7330009.24-784	House dust	Canada	Health Canada	MF473221	MF473643	MF474070
		DTO 323-D3	Indoor air	China	—	MF473222	MF473644	MF474071
C. psychrotolerans	sphaerospermum	CBS 119412*; dH 16390; EXF-391	Hypersaline water	Slovenia	S. Sonjak	DQ780386	JN906992	KJ596632
		DTO 305-G3; BH10AU-180	House dust	Australia: Tasmania	L. Agustini	MF473223	MF473645	MF474072
		DTO 307-H2; TA05NZ-343	House dust	New Zealand	T. Atkinson	MF473224	MF473646	MF474073
		EXF-332	Hypersaline water, saltern	Slovenia	—	DQ780385	KJ596591	EF101364
		EXF-714	Hypersaline water	Dominican Republic	—	DQ780384	KJ596592	EF101366
C. pulvericola sp. nov.	sphaerospermum	CBS 109788; DAOM 226470	Indoor air, residence	Canada	—	MF473225	MF473647	MF474074
		CBS 143362*; DTO 305-H8; TA05NZ-345	House dust	New Zealand	T.J. Atkinson	MF473226	MF473648	MF474075
		CPC 22403; EMSL 1931	Indoor air sample, living room	USA: ME	Ž. Jurjević	MF473227	MF473649	MF474076
		DTO 130-D6	Swab sample, food plant	Netherlands	M. Meijer	MF473228	MF473650	MF474077
		DTO 249-F4	Indoor environment, wooden window frame	Netherlands	F. Segers	KP701971	KP701848	KP702093
		DTO 255-F7	Indoor environment, swab sample	Netherlands	G. Piccolo Maitan-Alfenas	KP701979	KP701856	KP702101
		DTO 255-H5	Indoor environment, swab sample	Netherlands	G. Piccolo Maitan-Alfenas	KP701987	KP701864	KP702109
		DTO 307-E7; BH10AU-183	House dust	Australia: Tasmania	L. Agustini	MF473229	MF473651	MF474078
C. puyae	herbarum	CBS 274.80A*	*Puya goudotiana*	Colombia	W. Gams	KT600418	KT600516	KT600614

(*continued on next page*)

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
C. ramotenellum	herbarum	CBS 109031; IBT 13731	Cheese	Denmark	J. Frisvad	KT600419	KT600517	KT600615
		CBS 109501; dH 12343	Man, deep mycosis	Turkey	—	KT600420	KT600518	KT600616
		CBS 121627; CPC 12047; EXF-967	Air conditioning system, bathroom	Slovenia	M. Butala	EF679385	EF679463	EF679539
		CBS 121628*; CPC 12043; EXF-454	Hypersaline water	Slovenia	P. Zalar	EF679384	EF679462	EF679538
		CBS 139577; DTO 089-C1	Air sample, kitchen	Netherlands	M. Meijer	KP701892	KP701769	KP702015
		CBS 118.24; ATCC 36972; MUCL 10098	*Paeonia* sp.	Italy	—	KT600421	KT600519	KT600617
		CBS 133.29; ATCC 36970	*Populus tremuloides*, leaf spot	—	—	KT600422	KT600520	KT600618
		CBS 169.54; CBS 170.54; IMI 025324; NCTC 6740	*Arundo* sp., leaf	UK: England	—	AJ300335	MF473652	MF474079
		CBS 170.54; CBS 169.54; IMI 025324; NCTC 6740	*Arundo* sp., leaf	UK: England	—	AY213640	FJ936162	EF101352
		CBS 261.80	Margarine	Spain	—	KT600423	KT600522	KT600620
		CPC 11395	*Dioscorea tenuipes*	South Korea	H.D. Shin	KT600424	KT600523	KT600621
		CPC 11401	*Weigela subsessilis*	South Korea	H.D. Shin	KT600425	KT600524	KT600622
		CPC 11826	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus* sp.	USA: WA	D. Glawe	KT600426	KT600525	KT600623
		CPC 11832	Chasmothecia of *Phyllactinia guttata* on leaves of *Corylus* sp.	USA: WA	D. Glawe	KT600427	KT600526	KT600624
		CPC 12126; Hill 1192	*Yucca elephantipes*, leaf spot	New Zealand	C.F. Hill	KT600428	KT600527	KT600625
		CPC 12313	*Rosa* sp.	Germany	N. Ale-Agha	KT600429	KT600528	KT600626
		CPC 12385	*Eucalyptus* sp.	Australia	P.W. Crous	KT600430	KT600529	KT600627
		CPC 13407	*Ginkgo biloba*	Portugal	P.W. Crous	KT600431	KT600530	KT600628
		CPC 13789	*Protea* sp.	Spain: Tenerife	P.W. Crous	KT600432	KT600531	KT600629
		CPC 13792	Unknown plant	Spain: Tenerife	P.W. Crous	KT600433	KT600532	KT600630
		CPC 13795	*Leucospermum* sp.	Spain: Tenerife	P.W. Crous	KT600434	KT600533	KT600631
		CPC 13798	*Leucadendron* sp.	Spain: Tenerife	P.W. Crous	KT600435	KT600534	KT600632
		CPC 13801	*Leucadendron* sp.	Spain: Tenerife	P.W. Crous	KT600436	KT600535	KT600633
		CPC 13943	*Quercus infectoria*	Cyprus	A. van Iperen	KT600437	KT600536	KT600634
		CPC 14300; BA 1699	Indoor building material	Denmark	B. Andersen	KT600438	KT600537	KT600635
		CPC 14306; BA1705	Food, garfish gill	Denmark	B. Andersen	KT600439	KT600538	KT600636
		CPC 18224	*Phaenocoma prolifera*, leaf bracts	South Africa	K.L. Crous & P.W. Crous	JF499839	JF499877	JF499883
		CPC 19119; BA 2033	Indoor air	Denmark	B. Andersen	MF473230	MF473653	MF474080
		CPC 22370; EMSL 1883	Indoor air sample, hallway	USA: CA	Ž. Jurjević	MF473231	MF473654	MF474081
		DTO 084-F5	Indoor environment	Germany	LGA	MF473232	MF473655	MF474082
		DTO 097-H3	Swab sample, indoor environment	Netherlands	G.J. Dolphyn	MF473233	MF473656	MF474083

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 109-F4; BA 1919	Indoor environment	Denmark	B. Andersen	KP701917	KP701794	KP702040
		DTO 150-F5	Indoor environment	Portugal	—	MF473234	MF473657	MF474084
		DTO 151-G3	Indoor environment	Portugal	—	KP701947	KP701824	KP702069
		DTO 151-G6	Indoor environment	Portugal	—	KP701948	KP701825	KP702070
		DTO 152-B3	Indoor environment	Portugal	—	MF473235	MF473658	MF474085
		DTO 152-D9	Indoor environment	Portugal	—	KP701950	KP701827	KP702072
		DTO 305-H1; TA10NZ-295	House dust	New Zealand	T. Atkinson	MF473236	MF473659	MF474086
		DTO 305-I1; TA10NZ-240	House dust	New Zealand	T. Atkinson	MF473237	MF473660	MF474087
		DTO 306-A3; TA10NZ-322	House dust	New Zealand	T. Atkinson	MF473238	MF473661	MF474088
		DTO 306-B2; TA10NZ-324	House dust	New Zealand	T. Atkinson	MF473239	MF473662	MF474089
		DTO 306-C4; KJ09SA-88	House dust	South Africa	K. Jacobs	MF473240	MF473663	MF474090
		DTO 306-D1; TA10NZ-215B	House dust	New Zealand	T. Atkinson	MF473241	MF473664	MF474091
		DTO 306-D2; TA10NZ-289A	House dust	New Zealand	T. Atkinson	MF473242	MF473665	MF474092
		DTO 306-E7; TA10NZ-232	House dust	New Zealand	T. Atkinson	MF473243	MF473666	MF474093
		DTO 306-F5; TA10NZ-308	House dust	New Zealand	T. Atkinson	MF473244	MF473667	MF474094
		DTO 307-F2; TA10NZ-297A	House dust	New Zealand	T. Atkinson	MF473245	MF473668	MF474095
		DTO 307-I2; TA10NZ-286	House dust	New Zealand	T. Atkinson	MF473246	MF473669	MF474096
		DTO 323-B7	Indoor air	China	—	MF473247	MF473670	MF474097
		DTO 323-D4	Indoor air	China	—	MF473248	MF473671	MF474098
		DTO 323-D5	Indoor air	China	—	MF473249	MF473672	MF474099
		DTO 323-D6	Indoor air	China	—	MF473250	MF473673	MF474100
C. rectoides	cladosporioides	CBS 125994*; CPC 11624	*Vitis flexuosa*	South Korea	H.D. Shin	HM148193	HM148438	HM148683
		CBS 126357; CPC 11405	*Plectranthus* sp.	South Korea	H.D. Shin	HM148194	HM148439	HM148684
C. rhusicola	herbarum	CBS 140492*; CPC 15219	*Rhus* sp.	South Africa	F. Roets	KT600440	KT600539	KT600637
C. ruguloflabelliforme	sphaerospermum	CBS 140494*; CPC 19707	*Diatrapaceae* sp. on *Aloe* sp.	South Africa	P.W. Crous	KT600458	KT600557	KT600655
C. rugulovarians	cladosporioides	CBS 140495*; CPC 18444	Unidentified *Poaceae*, leaf sheaths	Brazil	P.W. Crous	KT600459	KT600558	KT600656
C. salinae	sphaerospermum	CBS 102047; MZKI B-1069	Hypersaline water, crystalisation pond	Slovenia	S. Sonjak	MF473251	MF473674	MF474101
		CBS 119413*; dH 16389; EXF-335	Hypersaline water, saltern	Slovenia	S. Sonjak	DQ780374	JN906993	EF101390
C. scabrellum	cladosporioides	CBS 126358*; CPC 14976; HJS 1031	*Ruscus hypoglossum*	Slovenia	H.J. Schroers	HM148195	HM148440	HM148685
C. silenes	cladosporioides	CBS 109082*	*Silene maritima*	UK: Wales	A. Aptroot	EF679354	EF679429	EF679506
C. sinense sp. nov.	herbarum	CBS 143363*; DTO 324-D2	Indoor air	China	—	MF473252	MF473675	MF474102
C. sinuatum	cladosporioides	CGMCC 3.18096*	Soil	China	T. Liu	KX938385	KX938402	KX938368
		CGMCC 3.18097	Soil	China	T. Liu	KX938386	KX938403	KX938369
		CGMCC 3.18098	Soil	China	T. Liu	KX938387	KX938404	KX938370
C. sinuosum	herbarum	ATCC 11285; CBS 164.48	Musci	France	—	KT600441	KT600540	KT600638

(*continued on next page*)

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CBS 121629*; CPC 11839; Hill 1134A; ICMP 15819	*Fuchsia excorticata*	New Zealand	A. Blouin	EF679386	EF679464	EF679540
		CBS 393.68	Air	Netherlands	—	KT600442	KT600541	KT600639
		CPC 14000; MRC 02998	*Triticum aestivum*	South Africa	—	KT600443	KT600542	KT600640
		CPC 15454	*Crocus sativus*	New Zealand	J. Rennie	KT600444	KT600543	KT600641
		CPC 17632	*Eryngium maritimum*	Germany	U. Damm	KT600445	KT600544	KT600642
		CPC 18365	*Iris pseudacorus*	Netherlands	P.W. Crous	KT600446	KT600545	KT600643
		DTO 109-I2; BA 1896	Indoor environment	Denmark	B. Andersen	KP701919	KP701796	KP702042
C. sloanii sp. nov.	sphaerospermum	CBS 143364*; DTO 130-D5	Swab sample, food plant	Netherlands	M. Meyer	MF473253	MF473676	MF474103
C. soldanellae	herbarum	CBS 132186*; CPC 13153	*Soldanella alpina*	Germany	K. Bensch	JN906982	JN906994	JN907001
C. sp.	herbarum	CPC 12485	*Pinus ponderosa*	Argentina	A. Greslebin	EF679395	EF679473	EF679549
C. sphaerospermum	sphaerospermum	CBS 102045; EXF-2524; MZKI B-1066	Hypersaline water	Spain	P. Zalar	DQ780351	EU570262	EF101378
		CBS 117728; ATCC 38493; CPC 12098; NRRL 8131	Wood	USA	—	AF393709	EU570268	EU570275
		CBS 139576; DTO 084-F4	Indoor environment	Germany	—	KP701884	KP701761	KP702007
		CBS 139584; DTO 150-H8	Indoor environment	Portugal	—	KP701944	KP701821	KP702066
		CBS 109.14; ATCC 36950; MUCL 10093	*Carya illinoensis*, leaf scale	USA	—	DQ780350	EU570260	EF101384
		CBS 193.54*; ATCC 11289; IMI 49637	Man, nails	Netherlands	G.A. de Vries	DQ780343	EU570261	EU570269
		CPC 11822	*Phyllactinia guttata* on *Corylus avellana*	USA	D. Glawe	EU570254	EU570263	EU570270
		CPC 12476	*Ambrosia artemisiifolia*	Germany	J. Nitzsche	EU570255	EU570264	EU570271
		CPC 13368	*Phaseolus lunatus*	Germany	N. Ale-Agha	EU570256	EU570265	EU570272
		CPC 13995	Thatch	South Africa	G. Marais	EU570257	EU570266	EU570273
		CPC 14016; MRC 10263	*Triticum aestivum*	South Africa	—	EU570258	EU570267	EU570274
		CPC 22270; EMSL 1728	Indoor air sample	USA: MN	Ž. Jurjević	MF473254	MF473677	MF474104
		CPC 22301; EMSL 1789	Indoor air sample, bathroom	USA: CA	Ž. Jurjević	MF473255	MF473678	MF474105
		CPC 22302; EMSL 1790	Indoor air sample, bathroom	USA: CA	Ž. Jurjević	MF473256	MF473679	MF474106
		CPC 22317; EMSL 1820	Indoor air sample	USA: MS	Ž. Jurjević	MF473257	MF473680	MF474107
		CPC 22339; EMSL 1852	Indoor air sample, warehouse	USA: NY	Ž. Jurjević	MF473258	MF473681	MF474108
		CPC 22357; EMSL 1870	Indoor air sample	UK: England	Ž. Jurjević	MF473259	MF473682	MF474109
		CPC 22361; EMSL 1874	Indoor air sample, bedroom	USA: VT	Ž. Jurjević	MF473260	MF473683	MF474110
		CPC 22379; EMSL 1892	Indoor air sample, family room	USA: CA	Ž. Jurjević	MF473261	MF473684	MF474111
		DTO 017-C7	Swab sample, bathroom	Netherlands	J. Houbraken	KP701867	KP701744	KP701990
		DTO 049-H5	Indoor environment	Netherlands	J. Houbraken & M. Meijer	KP701870	KP701747	KP701993
		DTO 086-E7	Air filter	Netherlands	I.J. Vlug	KP701889	KP701766	KP702012
		DTO 086-E8	Air filter	Netherlands	I.J. Vlug	KP701890	KP701767	KP702013
		DTO 089-E9	Indoor air, living room	Netherlands	J. Houbraken	KP701893	KP701770	KP702016
		DTO 090-A1	Indoor air sample, kitchen	Netherlands	J. Houbraken	KP701897	KP701774	KP702020
		DTO 090-H9	Swab sample, archive	Netherlands	M. Meijer	MF473262	MF473685	MF474112

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		DTO 090-I1	Swab sample, archive	Netherlands	M. Meijer	KP701902	KP701779	KP702025
		DTO 106-D4	Indoor air, butterfly area of zoo	Netherlands	B. Dictus	KP701907	KP701784	KP702030
		DTO 117-G5; HM1 RS3	Indoor environment of house	Netherlands	M. Meijer & O. Terhoeven	KP701927	KP701804	KP702050
		DTO 117-H2; HM2 RS4	Indoor environment of house	Netherlands	M. Meijer & O. Terhoeven	KP701928	KP701805	KP702051
		DTO 127-E5; AR385	Air sample, bakery	USA: WI	—	MF473263	MF473686	MF474113
		DTO 150-I3	Indoor environment	Portugal	—	MF473264	MF473687	MF474114
		DTO 150-I8	Indoor environment	Portugal	—	KP701945	KP701822	KP702067
		DTO 153-B7	Indoor air sample, bathroom	Netherlands	F. Hagen	KP701951	KP701828	KP702073
		DTO 153-C1	Indoor air sample, bathroom	Netherlands	F. Hagen	MF473265	MF473688	MF474115
		DTO 160-I4	Black spots in bathroom	Netherlands	J. Najafzadeh	KP701954	KP701831	KP702076
		DTO 161-D4	Swab sample, wall in apartment	Netherlands	J. Houbraken	KP701956	KP701833	KP702078
		DTO 161-D7	Swab sample, apartment	Netherlands	J. Houbraken	KP701959	KP701836	KP702081
		DTO 161-D8	Swab sample, wall near window in apartment	Netherlands	J. Houbraken	KP701960	KP701837	KP702082
		DTO 161-D9	Swab sample, wall near window in apartment	Netherlands	J. Houbraken	KP701961	KP701838	KP702083
		DTO 161-E1	Swab sample, wall near window in apartment	Netherlands	J. Houbraken	MF473266	MF473689	MF474116
		DTO 194-A4	Indoor environment, hospital	Netherlands	V. Zaat	KP701965	KP701842	KP702087
		DTO 244-C6	HA-coated hay pin	Germany	R. Raltenbacher	KP701970	KP701847	KP702092
		DTO 305-F5; KJ03SA-383B	House dust, small apartment	South Africa	K. Jacobs	MF473267	MF473690	MF474117
		DTO 306-D8; AA03US-373	House dust, basement HVAC room	USA: CA	A. Amend	MF473268	MF473691	MF474118
		DTO 306-E3; AA03US-478	House dust, basement HVAC room	USA: CA	A. Amend	MF473269	MF473692	MF474119
		DTO 307-G6; KJ08SA-151	House dust	South Africa	K. Jacobs	MF473270	MF473693	MF474120
		DTO 307-H1; BH02AU-119	House dust	Australia: Tasmania	B. Horton	MF473271	MF473694	MF474121
		DTO 307-I3; AA03US-549	House dust, basement HVAC room	USA: CA	A. Amend	MF473272	MF473695	MF474122
		EXF-1061	Hypersaline water, Dead Sea	Israel	—	DQ780346	—	EF101379
		EXF-455	Hypersaline water, saltern	Slovenia	—	DQ780349	KJ596600	EF101375
		EXF-458	Hypersaline water, saltern	Slovenia	—	DQ780345	—	EF101374
		EXF-738	Bathroom	Slovenia	—	DQ780348	—	EF101383
		EXF-739	Bathroom	Slovenia	—	DQ780344	KJ596601	EF101381
		EXF-962	Bathroom	Slovenia	—	DQ780347	—	EF101382
C. spinulosum	herbarum	CBS 119907*; EXF-334; MZKI B-1067	Hypersaline water	Slovenia	S. Sonjak	EF679388	EF679466	EF679542
		EXF-382	Hypersaline water, saltern	Slovenia	—	DQ780407	—	EF101356
C. subcinereum	herbarum	CBS 140465*; FMR 13370; UTHSC DI-13-257	Man, sputum	USA: MT	D.A. Sutton	LN834433	LN834529	LN834617
C. subinflatum	herbarum	CBS 121630*; CPC 12041; EXF-343	Hypersaline water, saltern	Slovenia	S. Sonjak	EF679389	EF679467	EF679543

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Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CPC 22303; EMSL 1791	Indoor air sample	USA: MN	Ž. Jurjević	MF473273	MF473696	MF474123
		CPC 22400; EMSL 1928	Indoor air sample, bathroom	USA: MO	Ž. Jurjević	MF473274	MF473697	MF474124
C. subtilissimum	herbarum	CBS 113753	Bing cherry fruits	USA	F.M. Dugan lab	EF679396	EF679474	EF679550
		CBS 113754*	Grape berry	USA	F.M. Dugan lab	EF679397	EF679475	EF679551
		CPC 12044; EXF-462	Hypersaline water, saltern (reserve pond)	Slovenia	P. Zalar	EF679398	EF679476	EF679552
C. subuliforme	cladosporioides	CBS 126500*; CPC 13735; FIH 401	*Chamaedorea metallica*	Thailand	I. Hidayat & J. Meeboon	HM148196	HM148441	HM148686
		DTO 130-H8	Indoor air, open Petri-dish	Thailand	P. Noonim	KP701938	KP701815	KP702060
		DTO 323-D1	Indoor air	China	—	MF473275	MF473698	MF474125
		DTO 324-B8	Indoor air	China	—	MF473276	MF473699	MF474126
		DTO 324-C7	Indoor air	China	—	MF473277	MF473700	MF474127
C. succulentum	sphaerospermum	CBS 140466*; FMR 13375; UTHSC DI-13-262	Dolphin, bronchus	USA: FL	D.A. Sutton	LN834434	LN834530	LN834618
C. tenellum	herbarum	CBS 121633; CPC 12051; EXF-1083	Hypersaline water, saltern	Israel	N. Gunde-Cimerman	EF679400	EF679478	EF679554
		CBS 121634*; CPC 12053; EXF-1735	Hypersaline water, Dead Sea	Israel	P. Zalar	EF679401	EF679479	EF679555
		CBS 139582; DTO 127-D7; AR295	Air sample, bakery	USA	—	KP701932	KP701809	KP702054
		CPC 11813	*Phyllactinia* sp. on leaves of *Corylus* sp.	USA: WA	D. Glawe	EF679399	EF679477	EF679553
		CPC 22290; EMSL 1771	Indoor air sample, bathroom	USA: MI	Ž. Jurjević	MF473278	MF473701	MF474128
		CPC 22291; EMSL 1772	Indoor air sample, bedroom	USA: OR	Ž. Jurjević	MF473279	MF473702	MF474129
		CPC 22410; EMSL 1941	Indoor air sample, classroom	USA: MI	Ž. Jurjević	MF473280	MF473703	MF474130
C. tenuissimum	cladosporioides	CBS 125995*; CPC 14253	*Lagerstroemia* sp.	USA: LA	P.W. Crous	HM148197	HM148442	HM148687
		CBS 126359; CPC 12794	*Musa* sp.	USA: HI	I. Budenhagen	HM148198	HM148443	HM148688
		CBS 126501; CPC 14410	*Musa* sp.	Ivory Coast	K. Daouda	HM148199	HM148444	HM148689
		CBS 117.79	Fruit	Burundi	J. Rammelo	HM148200	HM148445	HM148690
		CBS 262.80	Fruit	Nigeria	—	HM148201	HM148446	HM148691
		CPC 10538	*Musa* sp.	Mozambique	A. Viljoen	HM148202	HM148447	HM148692
		CPC 10882	*Gnaphalium affine*	South Korea	H.D. Shin	HM148204	HM148449	HM148694
		CPC 11521	*Acacia mangium*	Thailand	W. Himaman	HM148214	HM148459	HM148704
		CPC 11612	*Musa* sp.	Indonesia	M. Arzanlou	HM148206	HM148451	HM148696
		CPC 11929	*Acacia mangium*	Thailand	W. Himaman	HM148215	HM148460	HM148705
		CPC 12223	Unidentified rust fungus	Brazil	U. Braun	HM148208	HM148453	HM148698
		CPC 12795	*Musa* sp.	Polynesia	I. Budenhagen	HM148209	HM148454	HM148699
		CPC 13252	Rock	Australia	P.W. Crous	HM148216	HM148461	HM148706
		CPC 13732	*Shorea siamensis*	Laos	P. Phengsintham	HM148217	HM148462	HM148707
		CPC 14196	*Basella alba* (=*B. rubra*), leaves	Laos	P. Phengsintham	HM148218	HM148463	HM148708
		CPC 14311; BA 1710	Decayed branch under water	Venezuela	K. Lyhne	HM148219	HM148464	HM148709
		CPC 14370; BA 1737	Soil, bat cave	Bali	J.C. Frisvad	HM148221	HM148466	HM148711
		CPC 22277; EMSL 1748	Chili papper sample	Mexico	Ž. Jurjević	MF473281	MF473704	MF474131

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CPC 22320; EMSL 1823	Indoor air sample	Bermuda	Ž. Jurjević	MF473282	MF473705	MF474132
		CPC 22344; EMSL 1857	Indoor air sample, bedroom	USA: AZ	Ž. Jurjević	MF473283	MF473706	MF474133
		CPC 22383; EMSL 1896	Indoor air sample, bathroom	USA: TX	Ž. Jurjević	MF473284	MF473707	MF474134
		CPC 22398; EMSL 1926	Indoor air sample, classroom	USA: TX	Ž. Jurjević	MF473285	MF473708	MF474135
		DTO 109-A1	Bathroom ceiling	Thailand	P. Noonim	KP701910	KP701787	KP702033
		DTO 109-C4	Mycolab door	Thailand	P. Noonim	MF473286	MF473709	MF474136
		DTO 109-C7	Indoor air, open Petri-dish	Thailand	P. Noonim	MF473287	MF473710	MF474137
		DTO 131-A4	Indoor air, open Petri-dish	Thailand	P. Noonim	MF473288	MF473711	MF474138
		DTO 323-C5	Indoor air	China	—	MF473289	MF473712	MF474139
		DTO 323-C9	Indoor air	China	—	MF473290	MF473713	MF474140
		DTO 323-G2	Indoor air	China	—	MF473291	MF473714	MF474141
		DTO 323-G3	Indoor air	China	—	MF473292	MF473715	MF474142
		DTO 323-G4	Indoor air	China	—	MF473293	MF473716	MF474143
		DTO 323-G8	Indoor air	China	—	MF473294	MF473717	MF474144
		DTO 323-I4	Indoor air	China	—	MF473295	MF473718	MF474145
		DTO 323-I6	Indoor air	China	—	MF473296	MF473719	MF474146
		DTO 323-I8	Indoor air	China	—	MF473297	MF473720	MF474147
		DTO 323-I9	Indoor air	China	—	MF473298	MF473721	MF474148
		DTO 324-A1	Indoor air	China	—	MF473299	MF473722	MF474149
		DTO 324-A3	Indoor air	China	—	MF473300	MF473723	MF474150
		DTO 324-C2	Indoor air	China	—	MF473301	MF473724	MF474151
		DTO 324-C3	Indoor air	China	—	MF473302	MF473725	MF474152
		DTO 324-C5	Indoor air	China	—	MF473303	MF473726	MF474153
		DTO 324-C6	Indoor air	China	—	MF473304	MF473727	MF474154
		DTO 324-C9	Indoor air	China	—	MF473305	MF473728	MF474155
C. tianshanense	cladosporioides	CGMCC 3.18033*	*Saussurea involucrata*, rhizosphere soil	China	G. Wang	KX938381	KX938398	KX938364
		CGMCC 3.18034	*Saussurea involucrata*, rhizosphere soil	China	G. Wang	KX938382	KX938399	KX938365
C. tuberosum	herbarum	CBS 140693*; UTHSC DI-13-217; FMR 13330	Man, nasal biopsy	USA: FL	D.A. Sutton	LN834417	LN834513	LN834601
		FMR 13332; UTHSC DI-13-219	Man, foot	USA: WA	D.A. Sutton	LN834419	LN834515	LN834603
C. uredinicola	cladosporioides	CPC 5390; ATCC 46649	Hyperparasite on *Cronartium fusiforme* f. sp. *quercum* on *Quercus nigra* leaves	USA: AL	W.D. Kelley	AY251071	HM148467	HM148712
C. uwebraunianum sp. nov.	cladosporioides	CBS 139572; DTO 072-C8	Indoor air, archive	Netherlands	M. Meijer	KP701873	KP701750	KP701996
		CBS 143365*; DTO 072-D8	Indoor air, archive	Netherlands	M. Meijer	MF473306	MF473729	MF474156
		DTO 082-E3	Indoor air, archive	Netherlands	M. Meijer	KP701878	KP701755	KP702001
		DTO 090-D2	Swab sample, archive	Netherlands	M. Meijer	KP701899	KP701776	KP702022
		DTO 109-E8; BA 1908	Indoor environment	Denmark	B. Andersen	KP701914	KP701791	KP702037
		DTO 305-H9; TA10NZ-294A	House dust	New Zealand	T. Atkinson	MF473307	MF473730	MF474157

(*continued on next page*)

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
C. variabile	herbarum	CBS 121635**; CPC 12753	*Spinacia oleracea*	USA: WA	L. du Toit	EF679403	EF679481	EF679557
		CBS 121636**; CPC 12751	*Spinacia oleracea*	USA: WA	L. du Toit	EF679402	EF679480	EF679556
C. varians	cladosporioides	CBS 126360; CPC 11327	*Ulmus* sp.	Germany	K. Schubert	HM148222	HM148468	HM148713
		CBS 126361; CPC 11134	Leaf debris	India	W. Gams	HM148223	HM148469	HM148714
		CBS 126362*; CPC 13658; HAL 2061 F	*Catalpa bungei*	Russia	V.A. Melnik	HM148224	HM148470	HM148715
C. velox	sphaerospermum	CBS 119417*; CPC 11224	*Bambusa* sp.	India	W. Gams	DQ780361	JN906995	EF101388
		CPC 18450	*Zea mays*	Brazil	P.W. Crous	KT600457	KT600556	KT600654
		CPC 22359; EMSL 1872	Indoor air sample	USA: MA	Ž. Jurjević	MF473308	MF473731	MF474158
		DTO 317-H1	Indoor air	China	—	MF473309	MF473732	MF474159
		DTO 323-H8	Indoor air	China	—	MF473310	MF473733	MF474160
		EXF-466	Hypersaline water, saltern	Slovenia	—	DQ780359	KJ596597	EF101386
		EXF-471	Hypersaline water, saltern	Slovenia	—	DQ780360	KJ596599	EF101387
C. verrucocladosporioides	cladosporioides	CBS 126363*; CPC 12300	*Rhus chinensis*	South Korea	H.D. Shin	HM148226	HM148472	HM148717
C. verruculosum	herbarum	CGMCC 3.18099*	Soil	China	T. Liu	KX938388	KX938405	KX938371
		CGMCC 3.18100	Soil	China	T. Liu	KX938389	KX938406	KX938372
C. versiforme	herbarum	CBS 140491*; CPC 19053	*Hordeum* sp.	Iran	P.W. Crous	KT600417	KT600515	KT600613
C. vicinum sp. nov.	cladosporioides	CBS 143366*; CPC 22316; EMSL 1819	Indoor air sample	USA: WI	Ž. Jurjević	MF473311	MF473734	MF474161
		CBS 306.84	Urediniospores of *Puccinia allii*	UK: England	G.S. Taylor	HM148057	HM148299	HM148544
		CPC 11664; Hill 1076-2	*Oncoba spinosa*	New Zealand	C.F. Hill	HM148058	HM148300	HM148545
		CPC 13867	*Leptosphaeria* sp.	South Africa	P.W. Crous	HM148059	HM148301	HM148546
		CPC 15457	Imported buds of *Prunus avium*	New Zealand	J. Rennie	HM148060	HM148302	HM148547
		DTO 305-H5; TA10NZ-280B	House dust	New Zealand	T. Atkinson	MF473312	MF473735	MF474162
C. vignae	cladosporioides	CBS 121.25; ATCC 200933; MUCL 10110	*Vigna unguiculata* (= *V. sinensis*), living stems	USA: IN	M.W. Gardner	HM148227	HM148473	HM148718
C. westerdijkiae sp. nov.	cladosporioides	CBS 113746*	Bing cherry fruits	USA: WA	R.G. Roberts	HM148061	HM148303	HM148548
		CPC 10150	*Fatoua villosa*	South Korea	H.D. Shin	HM148062	HM148304	HM148549
		CPC 13362	*Paeonia obovata*	Germany	P.W. Crous	HM148063	HM148305	HM148550
		CPC 13978	*Pinus ponderosa*, needles	Argentina	A. Greslebin	HM148064	HM148306	HM148551
		CPC 14284; BA 1674	*Triticum* sp., grain	Germany	B. Andersen	HM148065	HM148307	HM148552
		DTO 084-F2	Indoor environment	Germany	LGA	KP701882	KP701759	KP702005
		DTO 109-F2; BA 1911	Indoor environment	Denmark	B. Andersen	KP701915	KP701792	KP702038
		DTO 152-A9	Indoor environment	Portugal	—	MF473313	MF473736	MF474163
		DTO 152-H9	Indoor environment	Portugal	—	MF473314	MF473737	MF474164
C. wyomingense sp. nov.	herbarum	CBS 143367*; CPC 22310; EMSL 1806	Indoor air sample, living room	USA: WY	Ž. Jurjević	MF473315	MF473738	MF474165
C. xanthochromaticum	cladosporioides	CBS 126364; CPC 14532	*Erythrophleum chlorostachys*	Australia	B.A. Summerell	HM148122	HM148366	HM148611

Table 1. (Continued).

Species	Species complex	Culture accession number(s)[1,2]	Substrate	Country[3]	Collector	GenBank accession numbers[4]		
						ITS	*tef1*	*act*
		CBS 140691*; UTHSC DI-13-211; FMR 13324	Man, bronchoalveolar lavage fluid	USA: TX	D.A. Sutton	LN834415	LN834511	LN834599
		CBS 167.54; ATCC 11276; IMI 049624	—	—	—	HM148124	HM148368	HM148613
		CGMCC 3.18101	Alpine soil	China	T. Liu	KX938390	KX938407	KX938373
		CGMCC 3.18102	Alpine soil	China	Y. Hao	KX938391	KX938408	KX938374
		CPC 11046	Margarine	Australia	N. Charley	HM148125	HM148369	HM148614
		CPC 11133	*Eucalyptus* sp.	India	W. Gams	HM148126	HM148370	HM148615
		CPC 11609	*Musa* sp.	India	M. Arzanlou	EF679356	EF679431	EF679508
		CPC 11806	*Strelitzia* sp.	South Africa	W. Gams	HM148129	HM148373	HM148618
		CPC 11856	*Acacia mangium*	Thailand	W. Himaman	HM148134	HM148378	HM148623
		CPC 12792	*Musa* sp.	Polynesia	I. Budenhagen	HM148136	HM148380	HM148625
		CPC 12793	*Musa* sp.	Polynesia	I. Budenhagen	HM148137	HM148381	HM148626
		CPC 14004; MRC 03367	Oats	South Africa	—	HM148143	HM148387	HM148632
		CPC 14008; MRC 10135	*Triticum aestivum*	South Africa	—	HM148144	HM148388	HM148633
		CPC 14256	Pecan tree, leaves	USA	P.W. Crous	HM148146	HM148390	HM148635
		CPC 14911	*Strelitzia* sp.	South Africa	P.W. Crous	HM148148	HM148392	HM148637
		CPC 22239; EMSL 1686	Indoor air sample, bedroom	USA: CO	Ž. Jurjević	MF473316	MF473739	MF474166
		CPC 22321; EMSL 1824	Indoor air sample	Bermuda	Ž. Jurjević	MF473317	MF473740	MF474167
		DTO 108-G8	Indoor air, open Petri-dish	Thailand	P. Noonim	KP701909	KP701786	KP702032
		DTO 317-I2	Indoor air	China	—	MF473318	MF473741	MF474168
		DTO 323-E2	Indoor air	China	—	MF473319	MF473742	MF474169
		DTO 323-E3	Indoor air	China	—	MF473320	MF473743	MF474170
		DTO 323-E5	Indoor air	China	—	MF473321	MF473744	MF474171
		DTO 323-E6	Indoor air	China	—	MF473322	MF473745	MF474172
		DTO 323-E7	Indoor air	China	—	MF473323	MF473746	MF474173
C. xylophilum	cladosporioides	CBS 113749	Bing cherry fruits	USA: WA	—	HM148228	HM148474	HM148719
		CBS 113756	Bing cherry fruits	USA: WA	—	HM148229	HM148475	HM148720
		CBS 125997*; CPC 12403	*Picea abies*, dead wood	Russia	D.A. Shabunin	HM148230	HM148476	HM148721

[1] ATCC: American Type Culture Collection, Virginia, USA; BA: Personal culture collection of Birgitte Andersen, Denmark; CAMS: SERA's Centre for Applied Mycological Studies, Forestry and Agricultural Biotechnology Institute, University of Pretoria, Pretoria, South Africa; CBS: Westerdijk Fungal Biodiversity Institute, Utrecht, The Netherlands; CGMCC: China General Microbiological Culture Collection Center, Institute of Microbiology, Chinese Academy of Sciences, Beijing, China; CIEFAP: Centro de Investigación y Extensión Forestal Andino Patagónico, Argentina; CPC: Culture collection of Pedro Crous, housed at CBS; DAOM: Plant Research Institute, Department of Agriculture (Mycology), Ottawa, Canada; dH: de Hoog Culture Collection, housed at CBS; DTO: Working collection of Jos Houbraken housed at CBS; EMSL: Working collection of Ž. Jurjević, EMSL Analytical, Inc., Cinnaminson, New Jersey, USA; EXF: Culture Collection of Extremophilic Fungi, Biotechnical Faculty, Ljubljana, Slovenia; FMR: Facultat de Medicina, Universitat Rovira i Virgili, Reus, Spain; Hill: Personal culture collection of Frank Hill, New Zealand; HJS: Personal culture collection of Hans-Josef Schroers, Agricultural institute of Slovenia, Ljubljana, Slovenia; IBT: IBT Culture Collection of Fungi, DTU Bioengineering, Technical University of Denmark, Denmark; ICMP: International Collection of Micro-organisms from Plants, Landcare Research, Private Bag 92170, Auckland, New Zealand; IFO: Institute for Fermentation, Osaka, Japan; IHEM: Collection of the Laboratorium voor Microbiologie en Microbiele Genetica, Gent, Belgium; IMI: International Mycological Institute, CABI-Bioscience, Egham, Bakeham Lane, UK; JCM: Japan Collection of Microorganism, RIKEN BioResource Center, Japan; Lynfield: Private culture collection and herbarium of Frank Hill, New Zealand; MRC: Medical Research Council, Cape Town, South Africa; MUCL: Mycotheque de l'Universite catholique de Louvain, Laboratoire de Mycologie Systematique et Appliquee, Universite catholique de Louvain, Louvain-la-Neuve, Belgium; MZKI: Microbiological Culture Collection of the National Institute of Chemistry, Ljubljana, Slovenia; NBRC: NITE Biological Resource Center, Department of Biotechnology, National Institute of Technology and Evaluation, Kisarazu, Chiba, Japan; NCPF: The National Collection of Pathogenic Fungi, Holborn, London, UK; NCTC: National Collection of Type Cultures, PHLS Central Public Health Laboratory, London, UK; NRRL: National Center for Agricultural Utilization Research, Peoria, Illinois, USA; PD: Plant Protection Service, nVWA, Division Plant, Wageningen, The Netherlands; UTHSC: Fungus Testing Laboratory at the University of Texas Health Science Center, San Antonio, TX, USA; VKM: All-Russian Collection of Microorganisms, Russian Academy of Sciences, Institute of Biochemistry and Physiology of Microorganisms, 142292 Pushchino, Moscow Region, Russia.

[2] *: ex-type culture.; **: ex-epitype culture.

[3] Abbreviations for USA according to ISO 3166.

[4] *act*: partial actin gene, *tef1*: partial translation elongation factor 1-alpha gene, ITS: internal transcribed spacer region including intervening 5.8S rRNA gene.

Table 2. Statistical information of the different multilocus analyses performed in this study. *act*: partial actin gene; *tef1*: partial translation elongation factor 1-alpha gene.

Dataset	Statistics for Bayesian analyses				
	Substitution models		Unique site patterns		Number of trees sampled
	act	*tef1*	*act*	*tef1*	
C. cladosporioides complex	HKY+G	HKY+I+G	145	235	963 978
C. herbarum complex	HKY+G	HKY+I+G	124	186	286 952
C. sphaerospermum complex	HKY+G	HKY+I+G	155	296	137 928
	Statistics for the parsimony analyses				
	Number of strains (incl. outgroup(s))	Number of included characters	Number of parsimony-informative characters	Number of parsimony-uninformative characters	Number of constant characters
C. cladosporioides complex	412	548	326	43	89
C. herbarum complex	220	403	253	59	91
C. sphaerospermum complex	309	505	365	78	62
	Tree length	Consistency index (CI)	Retention index (RI)	Rescaled CI (RC)	Number of saved trees
C. cladosporioides complex	3 053	0.294	0.894	0.263	1 000
C. herbarum complex	1 591	0.407	0.893	0.363	1 000
C. sphaerospermum complex	1 968	0.518	0.955	0.494	1 000
	Statistics for the maximum-likelihood analyses				
	Tree length	Alpha parameter value	Invar parameter value	Final ML Optimisation Likelihood	
C. cladosporioides complex	14.177192	1.200382	0.194342	−12952.10072	
C. herbarum complex	7.591637	1.015297	0.163303	−6775.467992	
C. sphaerospermum complex	6.896787	1.904976	0.151042	−7017.365135	

some cases, differences are also observed for the terminal nodes. For example, in the BI phylogeny, *C.* cf. *tenuissimum* (Clades 61) and *C. oxysporum* (Clade 62) are collapsed to a basal polytomy with clades 63 and 64 (*C. colocasiae* and *C. tenuissimum*), whereas *C. perangustum* (Clade 4) becomes unresolved lineages at the base of the ML tree and *C. tianshanense* (Clade 1) moves into the ML tree as a sister clade to *C. paracladosporioides* (Lineage 13). The ML phylogeny also failed to resolve *C. pseudocladosporioides* (Clade 56) completely and included both *C. crousii* (Clade 56) and *C. funiculosum* (Clade 55) as lineages inbetween isolates of *C. pseudocladosporioides*. *Cladosporium crousii* was included within the *C. pseudocladosporioides* clade (Clade 56) in all three phylogenetic analyses, but always on a longer branch; the *act* sequence of this species is identical to sequences of *C. pseudocladosporioides* while the *tef1* is clearly distinct from all known sequences.

The *C. herbarum* species complex phylogeny presented in Fig. 2 delimits 37 species clades. The position of clades changes between the different analyses, as can be observed by the low or absent support values on the backbone of the tree. For example, the position of *C. arthropodii* (lineage 32) is basal in the MP phylogeny, but identical to the position in Fig. 2 in the ML phylogeny. In some cases, differences are also observed for the terminal nodes. In the MP and ML phylogenies, *C. tuberosum* (Clade 3) clusters inbetween the two subclades of *C. floccosum* (Clade 4). *Cladosporium basiinflatum* was included within the *C. ramotenellum* clade (Clade 37) in all three analyses, but always on a long branch.

The *C. sphaerospermum* species complex phylogeny presented in Fig. 3 delimits 23 species clades. The position of clades changes between the different analyses, as can be observed by the low or absent support values on the backbone of the tree. In a few cases, differences are also observed for the terminal nodes. For example, the position of *C. lebrasiae* (lineage 5) is sister to *C. dominicanum* (Clade 4) in the MP phylogeny, but not well-resolved in the ML and BI phylogenies.

Maximum parsimony and Bayesian ITS phylogenies were also generated from sequences representing all *Cladosporium* species currently known from ITS sequence data (Supplementary Fig. S1). For the maximum parsimony analysis, 507 characters were included, 88 of which were parsimony-informative, 318 which were constant and 101 which were variable and parsimony-uninformative. The maximum of 1 000 equally most parsimonious trees were saved (Tree length = 429; CI = 0.681; RI = 0.845; RC = 0.575). The Bayesian analysis lasted 19 980 000 generations and yielded 299 702 trees which were used to calculate the best tree and the posterior probability values after discarding the burn-in trees; a SYM+I+G model was used and there were 150 unique site patterns in the alignment. These phylogenies show that ITS lacks the resolution to distinguish many species of *Cladosporium*, especially in the *C. cladosporioides* and *C. herbarum* species complexes. Although the three species complexes can be recognised in broad lines in the phylogenetic tree, there are some overlap among the species complexes. For example, *C. ruguloflabelliforme* is found inbetween sequences of the *C. cladosporioides* species complex while it belongs to the *C. sphaerospermum* species complex and *C. basiinflatum* is

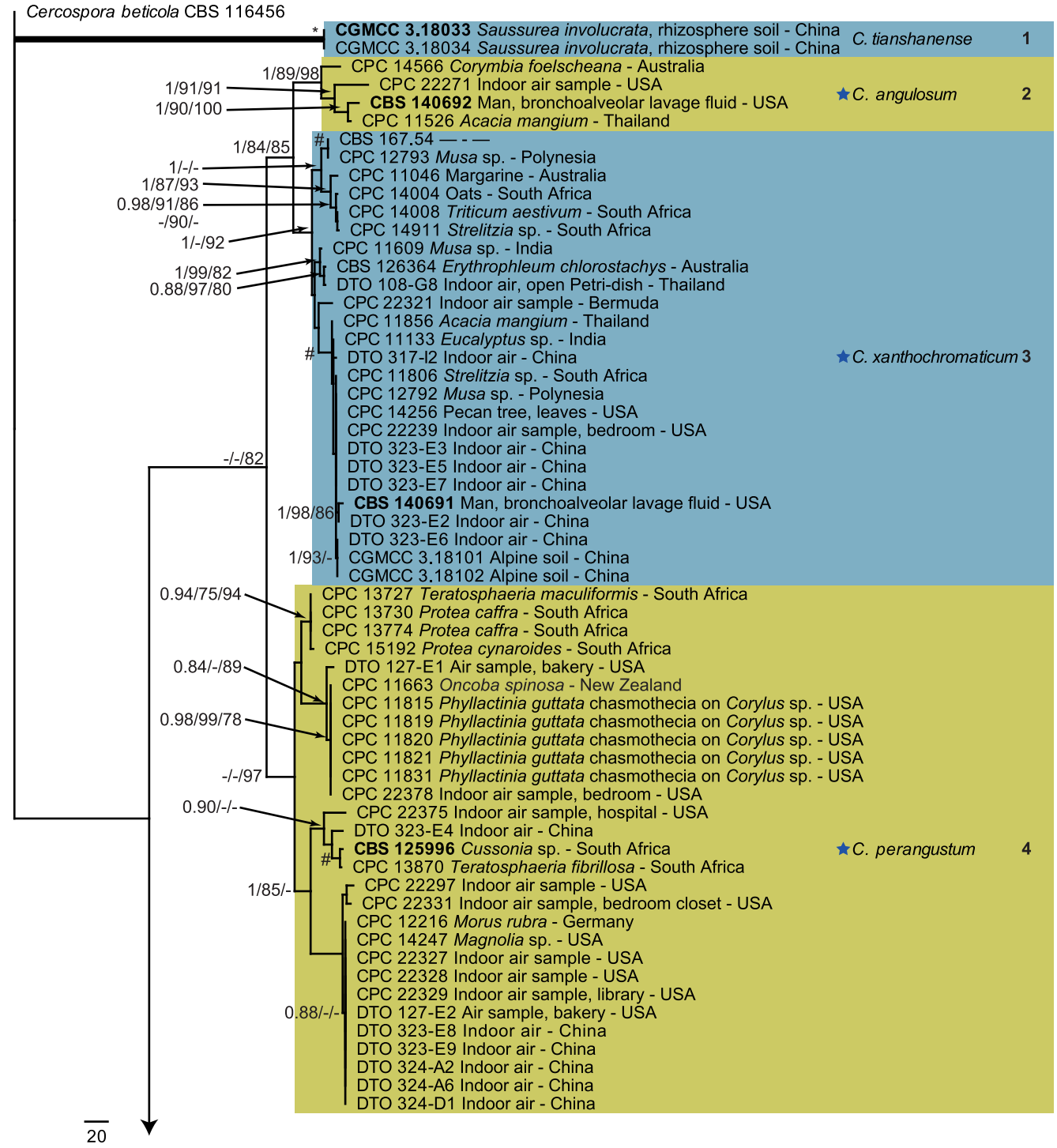


Fig. 1. The first of 1 000 equally most parsimonious trees obtained from a heuristic search of the *C. cladosporioides* species complex alignment. Bayesian posterior probabilities (BPP; >0.74), maximum-likelihood bootstrap support values (MLBS; >74 %) and maximum parsimony bootstrap support values (PBS; >74 %)) are shown at the nodes (BPP/MLBS/PBS). Thickened lines with an asterisk (*) represent nodes with PP = 1.00, MLBS = 100 % and PBS = 100 % and a hash (#) represents nodes with PP = >0.94, MLBS = >94 % and PBS = >94 %. The scale bar represents the number of changes. Species names are indicated to the right of the tree and clades/lineages are numbered to facilitate easier reference in the text. Species boundaries are indicated with coloured blocks. Names of novel species and culture numbers with type status are printed in **bold** face. Species from indoor environments are indicated with a blue star symbol in front of the species name. Isolation source and country of origin information are provided where known. The tree was rooted to *Cercospora beticola* (strain CBS 116456).

found inbetween sequences of the *C. cladosporioides* species complex while it belongs to the *C. herbarum* species complex. Assignment of an unknown isolate to a species complex should therefore be done based on high association to several species from the species complex and not based on a high association with only one species from the species complex. Overall, the topology of the resulting trees was poorly supported, both in the Bayesian and maximum parsimony analyses.

Taxonomy

The status of numerous indeterminate strains isolated from indoor environments included in this study have been subjected to polyphasic analyses, which revealed 16 novel species. The circumscriptions and delimitations of these species are mainly based on quantitative as well as qualitative morphological features and on molecular data. Features that proved to be

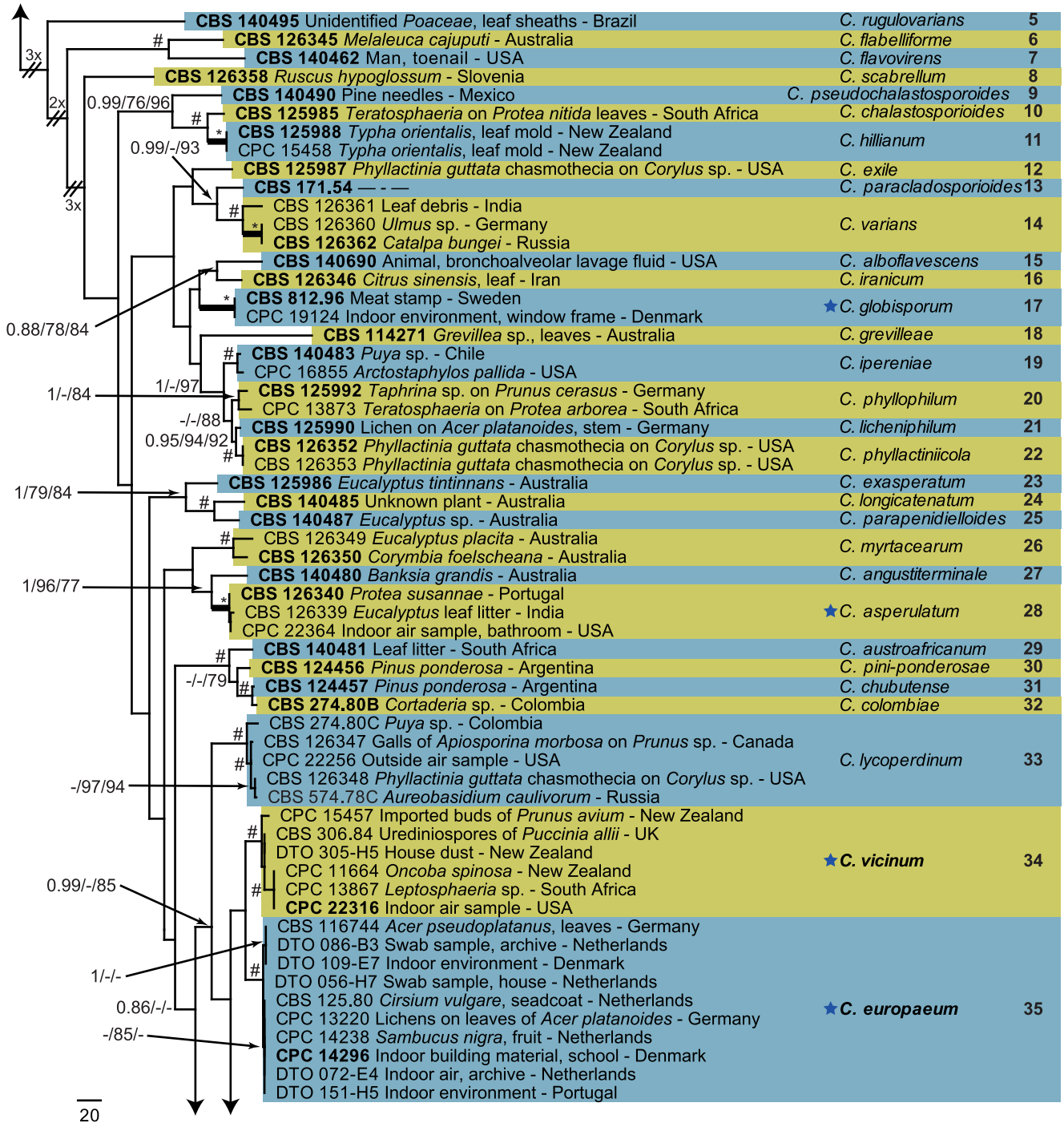


Fig. 1. (Continued).

diagnostic at species rank were discussed in Bensch *et al.* (2012, 2015) and are also applied here. Together with previously described species which proved to occur in indoor environments, the new taxa are treated in alphabetical order below. Detailed descriptions (on SNA if not indicated differently), supplementing literature (listed under Lit.), illustrations (listed under Ill.) and comments are provided.

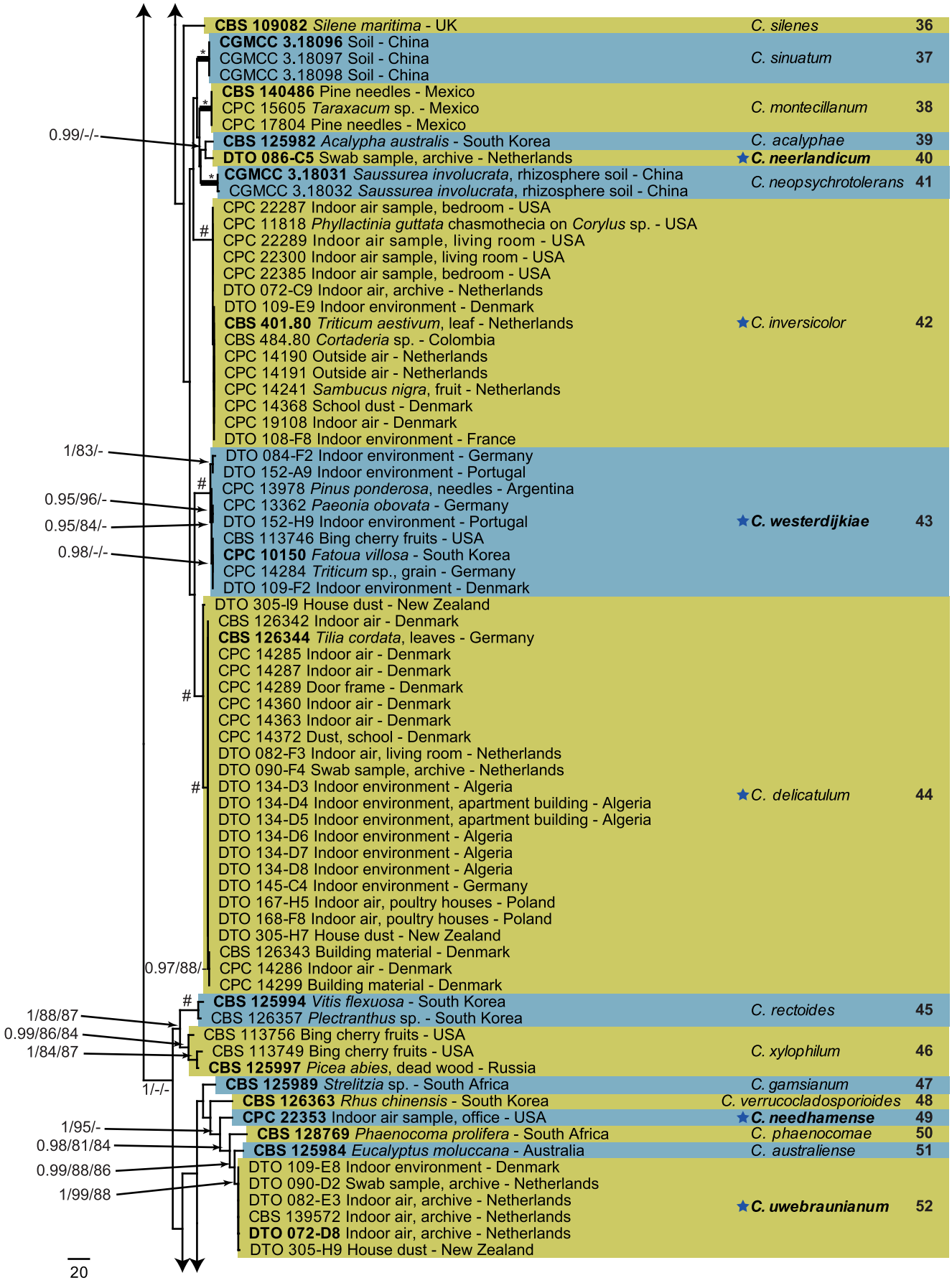
Cladosporium aerium Bensch & Samson, **sp. nov.** MycoBank MB822217. Fig. 4.

Etymology: Name refers to the substrate from which it was isolated, indoor air.

Holotype: **China**, isol. from indoor air, CBS H-23248. *Ex-type culture*: CBS 143356 = DTO 323-B4.

Diagnosis: Differs from *C. allii* in having narrower conidiophores as well as shorter and narrower, 0–2-septate conidia.

In vitro (on PDA): *Mycelium* abundantly formed, hyphae narrowly cylindrical-oblong or irregular in outline due to swellings, lateral outgrowth and constrictions, loosely branched, (1–)1.5–5 µm wide, septate, not constricted at septa, subhyaline, pale brown or pale olivaceous brown, almost smooth, asperulate to irregularly verruculose or verrucose, walls unthickened, occasionally anastomosing. *Conidiophores* macronematous, solitary, formed laterally or terminally from hyphae, straight or often somewhat flexuous, cylindrical-oblong or irregular in outline due to swellings and constrictions, often subnodulose or with unilateral swellings both terminally and intercalary, sometimes once slightly to distinctly geniculate-sinuous, rarely once branched,



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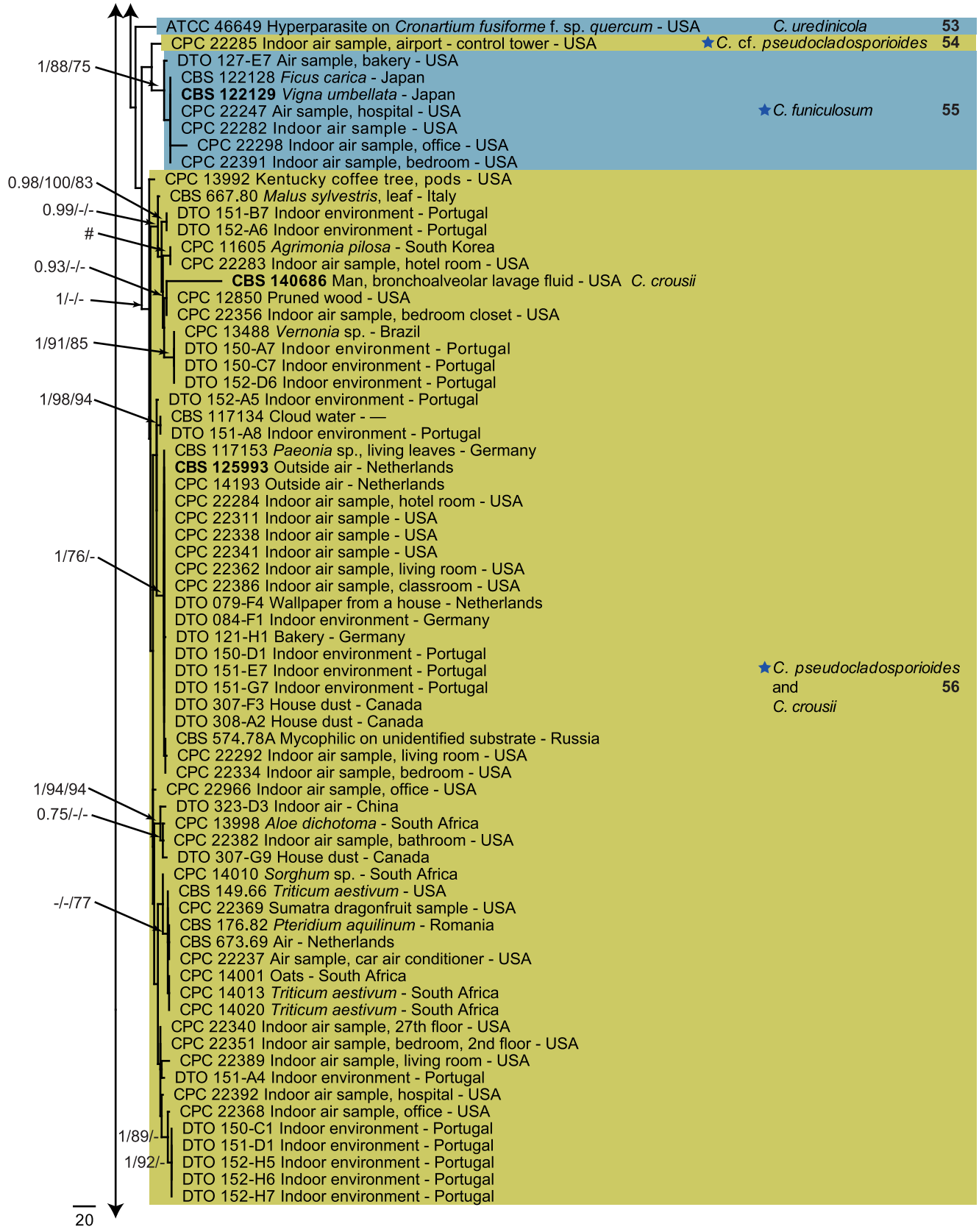


Fig. 1. (Continued).

17–190(–210) × (3–)4–5 µm, swellings 5–6.5(–8) µm diam, 0–4-septate, not constricted at septa, pale to medium olivaceous brown, smooth or almost so, walls slightly thickened; sometimes a few micro- and semimacronematous conidiophores formed. *Conidiogenous cells* integrated, mostly terminal, occasionally also intercalary, often quite long, 20–78 µm, cylindrical, subnodulose, with a single or rarely two unilateral swellings and occasionally an additional swollen shoulder at a lower level with 1–3(–4) conspicuous loci restricted to these swellings or shoulders, sometimes once geniculate-sinuous, with up to five loci per cell, loci protuberant, 1.5–2 µm diam, thickened and darkened-refractive. *Ramoconidia* absent. *Conidia* solitary or

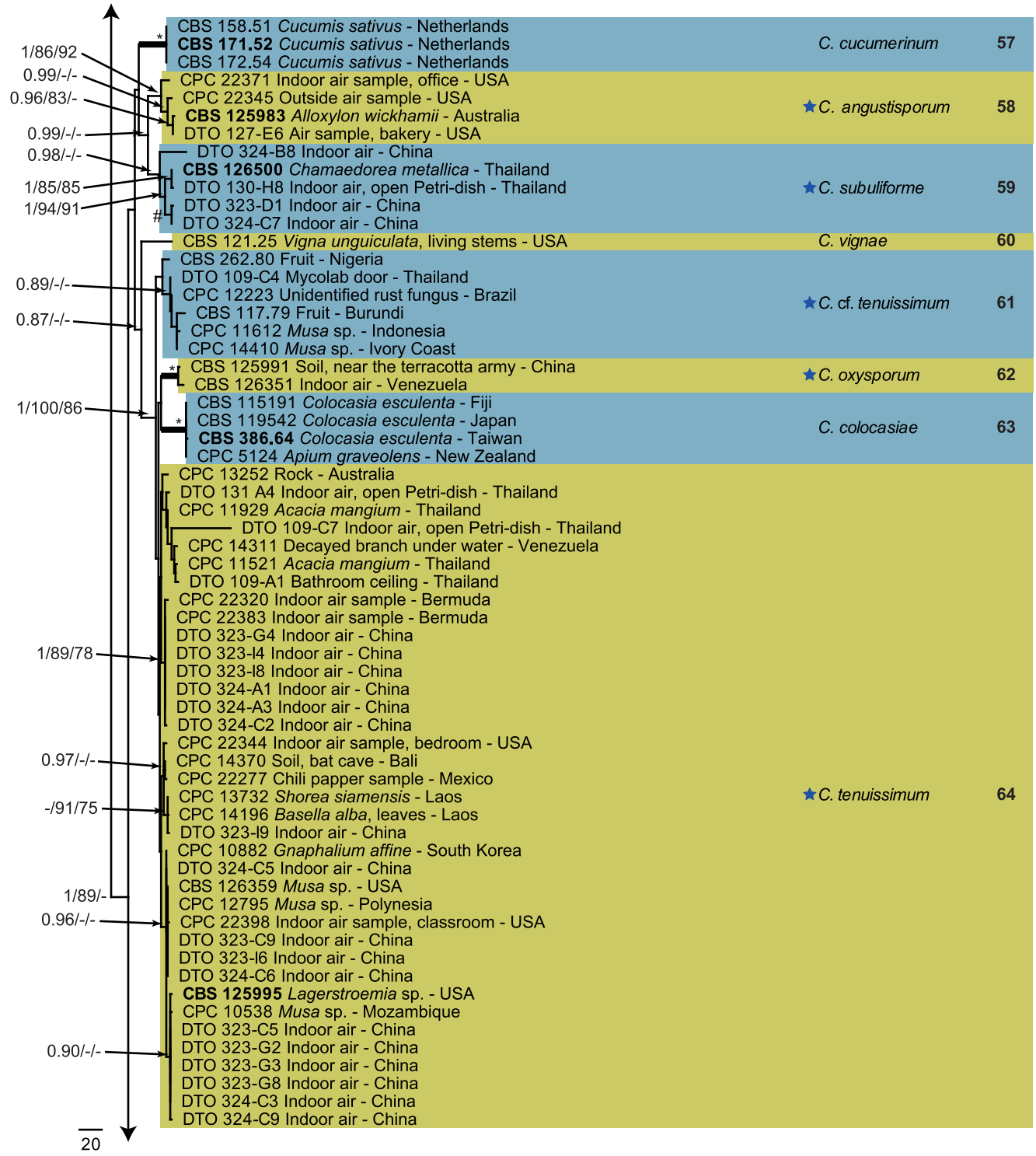
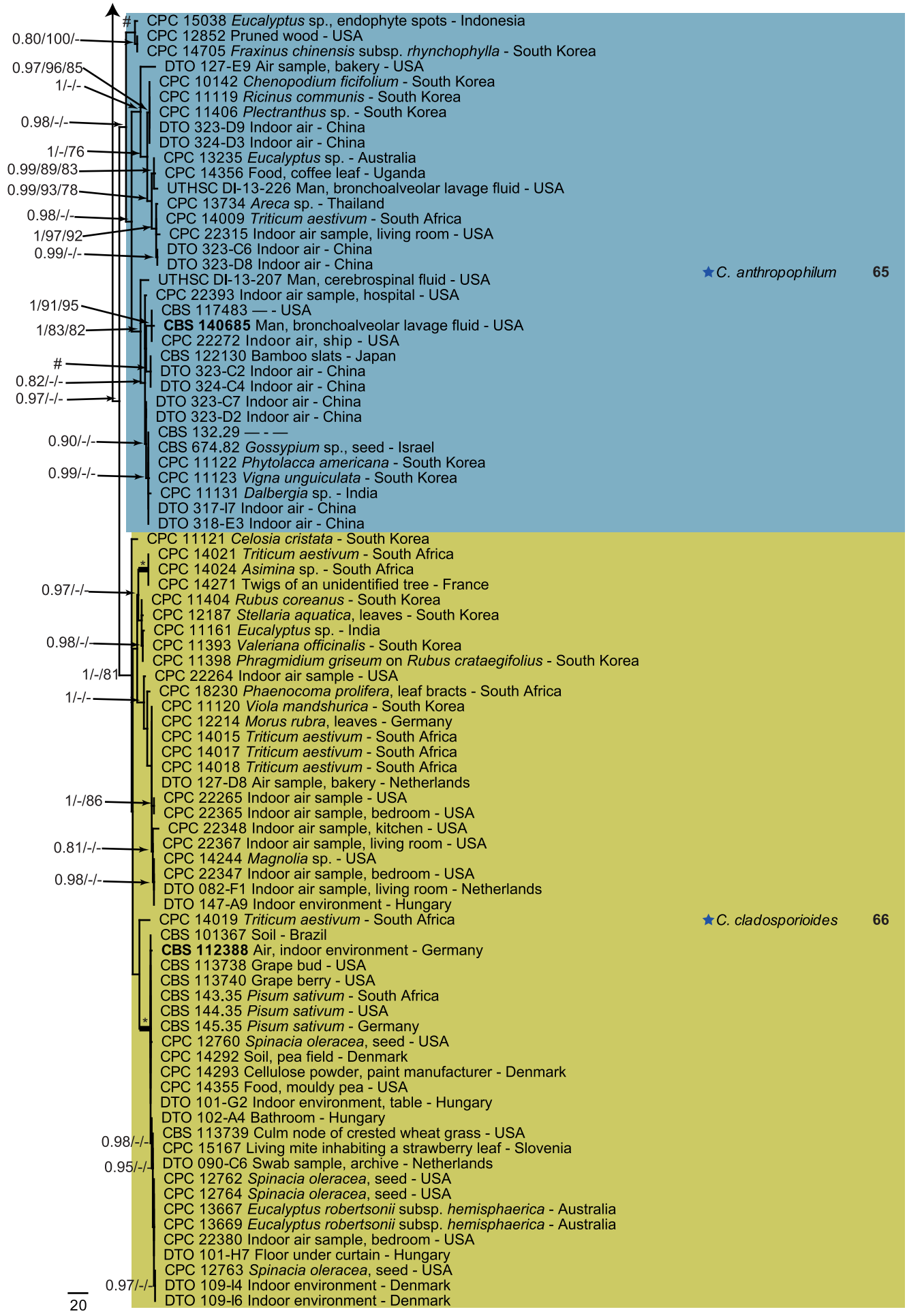


Fig. 1. (Continued).

formed in short, unbranched or branched chains, chains with only up to five conidia, solitary, terminal and intercalary conidia ellipsoid, broadly ovoid or subcylindrical, (8–) 9.5–17(–19) × (4.5–)5–6.5(–7) µm (av. ± SD: 12.5 ± 2.8 × 5.7 ± 0.9), 0(–1)-septate, hila 1–2 µm diam, basally formed conidia ellipsoid or subcylindrical, 13–24 × (5–) 6–7(–8) µm (av. ± SD: 18.0 ± 3.1 × 6.4 ± 0.7), 0–1-septate, septum median or in the upper half, becoming curved or sinuous with age, occasionally slightly constricted, pale olivaceous to medium olivaceous brown, verruculose to distinctly verrucose, verrucae up to 1 µm high, densely aggregated, walls unthickened or slightly thick-walled, slightly or distinctly attenuated towards apex and base, with 1–2(–3) distal hila, hila 1–2 µm diam, thickened and darkened-refractive. *Microcyclic conidiogenesis* giving rise to secondary conidiophores occasionally occurring.

