**Cladosporium** species in indoor environments

K. Bensch1,2*, J.Z. Groenewald1, M. Meijer1, J. Dijksterhuis1, Ž. Jurjević3, B. Andersen4, J. Houbraken1, P.W. Crous1,5,6, and R.A. Samson1

1Westerdijk Fungal Biodiversity Institute, Uppsalalaan 8, 3584 CT, Utrecht, The Netherlands; 2Botanische Staatsammlung München, Menzinger Straße 67, D-80638, München, Germany; 3EMSL Analytical, Inc., 200 Route 130 North, Cinnaminson, NJ, 08077, United States; 4DTU Bioengineering, Technical University of Denmark, Safotofs Plads Building 221, DK-2800 Kgs., Lyngby, Denmark; 5Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria, 0002, South Africa; 6Microbiology, Department of Biology, Utrecht University, Padualaan 8, 3584 CH, Utrecht, The Netherlands

*Correspondence: K. Bensch, k.bensch@westerdijkinstitute.nl

Abstract: As part of a worldwide survey of the indoor mycobionta 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. Forty-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 moulds, New species, Phylogeny, Taxonomy, 16 new taxa.

TAXONOMIC NOVELTIES: New species: Cladosporium aenium Bensch & Samson, C. coloradense Bensch & Samson, C. domesticicum Bensch & Samson, C. europaeum Bensch & Samson, C. neelhamense 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. sloani Bensch & Samson, C. uwebraunianum Bensch & Samson, C. vicinum Bensch & Samson, C. westerdjikiae Bensch & Samson, C. wyomingense Bensch & Samson.

Available online 7 March 2018; https://doi.org/10.1016/j.simyco.2018.03.002.

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 cladosporioid-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, Eurotiales), *Cladosporioides* species are among the most abundant fungi in outdoor and indoor air (Fradkin et al. 1988, 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 characteristics 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...
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/tel1 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, Conglomer 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-R2i 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 dissection 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 gold target 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/tel1 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) | Substrate | Country | Collector | GenBank accession numbers |
|--------------------------|-----------------|----------------------------|-----------|---------|-----------|--------------------------|
| 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 coryanthum | Australia | P.W. Crous | KT600411 KT600509 KT600607 |
| C. aerium sp. nov.       | herbarum        | CBS 143356*; DTO 323-84     | 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 | —         | EF679350 EF679425 EF679502 |
|                          |                 | CBS 121624*; CPC 12211      | Hordeum vulgare  | Belgium  | J.Z. Groenewald | EF679335 EF679406 EF679485 |
|                          |                 | CBS 139578; DTO 109-15      | 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 3586 | — | — | —         | EF679340 EF679412 EF679491 |
|                          |                 | 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 | AJ204227 EF679413 EF679492 |
|                          |                 | CBS 521.68                  | Air              | Netherlands | —         | EF679341 EF679414 EF679493 |
|                          |                 | CBS 572.78; VKM F-405       | Polyergus radiatus | Russia | —         | DQ289799 DQ289415 DQ289866 |
|                          |                 | CBS 813.71                  | Polygonatum odoratum, leaf | Czech Republic | — | — |
|                          |                 | CPC 11386                   | Tilia cordata, leaves | Germany | K. Schubert | EF679344 EF679419 EF679496 |
|                          |                 | CPC 11840                   | Oursia macrophylla | — | — | EF679345 EF679420 EF679497 |
|                          |                 | CPC 12042; EXF-389          | Hyphersaline water, saltrens (reserve pond) | Slovenia | P. Zalar | EF679346 EF679421 EF679498 |
|                          |                 | CPC 12045; EXF-594          | Hyphersaline water, saltrens (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)
| Species complex          | Culture accession number(s)¹,² | Substrate                        | Country³ | Collector          | GenBank accession numbers⁴ |
|--------------------------|--------------------------------|----------------------------------|---------|--------------------|----------------------------|