Culture characteristics: Colonies on PDA attaining 29–44 mm diam after 14 d at 25 °C, smoke-grey and olivaceous due to abundant and dense aerial mycelium, olivaceous grey and grey olivaceous towards margins, reverse leaden-grey, fluffy, margins narrow, white, somewhat feathery, regular or slightly undulate, growth flat, sporulation loose, mainly at colony margins. Colonies on MEA reaching 30–49 mm diam after 14 d at 25 °C, smoke-grey due to abundant aerial mycelium, whitish or glaucous-grey towards margins, reverse olivaceous grey, velvety or fluffy, margins narrow, white, regular to undulate,



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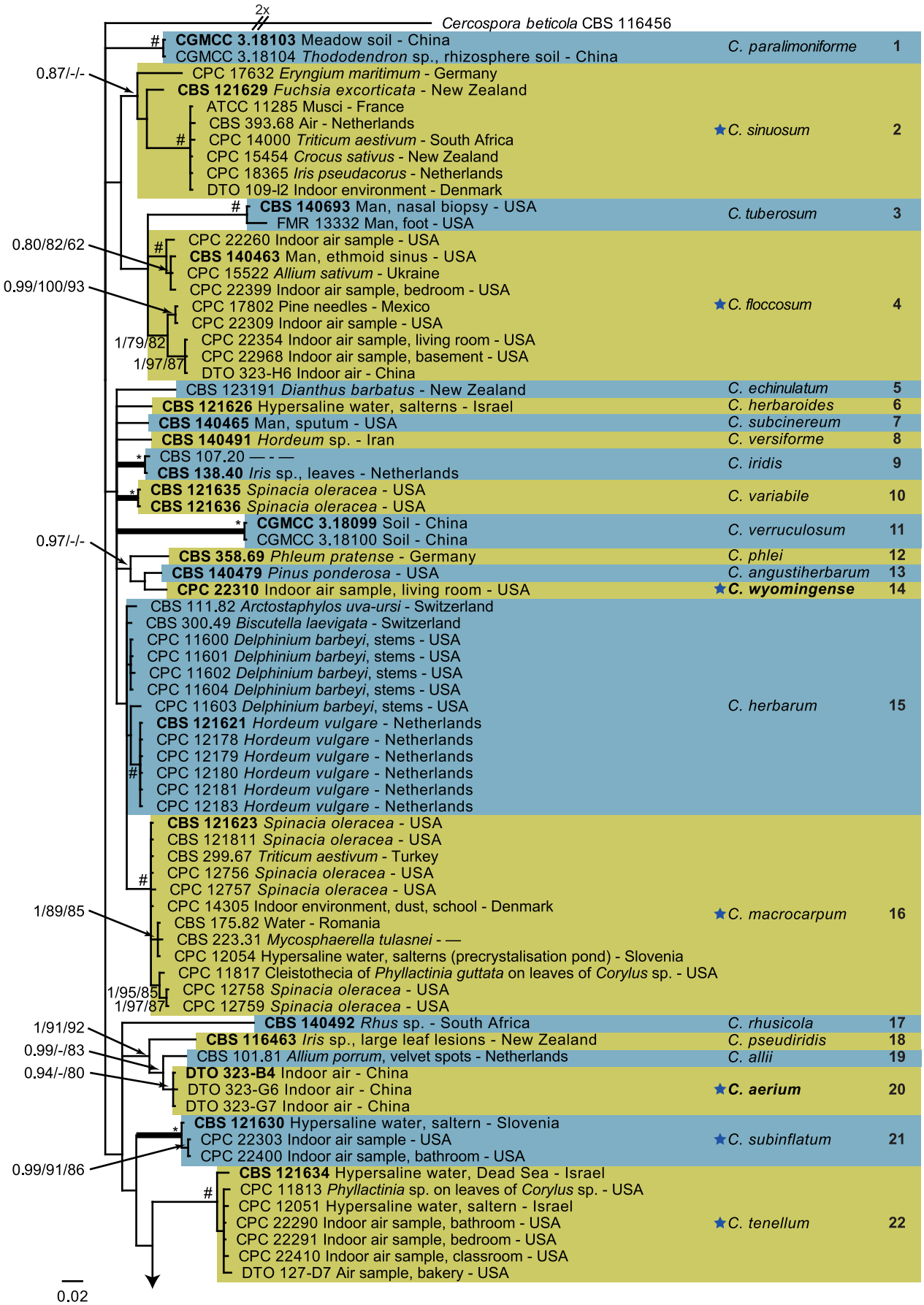


Fig. 2. Bayesian consensus phylogram (50 % majority rule) of the *C. herbarum* species complex alignment. Bayesian posterior probabilities (BPP; >0.74), maximum-likelihood bootstrap support values (MLBS; >74 %) and maximum parsimony bootstrap support values (PBS; >74 %)) are shown at the nodes (BPP/MLBS/PBS). Thickened lines with an asterisk (*) represent nodes with PP = 1.00, MLBS = 100 % and PBS = 100 % and a hash (#) represents nodes with PP = >0.94, MLBS = >94 % and PBS = >94 %. The scale bar represents the expected changes per site. Species names are indicated to the right of the tree and clades/lineages are numbered to facilitate easier reference in the text. Species boundaries are indicated with coloured blocks. Names of novel species and culture numbers with type status are printed in **bold** face. Species from indoor environments are indicated with a blue star symbol in front of the species name. Isolation source and country of origin information are provided where known. The tree was rooted to *Cercospora beticola* (strain CBS 116456).

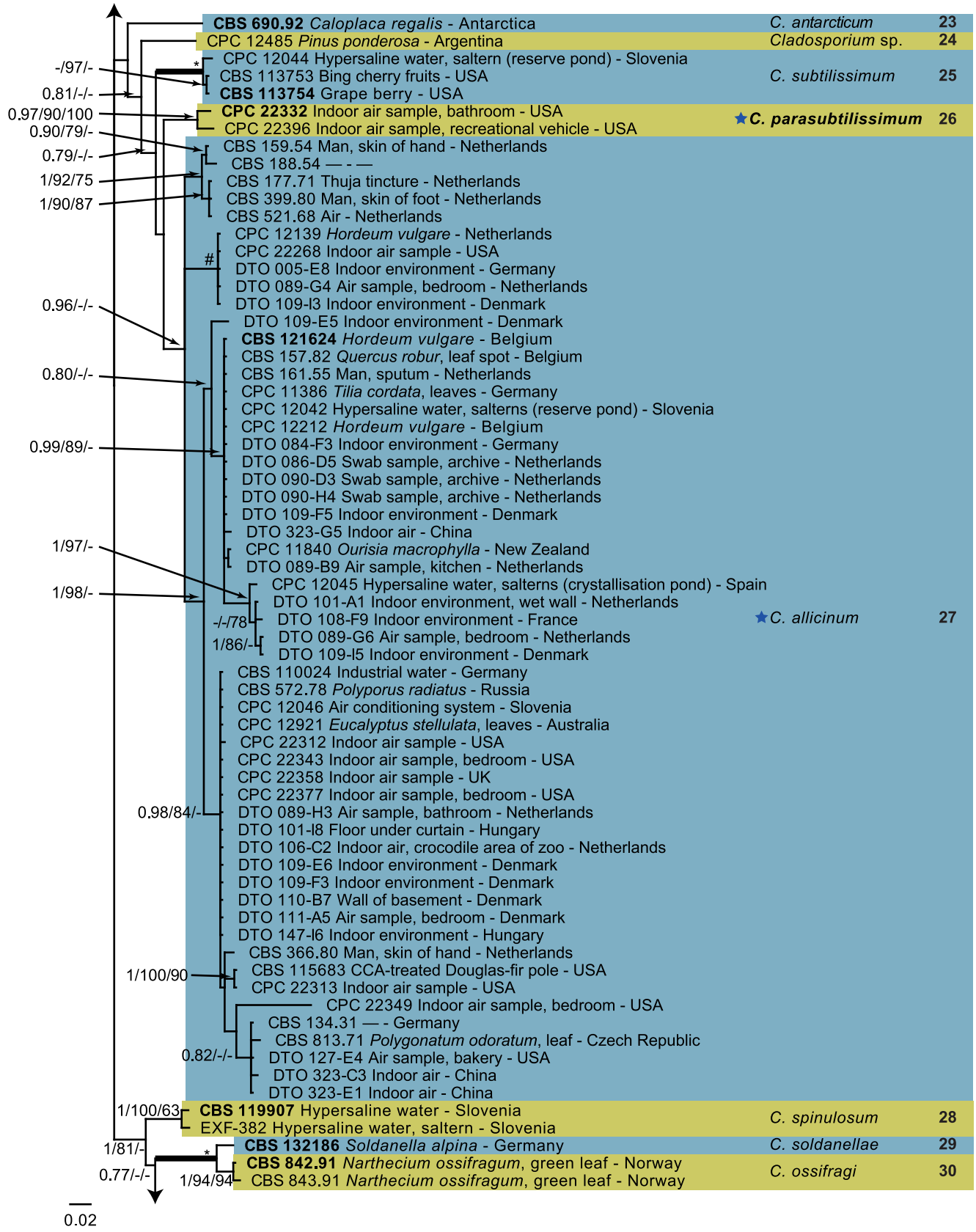
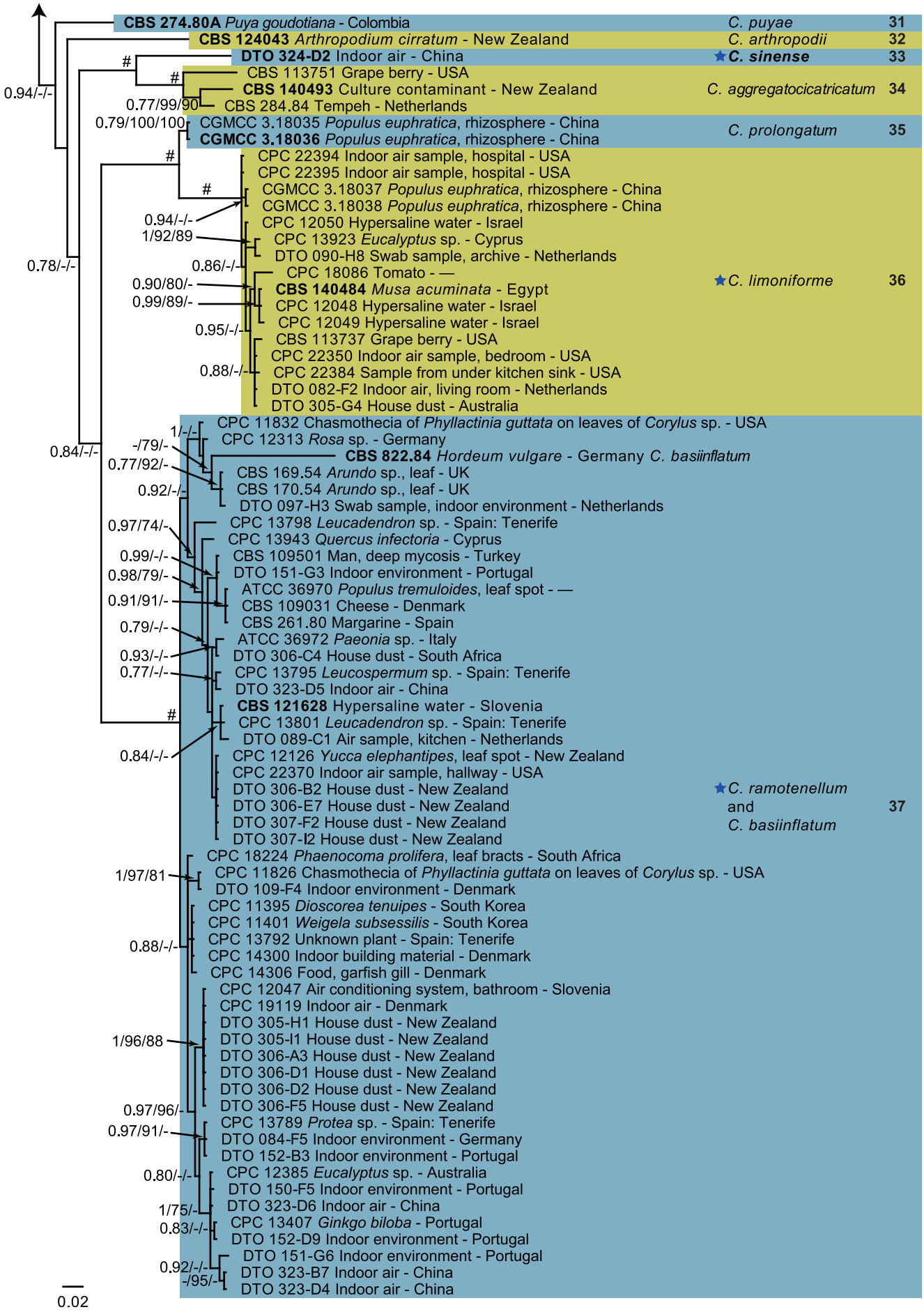


Fig. 2. (Continued).

growth flat to low convex, often radially furrowed, several small exudates formed, sporulation mainly at colony margins. Colonies on OA 21–42 mm diam after 14 d at 25 °C, smoke-grey, pale olivaceous grey with patches of iron-grey, reverse olivaceous to iron-grey, fluffy-felty, margins somewhat undulate, aerial mycelium abundant, dense, fluffy, covering almost the entire colony, growth flat, numerous very small exudates formed giving the surface a glittering appearance, sporulation at colony margins.

Substrate and distribution: Indoor air, Asia (China).

Additional materials examined: **China**, isol. from indoor air, DTO 323-G6; DTO 323-G7.



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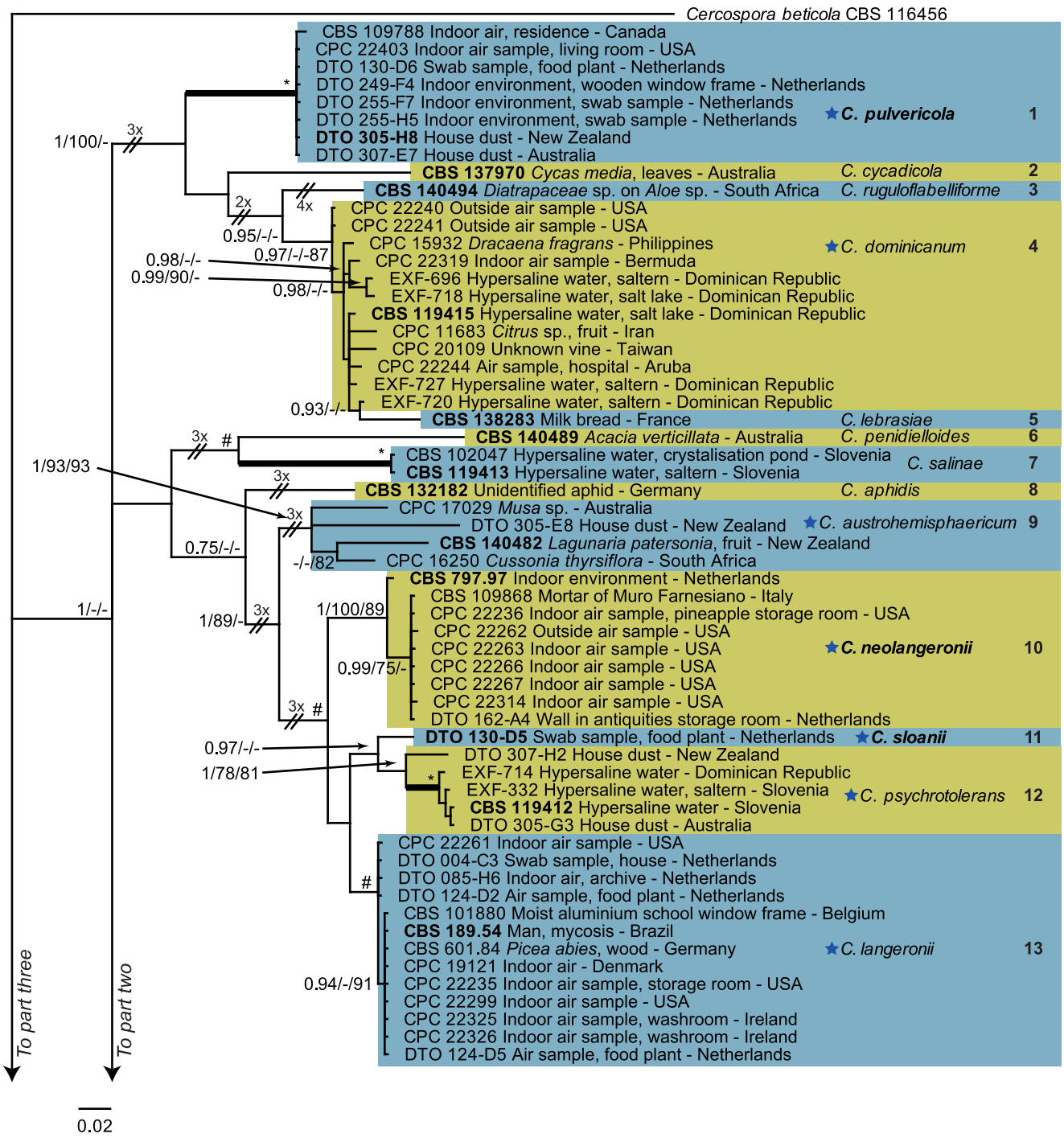

Fig. 3. Bayesian consensus phylogram (50 % majority rule) of the *C. sphaerospermum* species complex alignment. Bayesian posterior probabilities (BPP; >0.74), maximum-likelihood bootstrap support values (MLBS; >74 %) and maximum parsimony bootstrap support values (PBS; >74 %)) are shown at the nodes (BPP/MLBS/PBS). Thickened lines with an asterisk (*) represent nodes with PP = 1.00, MLBS = 100 % and PBS = 100 % and a hash (#) represents nodes with PP = >0.94, MLBS = >94 % and PBS = >94 %. The scale bar represents the expected changes per site. Species names are indicated to the right of the tree and clades/lineages are numbered to facilitate easier reference in the text. Species boundaries are indicated with coloured blocks. Names of novel species and culture numbers with type status are printed in **bold** face. Species from indoor environments are indicated with a blue star symbol in front of the species name. Isolation source and country of origin information are provided where known. The tree was rooted to *Cercospora beticola* (strain CBS 116456).

Notes: The description given above is from PDA; on SNA only very few conidiophores and conidia were formed after 7 d. *Cladosporium aerium* (Fig. 1, clade 20) is morphologically similar to *C. phlei* (Fig. 1, clade 12) and *C. sinuosum* (Fig. 1, clade 2); all three species have distinctly geniculate, subnodulose conidiophores and distinctly ornamented conidia. However, *C. phlei* forms ramoconidia and has longer and wider conidia and *C. sinuosum* possesses much longer conidiophores with swellings reaching up to 10 µm diam and shorter but wider conidia (Bensch *et al.* 2012, 2015). *Cladosporium allii* (Fig. 1, clade 19) which is the closest phylogenetic relative of *C. aerium*, differs in having wider conidiophores as well as longer and wider, 0–2(–4)-septate conidia (Bensch *et al.* 2012).

Cladosporium allicinum (Fr. : Fr.) Bensch *et al.*, Stud. Mycol. 72: 50. 2012. MycoBank MB800304. Fig. 5.

Holotype: **Sweden**, Skåne, on tip blight of living leaves of *Allium* sp. (*Amaryllidaceae*), Fr. no. F-09810, UPS-FRIES. *Neotype* of *Cladosporium bruhnei* (designated in Schubert *et al.* 2007b): **Belgium**, Kampenhout, isol. from *Hordeum vulgare* (*Poaceae*),

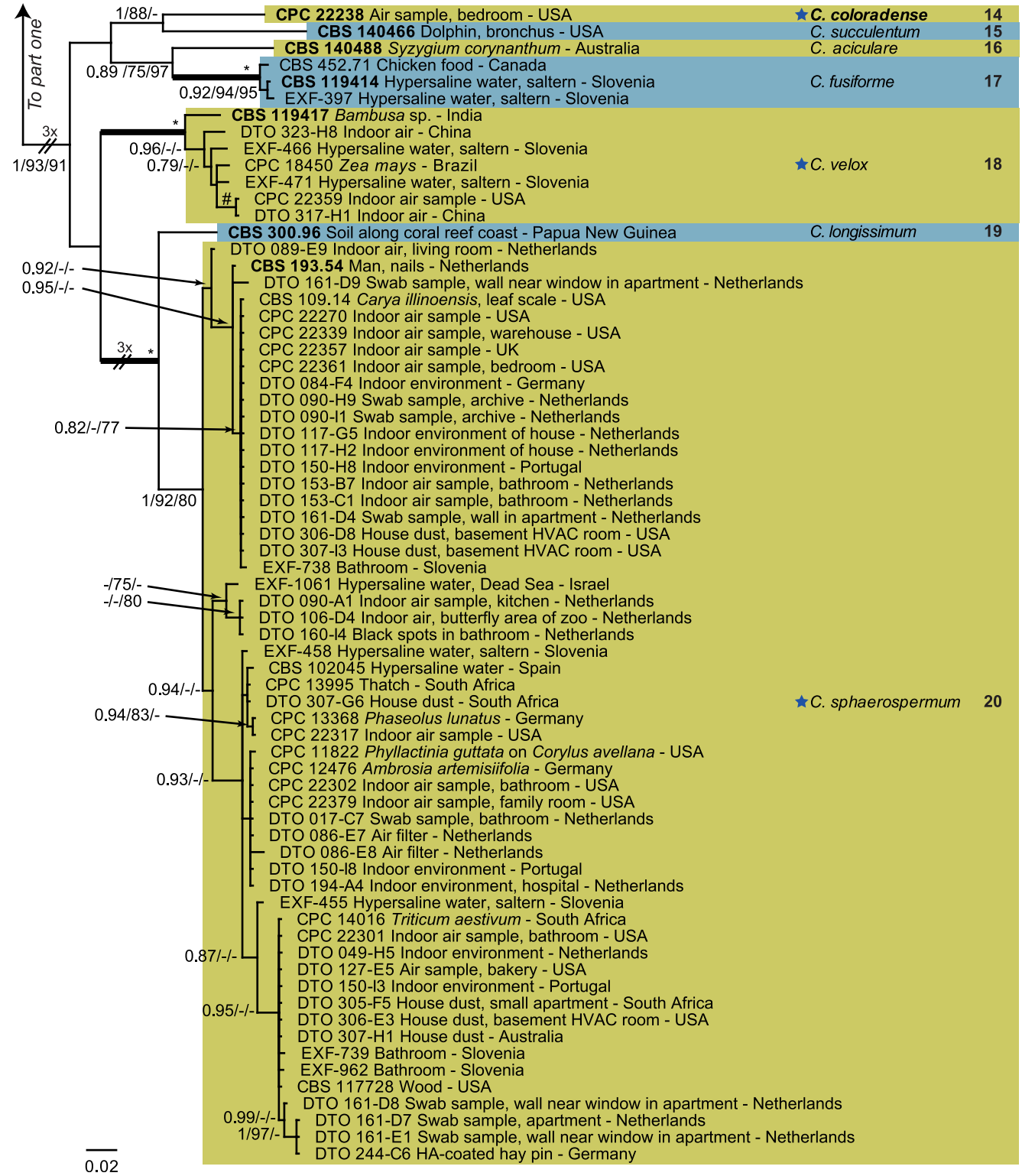

Fig. 3. (Continued).

26 Jun. 2005, J.Z. Groenewald, CBS H-19856. *Isoneotype*: HAL 2023 F. *Ex-neotype cultures*: CBS 121624 = CPC 12211, CPC 12212.

Lit.: Schubert *et al.* (2007b: 118–120).
Ill.: Schubert *et al.* (2007b: 118–120, figs 9–12), Bensch *et al.* (2012: 50–51, figs 14–17).

Mycelium superficial, hyphae branched, 1.5–8 µm wide, pluriseptate, broader hyphae usually slightly constricted at the septa and somewhat swollen, hyaline to subhyaline, almost smooth to somewhat verruculose or irregularly rough-walled, sometimes appearing to have a slime coat, walls unthickened. *Conidiophores* macronematous, sometimes also micronematous, arising as lateral or terminal branches from plagiotropous or ascending hyphae, erect, straight to more or less flexuous, sometimes geniculate, nodulose, usually with small headlike swellings, sometimes also with intercalary nodules, sometimes swellings protruding and elongated to one side, unbranched, occasionally branched, (7–)20–330 µm, sometimes even longer, (2–)3–5 µm wide, swellings (4–)5–8 µm wide, pluriseptate, not

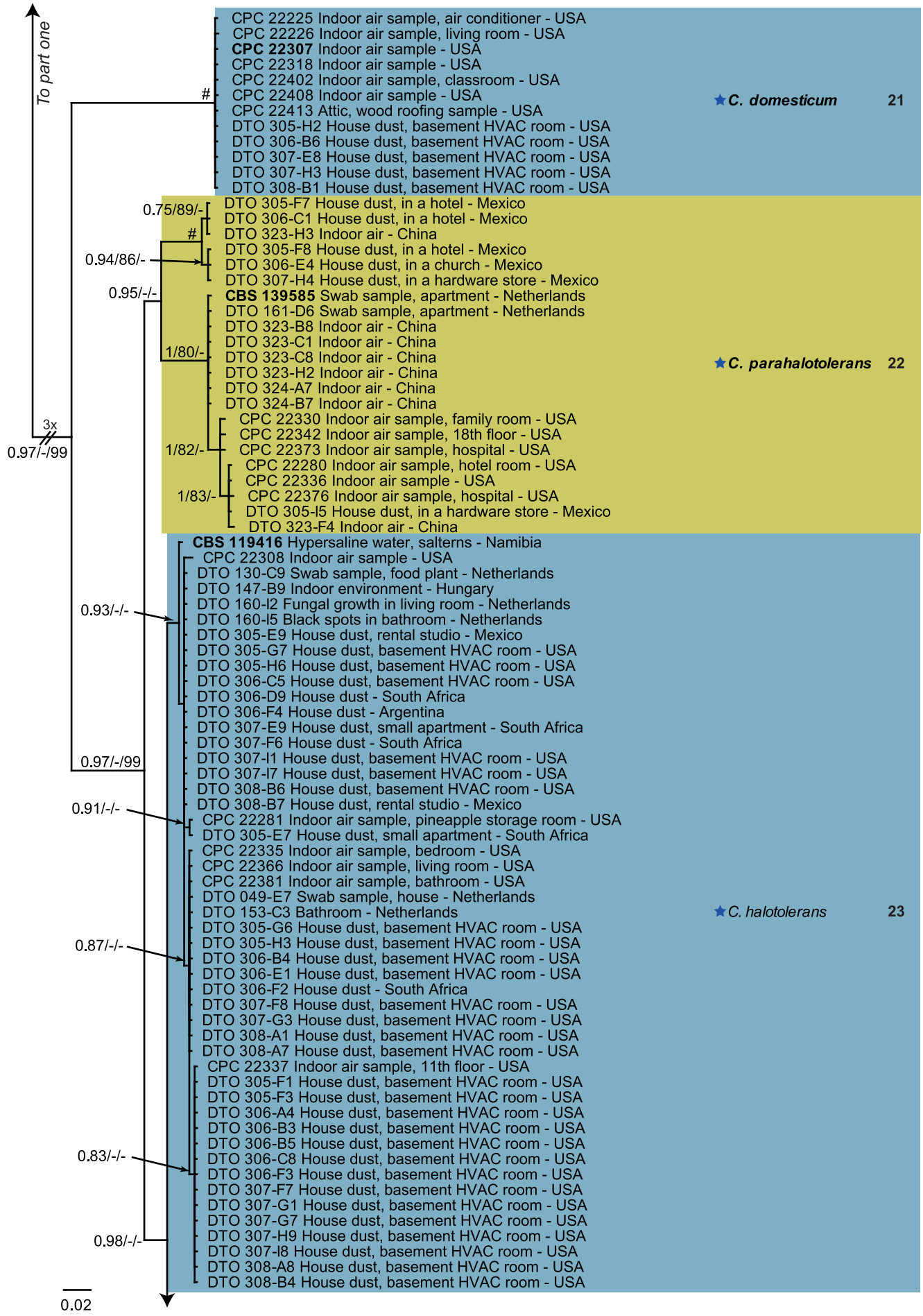

Fig. 3. (Continued).

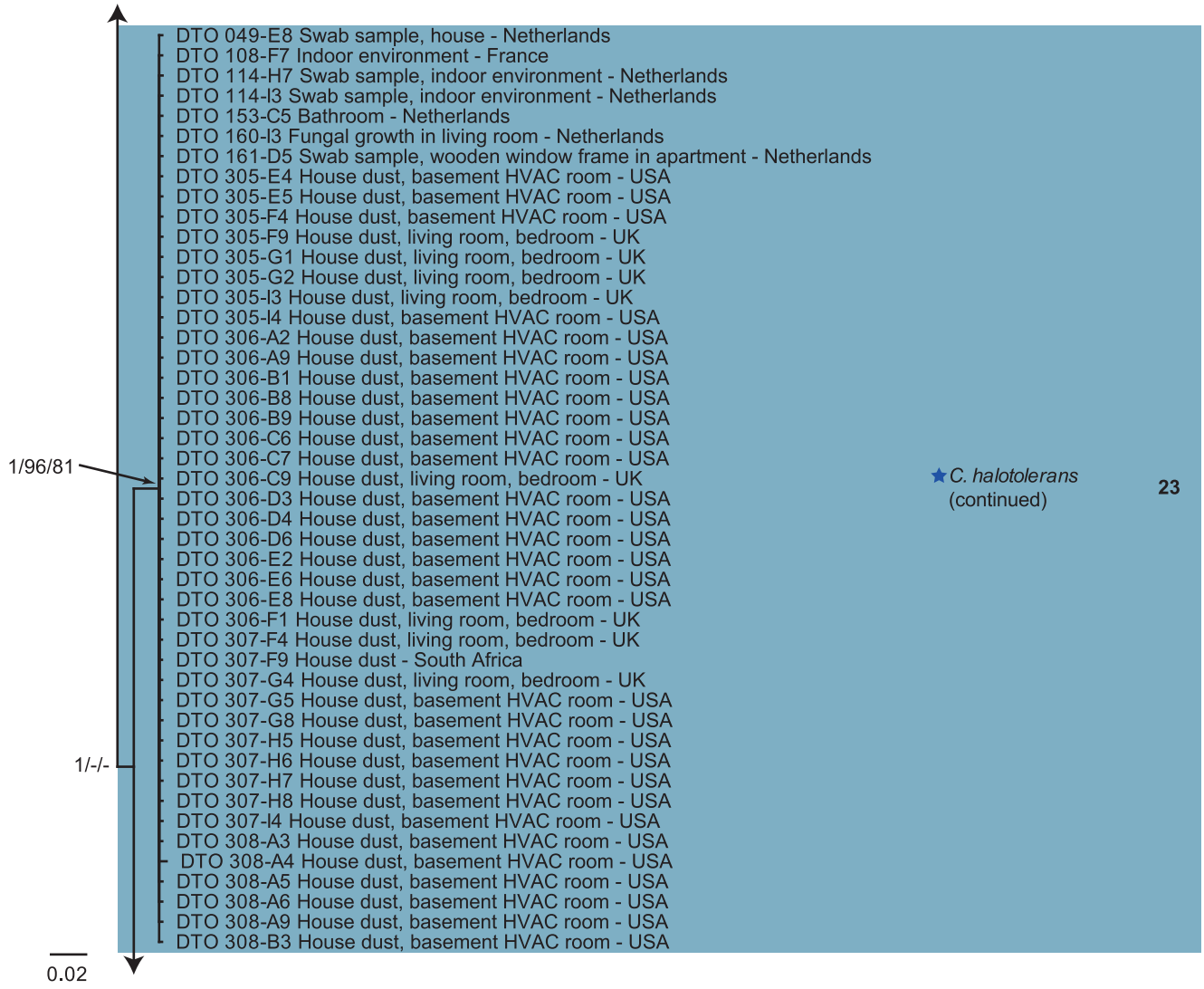

Fig. 3. (Continued).

constricted at the septa, septa sometimes not very conspicuous, subhyaline to pale brown or pale olivaceous, smooth or somewhat verruculose, walls unthickened or almost so, more thickened with age. *Conidiogenous cells* integrated, usually terminal, cylindrical with a terminal head-like swelling, sometimes with a second swelling, 15–40 µm long, proliferation sympodial, with few conidiogenous loci confined to swellings, up to six loci per swelling, loci protuberant, conspicuous, 1–2 µm diam, thickened and darkened-refractive. *Ramoconidia* occasionally formed, up to 34(–40) µm long, 3–4 µm wide, 0–2-septate. *Conidia* catenate, formed in branched chains, straight to slightly curved, *small terminal conidia* subglobose, ovoid to obovoid or somewhat limoniform, (3–)4–7(–9) × (2–)2.5–3.5 µm (av. ± SD: 5.3 ± 1.3 × 2.8 ± 0.4), aseptate; *intercalary conidia* ovoid, ellipsoid, 6–11(–12.5) × (2.5–)3–4 µm (av. ± SD: 8.6 ± 1.7 × 3.4 ± 0.5), 0(–1)-septate, *secondary ramoconidia* ellipsoid to subcylindrical or cylindrical, (8–)10–24(–31) × (3–)3.5–5(–7) µm (av. ± SD: 14.4 ± 4.1 × 4.2 ± 0.6), 0–1(–3)-septate, very rarely 5-septate, with up to 5 distal hila, subhyaline to pale brown or pale olivaceous, minutely verruculose to verrucose (mostly granulate with some muricate projections under SEM), walls unthickened or almost so, apex rounded or slightly attenuated towards apex and base, hila protuberant, conspicuous, 1–2 µm wide, up to 1 µm high, thickened and darkened-refractive; microcyclic conidiogenesis occurring.

Culture characteristics: Colonies on PDA reaching 22–32 mm diam after 14 d at 25 ºC, olivaceous grey to iron grey, sometimes whitish, smoke grey to pale olivaceous due to abundant aerial mycelium covering almost the whole colony, with age collapsing becoming olivaceous grey, occasionally zonate, velvety to floccose, margin narrow, entire edge, white, glabrous to somewhat feathery, aerial mycelium sparse to abundant, white, fluffy, growth regular, flat to low convex, sometimes forming few exudates in the colony centre, sporulating. Colonies on MEA reaching 21–32 mm diam after 14 d at 25 ºC, grey olivaceous, olivaceous grey to dull green or iron grey, sometimes whitish to pale smoke grey due to abundant aerial mycelium, olivaceous grey to iron grey reverse, velvety, margin narrow, entire edge to slightly undulate, white, radially furrowed, glabrous to slightly feathery, aerial mycelium sparse to abundant, mainly in the centre, white, fluffy, growth convex to raised, radially furrowed, distinctly wrinkled in the colony centre, without prominent exudates, sporulating. Colonies on OA reaching 20–32 mm diam after 14 d at 25 °C, smoke grey, grey olivaceous to olivaceous grey, greenish black or iron grey reverse, margin narrow, entire edge, colourless to white, glabrous, aerial mycelium sparse to abundant, dark smoke grey, diffuse, high, later collapsed, felty, growth flat, without prominent exudates, sporulation profuse.

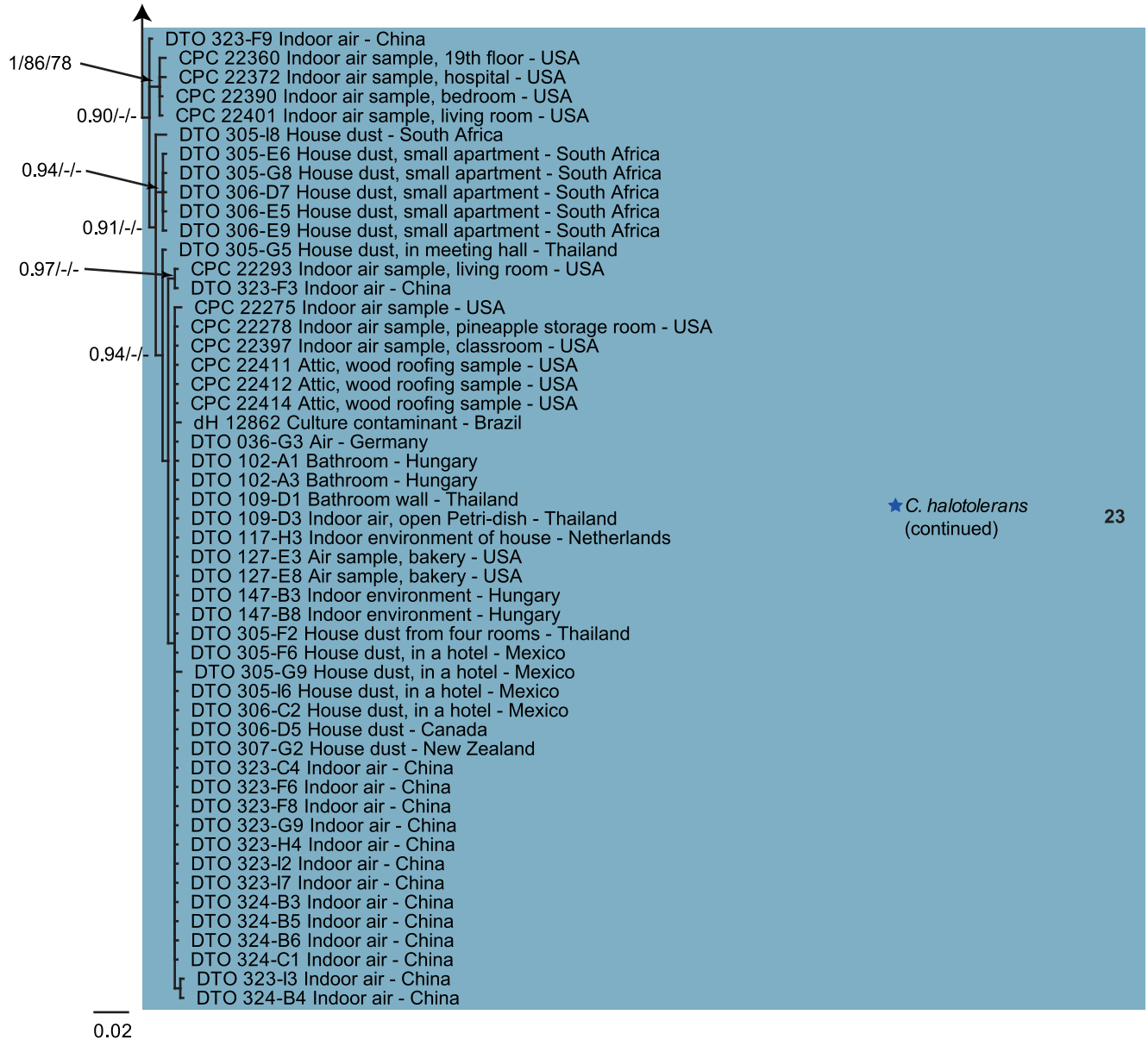

Fig. 3. (Continued).

Substrates and distribution: On living and decaying plant and fungal material, human, air, hypersaline and industrial water; worldwide.

Additional materials examined: **China**, isol. from indoor air, DTO 323-C3, DTO 323-E1, DTO 323-G5. **Denmark**, isol. from indoor environment, B. Andersen, CBS 139578 = DTO 109-I5, DTO 109-E5 = BA 1905, DTO 109-E6 = BA 1906, DTO 109-F3 = BA 1918, DTO 109-F5 = BA 1920, DTO 109-I3; BA 1897; Lyngby, isol. from an air sample, bedroom, U. Thrane, DTO 111-A5; isol. from wall basement, B. Andersen, DTO 110-B7. **France**, isol. from indoor environment, J. Dijksterhuis, DTO 108-F9. **Germany**, isol. from indoor environment, DTO 084-F3; G. Fischer, DTO 005-E8. **Hungary**, isol. from floor under curtain, DTO 101-I8; isol. from indoor environment, DTO 147-I6. **The Netherlands**, isol. from indoor air, area crocodiles, Zoo, DTO 106-C2; isol. from a wet wall, indoor, J. Houbraken, DTO 101-A1; Eindhoven, isol. from air sample, bedroom, J. Houbraken, DTO 089-G4, DTO 089-G6, DTO 089-H3; 's Hertogenbosch, from swab sample archive, M. Meijer, DTO 086-D5; Rijssen, isol. from an air sample, kitchen, M. Meijer, DTO 089-B9; Rijswijk, from swab sample archive, M. Meijer, DTO 090-D3; Utrecht, from swab sample archive, M. Meijer, DTO 090-H4. **UK**, Ditherington, isol. from indoor air sample, Dec. 2012, Ž. Jurjević, EMSL 1871 = CPC 22358. **USA**, California, Modesto, isol. from an indoor air sample, bedroom, Dec. 2012, Ž. Jurjević, EMSL 1862 = CPC 22349; Georgia, Tucker, isol. from an air sample, bakery, DTO 127-E4 = AR377; Minnesota, isol. from indoor air sample, Ž. Jurjević, EMSL 1726 = CPC 22268; New Jersey, Chatman, isol. from indoor air sample, Oct. 2012, Ž. Jurjević, EMSL 1808 = CPC 22312; Ž. Jurjević, EMSL 1809 = CPC 22313; New York, isol. from indoor air sample, bedroom, Dec. 2012, Ž. Jurjević, EMSL 1856 = CPC 22343; isol. from indoor air sample, bedroom, 15th floor, Jan. 2013, Ž. Jurjević, EMSL 1890 = CPC 22377.

Notes: *Cladosporium allicinum* (Fig. 2, clade 27) proved to be one of the most common *Cladosporium* species occurring in indoor environments after *C. halotolerans* (Fig. 3, clade 23), *C. sphaerospermum* (Fig. 3, clade 20) and *C. pseudocladosporioides* (Fig. 1, clade 56) (see also Segers *et al.* 2015). Surprisingly, none of the isolates included in the study of Segers *et al.* (2015) nor in this study turned out to be *C. herbarum*. This is of interest as *C. herbarum* is the most-studied species in allergy research (Breitenbach 2008, Poll *et al.* 2009). Segers *et al.* (2015) therefore recommended that specifically the common indoor fungi, *C. sphaerospermum*, *C. halotolerans* and *C. allicinum*, should be evaluated to assess whether the allergy screening panels of these fungi have to be adapted.

Fig. 4. *Cladosporium aerium* (CBS 143356). **A–C.** Colonies on PDA, MEA and OA. **D–I.** Conidiophores and conidia. **J.** Microcyclic conidiogenesis with a secondary ramoconidium forming a conidiophore with a conidium attached. **K–L.** Conidial chains. Scale bars = 10 µm.

Fig. 5. *Cladosporium allicinum* (DTO 109-E5). **A–C.** Colonies on PDA, MEA and OA. **D–G.** Macronematous conidiophores with conidial chains. **H–I.** Micronematous conidiophores. **J.** Conidia. Scale bars = 10 µm.

Cladosporium angulosum Sandoval-Denis *et al.*, Persoonia 36: 289. 2016. MycoBank MB815333.

Holotype: **USA**, Texas, from human bronchoalveolar lavage fluid, Sep. 2008, D.A. Sutton, CBS H-22380. *Ex-type culture*: CBS 140692 = UTHSC DI-13-235 = FMR 13348.

Ill.: Sandoval-Denis *et al.* (2016: 289, fig. 3).

Mycelium superficial and immersed, hyphae unbranched or loosely branched, 1–3 µm wide, septate, subhyaline or pale olivaceous brown, smooth or minutely verruculose, thin-walled, often forming loose to dense ropes. *Conidiophores* macro- and micronematous, arising terminally or laterally from hyphae or hyphal ropes, erect, straight to slightly flexuous, narrowly cylindrical-oblong, non-nodulose, usually not geniculate, unbranched or branched, frequently branching near the base in a 90° angle, branches short, often only as short lateral prolongations just below a septum, 9–150(–190) × (1.5–)2–4 µm, sometimes slightly attenuated towards the apex, septate, septa darkened, pale to medium olivaceous brown, smooth or minutely verruculose, especially towards the apex, thin-walled or slightly thickened. *Conidiogenous cells* terminal or intercalary, cylindrical, 8–46 × 2–3.5 µm, bearing up to four conidiogenous loci of 1–1.5 µm diam, darkened and refractive. *Ramoconidia* subcylindrical, straight, 24.5–46 × 2–3.5 µm, 0–1-septate, pale olivaceous brown, smooth or finely roughened, with protuberant, thickened and darkened scars, base broadly truncate, 2–2.5 µm wide, unthickened or slightly thickened, somewhat refractive. *Conidia* catenate, numerous conidia formed in densely branched chains, 1–4 conidia in the terminal unbranched part, *small terminal conidia* subglobose or obovoid, 2.5–4.5(–5) × (1.5–)2–2.5(–3) µm (av. ± SD: 3.6 ± 0.7 × 2.2 ± 0.4), aseptate; *intercalary conidia* ovoid, limoniform or ellipsoid, 4–10(–14.5) × 2–3 µm (av. ± SD: 7.2 ± 2.7 × 2.6 ± 0.3), 0(–1)-septate, with 1–4 hila at the apex, attenuated towards apex and base; *secondary ramoconidia* ellipsoid or subcylindrical to cylindrical, (7–)9–21.5(–30) × 2–3(–3.5) µm (av. ± SD: 15.9 ± 6.6 × 2.8 ± 0.5), 0–1(–2)-septate, often constricted at septum, with (2–)3–4(–5) distal hila, pale to medium olivaceous brown, smooth or loosely minutely verruculose, thin-walled, with protuberant 0.5–1.5 µm diam conidial hila; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on PDA attaining 50–56 mm diam after 14 d at 25 °C, olivaceous grey, olivaceous or iron-grey, reverse dull green to olivaceous black velvety to floccose, with regular white margin and a raised or umbonate centre and radially folded towards the periphery. Colonies on MEA reaching up to 75 mm diam after 14 d at 25 °C, white to pale olivaceous grey or rosy buff, reverse olivaceous grey or ochraceous, floccose or fluffy, margins narrow, radially furrowed, aerial mycelium abundantly formed, loose to dense. Colonies on OA reaching 52–55 mm diam after 14 d at 25 °C, grey olivaceous or pale olivaceous grey, reverse olivaceous grey, velvety to floccose or fluffy-felty, with regular margin, flat. Without prominent exudates on all media.

Cardinal temperature for growth: Optimum 25 °C, maximum 35 °C, minimum 5 °C (from Sandoval-Denis *et al.* 2016).

Substrates and distribution: Isolated from plant, human bronchoalveolar lavage fluid and indoor air; Asia (Thailand), Australasia (Australia), Central America (Panama), North America (USA).

Additional materials examined: **Australia**, Emerald Spring, isol. from *Corymbia foelscheana*, 22 Sep. 2007, B. Summerell, CPC 14566. **USA**, South Carolina, Charleston, isol. from indoor air sample, Aug. 2012, Ž. Jurjević, EMSL 1741 = CPC 22271.

Notes: *Cladosporium angulosum* (Fig. 1, clade 2) was introduced by Sandoval-Denis *et al.* (2016) as a closely related but phylogenetically distinct species of *C. perangustum* (Fig. 1, clade 4) showing sufficient genetic distance with respect to the ex-type strain of *C. perangustum*. Morphologically it differs from the latter species by forming smaller intercalary conidia and secondary ramoconidia. Conidia forming long branched chains with up to 14 conidia in the terminal unbranched part as described in Sandoval-Denis *et al.* (2016) could not be observed in the material examined. The strain CPC 14566 released some sulphur-yellow pigment into the PDA agar and some amber-coloured pigment into the OA agar. This has not been reported for the ex-type strain of *C. angulosum*. *Cladosporium xanthochromaticum* (Fig. 1, clade 3), another element of the *C. perangustum s. lat.* complex, was named for the production of a yellow diffusable pigment released into PDA agar and also some strains belonging to *C. perangustum s. str.* are able to produce an olivaceous buff or orange pigment in PDA agar and an amber coloured or orange pigment in OA agar. *Cladosporium xanthochromaticum* differs from *C. angulosum* in having longer conidia and in not growing at 35 °C (Sandoval-Denis *et al.* 2016).

The two isolates from *Ananas comosus* collected in Panama and reported in Bensch *et al.* (2015) as first records of *C. perangustum* in Central America proved to belong to *C. angulosum* (Sandoval-Denis *et al.* 2016).

Cladosporium angustisporum Bensch *et al.*, Stud. Mycol. 67: 17. 2010. MycoBank MB517071. Fig. 6.

Holotype: **Australia**, North Queensland, Daintree National Park, isol. from *Alloxylon wickhamii* (*Proteaceae*), coll. B.A. Summerell, isol. P.W. Crous, CBS H-20423. *Ex-type culture*: CBS 125983 = CPC 12437.

Ill.: Bensch *et al.* (2010: 21, figs 5–6).

Mycelium immersed and superficial; hyphae branched, 1–3 µm wide, septate, mostly not constricted at septa, subhyaline to olivaceous brown, smooth to verruculose or irregularly rough-walled, walls unthickened, sometimes irregular in outline due to swellings and constrictions, forming expanded hyphal ropes. *Conidiophores* solitary, macro- and micronematous, erect or ascending, arising terminally or laterally from hyphae, straight or flexuous, filiform to cylindrical-oblong, non-nodulose, usually not geniculate, unbranched or once branched, sometimes two types of conidiophores, short and long ones, 22–280 × (1.5–)2–4 µm, pluriseptate, not constricted at septa, but sometimes irregular in outline due to wider or narrower parts within the stalk, pale to medium olivaceous brown or pale olivaceous, smooth or verruculose at the base, walls unthickened or slightly thickened. *Conidiogenous cells* integrated, mainly terminal, sometimes also intercalary, neither nodulose nor geniculate, narrowly cylindrical-oblong, 10–27 µm long, with several loci crowded at the apex, in intercalary conidiogenous cells loci mainly situated on small lateral denticles just below a septum, subdenticulate, conspicuous, 1–1.5(–2) µm diam, thickened and darkened-refractive. *Ramoconidia* cylindrical, 18–42(–55) µm long, 0–1(–3)-septate, concolouress with tips of conidiophores, base broadly truncate, 2.5–3 µm wide, unthickened but sometimes slightly refractive. *Conidia* catenate, in branched chains, with 1–5 conidia in the terminal unbranched part of the chain, branching in all directions, *small terminal conidia* obovoid to

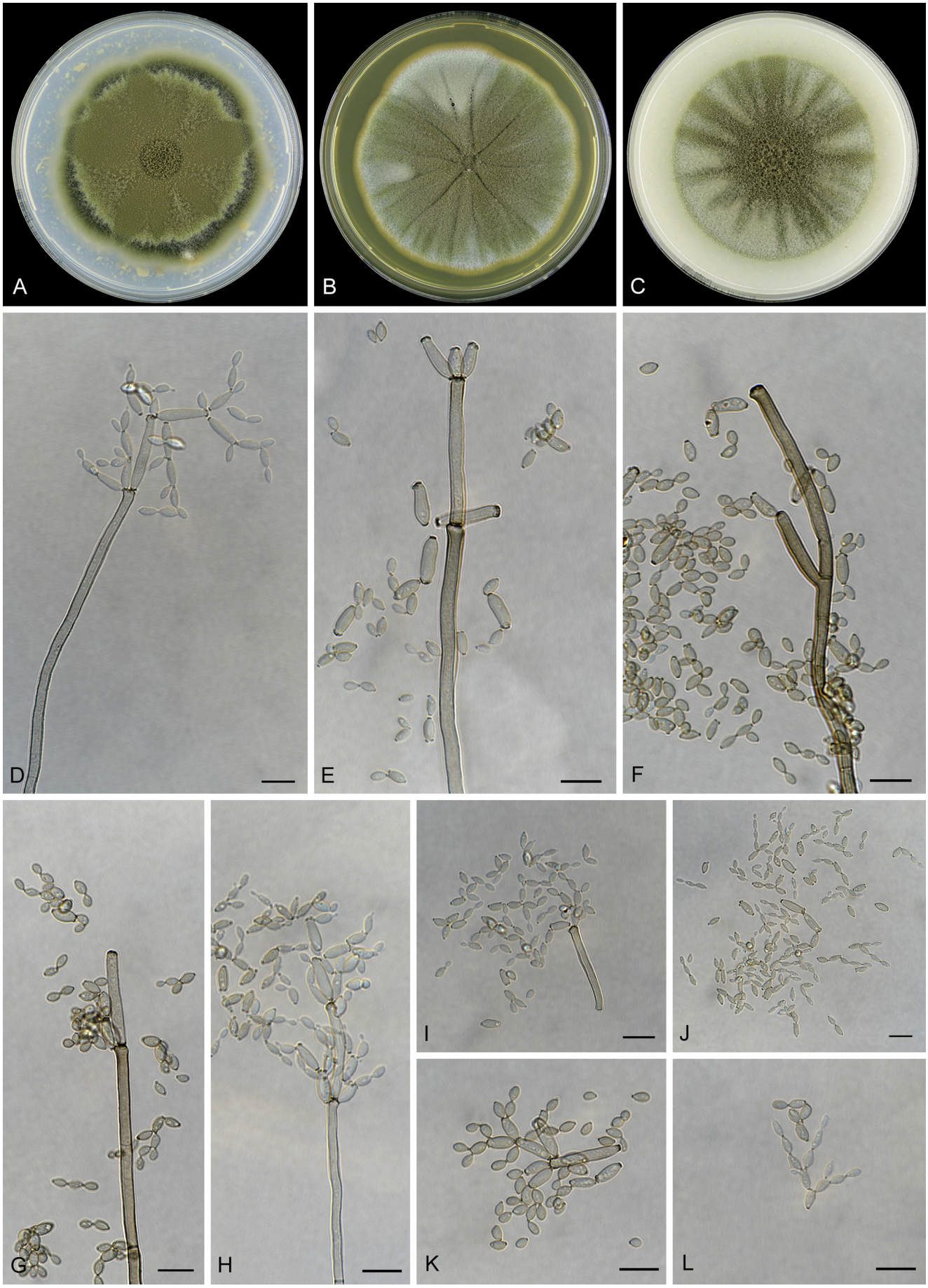

Fig. 6. *Cladosporium angustisporum* (CPC 22345). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Conidiophores and conidial chains. **I.** Ramoconidium and conidia. **J–L.** Conidial chains. Scale bars = 10 µm.

narrowly ellipsoid, 3−6.5 × 1.5−2 µm (av. ± SD: 4.9 ± 1.0 × 1.8 ± 0.3), aseptate, *intercalary conidia* narrowly ellipsoid, fusiform, (4−)5.5−11.5(−13) × (1.5−)2−2.5(−3) µm (av. ± SD: 8.1 ± 2.4 × 2.4 ± 0.4), 0(−1)-septate, with 1−3 distal hila, *secondary ramoconidia* ellipsoid to subcylindrical or cylindrical, (6−)7.5−26 × 2−3 µm (av. ± SD: 14.9 ± 6.1 × 2.7 ± 0.4), 0−1-septate, pale olivaceous or pale olivaceous brown, smooth or almost so, appearing to be reticulate, walls unthickened, somewhat attenuated towards apex and base, with 2−4(−5) distal hila, hila conspicuous, subdenticulate, 0.5−2 µm diam, thickened and darkened-refractive.

Culture characteristics: Colonies on PDA attaining 55−65 mm diam after 14 d at 25 °C, olivaceous or mouse-grey due to abundant sporulation with pale olivaceous grey or smoke-grey patches of aerial mycelium, reverse leaden-grey and iron-grey, velvety or fluffy, margin whitish, feathery, broad, aerial mycelium abundant, woolly to fluffy, loose diffuse or dense, growth low or high, without prominent exudates. Colonies on MEA reaching 45−62 mm diam after 14 d at 25 °C, smoke-grey, whitish to pale olivaceous grey due to abundant aerial mycelium, reverse iron-grey to pale greenish-grey, velvety to woolly-fluffy, margin narrow, whitish, regular or undulate, aerial mycelium abundant, loose diffuse or dense, fluffy, growth low convex, radially furrowed, sometimes with few prominent exudates, sporulation profuse. Colonies on OA attaining 60−65 mm diam after 14 d at 25 °C, olivaceous grey with patches of white and smoke-grey due to aerial mycelium, reverse leaden-grey and iron-grey, velvety or fluffy, margin regular, glabrous, growth flat, without exudates, sporulation profuse.

Substrate and distribution: On plant material as well as isolated from indoor and outside air, also reported from clinical samples; Australia, North America (USA).

Additional materials examined: **USA**, Alabama, Mobile, isol. from outside air sample, Dec. 2012, Ž. Jurjević, EMSL 1858 = CPC 22345; Florida, Miami, isol. from indoor air sample, office, Jan. 2013, Ž. Jurjević, EMSL 1884 = CPC 22371; Wisconsin, Oak Creek, isol. from air sample, bakery, DTO 127-E6 = AR387.

Notes: *Cladosporium angustisporum* (Fig. 1, clade 58) belongs to the *C. cladosporioides* species complex (Fig. 1) and is morphologically very close to *C. cladosporioides s. str.* but differs in having distinctly narrower conidia, 1.5−3 µm wide. Phylogenetically, *C. angustisporum* is allied to *C. subuliforme* (Fig. 1, clade 59) but the latter species is morphologically distinguishable in having slightly wider terminal and intercalary conidia and often awl-shaped conidiophores with a wider base and an attenuated apex (Bensch *et al.* 2010).

Until now *C. angustisporum* was only know from the type collected in Australia, but probably has an even wider distribution. It was recently reported from a clinical sample in the USA (Sandoval-Denis *et al.* 2015) and has been isolated several times from indoor and outside air (this study).

Cladosporium anthropophilum Sandoval-Denis *et al.*, Persoonia 36: 290. 2016. MycoBank MB815334.

Holotype: **USA**, Minnesota, from human bronchoalveolar lavage fluid, Sep. 2012, D.A. Sutton, CBS H-22381. *Ex-type culture*: CBS 140685 = UTHSC DI-13-269 = FMR 13382.

Ill.: Sandoval-Denis *et al.* (2016: 290, fig. 4).

Mycelium superficial and immersed, hyphae unbranched or branched, (1−)2−4 µm wide, septate, subhyaline to pale olivaceous, smooth or minutely verruculose at or towards the base of conidiophores, thick-walled, anastomosing. *Conidiophores* macro- and semimacronematous, erect, cylindrical, non-nodulose, sometimes geniculate, usually branched, up to 550 µm long, 2−5 µm wide, often slightly attenuated towards the apex, septate, pale to medium olivaceous brown, slightly roughened to verruculose toward the base, with a thickened and refractive wall; occasionally micronematous conidiophores formed, 1.5−2 µm wide. *Conidiogenous cells* terminal and intercalary, cylindrical or subcylindrical, 15−54 × 3−5 µm, often with a swollen apex, bearing 3−8(−10) conidiogenous loci, protuberant, subdenticulate, crowded, 1−2.5 µm diam, thickened and somewhat darkened. *Ramoconidia* cylindrical, 20−51 × 2−5 µm, 0(−2)-septate, pale olivaceous, smooth, with conidial scars protuberant, thickened and darkened. *Conidia* forming short, branched chains with up to four conidia in the terminal unbranched part of the chain, *small terminal conidia* ovoid or ellipsoid, 3.5−9 × 2−3 µm (av. ± SD: 5.1 ± 1.3 × 2.5 ± 0.5), *intercalary conidia* limoniform to ellipsoid, 4.5−12(−19) × 2−3(−4) µm (av. ± SD: 9.3 ± 2.3 × 3.0 ± 0.5), aseptate; *secondary ramoconidia* ellipsoid to subcylindrical, 7−28(−30) × (2−)3−4(−5) µm (av. ± SD: 18.7 ± 6.3 × 3.4 ± 0.6), 0−1(−2)-septate, often attenuated at the centre, subhyaline or pale olivaceous brown, smooth or finely roughened, reticulate under SEM, with 2−5 protuberant hila forming dense clusters at the distal end, 0.5−2 µm diam; microcyclic conidiogenesis sometimes occurring.

Culture characteristics: On PDA attaining 17−80 mm diam after 14 d at 25 °C, grey olivaceous, olivaceous or greenish olivaceous, reverse leaden-grey or olivaceous black, velvety or powdery, margin white, regular, flat or folded, aerial mycelium sparse, diffuse, sometimes showing cottony to floccose white to grey cushions. Colonies on MEA reaching 50−72 mm diam after 14 d at 25 °C, grey olivaceous, glaucous-grey towards margins, reverse iron-grey, powdery or fluffy-felty, margin regular, radially furrowed or wrinkled, aerial mycelium diffuse or more abundant in colony centre, fluffy-felty. Colonies on OA attaining 27−74 mm diam after 14 d at 25 °C, smoke-grey, grey olivaceous or olivaceous, greenish olivaceous towards margins, reverse leaden-grey, iron-grey or leaden-black, flat, velvety or fluffy-felty, margin fimbriate, aerial mycelium sparse or more abundant. Sporulation profuse on all media, without prominent exudates and diffusible pigment.

Cardinal temperature for growth: Optimum 25 °C, maximum 35 °C, minimum 5 °C (from Sandoval-Denis *et al.* 2016).

Substrates and distribution: Isolated from human clinical samples, indoor air, food and plant material; Africa (South Africa, Uganda), Asia (China, India, Indonesia, Israel, Japan, South Korea, Thailand), Australasia (Australia), North America (USA).

Additional materials examined: **China**, isol. from indoor air, DTO 317-I7, DTO 318-E3, DTO 323-C2, DTO 323-C6, DTO 323-C7, DTO 323-D2, DTO 323-D8, DTO 323-D9, DTO 324-C4, DTO 324-D3. **India**, isol. from *Dalbergia* sp., W. Gams, CPC 11131. **Israel**, isol. from seeds of *Gossypium* sp., CBS 674.82 = ATCC 200936. **Japan**, isol. from bamboo slats, CBS 122130 = ATCC 38012. **South Africa**, Baberton, Laeveld Coop, isol. from *Triticum aestivum*, CPC 14009. **South Korea**, isol. from *Phytolacca americana*, H.D. Shin, CPC 11122; isol. from *Ricinus communis*, 2003, H.D. Shin, CPC 11119. **Uganda**, Mubende, isol. from food, coffee leaf, B. Andersen, CPC 14356 = BA 1676. **USA**, Arizona, Tuscon, isol. from indoor air sample, hospital, Jan. 2013, Ž. Jurjević, EMSL 1908 = CPC 22393; Georgia, isol. from air sample, bakery, DTO 127-E9 = AR409; McDonough, isol. from indoor air sample, living room, Nov. 2012, Ž. Jurjević, EMSL 1818 = CPC 22315.

Notes: *Cladosporium anthropophilum* was recently introduced by Sandoval-Denis *et al.* (2016) and proved to be a common

saprobic fungus (see Table 1). It also represents a clinically relevant fungus, being the second most prevalent species identified in a set of clinical isolates from the USA after *C. halotolerans* (Sandoval-Denis *et al.* 2015), and has been isolated quite frequently from indoor environments. Although discussed as phylogenetically distant (Sandoval-Denis *et al.* 2016), *C. anthropophilum* (Fig. 1, clade 65) is shown to be morphologically and phylogenetically closely related to *C. cladosporioides* (Fig. 1, part 66). It mainly differs by its longer conidiophores, up to 550 µm long, with numerous loci crowded at or towards the often subnodulose apex and ovoid to ellipsoid terminal conidia, 3.5–9 µm long, showing a fine, dense reticulation under SEM, whereas *C. cladosporioides* forms shorter conidiophores (10–250 µm) with usually (1−)2−4 conidiogenous loci at the apex and subglobose to limoniform, 3−6(−7) µm long terminal conidia with an irregularly reticulate or striped wall. *Cladosporium anthropophilum* also resembles *C. pseudocladosporioides* and *C. tenuissimum*, but they are genetically well differentiated (Fig. 1, clades 65, 56 and 64, respectively) and morphologically, *C. anthropophilum* shows longer terminal conidia, [3.5–9 µm long (av. ± SD: 5.1 ± 1.3) *vs* 3−5.5 (av. ± SD: 4.1 ± 0.7) in *C. pseudocladosporioides* and (2−)2.5−5(−6) (av. ± SD: 3.7 ± 1.0) in *C. tenuissimum*] and forms longer conidiophores than *C. pseudocladosporioides* (15–155 µm long) (Bensch *et al.* 2012, Sandoval-Denis *et al.* 2016).

Cladosporium asperulatum Bensch *et al.*, Stud. Mycol. 67: 21. 2010. MycoBank MB517072. Fig. 7.

Holotype: **Portugal**, isol. from *Protea susannae* (*Proteaceae*), 1 May 2007, P.W. Crous, CBS H-20424. *Ex-type culture*: CBS 126340 = CPC 14040.

Lit.: Bensch *et al.* (2012: 70−72; 2015: 41).
Ill.: Bensch *et al.* (2010: 22−24, figs 7−9; 2012: 70−72, figs 42−44).

Mycelium immersed, sparingly superficial; hyphae unbranched or very sparingly branched, 2−4.5 µm wide, septate, not constricted at septa, subhyaline to pale or medium olivaceous brown, smooth to minutely verruculose or irregularly verrucose, walls unthickened or almost so, sometimes forming loose to dense ropes of a few or several hyphae. *Conidiophores* macro- and micronematous, solitary, arising terminally or laterally from hyphae, erect, straight to slightly flexuous, cylindrical-oblong, sometimes slightly geniculate towards the apex, non-nodulose, (15−)45−210(−360) × (2−)3−4(−5) µm, sometimes up to 5 µm wide at the base, unbranched, occasionally branched, branches below the apex or at a lower level, usually below a septum, sometimes up to 105 µm long, pluriseptate with 0−12 septa, not constricted, pale to medium olivaceous brown, paler towards the apex and sometimes attenuated, smooth to asperulate or minutely verruculose, walls slightly thickened; micronematous conidiophores filiform or narrowly cylindrical-oblong, about 2 µm wide, paler and narrower, subhyaline or pale olivaceous brown, mostly with a single apical scar. *Conidiogenous cells* integrated, mainly terminal, cylindrical-oblong, sometimes slightly geniculate-sinuous towards the apex, 22−38 µm long, smooth or almost so, with 2−4 apical loci, protuberant, subdenticulate, sometimes situated on peg-like prolongations, 1−2 µm diam, thickened and darkened-refractive. *Ramoconidia* cylindrical-oblong, 15−50 × 3−4 µm, 0(−1)-septate, concolouress with tips of conidiophores, smooth or almost so, base broadly truncate, (2.2−)2.5−3(−3.2) µm wide, unthickened. *Conidia* catenate, in branched chains, up to 8(−10) conidia in the terminal unbranched part of the chain, *small terminal conidia* obovoid, 4.5−7(−8) × 2−3(−3.5) µm (av. ± SD: 5.4 ± 1.0 × 2.6 ± 0.4), *intercalary conidia* ovoid, fusiform to ellipsoid, 5−11(−13) × 2.5−3(−4) µm (av. ± SD: 8.0 ± 2.2 × 2.9 ± 0.4), aseptate, *secondary ramoconidia* ellipsoid, fusiform, subcylindrical, (7.5−)9−26(−37) × (2.5−)3−4(−5) µm (av. ± SD: 17.9 ± 6.5 × 3.4 ± 0.6), 0(−1)-septate, very rarely with a second septum, not constricted at septa, subhyaline to pale olivaceous brown, smooth to minutely verruculose or irregularly rough-walled (LM), under SEM loosely verruculose or surface with irregularly reticulate structure or embossed stripes probably caused by diminishing turgor and shrivelling of tender conidia, walls slightly thickened, attenuated towards apex and base, hila protuberant, subdenticulate, 0.8−2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA attaining 48−53 mm diam after 14 d at 25 °C, olivaceous grey, iron-grey or grey olivaceous at margins, sometimes zonate, reverse leaden-grey, greyish blue to iron-grey, powdery to fluffy or hairy, margin white, narrow, glabrous, aerial mycelium abundantly formed, dense, fluffy and high in colony centre, growth flat to low convex with somewhat elevated colony centre, sometimes with prominent exudates, sporulation profuse. Colonies on MEA reaching 45−64 mm diam after 14 d at 25 °C, olivaceous grey to pale greenish grey, reverse olivaceous grey to iron-grey, powdery to fluffy, margin white to smoke-grey, narrow, regular, glabrous to feathery, radially furrowed, aerial mycelium abundant, sometimes several prominent exudates formed appearing blackish, sporulation profuse. Colonies on OA attaining 45−55 mm diam after 14 d at 25 °C, grey olivaceous or olivaceous, smoke-grey due to abundant fluffy-felty aerial mycelium, margin regular, without exudates, sporulation profuse.