|                          |                                |                                  |         |                    |                            |
| CPC 12921                | Eucalyptus stellulata, leaves  | Australia                        | B.A. Summerell |                    | EF679352 EF679427 EF679504 |
| CPC 22268; EMSL 1726      | Indoor air sample              | USA: MN                          | Z. Jurjević |                    | MF472900 MF473327 MF473750 |
| CPC 22312; EMSL 1808      | Indoor air sample              | USA: NJ                          | Z. Jurjević |                    | MF472901 MF473328 MF473751 |
| CPC 22313; EMSL 1809      | Indoor air sample              | USA: NJ                          | Z. Jurjević |                    | MF472902 MF473329 MF473752 |
| CPC 22343; EMSL 1856      | Indoor air sample, bedroom     | USA: NY                          | Z. Jurjević |                    | MF472903 MF473330 MF473753 |
| CPC 22349; EMSL 1862      | Indoor air sample, bedroom     | USA: CA                          | Z. Jurjević |                    | MF472904 MF473331 MF473754 |
| CPC 22358; EMSL 1871      | Indoor air sample              | UK: England                      | Z. Jurjević |                    | MF472905 MF473332 MF473755 |
| CPC 22377; EMSL 1890      | Indoor air sample, bedroom     | USA: NY                          | Z. 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. Houbraeken |                | KP701894 KP701771 KP702017 |
| DTO 089-G6               | Air sample, bedroom            | Netherlands                      | J. Houbraeken |                | KP701895 KP701772 KP702018 |
| DTO 089-H3               | Air sample, bathroom           | Netherlands                      | J. Houbraeken |                | KP701896 KP701773 KP702019 |
| DTO 090-D3               | Swab sample, archive           | Netherlands                      | M. Meijer |                    | KP701900 KP701777 KP702023 |
| DTO 090-H4               | Swab sample, archive           | Netherlands                      | M. Meijer |                    | KP701901 KP701778 KP702024 |
| DTO 101-A1               | Indoor environment, wet wall    | Netherlands                      | J. Houbraeken |                | KP701903 KP701780 KP702026 |
| DTO 101-I8               | Floor under curtain            | Hungary                          | —        |                    | KP701909 MF473336 MF473759 |
| DTO 106-C2               | Indoor air, crocodile area of zoo | Netherlands                  | B. Dictus |                    | KP701906 KP701783 KP702029 |
| DTO 108-P9               | Indoor environment             | France                           | J. Dijkstra-Huis |          | 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. Thane |                    | 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                       | 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 | LNB34425 LNB34521 LNB34609 |
|                          | CPC 11526                      | Acacia mangium                   | Thailand | W. Himamann | HM148127 HM148371 HM148616 |
|                          | CPC 14566                      | Corymbia foelscheana             | Australia | B.A. Summerell | HM148147 HM148391 HM148636 |
|                          | CPC 22271; EMSL 1741           | Indoor air sample                | USA: SC | Z. Jurjević | MF472918 MF473345 MF473768 |
|                          |                                |                                  |         |                    |                |
| C. angustherbarum        | herbarum                       |                                  |         |                    |                |
|                          | CBS 140479*; CPC 17814         | Pinus ponderosa                  | USA: UT | W. Quaedvlieg | KTa00378 KTa00475 KTa00574 |
| Species Complex | GenBank accession numbers | Indoors (continued) |
|-----------------|--------------------------|---------------------|
| **C. angustisporum** cladosporioides | CBS 125983*; CPC 12437 | **Alloxyton wickhamii** Australia | B.A. Summerell | HM147995 | HM148236 | HM148482 |
| CPC 22345; EMLS 1856 | Outside air sample USA: AL | Z. Jurjević | MF472919 | MF473346 | MF473769 |
| CPC 22371; EMLS 1884 | Indoor air sample, office USA: FL | Z. Jurjević | MF472920 | MF473347 | MF473770 |
| DTO 127-E9; AR387 | Air sample, bakery USA: WI | — | KP701935 | KP701812 | KP702057 |
| **C. angustiterminale** cladosporioides | CBS 140480*; CPC 15564 | **Bankia grandis** Australia | A.R. Wood | KT600379 | KT600676 | KT600575 |
| **C. anthropophilum** cladosporioides | CBS 690.92* | Caloplaea regalis Antarctica | C. Möller | EF679334 | EF679405 | EF679484 |
| CBS 117483; CPC 11684 | Bamboo slats Japan | — | — | HM148007 | HM148248 | HM148494 |
| CBS 122130; ATCC 38012; IFO 6539; JCM 10684; NBRC 6539 | | — | — | HM148008 | HM148249 | HM148495 |
| CBS 132.29 | Man, bronchoalveolar lavage fluid USA: MN | D.A. Sutton | LN834437 | LN834533 | LN834621 |
| CBS 674.82; ATCC 200936; ATCC 38026; CBS 320.87; IMI 126640 | Gossypium sp., seed Israel | — | — | HM148010 | HM148251 | HM148497 |
| CPC 10142 | Cheno podium filicifolium 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 | Prunus 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 | Trilicum aestivum South Africa | — | HM148037 | HM148278 | HM148524 |
| CPC 14366; BA 1676 | Food, coffee leaf Uganda | J.L. Särensen | HM148049 | HM148290 | HM148536 |
| CPC 14705 | Fuchsia 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; EMLS 1722 | Indoor air sample, ship USA: CA | Z. Jurjević | MF574171 | MF574173 | MF574175 |
| CPC 22315; EMLS 1818 | Indoor air sample, living room USA: GA | Z. Jurjević | MF472921 | MF473348 | MF473771 |
| CPC 22393; EMLS 1908 | Indoor air sample, hospital USA: AZ | Z. 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 | MF473870 |

(continued on next page)
| Species complex | Species | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|-----------------|---------|----------------------------|-----------|---------|-----------|------------------------|
| **Species**     |         |                            |           |         |           | **ITS** | **tef1** | **act** |
| C. aphidis      | sphaerospermum | CBS 132182**; CPC 13204 | Indoor air | China   | —         | MF472931   | MF473358 | MF473781 |
| C. arthropodi    | herbarum | CBS 124043**; CPC 16160 | Arthropodium cirratum | New Zealand | C.F. Hill | JN906978   | JN906985 | JN906997 |
| 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. austriancanum | cladosporioides | CBS 125984**; CPC 13226 | Eucalyptus moluccana | Australia | B.A. Summerell | HM147999 | HM148240 | HM148486 |
| C. austrohemisphaericum | cladosporioides | CBS 140481**; CPC 16763 | Leaf litter | South Africa | M. Gryzenhout | KT600381 | KT600478 | KT600577 |
|                  |          | CBS 140482**; CPC 12068 | Unidentified aphid | New Zealand | C.F. Hill | KT600382 | KT600479 | KT600578 |
| C. basiflavum    | herbarum | 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 | KT600385 | KT600482 | —         |
| C. basiflavum    | herbarum | CBS 822.84* | Hordeum vulgare | Germany | —         | HM148000 | HM148241 | HM148487 |
| C. chlorosporioides | cladosporioides | CBS 125985**; CPC 13864 | Fruiting bodies of Teratosphaeria proteae- | South Africa | P.W. Crous | HM148001 | HM148242 | HM148488 |
|                  |          | CBS 132182**; CPC 13204 | Unidentified aphid | Germany | N. Ale-Agha | JN906978 | JN906986 | JN906997 |
| C. affinis      | cladosporioides | CBS 132182**; CPC 13204 | Indoor air | China | —         | MF472931 | MF473358 | MF473781 |
| C. affinis      | cladosporioides | CBS 132182**; CPC 13204 | Indoor air | China | —         | MF472931 | MF473358 | MF473781 |
| C. affinis      | cladosporioides | CBS 132182**; CPC 13204 | Indoor air | China | —         | MF472931 | MF473358 | MF473781 |
| C. affinis      | cladosporioides | CBS 132182**; CPC 13204 | Indoor air | China | —         | MF472931 | MF473358 | MF473781 |
| C. basiflavum    | herbarum | 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 | KT600385 | KT600482 | —         |
| C. basiflavum    | herbarum | CBS 822.84* | Hordeum vulgare | Germany | —         | HM148000 | HM148241 | HM148487 |
| C. chlorosporioides | cladosporioides | CBS 125985**; CPC 13864 | Fruiting bodies of Teratosphaeria proteae- | South Africa | P.W. Crous | HM148001 | HM148242 | HM148488 |
|                  |          | CBS 132182**; CPC 13204 | Unidentified aphid | Germany | N. Ale-Agha | JN906978 | JN906986 | JN906997 |
| C. affinis      | cladosporioides | CBS 132182**; CPC 13204 | Indoor air | China | —         | MF472931 | MF473358 | MF473781 |
| C. affinis      | cladosporioides | CBS 132182**; CPC 13204 | Indoor air | China | —         | MF472931 | MF473358 | MF473781 |
| C. affinis      | cladosporioides | CBS 132182**; CPC 13204 | Indoor air | China | —         | MF472931 | MF473358 | MF473781 |
| C. affinis      | cladosporioides | CBS 132182**; CPC 13204 | Indoor air | China | —         | MF472931 | MF473358 | MF473781 |
| C. basiflavum    | herbarum | 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 | KT600385 | KT600482 | —         |
| C. basiflavum    | herbarum | CBS 822.84* | Hordeum vulgare | Germany | —         | HM148000 | HM148241 | HM148487 |