Substrates and distribution: Isolated from plant material and indoor environment; Asia (India), Europe (Portugal), North America (Mexico, USA).

Additional materials examined: **India**, isol. from *Eucalyptus* leaf litter (*Myrtaceae*), 1 Mar. 2004, coll. W. Gams, isol. P.W. Crous, CBS 126339 = CPC 11158. **USA**, California, Frazier Park, isol. from indoor air sample, bathroom, Dec. 2012, Ž. Jurjević, EMSL 1877 = CPC 22364.

Notes: *Cladosporium asperulatum* (Fig. 1, clade 28) is phylogenetically close to but distinct from *C. myrtacearum* (Fig. 1, clade 26; see Bensch *et al.* 2010) and *C. angustiterminale* (Fig. 1, clade 27; see Bensch *et al.* 2015). Morphologically this species is comparable with *C. subtilissimum* (Fig. 2, clade 25), which belongs to the *C. herbarum* species complex, but differs in having 0−12-septate, somewhat longer conidiophores and narrower conidia (Schubert *et al.* 2007b). It has recently been reported from Mexico (Bensch *et al.* 2015) and now proves to be also occurring in indoor environments.

Cladosporium austrohemisphaericum Bensch *et al.*, Stud. Mycol. 82: 42. 2015. MycoBank MB814626. Fig. 8.

Holotype: **New Zealand**, Auckland, Morrin Reserve, −37.00, 175.00, isolated from black mould on the surface of a fruit of *Lagunaria patersonia* (*Malvaceae*), 18 Apr. 2005, C.F. Hill, Hill 1163, CBS H-22350. *Ex-type culture*: CBS 140482 = CPC 12068.

Ill.: Bensch *et al.* (2015: 46, fig. 10).

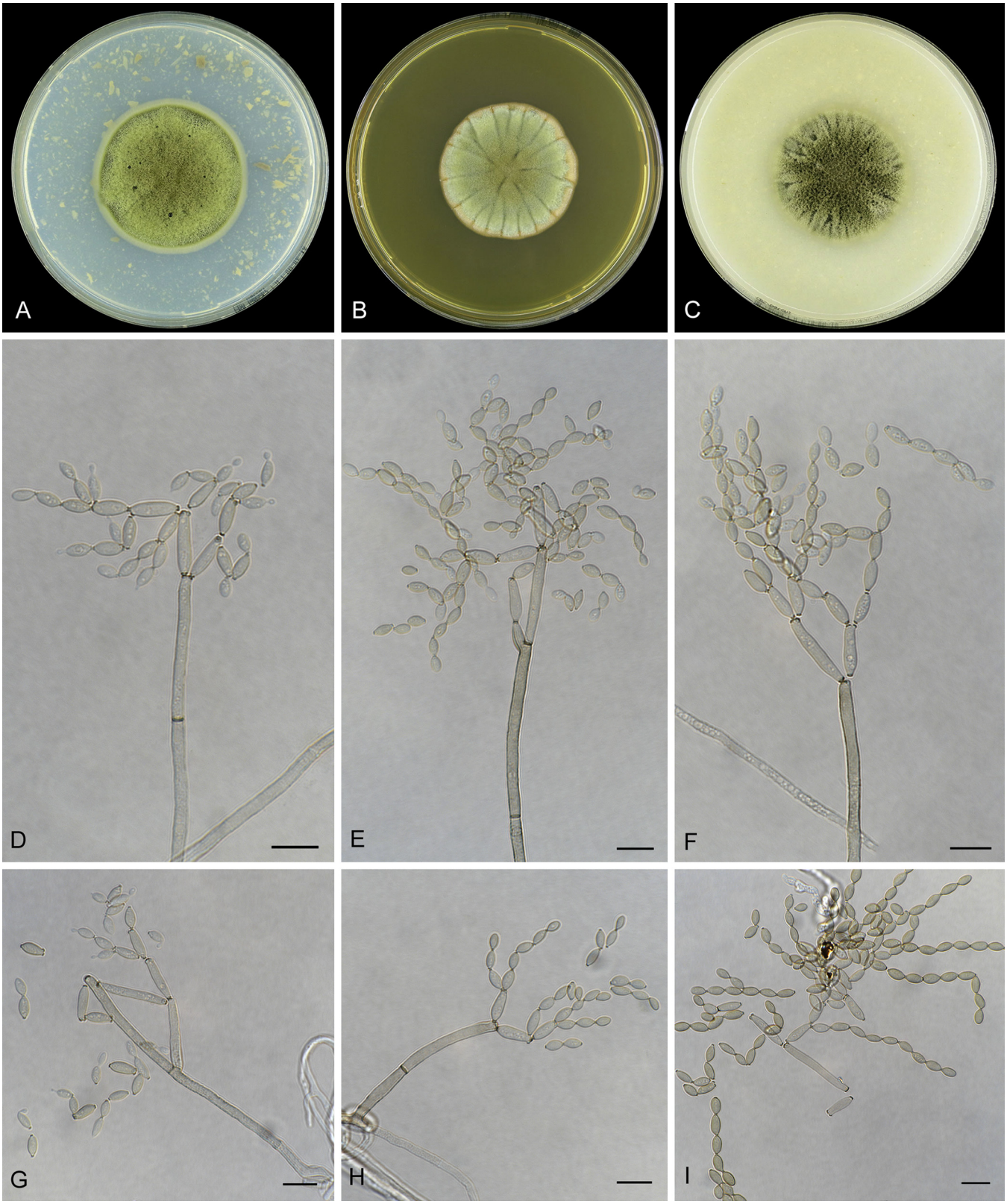

Fig. 7. *Cladosporium asperulatum* (CPC 22364). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Conidiophores and conidial chains. **I.** Ramoconidium with conidial chains. Scale bars = 10 µm.

Mycelium immersed, branched, 1–4 µm wide, septate, subhyaline to very pale olivaceous brown, asperulate, minutely verruculose, verruculose or even verrucose, walls unthickened, without any swellings and constrictions. *Conidiophores* micro- to semimacronematous or macronematous, arising terminally and laterally from erect or ascending hyphae, erect, solitary or in pairs or loose groups, straight to flexuous, filiform to narrowly cylindrical-oblong, sometimes once geniculate at or towards the apex, unbranched or once branched, branches often only as short lateral peg-like prolongations just below a septum, 20–135(–180) × (2–)2.5–3.5 µm, at the base up to 4.5 µm wide, septate, often only with up to four not very conspicuous septa, sometimes disarticulating at septa and forming ramoconidia and fragments, subhyaline to pale or medium olivaceous brown,

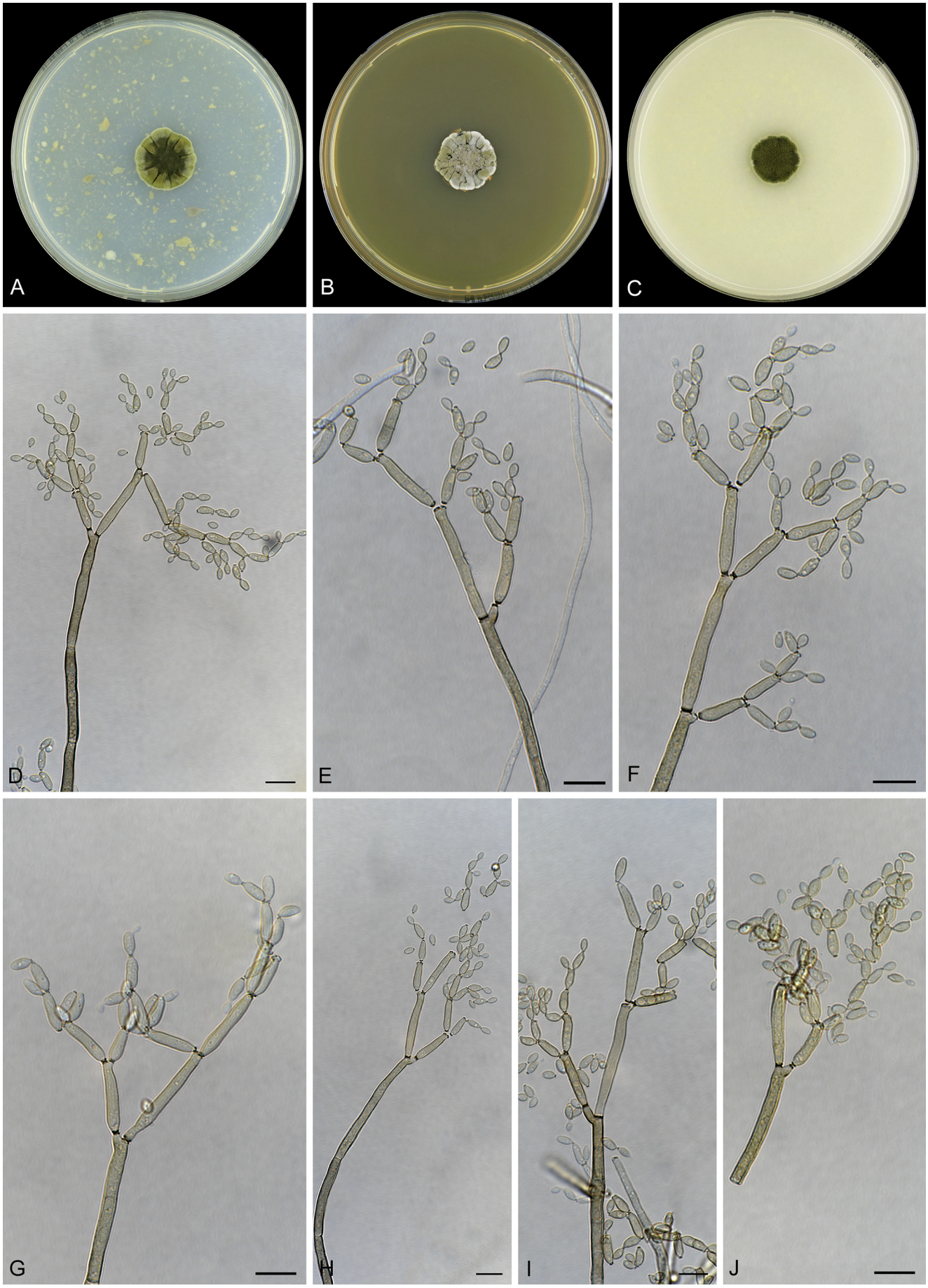

Fig. 8. *Cladosporium austrohemisphaericum* (DTO 305-E8). **A–C.** Colonies on PDA, MEA and OA. **D–I.** Unbranched or branched conidiophores with conidial chains. **J.** Ramoconidium with conidial chains. Scale bars = 10 µm.

minutely verruculose, asperulate, sometimes verrucose or irregularly rough-walled especially towards the base and almost smooth at or towards the apex, walls unthickened or slightly thick-walled, slightly attenuating towards the apex, sometimes conidiophores reduced to conidiogenous cells. *Conidiogenous cells* integrated, mostly terminal, sometimes intercalary, filiform to narrowly cylindrical-oblong, sometimes once geniculate, non-nodulose, (6–)13–45(–60) µm long, with 1–3(–4) apical loci, conspicuous, subdenticulate to denticulate, 1–2 µm diam, thickened and darkened-refractive. *Ramoconidia* cylindrical-oblong, 12–45 × 2–3(–3.5) µm, 0–1(–2)-septate, subhyaline to pale olivaceous brown, almost smooth to asperulate or minutely verruculose, base broadly truncate, 2–3 µm wide, neither thickened nor darkened. *Conidia* numerous, catenate, formed in branched chains, branching in all directions, in younger chains often dichotomously branched, 1–3 conidia in the terminal unbranched part of the chain, *small terminal conidia* globose, subglobose to obovoid or ovoid, 2–5(–7) × (1–)1.5–3 µm (av. ± SD: 3.3 ± 1.0 × 2.1 ± 0.5), aseptate, subhyaline to pale or medium olivaceous brown, minutely verruculose to verruculose or verrucose, hila 0.5–0.8 µm diam or narrower, *intercalary conidia* ovoid to ellipsoid-ovoid, 4–11 × 2–3.5 µm (av. ± SD: 7.1 ± 2.1 × 2.6 ± 0.4), 0(–1)-septate, septa sometimes not very conspicuous, surface ornamentation as in small terminal conidia, rounded or only very slightly attenuated towards the ends, with 2–4 distal hila, 0.5–1 µm diam, *secondary ramoconidia* ellipsoid to subcylindrical, (8–)10–27(–30) × 2–3.5(–4) µm (av. ± SD: 18.5 ± 6.2 × 2.9 ± 0.4), 0–1(–3)-septate, with age constricted at septa, septum median or in the upper half, 1–3(–4) distal hila, subhyaline to pale olivaceous brown, almost smooth to loosely verruculose or irregularly rough-walled, not or only slightly attenuated towards apex and base, hila conspicuous, subdenticulate, 1–2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on PDA attaining 35–45 mm diam after 14 d at 25 °C, grey olivaceous to dull green or iron-grey, reverse greyish blue to olivaceous black, velvety to powdery, margin white, narrow, glabrous to feathery, regular, aerial mycelium absent or sparse, loose, diffuse, growth flat or low convex, without prominent exudates, sporulation profuse. Colonies on MEA reaching 26–44 mm diam after 14 d at 25 °C, grey olivaceous to greenish grey or glaucous-grey at margins, paler in the centre, reverse olivaceous to olivaceous grey or iron-grey, velvety to powdery, margin white, very narrow, feathery, radially furrowed, growth flat to low convex with slightly elevated colony centre, wrinkled and folded, few prominent exudates formed, sporulation profuse. Colonies on OA attaining 26–34 mm diam after 14 d at 25 °C, grey olivaceous or iron-grey, smoke-grey due to abundant sporulation, reverse leaden-grey to leaden-black, powdery, margin white, very narrow, glabrous, slightly undulate, aerial mycelium absent or diffuse, without prominent exudates.

Substrates and distribution: On plant material and fruits of different hosts as well as indoor environments (house dust); Australasia (Australia, New Zealand), South Africa.

Additional material examined: **New Zealand**, isol. from house dust, DTO 305-E8 = TA05NZ-351A.

Notes: A single isolate from house dust collected in New Zealand morphologically fits the concept of the recently described species *C. austrohemisphaericum* which was isolated from black mould on the surface of a fruit in New Zealand. Therefore, it is herein treated as an additional isolate of that species although all four known isolates sit on quite long branches in a well-supported clade (Fig. 3, clade 9) and may each represent a cryptic species. For now we refrain from introducing further novel species for these morphologically similar isolates until additional isolates are available to formalise species concepts for these lineages.

Cladosporium cladosporioides (Fresen.) G.A. de Vries, Contr. Knowl. Genus *Cladosporium*: 57. 1952. MycoBank MB294915. Fig. 9

Type: **Germany**, on overwintered leaves of *Hydrangea* sp. (*Hydrangeaceae*) (not preserved). *Neotype* (designated in Bensch *et al.* 2010): **Germany**, isol. from indoor air, Ch. Trautmann, CBS H-20428. *Ex-type culture*: CBS 112388.

Lit.: Ellis (1971: 319), Domsch *et al.* (1980: 202), Ho *et al.* (1999: 121), Samson *et al.* (2000: 108), de Hoog *et al.* (2000: 583), Samson *et al.* (2001: 340), Park *et al.* (2004), Heuchert *et al.* (2005: 46–47), Bensch *et al.* (2010: 29–34), Bensch *et al.* (2012: 90–93).

Ill.: Fresenius (1850: Taf. 3, Figs 23–28), de Vries (1952: 58–59, Figs 10–11), Ellis (1971: 318, fig. 219 C), Domsch *et al.* (1980: 203, fig. 82), Ho *et al.* (1999: 122, figs 8–9), de Hoog *et al.* (2000: 583–584, figs), Samson *et al.* (2000: 108, fig. 48; 109, pl. 46), Bensch *et al.* (2010: 30–32, figs 17–19).

Mycelium immersed, rarely superficial; hyphae sparse, unbranched or sparingly branched, (1−)2−4(−5) µm wide, septate, septa occasionally darkened, without any swellings and constrictions, subhyaline, pale olivaceous brown or pale brown, smooth to minutely verruculose or rough-walled, walls unthickened. *Conidiophores* solitary, macro- or semimacronematous, sometimes micronematous, arising terminally from ascending hyphae or laterally from plagiotropous hyphae, straight to somewhat flexuous, narrowly cylindrical to cylindrical-oblong, sometimes filiform, non-nodulose, usually not geniculate-sinuous, occasionally once geniculate, 40−300(−350) × (2.5−)3−4(−5.5) µm, unbranched or occasionally branched, branches usually short, only as peg-like lateral outgrowth just below a septum, occasionally up to 60 µm, mostly in the upper third, pluriseptate, usually not constricted at septa, sometimes slightly constricted and one of the upper septa slightly darkened where ramoconidia are formed, pale to medium olivaceous brown or brown, smooth to minutely verruculose or verruculose especially towards the base, walls unthickened or slightly thickened, occasionally slightly attenuated towards the apex, base sometimes swollen, up to 7 µm wide; micronematous conidiophores shorter, narrower, paler, unbranched, 9−150 × (1−)1.5−2.5(−3) µm wide. *Conidiogenous cells* integrated, usually terminal, sometimes intercalary with conidiogenous loci situated on small peg-like or denticle-like lateral outgrowths just below a septum, cylindrical-oblong, not geniculate, non-nodulose, (7−)16−38 µm long, with up to four loci crowded at the apex, subdenticulate to denticulate, protuberant, 1−2(−2.5) µm diam, central dome often not very conspicuous, flat, somewhat thickened and darkened-refractive. *Ramoconidia* seceding at one of the upper, somewhat darkened septa, straight to slightly curved, cylindrical-oblong, 15−50 × (2.5−)3−5 µm, with up to three septa, pale olivaceous brown, concolourous with tips of conidiophores, smooth, base not cladosporioid, 2.5−4 µm wide, unthickened or slightly thickened, sometimes slightly refractive. *Conidia* numerous, catenate,

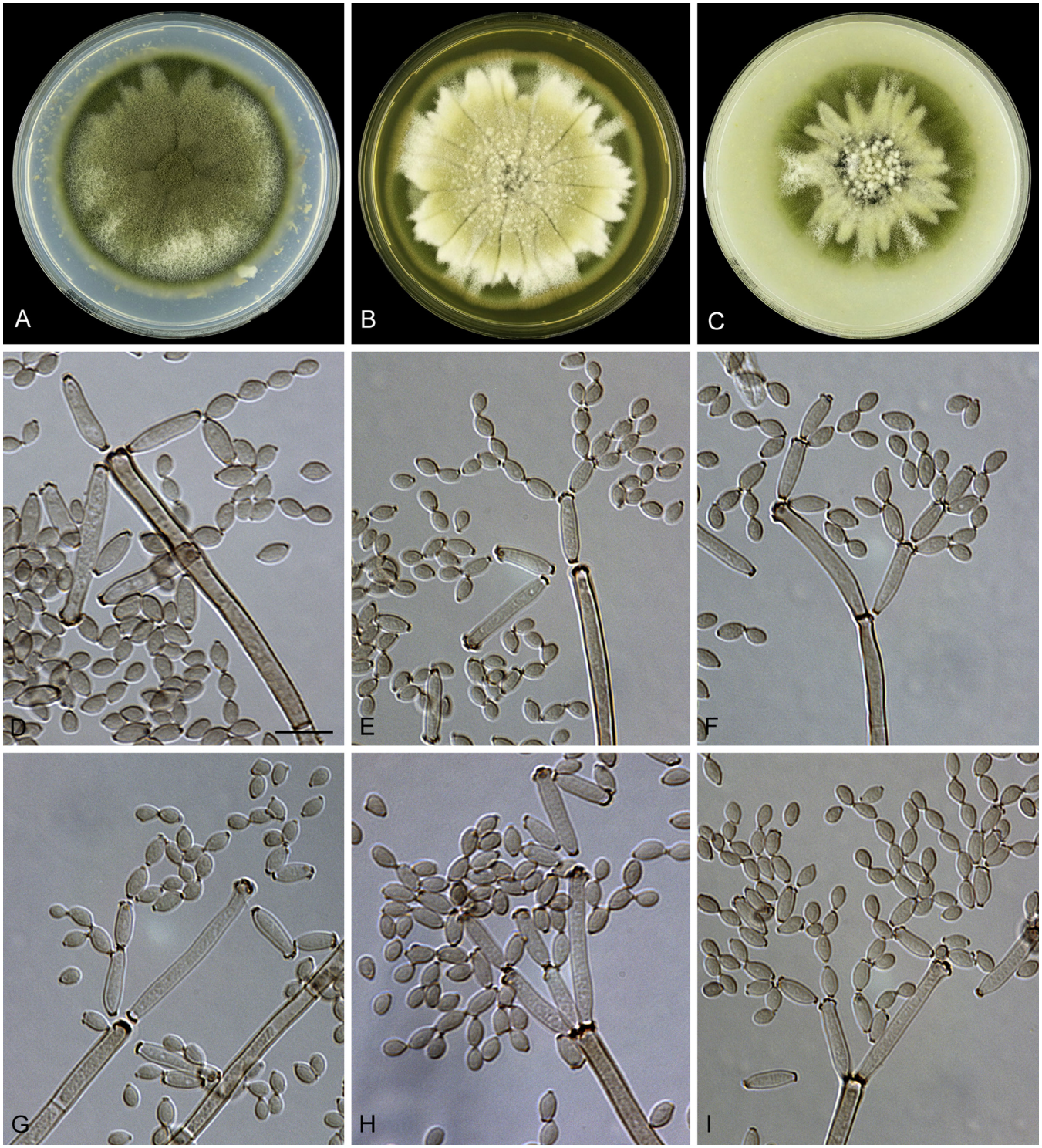

Fig. 9. *Cladosporium cladosporioides* (CBS 112388, adapted from Bensch *et al.* 2012). **A–C.** Colonies on PDA, MEA and OA. **D–I.** Macronematous conidiophores and conidial chains. Scale bar = 10 µm.

in long branched chains, up to 10 conidia in the upper unbranched part, branching in all directions, *small terminal conidia* subglobose, obovoid, ovoid to limoniform, 3–6(–7) × (1.5–)2–2.5(–3) µm (av. ± SD: 4.7 ± 0.9 × 2.4 ± 0.3), aseptate, *intercalary conidia* limoniform, ellipsoid-ovoid, sometimes fusiform or subcylindrical, 5–12(–14.5) × (2–)2.5–3(–4) µm (av. ± SD: 8.1 ± 2.2 × 2.9 ± 0.3), aseptate, with up to 3(–4) distal hila, *secondary ramoconidia* ellipsoid, subcylindrical to cylindrical-oblong, (7–)10–33(–38) × (2–)2.5–4(–6) µm (av. ± SD: 19.4 ± 6.6 × 3.2 ± 0.5), 0(–1)-septate, rarely with two septa, not constricted at septa, with up to four distal hila, subhyaline, pale brown or pale olivaceous brown, smooth, under SEM smooth or surface with somewhat irregularly reticulate structure or embossed stripes probably caused by diminishing turgor and shrivelling of tender young conidia, thin-walled, sometimes cell structure unusual, with a small cavity in the cells, hila conspicuous, subdenticulate to denticulate, 0.5–2(–2.5) µm diam, somewhat thickened and darkened-refractive; microcyclic conidiogenesis occasionally occurring.

Culture characteristics: Colonies on PDA up to 80 mm diam after 14 d at 25 °C, grey olivaceous to dull green or olivaceous grey, reverse iron-grey, leaden grey or olivaceous black, velvety to floccose, margins grey olivaceous to white, feathery, regular,

aerial mycelium sparse, diffuse, or sometimes abundantly formed, dense, floccose-felty, low, forming mats, growth flat to low convex, usually without prominent exudates, occasionally with several small prominent exudates. Colonies on MEA 54−72 mm diam after 14 d at 25 °C, grey olivaceous to olivaceous or olivaceous grey, pale olivaceous grey or whitish due to aerial mycelium, olivaceous black or olivaceous buff at margins, reverse olivaceous black or iron-grey, velvety to floccose, margins white to grey olivaceous, glabrous to feathery, aerial mycelium sparse, scattered, diffuse to floccose, sometimes abundantly formed, covering almost the whole colony, floccose-felty, whitish, growth flat to effuse, somewhat radially furrowed, without prominent exudates. Colonies on OA 65−70 mm diam after 14 d at 25 °C, grey olivaceous, towards margins at first greenish olivaceous, then dull-green and again grey olivaceous, sometimes white, reverse olivaceous grey to leaden-grey, sometimes pale mouse-grey, velvety to floccose, margins narrow, glabrous, regular, aerial mycelium scattered to sometimes abundant, floccose or felty, loose to somewhat dense, growth flat, no prominent exudates; sporulation usually profuse on all media.

Substrates and distribution: On fading and decaying plant material, on living leaves as secondary invader, isolated from air, soil, foodstuffs, water-damaged building materials and numerous other materials; cosmopolitan.

Additional materials examined: **Denmark**, isol. from indoor environment, B. Andersen, DTO 109-I4 = BA 1898, DTO 109-I6 = BA 1900. **Hungary**, isol. from indoor environment, DTO 147-A9; DTO 101-G2; isol. from floor under curtain, DTO 101-H7; isol. from a bathroom, DTO 102-A4. **The Netherlands**, air sample, bakery, DTO 127-D8 = AR362; Rijswijk, from swab sample archive, M. Meijer, DTO 090-C6; Weert, isol. from indoor air sample, living room, B. Favié, DTO 082-F1. **USA**, Arizona, Peoria, isol. from indoor air sample, bedroom, Jan. 2013, Ž. Jurjević, EMSL 1893 = CPC 22380; Florida, St. Augustine, isol. from indoor air sample, kitchen, Dec. 2012, Ž. Jurjević, EMSL 1861 = CPC 22348; Georgia, isol. from indoor air sample, Aug. 2012, Ž. Jurjević, EMSL 1722 = CPC 22264; Michigan, Dryden, isol. from indoor air sample, bedroom, Dec. 2012, Ž. Jurjević, EMSL 1860 = CPC 22347; Minnesota, isol. from indoor air sample, Aug. 2012, Ž. Jurjević, EMSL 1723 = CPC 22265; Vermont, Williston, isol. from indoor air sample, bedroom, Dec. 2012, Ž. Jurjević, EMSL 1878 = CPC 22365; Virginia, Arlington, isol. from indoor air sample, living room, Jan. 2013, Ž. Jurjević, EMSL 1880 = CPC 22367.

Notes: *Cladosporium cladosporioides* (Fig. 1, clade 66) as previously circumscribed on the basis of morphology represents a heterogeneous complex of numerous phylogenetically and more or less also morphologically distinct species (Bensch *et al.* 2010). *Cladosporium cladosporioides s. lat.* is one of the most common, saprobic *Cladosporium* species with worldwide distribution, frequently occurring as secondary invader on necrotic parts of many different host plants, isolated from air, soil, textiles and numerous other substrates (Ellis 1971) and found as a common endophytic fungus (Riesen & Sieber 1985, El-Morsy 2000, Kumaresan & Suryanarayanan 2002). Furthermore, the conidia of this species are among the most ubiquitous bioaerosols found in indoor and outdoor samples (Domsch *et al.* 1980, Mullins 2001, Park *et al.* 2004).

Yamamoto (1959), Ellis (1971), de Hoog *et al.* (2000) and Samson *et al.* (2000) discussed strains of "*C. cladosporioides*" with asperulate or finely verruculose conidia, which proved to represent different, phylogenetically clearly distinct species, as for instance *C. asperulatum* (Fig. 1, clade 28) and *C. perangustum* (Fig. 1, clade 4). Sandoval-Denis *et al.* (2016) introduced *C. anthropophilum* (Fig. 1, clade 65), a common saprobic fungus which can also represent a clinically relevant fungus (Sandoval-Denis *et al.* 2015), and discussed it to be phylogenetically distant from *C. cladosporioides* but in our analysis it now clusters close to it (Fig. 1, clades 65, 66). However, the association between the two clades is only supported by the Bayesian analysis (BPP = 0.97). Although difficult to separate morphologically, *C. anthropophilum* mainly differs in forming longer (up to 550 µm) conidiophores with numerous conidiogenous loci crowded at or towards the apex and ovoid to ellipsoid terminal conidia (3.5–9 µm long) which show a fine, dense reticulation under SEM (Sandoval-Denis *et al.* 2016).

Three morphologically almost indistinguishable but phylogenetically distinct lineages, indicated in Bensch *et al.* (2010) as *C. cladosporioides s. lat*. Lineages 1, 2 and 4 which cluster apart from *C. cladosporioides s. str.* (Fig. 1, clade 66) are introduced as new species in this paper, namely *C. europaeum* (Fig. 1, clade 35), *C. vicinum* (Fig. 1, clade 34) and *C. westerdijkiae* (Fig. 1, clade 43). Given their high morphological similarity the use of a molecular approach for the correct identification of all these species is highly recommended.

Cladosporium coloradense Bensch & Samson, **sp. nov.** MycoBank MB822218. Fig. 10

Etymology: Name refers to the place where it was collected, Colorado.

Holotype: **USA**, Colorado, Denver, isol. from air sample, bedroom, June 2012, Ž. Jurjević, CBS H-23249. *Ex-type culture*: CPC 22238 = CBS 143357 = EMSL 1685.

Diagnosis: Differs from *C. succulentum* by its narrowly ellipsoid terminal conidia and its longer conidiophores and conidia.

Superficial mycelium sparingly formed, unfertile hyphae filiform, narrowly cylindrical-oblong, 1−2.5 µm wide, septate, neither constricted nor swollen, subhyaline, walls unthickened, fertile hyphae forming conidiophores, darker and wider, often somewhat swollen at the base of conidiophores, 3−5(−6) µm wide, pale to medium olivaceous brown, somewhat constricted at septa, smooth, walls somewhat thickened, sometimes forming loose aggregations. *Conidiophores* macro- and micronematous, arising laterally or terminally from hyphae, solitary or in pairs, sometimes arising in loose groups of four from hyphal aggregations, straight or slightly flexuous, often very long, narrowly cylindrical-oblong, neither geniculate nor nodulose, unbranched, occasionally branched, (18−)30−510 µm long or even longer, (2.5−)3−4 µm wide, up to 5.5 µm wide at the base, pluriseptate, 1−18-septa, pale to medium olivaceous brown, often paler towards the apex, smooth or almost so, walls thickened, 0.5−1 µm thick. *Conidiogenous cells* integrated, terminal and intercalary, cylindrical or subcylindrical, neither geniculate nor nodulose, (13−)21−36 µm long, in terminal cells 2−4 loci crowded at the uppermost apex, in intercalary ones 1−3 loci situated on small lateral outgrowths just below or above a septum, loci 1−2 µm diam. *Ramoconidia* subcylindrical or cylindrical, 25−43 × 3−4.5 µm, 0(−2)-septate, base 2(−3) µm wide, neither thickened nor darkened. *Conidia* catenate, numerously formed, paler than conidiophores and ramoconidia, up to five conidia in the terminal unbranched part of the chain, branching in all directions, *small terminal conidia* narrowly ellipsoid, 3−5.5 × 1.5−2 µm (av. ± SD: 4.1 ± 0.7 × 1.7 ± 0.2), apex rounded, attenuated towards the base, subhyaline, pale olivaceous or pale olivaceous brown, almost smooth or asperulate, *intercalary conidia* narrowly ellipsoid, 4.5−10 2−3 µm (av. ± SD: 7.7 ± 2.7 × 2.5 ± 0.4), aseptate, with 1−3(−4) distal scars, almost

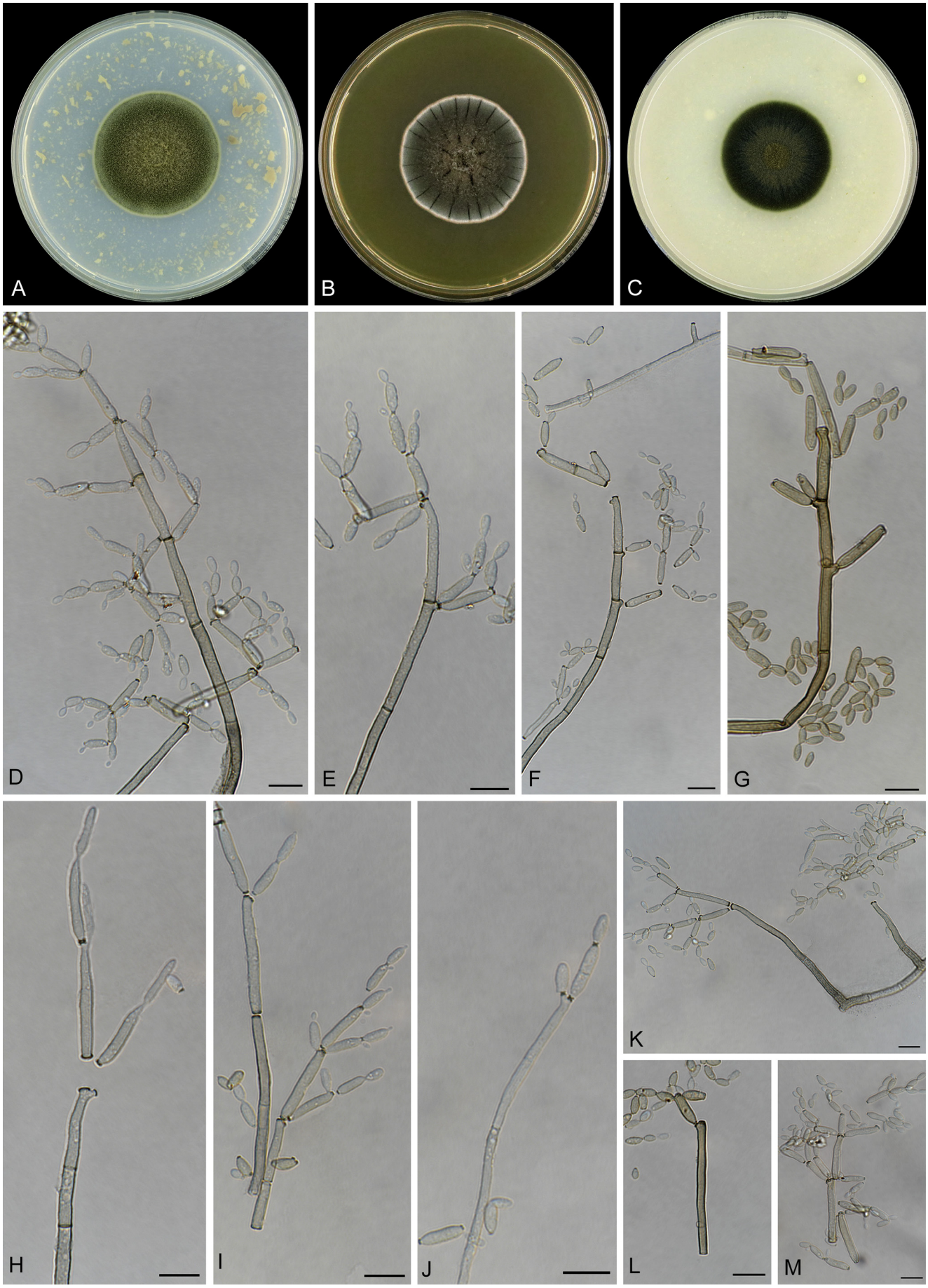

Fig. 10. *Cladosporium coloradense* (CBS 143357). **A–C.** Colonies on PDA, MEA and OA. **D–K.** Conidiophores and conidial chains. **L–M.** Ramoconidia and conidial chains. Scale bars = 10 µm.

smooth, asperulate or loosely minutely verruculose, *secondary ramoconidia* narrowly ellipsoid or subcylindrical, 9.5−19(−25) × 3−3.5(−4.5) µm (av. ± SD: 15.6 ± 3.9 × 3.3 ± 0.4), aseptate, almost smooth or asperulate, pale olivaceous brown or pale medium olivaceous brown, walls unthickened or very slightly thick-walled, with 2−4 distal scars, hila conspicuous, 0.5−2 µm diam; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on PDA reaching 43−58 mm diam after 14 d at 25 °C, olivaceous, iron-grey, reverse iron-grey, greyish blue towards margins, velvety or fluffy, margins glabrous, aerial mycelium diffuse, fluffy, without prominent exudates, sporulation profuse. Colonies on MEA attaining 41−49 mm diam after 14 d at 25 °C, olivaceous grey, olivaceous due to abundant sporulation mainly in colony centre, reverse olivaceous grey to iron-grey, powdery to velvety, margin narrow, white, glabrous or slightly feathery, aerial mycelium loose, diffuse to more densely and fluffy, high, growth low convex with somewhat elevated colony centre, radially furrowed, without exudates. Colonies on OA reaching 35−40 mm diam after 14 d at 25 °C, iron-grey, olivaceous due to abundant sporulation, reverse olivaceous grey to iron-grey, powdery or fluffy, margin regular, glabrous, aerial mycelium loose diffuse, high, growth flat, without exudates.

Substrates and distribution: Indoor air; North America (USA).

Notes: With its narrowly ellipsoid conidia *C. coloradense* (Fig. 3, clade 14) is not a very typical member of the *C. sphaerospermum* species complex, but reminds one of species belonging to the *C. cladosporioides* species complex. Similar as in *C. aciculare* (Fig. 3, clade 16) and *C. fusiforme* (Fig. 3, clade 17) the conidial shape departs from the globose to subglobose shape of typical members of this species complex. Both species are phylogenetically allied but *C. aciculare* can be distinguished by its narrower conidiophores, secondary ramoconidia and conidiogenous loci and hila (Bensch *et al.* 2015); and *C. fusiforme* possesses shorter conidiophores and wider, fusiform apical conidia (Zalar *et al.* 2007, Bensch *et al.* 2012). Its closest phylogenetic relative is *C. succulentum* (Fig. 3, clade 15), isolated from a dolphin bronchus, which can be differentiated from the new species by its oval to short clavate terminal conidia and its shorter conidiophores and conidia (Sandoval-Denis *et al.* 2016). Until now the species is known only from a single isolate.

Cladosporium delicatulum Cooke, Grevillea 5(33): 17. 1876. MycoBank MB164571. Fig. 11.

Holotype: **India**, on dead leaves (litter), Colonel Hobsen, No. 23 (K [M] 121551). *Isotypes*: Vize, Micro-Fungi Exot. 24 (*e.g.*, B 700006230).

Lit.: Bensch *et al.* (2010: 37–40; 2012: 102–106; 2015: 45).

Ill.: Bensch *et al.* (2010: 38–40, figs 22–25; 2012: 103–105, figs 87–92).

Mycelium immersed, rarely superficial; hyphae unbranched or sparingly branched, (0.5−)1−3(−4) µm wide, septate, without swellings and constrictions, subhyaline to pale olivaceous or pale olivaceous brown, smooth to minutely verruculose, sometimes loosely verrucose, sometimes forming ropes. *Conidiophores* macro- and micronematous, solitary, arising terminally and laterally from hyphae, erect, straight to somewhat flexuous, cylindrical-oblong, non-nodulose, sometimes slightly geniculate towards the apex, unbranched, occasionally branched, once or several times, often as short peg-like prolongations, 50−165(−200) × 3−4.5(−5) µm, 2−4(−7)-septate, sometimes attenuated at septa, pale olivaceous to pale medium olivaceous brown, smooth, sometimes loosely minutely verruculose at the base, walls unthickened or almost so, about 0.5 µm wide, sometimes slightly attenuated towards the apex, up to 5.5 µm wide at the base; micronematous conidiophores narrower and pale olivaceous, 19−75(−100) × (1.5−)2−2.5 µm. *Conidiogenous cells* integrated, terminal, sometimes intercalary, situated on small peg-like prolongations, cylindrical-oblong, sometimes geniculate at or towards the apex, non-nodulose, occasionally the whole cell inflated in shape like a secondary ramoconidium, 11−37 µm long, with (1−)2−3(−4) apical loci, crowded at the apex, conspicuous, subdenticulate to denticulate, sometimes situated on small lateral outgrowths, quite broad, truncate, rim and dome not distinctly visible, 1.5−2.2 µm diam, thickened and darkened-refractive. *Ramoconidia* cylindrical-oblong, 13−46 × 2.5−4(−5) µm, 0−1(−2)-septate, sometimes distinctly constricted at the median septum, base broadly truncate, 2−3 µm wide, neither thickened nor darkened-refractive. *Conidia* numerous, in densely branched chains, branching in all directions, up to four conidia in the terminal unbranched part of the chain, *small terminal conidia* obovoid, subglobose or globose, 2.5−4.5(−6) × (1.5−)2−2.5(−3.5) µm (av. ± SD: 3.7 ± 0.8 × 2.4 ± 0.4), aseptate, apex rounded, sometimes irregular due to additional lateral hila, *intercalary conidia* limoniform to ellipsoid-ovoid or sometimes irregular in outline due to lateral hila, 4−13(−17.5) × 2.5−3.5(−4) µm (av. ± SD: 7.8 ± 3.0 × 3.0 ± 0.4), 0−1-septate, attenuated towards apex and base, with 1−4(−6) distal hila, *secondary ramoconidia* ellipsoid-ovoid to subcylindrical or cylindrical, (6−)8−23.5(−31) × (2.5−)3−4.5(−5) µm (av. ± SD: 15.6 ± 5.4 × 3.6 ± 0.5), 0−1(−2)-septate, very rarely 3-septate, not constricted at septa, pale olivaceous to pale olivaceous brown, smooth or almost so, walls unthickened, often only slightly attenuated towards apex and base, with (1−)2−4(−5) distal hila, hila conspicuous, subdenticulate or denticulate, 0.5−2.2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA attaining 60−78 mm diam after 14 d at 25 °C, olivaceous grey, grey olivaceous to olivaceous and olivaceous black, reverse olivaceous black, floccose to villose, margins grey olivaceous, feathery, regular, aerial mycelium scattered to abundant, covering almost the whole colony surface, floccose to villose, low to rarely high, growth flat, without prominent exudates, sporulation sparse. Colonies on MEA reaching 67−76 mm diam after 14 d at 25 °C, smoke-grey to pale olivaceous grey, olivaceous grey or glaucous grey at margins, reverse olivaceous grey, floccose, fluffy, margins white, glabrous to feathery, regular, aerial mycelium abundant, covering the whole colony surface, floccose to fluffy, growth flat, radially furrowed and wrinkled in colony centre, without prominent exudates, sporulation sparse or absent. Colonies on OA reaching 55−74 mm diam after 14 d at 25 °C, smoke-grey to pale olivaceous grey, grey olivaceous or olivaceous due to abundant sporulation, reverse pale greenish grey to olivaceous grey, velvety to floccose, margins regular, glabrous, narrow, colourless, aerial mycelium sparse to abundant, covering the whole surface, floccose, loose to dense, low, growth flat, without prominent exudates, sporulation sparse to profuse.

Substrates and distribution: Isolated from air, building material and dust, saprobic on dead leaves, fruits, stems, tubers, or

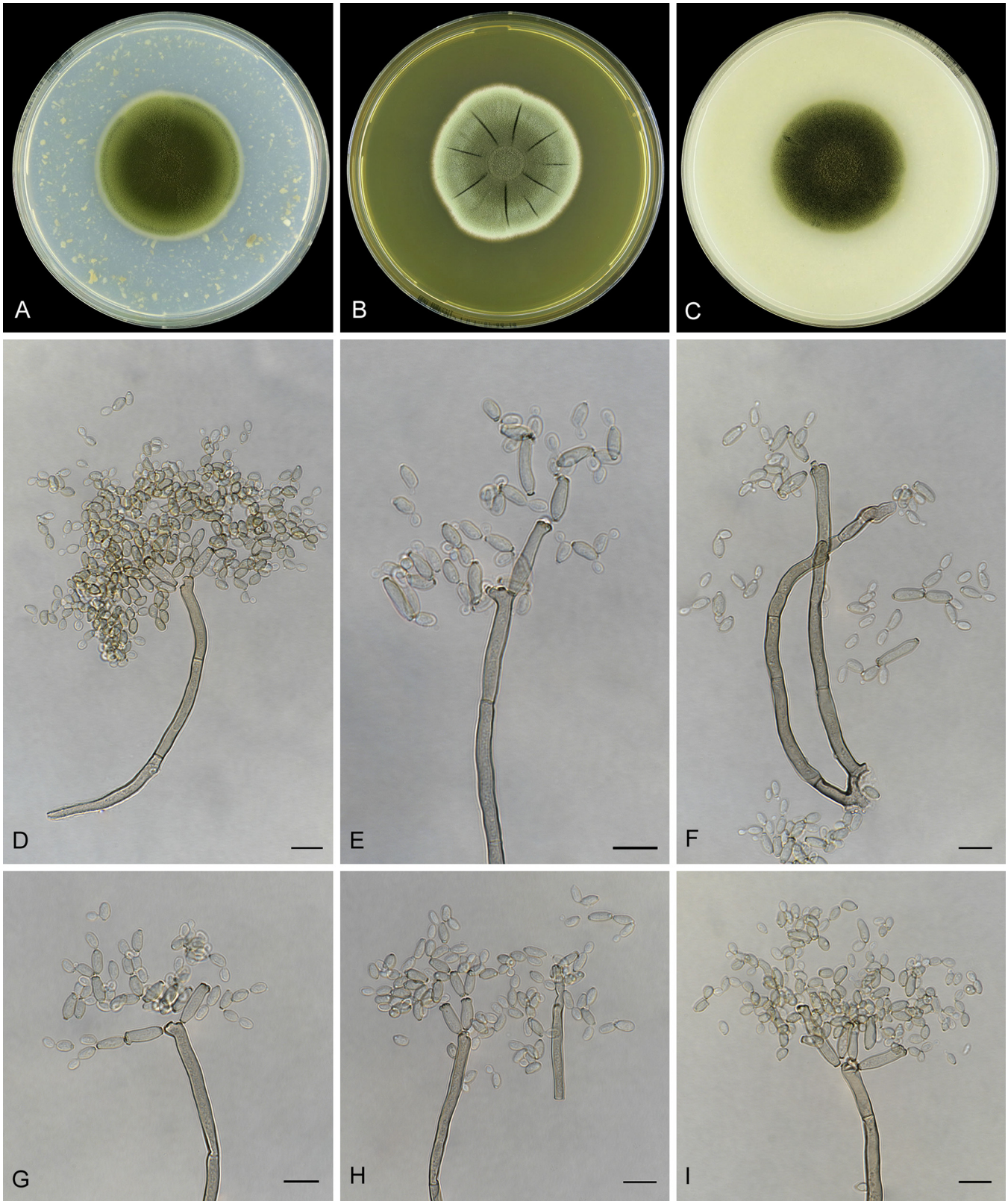

Fig. 11. *Cladosporium delicatulum* (DTO 167-H5). **A–C.** Colonies on PDA, MEA and OA. **D–I.** Conidiophores and conidial chains. Scale bars = 10 µm.

occurring as secondary invader on necrotic lesions caused by other fungi *in vivo*; widely distributed, Africa (Algeria), Asia (China, India, Taiwan), Australasia (New Zealand), Europe (Denmark, France, Germany, Poland, The Netherlands), North America (Mexico, USA), South America (Uruguay).

Additional materials examined: **Algeria**, isol. from indoor environment, L. Belhoucine, DTO 134-D3 = DR22, DTO 134-D4, DTO 134-D5 = O200, DTO 134-D6 = BT27, DTO 134-D7 = BT91, DTO 134-D8 = BT92. **Denmark**, isol. from indoor air, 2007, B. Andersen, BA 1679 = CPC 14285, BA 1680 = CPC 14286, BA 1681= CBS 126342 = CPC 14287; isol. from building material, school, 2007, B. Andersen, BA 1698 = CBS 126343 = CPC 14299; isol. from building material, 2007, B. Andersen, BA 1683 = CPC 14289; Asperen, swap sample archive, M. Meijer, DTO 090-F4; Broenshoej, isol. from indoor air, control room, 2000, B. Andersen, BA 1724 = CPC 14363; indoor air sample, in cup board, water damaged room, 2000, B. Andersen, BA 1718 = CPC 14360; Valleroed, isol. from dust, school, 2000, B. Andersen, BA 1740 = CPC 14372; Weert, isol. from indoor

air, living room, B. Favié, DTO 082-F3 = CBS 139574. **Germany**, isol. from indoor environment, DTO 145-C4; Sachsen-Anhalt, Halle (Saale), Robert-Franz-Ring, isol. from leaves of *Tilia cordata* (*Tiliaceae*), 2 Aug. 2004, K. Schubert, CBS H-20430, CBS 126344 = CPC 11389, reference strain of *C. delicatulum*. **New Zealand**, isol. from house dust, DTO 305-H7, DTO 305-I9 = TA05NZ-340. **Poland**, isol. from indoor air in poultry houses, K. Plewa, DTO 167-H5, DTO 168-F8.

Notes: This species is undoubtedly a widespread saprobic hyphomycete commonly isolated from indoor environments. Morphologically it is comparable with *C. cladosporioides* (Fig. 1, clade 66) but *C. delicatulum* (Fig. 1, clade 44) differs from the latter species in having 0–1-septate intercalary conidia and secondary ramoconidia, only a few conidia in the terminal unbranched part of conidial chains, shorter often slightly geniculate conidiophores and shorter secondary ramoconidia. *Cladosporium westerdijkiae* (Fig. 1, clade 43) is the closest relative in the tree but can be distinguished from *C. delicatulum* by usually aseptate and somewhat longer ramoconidia and secondary ramoconidia. *Cladosporium inversicolor* (Fig. 1, clade 42) is distinct by its longer conidial chains, longer small terminal and intercalary conidia, wider intercalary conidia and secondary ramoconidia, longer ramoconidia with a broader base, with conidia being smooth to loosely verruculose or irregularly rugose. The old, sparse type material of *C. delicatulum* is from India. New Indian collections and cultures are not available. Therefore, a formal epitypification of this species has not yet been proposed, but the German strain from *Tilia cordata* can serve as reference strain to fix the application of *C. delicatulum* and agrees well with the Indian type material (Bensch *et al.* 2010).

Cladosporium domesticum Bensch & Samson, **sp. nov.** MycoBank MB822219. Figs 12, 13.

Etymology: domesticum - Latin for house, all isolates from indoor environments.

Holotype: **USA**, New Jersey, Trenton, isol. from indoor air sample, Oct. 2012, Ž. Jurjević, CBS H-23250. *Ex-type culture*: CBS 143358 = CPC 22307 = EMSL 1803.

Diagnosis: Differs from *C. halotolerans* by its 0–2-septate ramoconidia (0–5-septate in *C. halotolerans*), its less densely septate conidiophores and its slightly narrower conidia. The small terminal and intercalary conidia are not globose and not distinctly darker than ramoconidia and conidiophores as it is typical for *C. halotolerans*.

Mycelium unbranched or branched, 0.5–2.5(–4) µm wide, filiform or narrowly cylindrical-oblong, septate, mostly without any constrictions or swellings, if swollen then swellings up to 6 µm diam, subhyaline or pale olivaceous, smooth or almost so or minutely verruculose especially those giving rise to conidiophores, often forming ropes of several hyphae, occasionally swollen hyphal cells or dense hyphal aggregations, swollen cells globose, doliiform or irregular in outline. *Conidiophores* macro-, semimacro- or micronematous, arising from hyphae, occasionally also from swollen hyphal cells or hyphal aggregations, erect, straight, filiform or narrowly cylindrical-oblong, neither nodulose nor geniculate, unbranched or branched, often with one or several denticles or peg-like short lateral prolongations just below a septum, (3–)30–125(–200) × 1.5–3 µm, septa appear to be darkened, sometimes somewhat constricted and thickened where ramoconidia will be seceded, subhyaline or very pale olivaceous, smooth or almost so, sometimes irregularly rough-walled, sometimes attenuated towards the apex, sometimes conidiophores very short, reduced to conidiogenous cells, formed as short denticle-like outgrowth of hyphae. *Conidiogenous cells* integrated, terminal and intercalary, (5–)10–39 µm long, with 1–3 conidiogenous loci at the apex or situated on short lateral prolongations, loci conspicuous, 1–1.5 µm diam, thickened and darkened-refractive. *Ramoconidia* formed but transition between ramoconidia and secondary ramoconidia difficult, 16–43 × 1.5–2.5 µm, 0–2-septate, base about 2 µm wide. *Conidia* catenate, numerous conidia formed in branched chains with branching in all directions, 1–5 conidia in the terminal unbranched part of the chain, *small terminal conidia* subglobose or obovoid, (2–)2.5–3.5(–4.5) × (1.5–)2–2.5(–3) µm (av. ± SD: 3.3 ± 0.8 × 2.2 ± 0.3), subhyaline or pale olivaceous brown, almost smooth to mostly irregularly verruculose, *intercalary conidia* limoniform, ovoid or ellipsoid, 4–11(–13) × 2–2.5(–3) µm (av. ± SD: 6.7 ± 2.2 × 2.4 ± 0.4), 0(–1)-septate, surface ornamentation and colour as in small terminal conidia, with 1–3 distal hila, *secondary ramoconidia* ellipsoid or subcylindrical, (6–)9–24(–31) × (1.5–)2–3(–3.5) µm (av. ± SD: 16.5 ± 6.0 × 2.4 ± 0.4), 0–1(–3)-septate, pale olivaceous brown, smooth or almost so or irregularly verruculose as in smaller conidia, with (1–)2–4 distal hila, hila 0.5–1.5 µm diam; microcyclic conidiogenesis occurring.

Culture characteristics: Colonies on PDA reaching 35–50 mm diam after 14 d at 25 °C, pale olivaceous grey or olivaceous grey mainly in colony centre due to dense and abundant aerial mycelium, towards margins large patches of grey olivaceous or olivaceous where profusely sporulating, reverse leaden-grey and olivaceous grey, powdery or fluffy-felty, margins white, regular, glabrous or somewhat feathery, aerial mycelium diffuse to mostly dense, sometimes very high in a few spots, growth flat or low convex with elevated and wrinkled colony centre, sometimes forming several prominent exudates, up to 2 mm diam. Colonies on MEA attaining 30–46 mm diam after 14 d at 25 °C, grey olivaceous where profusely sporulating, whitish or smoke-grey due to aerial mycelium, glaucous-grey, olivaceous grey or iron-grey at margins, reverse olivaceous grey and greyish sepia, velvety or felty, margins white, narrow, glabrous or somewhat feathery, radially furrowed, colony centre elevated, wrinkled and folded, aerial mycelium forming dense mats, low or high in a few spots, sometimes numerous small exudates starting to be formed. Colonies on OA reaching 35–50 mm diam after 14 d at 25 °C, grey olivaceous or olivaceous where sporulating, pale olivaceous grey to iron-grey due to aerial mycelium or where sterile, reverse smoke-grey, leaden-grey and olivaceous grey, velvety or fluffy-felty, margins glabrous, regular, aerial mycelium loose diffuse or mostly dense, low to very high, fluffy, without prominent exudates.

Substrates and distribution: Indoor environments (air, house dust); North America (USA).

Additional materials examined: **USA**, isol. from house dust, DTO 305-H2 = AA03US-480, DTO 306-B6 = AA03US-525, DTO 307-E8 = AA03US-368, DTO 307-H3 = AA03US-402, DTO 308-B1; AA03US-387; Florida, Oldsmar, isol. from indoor air sample, Nov. 2012, Ž. Jurjević, EMSL 1821 = CPC 22318; New Jersey, Trenton, isol. from indoor air sample, Oct. 2012, Ž. Jurjević, EMSL 1803 = CPC 22307; isol. from indoor air sample, 1st floor, Jan. 2013, Ž. Jurjević, EMSL 1936 = CPC 22408; Pennsylvania, isol. from attic wood roofing sample, Jan. 2012, Ž. Jurjević, EMSL 1962 = CPC 22413; Huntingdon Valley, isol. from indoor air sample, air conditioner, May 2012, Ž. Jurjević, EMSL 1658 = CPC 22225; Texas, Georgetown, isol. from indoor air sample, classroom, Jan. 2013, Ž. Jurjević, EMSL 1930 = CPC 22402.

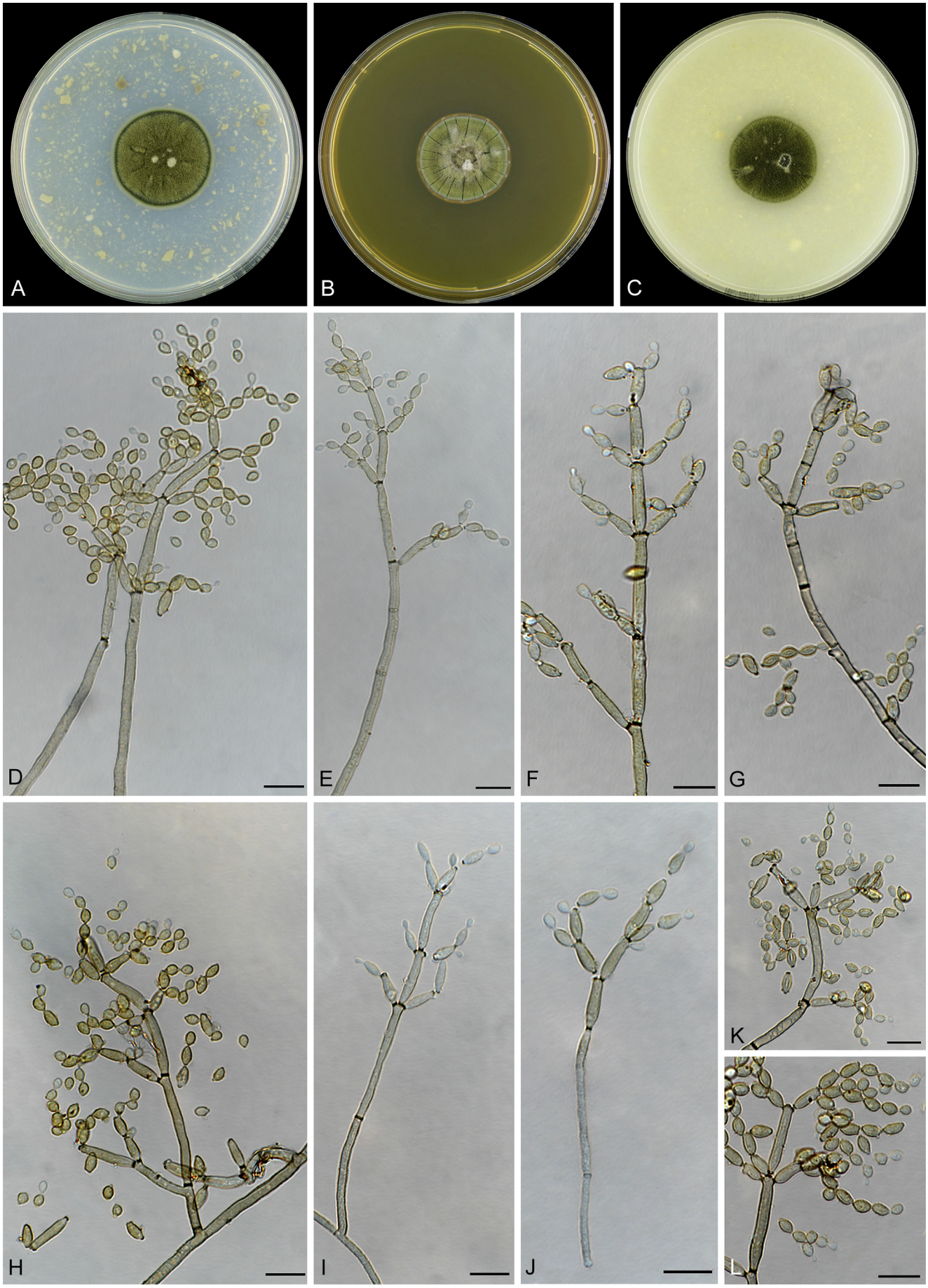

Fig. 12. *Cladosporium domesticum* (CBS 143358). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Macronematous conidiophores with conidial chains. **I–J.** Micronematous conidiophores with conidial chains. **K–L.** Conidial chains. Scale bars = 10 µm.

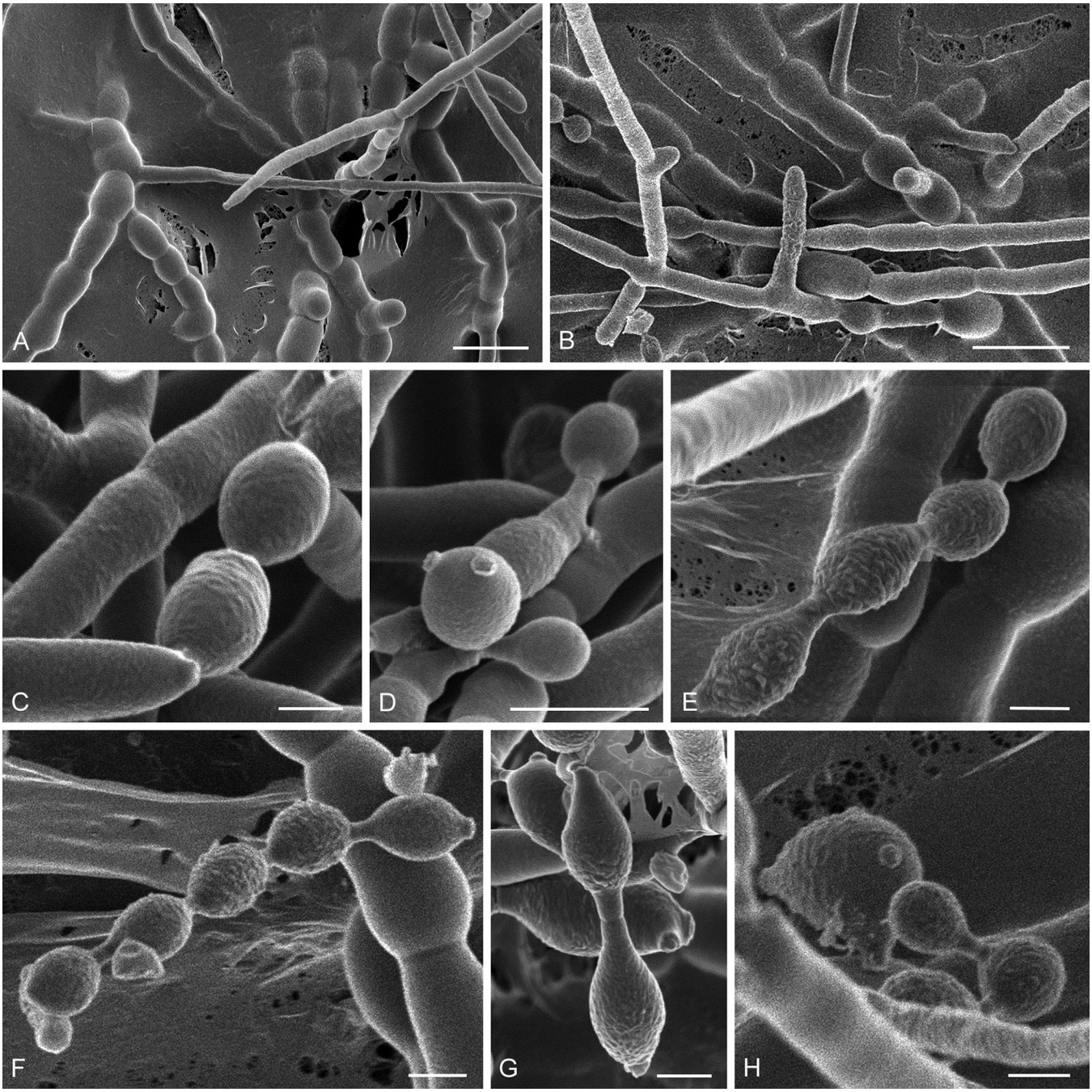

Fig. 13. *Cladosporium domesticum* (DTO 305-H2). **A, B.** Shows rows of rounded cells present at agar level that can form aerial hyphae and/or conidiophores. **C–H.** Details of conidia next to aerial or substrate fungal structures. Note the less distinct ornamentation of the *C. sphaerospermum* type containing out of ridges and warts. Scars on conidia (D, H) and ramoconidia (with differences in size, G) are visible. Note the very long "neck" area between conidia in D, F–H. Scale bars = 2 (C, E–H), 5 (D), 10 (A, B) µm.

Notes: *Cladosporium domesticum* (Fig. 3, clade 21) is phylogenetically and morphologically closely allied to *C. halotolerans* (Fig. 3, clade 23) from which it can be differentiated by its 0–2-septate ramoconidia (0–5-septate in *C. halotolerans*), its less densely septate conidiophores and its slightly narrower conidia which are not arranged like a string of pearls. The small terminal and intercalary conidia are not globose and not distinctly darker than ramoconidia and conidiophores as is typical for *C. halotolerans*. On OA ramoconidia of *C. domesticum* are commonly formed and the conidiophores are much longer, up to 375 µm long or even longer.

Cladosporium parahalotolerans (Fig. 3, clade 22), also newly described and phylogenetically close to both *C. halotolerans* and *C. domesticum*, forms wider conidia and ramoconidia.

Cladosporium dominicanum Zalar *et al.*, Stud. Mycol. 58: 169. 2007. MycoBank MB510995. Fig. 14.

Holotype: **Dominican Republic**, salt lake Enriquillo, isol. from hypersaline water, Jan. 2001, N. Gunde-Cimerman, isol. P. Zalar, CBS H-19733. *Ex-type culture*: EXF-732 = CBS 119415.

Lit.: Bensch *et al.* (2012: 108–110; 2015: 45).
Ill.: Zalar *et al.* (2007: 170, fig. 6), Bensch *et al.* (2012: 109, fig. 97).