| Species | Culture accession number(s) | Substrate | Country\(^3\) | Collector | GenBank accession numbers\(^4\) |
|---------|-----------------------------|-----------|---------------|-----------|-------------------------------|
| 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 12214 | Morus rubra, leaves | USA: WA | L. du Toit | HM148026, HM148267, HM148514 |
| CPC 12760 | Spinacia oleracea, seed | USA: WA | L. du Toit | HM148028, HM148269, HM148515 |
| CPC 12762 | Spinacia oleracea, seed | USA: WA | L. du Toit | HM148029, HM148270, HM148516 |
| CPC 12764 | Spinacia oleracea, seed | USA: WA | L. du Toit | HM148030, HM148271, HM148517 |
| CPC 13667 | Eucalyptus robertsonii subsp. hemisphaerica | South Africa | — | HM148038, HM148279, HM148525 |
| CPC 13667 | Eucalyptus robertsonii subsp. hemisphaerica | South Africa | — | HM148039, HM148280, HM148526 |
| 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 | Asmina sp. | South Africa | — | HM148043, HM148284, HM148530 |
| CPC 14244 | Magnolia sp. | USA: LA | P.W. Crous | HM148038, HM148279, HM148525 |
| CPC 14271 | Twigs of an unidentified tree | France | P.W. Crous | HM148040, 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. Favie | 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)
| Species            | Species complex | Culture accession number(s) | Substrate                      | Country | Collector | GenBank accession numbers |
|--------------------|-----------------|-----------------------------|--------------------------------|---------|-----------|---------------------------|
|                     |                 |                             |                                | ITS     | tef1      | act                       |
| C. colocasiae      | cladosporioide  | CBS 115191; CPC 4323; Lynfield 436 | Colocasia esculenta (=C. antiquorum) | Fiji    | C.F. Hill | AY251075 HM148308 HM148553 |
|                    |                 | CBS 119642; CPC 12726; JCM 13264 | Colocasia esculenta (=C. antiquorum) | Japan   | —         | HM148006 HM148309 HM148554 |
|                    |                 | CBS 386.64*; ATCC 200944; MUCL 10084 | Colocasia esculenta (=C. antiquorum) | Taiwan  | K. Sawada | HM148067 HM148310 HM148555 |
|                    |                 | CPC 5124 Apium graveolens | Indoor environment | New Zealand | C.F. Hill | AY251076 HM148311 HM148556 |
| C. colombiae       | cladosporioide  | CBS 274.80B* | Cortaderia sp. | Colombia | W. Gams | FJ936159 FJ936163 FJ936166 |
| C. coloradensiae sp. nov. | sphaerosperm | CBS 143357*; CPC 22238; EMSL 1685 | Air sample, bedroom | USA: SC | D.A. Sutton | LN834431 LN834527 LN834615 |
| C. crousii         | cladosporioide  | CBS 140668*; UTHSC DI-13-247; FMR 13360 | Man, bronchoalveolar lavage fluid | USA: SC | —         | LN834431 LN834527 LN834615 |
| C. cucumerinum     | cladosporioide  | 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 | —         | HM148071 HM148315 HM148560 |
|                    |                 | CBS 172.54 | Cucumis sativus | Netherlands | G.W. van der Helm | HM148073 HM148317 HM148562 |
| C. cycadicola      | sphaerosperm    | CBS 137970*; CPC 17251 | Cynas media, leaves | Australia | P.W. Crous & R.G. Shivas | KJ869122 KJ869236 KJ869227 |
| C. delicatatum     | cladosporioide  | CBS 126342; CPC 14237; BA 1681 | Indoor air | Denmark | B. Andersen | HM148079 HM148323 HM148568 |
|                    |                 | CBS 126343; CPC 14239; 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 | KP701930 KP701816 KP702063 |
|                    |                 | CPC 14265; BA 1679 | Indoor air | Denmark | B. Andersen | KP701941 KP701818 KP702063 |
|                    |                 | CPC 14286; BA 1680 | Indoor air | Denmark | B. Andersen | KP701920 KP701797 KP702043 |
|                    |                 | CPC 14289; BA 1683 | Door frame | Denmark | B. Andersen | KP701922 KP701799 KP702045 |
|                    |                 | CPC 14360; BA 1718 | Indoor air | Denmark | B. Andersen | KP701933 KP701810 KP702055 |
|                    |                 | CPC 14363; BA 1724 | Indoor air | Denmark | B. Andersen | KP701941 KP701818 KP702063 |
|                    |                 | CPC 14372; BA 1740 | Dust, school | Denmark | B. Andersen | KP701920 KP701797 KP702043 |
| DTO 090-F4         |                 | DTO 134-D3; DR22 | Indoor air, apartment building | Algeria | L. Belhoucine | MF472946 MF473373 MF473796 |
| DTO 134-D4         |                 | DTO 134-D5; O200 | Indoor air, apartment building | Algeria | L. Belhoucine | MF472946 MF473373 MF473796 |
| DTO 134-D6; BT27   |                 | DTO 134-D4 | Indoor air | Algeria | L. Belhoucine | MF472946 MF473373 MF473796 |
| DTO 134-D7; BT91   |                 | DTO 134-D6 | Indoor air | Algeria | L. Belhoucine | MF472946 MF473373 MF473796 |
| DTO 134-D8; BT92   |                 | DTO 134-D7 | Indoor air | Algeria | L. Belhoucine | MF472946 MF473373 MF473796 |
| Species | Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|---------|-----------------|----------------------------|-----------|---------|-----------|-------------------------|
| C. domesticum sp. nov. sphaerospermum | | 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 | | | | |
| | | CBC 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: CA | A. Amend | MF472963 MF473390 MF473813 |
| | | CPC 22318; EMSL 1821 | Indoor air sample | USA: FL | Z. Jurjević | MF472958 MF473385 MF473808 |
| | | CPC 22402; EMSL 1930 | Indoor air sample, classroom | USA: TX | Z. Jurjević | MF472959 MF473386 MF473809 |
| | | CPC 22408; EMSL 1936 | Indoor air sample | USA: NJ | Z. Jurjević | MF472960 MF473387 MF473810 |
| | | CPC 22413; EMSL 1962 | Attic, wood roofing sample | USA: PA | Z. Jurjević | MF472961 MF473388 MF473811 |
| | | DTO 305-H7; TA05NZ-346 | House dust, basement HVAC room | USA: CA | A. Amend | MF472962 MF473389 MF473812 |
| | | DTO 305-I9; TA05NZ-340 | House dust, basement HVAC room | USA: CA | A. Amend | MF472965 MF473392 MF473815 |
| | | DTO 307-H3; AA03US-402 | House dust, basement HVAC room | USA: CA | A. Amend | MF472966 MF473393 MF473816 |
| | | DTO 308-B1; AA03US-368 | House dust, basement HVAC room | USA: CA | A. Amend | MF472966 MF473393 MF473816 |
| | | 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 KT600586 |
| | | CPC 20109 | Unknown vine | Taiwan | P.W. Crous | KT600391 KT600488 KT600586 |
| | | CPC 22244; EMSL 1697 | Outside air sample | USA: CO | Z. Jurjević | MF472967 MF473394 MF473817 |
| | | CPC 22319; EMSL 1822 | Indoor air sample | Bermuda | Z. Jurjević | MF472970 MF473397 MF473820 |
| | | EXF-696 | Hypersaline water, saltlake | Dominican Republic | N. Gunde-Cimerman | DQ780353 JN906986 KJ596641 |
| | | EXF-718 | Hypersaline water, salt lake | Dominican Republic | N. Gunde-Cimerman | DQ780356 KJ596581 KJ596643 |
| | | EXF-720 | Hypersaline water, salt lake | Dominican Republic | N. Gunde-Cimerman | DQ780355 KJ596581 KJ596643 |
| | | EXF-721 | Hypersaline water, saltlake | Dominican Republic | N. Gunde-Cimerman | DQ780354 KJ596580 — |
| C. echinulatum herbarum | | CBS 123191; CPC 15386; reference | Dianthus barbatus | New Zealand | C.F. Hill | JN080680 JN080687 JN080699 |
| 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 |
| Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|-----------------|-----------------------------|-----------|---------|-----------|--------------------------|
| CBS 125.80      | Cirsium vulgare, seadcoat   | Netherlands | —       | B. Heuchert | 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      | Indoor air, archive         | Netherlands | M. Meijer | KPT01787 KPT01748 KPT01994 |
| DTO 072-E4      | Indoor air, archive         | Netherlands | M. Meijer | KPT01787 KPT01752 KPT01998 |
| DTO 096-B3      | Indoor air, archive         | Netherlands | M. Meijer | KPT01787 KPT01763 KPT02009 |
| DTO 109-E7; BA 1907 | Indoor environment      | Denmark     | B. Andersen | KPT01913 KPT01790 KPT02036 |
| DTO 151-H5      | Indoor environment         | Portugal     | —        | MF472971 MF473398 MF473821 |
| C. exasperatum   | cladosporioides             | Eucalyptus tintinnans | Australia | B.A. Summerell | HM148090 HM148334 HM148579 |
| C. exile        | cladosporioides             | Chasmothecia of Phyllactinia guttata on leaves of Corylus avellana | USA: WA | D. Glawe | HM148091 HM148335 HM148580 |
| C. flabelliforme | cladosporioides             | Melaleuca cajuputi | Australia | B.A. Summerell | HM148092 HM148336 HM148581 |
| C. flavovirens  | cladosporioides             | Man, toenail | USA: FL | D.A. Sutton | LN834440 LN834536 LN834624 |
| C. flaccosum    | herbarum                    | Man, ethmoid sinus | USA: MN | D.A. Sutton | LN834416 LN834512 LN834600 |
| C. fusiforme    | cladosporioides             | Allium sativum | Ukraine | A. Akulov | MF472972 MF473399 MF473822 |
| CPC 11807       | Pine needles                | Mexico       | M. de Jesús Yáñez-Morales | MF472973 MF473400 MF473823 |
| CPC 22200; EMSL 1715 | Indoor air sample       | USA: MN | Z. Jurjević | MF472974 MF473401 MF473824 |
| CPC 22309; EMSL 1805 | Indoor air sample       | USA: TN | Z. Jurjević | MF472975 MF473402 MF473825 |
| CPC 22354; EMSL 1867 | Indoor air sample, living room | USA: CO | Z. Jurjević | MF472976 MF473403 MF473826 |
| CPC 22399; EMSL 1927 | Indoor air sample, bedroom | USA: MO | Z. Jurjević | MF472977 MF473404 MF473827 |