Mycelium unbranched to sparingly branched, septate, not constricted at septa, pale olivaceous brown, minutely verruculose to irregularly rough-walled, walls unthickened or almost so, protoplasm somewhat aggregated in the centre of the cells,

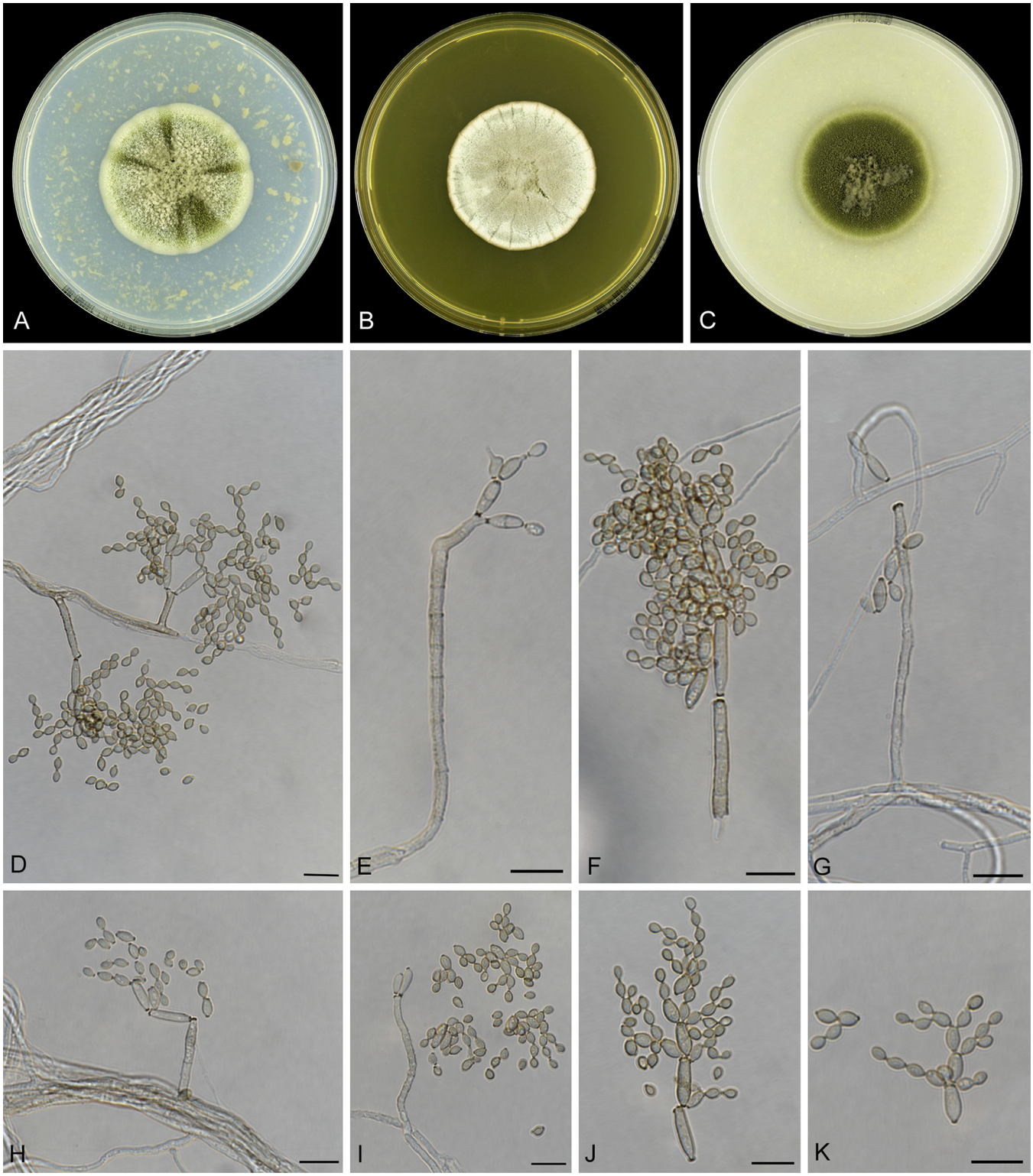

Fig. 14. *Cladosporium dominicanum* (CPC 22244). **A–C.** Colonies on PDA, MEA and OA. **D–I.** Conidiophores with conidial chains. **J–K.** Conidial chains. Scale bars = 10 µm.

granular, without extracellular polysaccharide-like material. *Conidiophores* micro- and semimacronematous, hardly distinguishable from hyphae, arising laterally and terminally on erect or ascending hyphae, erect, somewhat flexuous, filiform to cylindrical-oblong, usually neither geniculate nor nodulose, unbranched or branched, once or several times, branches as short lateral prolongations below a septum, (5–)10–100(–200) × (1–)2–2.5(–3.5) µm, aseptate or with few septa, pale olivaceous brown, smooth to minutely verruculose, walls thin-walled to slightly thickened; micronematous conidiophores often only as short denticle- or peg-like lateral outgrowths of hyphae. *Conidiogenous cells* integrated, terminal, sometimes intercalary or conidiophores reduced to conidiogenous cell, cylindrical, with a single or few apical loci, protuberant, denticulate, 0.8–1.5 µm diam, thickened and darkened-refractive. *Ramoconidia* occasionally formed, up to 40 µm long, base about 2 µm wide. *Conidia* catenate, in branched chains, branching in all directions, up to eight conidia in the unbranched parts, *small*

terminal conidia globose or subglobose to usually short-ovoid, narrower at both ends, (2–)3–3.5(–4.5) × 2–2.5 µm (av. ± SD: 3.0 ± 0.5 × 2.0 ± 0.2), aseptate, smooth to minutely verruculose, *intercalary conidia* ovoid, limoniform to ellipsoid, (3.5–)4–8.5(–12) × 2–3 µm (av. ± SD: 6.0 ± 2.1 × 2.6 ± 0.3), 0(–1)-septate, smooth to minutely verruculose, with 1–3(–4) distal hila, *secondary ramoconidia* cylindrical to almost spherical, attenuated towards apex and base, (6.5–)9–23(–28) × (2–)2.5–3(–4) µm, (av. ± SD: 15.4 ± 5.0 × 2.8 ± 0.4), 0–1(–2)-septate, not constricted at the median septum, with up to four distal scars, subhyaline to pale olivaceous or light brown, smooth or almost so, walls unthickened to slightly thickened, hila protuberant, conspicuous, denticulate, 0.5–1.5 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on PDA reaching 18–36 mm diam after 14 d at 25 °C, grey olivaceous in colony centre due to abundant sporulation, glaucous grey to greenish grey, reverse greenish grey, velvety to hairy or felty, margin regular, white, somewhat feathery, aerial mycelium abundant, high, fluffy to felty, covering most of the surface, flat or slightly furrowed, with at margin, numerous small droplets of light reseda-green (2E6) exudates sometimes present. Colonies on MEA reaching 30–32 mm diam after 14 d at 25 °C, reseda green (2E6), reverse dark green-brown, velvety, furrowed, with undulate margin. Colonies on MEA + 5 % NaCl reaching 37–41 mm diam after 14 d at 25 °C, reseda-green (2E6), reverse brownish green, radially furrowed, velvety, sporulating in the central part or all over the colony, margin white and regular. Colonies on OA reaching 19–34 mm diam after 14 d at 25 °C, dark mouse-grey, reverse black, velvety to loosely powdery with raised central part due to fasciculate bundles of conidiophores, aerial mycelium sparse, whitish to smoke-grey, without exudates, sporulating.

Maximum tolerated salt concentration: 75 % of tested strains develop colonies at 20 % NaCl after 7 d, while after 14 d all strains grow and sporulate.

Cardinal temperatures: No growth at 4 and 10 °C, optimum 25 °C (30–32 mm diam), maximum 30 °C (2–15 mm diam), no growth at 37 °C.

Differential parameters: No growth at 10 °C, oval conidia, large amounts of sterile mycelium (from Zalar *et al.* 2007).

Substrates and distribution: Saprobic on fruit surfaces, hypersaline waters in (sub)tropical climates, indoor environments; Asia (Iran, Philippines, Taiwan), North America (Bermuda, USA), Central America (Dominican Republic), South America (Aruba, Venezuela).

Additional materials examined: **Aruba**, Oranjestad, isol. from air sample, hospital, Jul. 2012, Ž. Jurjević, EMSL 1697 = CPC 22244. **Bermuda**, Samerset, isol. from indoor air sample, Nov. 2012, Ž. Jurjević, EMSL 1822 = CPC 22319. **USA**, Colorado, Denver, isol. from outside air sample, Jun. 2012, Ž. Jurjević, EMSL 1687, 1688 = CPC 22240, 22241.

Notes: Cultures of *C. dominicanum* (Fig. 3, clade 4) sporulate less abundantly than *C. sphaerospermum* (Fig. 3, clade 20) and *C. halotolerans* (Fig. 3, clade 23) and tend to lose their ability to sporulate with subculturing (Zalar *et al.* 2007). The species proved to have a wider host range and distribution than known before (Zalar *et al.* 2007, Bensch *et al.* 2012, 2015). It is not only known from fruit surfaces and hypersaline water but was also isolated both from indoor and outside air. The strains reported by Segers *et al.* (2015) as *C. dominicanum* proved to belong to the newly described species *C. pulvericola* (Fig. 3, clade 1). For a comparison with *C. pulvericola* please consult the notes under the latter species.

The included ex-type isolate of *Cladosporium lebrasiae* (Fig. 3, clade 5), a species recently described from milk bread rolls in France (Razafinariovo *et al.* 2016), clusters on a long branch among isolates of *C. dominicanum* (Fig. 3, clade 4). On the loci used in the present phylogeny, it is 93–98 % similar to *C. dominicanum*. In the parsimony analysis, this isolate clusters as a sister lineage to *C. dominicanum* (data not shown). Additional isolates are necessary to prove whether *C. lebrasiae* is a distinct species.

Cladosporium europaeum Bensch & Samson, **sp. nov.** MycoBank MB822220.

Etymology: Refers to the continent of origin, Europe.

Holotype: **Denmark**, isol. from indoor building material, school, 2007, B. Andersen, CBS H-23251. *Ex-type culture*: CBS 134914 = BA 1695 = CPC 14296.

Diagnosis: Differs from *C. vicinum*, its closest phylogenetic neighbour in having shorter conidiogenous cells, secondary ramoconidia and ramoconidia.

Mycelium immersed and superficial; hyphae sparingly branched, 2–4 µm wide, septate, without swellings and constrictions, pale olivaceous or pale olivaceous brown, smooth, minutely verruculose or rough-walled. *Conidiophores* macronematous, sometimes micronematous, arising terminally and laterally from hyphae, solitary, erect, straight or flexuous, cylindrical-oblong, neither geniculate nor nodulose, unbranched or once branched, 35–150(–290) × (2.5–)3–4.5 µm, septate, pale olivaceous or pale olivaceous brown, smooth, often minutely verruculose or rough-walled at the base; micronematous conidiophores about 2 µm wide. *Conidiogenous cells* integrated, terminal and intercalary, cylindrical-oblong, 6–36 µm long, with (1–)2–4 loci at the apex or on small lateral outgrowths in intercalary cells or situated on lateral shoulders, 1–2 µm diam. *Ramoconidia* cylindrical-oblong, 18–39 × 3–4 µm, 0–2-septate, smooth, base broadly truncate, 2–3 µm wide. *Conidia* numerously formed in branched chains, branching in all directions, with up to six conidia in the terminal unbranched part of the chain, *small terminal conidia* subglobose or obovoid, 2.5–4.5(–5.5) × 2–2.5(–3) µm (av. ± SD: 3.8 ± 0.7 × 2.3 ± 0.3), *intercalary conidia* ovoid, limoniform or ellipsoid, 4–14 × (2–)2.5–3.5(–4) µm (av. ± SD: 7.7 ± 2.6 × 3.0 ± 0.4), 0(–1)-septate, with 1–3(–4) distal hila, *secondary ramoconidia* ellipsoid or subcylindrical (7–)10–25(–28) × (2.5–)3–4 µm (av. ± SD: 16.4 ± 5.3 × 3.2 ± 0.4), 0–1-septate, pale olivaceous or pale olivaceous brown, smooth, walls unthickened, attenuated towards apex and base, with up to four distal hila, hila conspicuous, subdenticulate or denticulate, 0.5–2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on PDA attaining 73–82 mm diam after 14 d at 25 °C, grey olivaceous, olivaceous grey to olivaceous black with patches of smoke-grey or white due to aerial mycelium, reverse iron-grey, velvety or powdery, margin feathery, aerial mycelium sparse, more abundantly only in a few spots, growth flat, no exudates. Colonies on MEA reaching 50–76 mm diam after 14 d at 25 °C, grey olivaceous, reverse

iron-grey, powdery or velvety, margin feathery, radially furrowed, wrinkled and with elevated colony centre, aerial mycelium forming large whitish or smoke-grey patches, fluffy-woolly, dense, no exudates. Colonies on OA attaining about 55 mm diam after 14 d at 25 °C, pale olivaceous or brownish, white and smoke-grey due to patches of fluffy-felty aerial mycelium, reverse iron-grey or leaden-grey, powdery or fluffy-felty, margin glabrous, growth flat, sometimes few prominent olivaceous buff exudates formed. Sporulation profuse on all media.

Substrates and distribution: Isolated from plant material, lichens and indoor environments; Europe (Denmark, Germany, Portugal, The Netherlands).

Additional materials examined: **Denmark**, isol. from indoor environment, B. Andersen, DTO 109-E7 = BA 1907. **Germany**, isol. from leaves of *Acer pseudoplatanus* (*Aceraceae*), L. Pehl, CBS 116744 = dH 14053; Bavaria, isol. from a lichen on leaves of *Acer platanoides* (*Aceraceae*), 2006, W. von Brackel, CPC 13220. **Portugal**, isol. from indoor environment, DTO 151-H5. **The Netherlands**, Amsterdam, indoor air archive, M. Meijer, DTO 072-E4; 's Hertogenbosch, swab sample archive, Meijer, DTO 086-B3; Leiden, isol. from seed coat of *Cirsium vulgare* (*Aceraceae*), CBS 125.80; Millingerwaards, isol. from fruits of *Sambucus nigra* (*Caprifoliaceae*), 29 Aug. 2007, P.W. Crous, CPC 14238; Utrecht, swab sample, house, M. Meijer, DTO 056-H7.

Notes: *Cladosporium europaeum* (Fig. 1, clade 35), formerly treated as *C. cladosporioides* Lineage 1 (Bensch *et al.* 2010) differs from *C. cladosporioides s. str.* (Fig. 1, clade 66) in producing shorter, 0−1-septate conidia and ramoconidia and is phylogenetically distant with 538/538 (100 %), 410/436 (94 %) and 214/222 (96 %) sequence similarity for ITS, *tef1* and *act*, respectively when the ex-type sequences are compared. *Cladosporium vicinum* (Fig. 1, clade 34), its closest phylogenetic neighbour shows longer conidiogenous cells, secondary ramoconidia and ramoconidia.

Cladosporium floccosum Sandoval-Denis *et al.*, Persoonia 36: 293. 2016. MycoBank MB814509. Fig. 15.

Holotype: **USA**, Minnesota, from human ethmoid sinus, Sep. 2010, D.A. Sutton, CBS H-22327. *Ex-type culture*: CBS 140463 = UTHSC DI-13-212 = FMR 13325.

Ill.: Sandoval-Denis *et al.* (2016: 292, fig. 7).

Mycelium unbranched or loosely branched, filiform to cylindrical-oblong, fertile hyphae occasionally somewhat swollen and slightly constricted at septa, 1−4(−4.5) µm wide, septate, septa not very conspicuous, hyaline, subhyaline or pale olivaceous brown, smooth or almost so to verruculose or somewhat irregularly rough-walled especially in fertile hyphae at or near the base of conidiophores, sometimes forming small ropes of few hyphae, cell lumen often appearing granulose. *Conidiophores* macronematous, arising terminally or laterally from plagiotropous or ascending hyphae, erect, straight or curved, cylindrical or usually irregularly in outline in being often nodulose and once or few times distinctly geniculate-sinuous, rectangular, after a nodule has been formed growth often continues in a 45−90° angle at or somewhat below the nodule, shape very characteristic, swellings up to 8 µm diam, mostly unbranched, 10−150 µm long, but mostly shorter, up to 80 µm long, (2.5−)3−5 µm wide, 0−3(−6)-septate, pale to medium olivaceous brown, smooth, verruculose or somewhat irregularly rough-walled at or towards the base, walls refractive, slightly thickened or thickened. Occasionally micronematous conidiophores formed being short, non-nodulose and paler. *Conidiogenous cells* integrated, terminal and intercalary, usually nodulose and often distinctly geniculate-sinuous, 1−2 nodules per cell, 6−35 µm long, conidiogenous loci mainly confined to nodules, 1−5 loci per nodule, conspicuous, protuberant, 1−2(−2.5) µm diam, somewhat thickened and darkened-refractive. *Ramoconidia* occasionally formed, 0−1-septate, base 3−3.5 µm wide. *Conidia* solitary or formed in short unbranched chains with up to four conidia, very rarely in branched chains with few conidia possessing two distal hila, solitary and terminal conidia ellipsoid-ovoid, obovoid, rarely subglobose, sometimes subcylindrical, 6−15(−21.5) × (4−)5−7(−8) µm (av. ± SD: 11.7 ± 3.3 × 6.0 ± 0.9), 0−1-septate, apex rounded, often attenuated towards the base, lumen appearing to be granular, intercalary and basal conidia ellipsoid or subcylindrical, more or less attenuated towards apex and base, (8.5−)10−21(−27) × (4.5−)5.5−8(−10) µm (av. ± SD: 16.3 ± 4.0 × 7.0 ± 1.0), 0−1-septate, septum median or in the lower half, septum becoming sinuous with age, pale to medium olivaceous brown, densely verruculose, verrucose or echinulate, walls unthickened or only very slightly thickened, conidiogenous hila conspicuous, 1−2 µm diam, sometimes situated on small stalk-like prolongations, somewhat thickened and darkened-refractive; microcyclic conidiogenesis occasionally occurring.

Culture characteristics: Colonies on PDA attaining 50−68 mm diam after 14 d at 25 °C, olivaceous grey with patches of pale olivaceous grey aerial mycelium, reverse leaden-grey or iron-grey, fluffy. Colonies on MEA reaching 43−63 mm diam after 14 d at 25 °C, pale olivaceous grey and pale greenish grey with white or smoke-grey patches, reverse olivaceous grey, fluffy-felty, aerial mycelium abundant, dense, colony centre somewhat elevated, radially furrowed and folded. Colonies on OA reaching 47−61 mm diam after 14 d at 25 °C, olivaceous grey or grey olivaceous, reverse leaden-grey or iron-grey, fluffy-felty, margins regular, aerial mycelium abundant, diffuse or dense, white. Without prominent exudates, sporulation profuse on all media.

Substrate and distribution: Isolated from plant material, indoor air and a clinical sample; Asia (China), Europe (Ukraine), North America (Mexico, USA).

Additional materials examined: **China**, isol. from indoor air, DTO 323-H6. **Mexico**, Montecillo, Texcoco, isol. from pine needles (*Pinaceae*), 12 Oct. 2009, M. de Jesús Yáñez-Morales, as "*Penidiella*", CPC 17802. **Ukraine**, Kharkov district, Zolochev area, Chepelino village, isol. from *Allium sativum* (*Alliaceae*), 5 Jul. 2008, A. Akulov, stored as "*Stemphyllium vesicarium*", CPC 15522. **USA**, Colorado, Fort Collins, isol. from indoor air sample, living room, Dec. 2012, Ž. Jurjević, EMSL 1867 = CPC 22354; Minnesota, isol. from indoor air sample, Aug. 2012, Ž. Jurjević, EMSL 1715 = CPC 22260; Missouri, Fort Leonard Wood, isol. from indoor air sample bedroom, Jan. 2013, Ž. Jurjević, EMSL 1927 = CPC 22399; Tennessee, isol. from indoor air sample, Oct. 2012, Ž. Jurjević, EMSL 1805 = CPC 22309; Utah Draper, isol. from indoor air sample, basement, Feb. 2013, Ž. Jurjević, EMSL 2033 = CPC 22968.

Notes: *Cladosporium floccosum* (Fig. 2, clade 4), recently described from a clinical sample in the USA (Sandoval-Denis *et al.* 2016) proves to occur also in indoor environments and on plant material. The shape of its conidiophores is very characteristic in being nodulose and once or several times distinctly geniculate, sometimes being rectangular and its conidia are 0−1-septate, densely verruculose, verrucose or echinulate formed solitary or in short unbranched chains. It resembles *C. sinuosum* (Fig. 2, clade 2) and the newly introduced species *C. aerium* (Fig. 2, clade 20). However, *C. sinuosum* produces longer and slightly wider conidiophores (up to 380 µm long, 4−6(−7) µm wide) and slightly wider conidia, (4−)5−8(−9) wide; and *C. aerium* forms slightly longer and narrower conidia (8−)9.5−24 × (4.5−)

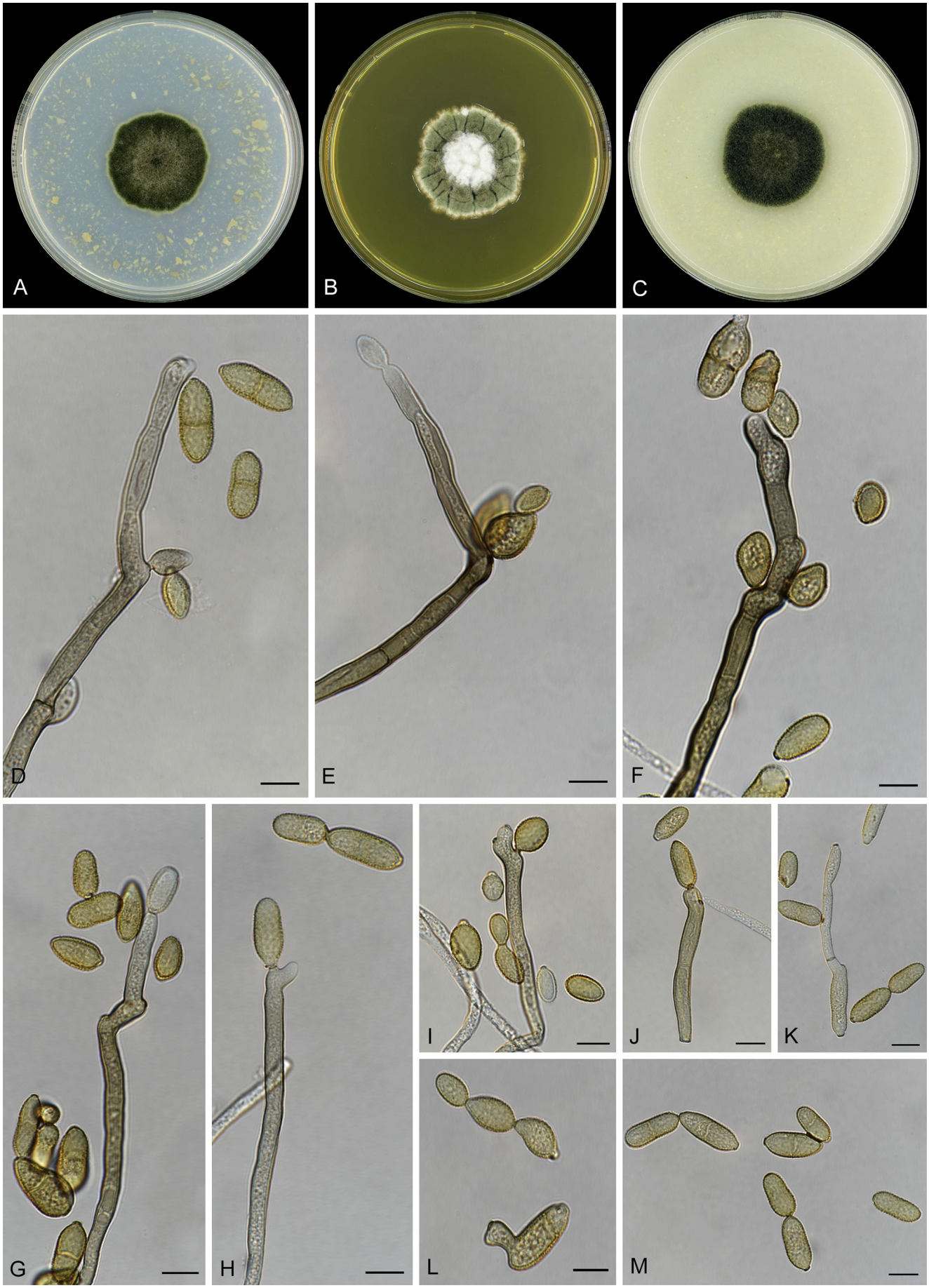

Fig. 15. *Cladosporium floccosum* (CPC 22399). **A–C.** Colonies on PDA, MEA and OA. **D–I.** Conidiophores and conidia. **J.** Ramoconidium. **K–L.** Microcyclic conidiogenesis with conidia forming secondary conidiophores. **M.** Conidia. Scale bars = 10 µm.

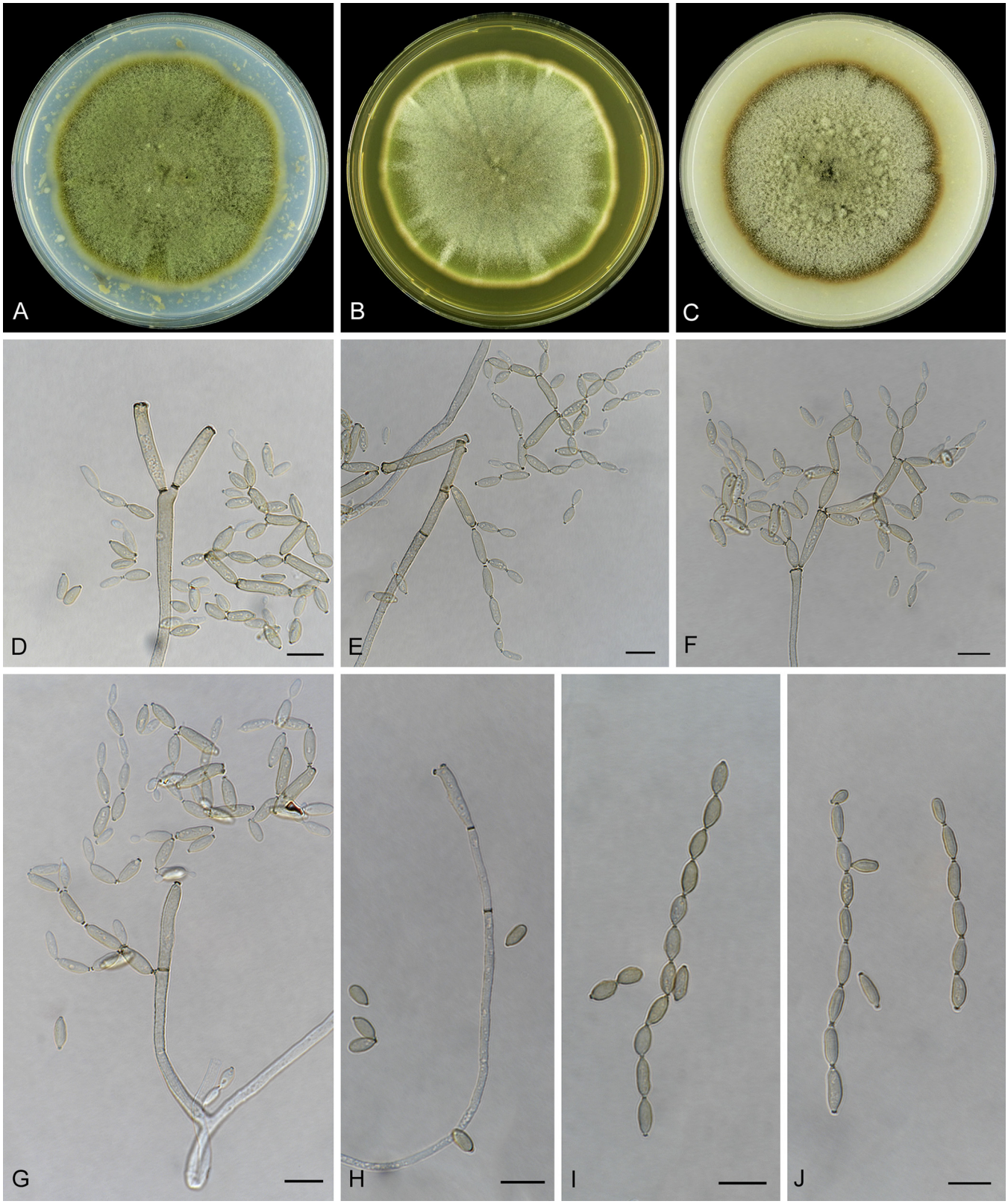

Fig. 16. *Cladosporium funiculosum* (DTO 127-E7). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Conidiophores and conidia. **I–J.** Long conidial chains. Scale bars = 10 µm.

6–7(–8) µm (av. ± SD: 18.0 ± 3.1 × 6.4 ± 0.7). Both species are phylogenetically distant from *C. floccosum* (*C. sinuosum* and *C. aerium* in clades 2 and 20, respectively, *vs* clade 4 in Fig. 2).

Cladosporium funiculosum W. Yamam., Sci. Rep. Hyogo Univ. Agric., Ser. Agric. 4(1): 5. 1959. **emend**. MycoBank MB102888. Fig. 16.

Holotype: **Japan**, isol. from leaves of *Vigna umbellata* [=*Phaseolus chrysanthos*] (*Fabaceae*), probably authentic strain of *C. funiculosum*. *Ex-type culture*: CBS 122129 = ATCC 38010 = IFO 6537 = JCM 10683.

Lit.: Bensch *et al.* (2010: 47–49; 2012: 128–129).
Ill.: Bensch *et al.* (2010: 48, figs 34–35; 2012: 128–129, figs 128–129).

Mycelium immersed and superficial, hyphae loosely branched, filiform to cylindrical-oblong or irregular in outline due to swellings, 1–3 µm wide, septate, smooth or loosely verruculose to densely verruculose, walls unthickened, sometimes forming ropes. *Conidiophores* micro-, semimacro- and macronematous, solitary, arising terminally and laterally from plagiotropous or ascending hyphae or hyphal strains, filiform to narrowly cylindrical-oblong, neither geniculate nor nodulose, unbranched, occasionally once branched, 10−120 × (2−)2.5−3.5(−4) µm, usually rather short, 0−2(−5)-septate, not constricted at septa, subhyaline to pale olivaceous brown, smooth or almost so, asperulate or minutely verruculose, walls unthickened. *Conidiogenous cells* integrated, terminal, sometimes intercalary, proliferation often distinctly sympodial, but neither geniculate nor nodulose, 10−45 µm long, with (1−)2−3(−4) loci crowded at the apex, sometimes few additional loci at a lower level, subdenticulate, 1−2 µm diam, somewhat thickened and darkened-refractive. *Ramoconidia* occasionally formed. *Conidia* catenate, in long unbranched or basely, often dichotomously branched chains, up to 8(−14) conidia in the unbranched terminal part, straight, *small terminal conidia* obovoid, narrowly ovoid, ellipsoid, sometimes narrowly obclavate, (2.5−)4−9 × (1.5−)2−2.5(−3) µm (av. ± SD: 5.3 ± 1.6 × 2.3 ± 0.3), aseptate, *intercalary conidia* narrowly ellipsoid, fusiform to subcylindrical, 5−13(−16) × 2−3 µm (av. ± SD: 9.6 ± 3.0 × 2.7 ± 0.3), 0−1-septate, with 1−3 distal hila, *secondary ramoconidia* ellipsoid to subcylindrical or cylindrical, (7−)11−23(−27) × 2.5−4.5(−5) µm (av. ± SD: 16.2 ± 5.1 × 3.3 ± 0.7), 0−1(−2)-septate, not constricted at septa, septum often somewhat in the upper half, with (1−)2−3(−4) distal hila, often with a second hilum near the base forming additional conidia "backwards", subhyaline to pale olivaceous, smooth or almost so, sometimes reticulate, walls unthickened, slightly to distinctly attenuated towards apex and base, hila conspicuous, subdenticulate, 0.5−2 µm diam, somewhat thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA attaining 57−78 mm diam after 14 d at 25 °C, glaucous-grey or olivaceous with tufts of pale olivaceous grey, reverse greenish grey, grey olivaceous or greyish blue, floccose, fluffy-felty, margin white to olivaceous, regular, aerial mycelium abundant, floccose to villose, low to high, growth effuse to low convex, somewhat wrinkled, sometimes with numerous small to large prominent exudates. Colonies on MEA 58−80 mm diam after 14 d at 25 °C, greenish or pale olivaceous grey to buff or rosy-buff, reverse olivaceous grey and iron-grey, velvety or floccose to felty, margin white, glabrous to feathery, aerial mycelium abundant, covering most of the colony surface, floccose to felty, smoke-grey or pale olivaceous grey, dense, low, growth effuse, radially furrowed and wrinkled, without prominent exudates. Colonies on OA attaining 47−67 mm diam after 14 d at 25 °C, white to smoke-grey, pale olivaceous grey or olivaceous grey, colony centre buff or rosy-buff, at margins faun, reverse leaden-grey, olivaceous grey to fawn, floccose to fluffy, margins glabrous, aerial mycelium abundant, covering almost the whole surface, floccose to felty, growth flat, with numerous small prominent exudates.

Substrate and distribution: Isolated from plant material and indoor air; Asia (Japan), North America (USA).

Additional materials examined: **USA**, Alabama, Birmingham, isol. from air sample, hospital, Jul. 2012, Ž. Jurjević, EMSL 1705 = CPC 22247; Massachusetts, Lekvile, isol. from indoor air sample, office, Oct. 2012, Ž. Jurjević, EMSL 1782 = CPC 22298; New Jersey, isol. from indoor air sample, Ž. Jurjević, EMSL 1756 = CPC 22282; Manasquan, isol. from indoor air sample, bedroom, Jan. 2013, Ž. Jurjević, EMSL 1906 = CPC 22391; Georgia, Tucker, isol. from indoor air sample, bakery, DTO 127-E7 = AR405.

Notes: The history of description, typification and deposited cultures of this species was discussed in Bensch *et al.* (2012). Conidiophore measurements and the species epithet "funiculosum" introduced in Yamamoto (1959) probably refer to hyphal strands and not conidiophores since these are often hardly distinguishable from hyphae or hyphal strands in the authentic strain. *Cladosporium funiculosum* was previously only known from two Japanese collections isolated from plant material (Bensch *et al.* 2010). Its species concept is herein emended to encompass several isolates from indoor environments collected in North America. It is characterised by its quite undifferentiated conidiophores and its smooth or somewhat reticulate conidia formed in long branched chains which is typical for species belonging to the *C. cladosporioides* species complex. Furthermore, it was reported from clinical samples in the USA (Sandoval-Denis *et al.* 2015). *Cladosporium funiculosum* (Fig. 1, clade 55) is phylogenetically distinct from other *Cladosporium* species.

Cladosporium globisporum Bensch *et al.*, Stud. Mycol. 67: 51. 2010. MycoBank MB517080. Fig. 17.

Holotype: **Sweden**, isol. from meat stamp, 1986, M. Olsen, No. M291, CBS H-20435. *Ex-type culture*: CBS 812.96.

Lit.: Bensch *et al.* (2012: 139−141).
Ill.: Bensch *et al.* (2010: 51−53, figs 38−40), Bensch *et al.* (2012: 141, figs 146−148).

Mycelium mainly immersed, sparingly branched, 2−5 µm wide, septate, not constricted at septa, pale brown, smooth to minutely verruculose, walls unthickened. *Conidiophores* macro- and micronematous, solitary, arising terminally and laterally from ascending or plagiotropous hyphae, erect, straight to slightly flexuous, cylindrical-oblong to filiform, non-nodulose, sometimes geniculate, unbranched to once branched, branches as short denticle-like lateral outgrowths, later becoming longer, 17−165 × 3−5 µm, micronematous conidiophores (1−)2−2.5(−3) µm wide, 0−4-septate, cells quite long, not constricted at septa, septa often darkened, pale to pale medium brown, slightly paler towards the apex, minutely verruculose, asperulate, walls unthickened or slightly thickened, up to 1 µm wide. *Conidiogenous cells* integrated, often distinctly sympodially proliferating, terminal, usually non-nodulose, sometimes slightly geniculate, filiform to cylindrical-oblong, somewhat flexuous, 17−55 µm long, with up to three apical loci, sitting close together at the apex, conspicuous, subdenticulate to denticulate, (1.2−)1.5−2(−2.2) µm diam, thickened and darkened-refractive. *Ramoconidia* cylindrical-oblong, 19−41(−56) × 3−4(−5) µm, 0(−2)-septate, base broadly truncate. *Conidia* catenate, in densely branched chains, straight to slightly curved, with 1−3 conidia in the terminal unbranched part of the chain, *small terminal conidia* globose, subglobose to obovoid, 2.5−6(−8) × (2.5−)3−4 µm (av. ± SD: 4.1 ± 1.3 × 3.1 ± 0.4), broadly rounded at the apex, *intercalary conidia* subglobose, broadly ellipsoid-ovoid, (4−)5−9(−14) × 3−4(−5) µm (av. ± SD: 6.9 ± 2.4 × 3.7 ± 0.5), aseptate, with up to 3(−5) distal hila, often distinctly denticulate, *secondary ramoconidia* ellipsoid to subcylindrical, 9−27(−30) × (3−)3.5−5(−6) µm (av. ± SD: 16.7 ± 5.7 × 4.2 ± 0.5), 0(−1)-septate, with 3−4 distal hila, sometimes hila not only distal but also lateral in the middle of the cell, pale brown, smooth or almost so, under SEM surface reticulate or with somewhat

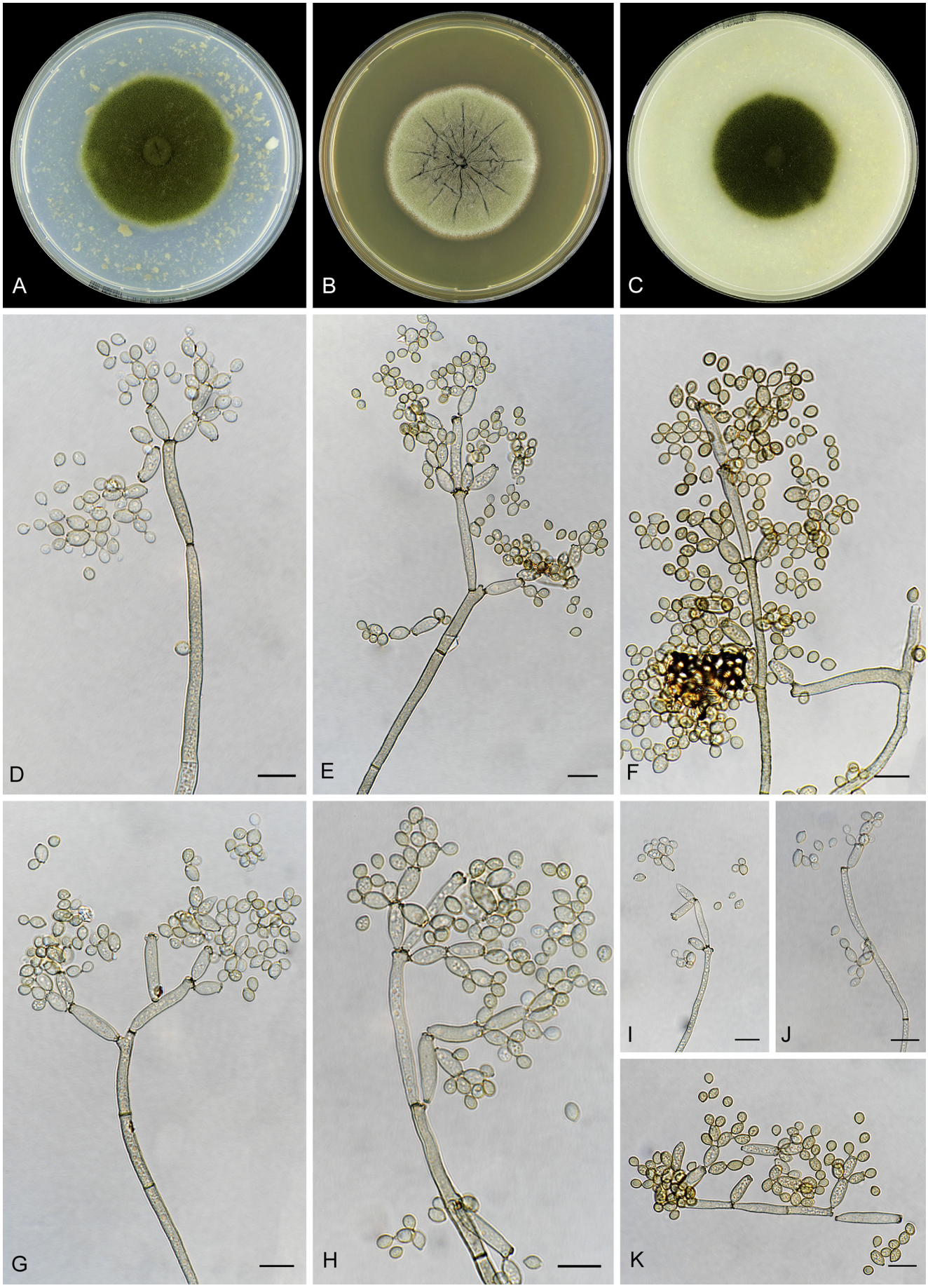

Fig. 17. *Cladosporium globisporum* (CPC 19124). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Conidiophores and conidial chains. **I–J.** Micronematous conidiophores. **K.** Conidial chain. Scale bars = 10 µm.

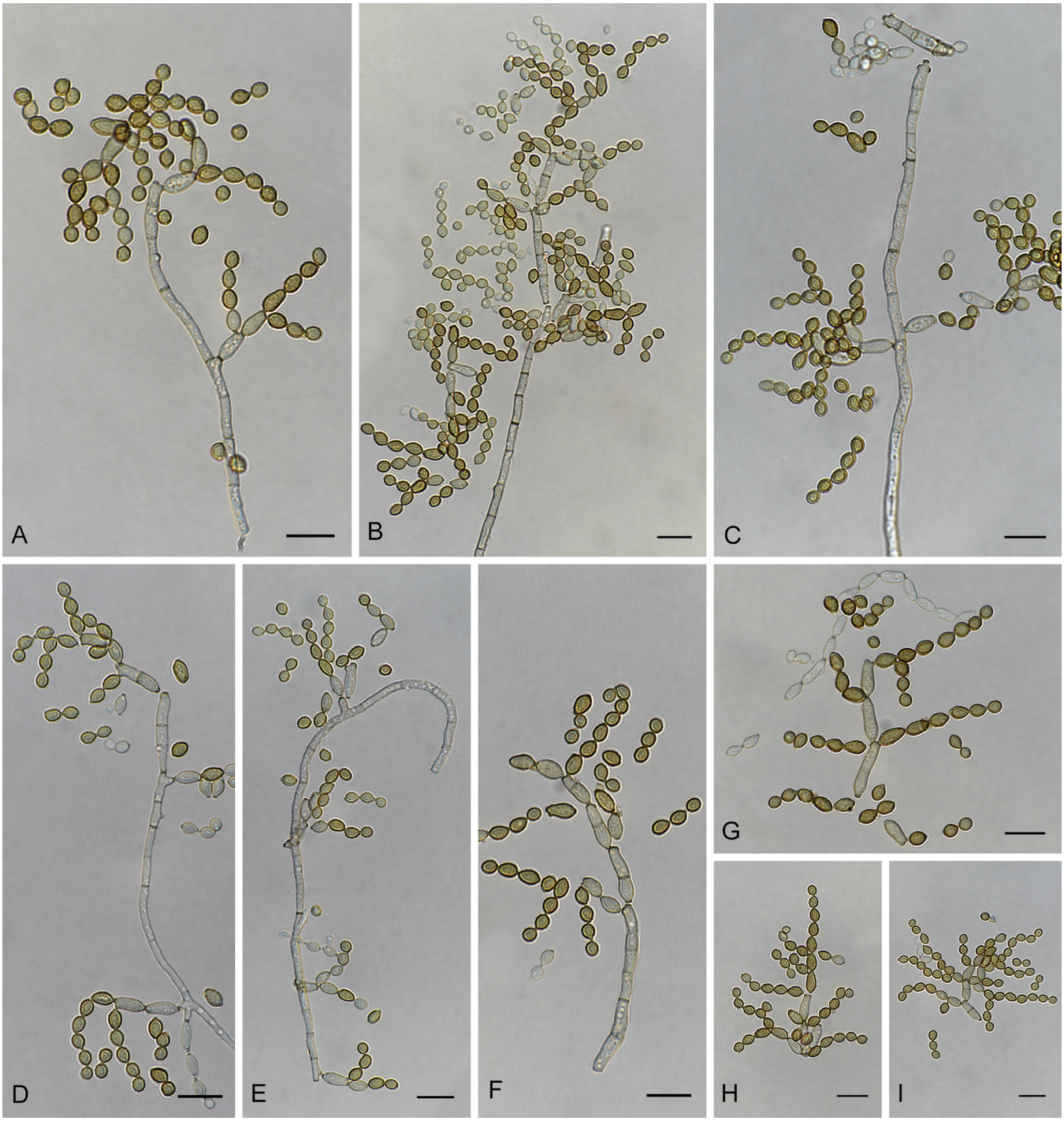

Fig. 18. *Cladosporium halotolerans* (DTO 161-D3). **A–F.** Conidiophores and conidial chains. **G–I.** Conidial chains. Scale bars = 10 µm.

embossed stripes caused by diminishing turgor and shrivelling of tender young conidia, walls unthickened or only slightly so, attenuated towards apex and base, hila conspicuous, often distinctly denticulate, 0.5−2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA grey olivaceous to olivaceous, reverse leaden-grey or olivaceous black, velvety to powdery or floccose, margin colourless to white, feathery, aerial mycelium sparse, loose, fluffy, only few areas covered, growth flat, without exudates, sporulation profuse. Colonies on MEA grey olivaceous, pale olivaceous grey towards margins, reverse olivaceous grey, velvety, due to aerial mycelium several white patches, fluffy, loose to dense, without exudates, sporulation profuse. Colonies on OA grey olivaceous to pale olivaceous due to profuse sporulation or olivaceous buff, reverse leaden-grey to iron-grey, velvety to powdery, glittering due to numerous small, not very prominent exudates (like little water drops), margin colourless, feathery, aerial mycelium absent or sparse, growth flat.

Substrate and distribution: Isolated from indoor environments (Denmark) and meat stamp (Sweden).

Additional material examined: **Denmark**, isol. from indoor environments, window frame, 7 Feb. 2011, B. Andersen, BA 2038 = CPC 19124.

Notes: *Cladosporium globisporum* (Fig. 1, clade 17) is morphologically somewhat intermediate between the *C. cladosporioides* and *C. sphaerospermum* species complexes. The conidiophores are *C. cladosporioides*-like, whereas the terminal and intercalary globose or subglobose conidia are

reminiscent of *C. sphaerospermum*, although they are smooth and not verruculose as in the latter species (Bensch *et al.* 2010, 2012). It has so far only been known from the type specimen (Sweden, meat stamp), but the examined strain isolated from a window frame fits the species concept very well.

Cladosporium halotolerans Zalar *et al.*, Stud. Mycol. 58: 172. 2007. MycoBank MB492439. Fig. 18.

Holotype: **Namibia**, isolated from hypersaline water of salterns, 1 Sep. 2000, coll. N. Gunde-Cimerman, isol. P. Zalar, 1 Oct. 2000, CBS H-19734. *Ex-type culture*: EXF-572 = CBS 119416.

Lit.: Haubold *et al.* (1998), Buzina *et al.* (2003), Meklin *et al.* (2004), Sandoval-Denis *et al.* (2015), Segers *et al.* (2016).
Ill.: Zalar *et al.* (2007: 172, fig. 8).

Mycelium party submerged, partly superficial; hyphae sparingly branched, (1–)2–4 µm wide, pluriseptate, septa often appearing somewhat darkened, usually not constricted, pale brown or pale olivaceous brown, almost smooth or minutely verruculose, walls unthickened, occasionally forming ropes. *Conidiophores* micro- to semimacronematous, arising laterally and terminally from hyphae, erect, straight to somewhat flexuous, narrowly cylindrical-oblong, occasionally slightly geniculate, non-nodulose, micronematous conidiophores filiform or only as short peg-like or denticle-like lateral outgrowths of hyphae, usually unbranched, sometimes intercalary with short lateral denticulate outgrowths just below a septum, 4–150(–300) × 2–3.5(–5.5) µm, micronematous conidiophores 1–1.5(–2) µm wide, mostly 0–3-septate, septa often appearing darkened, sometimes pluriseptate with up to 10 septa in short succession, especially towards the apex, septa not constricted, pale olivaceous brown, smooth to minutely verruculose, walls unthickened or almost so, sometimes forming ramoconidia and fragments. *Conidiogenous cells* integrated, terminal or sometimes intercalary, or conidiophores reduced to conidiogenous cells, cylindrical, 4–38 µm long, usually neither geniculate nor nodulose, with a single or up to four protuberant, subdenticulate or denticulate conidiogenous loci, 0.7–1.5(–2) µm diam, thickened and darkened. *Ramoconidia* 15–37(–46) × 2–3.5(–4) µm, 0–3(–5)-septate, base broadly truncate, about 2 µm wide, slightly thickened and somewhat darkened-refractive. *Conidia* catenate, in branched chains, conidial chains branching in all directions, terminal chains with up to 6(–9) conidia, *small terminal conidia* very numerously formed, globose or subglobose, 2–4(–6) × 2–3.5(–5) µm (av. ± SD: 3.5 ± 0.6 × 2.6 ± 0.5), aseptate, *intercalary conidia* subglobose, ovoid or ellipsoid, 3.5–9(–11) × (2–)2.5–3(–4) µm (av. ± SD: 6.2 ± 1.6 × 3.1 ± 0.5), 0(–1)-septate, pale to medium brown, often appear to be darker than conidiophores and secondary ramoconidia, minutely verruculose or verruculose, *secondary ramoconidia* ellipsoid, fusiform or cylindrical, 7–25(–31) × 2–3.5(–6.5) µm (av. ± SD: 16.2 ± 6.0 × 2.9 ± 2.0), 0–3(–4)-septate, mostly 1-septate, not constricted at septa, septa often somewhat darkened, pale to medium brown, almost smooth to minutely verruculose, walls unthickened, slightly attenuated towards apex and base, with up to four distal hila, hila protuberant, subdenticulate or denticulate, 0.5–1.5(–2) µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on PDA attaining 27–43 mm diam after 14 d at 25 °C, olivaceous, grey olivaceous or olivaceous grey, reverse olivaceous grey to leaden-grey or olivaceous black, velvety, powdery to felty-woolly, margins white, regular, glabrous or feathery, aerial mycelium absent or sparse, growth flat with a somewhat elevated colony centre, without prominent exudates, sporulation profuse. Colonies on MEA attaining 18–44 mm diam after 14 d at 25 °C, smoke-grey, pale olivaceous grey or olivaceous grey, sometimes glaucous grey at margin, reverse olivaceous grey, powdery to felty-woolly, margin colourless to white, glabrous or feathery, colony centre furrowed, aerial mycelium felty, abundant, covering most of the colony surface, sporulating. Colonies on MEA + 5 % NaCl 24–48 mm diam after 14 d at 25 °C, olive, furrowed, velvety, with more pale, undulate margins, reverse dark green to black. Colonies on OA reaching 29–40 mm diam after 14 d at 25 °C, smoke-grey to grey olivaceous or dark mouse-grey, reverse olivaceous or olivaceous grey, velvety to felty, fluffy, margin white, somewhat feathery, aerial mycelium sparse, diffuse or abundantly formed, high, dense, whitish, growth flat with papillate surface, sporulation profuse.

Maximum tolerated salt concentration: Only 15 % of tested strains develop colonies at 20 % NaCl after 7 d, whereas after 14 d all cultures grow and sporulate.

Cardinal temperatures: No growth at 4 °C, optimum at 25 °C, maximum at 30 °C. No growth at 37 °C (from Zalar *et al.* 2007).

Substrates and distribution: Saprobic, frequently isolated from indoor environments but also from hypersaline water in subtropical climates, Arctic ice and biomats, contaminant in lesions of humans and animals, plants, rock, soil, conifer wood and mycorrhizal roots; probably circumglobal, Africa (Namibia, South Africa), Arctics, Asia (China, India, Israel, Thailand, Turkey), Australasia (New Zealand), Europe (Belgium, Bosnia and Herzegovina, Denmark, Germany, France, Hungary, Italy, Russia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, UK), North America (Canada, Mexico, USA), Central and South America (Argentina, Brazil, Dominican Republic).

Additional materials examined: **China**, isol. from indoor air, DTO 323-F3. **UK**, isol. from house dust, DTO 306-C9. **USA**, California, isol. from house dust, basement HVAC room, A. Amend, DTO 305-H6; DTO 306-B3 = AA03US-471, DTO 306-B8. Additional isolates are listed in Table 1.

Notes: *Cladosporium halotolerans* (Fig. 3, clade 23) proved to be a common species with a worldwide distribution occurring on a wide range of different substrates. Sandoval-Denis *et al.* (2015) reported *C. halotolerans* as the most frequent *Cladosporium* species recovered from clinical samples in the USA and it proved to be the most common species isolated from indoor environments (this study) representing about a third of all new indoor isolates.

Cladosporium sphaerospermum (Fig. 3, clade 20) is morphologically close but differs in producing somewhat wider, 2.5–4.5(–6) µm, often branched, pluri- and densely septate conidiophores, slightly longer terminal conidia, (2–)3–5(–7) µm, longer ramoconidia, up to 50(–67) µm long and with up to five septa being commonly beaked (alternarioid) on MEA and PDA. *Cladosporium domesticum* (Fig. 3, clade 21) and *C. parahaloterans* (Fig. 3, clade 22) are introduced in the present study as two new species occurring in indoor environments; they proved to be closely related but are both phylogenetically as well as morphologically distinguishable from *C. halotolerans*. *Cladosporium parahalotolerans* forms wider conidia and ramoconidia; and *C. domesticum* produces narrower conidia and ramoconidia.

Cladosporium inversicolor Bensch *et al.*, Stud. Mycol. 67: 55. 2010. MycoBank MB517082. Fig. 19.

Fig. 19. *Cladosporium inversicolor* (CPC 22300). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Conidiophores and conidial chains. **J.** Ramoconidium and conidia. **K–L.** Conidia. Scale bars = 10 µm.

Holotype: **The Netherlands**, isol. from a leaf of *Triticum aestivum* (*Poaceae*), deposited Jul. 1980 as *C. cladosporioides*, isol. by N.J. Fokkema, ident. by G.A. de Vries, CBS H-20437. *Ex-type culture*: CBS 401.80 = ATCC 200941.

Lit.: Bensch *et al.* (2012: 163–165; 2015: 45).
Ill.: Bensch *et al.* (2010: 55–56, figs 43–44), Bensch *et al.* (2012: 164, figs 175–176).

Mycelium immersed and sparingly superficial; hyphae mainly unbranched, 1.5–3(–4.5) µm wide, septate, not constricted at septa, without swellings, pale olivaceous to pale olivaceous brown, smooth to often minutely verruculose, walls unthickened. *Conidiophores* macronematous, solitary, arising terminally and laterally from hyphae, erect, straight to somewhat flexuous, cladosporioides-like, cylindrical-oblong, somewhat geniculate-sinuous towards or at the apex, non-nodulose, unbranched or once branched, 15–225 × 2.5–4(–5) µm, aseptate or with few septa, not constricted at septa, subhyaline to very pale olivaceous brown, smooth, sometimes rough-walled at the base; occasionally also micronematous, about 1.5 µm wide. *Conidiogenous cells* integrated, mainly terminal, cylindrical-oblong, non-nodulose, sometimes geniculate at or towards the apex due to sympodial proliferation, 15–66 µm long, with (1–)2–3 loci, conspicuous, subdenticulate, 1–2 µm diam, somewhat thickened and darkened-refractive. *Ramoconidia* occasionally formed, cylindrical-oblong, 17–42 × 3–3.5 µm, 0–1(–3)-septate, occasionally with up to three septa, base (1.8–)2–3 µm wide, unthickened. *Conidia* numerous, catenate, in often dichotomously branched chains, sometimes branching in more directions, terminal unbranched parts of the chains often very long, up to eight conidia, sometimes even up to 17 conidia, *small terminal conidia* obovoid to ellipsoid, sometimes subglobose, (3–)5–7(–8.5) × 2–3(–3.5) µm (av. ± SD: 5.4 ± 1.5 × 2.6 ± 0.4), aseptate, apex rounded, attenuated towards the base, *intercalary conidia* ovoid, fusiform to ellipsoid, (5–)7–13(–20) × (2–)2.5–3.5(–4) µm (av. ± SD: 9.8 ± 3.4 × 2.9 ± 0.4), aseptate, attenuated towards apex and base, with 1–3(–4) distal hila, *secondary ramoconidia* subcylindrical, 10.5–24(–29) × (2.2–)2.8–4(–4.2) µm (av. ± SD: 16.6 ± 3.9 × 3.3 ± 0.5), 0–1(–2)-septate, but mainly aseptate, not constricted at septa, pale to olivaceous brown, small terminal conidia and intercalary conidia slightly darker than ramoconidia, secondary ramoconidia and conidiophores, smooth to loosely minutely verruculose or irregularly rough-walled, rugose, verruculose-rugose surface ornamentation especially in small terminal and intercalary conidia, conidia slightly attenuated towards apex and base, with (1–)2–4(–6) distal hila, walls unthickened or almost so, hila conspicuous, subdenticulate, 0.5–2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA attaining 42–70 mm diam after 14 d at 25 °C, olivaceous grey or olivaceous, grey olivaceous towards margins, leaden-grey to olivaceous black reverse with grey olivaceous margins, floccose, margins regular, white or colourless, aerial mycelium sparse to abundant, diffuse to floccose, loose to dense, growth effuse. Colonies on MEA 39–60 mm diam after 14 d at 25 °C, grey olivaceous to olivaceous grey or olivaceous, reverse iron-grey to black, velvety or powdery to floccose, margins colourless or white, regular or somewhat undulate, radially furrowed and somewhat wrinkled, aerial mycelium whitish to smoke-grey, felty-floccose, growth effuse. Colonies on OA 43–60 mm diam after 14 d at 25 °C, grey olivaceous to greenish olivaceous, olivaceous, olivaceous grey or olivaceous buff, reverse pale greenish grey to olivaceous grey, leaden-grey or iron-grey, velvety to floccose, margins glabrous, olivaceous grey, narrow, aerial mycelium smoke-grey to pale olivaceous grey, felty, growth flat. Sporulation profuse and without prominent exudates on all media.

Substrates and distribution: On plant material, isol. from air, indoor environments and food, also mycophilic; Africa (South Africa), Europe (Denmark, France, Germany, The Netherlands), North America (USA), South America (Colombia).

Additional materials examined: **Denmark**, isol. from indoor air, 2 Feb. 2011, B. Andersen, CPC 19108; isol. from indoor environment, B. Andersen, DTO 109-E9 = BA 1909. **France**, isol. from indoor environment, J. Dijksterhuis, DTO 108-F8. **The Netherlands**, Amsterdam, indoor air archive, M. Meijer, CBS 139573 = DTO 072-C9. **USA**, Oregon, Portland, isol. from indoor air sample, living room, October 2012, Ž. Jurjević, EMSL 1806 = CPC 22300; Salem, isol. from indoor air sample, bedroom, Sep. 2012, Ž. Jurjević, EMSL 1763 = CPC 22287; Washington, Tacoma, isol. from indoor air sample, bedroom, Jan. 2013, Ž. Jurjević, EMSL 1900 = CPC 22385.

Notes: *Cladosporium inversicolor* (Fig. 1, clade 42) belongs to the *C. cladosporioides* species complex. The name of this species is derived from the unusual pigmentation of conidia with small and intercalary conidia being usually darker than ramoconidia, secondary ramoconidia and conidiophores, which is unique and distinctive among *Cladosporium* species of this complex.

Cladosporium langeronii (Fonseca *et al.*) Vuillemin, Champ. Paras. Myc. Homme: 78. 1931. MycoBank MB328341. Figs 20, 21.

Basionym: *Hormodendrum langeronii* Fonseca *et al.*, Sciencia Med. 5: 563. 1927.

Neotype: **Brazil**, isolated from human ulcero-nodular mycosis of hand and arm, 1927, coll. & isol. by da Fonseca, CBS H-19737. *Ex-type culture*: CBS 189.54.

Lit.: Zalar *et al.* (2007: 173–174), Bensch *et al.* (2012: 171–172).
Ill.: Zalar *et al.* (2007: 174, fig. 9), Bensch *et al.* (2012: 171: fig. 184).

Mycelium partly immersed, partly superficial; hyphae branched, 1–3 µm wide, septate, without swellings and constrictions, subhyaline to pale brown, smooth or almost so, sometimes enveloped in polysaccharide-like material, sometimes forming few swollen hyphal cells, up to 7 µm diam, arranged like a starting stroma giving rise to several conidiophores appearing loosely fasciculate. *Conidiophores* macro- and micronematous, arising terminally and laterally from submerged and superficial hyphae, erect or ascending, straight to slightly flexuous. *Macronematous conidiophores* cylindrical-oblong, sometimes geniculate-sinuous, non-nodulose, (20–)50–235(–470) × 2.5–4.5(–6) µm, unbranched or often branched, once or several times, branches not only as short peg-like prolongations but longer, distinct, one branching often below the apex, pluriseptate, not constricted at septa, medium to dark brown, somewhat paler at the apex, smooth to verruculose or irregularly rough-walled, walls slightly thickened, about 0.5 µm wide. *Conidiogenous cells* integrated, terminal, sometimes also intercalary, cylindrical, 9–25 µm long, slightly attenuated at the apex, sometimes seceding and forming ramoconidia, usually with a single apical scar, protuberant, 0.8–1.5(–2) µm diam, thickened and darkened-refractive. *Micronematous conidiophores* filiform, mostly unbranched, rarely branched, 6–120 µm long or longer, 1–2 µm wide, pale brown, septate, smooth or almost so, walls unthickened.

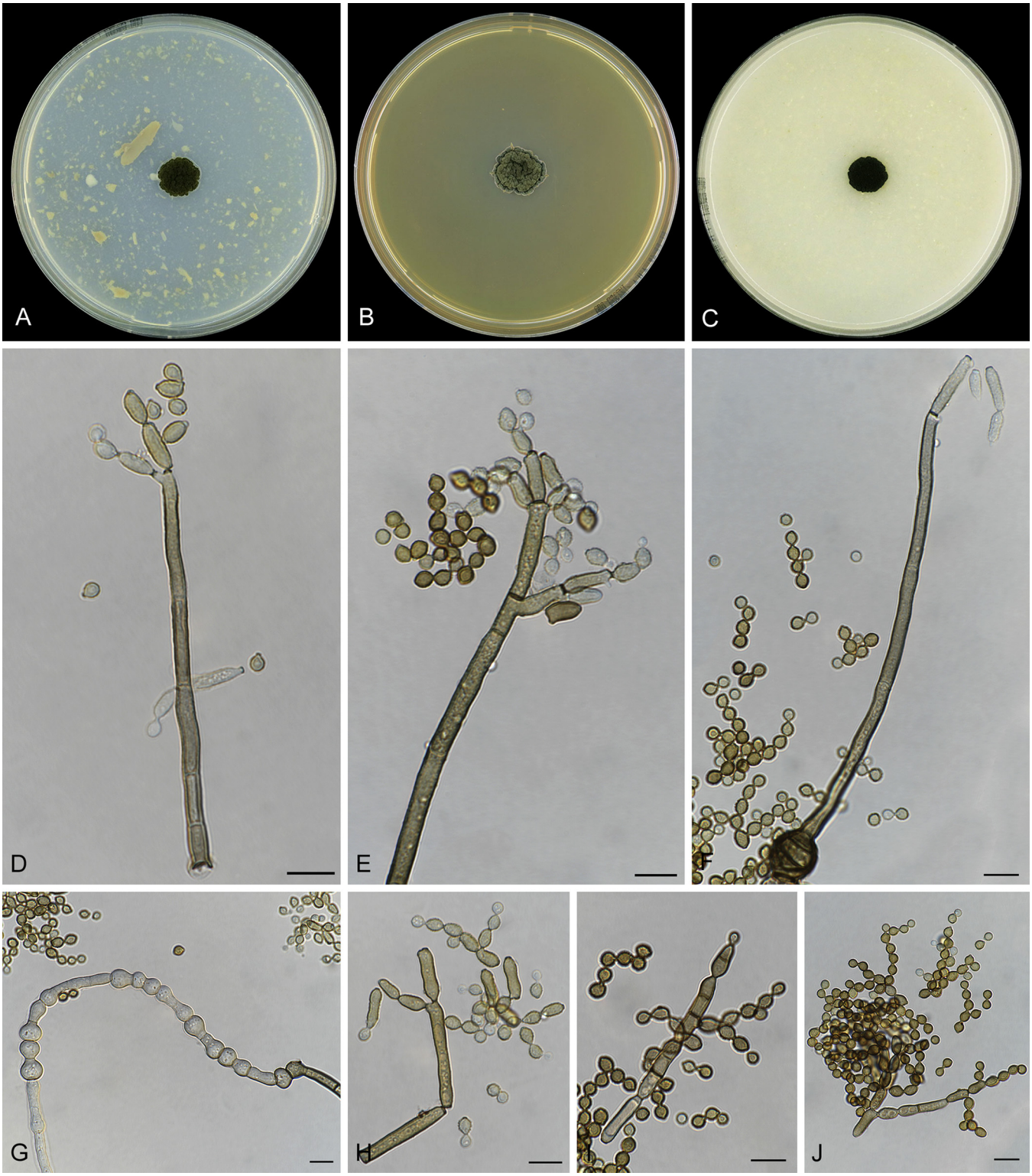

Fig. 20. *Cladosporium langeronii* (DTO 124-D5). **A–C.** Colonies on PDA, MEA and OA. **D–F.** Conidiophores and conidia. **G.** Superficial mycelium. **H.** Ramoconidium and conidial chains. **I–J.** Conidial chains. Scale bars = 10 µm.

Conidiogenous cells integrated, terminal or sometimes discrete, with a single apical scar, protuberant, 0.5–1 µm diam, thickened and darkened-refractive. *Ramoconidia* cylindrical, 0–1-septate, (10–)11–22(–42) × (3–)3.5–4.5(–5) µm, base broadly truncate, 2–3.5 µm wide, slightly thickened and somewhat darkened. *Conidia* catenate, in dichotomously branched chains, with up to 7(–8) conidia in the terminal, unbranched parts, straight, *small terminal conidia* subglobose or ovoid, (2.5–)4–5.5(–8) × (2–)3–4(–5) µm (av. ± SD: 3.7 ± 0.6 × 3.2 ± 0.4 µm), aseptate, rarely 1-septate, hila 0.5–0.8 µm diam, apex rounded, *intercalary conidia* broadly ovoid to ellipsoid, 5–8(–11) × 3–4 µm (av. ± SD: 6.7 ± 2.0 × 3.7 ± 0.5 µm), 0(–1)-septate, not constricted, attenuated towards apex and base, with a single apical hilum, 0.5–1 µm diam, *secondary ramoconidia* ellipsoid to cylindrical, (5.5–)9–20(–26) × (2.5–)3–4.5(–5.5) µm (av. 14.4 ± 4.3 × 3.5 ± 0.5 µm), 0–1(–2)-septate, not constricted at septa, pale to medium or dark brown, irregularly verruculose to sometimes loosely verrucose, walls slightly or more distinctly thickened, with 1–2(–3) distal hila, hila protuberant, peg-like, denticulate, 0.8–1.5(–2) µm diam, thickened and darkened-refractive; microcyclic conidiogenesis occasionally

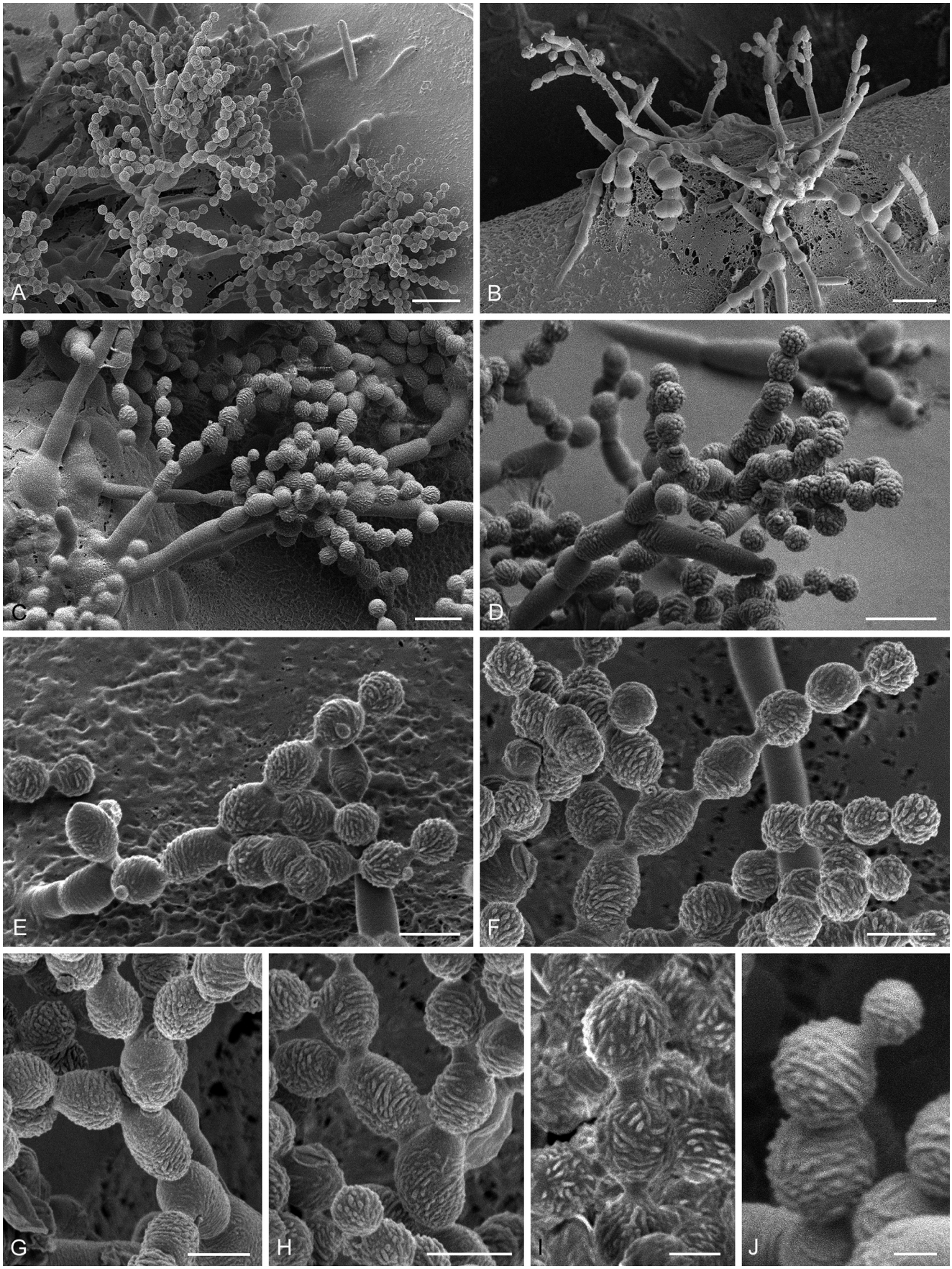

Fig. 21. *Cladosporium langeronii* (DTO 124-D5). **A.** Survey of colony structure of conidia on conidiophores. **B.** Young conidiophores formed on series of rounded cells, in one case with a transverse septum. **C.** As B, Here the distinct ornamentation of conidia is visible. **D.** Conidial chains, showing markedly less ornamentation at the apical end of the ramoconidia. E. Young conidiophore, with conidial chain, showing smooth apical zones and smooth necks between spores. **F.** Conidial chains showing the more distinct ornamentation in terminal conidia. Ornamentation exists out of distinct ridges that are more or less parallel. **G–J.** Details of conidial ornamentation with smooth apical zones and necks except in terminal conidia. Figure J shows a conidium initial. Scale bars = 2 (I, J), 5 (E–H), 10 (B–D), 20 (A) µm.

occurring. Conidia formed by micronematous conidiophores paler, narrower, usually only in unbranched chains, filiform, ellipsoid to obclavate, 3–12 × 1.5–2.5 µm, 0(–1)-septate.