| CPC 22968; EMSL 2033 | Indoor air sample, basement | USA: UT | Z. Jurjević | MF472978 MF473405 MF473828 |
| DTO 323-H6      | Indoor air                 | China        | —        | MF472979 MF473406 MF473829 |
| C. fusiforme    | cladosporioides             | Ficus carica | Japan     | — | HM148093 HM148337 HM148582 |
| CPC 11807       | Vigna umbellata             | Japan        | —        | HM148094 HM148338 HM148583 |
| CPC 22224; EMSL 1705 | Air sample, hospital     | USA: AL | Z. Jurjević | MF472980 MF473407 MF473830 |
| CPC 22282; EMSL 1756 | Indoor air sample     | USA: NJ | Z. Jurjević | MF472981 MF473408 — |
| CPC 22298; EMSL 1782 | Indoor air sample, office | USA: MA | Z. Jurjević | MF472982 MF473409 MF473831 |
| CPC 22391; EMSL 1906 | Indoor air sample, bedroom | USA: NJ | Z. Jurjević | MF472983 MF473410 MF473832 |
| DTO 127-E7; AR045 | Air sample, bakery        | USA        | —        | MF472984 MF473411 MF473833 |
| C. fusiforme    | sphaerospermum             | Hypersaline water, saltern | Slovenia | L. Butinar | DQ780388 JK96640 JK96640 |
| CBS 452.71      | Chicken food               | Canada      | —        | — | DQ780390 MF473412 EF101371 |
| EXF-397        | Hypersaline water, saltern | Slovenia     | —        | — | DQ780389 JK96695 EF101372 |
| C. gamainum    | cladosporioides            | Streitizia sp. | South Africa | W. Gams | HM148095 HM148339 HM148584 |
| Species          | Species complex  | Culture accession number(s) | Substrate                        | Country | Collector | GenBank accession numbers |
|------------------|-------------------|-----------------------------|----------------------------------|---------|-----------|--------------------------|
| *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; CNS 11416*: EXF-572; FMR 13493 | Indoor air sample; pineapple storage room | Germany | U. Weidner | MF472986 MF473414 MF473835 |
|                  |                   | CBS 139583; DTO 147-B9      | Indoor air sample, pineapple storage room | Namibia | N. Gunde-Cimerman | DQ780364 JN069389 KJ56633 |
| *CPC 22275; EMSL 1745* |              |                             | Indoor air sample, pineapple storage room | USA: SC | Ž. Jugevič | MF472987 MF473415 MF473836 |
|                  |                   | CPC 22278; EMSL 1749        | Indoor air sample, pineapple storage room | USA: DE | Ž. Jugevič | MF472988 MF473416 MF473837 |
|                  |                   | CPC 22281; EMSL 1755        | Indoor air sample, pineapple storage room | USA: DE | Ž. Jugevič | MF472989 MF473417 MF473838 |
|                  |                   | CPC 22293; EMSL 1774        | Indoor air sample, living room    | USA: NJ | Ž. Jugevič | MF472990 MF473418 MF473839 |
|                  |                   | CPC 22308; EMSL 1804        | Indoor air sample                 | USA: NJ | Ž. Jugevič | MF472991 MF473419 MF473840 |
|                  |                   | CPC 22335; EMSL 1848        | Indoor air sample, bedroom        | USA: NJ | Ž. Jugevič | MF472992 MF473420 MF473841 |
|                  |                   | CPC 22337; EMSL 1850        | Indoor air sample, 11th floor     | USA: NY | Ž. Jugevič | MF472993 MF473421 MF473842 |
|                  |                   | CPC 22380; EMSL 1873        | Indoor air sample, 19th floor     | USA: NY | Ž. Jugevič | MF472994 — MF473843 |
|                  |                   | CPC 22366; EMSL 1879        | Indoor air sample, living room    | USA: NY | Ž. Jugevič | MF472995 MF473422 MF473844 |
|                  |                   | CPC 22372; EMSL 1885        | Indoor air sample, hospital       | USA: NY | Ž. Jugevič | MF472996 MF473423 MF473845 |
|                  |                   | CPC 22381; EMSL 1894        | Indoor air sample, bathroom       | USA: WI | Ž. Jugevič | MF472997 MF473424 MF473846 |
|                  |                   | CPC 22390; EMSL 1905        | Indoor air sample, bedroom        | USA: NJ | Ž. Jugevič | MF472998 MF473425 MF473847 |
|                  |                   | CPC 22397; EMSL 1925        | Indoor air sample, classroom      | USA: TX | Ž. Jugevič | MF472999 MF473426 MF473848 |
|                  |                   | CPC 22401; EMSL 1929        | Indoor air sample, living room    | USA: NJ | Ž. Jugevič | MF473000 MF473427 MF473849 |
|                  |                   | CPC 22411; EMSL 1960        | Attic, wood roofing sample        | USA: PA | Ž. Jugevič | MF473001 MF473428 MF473850 |
|                  |                   | CPC 22412; EMSL 1961        | Attic, wood roofing sample        | USA: PA | Ž. Jugevič | MF473002 MF473429 MF473851 |
|                  |                   | CPC 22414; EMSL 1963        | Attic, wood roofing sample        | USA: PA | Ž. Jugevič | MF473003 MF473430 MF473852 |