Culture characteristics: Colonies on PDA, OA and MEA with restricted growth, attaining 2.5–4.5, 1.5–7 and 1–5.5 mm diam after 14 d at 25 °C, respectively. Colonies flat or heaped (up to 3 mm), dark green, with black reverse and slightly undulate margin with immersed mycelium. Sporulating on all media. On MEA + 5 % NaCl growth is faster, colonies attaining 8.5–12 mm diam after 14 d at 25 °C, sporulating and growing deeply into the agar.

Maximum tolerated salt concentration: All strains develop colonies at 17 % NaCl after 14 d at 25 °C.

Cardinal temperatures: No growth at 4 °C, optimum/maximum at 25 °C (1–5.5 mm diam), no growth at 30 °C (from Zalar *et al.* 2007).

Substrate and distribution: Indoor environments, air, conifer wood, humans; Europe (Belgium, Denmark, Ireland, The Netherlands), North America (USA), South America (Brazil).

Additional materials examined: **Belgium**, isol. from a moist aluminium school window frame, CBS 101880. **Denmark**, isol. from indoor air, 2 Feb 2011, BA 2035 = CPC 19121. **Ireland**, Dublin, isol. from indoor air sample, washroom, Nov. 2012, Ž. Jurjević, EMSL 1831, 1832 = CPC 22325, 22326. **The Netherlands**, Eindhoven, isol. from a swab sample, house, J. Houbraken, DTO 004-C3; 's Hertogenbosch, indoor air archive, M. Meijer, DTO 085-H6; Ospel, air sample food plant, DTO 124-D2, DTO 124-D5 = CBS 139581. **USA**, Delaware, isol. from indoor air storage sample, Pineapple room, June 2012, Ž. Jurjević, EMSL 1681 = CPC 22235; Minnesota, isol. from indoor air sample, Aug. 2012, Ž. Jurjević, EMSL 1716 = CPC 22261; Pennsylvania, Kutztown, isol. from indoor air sample, Oct. 2012, Ž. Jurjević, EMSL 1783 = CPC 22299.

Notes: *Cladosporium langeronii* (Fig. 3, clade 13) is a saprobic species belonging to the *C. sphaerospermum* species complex. It has been repeatedly isolated from indoor environments. The strain CBS 109868, which was previously identified and treated as *C. langeronii* (Zalar *et al.* 2007), proved to belong to the newly described species *C. neolangeronii* (Fig. 3, clade 10). The latter species which is both morphologically as well as phylogenetically closely allied differs from *C. langeronii* in having longer ramoconidia and secondary ramoconidia as well as faster growth rates. Zalar *et al.* (2007) stated already that *C. langeronii* most likely represents a complex of at least two species with strains from the Arctic and the Antarctic probably being distinct from *C. langeronii* on species level. These isolates from polar ice and biomats from the Arctic and Antarctic clustered with CBS 109868 in the phylogenetic analyses carried out by Zalar *et al.* (2007) and are, therefore, conspecific with *C. neolangeronii*.

Cladosporium limoniforme Bensch *et al.*, Stud. Mycol. 82: 47. 2015. MycoBank MB814628. Fig. 22.

Holotype: **Egypt**, isolated from *Musa acuminata* (*Musaceae*), 2005, coll. R.S. Summerbell, isol. P.W. Crous, CBS H-22354. *Ex-type culture*: CBS 140484 = CPC 12039.

Ill.: Bensch *et al.* (2015: 49–50, figs 13–14).

Mycelium sparingly formed, usually unbranched, 1.5–3 µm wide, pale olivaceous brown or subhyaline, asperulate to minutely verruculose, walls unthickened, sometimes forming small ropes of a few hyphae. *Conidiophores* micro- to semimacronematous, sometimes macronematous, short, sometimes only as very short lateral branches of hyphae, not very prominent, sometimes hardly distinguishable from hyphae, usually reduced to conidiogenous cells or 1(–2)-septate, terminally arising from hyphae, occasionally laterally arising from plagiotropous hyphae, unbranched, rarely branched, usually neither geniculate nor nodulose, rarely once geniculate, 5–90(–130) × (1–)2–3(–4) µm, mostly only up to 60 µm long, subhyaline, pale brown to pale olivaceous brown, concolourous with hyphae, smooth or almost so to asperulate or somewhat irregularly rough-walled. *Conidiogenous cells* integrated, terminal, occasionally intercalary, narrowly cylindrical, neither geniculate nor nodulose, 15–34(–50) µm long, with 1–3 pronounced scars at the apex or situated on short lateral outgrowths at the apex in terminal cells, in intercalary cells a single or two loci situated on small lateral prolongations just below a septum, conidiogenous loci 1–1.5 µm diam, somewhat thickened and darkened-refractive. *Ramoconidia* 15–40(–50) µm long, 0(–1)-septate, base 2–2.5(–3) µm wide, somewhat refractive. *Conidia* catenate, very numerous, usually 3–7(–8) conidia in the terminal unbranched part of the chain, occasionally up to 13, pale olivaceous brown or pale brown, ornamentation variable, loosely verruculose, sometimes somewhat spiny or irregularly rough-walled, walls unthickened, *small terminal conidia* obovoid to subglobose, apex rounded, attenuated towards the base, 3–4.5(–6.5) × (2–)2.5–3 µm (av. ± SD: 4.1 ± 0.8 × 2.6 ± 0.4), aseptate, *intercalary conidia* limoniform, ovoid to ellipsoid, sometimes fusiform, sometimes rostrate, (4–)5–10(–12) × 2.5–3.5(–4) µm (av. ± SD: 7.0 ± 1.9 × 3.1 ± 0.5), aseptate, very rarely 1-septate, attenuated towards apex and base, with 1–2(–3) distal hila, *secondary ramoconidia* ellipsoid, fusiform to subcylindrical, (8–)9.5–23(–30) × (2.5–)3–4 µm (av. ± SD: 16.2 ± 5.0 × 3.4 ± 0.4), 0–1-septate, septum sometimes becoming sinuous with age, pale olivaceous brown or pale brown, surface ornamentation variable, loosely verruculose, sometimes somewhat spiny or irregularly rough-walled, walls unthickened, with 2–3(–4) distal hila, hila protuberant, 0.5–1.5 µm diam, slightly thickened and somewhat darkened-refractive; microcyclic conidiogenesis occasionally occurring.

Culture characteristics: Colonies on PDA attaining 34–65 mm diam after 14 d at 25 °C, smoke-grey, iron-grey to dark grey olivaceous, sometimes dull green due to abundant sporulation, reverse iron-grey to olivaceous black, velvety to granular or floccose; margins regular, broad, white, glabrous to feathery; aerial mycelium sparse, diffuse, sometimes more abundantly formed in colony centre and then villose to densely tufted; growth flat, regular, sometimes with numerous small to large prominent exudates. Colonies on MEA reaching 39–57 mm diam after 14 d at 25 °C, grey olivaceous, greenish olivaceous to smoke-grey or glaucous-grey towards margins, sometimes large parts smoke-grey to glaucous-grey or whitish due to aerial mycelium, reverse olivaceous grey, iron-grey to black, granular, velvety to floccose; margins regular, narrow to broad, white, feathery to glabrous; aerial mycelium sparse or covering large parts of the colony; growth flat with somewhat elevated colony centre, radially furrowed, sporulation profuse. Colonies on OA attaining up to 69 mm diam after 14 d at 25 °C, grey olivaceous to olivaceous due to abundant sporulation forming concentric zones, reverse pale olivaceous grey to olivaceous grey or leaden-grey, velvety, floccose to felty; margins regular, narrow to broad, glabrous to feathery, greenish olivaceous; aerial mycelium absent, sparse or more abundantly formed covering large parts of the colony, smoke-grey; growth flat, without prominent exudates, sporulation profuse.

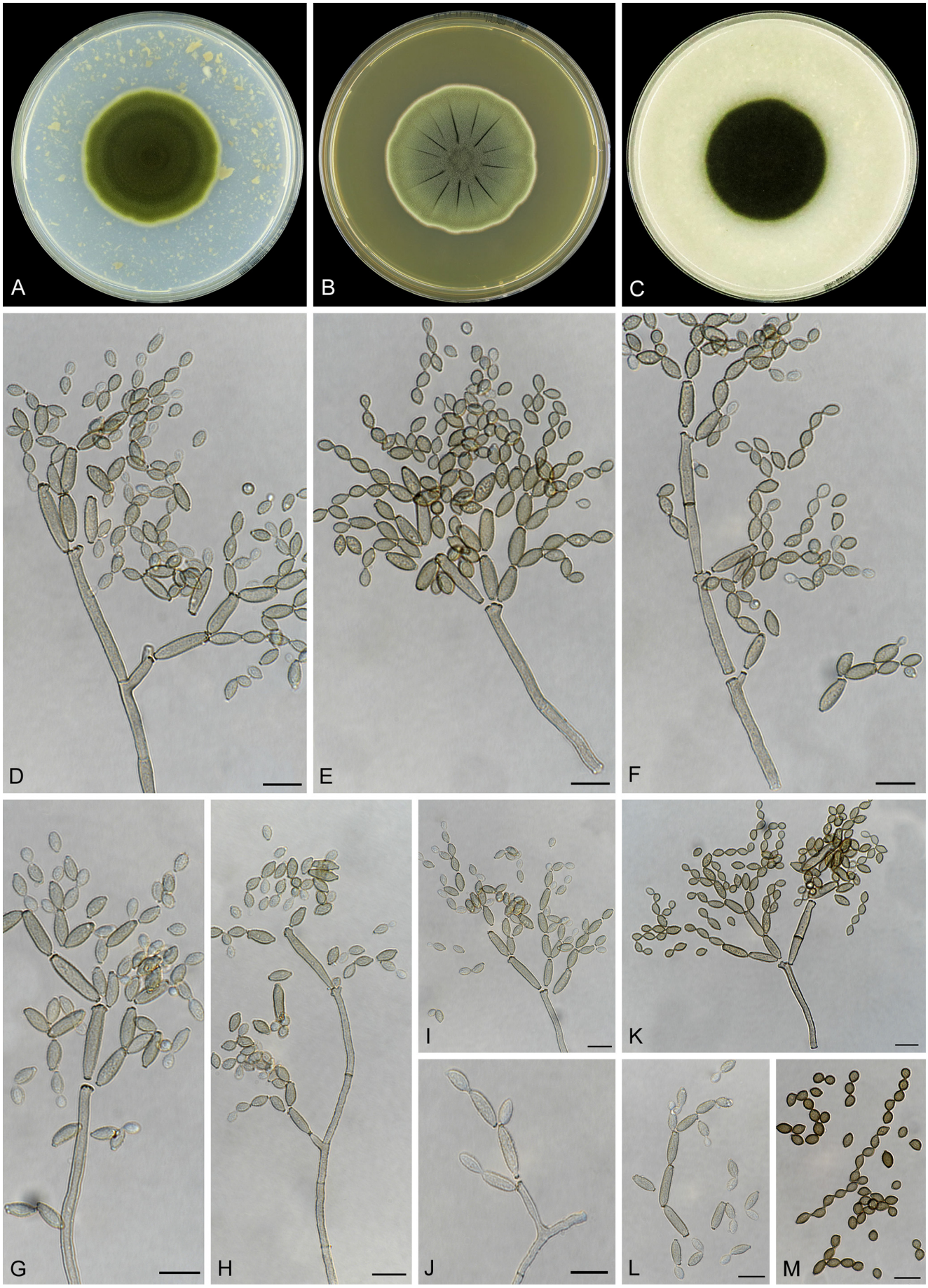

Fig. 22. *Cladosporium limoniforme* (CPC 22395). **A–C.** Colonies on PDA, MEA and OA. **D–K.** Conidiophores and conidial chains. **L–M.** Conidia. Scale bars = 10 µm.

Substrate and distribution: Isolated from plant material, indoor environments and hypersaline water; Africa (Egypt), Asia (Israel), Australia, Europe (Cyprus, The Netherlands) and North America (USA).

Strains examined: **Australia**, isol. from house dust, DTO 305-G4 = BH02AU-115. **Cyprus**, Polis, isol. from *Eucalyptus* sp. (*Myrtaceae*), 18 Mar. 2007, coll. A. van Iperen, isol. P.W. Crous, CPC 13923. **Israel**, Dead Sea, Ein Bokek, isol. from hypersaline water, 2004, P. Zalar, EXF-1062 = CPC 12049; Ein Gedi, 31.45, 35.3833, isol. from hypersaline water, 2004, P. Zalar, EXF-1060 = CPC 12048, EXF-1081 = CPC 12050. **The Netherlands**, Utrecht, swab sample, archive, M. Meijer, DTO 090-H8; Weert, isol. from indoor air living room, B. Favié, DTO 082-F2. **USA**, isolated from grape berry, F.M. Dugan lab, CBS 113737; Arizona, Tuscon, isol. from indoor air sample, hospital, Jan 2013, Ž. Jurjević, EMSL 1909, 1910 = CPC 22394, 22395; California, Indio, isol. from under kitchen sink sample, Jan 2013, Ž. Jurjević, EMSL 1899 = CPC 22384; La Mesa, isol. from indoor air sample, bedroom, Dec. 2012, Ž. Jurjević, EMSL 1863 = CPC 22350. **Unknown**, from tomato, CPC 18086 = KSU C1.

Notes: *Cladosporium limoniforme* (Fig. 2, clade 36) is well characterised by its few micronematous conidiophores forming large numbers of conidia and its limoniform intercalary conidia. Conidial surface ornamentation is typical for species belonging to the *C. herbarum* species complex. It is phylogenetically but not morphologically allied to *C. aggregatocicatricatum* (Fig. 2, clade 34). The latter species clearly differs in having much longer macronematous conidiophores being once or several times slightly to distinctly geniculate-sinuous or subnodulose with clusters of pronounced scars at apices or intercalary. The closest phylogenetic relative of *C. limoniforme* proved to be *C. prolongatum* (Fig. 2, clade 35) which was recently described from soil in China but differs in having shorter secondary ramoconidia and a densely verruculose conidial surface ornamentation (Ma *et al.* 2017). *Cladosporium paralimoniforme* (Fig. 2, clade 1), an additional species described from soil in China, resembles *C. limoniforme* but forms a distinct clade distant from *C. limoniforme* in the *C. herbarum* species complex and is distinguishable in having shorter conidiophores, ramoconidia and secondary ramoconidia (Ma *et al.* 2017).

Cladosporium lycoperdinum Cooke, Grevillea 12(61): 32. 1883. MycoBank MB217533.

Lectotype (designated in Heuchert *et al.* 2005): **USA**, South Carolina, Aiken, on *Lycoperdon* sp. (*Agaricales*), Ravenel & Cooke, Fungi Amer. Exs. 595 (K 121561). *Isolectotypes*: Ravenel & Cooke, Fungi Amer. Exs. 595 (e.g., BPI 427244, NY).

Lit.: Heuchert *et al.* (2005: 33–36), Bensch *et al.* (2010: 58–60; 2012: 178–180).
Ill.: Heuchert *et al.* (2005: 34–35, figs 11–12), Bensch *et al.* (2010: 59, fig. 48; 2012: 194–195).

Mycelium unbranched or loosely branched, filiform to cylindrical-oblong, (0.5–)1–5 µm wide, not constricted at septa, subhyaline to pale or medium olivaceous brown, smooth or almost so to often minutely verruculose or loosely verrucose, walls unthickened or almost so, occasionally forming ropes. *Conidiophores* macro- and micronematous, solitary, arising terminally and laterally from hyphae, erect, straight or slightly flexuous, macronematous conidiophores cylindrical-oblong or filiform, nonnodulose, usually not geniculate, occasionally slightly geniculate at or towards the apex due to sympodial proliferation, unbranched or once, rarely twice branched, branches often only as short lateral peg-like prolongations just below a septum, 20–250 × (2.5–)3–6(–6.5) µm, pluriseptate, with septa occasionally in short succession, not constricted at septa, few septa sometimes darkened just below potential ramoconidia or where conidiophores disarticulate into shorter pieces, pale olivaceous to medium olivaceous brown, smooth to somewhat irregularly rough-walled or minutely verruculose, especially at or towards the base, walls unthickened or almost so, about 0.5 µm wide, sometimes slightly attenuated towards the apex or intercalary somewhat wider; micronematous conidiophores narrower, shorter and paler, 9–105 × 1.5–2.5 µm, filiform, not geniculate, unbranched or once branched, 0–5-septate, subhyaline to pale olivaceous, conidiogenous cells 6.5–50 µm long, loci 0.5–1.2 µm diam. *Conidiogenous cells* integrated, terminal, intercalary or sometimes pleurogenous, often seceding and forming ramoconidia, cylindrical-oblong, sometimes slightly geniculate due to sympodial proliferation, 10–57 µm long, with (1–)2–4 loci at or towards the apex, sometimes with additional loci situated on a lower level, in intercalary conidiogenous cells loci usually situated on small peg-like lateral outgrowths, loci conspicuous, subdenticulate to denticulate, 1–2 µm diam, thickened and darkened-refractive. *Ramoconidia* often formed, cylindrical-oblong, 13.5–55 × 3–5(–5.5) µm, 0–3(–6)-septate, not constricted at septa, with 2–4 distal hila, base broadly truncate, 2.2–3(–3.5) µm wide, unthickened or slightly thickened, often somewhat darkened or refractive, without dome and rim. *Conidia* catenate, in branched chains branching in all directions, up to 5(–7) conidia in the terminal unbranched part of the conidial chains, straight, *small terminal conidia* subglobose to obovoid or narrowly ellipsoid, (2–)3.5–5 × (1.5–)2–2.5(–3) µm (av. ± SD: 4.2 ± 0.7 × 2.0 ± 0.3), aseptate, *intercalary conidia* limoniform, ovoid to ellipsoid, 4–14(–16.5) × (2–)2.5–3(–4) µm (av. ± SD: 8.6 ± 3.0 × 2.8 ± 0.5), 0(–1)-septate, with 1–3(–4) distal hila, *secondary ramoconidia* ellipsoid to cylindrical, sometimes almost doliiform, 8–32(–38) × (2.5–)3–4(–5) µm (av. ± SD: 15.6 ± 6.3 × 3.5 ± 0.5), 0–1(–3)-septate, not constricted at septa, pale olivaceous to pale olivaceous brown, smooth or almost so, walls unthickened or almost so, with 2–5 distal hila, intercalary conidia and secondary ramoconidia sometimes formed in dense whirls at the conidiogenous cells or secondary ramoconidia, hila conspicuous, subdenticulate, 0.5–2(–2.5) µm diam, thickened and darkened-refractive; microcyclic conidiogenesis occasionally occurring.

Culture characteristics: Colonies on PDA attaining 50–68 mm diam after 14 d at 25 °C, olivaceous grey, grey olivaceous towards margins, reverse leaden-grey to olivaceous black, floccose to fluffy, margins white to grey olivaceous, feathery, regular, aerial mycelium abundant, covering the whole colony surface, floccose to fluffy, growth flat to low convex, without prominent exudates, sporulation profuse. Colonies on MEA reaching 50–62 mm diam after 14 d at 25 °C, olivaceous grey to pale olivaceous grey, sometimes smoke-grey or white, reverse olivaceous grey to iron-grey, floccose to felty, margins white, narrow, feathery, regular, aerial mycelium abundant, covering the whole colony surface, growth flat to low convex, sometimes radially furrowed, without prominent exudates, sporulation profuse. Colonies on OA attaining 58–70 mm diam after 14 d at 25 °C, olivaceous to greenish olivaceous, olivaceous grey at margins, reverse leaden-grey to olivaceous grey, floccose to felty, margins glabrous, aerial mycelium abundant covering almost the whole colony surface, loose to dense, low to rarely high, growth at, without prominent exudates, sporulation profuse.

Substrate and distribution: On ascomycetes and fruiting bodies of different basidiomycetous fungi, as well as isolated from plant

material and outside air; Europe (Germany, Russia), North America (Canada, USA) and South America (Colombia, Uruguay).

Additional material examined: **USA**, Minnesota, isol. from outside air sample, Jul. 2012, Ž. Jurjević, EMSL 1711b = CPC 22256.

Notes: The outside air sample from Minnesota proved to cluster with isolates that have been identified as *C. lycoperdinum* (Fig. 1, clade 33). An epitype for that species has not yet been designated since type material was collected on a basidiomycete, but the available cultures, which morphologically coincide with *C. lycoperdinum* (Heuchert *et al.* 2005), were isolated from ascomycetes or plant material (Bensch *et al.* 2010).

Cladosporium macrocarpum Preuss, in Sturm, Deutsch. Fl. 3(26): 27. 1848. MycoBank MB217783.

Neotype (designated by Schubert *et al.* 2007b): **USA**, Washington, isolated from *Spinacia oleracea* (*Chenopodiaceae*), 1 Jan. 2003, L. du Toit, CBS H-19855. *Isoneotype*: HAL 2020 F. *Ex-neotype culture*: CBS 121623 = CPC 12755.

Lit.: Bensch *et al.* (2012: 180–185).
Ill.: Schubert *et al.* (2007b: 129–132, figs 22–25), Bensch *et al.* (2012: 180–183, figs 196–199).

Mycelium unbranched or loosely branched, 1–4.5(–5) µm wide, septate, sometimes slightly constricted at septa, hyaline to pale brown, smooth to minutely verruculose, walls unthickened or slightly thickened. *Conidiophores* micronematous and macronematous, solitary, arising terminally from plagiotropous hyphae or terminally from ascending hyphae. *Macronematous conidiophores* erect, straight to somewhat flexuous, cylindrical-oblong, nodulose to nodose, with a single apical or usually several swellings either somewhat distinct from each other or often in short succession giving conidiophores a knotty appearance, swellings sometimes laterally elongated or formed at the top of a branch-like outgrowth below the apical swelling, sometimes distinctly geniculate, unbranched, sometimes branched, 12–260 × (3–)4–6 µm, swellings 5–10 µm wide, pluriseptate, sometimes slightly constricted at septa, pale to medium brown or olivaceous brown, somewhat paler at apices, smooth to minutely verruculose or verruculose, walls somewhat thickened, sometimes even two- layered. *Conidiogenous cells* integrated, terminal or intercalary, cylindrical, nodulose with lateral shoulders or nodose with swellings round about the stalk, with conidiogenous loci confined to swellings, 12–37 µm long, with up to 12 loci per cell, usually with up to six, loci conspicuous, protuberant, (1–)1.5–2 µm diam, somewhat thickened and darkened-refractive. *Micronematus conidiophores* almost indistinguishable from hyphae, straight, narrowly filiform, non-nodulose or with a single or few swellings, mostly with small head-like swollen apices, usually only few micrometer long, 1.5–3 µm wide, aseptate or with only few septa, subhyaline, smooth or almost so, walls unthickened, with a single or only few conidiogenous loci, narrow, 0.8–1.2 µm diam, thickened and somewhat darkened-refractive. *Conidia* catenate, in branched chains, *small terminal conidia* subglobose, obovoid, oval, limoniform, 4–11 × (3–)4–6 µm [av. ± SD, 7.6 (± 1.9) × 5.0 (± 0.8) µm], aseptate, *intercalary conidia* broadly ovoid-ellipsoid, 10–17 × (4.5–)5–9 µm [av. ± SD, 12.7 (± 2.1) × 6.8 (± 0.8) µm], 0–1-septate; *secondary ramoconidia* broadly ellipsoid to subcylindrical, 14–25(–30) × (5–)6–9(–10) µm [av. ± SD, 19.4 (± 3.5) × 7.6 (± 1.0) µm], 0–2(–3)-septate, sometimes slightly constricted at the septa, septa somewhat sinuous with age, pale brown to medium olivaceous brown or brown, sometimes even dark brown, verruculose to echinulate (muricate under SEM), walls thickened, up to 1 µm thick, mostly broadly rounded at apex and base, sometimes attenuated, sometimes guttulate by oil drops, with up to three apical hila, mostly 1–2, hila sessile (apparently somewhat immersed) to somewhat protuberant, 1–2(–2.5) µm diam, thickened and darkened-refractive; microcyclic conidiogenesis occurring with conidia forming secondary micro- and macronematous conidiophores, conidia often germinating with long hyphae. *Conidia* formed by micronematous conidiophores usually smaller, narrower and paler, catenate, in short unbranched or branched chains, subglobose, obovoid to limoniform, ellipsoid or fusiform, 2.5–16 × 1.5–5 µm, 0(–1)-septate, few longer conidia subcylindrical to clavate, up to 37(–43) µm long, 0–2(–3)-septate, occasionally with up to four septa, sometimes slightly constricted at the septa, subhyaline to pale brown, almost smooth to minutely verruculose, walls unthickened, hila 0.8–1.2 µm diam, thickened and darkened-refractive.

Culture characteristics: Colonies on PDA reaching 30–43 mm in diam after 14 d at 25 °C, dark dull green to olivaceous grey, olivaceous grey, dark olivaceous to iron-grey reverse, pulvinate, velvety, sometimes somewhat zonate, paler zones towards the margin, margin regular, entire edge, almost colourless to white, glabrous to feathery, aerial mycelium sparse to more abundant in the colony centre or covering large areas of the colony, hairy, fluffy or felty, whitish to smoke-grey, sometimes becoming reddish, livid red to vinaceous, growth flat, regular, sometimes forming few prominent exudates, exudates sometimes slightly purplish, sporulation profuse with two kinds of conidiophores, low and high. Colonies on MEA reaching 31–50 mm in diam after 14 d at 25 °C, grey olivaceous to olivaceous grey or iron-grey, sometimes pale olivaceous grey to whitish due to abundant aerial mycelium, olivaceous grey or iron-grey reverse, velvety or powdery, margin narrow, entire edge, colourless to white, glabrous, aerial mycelium sparse to abundant, hairy or felty, growth regular, flat to low convex, radially furrowed, without prominent exudates, sporulation profuse. Colonies on OA reaching 29–40 mm in diam after 14 d at 25 °C, grey olivaceous, olivaceous grey to dark smoke-grey, olivaceous black or iron-grey reverse, margin entire edge, narrow, colourless or white, glabrous, aerial mycelium sparse, mainly in the colony centre, felty, white to smoke-grey or grey-olivaceous, felty, growth flat, regular, without exudates, sporulating.

Substrate and distribution: Decaying plant material, on dead fruiting bodies of other fungi, occasionally as secondary invader on lesions caused by other fungi, isolated from dust, human, water, incl. hypersaline water; widespread, almost cosmopolitan.

Additional material examined: **Denmark**, isol. from dust, school, 2007, B. Andersen, BA 1704 = CPC 14305.

Notes: This isolate from dust agrees well with the species concept of *C. macrocarpum* (Fig. 2, clade 16).

Cladosporium needhamense Bensch & Samson, **sp. nov.** MycoBank MB822221. Fig. 23.

Etymology: Name refers to the place where the type specimen was collected, Needham.

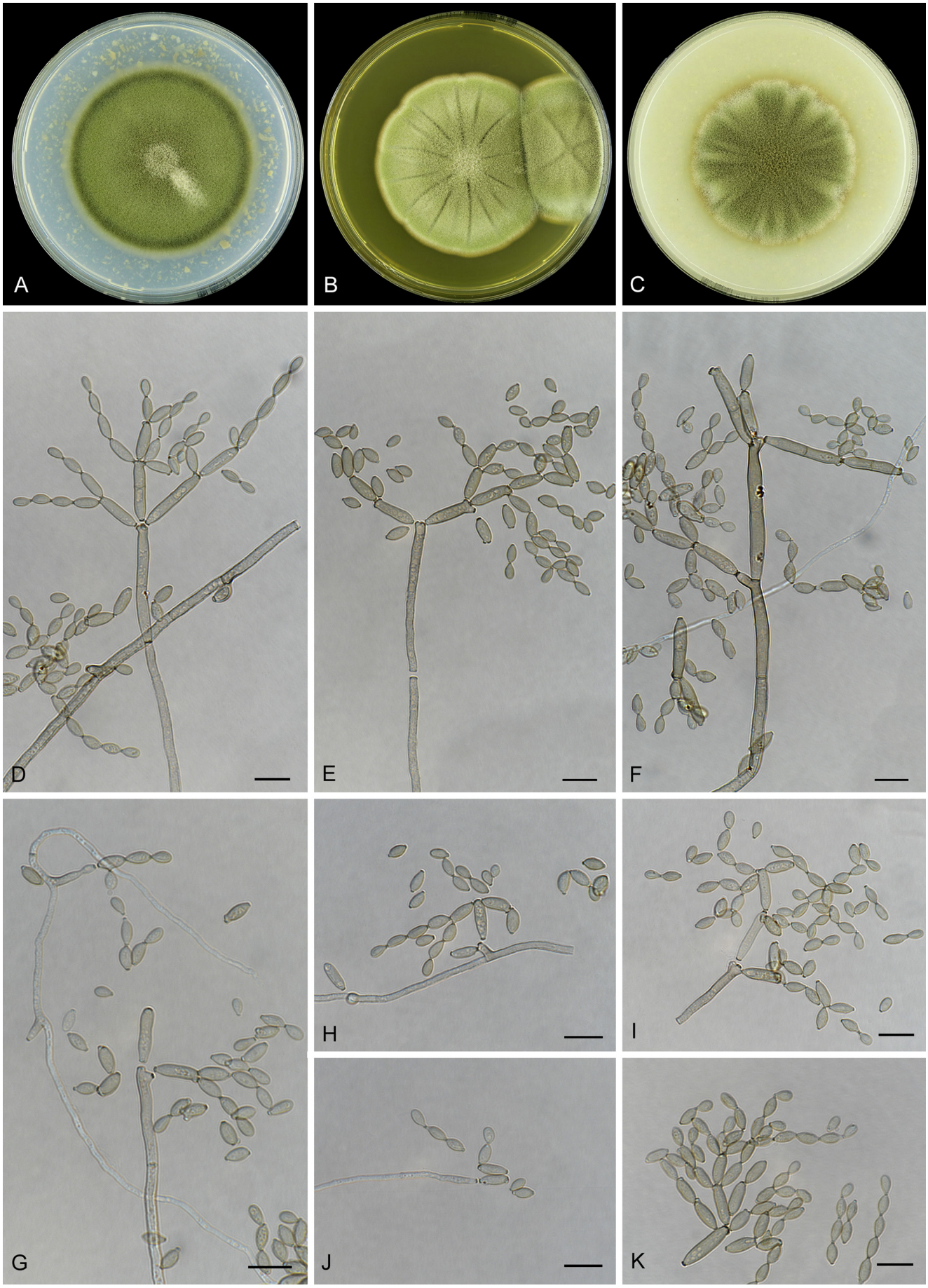

Fig. 23. *Cladosporium needhamense* (CBS 143359). **A–C.** Colonies on PDA, MEA and OA. **D–G.** Macronematous conidiophores and conidia. **H, J.** Micronematous conidiophores and conidia. **I.** Ramoconidium and conidial chains. **K.** Conidial chains. Scale bars = 10 µm.

Holotype: **USA**, Massachusetts, Needham, isol. from indoor air sample, office, Dec. 2012, Ž. Jurjević, CBS H-23252. *Ex-type culture*: CBS 143359 = CPC 22353 = EMSL 1866.

Diagnosis: Differs from *C. uwebraunianum* in having shorter conidiogenous cells (3–22 µm *vs* 17–50(–65) µm) and in forming densely branched chains, with 1–6(–8) conidia in the terminal unbranched part of the chains.

Superficial mycelium commonly formed, filiform or narrowly cylindrical-oblong, loosely branched, (0.5–)1–3.5 µm wide, sometimes up to 6 µm wide and then constricted at septa, pluriseptate, subhyaline or pale olivaceous or olivaceous brown, smooth or almost so, minutely verruculose or irregularly rough-walled, sometimes forming ropes of a few hyphae. *Conidiophores* micro-, semimacro- and macronematous, numerously formed both laterally and terminally, arising from hyphae as short peg-like lateral outgrowths or longer, filiform to cylindrical-oblong, straight or flexuous, sometimes geniculate due to sympodial proliferation, once or several times, variable with regard to shape and size, unbranched or branched, 3–120 µm long, micronematous conidiophores 0.5–2 µm wide, macro- and semimacronematous conidiophores 2.5–3.5(–4) µm wide, septate, sometimes distinctly constricted at one of the septa, subhyaline or olivaceous brown, almost smooth, verruculose or irregularly rough-walled. *Conidiogenous cells* 3–22 µm long, terminal with dense clusters of pronounced scars at or towards the apex, up to seven loci closely aggregated, or reduced to conidiogenous cells, formed as short peg-like lateral outgrowth of hyphae, loci conspicuous, 0.5–2 µm diam, thickened and darkened-refractive. *Ramoconidia* commonly formed, cylindrical-oblong, up to 52 µm long, 3–4 µm wide, base about 2.5 µm wide. *Conidia* numerously formed in densely branched chains, with 1–6(–8) conidia in the terminal unbranched part of the conidial chain, *small terminal conidia* obovoid, ovoid or ellipsoid, 4–6 × 1.5–2(–3) µm (av. ± SD: 4.6 ± 0.9 × 2.1 ± 0.5), *intercalary conidia* ellipsoid, limoniform or fusiform, (5–)6.5–12(–14) × 2.5–3 µm (av. ± SD: 9.1 ± 2.8 × 2.8 ± 0.2), with (1–)2–4 distal hila, *secondary ramoconidia* ellipsoid to cylindrical, 8–33(–37) × 2–4(–4.5) µm (av. ± SD: 20.7 ± 9.9 × 3.4 ± 0.7), 0–2-septate, septum median or in the upper half, with dense clusters of pronounced scars (2–6 hila) at the distal end, sometimes with additional hila near the basal hilum, smooth or irregularly rugulose, subhyaline or pale olivaceous, conidia formed by micronematous conidiophores shorter, narrower and paler, hila conspicuous, 0.5–2 µm diam; microcyclic conidiogenesis sometimes occurring.

Culture characteristics: Colonies on PDA attaining 65–72 mm diam after 14 d at 25 °C, grey olivaceous, smoke-grey and pale olivaceous grey, reverse iron-grey, fluffy-felty, margin regular, white, growth low convex, without prominent exudates. Colonies on MEA 68–76 mm diam after 14 d at 25 °C, whitish, smoke-grey and pale olivaceous grey, reverse olivaceous grey and iron-grey, velvety or fluffy, margins glabrous, radially furrowed, aerial mycelium abundant, dense, fluffy, several small but prominent exudates formed. Colonies on OA 55–65 mm diam after 14 d at 25 °C, grey olivaceous, pale olivaceous grey or smoke-grey, reverse leaden-grey and olivaceous grey, velvety or fluffy-felty. Sporulating on all media.

Substrate and distribution: Indoor environment; North America (USA).

Notes: *Cladosporium needhamense* (Fig. 1, clade 49), a morphologically very variable species, is phylogenetically inbetween *C. verrucocladosporioides* (Fig. 1, clade 48), *C. phaenocomae* (Fig. 1, clade 50) and *C. australiense* (Fig. 1, clade 51). It differs from *C. australiense* in that the latter species has macronematous, often seta-like and very long conidiophores (48–285 µm), only occasionally forming ramoconidia and smooth conidia (Bensch *et al.* 2012). *Cladosporium verrucocladosporioides* forms 0–1-septate, wider terminal and intercalary conidia showing a more prominent surface ornamentation (Bensch *et al.* 2010); and *C. phaenocomae* produces finely verruculose conidia and narrower conidiogenous loci and conidial hila (Crous & Groenewald 2011).

Cladosporium uwebraunianum (Fig. 1, clade 52), newly described from indoor environments, is also closely related but is distinct in having longer conidiogenous cells (17–50(–65) µm long), and conidia formed in long branched chains with up to 10(–13) conidia in the terminal unbranched part of the chain. Until now *C. needhamense* is known only from a single isolate.

Cladosporium neerlandicum Bensch & Samson, **sp. nov.** MycoBank MB822222. Fig. 24.

Etymology: Name refers to the country, where the type specimen was isolated, The Netherlands.

Holotype: **The Netherlands**, 's Hertogenbosch, swab sample archive, M. Meijer, CBS H-23253. *Ex-type culture*: CBS 143360 = DTO 086-C5.

Diagnosis: Differs from *C. acalyphae* in having shorter, 0–3-septate conidiophores and shorter as well as narrower, smooth conidia.

Mycelium immersed, sparsely superficial, hyphae unbranched or loosely branched, 1.5–5 µm wide, septate, often slightly or distinctly constricted at the somewhat darkened and thickened septa, pale to medium olivaceous brown, verruculose. *Conidiophores* solitary or in pairs, macronematous, occasionally micronematous, straight or sometimes slightly flexuous, subcylindrical or conical being attenuated towards the apex, usually not geniculate, unbranched or once branched, (8–)12–60 µm long, 3–5(–6) µm wide at the base, 2.5–3.5 µm wide at the apex, 0–3-septate, septa somewhat darkened, pale to medium olivaceous brown, smooth, walls slightly thickened; micronematous conidiophores filiform, about 2 µm wide. *Conidiogenous cells* terminal, subcylindrical or cylindrical, neither geniculate nor nodulose, 7.5–20 µm long, with 2–5 loci crowded at the apex, loci 1–1.5(–1.8 µm) diam. *Ramoconidia* not occurring. *Conidia* catenate with conidial chains branching in all directions, with 1–5 conidia in the terminal unbranched part of the chains, *small terminal conidia* obovoid or ellipsoid, 4–8 × (2–)2.5–3 µm (av. ± SD: 5.8 ± 1.4 × 2.7 ± 0.4), apex rounded or with a single hilum, *intercalary conidia* ellipsoid, 5.5–11 × (2.5–)3–3.5 µm (av. ± SD: 7.4 ± 2.0 × 3.1 ± 0.3), aseptate, with 1–4 distal hila crowded at the apex, *secondary ramoconidia* ellipsoid or subcylindrical, (8–)9.5–18(–23) × 3–3.5(–4) µm (av. ± SD: 13.6 ± 3.8 × 3.4 ± 0.3), 0–1-septate, with (2–)3–6 distal hila forming dense cluster of pronounced scars, sometimes hila also situated on lateral prolongations or with one or few additional hila the lower end, pale olivaceous or pale olivaceous brown, smooth or almost so, hila protuberant, subdenticulate, 0.5–1.5(–1.8) µm diam, somewhat darkened,

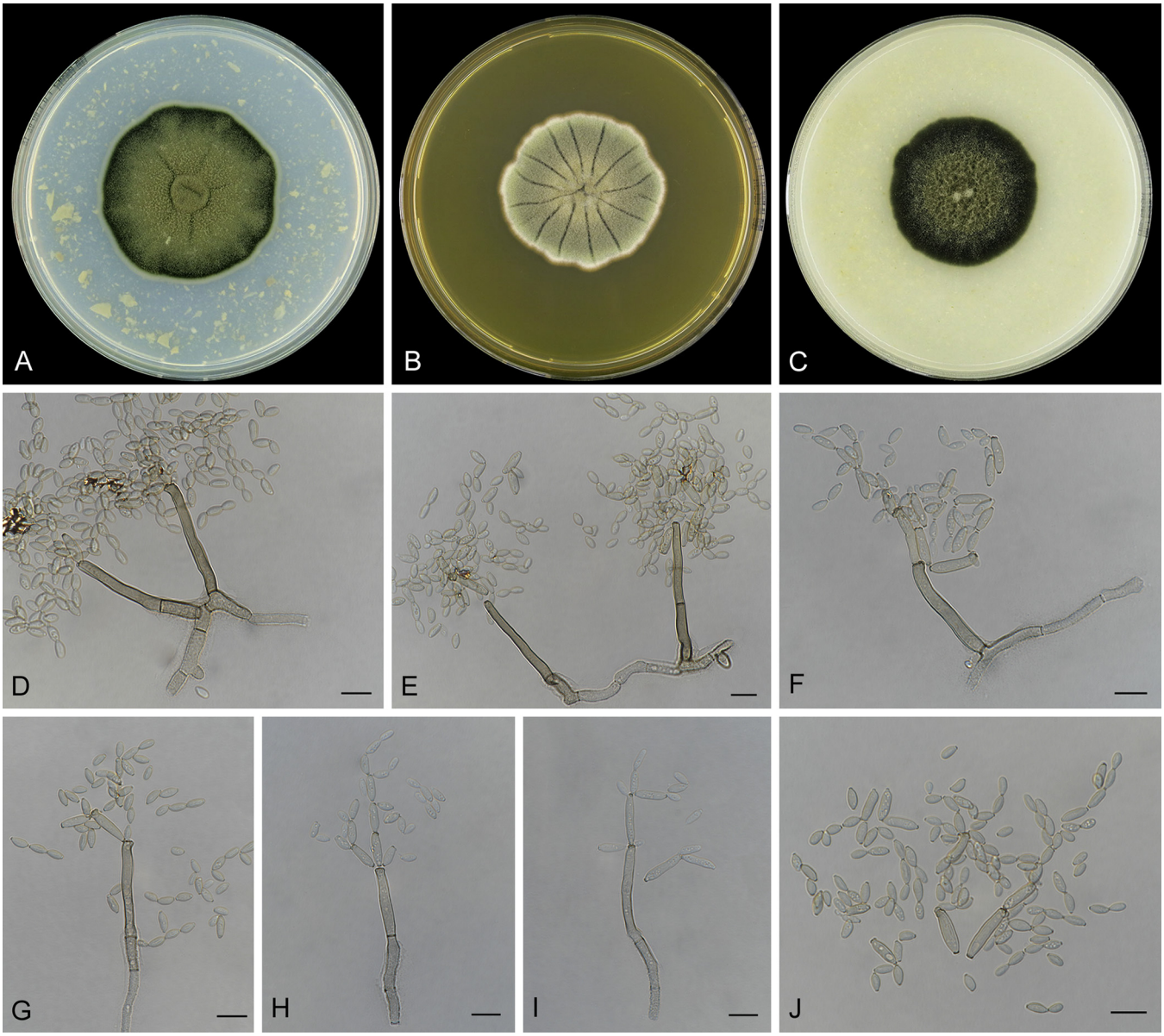

Fig. 24. *Cladosporium neerlandicum* (CBS 143360). **A–C.** Colonies on PDA, MEA and OA. **D–I.** Conidiophores and conidia. **J.** Conidial chains. Scale bars = 10 µm.

conidia often germinating, germ tubes up to 80 µm long or even longer, septate, about 1 µm wide.

Culture characteristics: Colonies on PDA attaining 33−37 mm diam after 14 d at 25 °C, olivaceous or olivaceous grey, reverse leaden-grey and iron-grey, velvety or floccose, margins narrow, undulate, white, growth flat, sometimes radially furrowed with slightly elevated and folded colony centre, aerial mycelium loose, diffuse. Colonies on MEA reaching 30−35 mm diam after 14 d at 25 °C, smoke-grey, glaucous grey towards margin, reverse olivaceous grey, velvety or powdery, margins white, undulate, glabrous, radially furrowed or wrinkled. Colonies on OA 24−34 mm diam after 14 d at 25 °C, olivaceous, iron-grey or olivaceous black towards margins, reverse olivaceous grey or iron-grey, powdery or fluffy, margins narrow, regular or slightly undulate. Sporulation profuse on all media, without prominent exudates.

Substrate and distribution: Indoor environment; Europe (The Netherlands).

Notes: Phylogenetically *C. neerlandicum* (Fig. 1, clade 40) is closely allied to *C. acalyphae* (Fig. 1, clade 39), a species described from South Korea on *Acalypha australis*. The latter species differs however in having very long, pluriseptate conidiophores (up to 430 µm long), ramoconidia and longer and wider, finely verruculose (reticulate under SEM) conidia (Bensch *et al.* 2010, 2012). On *act*, the two species are 167/171 (98 %) similar and on *tef1* they are 254/256 (99 %) similar; they are identical on ITS. Until now *C. neerlandicum* is known only from a single isolate.

Cladosporium neolangeronii Bensch & Samson, **sp. nov.** MycoBank MB822223. Fig. 25.

Etymology: Name refers to its morphological and phylogenetic similarity with *C. langeronii*.

Holotype: **The Netherlands**, 's-Hertogenbosch' and Breda, isol. from indoor environment, 1996, O. Adan (until now stored as "*C. sphaerospermum*" in the CBS collection), CBS H-23254. *Ex-type culture*: CBS 797.97.

Diagnosis: Differs from *C. langeronii* in having faster growth rates and longer ramoconidia.

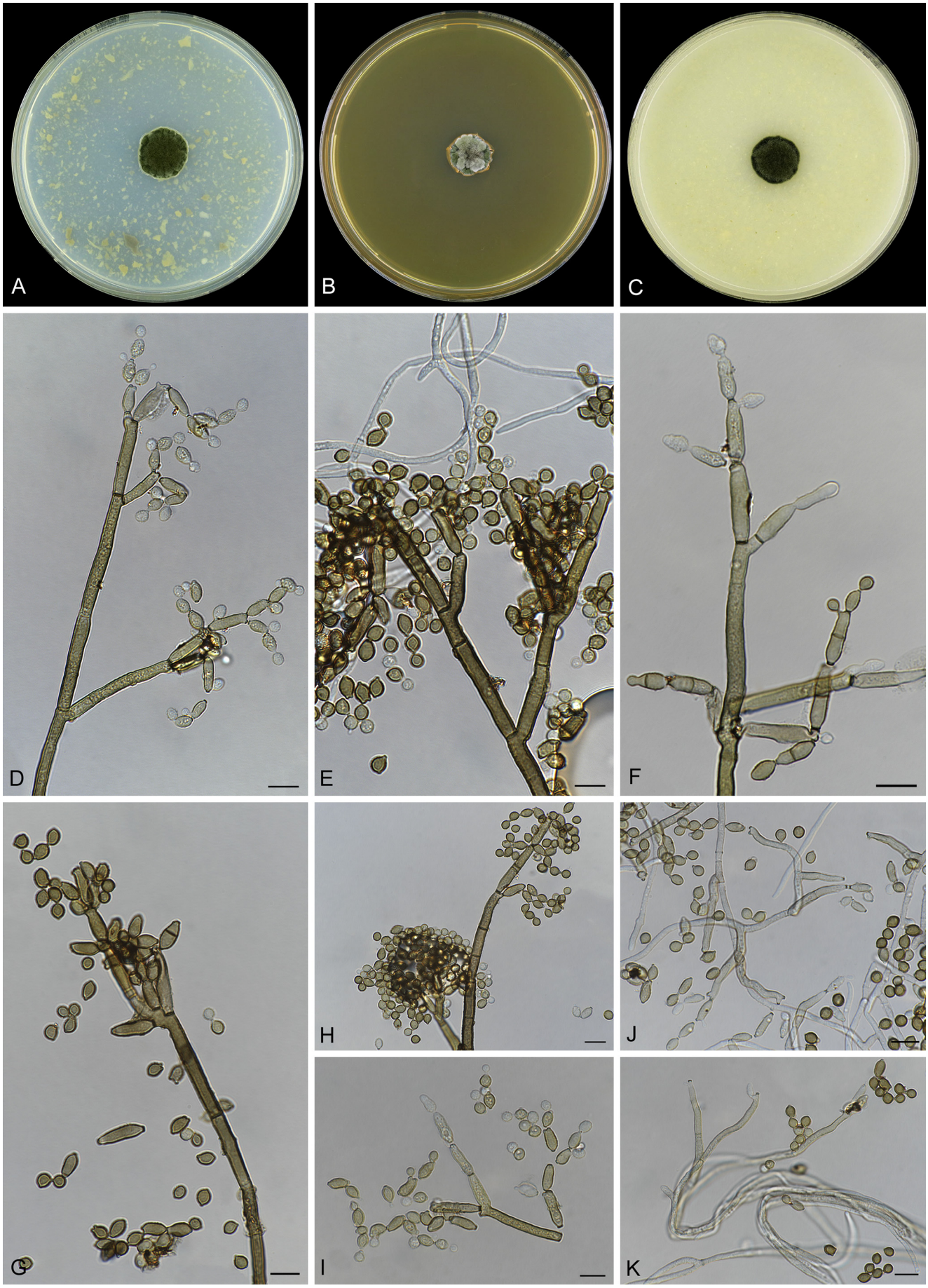

Fig. 25. *Cladosporium neolangeronii* (CBS 797.97). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Macronematous conidiophores and conidia. **I, K.** Micronematous conidiophores and conidia. **J.** Ramoconidium and conidia. Scale bars = 10 µm.

Mycelium loosely branched, filiform or narrowly cylindrical, hyphae 1.5–5(−6) µm wide, septate, sometimes constricted and swollen, subhyaline, pale to medium olivaceous brown, smooth or almost so or minutely verruculose, walls unthickened or only slightly thickened, occasionally forming ropes or stromatic hyphal aggregations composed of swollen hyphal cells. *Conidiophores* mainly macronematous and micronematous, arising terminally or laterally from hyphae, solitary, in pairs of two or in small groups of 3–4, filiform to subcylindrical or cylindrical-oblong, 20–440(−640) × (2–)2.5–4(−5) µm, sometimes wider at the base and attenuated and paler towards the apex, neither geniculate nor nodulose, unbranched or branched, once or several times, branchlets sometimes quite long, up to 100 µm or even longer, pluriseptate, not constricted, pale olivaceous to medium olivaceous brown, smooth or almost so or minutely verruculose especially towards the apex, walls unthickened or slightly to distinctly thick-walled, sometimes up to 1 µm thick. *Conidiogenous cells* integrated, terminal and intercalary, cylindrical-oblong, 10–60 µm long, with 1–5 loci at the apex, in intercalary cells mostly a single locus situated on small lateral prolongations or subdenticulate just below a septum, loci 1–2(−2.5) µm diam, somewhat thickened and darkened; often seceding at septa and forming ramoconidia. *Ramoconidia* frequently formed, cylindrical, 35–52 × (2−)3−4 µm, 0–1-septate, smooth or almost so or irregularly minutely verruculose, base truncate, 2–3 µm wide, slightly darkened. *Conidia* catenate, numerous, in branched chains, branching in all directions or dichotomously, with 1−5(−6) conidia in the terminal unbranched part of the chain; *small terminal conidia* globose, subglobose, obovoid, occasionally subrostrate or rostrate at the base, 2.5–5 × (2–)3−4(−4.5) µm (av. ± SD: 4.0 ± 0.6 × 3.3 ± 0.5), aseptate, *intercalary conidia* subglobose, ovoid, limoniform or ellipsoid, 4.5–11(–15) × (2−)3–4 µm (av. ± SD: 7.7 ± 2.9 × 3.6 ± 0.5), usually aseptate, sometimes irregular in shape due to lateral hila, 1–3 distal hila, sometimes subrostrate or rostrate towards hila, small terminal and intercalary conidia medium olivaceous brown, loosely and irregularly verruculose or verrucose, young conidia paler; *secondary ramoconidia* ellipsoid to subcylindrical or cylindrical, (6–)11–25(–35) × (2.5–)3−4(−5) µm (av. ± SD: 19.7 ± 6.6 × 3.4 ± 0.6), 0–1(−3)-septate, pale or medium olivaceous brown, surface ornamentation often not as prominent as in terminal and intercalary conidia, almost smooth, loosely minutely verruculose or irregularly rough-walled, walls somewhat thickened, slightly attenuated toward the base, with (1–)2–4(–5) distal hila, hila conspicuous, subdenticulate, 0.5–2(−2.5) µm diam, somewhat thickened and darkened-refractive; microcyclic conidiogenesis occasionally occurring.

Culture characteristics: Colonies on PDA attaining 12–23 mm diam after 14 d at 25 °C, iron-grey or olivaceous black, pale olivaceous grey or olivaceous grey due to aerial mycelium, reverse olivaceous black, velvety or powdery, margin narrow, white, aerial mycelium loose, diffuse to denser, floccose, growth low convex to convex with elevated colony centre, radially furrowed. Colonies on MEA reaching 7–19 mm diam after 14 d at 25 °C, grey olivaceous, olivaceous grey and olivaceous due to abundant sporulation, in colony centre smoke-grey due to dense aerial mycelium, glaucous-grey at margins, reverse iron-grey, floccose or fluffy, margins narrow, white, growth low convex or convex, radially furrowed and folded in colony centre. Colonies on OA attaining 10–20 mm diam after 14 d at 25 °C, olivaceous grey and iron-grey, reverse leaden-grey, velvety-floccose, aerial mycelium loose to dense, especially in colony centre, growth flat. Sporulation profuse on all media, on PDA and MEA sometimes prominent exudates formed.

Substrate and distribution: Isolated from indoor environments and from a mortar of Muro Farnesiano; Europe (Italy, The Netherlands), North America (USA).

Additional materials examined: **Italy**, Parma, isol. from mortar of Muro Farnesiano, coll. by C. Urzi, Dept. Sci. Microbiol. Gen. Mol., Univ. of Messina, Italy, No. MC 783, CBS 109868. **The Netherlands**, wall in a storage room of antiquities with mold growth, J. Houbraken, DTO 162-A4. **USA**, Delaware, isol. from indoor air storage sample, pineapple room, Jun. 2012, Ž. Jurjević, EMSL 1682 = CPC 22236; Minnesota, isol. from indoor air sample, Aug. 2012, Ž. Jurjević, EMSL 1724, 1725 = CPC 22266, 22267; isol. from outside air sample, Aug. 2012, Ž. Jurjević, EMSL 1717 = CPC 22262, 22263; New Jersey, Chatman, isol. from indoor air sample, Oct. 2012, Ž. Jurjević, EMSL 1810 = CPC 22314.

Notes: *Cladosporium neolangeronii* (Fig. 3, clade 10) is both morphologically as well as phylogenetically closely related to *C. langeronii* (Fig. 3, clade 13) and *C. psychrotolerans* (Fig. 3, clade 12). *Cladosporium psychrotolerans* differs in having paler and narrower, smooth or minutely verruculose conidia; and *C. langeronii* has lower growth rates (2.5–4.5, 1.5–7 and 1–5.5 mm on PDA, OA and MEA) and shorter ramoconidia (10–22(–42) µm long) (Zalar *et al.* 2007).

Cladosporium parahalotolerans Bensch & Samson, **sp. nov.** MycoBank MB822224. Fig. 26.

Etymology: Name refers to its morphological and phylogenetic similarity with *C. halotolerans*.

Holotype: **The Netherlands**, Gilze, swab sample in an apartment, J. Houbraken, CBS H-23255. *Ex-type culture*: CBS 139585 = DTO 161-D3.

Diagnosis: Differs from *C. halotolerans* in having distinctly wider conidia and less densely septate conidiophores.

Mycelium internal and superficial, hyphae sparingly branched, filiform or narrowly cylindrical-oblong, 1−4 µm wide, septate, subhyaline or pale olivaceous brown, almost smooth or minutely verruculose, sometimes forming ropes. *Conidiophores* macro-, semimacro- and micronematous, arising terminally or laterally from hyphae, filiform or narrowly cylindrical-oblong, unbranched or branched, 5−130 × 2−3.5(−4) µm, 1−7-septate, septa often darkened where ramoconidia secede, but not constricted, subhyaline, pale olivaceous up to pale medium olivaceous brown, smooth or almost so. *Conidiogenous cells* integrated, terminal and intercalary, in micronematous conidiophores usually reduced to conidiogenous cell, 5−35 µm long, with 2−4 loci at the uppermost apex or in intercalary cells 1−2 loci situated on a short peg-like lateral outgrowth just below a septum, loci subdenticulate, 1−1.5 µm diam. *Ramoconidia* subcylindrical or cylindrical, 24−37 × 2.5−3.5(−4) µm, 0−1(−3)-septate, with 2−4 distal scars, non-cladosporioid base about (2−)2.5−3 µm wide. *Conidia* catenate, in branched chains, 1−3(−6) conidia in the terminal unbranched part of the conidial chain, *small terminal conidia* sphaerical, 3−5 × 3.5−4 µm (av. ± SD: 3.8 ± 0.4 × 3.7 ± 0.3), *intercalary conidia* sphaerical or ovoid 4.5−9(−11) × (2.5−)3.5−4.5(−5) µm (av. ± SD: 6.4 ± 1.6 × 4.0 ± 0.4), pale olivaceous to often medium olivaceous brown, spore masses appear even darker, often distinctly darker than secondary ramoconidia, ramoconidia and conidiophores, minutely verruculose or verruculose, not attenuated towards apex and base, *secondary ramoconidia* ellipsoid or subcylindrical, (7−)8.5−23(−30) × (2.5−)3−4(−4.5) µm (av. ± SD: 16.9 ± 7.0 × 3.4 ± 0.5), 0−1(−3)-septate,

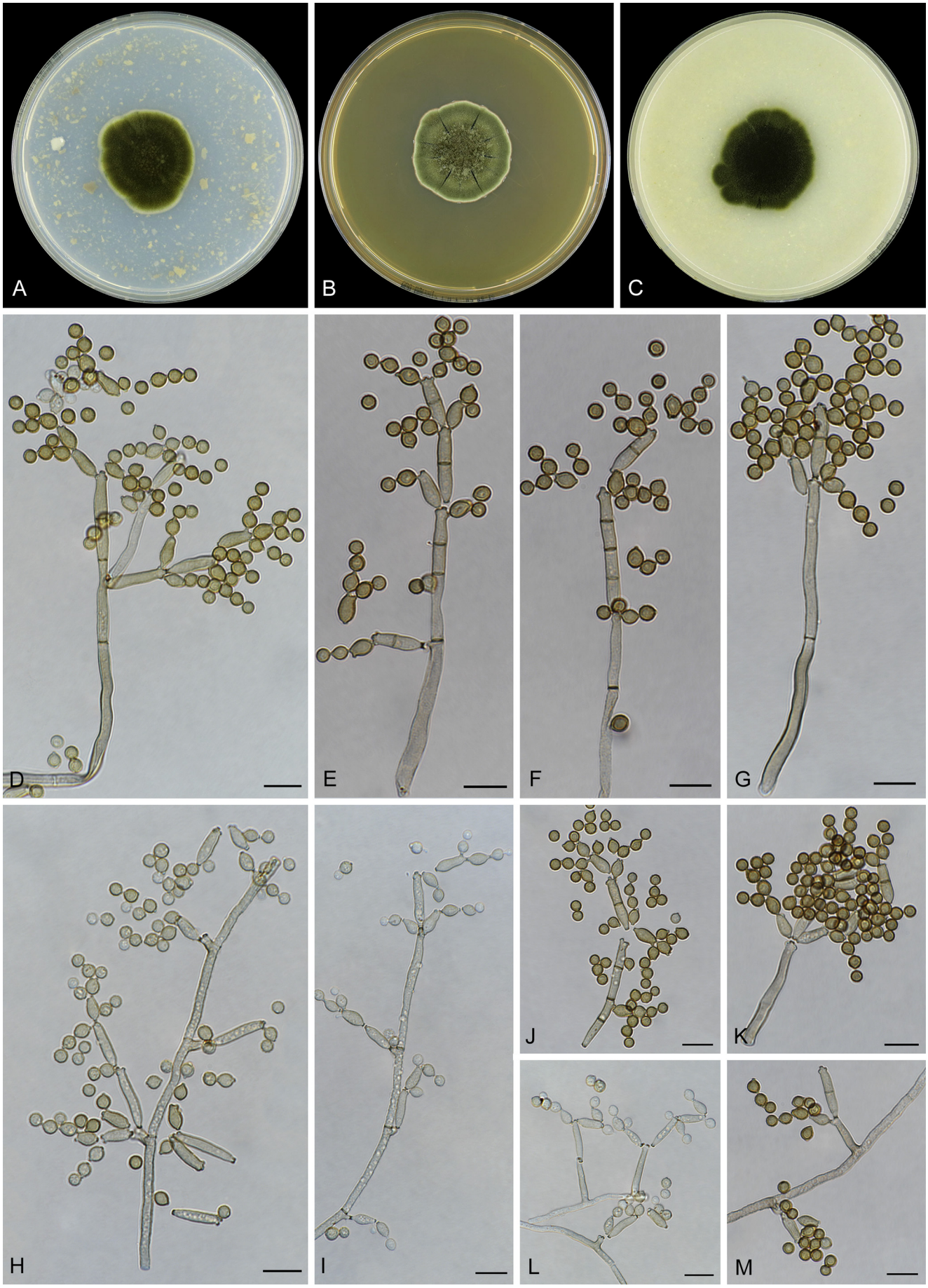

Fig. 26. *Cladosporium parahalotolerans* (CBS 139585). **A–C.** Colonies on PDA, MEA and OA. **D–I.** Conidiophores and conidial chains. **J–K.** Ramoconidium and conidial chains. **L–M.** Micronematous conidiophores and conidia. Scale bars = 10 µm.

septa often appear somewhat darkened, pale olivaceous or pale medium olivaceous brown, smooth or almost so, hila protuberant, subdenticulate, 0.5−1.5 µm diam; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on PDA attaining 27−40 mm diam after 14 d at 25 °C, olivaceous or olivaceous grey, reverse olivaceous grey to leaden-grey or olivaceous black, velvety, powdery to felty-woolly, margins white, aerial mycelium diffuse or floccose. Colonies on MEA attaining 18−40 mm diam after 14 d at 25 °C, smoke-grey, pale olivaceous grey or olivaceous grey, sometimes glaucous-grey at margin, reverse olivaceous grey, powdery to felty-woolly, margin colourless to white, glabrous or feathery, radially furrowed, aerial mycelium felty, abundant. Colonies on OA reaching 29−40 mm diam after 14 d at 25 °C, grey olivaceous, olivaceous or olivaceous black, reverse olivaceous or olivaceous grey, velvety or floccose, margin narrow, somewhat feathery, aerial mycelium sparse, diffuse or abundantly formed, high, dense. Without prominent exudates but sporulation profuse on all media.

Substrate and distribution: Indoor environments; Asia (China), Europe (The Netherlands), North America (Mexico, USA).

Additional materials examined: **China**, isol. from indoor air, DTO 323-B8, DTO 323-C1, DTO 323-C8, DTO 323-F4, DTO 323-H2, DTO 323-H3, DTO 324-A7, DTO 324-B7. **Mexico**, isol. from house dust, DTO 305-F7 = AA07MX-953, DTO 305-F8 = AA07MX-935, DTO 305-I5 = AA03MX-750, DTO 306-C1 = AA07MX-836, DTO 306-E4 = AA02MX-573, DTO 307-H4; AA03MX-612. **The Netherlands**, Gilze, swab sample in apartment, J. Houbraken, DTO 161-D6. **USA**, Maine, isol. from indoor air sample, hotel room, Sep. 2012, Ž. Jurjević, EMSL 1784 = CPC 22280; New Hamshire, Alstead, isol. from indoor air sample, family room, Dec. 2012, Ž. Jurjević, EMSL 1843 = CPC 22330; New Jersey, Rockaway, isol. from indoor air sample, Dec. 2012, Ž. Jurjević, EMSL 1849 = CPC 22336; New York, New York, isol. from indoor air sample, 18th floor, Dec. 2012, Ž. Jurjević, EMSL 1855 = CPC 22342; isol. from indoor air sample, hospital, Jan. 2013, Ž. Jurjević, EMSL 1886, 1889 = CPC 22373, 22376.

Notes: *Cladosporium parahalotolerans* (Fig. 3, clade 22) is morphologically and phylogenetically related to *C. halotolerans* (Fig. 3, clade 23) and *C. domesticum* (Fig. 3, clade 21). However, the new species is genetically well differentiated (478/478 (100 %), 256/291 (88 %) and 163/165 (99 %) sequence similarity for ITS, *tef1* and *act* to *C. halotolerans*, 545/556 (98 %), 245/295 (83 %) and 143/168 (85 %) sequence similarity for ITS, *tef1* and *act* to *C. domesticum* respectively when ex-type sequences are compared) and produces distinctly wider conidia and less densely septate conidiophores.

Cladosporium parasubtilissimum Bensch & Samson, **sp. nov.** MycoBank MB822225. Fig. 27.

Etymology: Name refers to the morphological similarity with *C. subtilissimum*.

Holotype: **USA**, New Mexico, Albuquerque, isol. from indoor air sample, bathroom, Nov. 2012, Ž. Jurjević, CBS H-23256. *Ex-type culture*: CBS 143361 = CPC 22332 = EMSL 1845.

Diagnosis: Differs from *C. subtilissimum* by having shorter and slightly narrower conidia formed in shorter chains with 1−4(−5) conidia in the unbranched terminal part of the chain.

Mycelium internal and superficial, hyphae usually unbranched, filiform or narrowly cylindrical-oblong, 1.5−4 µm wide, without swellings and constrictions, septate, septa sometimes darkened, subhyaline or pale olivaceous, verruculose, verrucose or irregularly rough-walled, walls unthickened. *Conidiophores* macro- and micronematous, filiform or narrowly cylindrical-oblong, unbranched or once branched, non-nodulose, sometimes once geniculate, macronematous conidiophores 15−200 × 2.5−4 µm, 0−6-septate, micronematous conidiophores 9−60 × 2−2.5 µm, 0−4-septate, pale or medium olivaceous brown, smooth or almost so, sometimes asperulate, walls unthickened or slightly thick-walled. *Conidiogenous cells* terminally and intercalary, cylindrical-oblong, occasionally with a single geniculation, 9−25 µm long, with 2−4(−5) loci crowded at the uppermost apex, sometimes with 1−2(−3) additional loci at a lower level, sometimes situated on lateral prolongations at the apex, loci conspicuous, subdenticulate, 1−2 µm diam, thickened and darkened. *Ramoconidia* rarely formed, up to 34 µm long, base about 2.5 µm wide. *Conidia* numerous, catenate, formed in branched chains, branching in all directions, 1−4(−5) conidia in the unbranched terminal part of the conidial chain, *small terminal conidia* obovoid or ellipsoid, sometimes subglobose, 3−4.5(−5.5) × (2−)2.5−3 µm (av. ± SD: 4.0 ± 0.7 × 2.5 ± 0.3), apex rounded or attenuated towards apex and base, *intercalary conidia* ellipsoid-ovoid, limoniform, 5.5−12(−13.5) × (2.5−)3−4 µm (av. ± SD: 7.8 ± 2.4 × 3.2 ± 0.4), aseptate, with (1−)2−3(−4) distal hila, about 0.5−1 µm diam, *secondary ramoconidia* ellipsoid or subcylindrical, (6.5−)9−26 × 3−4(−5) µm (av. ± SD: 15.4 ± 5.2 × 3.7 ± 0.5), 0−1(−2)-septate, with (1−)2−4 distal hila, sometimes even up to eight distal hila crowded at the distal end and then conidia somewhat irregular in shape due to these clusters of scars, intercalary conidia then formed in dense whirls, hila 1−2 µm diam, pale to medium olivaceous brown, minutely verruculose or verruculose, walls unthickened, hila conspicuous, microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA attaining 48−57 mm diam after 14 d at 25 °C, olivaceous grey or pale olivaceous grey, reverse leaden-grey and iron-grey, velvety or fluffy-felty, margin regular to undulate, somewhat feathery, radially furrowed, aerial mycelium loose, diffuse to dense, low to high, fluffy-felty, forming pale olivaceous grey patches, sporulation profuse. Colonies on MEA reaching up to 50 mm diam after 14 d at 25 °C, olivaceous grey, whitish, smoke grey or pale olivaceous grey due to the fluffy-felty aerial mycelium mainly formed in colony centre, reverse iron-grey or black, margin narrow, white, feathery, radially furrowed, growth low convex with slightly elevated colony centre, sporulation profuse. Colonies on OA attaining 45−65 mm diam after 14 d at 25 °C, olivaceous grey or olivaceous due to abundant sporulation, reverse leaden-grey and olivaceous grey, velvety or fluffy, margin regular, white, aerial mycelium loose, diffuse or forming a few smoke-grey high and fluffy spots. Sporulation profuse on all media but no prominent exudates formed.

Substrate and distribution: Indoor air; North America (USA).

Additional material examined: **USA**, California, Gerber, isol. from indoor air sample, recreational vehicle, Jan. 2013, Ž. Jurjević, EMSL 1924 = CPC 22396.

Notes: Both phylogenetically and morphologically this new species (Fig. 2, clade 26) is closely related to *C. subtilissimum* (Fig. 2, clade 25) but the latter species can be distinguished by its longer and slightly wider conidia formed in long chains with up to 12 or even more conidia (Bensch *et al.* 2012).

Cladosporium perangustum Bensch *et al.*, Stud. Mycol. 67: 65. 2010. MycoBank MB517085. Fig. 28.