|                  |                   | dH12862 Culture contaminant  | Culture contaminant                | Brazil  | —         | DQ780371 EF101400 — |
| DTO 049-E7       |                   |                             | Swab sample, house                | Netherlands | J. Houbraken | MF473004 MF473431 MF473853 |
| DTO 049-E9       |                   |                             | Swab sample, house                | Netherlands | J. Houbraken | MF473005 MF473432 MF473854 |
| DTO 102-A1       |                   |                             | Swab sample, house                | Hungary  | van Mil    | MF473006 MF473433 MF473855 |
| DTO 102-A3       |                   |                             | Swab sample, house                | Hungary  | van Mil    | MF473006 MF473433 MF473855 |
| DTO 108-F7       |                   |                             | Swab sample, indoor environment   | France   | Dijksterhuis | MF473007 MF473434 MF473856 |
| DTO 109-D1       |                   |                             | Swab sample, indoor environment   | Thailand | Noonim     | MF473008 MF473435 MF473857 |
| DTO 109-D3       |                   |                             | Swab sample, indoor environment   | Thailand | Noonim     | MF473011 MF473188 MF473204 |
| DTO 114-H7       |                   |                             | Swab sample, indoor environment   | Netherlands | Noonim | MF473015 MF473202 MF473204 |
| DTO 114-I3       |                   |                             | Swab sample, indoor environment   | Netherlands | Noonim | MF473016 MF473203 MF473204 |
| DTO 117-H3; HM2 RS5 |                 |                             | Indoor environment of house       | Netherlands | M. Meijer & O. Terhoeven | MF473019 MF473186 MF473205 |
| Species   | Species complex | Culture accession number(s) | Substrate                      | Country | Collector | GenBank accession numbers |
|----------|----------------|-----------------------------|--------------------------------|---------|-----------|--------------------------|
| DTO 127-E3; AR373 |  |  | Air sample, bakery | USA: GA | — | MF473009 MF473436 MF473858 |
| DTO 127-E8; AR407 |  |  | Air sample, bakery | USA: GA | — | KPT01936 KPT01813 KPT02058 |
| 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 | KPT01952 KPT01829 KPT02074 |
| 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 | KPT01957 KPT01834 KPT02079 |
| 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-583 |  |  | 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 |
| Species | Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|---------|----------------|---------------------------|-----------|---------|-----------|--------------------------|
| 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 306-B2; 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 |

(continued on next page)
| Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|-----------------|----------------------------|-----------|---------|-----------|--------------------------|
| 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; KJ03SA-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 |
| Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|-----------------|-----------------------------|-----------|---------|-----------|--------------------------|
|                 |                             |           |         |           |                          |
| 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 |

(continued on next page)
| Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|-----------------|----------------------------|-----------|---------|-----------|--------------------------|
| **C. herbaroides** **herbarum** | CBS 121626; CPC 12052; EXF-1733 | Indoor air, archive | 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 |
| **C. hillianum** **cladosporioides** | CBS 125988; CPC 15459; C92 | Typha orientalis, leaf mold | New Zealand | R. Beever | HM148097, HM148341, HM148586 |
| **C. inversicolor** **cladosporioides** | CBS 139573; DTO 072-C9 | Indoor air, archive | Netherlands | M. Meijer | KP701784, KP701751, KP701997 |

**Table 1.**
| Species | Species complex | Culture accession number(s)¹,² | Substrate | Country³ | Collector | GenBank accession numbers⁴ |
|---------|----------------|-------------------------------|-----------|----------|-----------|--------------------------|
| CPC 14191 | Outside air | Netherlands | M. Meijer | HM148107 | HM148351 |
| CPC 14241 | Sambucus nigra, fruit | Netherlands | P.W. Crous | HM148108 | HM148352 |
| CPC 14368; BA 1735 | School dust | Denmark | B. Andersen | HM148109 | HM148353 |