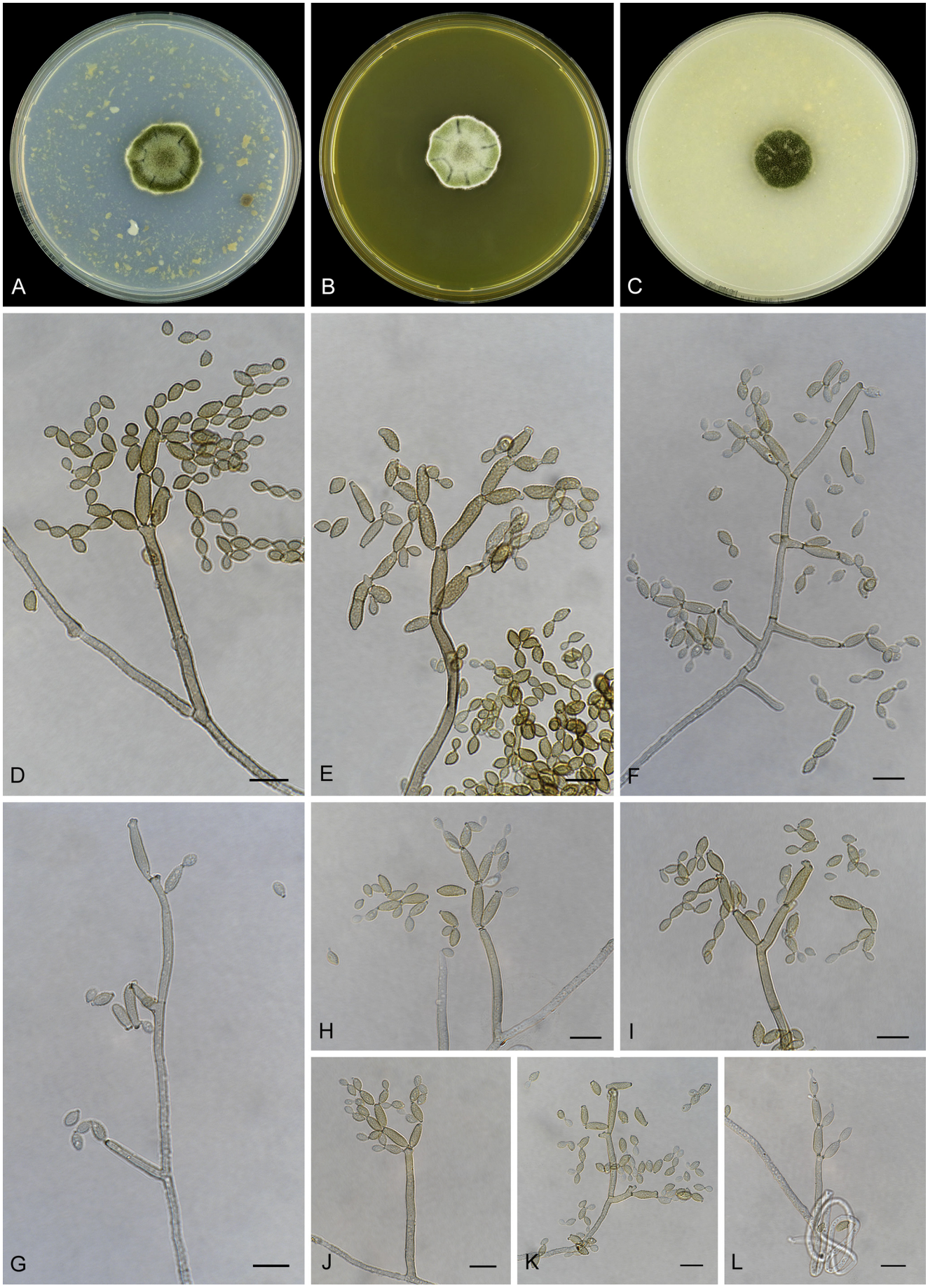

Fig. 27. *Cladosporium parasubtilissimum* (CBS 143361). **A–C.** Colonies on PDA, MEA and OA. **D–L.** Macro- and micronematous conidiophores and conidial chains. Scale bars = 10 µm.

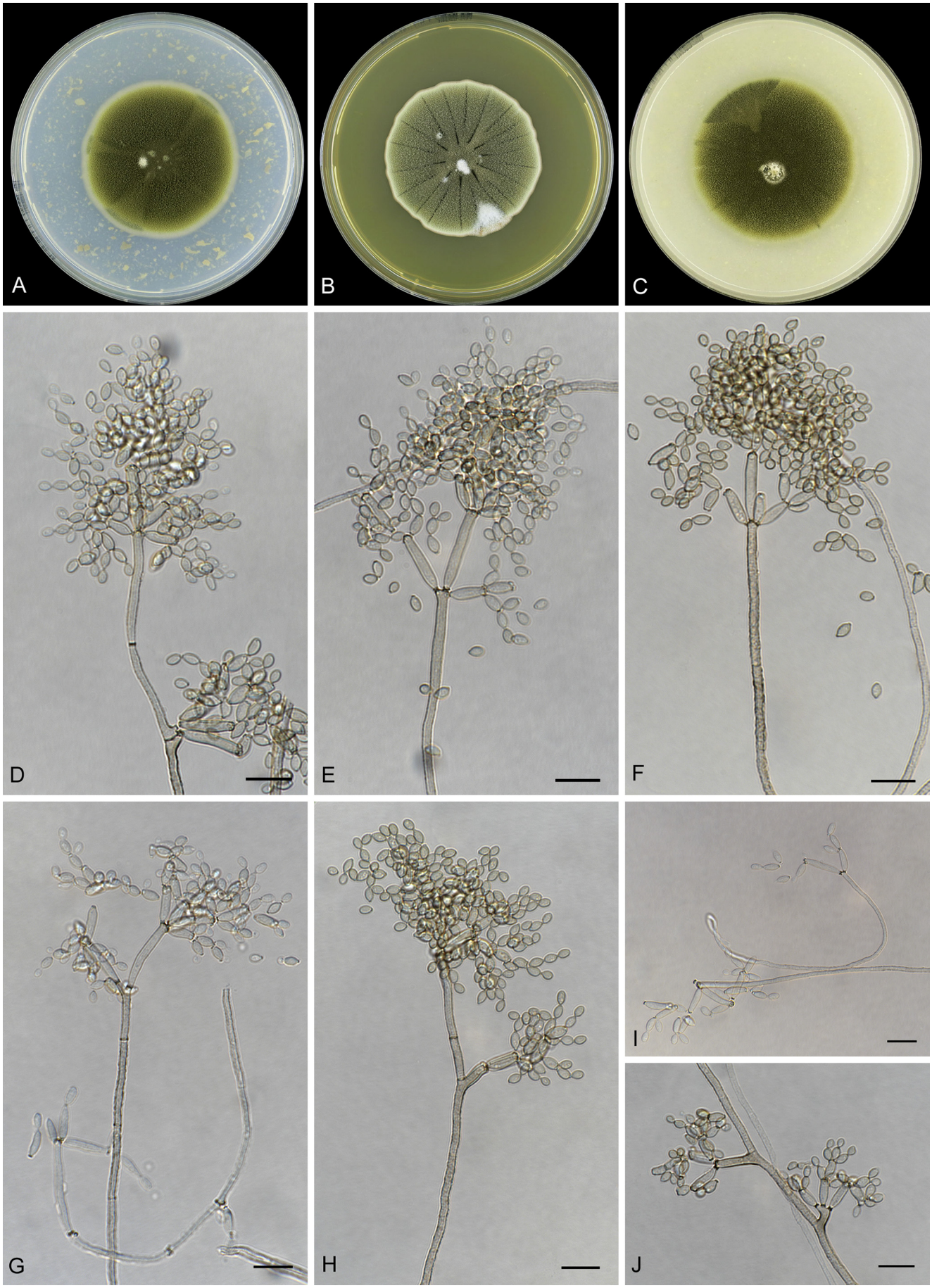

Fig. 28. *Cladosporium perangustum* (DTO 127-E1). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Macronematous conidiophores and conidial chains. **I–J.** Micronematous conidiophores and conidia. Scale bars = 10 µm.

Holotype: **South Africa**, Pretoria, Walter Sisulu park, isol. from *Cussonia* sp. (*Araliaceae*), 20 Feb. 2007, P.W. Crous, CBS H-20451. *Ex-type culture*: CBS 125996 = CPC 13815.

Lit.: Bensch *et al.* (2012: 208−210; 2015: 57), Jang *et al.* (2013), Sandoval-Denis *et al.* (2016).
Ill.: Bensch *et al.* (2010: 66−67, figs 54−56; 2012: 209−210, figs 233−235), Jang *et al.* (2013: 23, figs 1−2).

Mycelium immersed and superficial; hyphae filiform to narrowly cylindrical-oblong, loosely branched, (0.5−)1−4 µm wide, septate, sometimes irregular due to intercalary swellings and constrictions, subhyaline to pale olivaceous or pale olivaceous brown, smooth to usually verruculose or irregularly rough-walled, walls unthickened or almost so, sometimes swollen at the base of conidiophores, sometimes forming dense ropes. *Conidiophores* solitary, sometimes in pairs, macro-, semimacro- or micronematous, arising terminally and laterally from hyphae or from swollen hyphal cells, erect, straight or slightly flexuous, filiform to narrowly cylindrical-oblong, usually neither geniculate nor nodulose, sometimes geniculate-sinuous or unilaterally slightly swollen at the apex, unbranched, occasionally branched, once or several times, branches short, peg-like or up to 30 µm long, conidiophores (8−)12−130(−150) × (1.5−)2−3.5(−4) µm, 0−6-septate, usually not constricted at septa, occasionally septa darkened, subhyaline, pale olivaceous or pale olivaceous brown, more or less rough-walled, especially towards the base of conidiophores, asperulate-verruculose, at the apex smooth or almost so, walls unthickened or slightly thickened, about 0.5 µm wide, sometimes slightly attenuated towards the apex, at the base sometimes up to 4.5 µm wide. *Conidiogenous cells* integrated, mainly terminal, sometimes also intercalary, narrowly cylindrical-oblong, sometimes geniculate-sinuous, in intercalary cells loci situated on small peg-like lateral prolongations or just below the septum, 7−40 µm long, with 1−4(−5) apically crowded loci, forming clusters of pronounced scars, conspicuous, subdenticulate to denticulate, 0.8−1.5 µm diam, thickened and darkened-refractive. *Ramoconidia* cylindrical-oblong, 25−45 × 2.5−3(−4) µm, 0−1(−2)-septate, base truncate, 2−2.5(−4) µm wide, sometimes slightly darkened or refractive. *Conidia* numerous, catenate, in branched chains, branching in all directions, 1−4 conidia in the terminal unbranched part of the chain, *small terminal conidia* globose, subglobose or ovoid to obovoid, 2−4(−5) × (1.5−)2−2.5 µm (av. ± SD: 3.2 ± 0.7 × 2.1 ± 0.2), apex broadly rounded or slightly attenuated, *intercalary conidia* ovoid, limoniform to ellipsoid, somewhat fusiform or subcylindrical, 4−15.5(−18) × 2−3(−3.5) µm (av. ± SD: 8.6 ± 3.8 × 2.5 ± 0.4), 0(−1)-septate, attenuated towards apex and base, with 1−3(−5) distal hila, *secondary ramoconidia* narrowly ellipsoid to cylindrical- oblong, 6−33(−40) × 2−3(−3.5) µm (av. ± SD: 17.3 ± 7.3 × 2.5 ± 0.4), 0−1(−3)-septate, septum median or often somewhat in the upper half, with 2−4(−7) distal hila, pale olivaceous brown, smooth or almost so to finely verruculose (LM), under SEM smooth or surface with somewhat irregularly reticulate structure or embossed stripes probably caused by diminishing turgor and shrivelling of tender conidia, thin-walled, hila conspicuous, subdenticulate to denticulate, (0.8−)1−1.5 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis occasionally occurring.

Culture characteristics: Colonies on PDA attaining 33−76 mm diam after 14 d at 25 °C, grey olivaceous to olivaceous, olivaceous grey or iron-grey, sometimes with patches of smoke-grey or pale greenish grey, reverse olivaceous grey, iron-grey or olivaceous black, sometimes releasing an olivaceous buff or orange to luteous soluble pigment into the agar, velvety, fluffy, floccose or powdery, margins glabrous to feathery, whitish, olivaceous buff or pale luteous due to the pigment, broad, regular or somewhat undulate, aerial mycelium diffuse to loosely floccose or felty, growth effuse, usually without prominent exudates, occasionally numerous small to large prominent exudates formed, sporulation profuse. Colonies on MEA reaching 40−72 mm diam after 14 d at 25 °C, pale olivaceous grey to glaucous grey or grey olivaceous, whitish to smoke-grey due to aerial mycelium, reverse olivaceous grey to iron-grey, occasionally releasing an orange soluble pigment into the agar, velvety to floccose, margins white, narrow, regular to undulate, glabrous to somewhat feathery, aerial mycelium abundantly formed, covering most parts of colony surface, loosely to densely floccose or felty, white to pale olivaceous grey or smoke-grey, growth effuse with sometimes elevated colony centre, radially furrowed, sometimes few small prominent exudates formed, sporulation profuse. Colonies on OA 40−75 mm diam after 14 d at 25 °C, whitish to smoke-grey and pale olivaceous grey or grey olivaceous, reverse pale olivaceous grey, pale greenish grey to olivaceous grey, leaden-grey or sometimes amber-coloured due to the pigment released into the agar, velvety or fluffy to felty-floccose, margins white or greenish olivaceous, glabrous, regular, aerial mycelium abundant, covering large parts of the colony surface, dense, low to high, white, growth effuse, sometimes few prominent exudates formed, sporulating.

Substrate and distribution: On plant material, ascomycetes and isolated from indoor environments; Africa (South Africa), Asia (China, Korea), Australasia (New Zealand), Europe (Germany), North America (USA).

Additional materials examined: **China**, isol. from indoor air, DTO 323-E4, DTO 323-E8, DTO 323-E9, DTO 324-A2, DTO 324-A6, DTO 324-D1. **Germany**, Essen, botanical garden, 51.45, 7.0167, isol. from *Morus rubra* (*Moraceae*), 2005, N. Ale-Agha, CPC 12216. **New Zealand**, Auckland, Auckland University campus, isol. from leaves of *Oncoba spinosa* (*Salicaceae*), Sep. 2004, C.F. Hill, Hill 1076-1 = CPC 11663. **South Africa**, Pretoria, Walter Sisulu park, isol. from *Protea caffra* (ascospore isolate) (*Proteaceae*), 2 Jan. 2007, P.W. Crous, CPC 13730, 13774; isol. from *Teratosphaeria maculiformis* (*Teratosphaeriaceae*) on *Protea caffra*, 2 Jan. 2007, P.W. Crous, CPC 13727; Western Cape Province, Jonkershoek Nature Reserve, isol. from *Teratosphaeria fibrillosa* (*Teratosphaeriaceae*), 30 Mar. 2007, P.W. Crous, CPC 13870; Western Cape, Betties Bay, Harold Porter National Park, isol. from *Protea cynaroides* (*Proteaceae*), 4 Dec. 2008, L. Mostert, CPC 15192. **USA**, California, San Diego, isol. from indoor air sample, bedroom closet, Dec. 2012, Ž. Jurjević, EMSL 1844 = CPC 22331; Thousand Oaks, isol. from indoor air sample, bedroom, Jan. 2013, Ž. Jurjević, EMSL 1891 = CPC 22378; Connecticut, Mancester, isol. from indoor air, library, Nov. 2012, Ž. Jurjević, EMSL 1835 = CPC 22329; Georgia, Tucker, isol. from air sample, bakery, DTO 127-E1 = AR368, DTO 127-E2 = AR371; Louisiana, Baton Rouge, isol. from *Magnolia* sp. (*Magnoliaceae*), 8 Sep. 2007, P.W. Crous, CPC 14247; Maine, Westbrook, isol. from indoor air sample, Nov. 2012, Ž. Jurjević, EMSL 1833 = CPC 22327, CPC 22328; New York, New York, isol. from indoor air sample, hospital, Jan. 2013, Ž. Jurjević, EMSL 1888 = CPC 22375; Pennsylvania, Chaddes Ford, isol. from indoor air sample, Oct. 2012, Ž. Jurjević, EMSL 1781 = CPC 22297; Washington, Seattle, University of Washington campus, isol. from chasmothecia of *Phyllactinia guttata* (*Erysiphales*) on leaves of *Corylus avellana* (*Betulaceae*), 16 Sep. 2004, D. Glawe (CBS 126365 = CPC 11820, CPC 11815, 11819, 11821, 11831).

Notes: Bensch *et al.* (2010, 2012) already discussed the phylogenetic variability within the subclades of *C. perangustum* (Fig. 1, clade 4, previously also including clades 2 and 3) but based on the quite conserved morphology refrained from splitting this species based on the sampling available at that stage. However, Sandoval-Denis *et al.* (2016) introduced two additional species, *C. angulosum* (Fig. 1, clade 2) and *C. xanthochromaticum* (Fig. 1, clade 3) for two

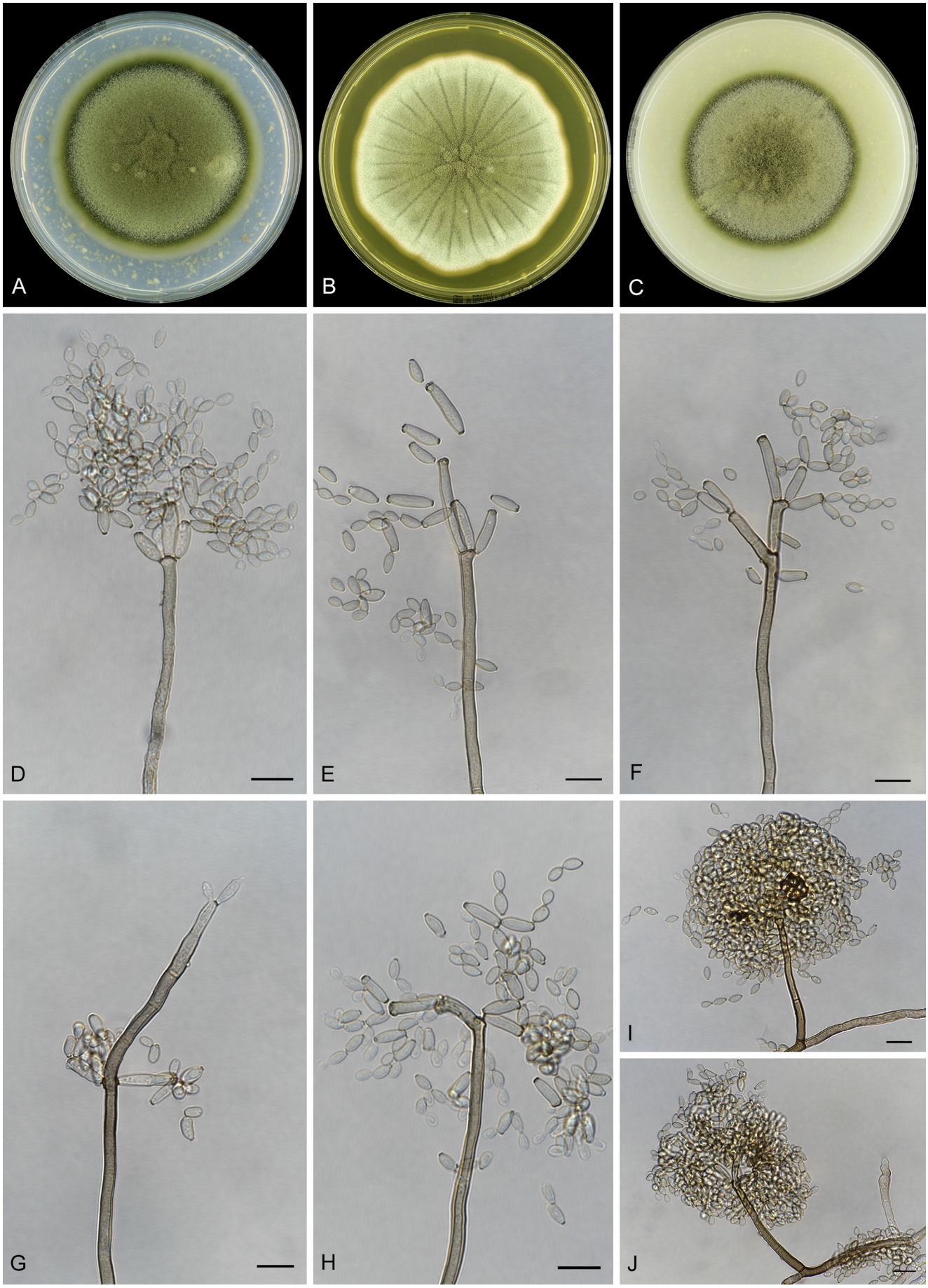

Fig. 29. *Cladosporium pseudocladosporioides* (DTO 151-A4). **A–C.** Colonies on PDA, MEA and OA. **D–J.** Conidiophores and conidial chains. Scale bars = 10 µm.

of the subclades of *C. perangustum*. *Cladosporium angulosum* differs in having slightly shorter intercalary conidia and secondary ramoconidia. Conidiophores described as typical for *C. angulosum* in being frequently branched in a 90° angle (Sandoval-Denis *et al.* 2016) are sometimes also formed in strains of *C. perangustum* (see Fig. 28). *Cladosporium xanthochromaticum* has slightly longer and wider secondary ramoconidia and usually smooth conidiophores; its ramoconidia are slightly wider but not shorter as in *C. perangustum*. Due to high similarity and overlapping characters within these three species an identification based on morphology alone will be difficult. Therefore, a molecular approach is highly recommended for a correct identification.

Cladosporium pseudocladosporioides Bensch *et al.*, Stud. Mycol. 67: 71. 2010. MycoBank MB517087. Fig. 29.

Holotype: **The Netherlands**, Zwolle, isol. from outside air, 7 Jan. 2007, M. Meijer, CBS H-20445. *Ex-type cultures*: CBS 125993 = CPC 14189, CPC 14193.

Lit.: Bensch *et al.* (2012: 226–228).
Ill.: Bensch *et al.* (2010: 71–72, figs 60–61; 2012: 226–227, figs 257–258).

Mycelium immersed and superficial; hyphae unbranched or sparingly branched, (0.5–)1–4 µm wide, septate, sometimes constricted at septa, especially in wider ones, subhyaline to pale olivaceous or pale olivaceous brown, smooth or almost so, walls sometimes slightly thickened, about 0.5 µm wide, sometimes irregular in outline due to swellings and constrictions, sometimes forming small ropes of few hyphae, sometimes cells swollen, up to 6.5 µm wide, fertile hyphae minutely verruculose, mainly at the base of conidiophores. *Conidiophores* macronematous, sometimes also micronematous, solitary or in small loose groups, arising terminally and laterally from hyphae or swollen hyphal cells, erect, straight to slightly flexuous, cylindrical-oblong, non-nodulose, sometimes once geniculate-sinuous or slightly swollen at the apex, unbranched or branched once or twice, occasionally three times, branches often only as short denticle-like lateral outgrowths just below a septum, 15–155 µm long, 2–4 µm, sometimes attenuated towards apex, 0–5-septate, sometimes slightly constricted at septa, pale to pale medium olivaceous brown, sometimes paler towards the apex, smooth or almost so, at the base asperulate or finely verruculose like fertile hyphae, walls slightly thickened, about 0.5 µm wide or unthickened; micronematous conidiophores filiform, narrower, not attenuated, about 1.8 µm wide. *Conidiogenous cells* integrated, terminal, sometimes intercalary, slightly attenuated, narrowly cylindrical-oblong, sometimes once geniculate, non-nodulose, (6.5–)9–33 µm long, with 1–4 loci at the apex, occasionally with up to seven loci crowded at or towards the apex, in intercalary cells loci situated on small lateral peg-like outgrowths, 1–2(–3) loci, conspicuous, subdenticulate, 1–1.5(–1.8) µm diam, somewhat thickened and darkened-refractive. *Ramoconidia* cylindrical-oblong, 19–48 × 3–4 µm, 0–2(–3)-septate, pale olivaceous brown, smooth, base broadly truncate, 2–3 µm wide, unthickened or slightly thickened, sometimes slightly refractive. *Conidia* very numerous, catenate, in branched chains, branching in all directions with 3–6(–9) conidia in the terminal unbranched part of the chain, *small terminal conidia* obovoid, ovoid to limoniform or ellipsoid, sometimes subglobose, 3–5.5 × (1–)1.5–2.5 µm (av. ± SD: 4.1 ± 0.7 × 2.1 ± 0.3), apex rounded or attenuated towards apex and base, *intercalary conidia* ovoid, limoniform to ellipsoid or subcylindrical, 4.5–13(–19) × (1.8–)2–3 µm (av. ± SD: 8.8 ± 3.9 × 2.6 ± 0.3), 0(–1)-septate, slightly attenuated towards apex and base, with 1–4(–5) distal hila, *secondary ramoconidia* ellipsoid-ovoid to subcylindrical or cylindrical-oblong, (6.5–)8–23(–29) × (2–)2.5–3.5(–4) µm (av. ± SD: 16.1 ± 5.1 X 2.9 ± 0.3), 0–1(–2)-septate, septum median or often somewhat in the lower half, pale olivaceous to pale olivaceous brown, smooth or almost so, sometimes slightly rough-walled, walls unthickened, with (1–)2–4(–6) distal hila, conspicuous, subdenticulate, 0.5–1.5(–1.8) µm diam, somewhat thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA attaining 65–78 mm diam after 14 d at 25 °C, olivaceous grey to grey olivaceous, reverse leaden-grey to olivaceous black, felty-floccose, margins regular, glabrous to feathery, grey olivaceous, aerial mycelium felty-floccose, growth effuse to low convex, few small prominent exudates formed, sporulation profuse. Colonies on MEA attaining 52–75 mm diam after 14 d at 25 °C, smoke-grey to dark smoke-grey or grey olivaceous, reverse iron-grey, floccose, margins white, narrow, glabrous to somewhat feathery, aerial mycelium white, floccose, abundant, dense, growth effuse and somewhat radially furrowed, mostly without prominent exudates, sporulation profuse. Colonies on OA reaching 55–73 mm diam after 14 d at 25 °C, olivaceous to grey olivaceous or olivaceous buff, pale olivaceous grey to greenish grey towards margins, reverse pale greenish grey, leaden-grey to iron-grey, floccose, margins colourless, glabrous, regular, aerial mycelium floccose to felty, sometimes covering large parts of colony surface, growth effuse with few prominent exudates, sporulation profuse.

Substrates and distribution: On plant material and fungal fruiting bodies, isolated from air, indoor environments, clinical samples, soil, water and food; widely distributed, Africa (South Africa, Uganda), Asia (China, Indonesia, South Korea), Australasia (Australia, New Zealand), Europe (France, Germany, Italy, Portugal, Romania, Russia, Slovenia, The Netherlands), North America (Canada, USA), South America (Brazil, Chile).

Additional materials examined: **Canada**, isol. from house dust, Health Canada, DTO 307-F3, DTO 307-G9. **China**, isol. from indoor air, DTO 323-D3. **Germany**, isol. from indoor environment, CBS 139575 = DTO 084-F1. **Portugal**, isol. from indoor environment, DTO 151-A4, **The Netherlands**, isol. from outside air, M. Meijer, CBS 125993 = CPC 14189; isol. from a wallpaper from a house, J. Hooiveld, DTO 079-F4. **USA**, Arizona, Tuscon, isol. from indoor air sample, office, Feb. 2013, Ž. Jurjević, EMSL 2014 = CPC 22966; isol. from indoor air sample, hospital, Jan. 2013, Ž. Jurjević, EMSL 1907 = CPC 22392; Florida, Coral Springs, isol. from air sample, car air conditioner, Jun. 2012, Ž. Jurjević, EMSL 1683 = CPC 22237; Georgia, Carrollton, isol. from indoor air sample, office, Jan. 2013, Ž. Jurjević, EMSL 1881 = CPC 22368; New Jersey, Bridgeport, isol. from indoor air sample, bedroom, 2nd floor, Dec. 2012, Ž. Jurjević, EMSL 1864 = CPC 22351; Manasquan, isol. from indoor air sample, living room, Jan. 2013, Ž. Jurjević, EMSL 1904 = CPC 22389; New York, New York, isol. from indoor air sample, 27th floor, Dec. 2012, Ž. Jurjević, EMSL 1853, 1854 = CPC 22340, 22341; Ohio, Columbus, isol. from indoor air sample, bedroom, Dec. 2012, Ž. Jurjević, EMSL 1847 = CPC 22334; Pennsylvania, Chalfont, isol. from indoor air sample, living room, Dec. 2012, Ž. Jurjević, EMSL 1875 = CPC 22362; Rhode Island, North Providence, isol. from indoor air sample, classroom, Jan. 2013, Ž. Jurjević, EMSL 1901 = CPC 22386; Texas, Haltom City, isol. from indoor air sample, bathroom, Jan. 2013, Ž. Jurjević, EMSL 1895 = CPC 22382. Additional isolates are listed in Table 1.

Notes: *Cladosporium pseudocladosporioides* (Fig. 1, clade 56) is a common, widespread saprobic hyphomycete phylogenetically and morphologically very close to *C. cladosporioides* (Fig. 1, clade 66) but clearly distinct by forming a separate lineage in

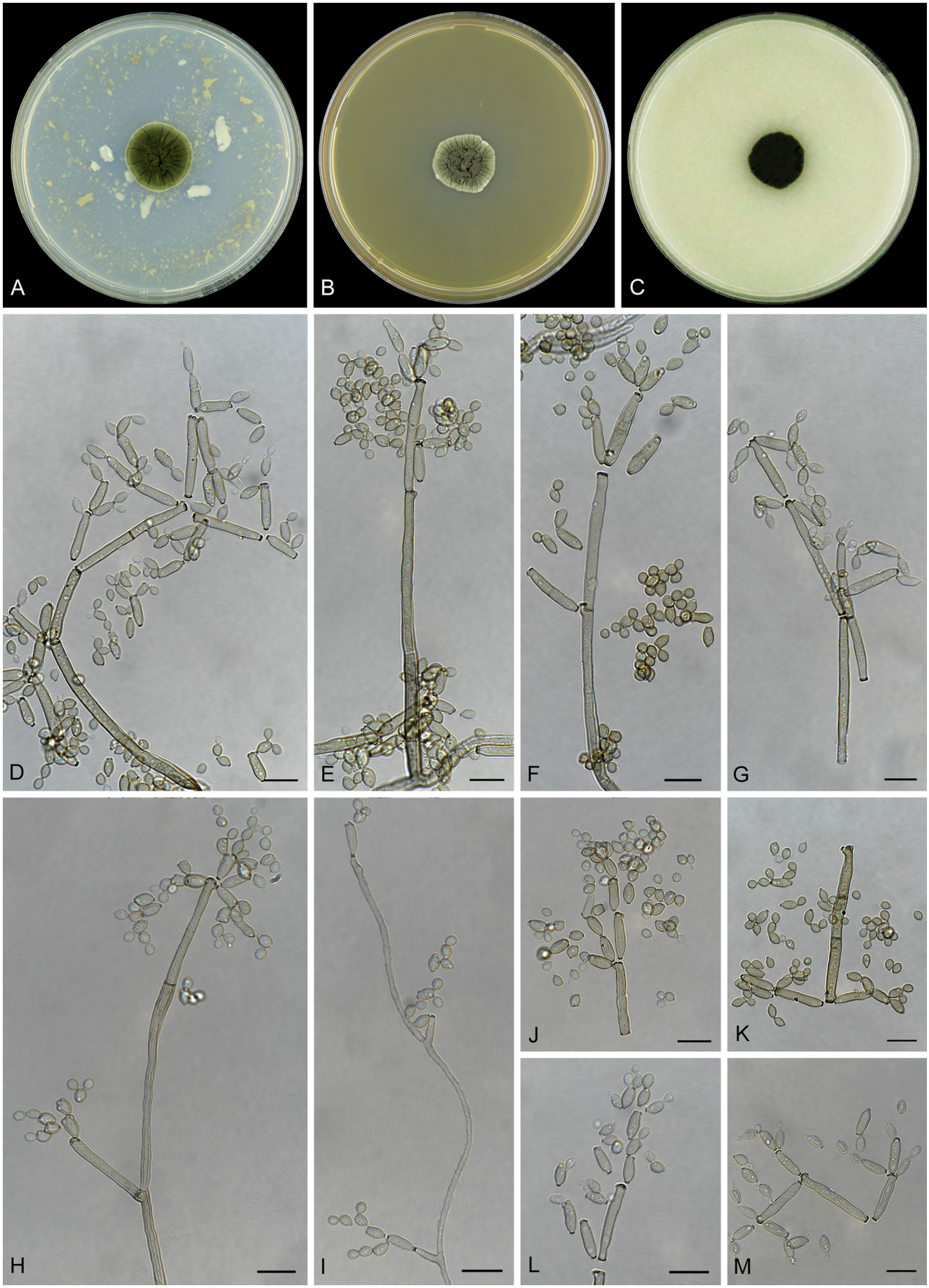

Fig. 30. *Cladosporium psychrotolerans* (DTO 307-H2). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Conidiophores and conidia. **I.** Micronematous conidiophores. **J–L.** Ramoconidia and conidia. **M.** Conidia. Scale bars = 10 µm.

phylogenetic analyses (also see Bensch *et al.* 2010) and by having shorter and somewhat narrower, 0–1(–2)-septate secondary ramoconidia, narrower conidiogenous loci and hila, and hyphae sometimes forming ropes. However, the distinction between the two species only based on morphology is difficult and not always possible with certainty, which is additionally complicated by the internal genetic structure of the *C. pseudocladosporioides* clade, suggesting that it possibly represents a complex containing cryptic species (observed in both the *act* and *tef1* alignments in Bensch *et al.* 2010). Uncertain strains should simply be referred to as *C. cladosporioides s. lat.* (complex). *Cladosporium paracladosporioides* (Fig. 1, lineage 13) is also similar but differs in having wider, 0–3-septate secondary ramoconidia, wider conidiogenous loci and hila and is phylogenetically distinct (see Bensch *et al.* 2010).

Sandoval-Denis *et al.* (2015) reported *C. pseudocladosporioides* as one of the more frequently isolated species from clinical samples in the USA. Within the *C. cladosporioides* complex it proved to be the most common species occurring in indoor environments (this study).

In the present analysis, *Cladosporium crousii* recently described from human bronchoalveolar lavage fluid in the USA (Sandoval-Denis *et al.* 2016), clusters on a long branch within the larger *C. pseudocladosporioides* clade (Fig. 1, clade 56) and is therefore probably conspecific with the latter species. The given description in Sandoval-Denis *et al.* (2016) is very close to that of *C. pseudocladosporioides* but in their analysis the ex-type strain clustered close to but outside that species. This could be an artefact of the phylogenetic analysis due to the much larger sampling of *C. pseudocladosporioides* strains in the present study, as *C. crousii* is 206/238 (87 %) similar on *tef1* and up to 100 % identical on *act* to the closest *C. pseudocladosporioides* sequences included in our phylogeny.

Cladosporium psychrotolerans Zalar *et al.*, Stud. Mycol. 58: 175. 2007. MycoBank MB492428. Fig. 30.

Holotype: **Slovenia**, Sečovlje salterns, isolated from hypersaline water, May 1999, S. Sonjak, CBS H-19730. *Ex-type culture*: EXF-391 = CBS 119412.

Lit.: Bensch *et al.* (2012: 229–230).
Ill.: Zalar *et al.* (2007: 166, fig. 5 e, 176, fig. 11), Bensch *et al.* (2012: 230, fig. 261).

Mycelium partly superficial and partly submerged, with numerous lateral pegs, consistently enveloped in polysaccharide-like material; hyphae unbranched or sparingly branched, 1–3(–5) µm wide, septate, not constricted at septa, pale brown or pale olivaceous brown, almost smooth to verruculose, thin-walled. *Conidiophores* macro- and micronematous, arising terminally and laterally from hyphae, erect or ascending, straight or somewhat flexuous, neither geniculate nor nodulose, cylindrical-oblong, unbranched or branched, once or few times, 20–220 × (2–)3–4(–5) µm, micronematous 1–2 µm wide, septate, not constricted at septa, pale olivaceous brown or brown, smooth or almost so, sometimes verruculose at the base, walls slightly thickened, about 0.5 µm wide. *Conidiogenous cells* integrated, terminal and intercalary, cylindrical, 12–65 µm long, producing sympodial clusters of pronounced, conspicuous denticles (1–4 loci) at their distal ends, loci 1.5–2 µm diam, often seceding at a septum and behaving like conidia. *Ramoconidia* cylindrical with a broadly truncate base, 16–43(–47) × (2–)3–4(–4.5) µm, aseptate, rarely 1(–2)-septate, not or only very slightly attenuated towards the base, base 2–2.5(–3) µm wide, somewhat darkened-refractive. *Conidia* catenate, in branched chains, branching in all directions, terminal chains with up to six conidia, *small terminal conidia* subglobose to ovoid, globose, (2–)3–5 × 2–2.5(–3) µm (av. ± SD: 3.9 ± 0.8 × 2.7 ± 0.4), aseptate, pale brown, smooth to minutely verruculose, rounded at the apex, attenuated towards the base, hila 0.5–0.8 µm diam, *intercalary conidia* ovoid, limoniform to ellipsoid, 5–9(–13) × 2.5–3(–3.5) µm (av. ± SD: 7.2 ± 1.9 X 3.2 ± 0.5), 0(–1)-septate, pale brown, smooth to minutely verruculose, with up to three distal hila, 0.5–1 µm diam, *secondary ramoconidia* ellipsoid to cylindrical, (7.5–)12–25(–31) × 2.5–3.5(–4.5) µm (av. ± SD: 17.8 ± 5.6 × 3.3 ± 0.4), 0–1(–2)-septate, not constricted at septa, pale brown or olivaceous brown, smooth, somewhat attenuated towards apex and base, with 3(–5) distal hila, protuberant, denticulate, 1–2 ìm diam, thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA reaching 10–27 µm diam after 14 d at 25 °C, grey olivaceous to olivaceous, becoming pale olivaceous grey or smoke grey due to abundant aerial mycelium, reverse olivaceous grey to iron-grey and leaden-grey, velvety to felty-woolly; margin narrow to wide, white, regular to undulate, glabrous to feathery; aerial mycelium at first absent, later abundantly formed, felty, high; growth flat to later convex, sometimes either heaped or radially furrowed; few prominent exudates formed; sporulation profuse. Colonies on MEA reaching 8–19 mm diam after 14 d at 25 °C, grey olivaceous, glaucous-grey at margin, smoke-grey to pale mouse-grey or whitish due to aerial mycelium, reverse olivaceous grey to iron-grey, velvety to woolly-felty, margin white, narrow, glabrous to feathery, radially furrowed; aerial mycelium abundant, fluffy; few prominent exudates formed; sporulation profuse. Colonies on MEA with 5 % NaCl growing much faster than on other media, reaching 25–38 mm diam after 14 d at 25 °C, of different colours, mostly reseda-green and granulate due to profuse sporulation, margin olive-yellow, reverse yellow to dark green. Colonies on OA reaching 7–20 mm diam after 14 d at 25 °C, at first grey olivaceous to olivaceous, reverse leaden-grey to leaden-black, later pale mouse-grey to pale olivaceous due to aerial mycelium, reverse black, velvety to felty; margin white, glabrous, regular or either undulate or arachnoid, deeply furrowed; aerial mycelium sparse to felty, dense, pale mouse-grey, covering only parts of the colony, mainly the colony centre; growth flat with papillate surface; without prominent exudates; sporulation profuse.

Maximum tolerated salt concentration: MEA + 17 % NaCl after 14 d.

Cardinal temperatures: No growth at 4 °C, optimum and maximum temperature at 25 °C (8–19 mm diam), no growth at 30 °C (from Zalar *et al.* 2007).

Substrates and distribution: Isolated from hypersaline water, indoor environments and plant material; Australasia (Australia, New Zealand), Europe (Germany, Slovenia), North America (USA), West Indies (Dominican Republic).

Additional materials examined: **Australia**, isol. from house dust, DTO 305-G3 = BH10AU-180. **New Zealand**, isol. from house dust, DTO 307-H2 = TA05NZ-343.

Notes: *Cladosporium psychrotolerans* (Fig. 3, clade 12), which belongs to the *C. sphaerospermum* species complex, differs from *C. halotolerans* (Fig. 3, clade 23) in having 0–1(–2)-septate

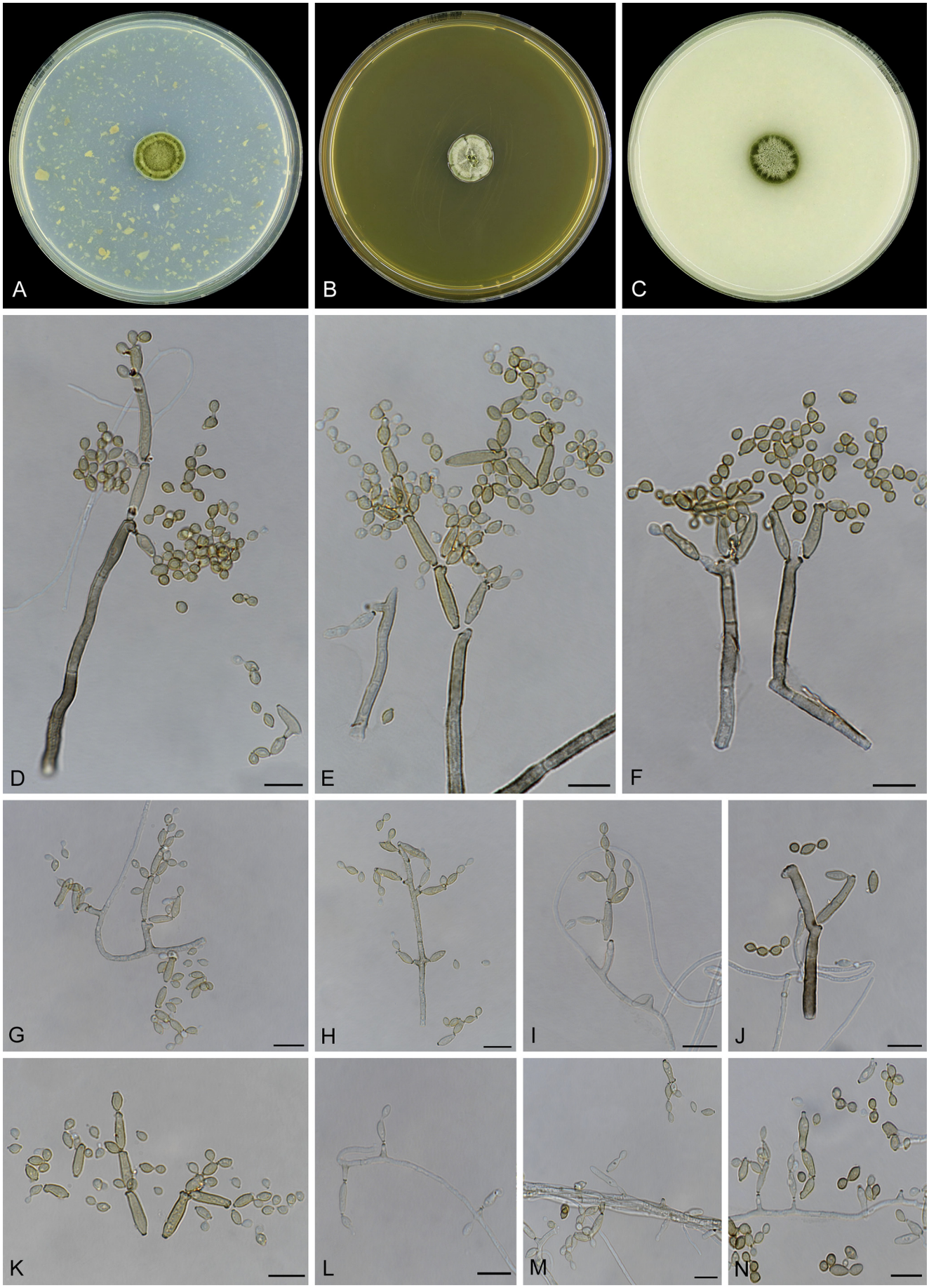

Fig. 31. *Cladosporium pulvericola* (CBS 143362). **A–C.** Colonies on PDA, MEA and OA. **D–F, J.** Macronematous conidiophores and conidial chains. **G–I, L–N.** Micronematous conidiophores and conidial chains. **K.** Conidia. Scale bars = 10 µm.

secondary ramoconidia with septa neither darkened nor thickened and globose, subglobose or ovoid small terminal conidia. It has been repeatedly isolated from indoor environments and is now also reported from Australasia. Phylogenetically, it is closely related to *C. sloanii* (Fig. 3, clade 11), *C. langeronii* (Fig. 3, clade 13) and *C. neolangeronii* (Fig. 3, clade 10). However, *C. langeronii* is particularly well distinguishable from all other *Cladosporium* species by its slow growing colonies and its larger apical conidia (4–5.5 × 3–4 µm *vs* 3–4 × 2.5–3 µm in *Cladosporium psychrotolerans*) (Zalar *et al.* 2007); and *C. neolangeronii* exhibits longer conidiophores and has somewhat darker and wider apical conidia. *Cladosporium sloanii* is a xerophilic species growing on MA+ 20 % sucrose and DG 18 but usually not on the typical media used for *Cladosporium* and differs by having usually shorter conidiophores and wider conidia. *Cladosporium neopsychrotolerans*, recently described from soil in China, is also a psychrotolerant species and shares similar cultural characters but is both morphologically and phylogenetically distant from *C. psychrotolerans* in clustering in the *C. cladosporioides* species complex (Ma *et al.* 2017).

Cladosporium pulvericola Bensch & Samson, **sp. nov.** MycoBank MB822226. Fig. 31.

Etymology: From the Latin *pulveris*, of dust, -cola, living in, named for the substrate from which the type specimen was isolated, house dust.

Holotype: **New Zealand**, Otago, Dunedin, Warrington, 284 Coast Road, isol. from house dust, Duststream collection tube on vacuum cleaner, 1 May 2009, T.J. Atkinson, CBS H-23257. *Ex-type culture*: CBS 143362 = DTO 305-H8 = TA05NZ-345.

Diagnosis: Differs from *C. dominicanum* in having shorter conidiophores, slightly longer secondary ramoconidia and a significantly lower growth rate.

Mycelium filiform or narrowly cylindrical, sparsely branched, (0.5–)2–4 µm wide, pluriseptate, subhyaline, pale olivaceous or pale to medium olivaceous brown, smooth or almost so to minutely or irregularly rough-walled, sometimes forming ropes of a few hyphae. *Conidiophores* macro- and micronematous, cylindrical-oblong, occasionally once geniculate, non-nodulose, mostly unbranched, (3–)12–80(–100) × 2.5–4 µm, micronematous starting as small lateral outgrowth of hyphae, 1–2 µm wide, septate, subhyaline, pale to medium olivaceous brown, smooth or minutely verruculose, walls thickened in macronematous conidiophores. *Conidiogenous cells* integrated, usually terminal, cylindrical, 6–18 µm long, with 2–4 loci crowded at the apex and sometimes 1–2 additional loci at a lower level, in micronematous conidiophores often only a single locus at the apex, loci conspicuous, 1–1.5 µm diam, thickened and darkened-refractive. *Ramoconidia* occasionally formed, up to 35 µm long, often 1-septate, base about 2.5 µm wide. *Conidia* very numerous, catenate, formed in branched chains, 1–7 conidia in the terminal unbranched part of the chains, *small terminal conidia* very small, subglobose, obovoid or limoniform, (1.5–)2.5–4(–5.5) × (1–)1.5–2.5(–3) µm (av. ± SD: 3.3 ± 0.8 × 2.3 ± 0.5 µm), aseptate, apex rounded or with a single distal hilum, subhyaline or very pale olivaceous, hila about 0.5 µm diam or even narrower, smooth or almost so, with age somewhat darker and with a more prominent verruculose surface ornamentation, *intercalary conidia* ovoid or ellipsoid, 4–12 × 2–3(–3.5) µm (av. ± SD: 7.2 ± 2.5 × 2.6 ± 0.4 µm), 0–1-septate, very pale olivaceous or pale olivaceous brown, smooth or almost so to somewhat irregularly rough-walled, (1–)2–3 distal hila, hila (0.5–)0.8–1 µm diam, *secondary ramoconidia* ellipsoid or subcylindrical, (7–)10–25(–33) × (2–)2.5–3(–4) µm (av. ± SD: 17.6 ± 6.5 × 2.9 ± 0.4 µm), 0–1(–3)-septate, pale olivaceous brown, almost smooth or irregularly rough-walled, walls unthickened or almost so, with 2–3(–5) distal hila, hila 1–1.5 µm diam, conspicuous, darkened-refractive; microcyclic conidiogenesis occurring, sometimes germinating.

Culture characteristics: Colonies on PDA attaining 9–32 mm diam after 14 d at 25 °C, greenish olivaceous, olivaceous grey to dull-green, zonate, reverse leaden-grey to leaden-black, with a narrow, regular, white margin, aerial mycelium loose, diffuse, smoke-grey, growth convex with slightly elevated colony centre, wrinkled at margins, without exudates, sporulation profuse. Colonies on MEA reaching 10–28 mm diam after 14 d at 25 °C, smoke-grey, grey olivaceous, greenish glaucous towards margin, reverse olivaceous grey or iron-grey, powdery or velvety, margins narrow, white, radially furrowed, aerial mycelium sparse, diffuse, wrinkled and folded in colony centre, a few prominent exudates formed, sporulation profuse. Colonies on OA attaining 10–18 mm diam after 14 d at 25 °C, grey olivaceous or olivaceous grey, olivaceous when sporulating profusely, sometimes glaucous-grey at margin, reverse iron-grey or leaden-grey, velvety or powdery, margins narrow, white, regular, aerial mycelium loose or fluffy and high, smoke-grey, growth flat, without exudates.

Substrate and distribution: Indoor air, dust and indoor surfaces; Australasia (Australia, New Zealand), Europe (The Netherlands), North America (Canada, USA).

Additional materials examined: **Australia**, Tasmania, isol. from house dust, L. Agustini, DTO 307-E7 = BH10AU-183. **Canada**, isol. from air in a residence, 2001, isol. by J. Bissett, deposited as *C. sphaerospermum*, CBS 109788 = DAOM 226470. **The Netherlands**, Born, swab sample, food plant, M. Meijer, DTO 130-D6; The Hague, swab sample, DTO 249-F4; Utrecht, swab sample, DTO 255-F7; DTO 255-H5 = CBS139591. **USA**, Maine, Falmouth, isol. from indoor air sample, living room, Jan. 2013, Ž. Jurjević, EMSL 1931 = CPC 22403.

Notes: *Cladosporium pulvericola* (Fig. 3, clade 1) is a typical taxon of the *C. sphaerospermum* species complex. It is morphologically and phylogenetically closely allied to *C. dominicanum* (Fig. 3, clade 4) but differs in having shorter conidiophores, slightly longer secondary ramoconidia and a significantly lower growth rate. *Cladosporium sphaerospermum* (Fig. 3, clade 20) is distinguishable by its slightly wider conidiophores with often several darkened and somewhat thickened septa, 0–3-septate, slightly wider secondary ramoconidia and often verrucose small terminal conidia.

Cladosporium ramotenellum K. Schub. *et al.*, Stud. Mycol. 58: 137. 2007, emended in Bensch *et al.* 2015. MycoBank MB504577. Fig. 32.

Holotype: **Slovenia**, Sečovlje, isolated from hypersaline water from reverse ponds, salterns, 2005, P. Zalar, CBS H-19862. *Isotype*: HAL 2026 F. *Ex-type culture*: CBS 121628 = CPC 12043 = EXF-454.

Lit.: Bensch *et al.* (2012: 230–232; 2015: 60–62), Lee *et al.* (2011), Jang *et al.* (2013).
Ill.: Schubert *et al.* (2007b: 138–139, figs 31–33), Bensch *et al.* (2012: 231–232, figs 262–264), Jang *et al.* (2013: 25, figs 3–4).

Mycelium unbranched or only sparingly branched, 1.5–4 µm wide, septate, without swellings and constrictions, hyaline or subhyaline,

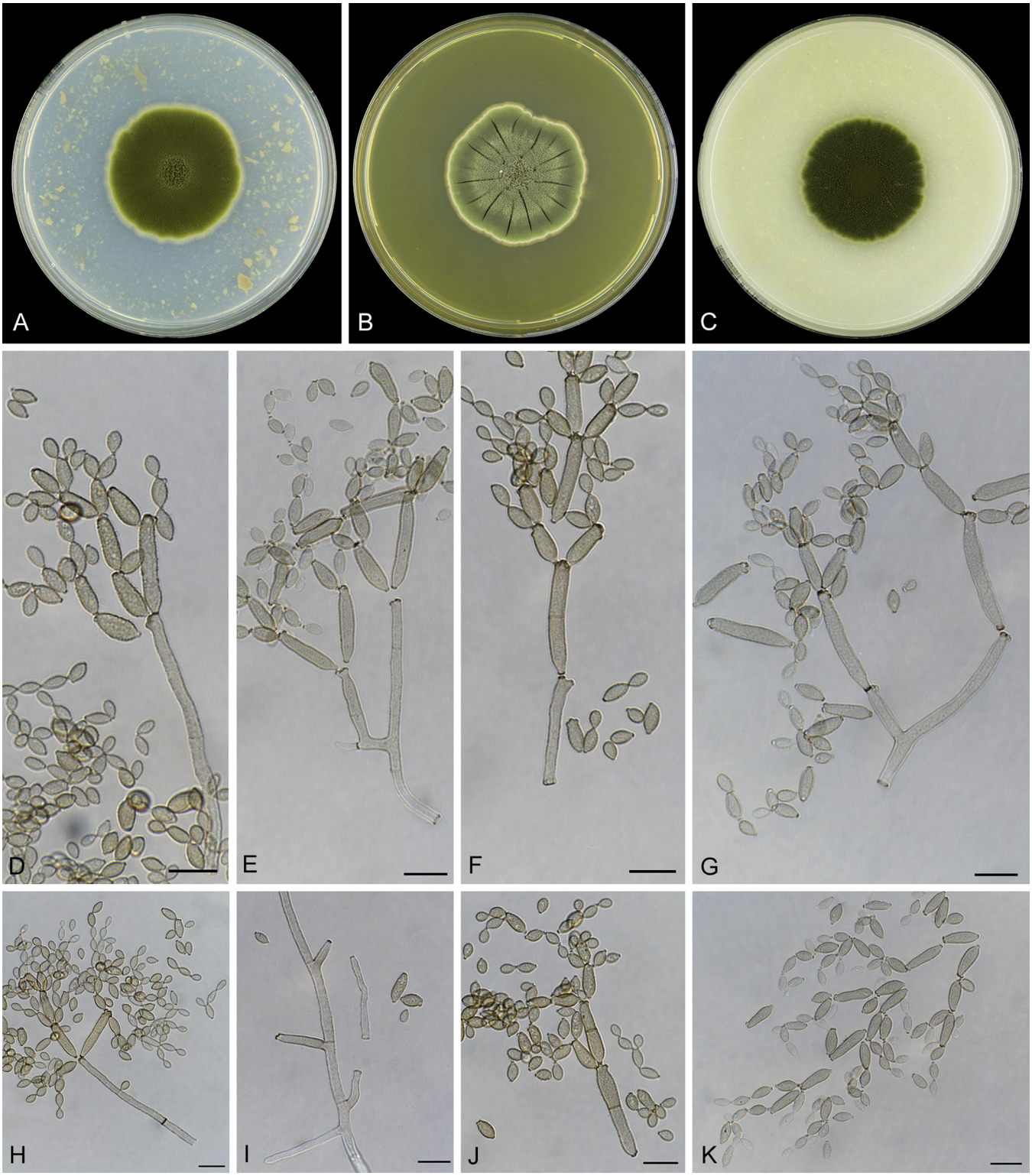

Fig. 32. *Cladosporium ramotenellum* (DTO 097-H3). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Macronematous conidiophores and conidial chains. **I.** Micronematous conidiophores. **J–K.** Conidial chains. Scale bars = 10 µm.

smooth, sometimes irregularly rough-walled, walls unthickened. *Conidiophores* solitary, macro- and micronematous, arising as lateral branches of plagiotropous hyphae or terminally from ascending hyphae, erect, straight or slightly flexuous, cylindrical, neither geniculate nor nodulose, without capitate apices or intercalary swellings, unbranched, sometimes branched, branches often only as short lateral prolongations, mainly formed below a septum, 14–120(–230) × (1–)2–4(–5) µm, septate, not constricted at septa, subhyaline to pale olivaceous or brown, smooth to minutely verruculose, walls unthickened, sometimes guttulate. *Conidiogenous cells* integrated, terminal, sometimes also intercalary, cylindrical, 10–28(–50) µm long, proliferation sympodial, sometimes swollen, up to 7 µm wide, with few conidiogenous loci, mostly 1–3, loci sometimes situated on small lateral prolongations, protuberant, 0.5–1.5(–2) µm diam, thickened and somewhat darkened-refractive. *Ramoconidia* cylindrical-oblong, 15–55 × 2–4(–5) µm, 0–1(–3)-septate, rarely up to 4-septate, subhyaline to very pale olivaceous, smooth or almost so, with a broadly truncate base lacking a dome and raised rim, 2–3 µm wide, not thickened but somewhat refractive. *Conidia* numerous, polymorphous,

catenate, in branched chains with 2–5(–6) conidia in the terminal unbranched part of the chain, straight, sometimes slightly curved, *small terminal conidia* numerous, globose, subglobose or ovoid, obovoid or limoniform, 2.5–6(–7) × 2–4(–4.5) µm (av. ± SD: 4.5 ± 1.1 × 2.8 ± 0.6 µm), aseptate, without distal hilum or with a single apical hilum, *intercalary conidia* ellipsoid, limoniform to subcylindrical, 5–12(15) × (2.5–)3–4(–5) µm (av. ± SD: 8.7 ± 2.6 × 3.6 ± 0.5 µm), 0–1-septate; *secondary ramoconidia* ellipsoid, subcylindrical to cylindrical-oblong, (6–)9–30(–39) × (2.5–)3–4(–5) µm (av. ± SD: 17.9 ± 6.2 × 3.9 ± 0.6 µm], sometimes swollen up to 7 µm, 0–1(–3)-septate, usually not constricted at septa, sometimes distinctly constricted at the median septum, subhyaline to very pale olivaceous, minutely verruculose (granulate under SEM), walls unthickened or almost so, apex broadly rounded or slightly attenuated towards apex and base, sometimes guttulate, hila protuberant, conspicuous, 0.8–1.5(2) µm diam, somewhat thickened and darkened-refractive; microcyclic conidiogenesis occurring.

Culture characteristics: Colonies on PDA reaching 46–49 mm diam after 14 d at 25 °C, olivaceous to grey olivaceous due to abundant sporulation, appearing zonate in forming concentric zones, margin entire edge to slightly undulate, white, glabrous, aerial mycelium absent or sparse, growth flat with a somewhat folded and wrinkled colony centre, without prominent exudates, sporulation profuse. Colonies on MEA reaching 48–49 mm diam after 14 d at 25 °C, grey olivaceous to olivaceous grey, velvety, olivaceous grey to iron-grey reverse, margin entire edge to undulate, radially furrowed, glabrous to feathery, aerial mycelium sparse, diffuse, growth flat with slightly elevated colony centre, distinctly wrinkled, prominent exudates not formed, abundantly sporulating. Colonies on OA attaining 40 mm diam after 14 d at 25 °C, grey olivaceous, margin entire edge, hyaline or white, glabrous, aerial mycelium absent or sparse, growth flat, without exudates, sporulation profuse.

Substrate and distribution: Hypersaline water, air, indoor environments, food and plant material; Africa (South Africa), Australasia (Australia, New Zealand), Asia (China, South Korea), Europe (Cyprus, Denmark, Germany, Italy, Portugal, Slovenia, Spain, The Netherlands, Turkey, UK), North America (USA).

Additional materials examined: **China**, isol. from indoor air, DTO 323-B7, DTO 323-D4, DTO 323-D5, DTO 323-D6. **Denmark**, isol. from indoor environment, B. Andersen, BA 1919 = DTO 109-F4; isol. from indoor air, 2 Feb. 2011, B. Andersen, BA 2033 = CPC 19119. **Germany**, isol. from indoor environment, LGA, DTO 084-F5. **New Zealand**, isol. from house dust, T. Atkinson, DTO 305-H1 = TA10NZ-295, DTO 305-I1 = TA10NZ-240, DTO 306-A3 = TA10NZ-322, DTO 306-B2 = TA10NZ-324, DTO 306-D1 = TA10NZ-215B, DTO 306-D2 = TA10NZ-289A, DTO 306-E7 = TA10NZ-232, DTO 306-F5; TA10NZ-308, DTO 307-F2 = TA10NZ-297A, DTO 307-I2 = TA10NZ-286. **Portugal**, indoor environment, DTO 150-F5, DTO 151-G3, DTO 151-G6, DTO 152-B3, DTO 152-D9. **South Africa**, isol. from house dust, K. Jacobs, DTO 306-C4 = KJ09SA-88. **The Netherlands**, swab sample indoor environment, G.J. Dolphyn, DTO 097-H3; Rijssen, air sample kitchen, M. Meijer, CBS 139577 = DTO 089-C1. **USA**, California, isol. from indoor air sample, hallway, Jan. 2013, Ž. Jurjević, EMSL 1883 = CPC 22370.

Notes: *Cladosporium ramotenellum* (Fig. 2, clade 37) was originally described from two Slovenian isolates (Schubert *et al.* 2007b), one being the type isolated from hypersaline water and an additional strain isolated from an air conditioning system. Recent molecular and morphological studies showed this species to be a common saprobic species occurring on various substrates with a wider geographic distribution. Based on these studies its species description was emended in Bensch *et al.* (2015). Samson (2014) showed that *C. ramotenellum* is also quite common in indoor environments which can be confirmed in the present study. Furthermore, it has been reported from clinical samples in the United States in Sandoval-Denis *et al.* (2015). *Cladosporium basiinflatum* was included within the *C. ramotenellum* clade in all three analyses, but always on a long branch; this isolate is up to 100 % identical on *tef1* and 180/219 (82 %) similar on *act* to the closest *C. ramotenellum* sequences included in our phylogeny.

Cladosporium sinense Bensch & Samson, **sp. nov.** MycoBank MB822227. Figs 33, 34.

Etymology: Refers to the country of origin, China.

Holotype: **China**, Beijing, office building, isol. from indoor air, Sep. 2010, CBS H-23258. *Ex-type culture*: CBS 143363 = DTO 324-D2.

Diagnosis: Differs from *C. aggregatocicatricatum* in having shorter, neither nodulose nor geniculate-sinuous conidiophores as well as shorter and narrower conidia.

Mycelium abundantly formed, hyphae filiform or narrowly cylindrical, sparsely branched, 0.5–3(–4) µm wide, subhyaline or very pale olivaceous, septate, neither constricted nor swollen, smooth or almost so, asperulate, minutely verruculose or somewhat irregularly ornamented, especially where conidiophores are formed, sometimes anastomosing, often forming ropes of two or few hyphae. *Conidiophores* macronematous, solitary, erect or ascending, straight or curved, arising mostly laterally but also terminally from hyphae, narrowly cylindrical-oblong, often slightly attenuated towards the apex, neither nodulose nor geniculate, unbranched, 13–90(–110) × 2–3.5 µm, at the base up to 4.5 µm wide, pale to medium olivaceous or olivaceous brown, often slightly paler towards the apex, 0–4(–5)-septate, not constricted but septa sometimes darkened, smooth or almost so to asperulate with LM, walls unthickened or slightly thickened. *Conidiogenous cells* integrated, usually terminal, very rarely intercalary, short cylindrical-oblong, 13–30 µm long, with (1–)2–4 distal loci crowded at the apex and forming dense clusters of pronounced scars, loci conspicuous, subdenticulate, 1–1.5 µm diam, somewhat thickened and darkened. *Ramoconidia* formed, 18–40 × 2.5–3(–3.5) µm, 0–2-septate, with 2–4 distal scars, base about 2(–2.5) µm wide, non-cladosporioid but slightly thickened and somewhat darkened. *Conidia* catenate, formed in branched chains, branching in all directions, with 1–3 conidia in the terminal unbranched part of the chain, *small terminal conidia* subglobose or obovoid, 3–4 × 2–2.5 (–3) µm (av. ± SD: 3.5 ± 0.5 × 2.3 ± 0.4 µm), apex broadly rounded; *intercalary conidia* limoniform or ellipsoid, 3.5–8.5(–10) × 2.5–3.5 µm (av. ± SD: 6.2 ± 2.0 × 2.9 ± 0.3 µm], aseptate, very rarely 1-septate, with 1–3 distal hila; *secondary ramoconidia* ellipsoid, subcylindrical or cylindrical, (5.5–)8–23 × (2.5–)3–3.5(–4) µm (av. ± SD: 14.3 ± 5.0 × 3.2 ± 0.4 µm), 0(–1)-septate, with 2–4 distal hila densely crowded at the uppermost apex, pale olivaceous or olivaceous brown, almost smooth, often asperulate or loosely to densely minutely verruculose (LM), walls unthickened or almost so, hila conspicuous, subdenticulate, 0.5–1.5 µm diam, somewhat thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA attaining 43–50 mm diam after 14 d at 25 °C, olivaceous to grey olivaceous, reverse greyish-blue to olivaceous grey, fluffy, margin glabrous, aerial

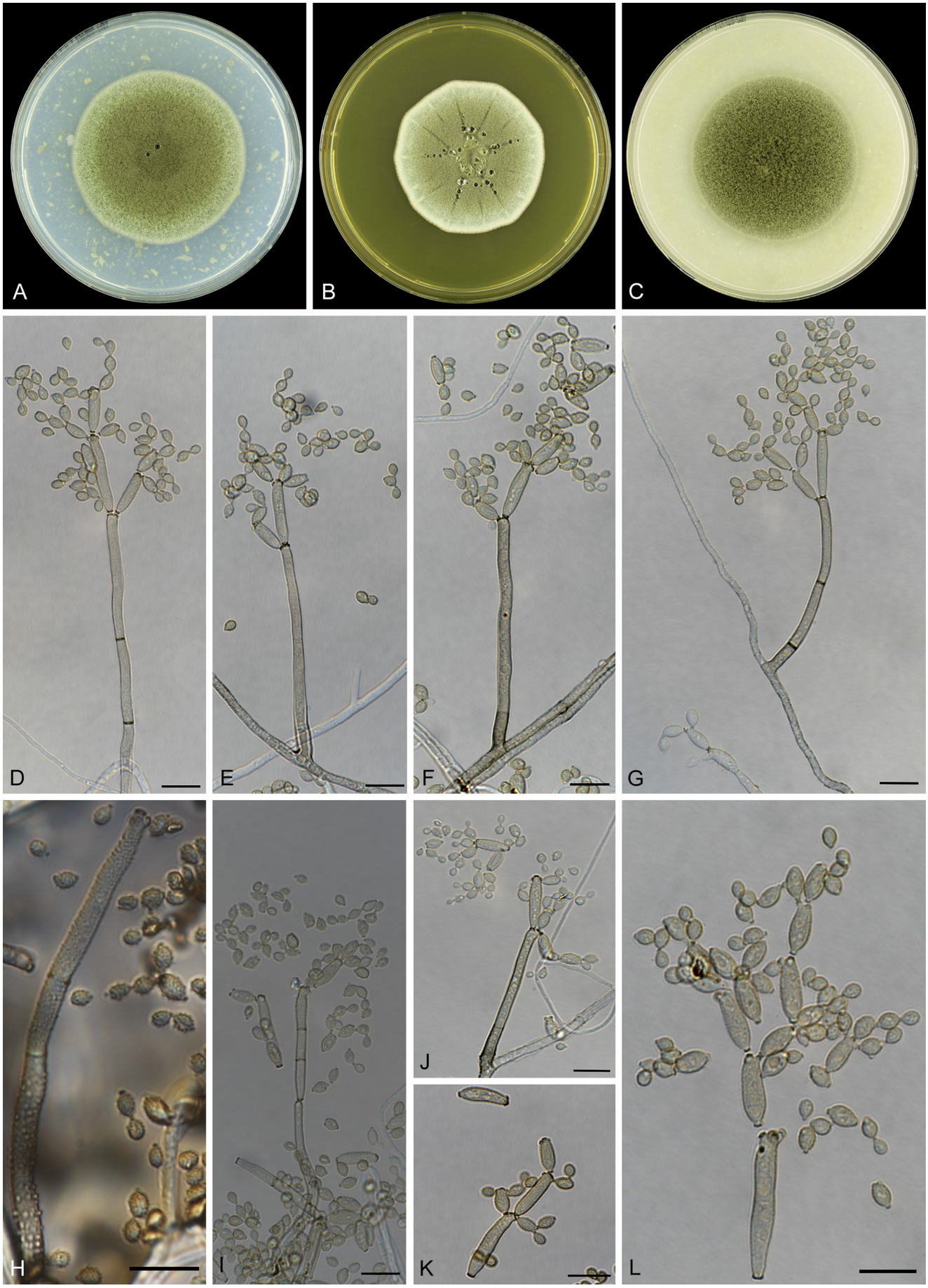

Fig. 33. *Cladosporium sinense* (CBS 143363). **A–C.** Colonies on PDA, MEA and OA. **D–G, J.** Conidiophores and conidia. **H.** Surface ornamentation of conidiophores and conidia shown in an air bubble. **I, K–L.** Conidial chains. Scale bars = 10 µm.

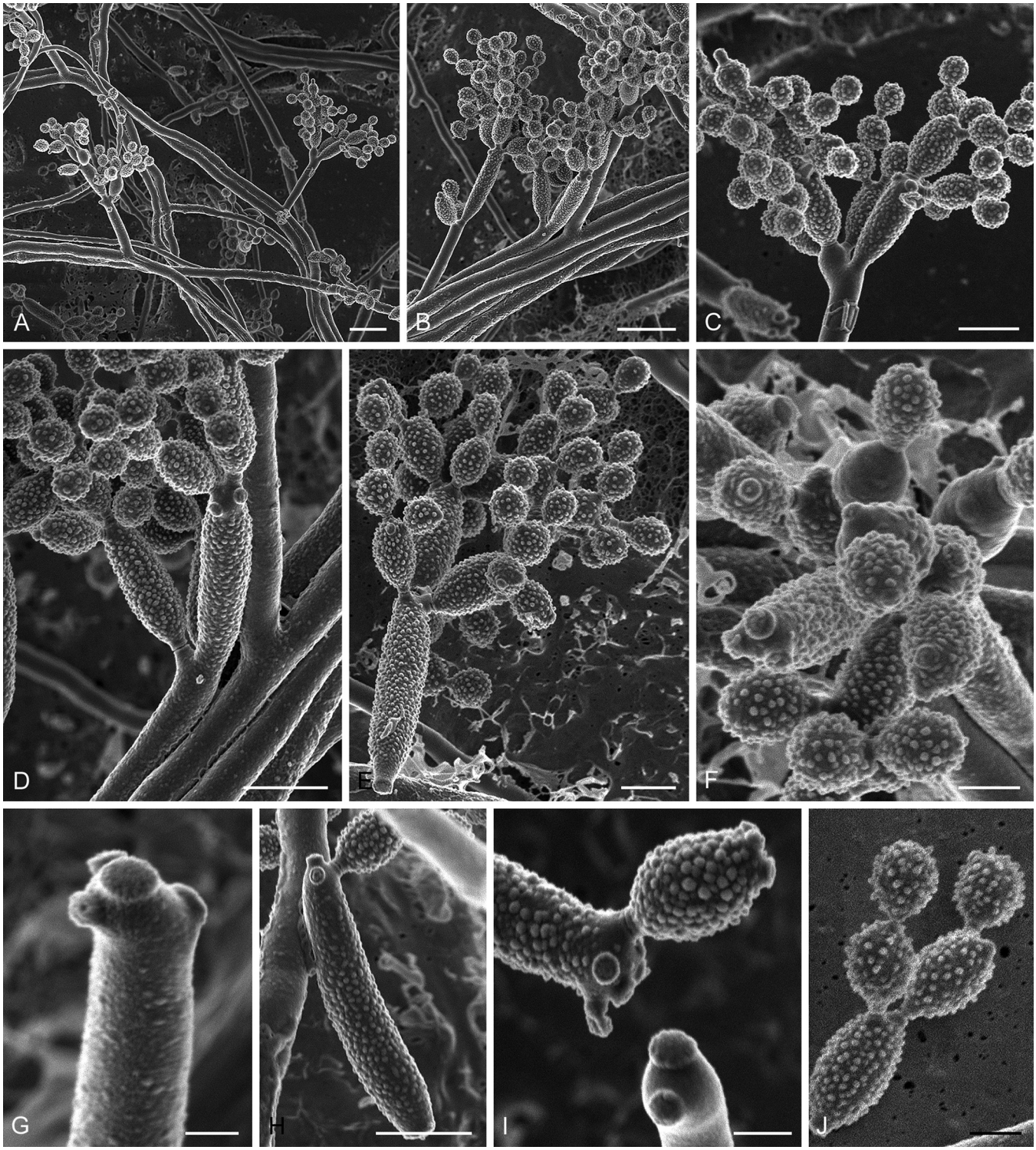

Fig. 34. *Cladosporium sinense* (CBS 143363). **A.** Overview of bundles of aerial hyphae, conidiophores and conidia. **B.** Bundles of hyphae also end as conidiophores. The conspicuous ornamentation of the *C. herbarum* type is already visible at the ends of the conidiophores. **C.** Detail of A. showing a smooth conidiophore stipe with short branch, ramoconidia, terminal conidia and conidium initial. **D.** Detail of B showing the transition of a branch of an aerial hyphae (see B) into a ramoconidium. Note the scars on the ramoconidium and the round terminal ornamented conidia. **E.** Nearly intact top end of a conidiophore containing ramoconidium and most derived structures. **F.** Details of conidia and scars. Note the distinct ornamentation of conidia consisting out of single regular extensions. **G–J.** Details of conidiophores and conidia. The different sizes of the scars on conidiophore stipes are well visible (G and I). These flattened scars are different from the scars on conidia that exhibit a core surrounded by a rim structure. Scale bars = 2 (F–G, I–J), 5 (C–E, H), 10 (A, B) µm.

mycelium abundantly formed, fluffy, loose to dense, growth low convex, with few prominent exudates, sporulation profuse. Colonies on MEA reaching 38–44 mm diam after 14 d at 25 °C, pale olivaceous grey, glaucous-grey to white at colony margins, reverse olivaceous grey, fluffy, margin white, glabrous, somewhat undulate, radially furrowed, somewhat folded in colony centre, several large exudates formed, sporulation profuse. Colonies on OA attaining 42–50 mm diam after 14 d at 25 °C, olivaceous, pale olivaceous grey towards margins, reverse greenish grey to olivaceous grey, fluffy-felty, margins regular, glabrous, aerial mycelium abundantly formed, dense, high, growth low convex, sporulation profuse, without prominent exudates.

Substrate and distribution: Indoor air; Asia (China).

Fig. 35. *Cladosporium sinuosum* (DTO 109-I2). **A–C.** Colonies on PDA, MEA and OA. **D–G.** Conidiophores and conidia. **H.** Superficial mycelium. **I.** Ramoconidium and conidia. **J.** Conidia. Scale bars = 10 µm.

Notes: This new species (Fig. 2, lineage 33) is phylogenetically allied to *C. aggregatocicatricatum* (Fig. 2, clade 34) but the latter species differs in having longer, once or several times slightly to distinctly, loosely to densely geniculate-sinuous or subnodulose conidiophores as well as longer and wider conidia (Bensch *et al.* 2015). Until now *C. sinense* is known only from a single isolate.

Cladosporium sinuosum K. Schub. *et al.*, Stud. Mycol. 58: 141. 2007, emended in Bensch *et al.* 2015. MycoBank MB504578. Fig. 35.

Holotype: **New Zealand**, Te Anau, isolated from leaves of *Fuchsia excorticata* (*Onagraceae*), 31 Jan. 2005, A. Blouin, C.F. Hill 1134A, CBS H-19863. *Ex-type culture*: CBS 121629 = CPC 11839 = ICMP 15819.

Lit.: Bensch *et al.* (2012: 245–246; 2015: 67–68).
Ill.: Schubert *et al.* (2007b: 140–141, figs 34–35), Bensch *et al.* (2012: 245–246, figs 281–282; 2015: 69–71, figs 34–36).

Mycelium filiform or narrowly cylindrical-oblong, loosely branched, 1–5(–7) µm wide, irregular in outline due to swellings and constrictions, sometimes swollen up to 7 µm, subhyaline to pale or medium olivaceous brown, smooth, minutely verruculose or irregularly rough-walled, walls unthickened, sometimes forming loose stromatic hyphal aggregations of swollen hyphal cells, hyphal cells up to 15 µm diam, medium brown or olivaceous brown, walls somewhat thickened; sterile hyphae sometimes forming ropes. *Conidiophores* macronematous, erect, solitary or on loose groups, straight to often flexuous, arising terminally and laterally from hyphae or from swollen bulbous hyphal cells, long, subnodulose or nodulose, with uni- or multilateral swellings, several times slightly to distinctly geniculate-sinuous due to sympodial proliferation, sometimes even zig-zag-like (see Bensch *et al.* 2012, fig. 282B), unbranched or branched, up to 380 µm long, (3.5–)4–6(–7) µm wide, swellings up to 10 µm wide, pluriseptate, septa often in short succession and somewhat darkened-refractive, medium olivaceous brown, smooth or minutely verruculose, walls thickened, sometimes even distinctly two-layered, 1(–1.5) µm thick. *Conidiogenous cells* integrated, terminal and intercalary, cylindrical-oblong, with 1–2 uni- or multilateral swellings per cell, rarely more, geniculate-sinuous, 8–35(–49) µm long, loci confined to swellings, up to four loci per nodule, loci conspicuous, prominent, 1–2(–2.2) µm diam, thickened and darkened-refractive. *Ramoconidia* not observed. *Conidia* solitary or in short unbranched or branched chains, up to four conidia in a chain, conidia without a distal hilum ovoid, obovoid to broadly ellipsoid or doliiform, (5–)8–15(–17) × (4–)5–8(–9) µm (av. ± SD: 11.3 ± 2.8 × 7.0 ± 1.2 µm), 0–1-septate, basal and intercalary conidia ellipsoid-ovoid to subcylindrical, 11–19(–24) × (5–)6–9(–11) µm (av. ± SD: 15.9 ± 2.7 × 7.7 ± 1.0 µm), 0–1(–2)- septate, septa median or somewhat in the upper half, becoming curved or sinuous with age, pale olivaceous to medium olivaceous brown or pale greyish brown, densely verrucose to echinulate, walls appearing to be thick-walled due to surface ornamentation, 1–2 µm wide, with 1–2(–3) distal hila, hila protuberant, more or less conspicuous, sometimes immersed in surface ornamentation and therefore not very prominent, 1–2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not observed on SNA but occurring while growing on PDA, MEA and OA.

Culture characteristics: Colonies on PDA attaining 16–47 mm diam after 14 d at 25 °C, smoke-grey to pale olivaceous grey due to aerial mycelium, grey olivaceous towards margins, reverse leaden-grey or olivaceous black, fluffy-felty, margins somewhat feathery, aerial mycelium high, loose to dense, fluffy, growth low convex, without prominent exudates. Colonies on MEA reaching 18–55 mm diam after 14 d at 25 °C, greenish grey to grey olivaceous, white or smoke-grey due to abundant aerial mycelium, reverse olivaceous grey, woolly-felty, margins white, narrow, glabrous to somewhat feathery, radially furrowed and folded, aerial mycelium loose to dense, fluffy to woolly or diffuse, growth flat or effuse, sporulation profuse. Colonies on OA attaining 15–37 mm diam after 14 d at 25 °C, white, smoke-grey to pale olivaceous grey, olivaceous grey at margins, reverse iron-grey or leaden-grey, woolly-felty, margins crenate, aerial mycelium abundant, covering almost the whole colony, woolly-felty, dense, low to high, growth flat, sporulation profuse.

Substrate and distribution: Isolated from various plants and mosses, air and indoor environments; Africa (South Africa), Australasia (New Zealand), Europe (Denmark, France, Germany, The Netherlands).

Additional material examined: **Denmark**, isol. from indoor environment, B. Andersen, DTO 109-I2 = BA 1896.

Notes: *Cladosporium sinuosum* (Fig. 2, clade 2), introduced by Schubert *et al.* (2007b) as a member of the *C. herbarum* species complex, was described from a single collection on living leaves of *Fuchsia excorticata* from New Zealand. In Bensch *et al.* (2015) the species concept was emended since several isolates from different substrates from Europe and South Africa were shown to belong to this species in that phylogenetic study. The isolate from indoor environments in Denmark agrees well with the emended species concept.

Cladosporium floccosum (Fig. 2, clade 4), introduced by Sandoval-Denis *et al.* (2016) as a new species associated with human infections, is morphologically very similar to *C. sinuosum* but differs in having shorter, rarely branched conidiophores and slightly shorter terminal conidia (up to 12.5 µm long). It proved to occur also in indoor environments, although there appears to be some intraspecific variation in this species.

Cladosporium sloanii Bensch & Samson, **sp. nov.** MycoBank MB822228. Fig. 36.

Etymology: Latin, *sloanii*, named in honour of Alfred P. Sloan.

Holotype: **The Netherlands**, Born, isol. from swab sample food plant, M. Meijer, CBS H-23259. *Ex-type culture*: CBS 143364 = DTO 130-D5.

Diagnosis: Xerophilic species that does not grow on general media, but well on DG18 and MA + 20 % sucrose.

Mycelium sparingly formed, hyphae cylindrical-oblong, (2–)3–5 µm wide, septate, often with swellings and constriction, pale olivaceous, smooth or almost so to minutely verruculose, forming swollen hyphal cells or stromatic hyphal aggregations, hyphal cells up to 9(–12) µm diam, medium to dark olivaceous brown. *Conidiophores* macronematous, arising solitary from hyphae, mainly laterally, or in small groups from swollen hyphal cells or stromatic hyphal aggregations, cylindrical-oblong, sometimes geniculate towards the apex, unbranched or branched, 40–90(–235) × 2.5–4 µm, up to 5 µm wide at the base, often slightly attenuated towards the apex, 1–4(–7)-septate, septa sometimes in short succession, often somewhat darkened,

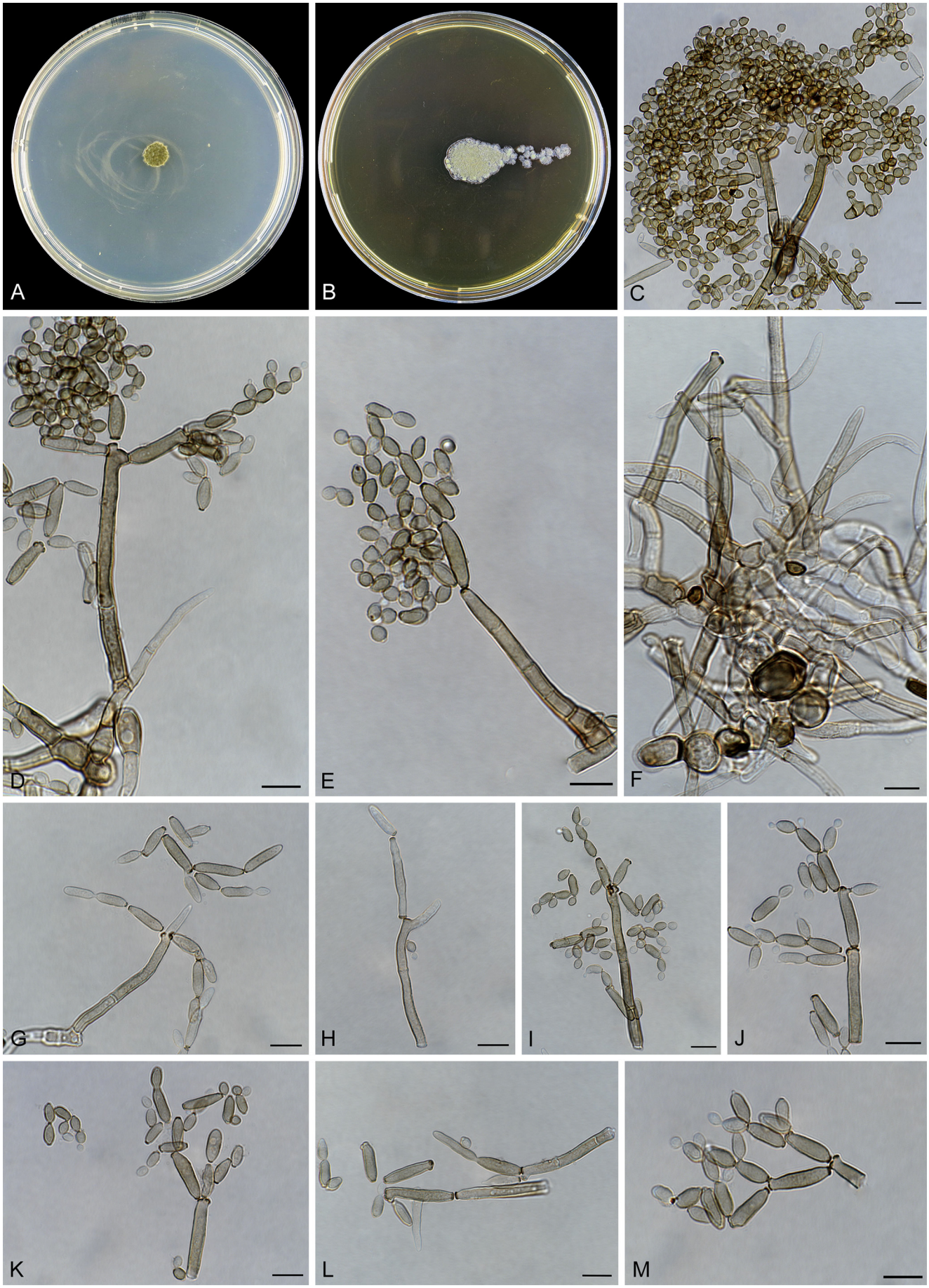

Fig. 36. *Cladosporium sloanii* (CBS 143364). **A–C.** Colonies on DG18 and MA + 20 % sucrose. **C–G, I.** Conidiophores and conidia. **H, J–L.** Ramoconidia and conidia. **M.** Conidial chains. Scale bars = 10 µm.

sometimes slightly constricted, pale to medium olivaceous brown, smooth or almost so. *Conidiogenous cells* integrated, mainly terminal, cylindrical-oblong, 12–31 µm long, with 1–3 conidiogenous loci at the apex, loci conspicuous, 1–2 µm diam, thickened and darkened-refractive. *Ramoconidia* frequently formed, cylindrical, 12–36(–42) × (2.5–)3–4 µm, 0(–3)-septate, smooth or minutely verruculose, not attenuated towards the base, base broadly truncate, 2.5–3.5(–4) µm wide, somewhat refractive. *Conidia* catenate, often formed in dichotomously branched chains, with 1–2(–3) conidia in the terminal unbranched part, *small terminal conidia* globose, subglobose, obovoid or ellipsoid, 3–7(–11) × (2.5–)3–4(–5) µm (av. ± SD: 5.9 ± 2.5 × 3.5 ± 1.0 µm), *intercalary conidia* ovoid, ellipsoid, 4.5–11(–13) × 3–4.5 µm (av. ± SD: 7.6 ± 2.6 × 3.6 ± 0.7 µm), 0(–1)-septate, with 1–2(–3) distal hila, *secondary ramoconidia* ellipsoid or subcylindrical, slightly attenuated towards apex and base, 9.5–21(–28) × 3–4(–4.5) µm (av. ± SD: 16.4 ± 4.4 × 3.7 ± 0.4 µm), 0–1(–2)-septate, septa sometimes refractive or distinctly constricted, pale to medium olivaceous brown, becoming dark brown and more swollen with age, smooth or almost so to often minutely verruculose, sometimes irregularly verruculose, hila conspicuous, 1–2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on DG18 reaching 8−9 mm diam after 14 d at 25 °C, olivaceous grey, reverse olivaceous black, velvety, margin narrow, whitish, feathery, crenate, aerial mycelium loose to dense, growth high, up to 2 mm, several very small exudates formed, sporulating. Colonies on MA + 20 % sucrose attaining 4−14 mm diam after 14 d at 25 °C, olivaceous grey to iron-grey, reverse leaden-black, velvety to powdery, margin glabrous to somewhat feathery, narrow, crenate, aerial mycelium loose diffuse to more densely, several exudates formed especially at colony margins, sporulating. Sporulating on SNA, only very sparsely sporulating on OA, only few spores formed.

Substrates and distribution: Swab sample food plant; Europe (The Netherlands).

Notes: Visagie *et al.* (2014) described *Aspergillus sloanii* among interesting new species isolated from dust; this species is not able to grow on any of the media generally used for *Aspergillus* identifications, which was a remarkable finding. *Cladosporium sloanii* (Fig. 3, clade 11), known from a single isolate, is also not able to grow on most of the generally used media for *Cladosporium* identification. It is an obligate xerophilic species only growing on low water activity media such as DG18 and MA + 20 % sucrose, which is so far unique for species belonging to the genus *Cladosporium*. *Cladosporium halotolerans* and *C. sphaerospermum* also proved to be able to grow at lower water activity (Segers *et al.* 2015, 2016) but are not restricted in their growth abilities to these media. *Cladosporium psychrotolerans*, the closest relative of *C. sloanii*, differs in forming longer conidiophores and narrower conidia.

Cladosporium sphaerospermum Penzig, Michelia 2(8): 473. 1882. MycoBank MB119529. Figs 37, 38.

Neotype: (designated by Zalar *et al.* 2007): *Sine loco*, isolated from a human nail, 1949, R.W. Zappey, CBS H-19738. *Ex-neotype culture*: CBS 193.54 = ATCC 11289 = IMI 049637. [*Type*: Italy, Padova, on faded leaves and stems of Citrus sp. (*Rutaceae*), Feb. 1882, O. Penzig (not preserved)].

Lit.: de Hoog *et al.* (2000: 591), Samson *et al.* (2000: 114, 2001: 340), Zalar *et al.* (2007: 177–179). Dugan *et al.* (2008: 9–16), Bensch *et al.* (2012: 250–254), Segers *et al.* (2015).
Ill.: de Hoog *et al.* (2000: 591–592, figs), Samson *et al.* (2000: 114, fig. 51; 115, pl. 49), Zalar *et al.* (2007: 166, fig. 5 g, 178, fig. 12), Dugan *et al.* (2008: 13–14, figs 2–3), Bensch *et al.* (2012: 251–253, figs 287–289).

Mycelium partly submerged, partly superficial; hyphae sparingly branched, 1–3 µm wide, septate, pale to pale medium olivaceous brown, smooth to sometimes minutely verruculose, walls slightly thickened, not enveloped in polysaccharide-like material. *Conidiophores* micro- and macronematous, arising terminally and laterally from hyphae, erect or ascending, straight to slightly flexuous. *Macronematous conidiophores* cylindrical-oblong, neither geniculate nor nodulose, unbranched or branched, (10–)45–130(–300) × 2.5–4.5(–6) µm, pluriseptate, with relatively dense septation (cells mostly 4.5–23 µm long), septa darkened and somewhat thickened, pale medium to medium olivaceous brown, smooth to minutely verruculose, walls thickened. *Conidiogenous cells* integrated, terminal, sometimes intercalary, cylindrical, usually short, 6–18 µm long, proliferation sympodial, with a single or few apical scars, loci protuberant, denticulate, 0.8–1.5 µm diam, thickened and darkened-refractive. *Micronematous conidiophores* filiform to narrowly cylindrical-oblong, up to 80 µm long or even longer, 1–2 µm wide, pluriseptate, not that densely septate as macronematous conidiophores, septa also somewhat darkened and thickened, pale to medium olivaceous brown, walls almost unthickened. *Conidiogenous cells* integrated, terminal and intercalary, short cylindrical, 9–27 µm long, with a few subdenticulate loci, 0.5–0.8 µm diam, thickened and darkened-refractive. *Ramoconidia* often formed, cylindrical, (11.5–)20.5–50(–67) × (2.5–)3(–3.5) µm, with up to five septa, base broadly truncate, 2–3 µm wide, slightly thickened and somewhat darkened-refractive, but not coronate. *Conidia* catenate, in branched chains, branching in all directions, with up to six conidia in the unbranched parts, straight, *small terminal conidia* globose to subglobose, sometimes ovoid, (2–)3–5(–7) × (2–)3–3.5 µm (av. ± SD: 4.1 ± 0.7 × 3.2 ± 0.3 µm), aseptate, minutely verruculose to verrucose, narrower at both ends, *intercalary conidia* with 1–2 apical hila subglobose, ovoid to ellipsoid, 4.5–10(–12) × 2.5–3.5(–4.5) µm (av. ± SD: 6.5 ± 1.6 × 3.6 ± 0.3 µm), aseptate, attenuated towards apex and base, *secondary ramoconidia* ellipsoid to cylindrical, 8–24(–38) × (2–)2.5–3.5(–4) µm (av. ± SD: 15.4 ± 5.1 × 3.6 ± 0.5 µm), 0–3(–4)-septate, not constricted at septa, but septa somewhat darkened and thickened, pale to usually medium olivaceous brown, sometimes dark brown, smooth to minutely verruculose, walls thickened, with up to six pronounced, denticulate distal hila, 0.8–1.5 µm diam, sometimes loci situated at the end of protuberant, short, terminal projections, 1–2 µm long or even longer in secondary ramoconidia with beak-like ends, sometimes alternarioid, obclavate, subrostrate (not observed when cultivated on SNA after 7 d, but on PDA and MEA), thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA reaching 21–50 mm diam in 14 d at 25 °C, grey olivaceous or greenish olivaceous, reverse dark grey olivaceous, iron-grey or greyish blue, velvety, margin white, regular, narrow, somewhat feathery, aerial mycelium absent or sparse, growth flat with an elevated colony centre, numerous prominent exudates formed, sporulating, some strains release green soluble pigment into the agar. Colonies on MEA attaining 15–45 mm diam after 14 d at 25 °C, grey olivaceous to

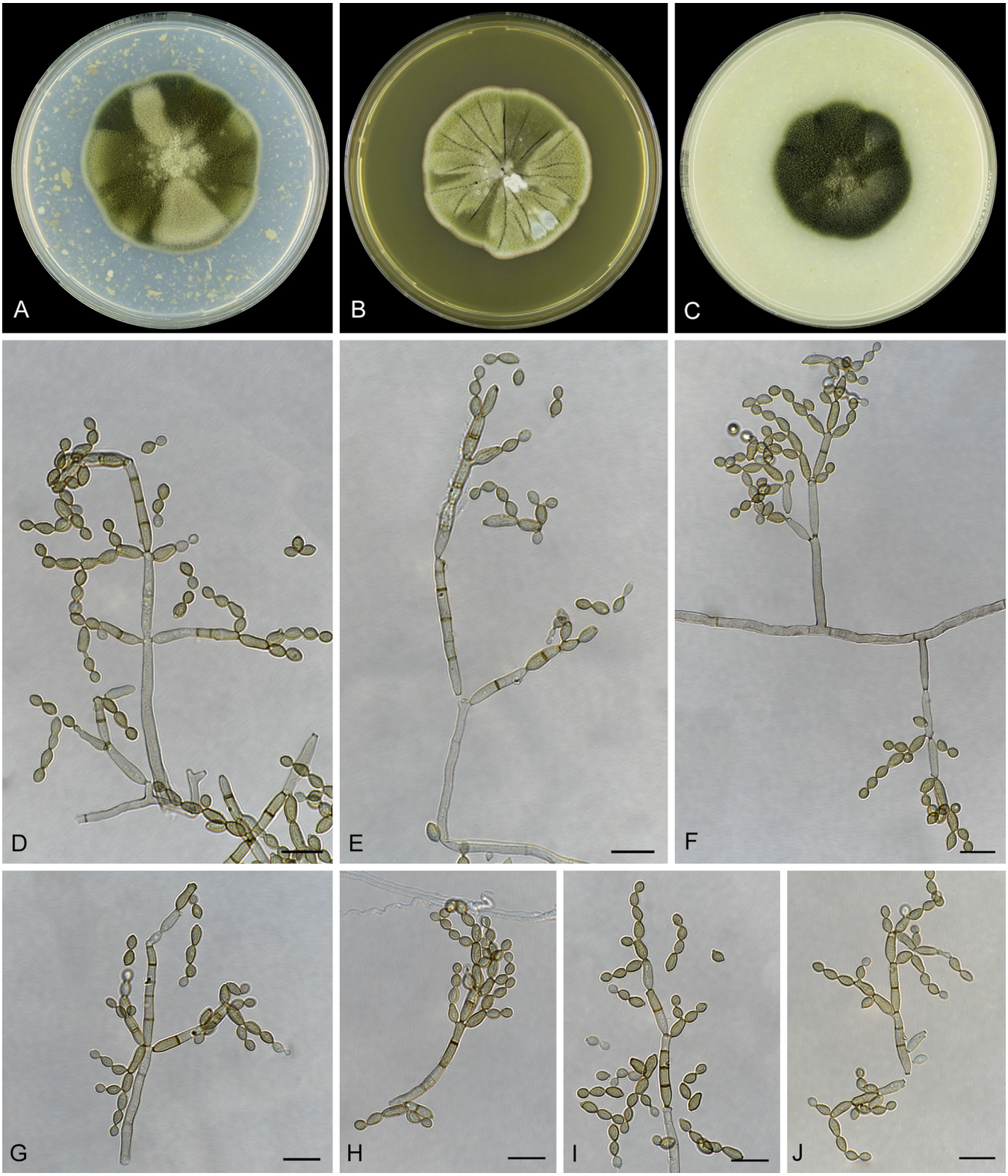

Fig. 37. *Cladosporium sphaerospermum* (DTO 160-I2). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Conidiophores and conidial chains. **I–J.** Conidial chains. Scale bars = 10 µm.

olivaceous grey, reverse olivaceous grey to iron-grey, powdery, velvety, margin colourless or white, feathery, regular, radially furrowed, aerial mycelium almost absent, growth low convex with elevated colony centre, centre often wrinkled forming a crater-like structure, without prominent exudates, sporulation profuse. Colonies on OA reaching 21–38 mm diam after 14 d at 25 °C, dark grey olivaceous, olivaceous or olivaceous grey due to profuse sporulation, reverse greenish grey, velvety, aerial mycelium absent, growth flat with papillate surface, without prominent exudates. Colonies on MEA with 5 % NaCl growing faster than on other media, reaching 31–60 mm diam after 14 d at 25 °C, mainly olive, either being almost flat or radially furrowed, with margin of superficial mycelium, sporulation dense, reverse ochraceous or dark green.

Maximum tolerated salt concentration: On MEA + 20 % NaCl 89 % of all strains tested develop colonies after 7 d, 96 % after 14 d.

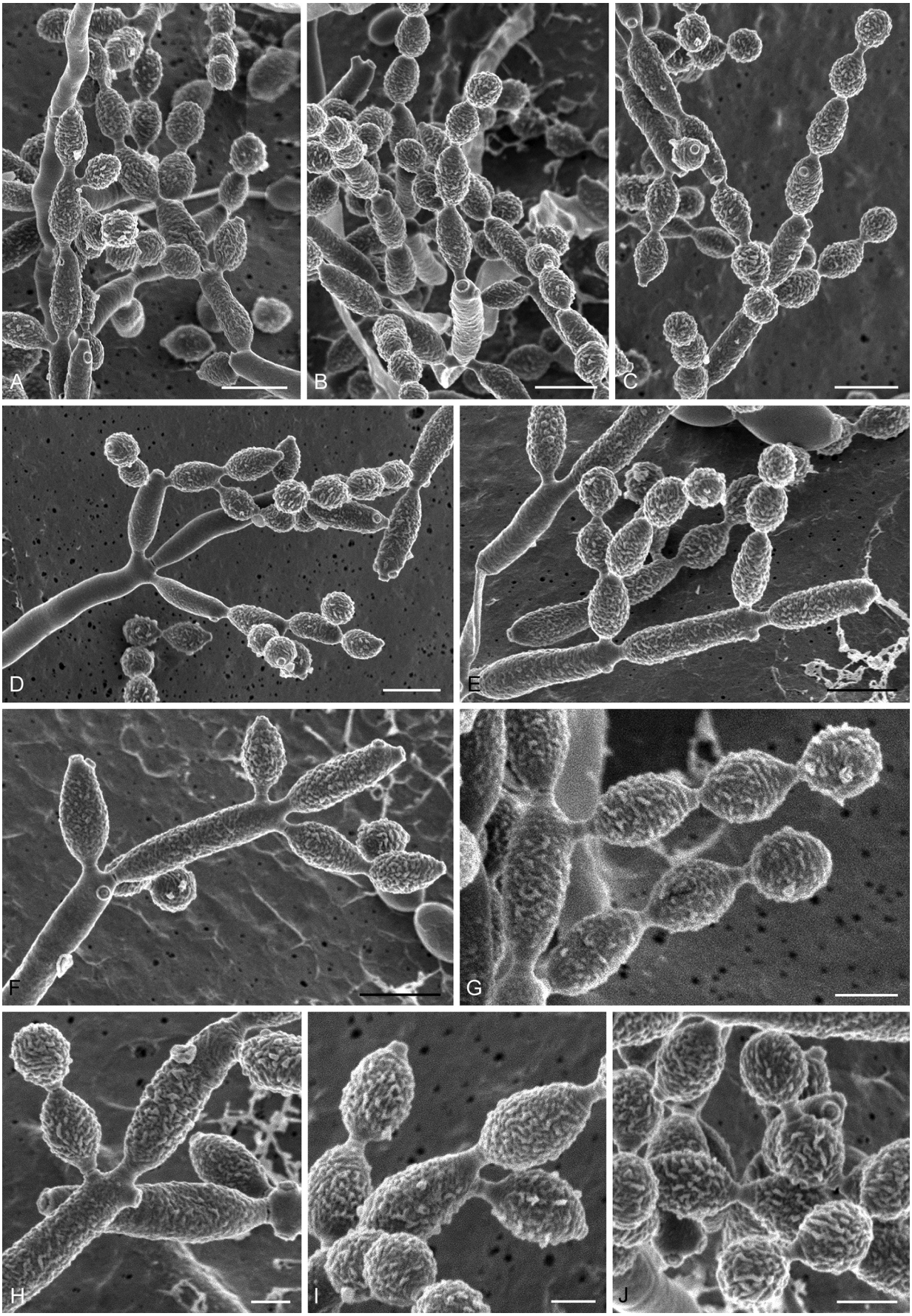

Fig. 38. *Cladosporium sphaerospermum* (DTO 160-I2). **A.** Conidiophores, ramoconidia and terminal conidia showing characteristic ornamentation. **B.** Scars on ramoconidia and conidial chains. Note the smooth apical zones on the spores. **C.** Conidial chains and scars. Note that terminal conidia do not have smooth regions. **D.** Conidiophore with primary and secondary ramoconidia and conidial chains. Note the smooth cell wall of conidiophore stipe and primary ramoconidium. **E.** Ramoconidia and chains. **F.** Branching points on ramoconidium with smooth apical zones and scars. **G–J.** Details of ramoconidia, intercalary conidia and terminal conidia. Note the ornamentation consisting out of ridges, which are often twisted (see I, J); the smooth cells wall next to the scars (H) and between conidia (G). Scale bars = 2 (G–J), 5 (A–F) µm.

Cardinal temperatures: No growth at 4 °C, optimum at 25 °C, maximum at 30 °C, no growth at 37 °C. (from Zalar *et al.* 2007).

Substrates and distribution: Occurring as secondary invader on numerous plants, saprobic on dead leaves, stems, wood and other plant organs, isolated from outdoor and indoor air, soil, hypersaline water, indoor wet cells, foodstuffs and other organic matter, paint, silicon, textiles and occasionally isolated from human and animals (nails, nasal mucus, etc.); cosmopolitan.

Additional materials examined: **Australia**, Tasmania, isol. from house dust, B. Horton, DTO 307-H1; BH02AU-119. **Portugal**, isol. from indoor environment, DTO 150-I3; DTO 150-I8. **South Africa**, isol. from house dust, K. Jacobs, DTO 305-F5 = KJ03SA-383B, DTO 307-G6 = KJ08SA-151. **The Netherlands**, Gilze, swab sample of wall near window in apartment, DTO 161-E1, J. Houbraken; Utrecht, swab sample archive, M. Meijer, DTO 090-H9. **UK**, Ditherington, isol. from indoor air sample, Dec. 2012, Ž. Jurjević, EMSL 1870 = CPC 22357. **USA**, isol. from house dust, A. Amend, DTO 306-D8 = AA03US-373, DTO 306-E3 = AA03US-478, DTO 307-I3 = AA03US-549; California, Newport Beach, isol. from indoor air sample, bathroom, Oct. 2012, Ž. Jurjević, EMSL 1789, 1790 = CPC 22301, 22302; San Francisco, isol. from indoor air sample, family room, Jan. 2013, Ž. Jurjević, EMSL 1892 = CPC 22379; Minnesota, isol. from indoor air sample, Aug. 2012, Ž. Jurjević, EMSL 1728 = CPC 22270; Mississippi, Ridgeland, isol. from indoor air sample, Nov. 2012, Ž. Jurjević, EMSL 1820 = CPC 22317; New York, Hamlet, isol. from indoor air sample, warehouse, Dec. 2012, Ž. Jurjević, EMSL 1852 = CPC 22339; Vermont, Williston, isol. from indoor air sample, bedroom, Dec. 2012, Ž. Jurjević, EMSL 1874 = CPC 22361; Wisconsin, Oak Creek, isol. from air sample, bakery, DTO 127-E5 = AR385. Additional isolates are listed in Table 1.

Notes: *Cladosporium sphaerospermum* (Fig. 3, clade 20) was described by Penzig (1882) from decaying *Citrus* leaves and branches in Italy. Penzig's original material is not known to be preserved. Later, a culture derived from CBS 193.54, originating from a human nail, was accepted as typical for *C. sphaerospermum*. However, de Vries (1952), incorrectly cited it as "lectotype", and thus the same specimen was designated as neotype in Zalar *et al.* (2007), with the derived culture (CBS 193.54) used as ex-neotype strain. Zalar *et al.* (2007) considered *C. sphaerospermum* as halo- or osmotolerant. Although *C. sphaerospermum* has commonly been isolated from osmotically stressed environments, it is also known from non-stressed niches. It is a cosmopolitan species that has been studied from the perspectives of phylogeny, halotolerance and general ecology (summarised in Zalar *et al.* 2007), biodegradative capacities (*e.g.*, Weber *et al.* 1995, Prenafeta-Boldú *et al.* 2001, Potin *et al.* 2004, Nieves-Rivera *et al.* 2006, Kim *et al.* 2007), and clinical aspects (summarised in de Hoog *et al.* 2000, Zalar *et al.* 2007, Sandoval-Denis *et al.* 2015). In the study of Sandoval-Denis *et al.* (2015) most of the clinical isolates morphologically identified as *C. sphaerospermum* were genetically reidentified as belonging to the phenotypically similar species *C. halotolerans*, which according to their data, emerged as the most common species from clinical origin.

Furthermore, *Cladosporium sphaerospermum* proved to be a common species isolated from indoor environments (Segers *et al.* 2015; this study, see Table 1). It is a phylogenetically well-delineated species (see Fig. 3, clade 20 and Zalar *et al.* 2007) which differs from *C. halotolerans* in forming often branched and densely septate, somewhat wider conidiophores, 2.5–4.5(–6) µm, and producing slightly longer small terminal conidia, (2–)3–5(–7) and with up to 5-septate ramoconidia being up to 50(–67) µm long, commonly beaked (alternarioid) on MEA and PDA.

Cladosporium subinflatum K. Schub. *et al.*, Stud. Mycol. 58: 143. 2007. MycoBank MB504579. Fig. 39.

Holotype: **Slovenia**, Sečovlje, crystallisation ponds, salterns, isolated from hypersaline water, 2005, S. Sonjak, CBS H-19864. *Isotype*: HAL 2027 F. *Ex-type culture*: CBS 121630 = CPC 12041 = EXF-343.

Lit.: Bensch *et al.* (2012: 258–260), Bensch *et al.* (2015: 68). *Ill.*: Schubert *et al.* (2007b: 143–144, figs 37–39), Bensch *et al.* (2012: 258–259, figs 296–298).

Mycelium unbranched or occasionally branched, 1.5–4 µm wide, later more frequently branched and wider, up to 7 µm wide, sometimes anastomosing, septate, not constricted at the septa, but sometimes single septa darkened, subhyaline or pale olivaceous brown, almost smooth to somewhat verruculose or irregularly rough-walled in fertile hyphae, walls unthickened. *Conidiophores* mainly macronematous, sometimes also micronematous, arising terminally from ascending hyphae or laterally from plagiotropous hyphae, erect or subdecumbent, straight or flexuous, sometimes bent, cylindrical, nodulose, usually with small head-like swellings, sometimes swellings also on a lower level or intercalary, occasionally geniculate, unbranched, occasionally branched, (5–)10–100(–270) × (1.5–)2.5–4.5(–5.5) µm, swellings 3–6.5 µm wide, aseptate or with few septa, not constricted at the septa, pale brown, pale or medium olivaceous brown, smooth, usually verruculose or irregularly rough-walled and paler, subhyaline towards the base, walls thickened, sometimes appearing even two-layered, up to 1 µm thick; micronematous conidiophores narrower, paler and shorter, mostly without capitate apex, short narrowly cylindrical, up to 35 µm long, 2–3 µm wide. *Conidiogenous cells* integrated, usually terminal or conidiophores reduced to conidiogenous cells, cylindrical, nodulose, usually with small head-like swellings with loci confined to swellings, sometimes geniculate, 5–42 µm long, proliferation sympodial, with several loci, up to four situated at nodules or on lateral swellings, protuberant, conspicuous, denticulate, (0.8–)1–2 µm diam, thickened and darkened-refractive. *Ramoconidia* rarely formed. *Conidia* catenate, in short branched chains, 1–4 conidia in the terminal unbranched part of the chain, more or less straight, numerous globose and subglobose conidia, ovoid, obovoid, broadly ellipsoid to cylindrical, *small terminal conidia* subglobose, obovoid or ellipsoid, (3–)4–7(–9) × (2.5–)3–4 µm (av. ± SD: 5.4 ± 1.4 × 3.3 ± 0.5 µm), *intercalary conidia* ovoid, ellipsoid, 5.5–9(–12.5) × (3–)3.5–4(–4.5) µm (av. ± SD: 8.5 ± 2.1 × 3.8 ± 0.4 µm), aseptate, with 1(–2) distal hila, *secondary conidia* ellipsoid or subcylindrical, (7–)8.5–20(–25) × (3–)4–5.5(–7) µm (av. ± SD: 13.5 ± 4.2 × 4.6 ± 0.5 µm), 0–1(–2)-septate, with (1–)2–3(–4) distal hila, pale to medium olivaceous brown, ornamentation variable, mainly densely verruculose to echinulate (loosely muricate under SEM), spines up to 0.8 µm high, sometimes irregularly verrucose with few scattered tubercles or irregularly echinulate, walls unthickened or slightly thickened, apex rounded or slightly attenuated towards apex and base, hila conspicuous, protuberant, denticulate, 0.5–2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis observed.

Culture characteristics: Colonies on PDA attaining 26–60 mm diam after 14 d at 25 ºC, pale olivaceous grey to olivaceous grey, or dull-green, reverse iron-grey or olivaceous black, margin regular, entire edge, narrow, colourless to white, glabrous, aerial mycelium abundantly formed, fluffy, dense, growth flat, somewhat folded in the colony centre, deep into the agar, few prominent exudates formed with age, sporulation profuse.

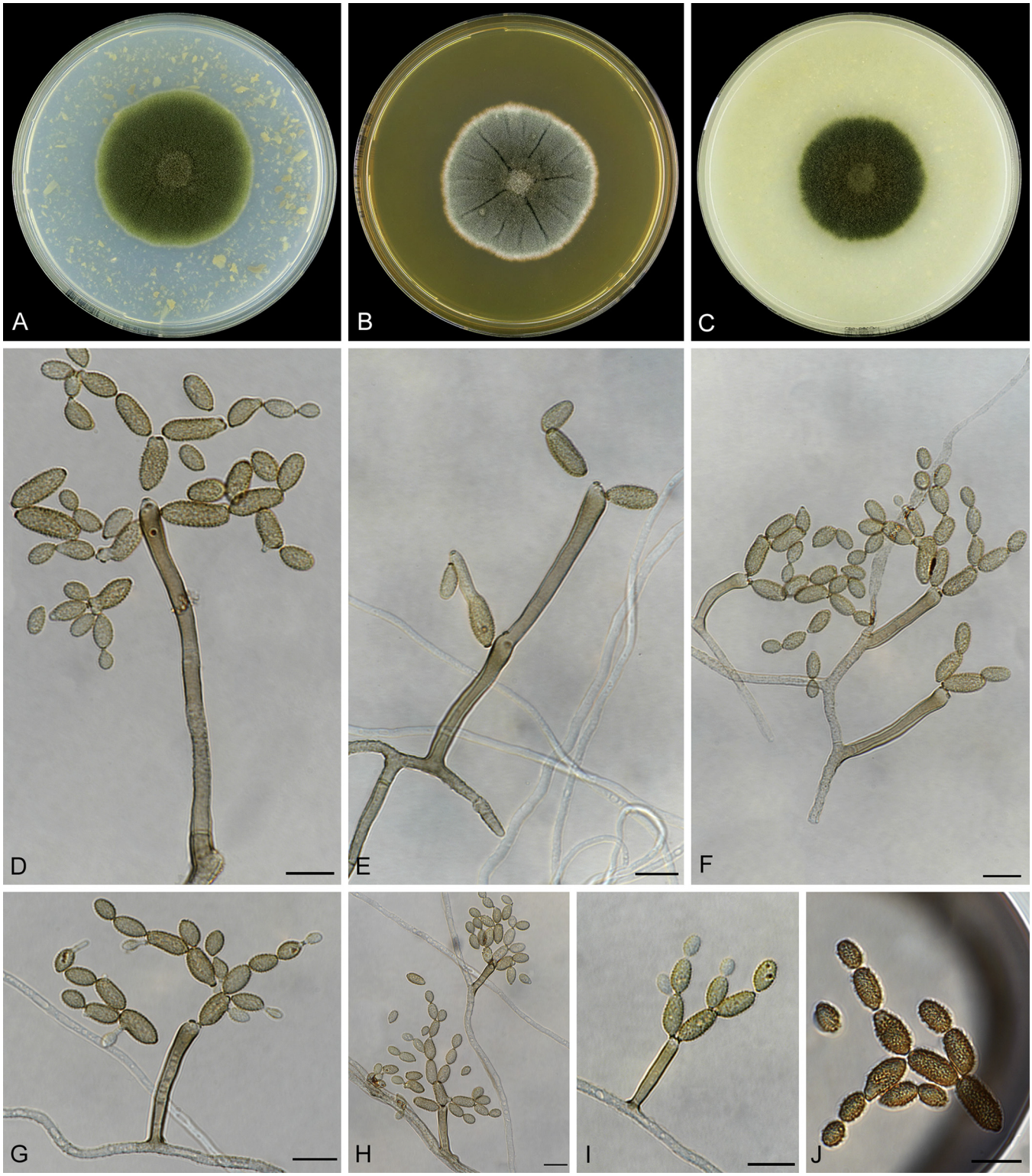

Fig. 39. *Cladosporium subinflatum* (CPC 22303). **A–C.** Colonies on PDA, MEA and OA. **D–G.** Conidiophores and conidial chains. **H–I.** Micronematous conidiophores. **J.** Conidial chains with conidia showing the densely verruculose to echinulate surface ornamentation. Scale bars = 10 µm.

Colonies on MEA attaining 25–60 mm diam after 14 d at 25 °C, olivaceous grey to olivaceous due to abundant sporulation in the colony centre, pale greenish grey towards margin, iron-grey or olivaceous grey on reverse, velvety to powdery, margin narrow, white, glabrous, radially furrowed, aerial mycelium diffuse, growth convex with papillate surface, wrinkled colony centre, without prominent exudates, sporulation profuse. Colonies on OA attaining 26–58 mm diam after 14 d at 25 °C, olivaceous, dull-green towards margins, reverse iron-grey, leaden-grey to greenish black, velvety to fluffy, margin regular, aerial mycelium loose, diffuse or denser in colony centre, growth flat, deep into the agar, with a single exudate, abundantly sporulating.

Substrate and distribution: Hypersaline water, indoor air and plant material; Europe (Slovenia, Ukraine), North America (USA).

Additional materials examined: **USA**, Minnesota, Fergus Falls, isol. from indoor air sample, Oct. 2012, Ž. Jurjević, EMSL 1791 = CPC 22303; Missouri, Fort Leonard Wood, isol. from indoor air sample bathroom, Jan. 2013, Ž. Jurjević, EMSL 1928 = CPC 22400.

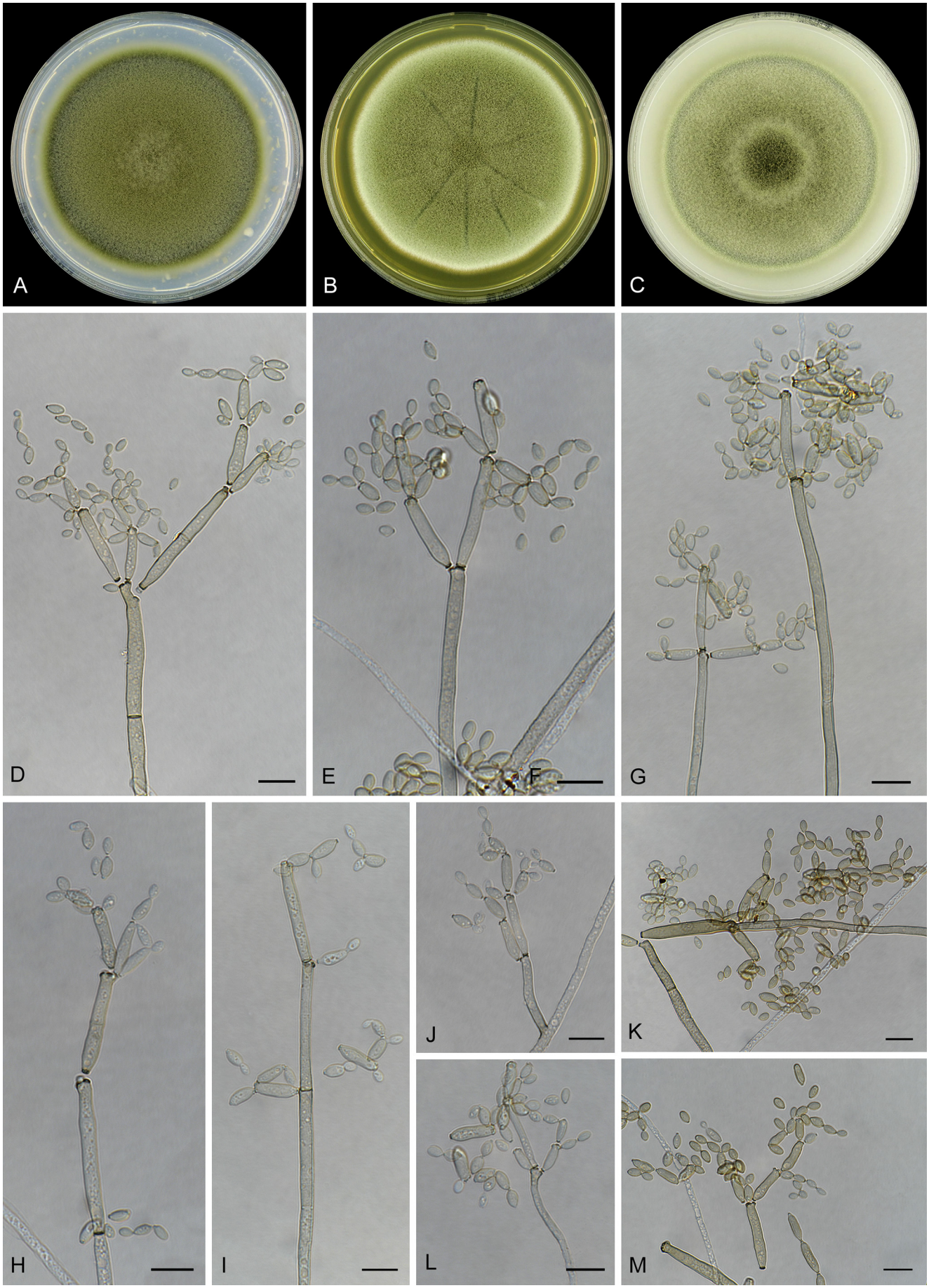

Fig. 40. *Cladosporium subuliforme* (DTO 324-C7). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Macronematous conidiophores and conidial chains. **I, K.** Micronematous conidiophores. **J.** Ramoconidium seceded at a conidiophore. **L.** Conidial chains. Scale bars = 10 µm.

Notes: *Cladosporium subinflatum* (Fig. 2, clade 21) is a saprobic hyphomycete well characterised by the formation of numerous globose or subglobose conidia, resembling members of the *C. sphaerospermum* species complex (Fig. 3), with its coarse surface ornamentation ranging from verruculose to distinctly spiny. *Cladosporium spinulosum* (Fig. 2, clade 28), also isolated from hypersaline water, is morphologically close to *C. subinflatum*, but differs from the latter species in having somewhat narrower macronematous conidiophores, narrower conidiogenous loci and hila, and conidia with longer spines, up to 1.3 µm. *Cladosporium allicinum* (Fig. 2, clade 27) may superficially also be confusable, but its conidia are minutely verruculose to verrucose but never spiny.

The species was previously known only from hypersaline environments and plant material but is now also reported from indoor environments and known from clinical samples (Sandoval-Denis *et al.* 2015).

Cladosporium subuliforme Bensch *et al.*, Stud. Mycol. 67: 77. 2010. MycoBank MB517090. Fig. 40.

Holotype: **Thailand**, Chiang Mai, Sansai, Mai Jo, palm nursery, isol. from *Chamaedorea metallica* (*Arecaceae*), 26 Dec. 2006, coll. I. Hidayat & J. Meeboon, FIH 401, isol. P.W. Crous, CBS H-20448. *Ex-type culture*: CBS 126500 = CPC 13735.

Lit.: Bensch *et al.* (2012: 264–265; 2015: 68), Ramos-García *et al.* (2016).
Ill.: Bensch *et al.* (2010: 78, figs 67–68; 2012: 264–265, figs 305–306).

Mycelium internal and superficial, abundantly formed; hyphae sparingly branched, 1–4 µm wide, septate, sometimes slightly constricted at the base of conidiophores, subhyaline to pale olivaceous brown, smooth to minutely verruculose or verruculose, often somewhat swollen at the base of conidiophores, up to 6 µm wide, sometimes forming ropes. *Conidiophores* macro-, semimacro- or micronematous, solitary or in pairs, arising terminally and laterally from hyphae, erect, straight to mostly flexuous, filiform to narrowly cylindrical-oblong, often slightly to distinctly attenuated towards the apex and wider at the base, not nodulose or geniculate, unbranched or branched, branches often only as short peg-like lateral outgrowths just below a septum bearing conidiogenous loci, branches occasionally longer, up to 20 µm, 9–330 × (1.5–)2–4 µm, often wider towards the base, pluriseptate, usually not constricted at septa, pale to medium olivaceous brown, smooth to sometimes minutely verruculose, parts of the stalk occasionally verrucose or irregularly rough-walled, basal cell sometimes swollen up to 8(–10) µm, walls unthickened or only slightly thickened, about 0.5 µm wide. *Conidiogenous cells* integrated, mainly terminal but also intercalary, narrowly cylindrical-oblong, neither nodulose nor geniculate, 9–40 µm long, with up to five loci crowded at the uppermost apex, in intercalary cells loci often situated on small denticle- or peg-like lateral outgrowths just below a septum, loci conspicuous, subdenticulate, (0.8–)1–1.5(–2) µm diam, thickened and darkened-refractive. *Ramoconidia* commonly formed, cylindrical-oblong, differentiation between ramoconidia and secondary ramoconidia often quite difficult, (14–)17–39 × (1.5–)2–3 µm, 0(–1)-septate, pale olivaceous brown, smooth, walls unthickened, not attenuated towards the base, base broadly truncate, 2–2.5 µm wide, unthickened, but often somewhat darkened or refractive. *Conidia* numerous, catenate, in branched chains, up to 2–6 conidia in the unbranched terminal part of the chain, branching in all directions, straight, *small terminal conidia* obovoid, subglobose, ovoid to limoniform or ellipsoid, 2.5–4.5(–5.5) × 2–2.5 µm (av. ± SD: 4.1 ± 0.7 × 2.2 ± 0.3), aseptate, rounded at the apex, attenuated towards the base, *intercalary conidia* ellipsoid to subcylindrical, 5–13 × 2–3(–3.5) µm (av. ± SD: 8.3 ± 2.6 × 2.8 ± 0.4), aseptate, with up to four distal hila, attenuated towards apex and base, *secondary ramoconidia* ellipsoid to subcylindrical, sometimes cylindrical-oblong, (6–)8–27(–34) × 2–3.5 µm (av. ± SD: 17.6 ± 7.3 × 2.9 ± 0.4), 0–1-septate, not constricted at septa, median or somewhat in the lower half, usually somewhat attenuated towards the base, (2–)3–4(–5) distal hila, pale olivaceous brown, smooth or almost so (LM), walls unthickened, hila conspicuous, subdenticulate to denticulate, (0.2–)0.5–1.5(–2) µm diam, somewhat thickened and darkened-refractive; microcyclic conidiogenesis occasionally occurring.

Culture characteristics: Colonies on PDA attaining up to 80 mm diam after 14 d at 25 °C, grey olivaceous to mainly olivaceous grey, reverse olivaceous grey, velvety to floccose, fluffy, margins grey olivaceous to white, feathery, regular or slightly undulate, aerial mycelium abundant, loose, fluffy, growth effuse to low convex, without exudates, sporulation profuse. Colonies on MEA reaching 60–80 mm diam after 14 d at 25 °C, greenish olivaceous to pale olivaceous grey and olivaceous buff, glaucous-grey at margins, reverse olivaceous grey, floccose to fluffy, margins white, glabrous, regular to somewhat undulate, radially furrowed and wrinkled, effuse, aerial mycelium abundant, fluffy, mainly in colony centre, without exudates, sporulation profuse. Colonies on OA attaining up to 80 mm diam after 14 d at 25 °C, whitish to smoke-grey and pale olivaceous grey, olivaceous buff and dull green towards margins, somewhat zonate, grey olivaceous due to sporulation, reverse leaden-grey, floccose to felty, margins dull green or colourless, regular, glabrous, aerial mycelium abundant, floccose to fluffy-felty, covering large parts of colony surface, growth effuse, without exudates, sporulating.

Substrate and distribution: Isolated from plant material and indoor environments; Africa (South Africa), Asia (China, Thailand), Central and South America (Brazil, Cuba), North America (Mexico, USA).

Additional materials examined: **China**, isol. from indoor air, DTO 323-D1, DTO 324-B8, DTO 324-C7. **Thailand**, Surat Thani, isol. from indoor air (open Petri-dish), P. Noonim, DTO 130-H8.

Notes: *Cladosporium subuliforme* (Fig. 1, clade 59) belongs to the *C. cladosporioides* species complex, but deviates from allied species, specifically *C. cladosporioides* (Fig. 1, clade 66) and *C. tenuissimum* (Fig. 1, clade 64), by its long narrow subulate conidiophores with several loci crowded at the apex and its numerous ramoconidia with narrow loci and hila. *Cladosporium angustisporum* (Fig. 1, clade 58) is phylogenetically close to this species (also see Bensch *et al.* 2010, 2012, 2015) but morphologically easily separable. The conidiophores are not subuliform and the terminal conidia are somewhat longer and narrower.

Sandoval-Denis *et al.* (2015) reported *C. subuliforme* for the first time from clinical samples in the United States. In the present study it is now also reported to occur in indoor environments.

Cladosporium tenellum K. Schub. *et al.*, Stud. Mycol. 58: 149. 2007. MycoBank MB504581. Fig. 41.

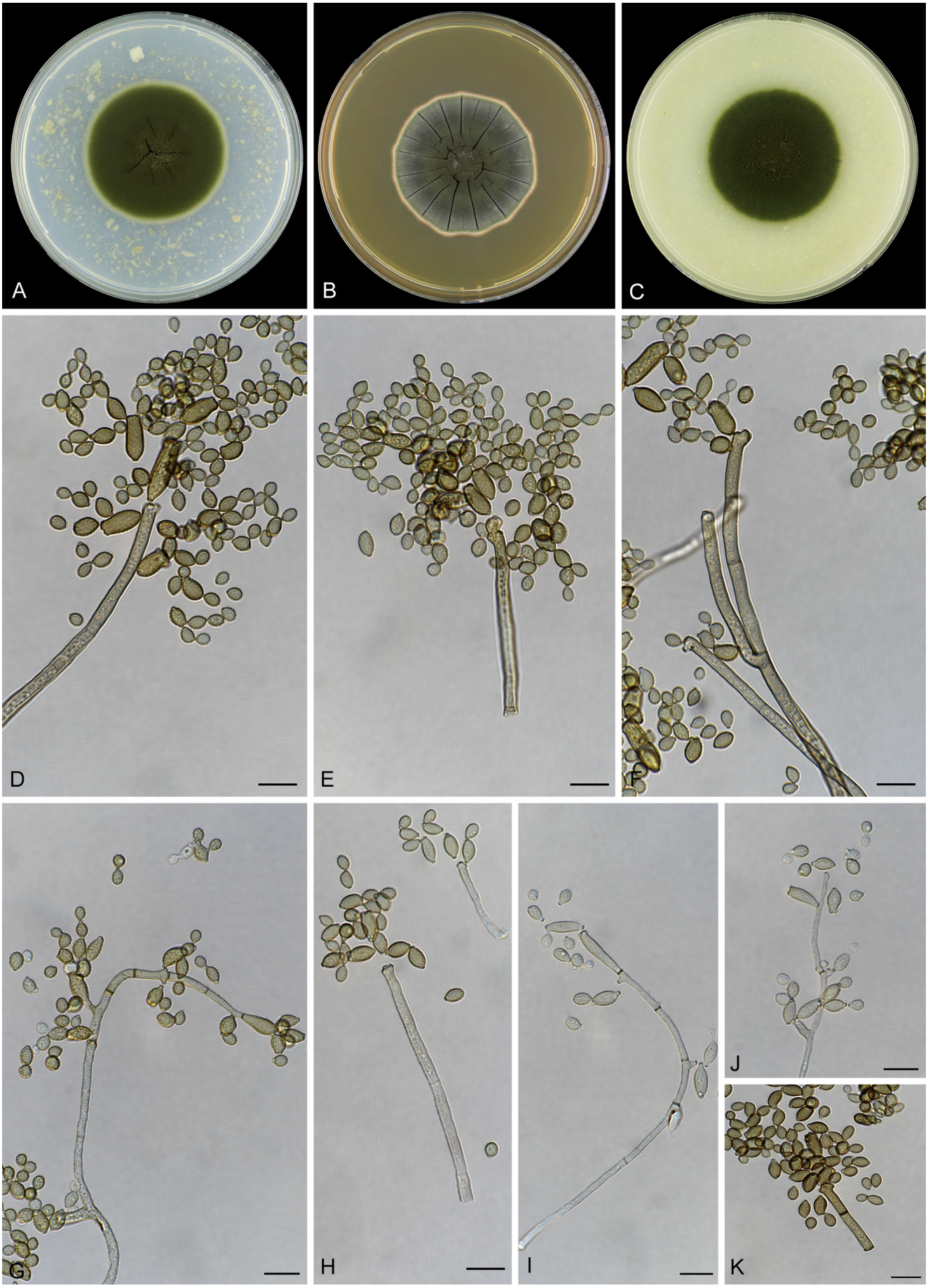

Fig. 41. *Cladosporium tenellum* (CPC 22290). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Conidiophores and conidial chains. **I–J.** Micronematous conidiophores. **K.** Ramoconidium and conidia. Scale bars = 10 µm.

Holotype: **Israel**, Ein Bokek, Dead Sea, isolated from hypersaline water, 2004, M. Ota, CBS H-19866. *Isotype*: HAL 2029 F. *Ex-type culture*: CBS 121634 = CPC 12053 = EXF-1735.

Lit.: Bensch *et al.* (2012: 268–269).
Ill.: Schubert *et al.* (2007b: 148–149, figs 43–45), Bensch *et al.* (2012: 268–269, figs 311–313).

Mycelium sparingly branched, 1–3 µm wide, septate, septa often not very conspicuous, not constricted at the septa, sometimes slightly swollen, subhyaline, smooth, walls unthickened. *Conidiophores* macro- and micronematous, solitary, arising terminally or laterally from plagiotropous or ascending hyphae, erect or subdecumbent, almost straight to more or less flexuous, cylindrical, sometimes geniculate towards the apex, but not nodulose, sometimes with short lateral prolongations at the apex, unbranched to once or twice branched (angle usually 30–45° degree, sometimes up to 90°), branches usually below a septum, 6–200 × (1–)2–4(–5) µm, septate, septa often not very conspicuous, occasionally appearing somewhat darkened, not constricted at the septa, sometimes septa in short succession, subhyaline to pale brown, almost smooth to usually asperulate, walls unthickened or almost so. *Conidiogenous cells* integrated, terminal or intercalary, sometimes conidiophores reduced to conidiogenous cells, cylindrical, sometimes geniculate, non-nodulose, 6–40 µm long, proliferation sympodial, with several conidiogenous loci often crowded at the apex and sometimes also at a lower level, situated on small lateral shoulders, unilateral swellings or prolongations, with up to 6(–10) denticulate loci, forming sympodial clusters of pronounced scars, intercalary conidiogenous cells with short or somewhat long lateral outgrowths, short denticle-like or long branches with several scars at the apex, usually below a septum, loci protuberant, 1–1.5(–2) µm diam, thickened and darkened-refractive. *Ramoconidia* sometimes occurring, cylindrical, up to 32 µm long, 2.5–4(–4.5) µm wide, with a broadly truncate, unthickened base, about 2(–2.5) µm wide. *Conidia* catenate, formed in branched chains, straight, *small terminal conidia* globose, subglobose, ovoid, (2.5–)3–5(–6) × (2–)2.5–3.5(–4) µm (av. ± SD: 4.0 ± 0.7 × 2.9 ± 0.5 µm), aseptate, asperulate, with 0–1 distal hila, *intercalary conidia* ovoid or ellipsoid, 5–11(–13) × 3 4.5(5) µm (av. ± SD: 7.4 ± 1.9 × 3.8 ± 0.6 µm), aseptate, with 1–4 distal hila, *secondary ramoconidia* ellipsoid-ovoid, ellipsoid to subcylindrical, (6–)8–21(–28) × (2.5–)3–5(–6) µm (av. ± SD: 14.4 ± 4.7 × 4.6 ± 3.8 µm), 0–1-septate, rarely with up to three septa, sometimes slightly constricted at septa, subhyaline, pale brown to medium olivaceous brown, asperulate or verruculose (muricate, granulate or colliculate under SEM), walls unthickened or slightly thickened, apex rounded or slightly to distinctly attenuated towards apex and base, often forming several apical hila, up to 7(–9), crowded, situated on small lateral outgrowths giving them a somewhat irregular appearance, hila protuberant, 0.5–1.5 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis sometimes occurring.

Culture characteristics: Colonies on PDA reaching 27–34 mm diam after 14 d at 25 ºC, smoke-grey, grey olivaceous to olivaceous grey, olivaceous grey to iron-grey reverse, velvety to powdery, margin regular, entire edge, narrow, colourless to white, aerial mycelium absent or sparingly formed, felty, whitish, growth regular, flat, radially furrowed, with folded and elevated colony centre, deep into the agar, with age forming few to numerous prominent exudates, sporulation profuse, few high conidiophores formed. Colonies on MEA reaching 25–44 mm diam after 14 d at 25 ºC, olivaceous grey to olivaceous or iron-grey due to abundant sporulation in the colony centre, velvety, margin regular, entire edge, narrow, colourless, white to pale olivaceous grey, aerial mycelium loose, diffuse, growth convex with papillate surface, radially furrowed, wrinkled, without prominent exudates, sporulating. Colonies on OA reaching 23–32 mm diam after 14 d at 25 ºC, grey olivaceous, olivaceous grey to olivaceous due to abundant sporulation in the colony centre, olivaceous or iron-grey reverse, velvety, margin regular, entire edge, narrow, colourless or white, aerial mycelium sparse, diffuse, floccose, growth flat to low convex, radially furrowed, wrinkled, without prominent exudates, sporulation profuse.

Substrate and distribution: Hypersaline water, indoor environments and plant material; Middle East (Israel), North America (USA).

Additional materials examined: **USA**, isol. from air sample, bakery, CBS 139582 = DTO 127-D7 = AR295; Michigan, Big rapids, isol. from indoor air sample, classroom, Jan. 2013, Ž. Jurjević, EMSL 1941 = CPC 22410; Okemos, isol. from indoor air sample, bathroom, Sep. 2012, Ž. Jurjević, EMSL 1771 = CPC 22290; Oregon, Salem, isol. from indoor air sample, bedroom, Sep. 2012, Ž. Jurjević, EMSL 1772 = CPC 22291.

Notes: *Cladosporium tenellum* (Fig. 2, clade 22) comprises characters of various species complexes of the genus *Cladosporium*. The formation of globose or subglobose terminal conidia is reminiscent of members of the *C. sphaerospermum* species complex (Fig. 3). Based on the general morphology and size of conidiophores and conidia *C. tenellum* is rather comparable with species of the *C. cladosporioides* species complex (Fig. 1), e.g. *C. cladosporioides s. str.* characterised by smooth conidiophores and conidia with only few conidiogenous loci and conidial hila crowded at the apex and somewhat wider conidiophores, 3–5(–6) µm. However, it belongs to the *C. herbarum* species complex (Fig. 2) where it resembles *C. subtilissimum* (Fig. 2, clade 25) and *C. ramotenellum* (Fig. 2, clade 37; Schubert *et al.* 2007b). In *C. subtilissimum* the small terminal conidia are not globose but rather narrowly obovoid to limoniform, the conidiogenous loci and conidial hila are somewhat wider, (0.5–)0.8–2(–2.2) µm, and at the apices of conidiophores and conidia only few scars are formed. *Cladosporium ramotenellum* possesses longer and narrower, 0–3-septate conidia, 2.5–35 × 2–4(–5) µm, but forms only few conidiogenous loci and conidial hila at the apices of conidiophores and conidia (Bensch *et al.* 2012). It has not only been isolated from hypersaline water and plant material but also from indoor environments.

Cladosporium tenuissimum Cooke, Grevillea 6(40): 140. 1878. MycoBank MB145672. Fig. 42.

Lectotype (designated by Heuchert *et al.* 2005): **USA**, South Carolina, Aiken, on leaf sheets of *Zea mays* (*Poaceae*), H.W. Ravenel, Ravenel, Fungi Amer. Exs. 160 (NY). *Isolectotypes*: Ravenel, Fungi Amer. Exs. 160 (*e.g.*, K, PH 01020427). *Topotype material*: Roumeguère, Fungi Sel. Gall. Exs. 5295 (*e.g.*, NY). *Epitype* (designated by Bensch *et al.* 2010): **USA**, Louisiana, Baton Rouge, isol. from fruits of *Lagerstroemia* sp. (*Lythraceae*), 8 Sep. 2007, P.W. Crous, CBS H-20449. *Ex-epitype culture*: CBS 125995 = CPC 14253.

Lit.: Ellis (1976: 326), Ho *et al.* (1999: 140), Heuchert *et al.* (2005: 50–52), Bensch *et al.* (2010: 78–81; 2012: 269–272).

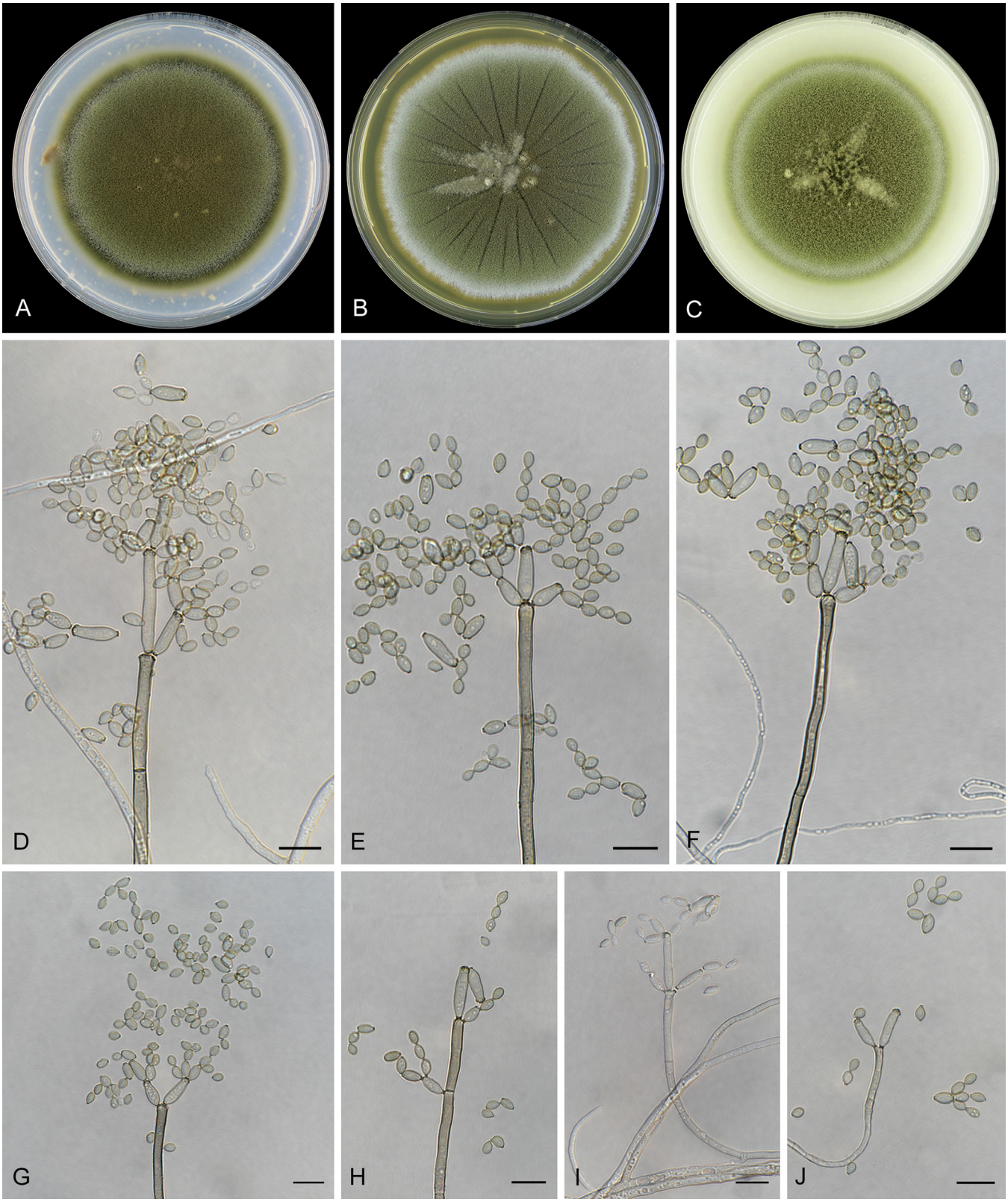

Fig. 42. *Cladosporium tenuissimum* (DTO 323-G3). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Macronematous conidiophores and conidial chains. **I–J.** Micronematous conidiophores and conidia. Scale bars = 10 µm.

Ill.: Ellis (1976: 327, fig. 245 A), Ho *et al.* (1999: 143, figs 46–47), Heuchert *et al.* (2005: 51, fig. 20), Bensch *et al.* (2010: 80–81, figs 69–70; 2012: 270–271, figs 314–316).

Mycelium immersed and superficial, hyphae branched, (0.5–) 1–5 µm wide, septate, sometimes constricted at septa, subhyaline to pale or medium brown, with swellings and constrictions, often irregular in outline, smooth to sometimes minutely verruculose, sometimes appearing rough-walled, walls unthickened or very slightly thickened, sometimes forming ropes. *Conidiophores* solitary, macro- and micronematous, arising terminally and laterally from hyphae; macronematous conidiophores solitary, sometimes in groups of 2–3, erect, straight or slightly flexuous, cylindrical-oblong to almost filiform, sometimes slightly to distinctly geniculate towards the apex, often subnodulose or nodulose with an apical and sometimes a few

additional swellings on a lower level, swellings quite distant from the apex and from each other, most conidiophores neither geniculate nor nodulose, unbranched or branched, branching often at an angle of 45−90°, just below the apex or at a lower level, branches sometimes only as short denticle-like prolongations just below a septum, occasionally long, conidiophores 30−310(−460) × 2.5−4 µm (on OA up to 900 µm long), septate, sometimes distinctly constricted at septa, pale to medium brown or olivaceous brown, smooth, sometimes slightly rough-walled at the base, walls somewhat thickened, sometimes slightly attenuated towards the apex and distinctly swollen at the base, with age conidiophores becoming darker and more thick-walled; micro- to semimacronematous conidiophores narrower, paler, filiform to narrowly cylindrical-oblong, non-nodulose or only slightly swollen at the apex, unbranched, 17−85 × (1−)2−2.5 µm, with few septa or reduced to conidiogenous cells, pale brown or subhyaline, smooth, walls unthickened or almost so, with a single or up to seven subdenticulate, pronounced loci crowded at the apex. *Conidiogenous cells* integrated, terminal and intercalary, cylindrical-oblong, sometimes short geniculate at the apex, often nodulose, swellings up to 5 µm wide, cells (4−)10−44 µm long, loci often situated on swellings but not restricted to them, mostly only a single swelling per cell, in terminal cells apex usually head-like, uni- or multilaterally swollen with up to eight pronounced, subdenticulate to denticulate loci crowded at the tip, in intercalary conidiogenous cells loci often sitting at about the same level (arranged like a garland round about the stalk) or situated on small lateral shoulders, loci 1−1.5(−2) µm diam, thickened and darkened-refractive. *Ramoconidia* occasionally formed, subcylindrical or cylindrical-oblong, 22−41 × 3−4(−5) µm, 0(−1)-septate, base broadly truncate, 2−3.5 µm wide. *Conidia* catenate, in densely branched chains, 1−4(−6) conidia in the terminal unbranched part of the chain, branching in all directions, straight, *small terminal conidia* subglobose, obovoid, limoniform, sometimes globose, (2−)2.5−5(−6) × (1.5−)2−3 µm (av. ± SD: 3.7 ± 1.0 × 2.2 ± 0.4), aseptate, apex broadly rounded, *intercalary conidia* ovoid, ellipsoid or subcylindrical, 4−12(−17) × (1−)2−3(−4.5) µm (av. ± SD: 8.1 ± 2.7 × 2.8 ± 0.6), aseptate, occasionally 1-septate, with up to 5(−7) distal hila, sometimes cell lumen distinct, *secondary ramoconidia* ellipsoid, fusiform to subcylindrical or cylindrical, (6−)7−25(−31) × (2−)2.5−4(−5) µm (av. ± SD: 15.0 ± 5.8 × 3.2 ± 0.5), with (1−)2−6(−7) distal hila, sometimes with 1−2 hila at the basal end, 0−1(−2)-septate, sometimes distinctly constricted at septa, with age more frequently septate, pale brown or pale olivaceous brown, smooth, occasionally irregularly rough-walled, walls unthickened or almost so, attenuated towards apex and base, hila conspicuous, subdenticulate to denticulate, 0.5−1.8(−2) µm diam, thickened and darkened-refractive; microcyclic conidiogenesis occasionally occurring with conidia forming secondary conidiophores.

Culture characteristics: Colonies on PDA attaining up to 84 mm diam after 14 d at 25 °C, smoke-grey to grey olivaceous or olivaceous grey, reverse leaden-grey to olivaceous black, woolly to fluffy, margin glabrous to feathery, grey olivaceous to white, aerial mycelium abundant, high, fluffy, smoke-grey, dense, without prominent exudates, sporulating. Colonies on MEA reaching 70−80 mm diam after 14 d at 25 °C, smoke-grey to pale olivaceous grey, pale olivaceous due to abundant sporulation, reverse olivaceous grey, woolly, fluffy, margins narrow, glabrous to feathery, colourless to white, sometimes radially furrowed and wrinkled, aerial mycelium abundant, fluffy, dense, high, pale olivaceous grey, covering large parts of the colony surface, growth low convex, few prominent exudates formed, sporulating. Colonies on OA attaining 65−73 mm diam after 14 d at 25 °C, smoke-grey, pale olivaceous grey to whitish due to aerial mycelium, greenish grey towards margin, reverse olivaceous grey to iron-grey or leaden-grey, woolly-fluffy to felty, margin colourless to white, narrow, glabrous, aerial mycelium high, abundantly formed, fluffy to felty, whitish, growth at to low convex, mostly without prominent exudates, sporulating.

Substrate and distribution: On different host plants isolated from dead leaves, twigs, stems, wood and other organic matter, also isolated from air, bread, clinical samples, soil and water; cosmopolitan but especially common in the tropics.

Additional materials examined: **Bermuda**, Samerset, isol. from indoor air sample, Nov. 2012, Ž. Jurjević, EMSL 1823 = CPC 22320. **China**, isol. from indoor air, DTO 323-C5, DTO 323-C9, DTO 323-G2, DTO 323-G3, DTO 323-G4, DTO 323-G8, DTO 323-I4, DTO 323-I6, DTO 323-I8, DTO 323-I9, DTO 324-A1, DTO 324-A3, DTO 324-C2, DTO 324-C3, DTO 324-C5, DTO 324-C6, DTO 324-C9. **Mexico**, isol. from chili pepper sample, Aug. 2012, Ž. Jurjević, EMSL 1748 = CPC 22277. **Thailand**, Surat Thani, isol. from bathroom ceiling, P. Noonim, DTO 109-A1; from indoor environments (mycolab door), P. Noonim, DTO 109-C4; isol. from indoor air (open Petri-dish), P. Noonim, DTO 109-C7; Trang, isol. from indoor air (open Petri-dish), P. Noonim, DTO 131-A4. **USA**, Arizona, Casa Grande, isol. from indoor air sample, bedroom, Dec. 2012, Ž. Jurjević, EMSL 1857 = CPC 22344; Texas, Georgetown, isol. from indoor air sample, classroom, Jan. 2013, Ž. Jurjević, EMSL 1926 = CPC 22398.

Notes: *Cladosporium tenuissimum* (Fig. 1, clade 64) is a common saprobic hyphomycete comparable and confusable with *C. cladosporioides* (Fig. 1, clade 66), but genetically as well as morphologically distinct as demonstrated and discussed in Bensch *et al.* (2010, 2012). *Cladosporium stanhopeae*, a species described on *Stanhopea* (*Orchidaceae*) from Germany (Schubert & Braun 2004, Schubert 2005), resembles *C. tenuissimum* but is tentatively maintained as a separate species until isolates from that host can be included in molecular studies.

Cladosporium tenuissimum has been reported from several clinical samples in the USA (Sandoval-Denis *et al.* 2015) as the second most frequently isolated species after *C. halotolerans* and proved to be also commonly occurring in indoor environments.

Cladosporium uwebraunianum Bensch & Samson, **sp. nov.** MycoBank MB822229. Figs 43, 44.

Etymology: In honour of Uwe Braun for his valuable and extensive work on *Cladosporium* and other cladosporium-like genera.

Holotype: **The Netherlands**, Amsterdam, indoor air, archive, M. Meijer, CBS H-23260. *Ex-type culture*: CBS 143365 = DTO 072-D8.

Diagnosis: Differs from the phylogenetically closely related *C. australiense* in producing shorter conidiophores (up to 95(−135) µm), longer conidiogenous cells (17−50(−65) µm) and conidia formed in long branched chains with up to 10(−13) conidia in the terminal unbranched part of the chain.

Mycelium unbranched or loosely branched, hyphae (1−)2−5(−6.5) µm wide, septate, pale or medium olivaceous brown, smooth or almost so, minutely verruculose or irregularly rough-walled, walls slightly thickened. *Conidiophores* macro- and micronematous, formed solitary or in small groups of three laterally or terminally from hyphae, straight or somewhat flexuous, neither geniculate nor nodulose, cylindrical-oblong, quite

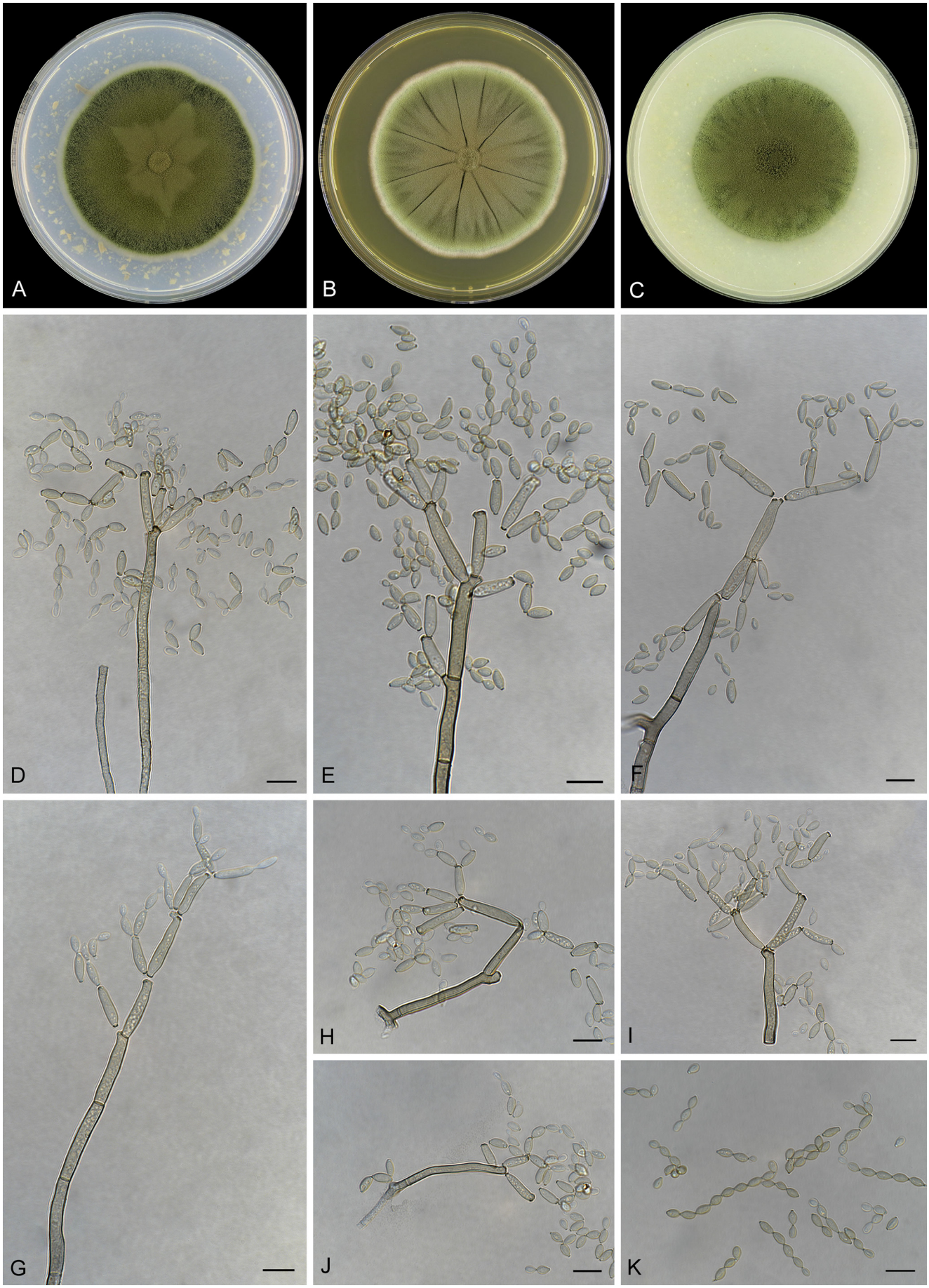

Fig. 43. *Cladosporium uwebraunianum* (CBS 143365). **A–C.** Colonies on PDA, MEA and OA. **D–H, J.** Conidiophores and conidial chains. **I.** Ramoconidium and conidial chains. **K.** Conidial chains. Scale bars = 10 µm.

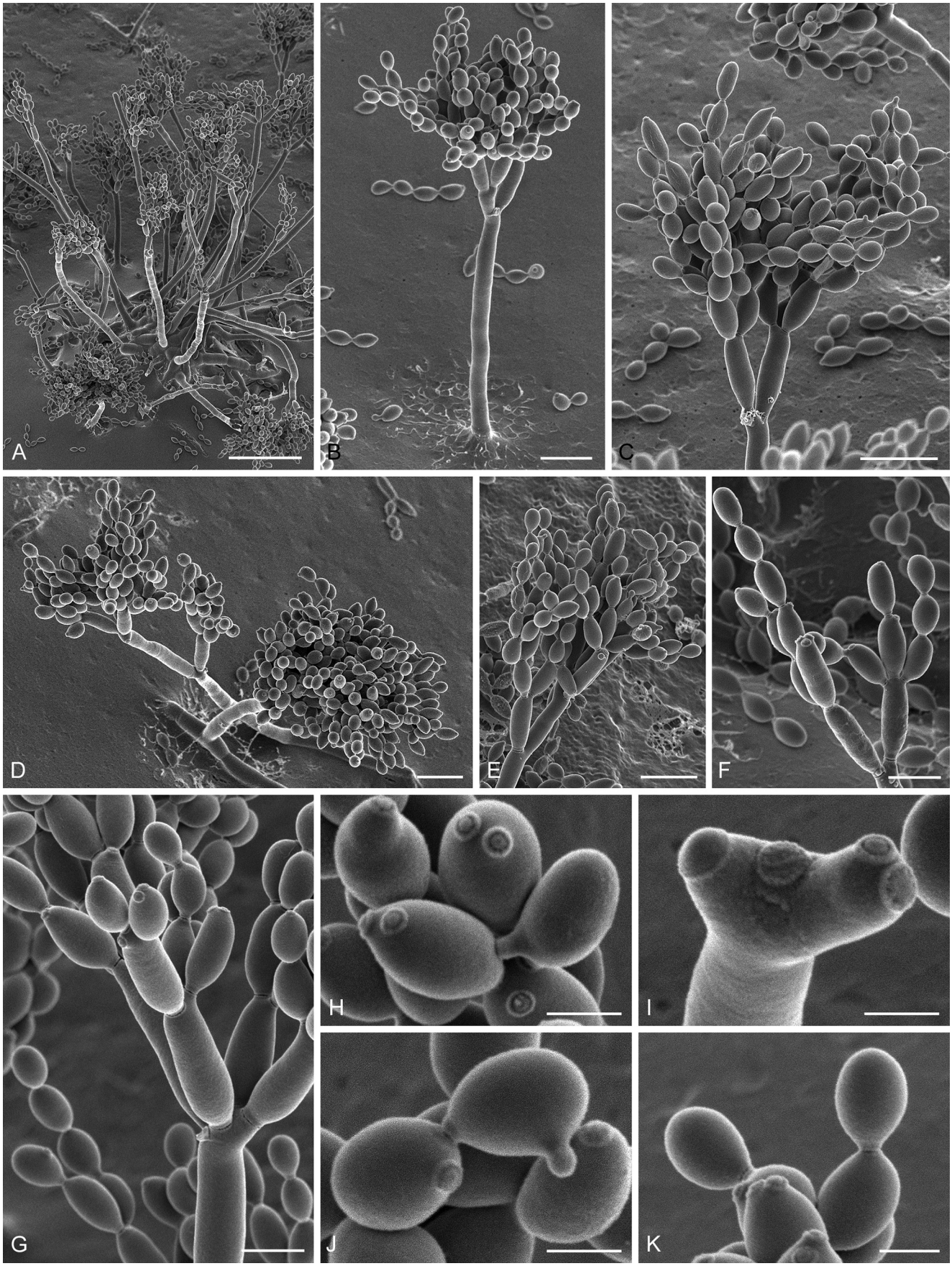

Fig. 44. *Cladosporium uwebraunianum* (CBS 143365). **A.** Survey of conidiophores sprouting from a common base, consisting out of a tissue of broadened connected cells, partially located under the agar surface. **B.** Free-standing conidiophore with intact stipes, ramoconidia, intercalary and terminal conidia. **C.** Conidia on conidiophore. Conidia are very smooth; some bear a subtle net-like ornamentation (typical for the *C. cladosporioides* complex). Some initials are visible; other chains are broken as judged by the scars on the conidia. **D.** Two intact conidiophores bearing numerous spores. This micrograph shows the compactness of the spore mass and also illustrates that conidial chains support each other throughout formation. **E.** Conidia on conidiophore showing some initials. **F.** Chains of conidia, two of the ending in terminally conidia. Scars are visible on a secondary ramoconidium. **G.** Details of the conidiophore. Note the very smooth surface of the conidia and conidiophore. Fine breaks delineate several spores. **H, J, K.** Details of scars of intercalary and also terminal conidia (H, J) and initial (J). **I.** Details of scars on a conidiophore. Note the difference in size of the scars, compare with the lines in Figure G. Scale bars = 2 (H–K), 5 (F, G), 10 (B–E), 50 (A) µm.

short, 15–95(–135) µm long, 2–2.5 µm wide in micronematous conidiophores, 2.5–4 µm wide in macronematous conidiophores, unbranched or branched, branchlets as small lateral outgrowths just below or above a septum, 0–2(–4)-septate, pale to medium sometimes even dark olivaceous brown, smooth, walls slightly thickened. *Conidiogenous cells* usually terminally or conidiophores reduced to conidiogenous cells, rarely intercalary in branched conidiophores, 17–50(–65) µm long, with 2–3(–4) distal scars situated at the apex, loci more or less truncate, 1–2 µm diam. *Ramoconidia* occasionally formed, 23–42 × 3–4 µm, base (2.5–)3(–3.5) µm wide. *Conidia* numerously formed in branched chains, branching in all directions, with up to 10(–13) conidia in the terminal unbranched part of the conidial chains, *small terminal conidia* obovoid, limoniform or ellipsoid, (3–)4–7(–10) × 2–3 µm (av. ± SD: 5.9 ± 1.5 × 2.5 ± 0.4), *intercalary conidia* ellipsoid or subcylindrical, (6–)7–12(–15) × 2.5–3(–3.5) µm (av. ± SD: 9.1 ± 2.4 × 2.8 ± 0.3), 0(–1)-septate, with (1–)2–3(–4) distal hila, *secondary ramoconidia* subcylindrical or cylindrical, 8.5–27(–35) × (2.5–)3–4 µm (av. ± SD: 17.2 ± 5.8 × 3.5 ± 0.5), 0(–2)-septate, with 2–3 distal hila, pale or medium olivaceous brown, sometimes pale olivaceous, smooth or almost so, small terminal and intercalary conidia appear to be reticulate, walls unthickened, hila 0.5–2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA reaching 49–58 mm diam after 14 d at 25 °C, grey olivaceous, olivaceous or olivaceous black, reverse olivaceous grey and leaden-grey, velvety or powdery, margins glabrous, white, aerial mycelium loose diffuse, low or higher, growth flat, sometimes radially furrowed, without prominent exudates, profusely sporulating. Colonies on MEA attaining 51–58 mm diam after 14 d at 25 °C, olivaceous, grey olivaceous or olivaceous grey, reverse iron-grey and leaden-grey, velvety or powdery, margins white, somewhat feathery, aerial mycelium sparse, loose diffuse, growth flat to low convex, radially furrowed, colony centre somewhat elevated, without prominent exudates, densely sporulating. Colonies on OA reaching 47–57 mm diam after 14 d at 25 °C, greenish olivaceous or olivaceous due to dense sporulation, dull-green towards margins, reverse iron-grey or leaden-grey, velvety or powdery, margins narrow, glabrous, regular, aerial mycelium sparse, loose diffuse, growth flat, with numerous very small exudates giving the surface a glittering appearance.

Substrates and distribution: Isolated from indoor environments (air, house dust); Australasia (New Zealand), Europe (Denmark, The Netherlands).

Additional materials examined: **Denmark**, isol. from indoor environments, B.A. Andersen, DTO 109-E8 = BA 1908. **New Zealand**, isol. from house dust, DTO 305-H9 = TA10NZ-294A. **The Netherlands**, Amsterdam, indoor air, archive, M. Meijer, DTO 072-C8, DTO 082-E3; Rijswijk, swap sample, archive, M. Meijer, DTO 090-D2.

Notes: *Cladosporium uwebraunianum* (Fig. 1, clade 52) is closely related to *C. australiense* (Fig. 1, clade 51), but morphologically they are clearly differentiated. The former species is characterised by shorter conidiophores (up to 95(–135) µm), longer conidiogenous cells (17–50(–65) µm) and conidia formed in long branched chains with up to 10(–13) conidia in the terminal unbranched part of the chain. In contrast, *C. australiense* exhibits very long, seta-like conidiophores (48–285 µm long) with shorter conidiogenous cells (6–15(–40) µm) and conidial chains with only 2–4(–5) conidia in the terminal part of the chain (Bensch *et al.* 2010). *Cladosporium funiculosum* (Fig. 1, clade 55) is morphologically very similar in also forming quite long conidial chains with 8(–14) conidia in the unbranched terminal part, but the chains are often dichotomously branched and the conidiophores narrower (2–3 µm).

Cladosporium velox Zalar *et al.*, Stud. Mycol. 58: 181. 2007. MycoBank MB492435. Fig. 45.

Holotype: **India**, Charidij, isolated from *Bambusa* sp. (*Poaceae*), W. Gams, CBS H-19735. *Ex-type culture*: CBS 119417.

Lit.: Bensch *et al.* (2012: 284–286; 2015: 68).
Ill.: Zalar *et al.* (2007: 166, fig. 5 i, 180, fig. 14), Bensch *et al.* (2012: 285, fig. 334).

Mycelium partly superficial partly submerged; hyphae branched, 2–4 µm wide, septate, often with swellings and constrictions, therefore appearing irregular in outline, pale brown to pale olivaceous brown, smooth, walls unthickened to slightly thickened, often somewhat swollen at the base of conidiophores, without extracellular polysaccharide-like material. *Conidiophores* arising laterally or terminally from plagiotropous or ascending hyphae, erect, straight to slightly flexuous, filiform to narrowly cylindrical-oblong, sometimes slightly geniculate, due to this geniculation slightly subnodulose, occasionally nodulose, (10–)25–150(–250) × (2–)2.5–4(–4.5) µm, unbranched or branched, branches often only as short denticle-like prolongations below a septum, later branches longer, dichotomously branched in an angle of 30–45°, 0–7-septate, not constricted, septa often somewhat darkened, especially where ramoconidia are seceding, pale to medium olivaceous brown, smooth, walls somewhat thickened, often slightly attenuated towards the apex. *Conidiogenous cells* integrated, mainly terminal but also intercalary, sometimes conidiophores reduced to conidiogenous cells, filiform to narrowly cylindrical-oblong, 20–42 µm long, proliferation sympodial, with a single or several conidiogenous loci, often somewhat crowded at the apex, subdenticulate, protuberant, 0.8–1.5 µm diam, thickened and darkened-refractive. *Ramoconidia* subcylindrical or cylindrical, 20–50(–63) × 2.5–3 µm, 0–1-septate, base truncate, 2–3 µm wide, somewhat darkened-refractive. *Conidia* catenate, in branched chains, branching in all directions, terminal chains with up to five conidia, straight, *small terminal conidia* globose, subglobose, ovoid, 2.5–4 × (1.5–)2–2.5 µm (av. ± SD: 3.2 ± 0.4 × 2.1 ± 0.3), aseptate, apex rounded, *intercalary conidia* limoniform to narrowly ellipsoid, 3.5–10(–13) × 2–3 µm (av. ± SD: 6.7 ± 2.5 × 2.5 ± 0.4), aseptate, with up to 3(–4) distal hila, attenuated towards apex and base, *secondary ramoconidia* narrowly ellipsoid to cylindrical-oblong, straight to slightly curved, (6–)10–30(–42) × 2–3.5(–4.5) µm (av. ± SD: 20.0 ± 8.6 × 2.9 ± 0.6), 0–1-septate, not constricted at septa, with up to 4(–5) distal hila, pale brown, smooth or almost so to very finely verruculose, walls unthickened or almost so, slightly attenuated towards apex and base, hila conspicuous, subdenticulate to denticulate, 0.8–1.5 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA reaching 35–65 mm diam after 14 d at 25 °C, grey olivaceous to olivaceous, reverse leaden-grey, iron-grey or olivaceous black, velvety to powdery, margin broad, white, regular, glabrous to feathery, aerial

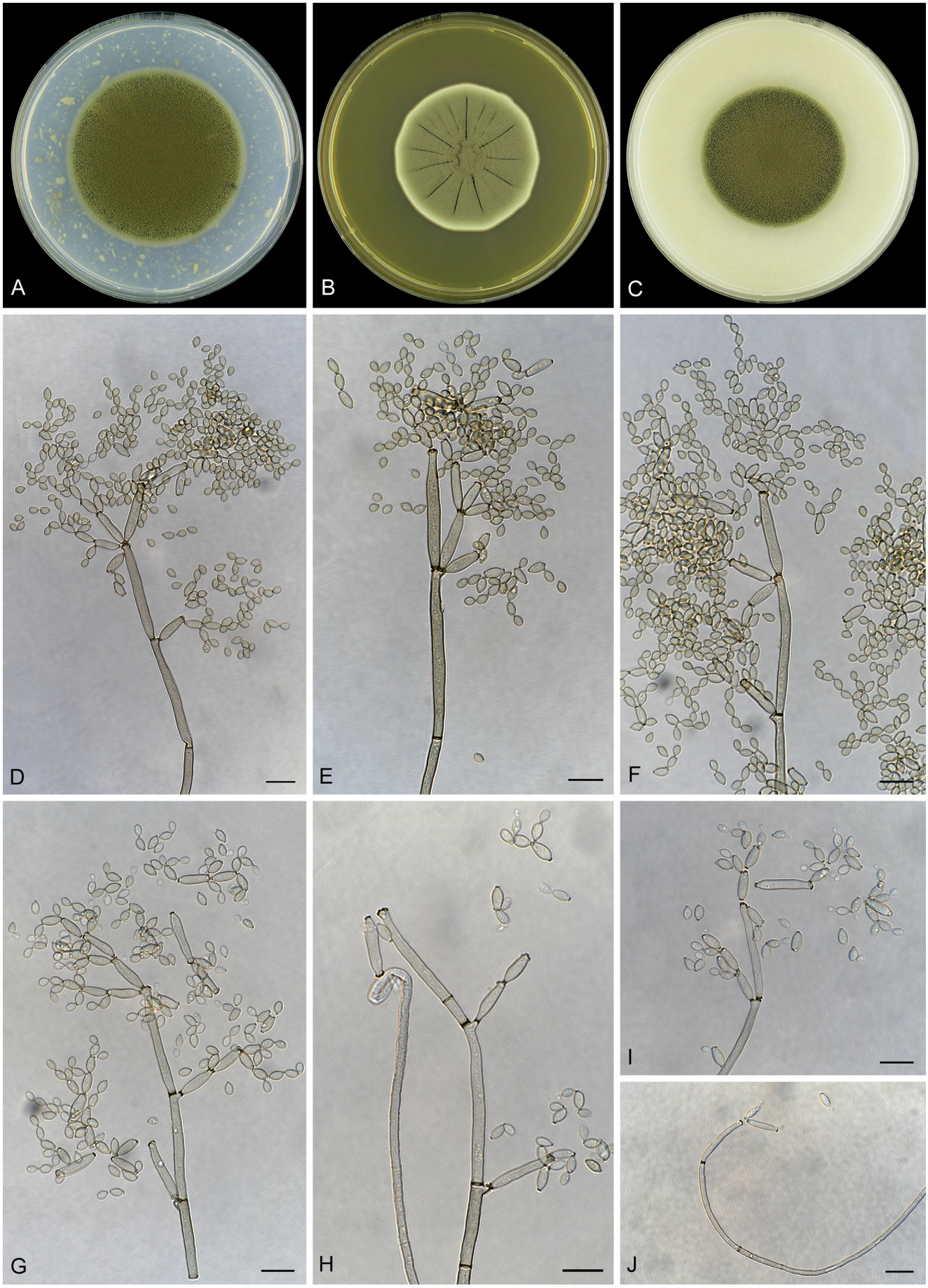

Fig. 45. *Cladosporium velox* (DTO 317-H1). **A–C.** Colonies on PDA, MEA and OA. **D–H.** Macronematous conidiophores and conidial chains. **I–J.** Micronematous conidiophores and conidia. Scale bars = 10 µm.

mycelium absent or sparse, growth regular, low convex, sometimes with numerous prominent exudates, sporulation profuse. Colonies on MEA reaching 30–55 mm diam after 14 d at 25 °C, olivaceous, grey olivaceous and pale olivaceous grey towards margins, radially furrowed, with raised, crater-shaped colony centre, with white, undulate, submerged margin, sporulation profuse. Colonies on OA reaching 30–52 mm diam after 14 d at 25 °C, olivaceous, reverse iron-grey and leaden-grey, velvety to powdery, margin regular, aerial mycelium sparse, without prominent exudates, sporulation profuse. Colonies on MEA with 5 % NaCl reaching 35–45 mm diam after 14 d at 25 °C, pale green, reverse pale green, velvety, flat with regular margin, sporulation poor.

Cardinal temperatures: Minimum at 10 °C (9 mm diam), optimum at 25 °C (30–42 mm diam) and maximum at 30 °C (5–18 mm diam) (from Zalar *et al.* 2007).

Substrates and distribution: Hypersaline water, indoor air and plant material (bamboo and *Zea mays*); Asia (China, India), Europe (Slovenia), North America (USA), South America (Brazil).

Additional materials examined: **China**, isol. from indoor air sample, DTO 317-H1, DTO 323-H8. **USA**, Massachusetts, Needham, isol. from indoor air sample, office, Dec. 2012, Ž. Jurjević, EMSL 1872 = CPC 22359.

Notes: *Cladosporium velox* (Fig. 3, clade 18) is a species of the *C. sphaerospermum* species complex. The small terminal conidia are, however, more ovoid and almost smooth (light microscopy). It was first described from bamboo collected in India and a few additional isolates from hypersaline water from salterns in Slovenia (Zalar *et al.* 2007). Bensch *et al.* (2015) recorded it also from Brazil isolated from *Zea mays*. The three additional isolates from indoor air samples collected in North America and China indicate that the species is probably much wider distributed than previously assumed.

Cladosporium vicinum Bensch & Samson, **sp. nov.** MycoBank MB822230.

Etymology: Latin vicinus in the meaning of next to, neighbouring refers to the close phylogenetic and morphological relationship with *C. europaeum*.

Holotype: **USA**, Wisconsin, Racine, isol. from indoor air sample, Nov. 2012, Ž. Jurjević, CBS H-23261. *Ex-type culture*: CBS 143366 = CPC 22316 = EMSL 1819.

Diagnosis: Differs from *C. cladosporioides* in forming more frequently septate conidia (usually aseptate in *C. cladosporioides s. str. vs* 0–1(–3) septate in *C. vicinum*).

Mycelium internal and superficial; hyphae sparingly branched, (1–)2–5.5 µm wide, septate, subhyaline or pale olivaceous, smooth or minutely verruculose, walls unthickened or slightly thickened. *Conidiophores* macro- and micronematous, arising terminally and laterally from hyphae, erect, solitary, occasionally in pairs of two, straight or slightly flexuous. *Macronematous conidiophores* cylindrical-oblong, non-nodulose, rarely once geniculate unbranched or branched, branches only as short peg-like lateral outgrowths just below a septum, 80–190(–235) × 3–5(–6) µm, septate, sometimes slightly attenuated or constricted at septa, pale olivaceous or pale olivaceous brown, smooth, walls unthickened or almost so. *Conidiogenous cells* integrated, terminal and intercalary, cylindrical-oblong, (5–)23–60 µm long, terminal cells with 1–5(–7) loci crowded at or towards the apex and occasionally 1–2 additional loci at a lower level, often seceded as ramoconidia, in intercalary cells loci situated on small denticle-like lateral outgrowth just below a septum, loci conspicuous, subdenticulate or denticulate, 1–2(–2.5) µm diam, thickened and darkened-refractive. *Micronematous conidiophores* narrower and paler, filiform or narrowly cylindrical-oblong, 23–75(–125) × (1–)2–2.8 µm, septate, subhyaline or pale olivaceous, often with only a single locus at the apex, loci 1–1.5 µm diam, conidia formed by micronematous conidiophores narrower, about 2.5 µm wide. *Ramoconidia* cylindrical-oblong, 20–60(–70) × 3–4(–4.5) µm, 0–1(–3)-septate, base broadly truncate, (2.2–)2.5–3.5 µm wide, somewhat refractive. *Conidia* catenate, in branched chains, branching in all directions, with up to 6(–9) conidia in the unbranched terminal part of the chains, *small terminal conidia* subglobose or obovoid, 2–5 × 2–2.5(–3) µm (av. ± SD: 3.5 ± 0.8 × 2.2 ± 0.3), apex rounded, *intercalary conidia* limoniform, ellipsoid or subcylindrical, 4–16(–19) × (2–)2.5–3.5(–4) µm (av. ± SD: 8.5 ± 3.6 × 3.0 ± 0.5), 0(–1)-septate, with 1–4(–6) distal hila, *secondary ramoconidia* ellipsoid, subcylindrical or cylindrical, (7–)9–31.5(–40) × (2.5–)3–4(–5) µm (av. ± SD: 20.2 ± 8.4 × 3.6 ± 0.5), 0–1(–3)-septate, median or often in the upper half, with (1–)2–4(–5) distal hila, pale olivaceous or pale to medium olivaceous brown, smooth, occasionally slightly rough-walled, walls unthickened or almost so, hila conspicuous, subdenticulate or denticulate, 0.5–2(–2.5) µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on PDA reaching 55–79 mm diam after 14 d at 25 °C, olivaceous grey or iron-grey, reverse olivaceous black, floccose or felty, margins regular, glabrous or feathery, aerial mycelium abundantly formed, loose to dense, smoke-grey, growth flat to low convex. Colonies on MEA reaching 58–82 mm diam after 14 d at 25 °C, grey olivaceous or olivaceous grey, reverse iron-grey, floccose or fluffy-felty, margin regular, feathery, aerial mycelium whitish, smoke-grey or pale olivaceous grey, abundant, growth effuse, flat or low convex, radially furrowed, somewhat wrinkled in colony centre. Colonies on OA attaining 60–65 mm diam after 14 d at 25 °C, grey olivaceous or smoke-grey, dull-green at margins, reverse pale greenish-grey or olivaceous grey, floccose or felty, margins regular, glabrous, aerial mycelium covering large parts, smoke-grey, growth effuse. Without prominent exudates, sporulation profuse on all media.

Substrates and distribution: Isolated from indoor environments and plant material; Africa (South Africa), Australasia (New Zealand) Europe (UK), North America (USA).

Additional materials examined: **New Zealand**, isol. from house dust, DTO 305-H5 = TA10NZ-280B; isol. from imported buds of *Prunus avium*, J. Rennie, CPC 15457; Auckland, Auckland University campus, isol. from leaves of *Oncoba spinosa*, Sep. 2004, C.F. Hill 1076-2, CPC 11664. **South Africa**, isol. from *Leptosphaeria* sp., P.W. Crous, CPC 13867. **UK**, Manchester, isol. from uredospores of *Puccinia allii*, May 1984, G.S. Taylor, CBS 306.84.

Notes: This new species (Fig. 1, clade 34) is formerly known as *C. cladosporioides* Lineage 2 *sensu* Bensch *et al.* (2010). Bensch *et al.* (2010) hesitated in naming this phylogenetically distinct lineage since it is morphologically almost indistinguishable from *C. cladosporioides s. str.* Morphologically, *C. vicinum* is the closest of the three phylogenetically distinct lineages to *C. cladosporioides s. str.* (Fig. 1, clade 66) but differs in more frequently forming septate conidia (usually aseptate in

C. cladosporioides s. str. vs 0–1(–3)-septate in *C. vicinum*). *Cladosporium europaeum* (formerly *C. cladosporioides* Lineage 1 *sensu* Bensch *et al.* (2010); Fig. 1, clade 35) is the closest phylogenetic relative of *C. vicinum* (see species notes under *C. europaeum* for sequence similarities) but produces somewhat shorter conidiogenous cells, secondary conidia and ramoconidia. *Cladosporium westerdijkiae* (formerly *C. cladosporioides* Lineage 4 *sensu* Bensch *et al.* (2010); Fig. 1, clade 43) introduced below differs from *C. vicinum* in having shorter intercalary conidia and secondary ramoconidia which are usually aseptate.

Cladosporium westerdijkiae Bensch & Samson, **sp. nov.** MycoBank MB822231.

Etymology: Named for Johanna Westerdijk, the first director of the Centraalbureau voor Schimmelcultures (now renamed as Westerdijk Fungal Biodiversity Institute) and the first female professor in the Netherlands.

Holotype: **USA**, Washington State, isol. from bing cherry fruits, R.G. Roberts, CBS H-23262. *Ex-type culture*: CBS 113746.

Diagnosis: Differs from *C. cladosporioides* in producing slightly shorter and narrower conidia formed in shorter conidial chains (only up to four in the terminal unbranched part of the chain *vs* up to 10 in *C. cladosporioides*).

Mycelium immersed, sparingly superficial; hyphae unbranched or sparingly branched, 1–5 µm wide, septate, sometimes slightly constricted at septa, subhyaline or pale olivaceous brown, smooth or minutely verruculose or irregularly rough-walled, walls unthickened or slightly so, sometimes forming ropes. *Conidiophores* marco- and micronematous, solitary, arising terminally and laterally from hyphae, erect, straight, flexuous or sometimes once bent at the apex, cylindrical-oblong or filiform, neither nodulose nor geniculate, unbranched, occasionally branched, 23–125(–185) × 3–5 µm, 0–3(–4)-septate, subhyaline or pale to medium olivaceous brown, smooth, sometimes minutely verruculose or irregularly rough-walled towards the base, walls unthickened or almost so, sometimes slightly attenuated towards the apex; *micronematous conidiophores* shorter, narrower and paler, filiform or narrowly cylindrical-oblong, 17–78 × 2–3 µm, subhyaline or pale olivaceous brown. *Conidiogenous cells* integrated, usually terminal, very rarely intercalary, cylindrical, (12–)23–54 µm long, in micronematous conidiophores 16–36 µm, with a single or two apical loci, sometimes up to four loci, conspicuous, denticle-like, sometimes situated on peg-like lateral prolongations, 1–2 µm diam, thickened and darkened-refractive. *Ramoconidia* occasionally formed, 22–52 × 3.5–4.5 µm, aseptate, base 3–3.5 µm wide, unthickened but somewhat refractive. *Conidia* numerous, catenate, with up to 4(–6) conidia in the terminal unbranched part of the conidial chains, *small terminal conidia* oval, 4–5(–5.5) × 2–2.5 µm (av. ± SD: 4.6 ± 0.6 × 2.1 ± 0.2), *intercalary conidia* oval or ellipsoid, 5–8.5(–12) × 2–3 µm (av. ± SD: 6.5 ± 1.7 × 2.6 ± 0.4), aseptate, with 1–2(–3) distal hila, very pale olivaceous, *secondary ramoconidia* ellipsoid, subcylindrical or cylindrical, (6–)9–27(–35) × 3–4(–5) µm (av. ± SD: 17.4 ± 6.8 × 3.6 ± 0.5), 0(–1)-septate, with up to 3 distal hila, pale olivaceous brown, smooth, walls unthickened, slightly attenuated towards apex and base, hila subdenticulate or denticulate, protuberant, 0.8–2 µm diam, thickened and darkened-refractive; microcyclic conidiogenesis not occurring.

Culture characteristics: Colonies on PDA reaching up to 61–75 mm diam after 14 d at 25 °C, grey olivaceous, olivaceous grey or dull-green, reverse greyish blue or iron-grey, powdery or floccose, margin colourless or white, narrow, feathery, aerial mycelium loose, diffuse, whitish, growth flat, without prominent exudates. Colonies on MEA attaining 46–75 mm diam after 14 d at 25 °C, grey olivaceous or olivaceous grey, sometimes greenish glaucous at margins, reverse leaden-grey or iron-grey, velvety, margins narrow, glabrous or feathery, radially furrowed, folded and wrinkled in colony centre, aerial mycelium sparse, diffuse, no prominent exudates formed. Colonies on OA reaching 53–75 mm diam after 14 d at 25 °C, olivaceous grey or grey olivaceous, greenish grey towards margins, reverse leaden-grey or iron-grey, powdery to felty-floccose, margins very narrow, aerial mycelium mainly on colony centre, growth flat, sometimes numerous small, not very prominent exudates formed giving the colony a glittering appearance. Sporulation profuse on all media.

Substrates and distribution: Isolated from plant material and indoor environments; Asia (South Korea), Europe (Denmark, Germany, Portugal), North America (USA), South America (Argentina).

Additional materials examined: **Denmark**, isol. from indoor environment, DTO 109-F2 = BA 1911. **Germany**, isol. from indoor environment, DTO 084-F2. **Portugal**, isol. from indoor environment, DTO 152-A9, DTO 152-H9. **South Korea**, Pochon, National Arboretum, isol. from *Fatona villosa*, 18 Oct. 2002, H.D. Shin, CPC 10150.

Notes: *Cladosporium westerdijkiae* (Fig. 1, clade 43) was formerly treated as *C. cladosporioides* Lineage 4 *sensu* Bensch *et al.* (2010) as it was phylogenetically distinct but morphologically almost indistinguishable from *C. cladosporioides s. str.* (Fig. 1, clade 66). As more isolates could be included it is herein named and described as a new species. It is genetically distant to *C. cladosporioides* (clade 43 *vs* clade 66 in Fig. 1). Furthermore, the conidia are slightly shorter and narrower and form shorter conidial chains (only up to four in the terminal unbranched part of the chain *vs* up to 10 in *C. cladosporioides*). Its closest phylogenetic neighbour proved to be *C. delicatulum* (Fig. 1). This species differs in forming shorter conidiogenous cells (11–37 µm long), 0–1(–2)-septate ramoconidia and slightly shorter, 0–1(–2)-septate secondary ramoconidia.

Cladosporium wyomingense Bensch & Samson, **sp. nov.** MycoBank MB822233. Fig. 46.

Etymology: Named after the place of origin, Wyoming, where the type specimen was collected.

Holotype: **USA**, Wyoming, isol. from indoor air sample, living room, Oct. 2012, Ž. Jurjević, CBS H-23263. *Ex-type culture*: CBS 143367 = CPC 22310 = EMSL 1806.

Diagnosis: Differs from *C. herbarum* and *C. macrocarpum* in having shorter and narrower conidiophores and slightly shorter and narrower conidia.

Mycelium abundantly formed, filiform or narrowly cylindrical, branched, 1–4 µm wide, septate, neither swollen nor constricted, subhyaline or pale olivaceous, almost smooth, asperulate or loosely verruculose, especially those hyphae forming conidiophores with surface ornamentation. *Conidiophores* macro- and micronematous, arising terminally or laterally from plagiotropous or ascending hyphae, macronematous conidiophores narrowly cylindrical-oblong, often distinctly geniculate, sometimes growth proceeding at an angle of 45–90°, subnodulose, sometimes forming lateral shoulders at or towards the apex,

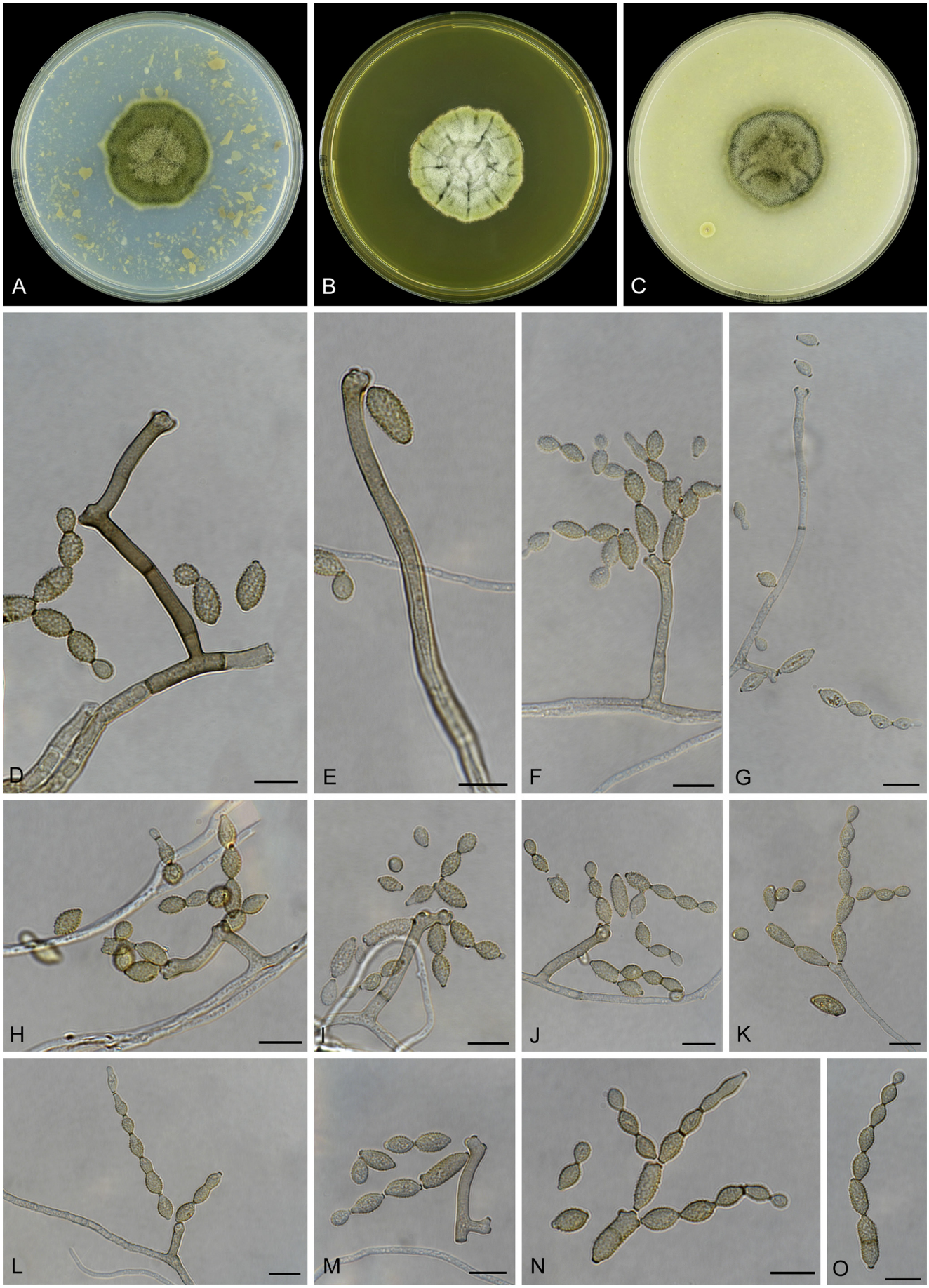

Fig. 46. *Cladosporium wyomingense* (CBS 143367). **A–C.** Colonies on PDA, MEA and OA. **D–F, H–J.** Macronematous conidiophores and conidial chains. **G, K–L.** Micronematous conidiophores and conidia. **M.** Ramoconidium and conidia. **N–O.** Conidial chains. Scale bars = 10 µm.

mostly unbranched, 10−70(−120) × 2.5−3.5(−4) µm, 0−3(−4)-septate, pale olivaceous or pale olivaceous brown, smooth or almost so, asperulate or minutely verruculose, walls slightly thickened; micronematous conidiophores shorter, narrower, 1.5−2 µm wide, and paler, subhyaline. *Conidiogenous cells* integrated, mainly terminal, occasionally also intercalary, 8−21(−43) µm long, geniculate and subnodulose, with loci often situated on lateral shoulders or short lateral prolongations, up to six loci per cell, conspicuous, 1−2 µm diam, thickened and darkened-refractive; in micronematous conidiophores cells usually without swellings and geniculations, with 1−2 loci at the apex, about 1 µm diam. *Ramoconidia* occasionally formed. *Conidia* catenate, formed in unbranched or basely branched chains, 3−7(−10) conidia in the unbranched part of the chain, verruculose or echinulate, *small terminal conidia* subglobose, obovoid or ellipsoid, occasionally globose, 3.5−10(−12.5) × 3−5(−5.5) µm (av. ± SD: 6.8 ± 2.9 × 4.0 ± 0.9), often with a broadly rounded apex; *intercalary conidia* ovoid and ellipsoid, 6.5−11.5 × 4−5 µm (av. ± SD: 9.1 ± 1.7 × 4.4 ± 0.4), 0(−1)-septate, slightly attenuated towards apex and base, with 1(−2) distal hila; *secondary ramoconidia* ellipsoid, fusiform or subcylindrical, (7−)10−22(−28) × (3−)4−6(−7) µm (av. ± SD: 16.4 ± 5.2 × 4.9 ± 0.7), 0−1-septate, slightly attenuated towards apex and base, with 1−2(−3) distal hila, pale olivaceous or medium olivaceous brown, hila conspicuous, (0.5−)0.8−2 µm diam, thickened and darkened; microcyclic conidiogenesis not observed.

Culture characteristics: Colonies on PDA reaching up to 60 mm diam after 14 d at 25 °C, olivaceous grey and pale olivaceous grey, dull-green towards margins, reverse leaden-grey, dull green towards margins, fluffy-felty, margin broad, white, feathery, somewhat undulate, aerial mycelium abundant, loose to dense, low to high, without prominent exudates, sporulating. Colonies om MEA attaining up to 60 mm diam after 14 d at 25 °C, smoke-grey, pale olivaceous grey, olivaceous grey at margins where sporulation is profuse, reverse olivaceous grey, fluffy-felt, margin white, feathery, aerial mycelium abundant, loose to high, colony centre folded and wrinkled, radially furrowed, without prominent exudates. Colonies on OA reaching up to 45 mm diam after 14 d at 25 °C, smoke-grey, pale greenish grey, dull-green towards margins, reverse smoke-grey and olivaceous grey, fluffy-felt, margin slightly undulate, aerial mycelium low to high, often felted, dense, with numerous very small exudates, sporulation sparse.

Substrates and distribution: Indoor air; North America (USA).

Notes: With its subnodulose conidiophores and ornamented conidia, *C. wyomingense* (Fig. 2, lineage 14) is a typical member of the *C. herbarum* species complex. It is allied to *C. angustiherbarum* (Fig. 2, lineage 13), *C. phlei* (Fig. 2, clade 12), *C. herbarum* (Fig. 2, clade 15) and *C. macrocarpum* (Fig. 2, clade 16) but differs in having shorter and narrower conidiophores and slightly shorter and narrower conidia (Bensch *et al.* 2012). Morphologically it resembles *C. angustiherbarum* (Fig. 2, lineage 13) but the latter species possesses narrower conidiogenous loci and conidial hila and the conidiophores do not grow in an up to 90° angle (Bensch *et al.* 2015). Until now it is known only from a single isolate.

Cladosporium xanthochromaticum Sandoval-Denis *et al.*, Persoonia 36: 295. 2016. MycoBank MB817340.

Holotype: **USA**, Texas, from human bronchoalveolar lavage fluid, Sep. 2010, D.A. Sutton, CBS H-22388. *Ex-type culture*: CBS 140691 = UTHSC DI-13-211 = FMR 13324.

Ill.: Sandoval-Denis *et al.* (2016: 296, fig. 11).

Mycelium superficial and immersed, hyphae branched, 1–3 µm wide, septate, subhyaline, pale olivaceous or pale olivaceous brown, smooth or slightly rough-walled, thin-walled, sometimes forming ropes, occasionally swollen at the base of conidiophores. *Conidiophores* erect, solitary, macro- or micronematous, arising terminally or laterally from hyphae as short peg-like lateral outgrowths or longer, filiform or narrowly cylindrical-oblong, non-nodulose, occasionally once geniculate, unbranched or branched typically immediately before a septum, up to 210 µm long, (1.5–)2–4 µm wide, septate, pale brown, pale olivaceous or olivaceous brown, usually smooth and thin-walled. *Conidiogenous cells* terminal, sometimes also intercalary, cylindrical, sometimes geniculate, 12–37 × 3–4 µm, bearing up to three conidiogenous loci of 1–1.5 µm diam, darkened and refractive. *Ramoconidia* subcylindrical to cylindrical, 17–42(–50) × 2–3.5(–4) µm, 0–1-septate, smooth or finely roughened, base about 2–2.5(–3.5) µm wide. *Conidia* forming branched chains, with 2–6(–7) conidia in the terminal unbranched part, *small terminal conidia* obovoid, limoniform or short ellipsoid (2.5–)3–5(–9) × (1.5–)2–2.5(–3) µm (av. ± SD: 4.1 ± 1.2 × 2.1 ± 0.4), aseptate; *intercalary conidia* ovoid, limoniform or ellipsoid, (4.5–)5–14(–18) × 2–3.5(–4) µm (av. ± SD: 8.2 ± 3.3 × 2.6 ± 0.5), 0(–1)-septate, with 1–4 distal hila; *secondary ramoconidia* ellipsoid to cylindrical, (7–)10–30(–38) × (2–)2.5–4 µm (av. ± SD: 20.5 ± 7.3 × 2.9 ± 0.5), 0–1(–3)-septate, sometimes slightly constricted at the median septum, pale olivaceous brown, smooth- and thin-walled, with protuberant, somewhat darkened, 0.5–1.5 µm diam conidial hila; microcyclic conidiogenesis occasionally occurring.

Culture characteristics: Colonies on PDA attaining 60–75 mm diam after 14 d at 25 °C, grey olivaceous or olivaceous, reverse grey olivaceous, olivaceous grey or olivaceous, olivaceous buff towards margins, sometimes with a light yellow, grey-yellow or citrine-green diffusible pigment released into the agar, velvety, floccose or felty, margin regular, white to yellow, flat or folded at centre, with abundant submerged mycelium. Colonies on MEA reaching 62–70 mm diam after 14 d at 25 °C, olivaceous, reverse iron-grey, velvety or floccose, margins white, narrow, radially furrowed, sometimes a few small but prominent exudates formed. Colonies on OA attaining 40–65 mm diam after 14 d at 25 °C, olivaceous or grey olivaceous, whitish and smoke grey due to aerial mycelium, reverse olivaceous grey, leaden-grey or leaden-black, floccose or fluffy-felty, radiate, margin regular, white, narrow, growth flat, and with abundant submerged mycelium; sometimes releasing an amber-coloured pigment into the agar. Sporulation profuse on all media. Cardinal temperature for growth – Optimum 20 °C, maximum 30 °C, minimum 5 °C.

Substrate and distribution: Isolated from plant material, food, indoor environments and human bronchoalveolar lavage fluid; Africa (South Africa), Asia (China, India, Polynesia, Thailand), Australasia (Australia), North America (Bermuda, USA).

Additional materials examined: *Sine loco*, *sine dato*, isol. by C.H. Hassall, No. 4-1949, ident. by G.A. de Vries as *C. cladosporioides*, CBS 167.54 = ATCC 11276 = IMI 049624. **Australia**, isol. from margarine, N. Charley, CPC 11046; isol. from *Erythrophleum chlorostachys* (*Fabaceae*), 9 Jan. 2007, B.A.

Summerell, CBS 126364 = CPC 14532. **Bermuda**, Samerset, isol. from indoor air sample, Nov. 2012, Ž. Jurjević, EMSL 1824 = CPC 22321. **China**, isol from indoor air sample, DTO 317-I2, 323-E2 – 323-E7. **India**, isol. from *Eucalyptus* sp. (*Myrtaceae*), 3 Jan. 2004, coll. W. Gams, isol. P.W. Crous, CPC 11133; isol. from *Musa* sp. (*Musaceae*), 25 Oct. 2004, M. Arzanlou, CPC 11609. **Polynesia**, reserve Pun Kukui in forest, isol. from banana "Eka ulu", 2006, coll. I. Budenhagen, isol. P.W. Crous, CPC 12792, 12793. **South Africa,** Alkmar, Laeveld Coop, isol. from wheat, 1988, CPC 14008 = MRC 10135; Durban, botanical garden Durban near Reunion, -29.85, 31.0167, isol. from *Strelitzia* sp. (*Strelitziaceae*), 2005, coll. W. Gams, isol. P.W. Crous, CPC 11806; Free State, Danielsrus, isol. from oats, 1983, CPC 14004 = MRC 03367; Transkei, Mazeppa Bay, isol. from *Strelitzia* sp., growing on fruiting structures, 1 June 2008, P.W. Crous, CPC 14911. **Thailand**, isol. from *Acacia mangium* (*Fabaceae*), 2005, coll. W. Himaman, isol. P.W. Crous, CPC 11526, 11856; Surat Thani, isol from indoor air (open Petri-dish), P. Noomin, DTO 108-G8. **USA**, Colorado, Denver, isol. from air sample, bedroom, June 2012, Ž. Jurjević, EMSL 1686 = CPC 22239; Louisiana, Baton Rouge, isol. from leaves of pecan tree, 8 Sep. 2007, P.W. Crous, CPC 14256.

Notes: Sandoval-Denis *et al.* (2016) splitted *C. perangustum*, a phylogenetically diverse but morphologically quite uniform species, into three species, *C. perangustum s. str.* (Fig. 1, clade 4), *C. angulosum* (Fig. 1, clade 2) and *C. xanthochromaticum* (Fig. 1, clade 3). Forming a basal lineage in the *C. cladosporioides* species complex they are characterised by narrow conidia and slightly roughened conidiophores and conidia. The ramoconidia in *C. xanthochromaticum* proved to be not significantly shorter than in *C. perangustum* (Sandoval-Denis *et al.* 2016) but often slightly wider, but the conidiophores are usually smooth compared to the asperulate or verruculose ones in *C. perangustum*. Furthermore, the secondary ramoconidia are also slightly wider [(2–)2.5–4 µm *vs* 2–3(–3.5) µm in *C. perangustum*]. *Cladosporium angulosum* differs from *C. xanthochromaticum* in having shorter conidia and in growing at 35 °C (Sandoval-Denis *et al.* 2016). All three species proved to occur in indoor environments.

KEY TO THE MOST FREQUENTLY OCCURRING *CLADOSPORIUM* SPECIES IN INDOOR ENVIRONMENTS

1 Conidial surface ornamentation usually smooth, occasionally finely roughened; faster growth rates (up to 75 mm diam on MEA after 14 d)……**2**

1 Conidial surface ornamentation usually minutely verruculose to verrucose; slower growth rates (up to 45 mm diam on MEA after 14 d)……**3**

2 Conidiophores longer, up to 310(–460) µm long, often with a head-like swollen apex, sometimes with few nodules on a lower level……***C. tenuissimum***

2 Conidiophores shorter, up to 155 µm long, usually neither nodulose nor geniculate……..***C. pseudocladosporioides***

3 Conidiophores nodulose, usually with small terminal head-like swellings, sometimes with additional intercalary swellings, secondary ramoconidia 3–5(–7) µm wide……
……***C. allicinum***

3 Conidiophores non-nodulose, secondary ramoconidia narrower, 2–4(–5) µm wide……**4**

4 Conidia minutely verruculose, small terminal conidia subglobose or obovoid, conidial septa not darkened……
……***C. ramotenellum***

4 Small terminal and intercalary conidia usually globose, minutely verruculose to distinctly verrucose, but secondary ramoconidia almost smooth, septa usually darkened……**5**

5 Conidiophores *in vitro* 2–3.5(–5.5) µm wide, usually unbranched, 0–3-septate; small terminal conidia 2–4(–6) µm long; ramoconidia up to 37(–46) µm long, usually 0–3-septate……***C. halotolerans***

5 Conidiophores somewhat wider, 2.5–4.5(–6) µm, often branched, pluriseptate, with often dense septation; small terminal conidia slightly longer, (2–)3–5(–7); ramoconidia up to 50(–67) µm long, with up to five septa……
……***C. sphaerospermum***

DISCUSSION

The genus *Cladosporium* has been extensively reviewed in recent years in efforts to clarify the phylogeny and taxonomic structure of its species and allied fungi, and has resulted in a modern redefinition of the genus (Crous *et al.* 2007a, b, Schubert *et al.* 2007b, Zalar *et al.* 2007, Bensch *et al.* 2010, 2012, 2015). However, until recently, no attempt had been made to study the impact of these new approaches in the diversity of *Cladosporium* species occurring in indoor environments. This study presents a molecular phylogenetic study of species in this genus known from culture, with the intention to identify the common indoor species. Since fungi present in indoor environments can produce toxins or carry allergens which cause health hazards, it is important to know which fungal species are present indoors. *Cladosporium* species are found on plant material, in soil and air and are isolated from food and building material. Several species are known from clinical samples (Sandoval-Denis *et al.* 2016).

Of the 46 species found indoors 14 species are found in relation with human-derived samples. Sixteen species are described as new of which six species belonged to the *C. cladosporioides* species complex, four to the *C. herbarum* species complex and six to the *C. sphaerospermum* species complexes, respectively. *Cladosporium halotolerans* proved to be the most common species in indoor environments in this study (144 isolates), followed by *C. sphaerospermum* (46 isolates) and *C. pseudocladosporioides* (46 isolates) as well as *C. allicinum* (36 isolates).

Based on the studies of Fradkin *et al.* (1987) and Horner *et al.* (2004) one would expect to find *C. cladosporioides* as a dominant indoor fungus. This fungus is dominant in outdoor air and as the composition of indoor species reflects the composition of outdoor species one would expect to find *C. cladosporioides* as dominant indoors. However, a pilot study of indoor samples suggest (Segers *et al.* 2015) that members of the *C. sphaerospermum* species complex are also important and in the selection used in this study predominant in indoor environments. This was the case in indoor air samples, but even more so when samples were taken from indoor surfaces. As these fungi could grow at a lower water activity compared to the other *Cladosporium* species complexes, this habit might help the fungi to survive on indoor surfaces. Even more important was the ability of *C. halotolerans*, a member of the *C. sphaerospermum* species complex, to deal with transient changes in relative humidity during growth (Segers *et al.* 2016). Colonies of the fungus resumed growth better compared to the indoor fungi *Aspergillus niger* and *Penicillium rubens* and hardly

showed cell damage after the changes. This occurred despite the fact that the latter fungi grow on media with a static water availability that was similar or lower compared to *C. halotolerans*. Under these conditions this fungus exhibits a very condensed growth pattern existing by the formation of rounded, pigmented cells in the central colony, the occurrence of bundles of hyphae and very quick spore formation. *Cladosporium halotolerans* and *P. rubens* were able to grow on phosphogypsum without added nutrients (Segers *et al.* 2017). Thus *C. sphaerospermum* and the related taxa develop under low nutrient conditions and deal with humidity changes, both so characteristic for indoor situations. As *C. herbarum* is the most studied species in allergy research (Breitenbach 2008, Poll *et al.* 2009) the indoor dominance of *C. halotolerans* and other taxa is interesting. From our studies it is evident that *C. herbarum* does not belong to the common indoor Cladosporia and therefore, evaluation if allergens produced by *C. herbarum* are the same as produced by the other Cladosporia is important. If there are differences, we could gain insight how important indoor Cladosporia are in evoking titers of antibodies and allergic reactions compared to outdoor Cladosporia. The ability of *C. halotolerans* to deal with dynamic water availability is probably related to the ecological niche of this fungus (Segers *et al.* 2016). *Cladosporium* species grow on leaves and are therefore called phylloplane fungi (Park 1982, Moody *et al.* 1999). The available water for fungi growing on leaves is highly dynamic and is influenced by changing temperature, dew formation, sunlight, and rain. It is interesting that the indoor environment is also characterized by changes in humidity during the day. Park (1982) reports that phylloplane fungi can restore growth after minutes to hours of rehydration after drying for 2–3 wk.

This study and the study of Sandoval-Denis *et al.* (2016) show that pure morphological identification of *Cladosporium* species are no longer unequivocally possible without the aid of molecular data. One example of this is the four *C. cladosporioides* lineages *sensu* Bensch *et al.* (2010) which were morphologically indistinguishable from *C. cladosporioides s. str.* and at that time not formally named by the authors due to the lack of diagnostic morphological characters. In the present study, three of these lineages are introduced as new species, namely *C. europaeum* ("Lineage 1"), *C. vicinum* ("Lineage 2") and *C. westerdijkiae* ("Lineage 4"). The third lineage was published as *C. silenes* by Crous *et al.* (2011). Likewise, Sandoval-Denis *et al.* (2016) introduced two additional species, *C. angulosum* and *C. xanthochromaticum*, for the two lineages sister to the clade containing the type strain in the phylogenetically variable species *C. perangustum*. Although ITS is a suitable locus to identify an isolate as belonging to the genus *Cladosporium*, and to some extent even a specific species complex, additional loci are required to reach a conclusive species, or even species complex, identification. Therefore, the use of a molecular approach for the correct identification of all these species is highly recommended.

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APPENDIX A. SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.simyco.2018.03.002

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