| CPC 19108; BA 2015 | Indoor air | Denmark | B. Andersen | M473120 | M473547 |
| CPC 22267; EMSL 1763 | Indoor air sample, bedroom | USA: OR | Z. Jurjević | M473121 | M473548 |
| CPC 22289; EMSL 1765 | Indoor air sample, living room | USA: AK | Z. Jurjević | M473122 | — |
| CPC 22300; EMSL 1786 | Indoor air sample, living room | USA: OR | Z. Jurjević | M473123 | M473549 |
| CPC 22365; EMSL 1900 | Indoor air sample, bedroom | USA: WA | Z. Jurjević | M473124 | M473550 |
| DTO 108-F8 | Indoor environment | France | J. Dijksterhuis | KP701908 | KP701765 |
| DTO 109-E9; BA 1909 | Indoor environment | Denmark | B. Andersen | M473125 | M473551 |
| C. ipereniae | cladosporioides | Puya sp. | A. van Iperen | KT600394 | KT600491 |
| CPC 16855 | Arctostaphylos pallida | USA: CA | P.W. Crous | KT600395 | KT600492 |
| C. iranicum | cladosporioides | Citrus sinensis, leaf | Iran | HM148110 | HM148354 |
| C. iridis | herbarum | — | — | EF679369 | EF679446 |
| CBS 136.40** | Iris sp., leaves | Netherlands | — | EF679370 | EF679447 |
| C. fangeronii | sphaerospermum | Moist aluminium school window frame | Belgium | DQ780380 | M473552 |
| CBS 139561; DTO 124-D5 | Air sample, food plant | Netherlands | M. Meijer | KP701931 | KP701808 |
| CBS 189.54* | Man, mycosis | Brazil | Fonseca | DQ780379 | JN960690 |
| CBS 601.84 | Picea abies, wood | Germany | — | DQ780382 | M473553 |
| CPC 19121; BA 2035 | Indoor air | Denmark | — | M473126 | M473554 |
| CPC 22235; EMSL 1681 | Indoor air sample, storage room | USA: DE | Z. Jurjević | M473127 | M473555 |
| CPC 22261; EMSL 1716 | Indoor air sample | USA: MN | Z. Jurjević | M473128 | M473556 |
| CPC 22299; EMSL 1783 | Indoor air sample | USA: PA | Z. Jurjević | M473129 | M473557 |
| CPC 22325; EMSL 1831 | Indoor air sample, washroom | Ireland | Z. Jurjević | M473130 | M473558 |
| CPC 22326; EMSL 1832 | Indoor air sample, washroom | Ireland | Z. Jurjević | M473131 | M473559 |
| DTO 004-C3 | Swab sample, house | Netherlands | J. Houbraeken | M473132 | M473560 |
| DTO 085-H6 | Indoor air, archive | Netherlands | M. Meijer | KP701885 | KP701762 |
| DTO 124-D2 | Air sample, food plant | Netherlands | M. Meijer | M473133 | M473561 |
| C. lebrasiae | sphaerospermum | Milk bread | France | KJ596568 | KJ596583 |
| CBS 138283*; UBOCC-A-112063 | Lichen Phaeophysica orbicularis and Physcia sp. on stems and bark of Acer platanoides | Germany | M. Le Bras | KJ596631 | |
| C. licheniphilum | cladosporioides | CBS 125990*; CPC 13224 | Lichen | W. von Brackel | HM148111 | HM148355 |
| C. limoniforme | herbarum | CBS 113737 | Grape berry | USA: WA | F.M. Dugan lab | KJ600396 |
| CBS 140484*; CPC 12039 | Mira acuminata | Egypt | R.S. Summerbell | KJ600493 | KJ600494 |
| CGMCC 3.18037 | Populus euphratica, rhizosphere | China | Y. Hao | KX938396 | KX938413 |
| CGMCC 3.18038 | Populus euphratica, rhizosphere | China | — | KX938397 | KX938414 |
| CPC 12048; EXF-1060 | Hypersaline water | Israel | P. Zalar | KT600398 | KT600495 |
| CPC 12049; EXF-1062 | Hypersaline water | Israel | P. Zalar | KT600399 | KT600496 |

(continued on next page)
| Species | Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|---------|----------------|-----------------------------|-----------|---------|-----------|-------------------------|
| 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 22250; EMSL 1863 | | Indoor air sample, bedroom | USA: CA | Z. Jurjević | MF473134 | MF473562 | MF473983 |
| CPC 22384; EMSL 1899 | | Sample from under kitchen sink | USA: CA | Z. Jurjević | MF473135 | MF473563 | MF473984 |
| CPC 22394; EMSL 1909 | | Indoor air sample, hospital | USA: AZ | Z. Jurjević | MF473136 | MF473564 | MF473985 |
| CPC 22395; EMSL 1910 | | Indoor air, living room | Netherlands | B. Favé | MF473137 | MF473565 | MF473986 |
| DTO 082-F2 | | Outside air sample | USA: MN | | KT600403 | KT600500 | KT600598 |
| 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 |
| CPC 12748; CPC 11833 | | Chasmothecia of Phylosticta 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 | | Aurobasidium caulivorum | Russia | | HM148115 | HM148359 | HM148604 |
| CPC 22256; EMSL 1711.b | | Outside air sample | USA: MN | Z. Jurjević | MF473140 | MF473568 | MF473989 |
| CBS 121623*; CPC 12752 | | Spinica oleracea | USA: WA | L. du Toit | EF679375 | EF679453 | EF679529 |
| CBS 121811; CPC 12755 | | Spinica 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 | | Mucopsphaeria tulasnei | | | AF222830 | EF679449 | EF679525 |
| CBS 299.67 | | Triticum aestivum | Turkey | | EF679372 | EF679450 | EF679526 |
| CPC 11817 | | Cleistothecia of Phylosticta guttata on leaves of Corylus sp. | USA: WA | D. Glawe | EF679373 | EF679451 | EF679527 |
| CPC 12054; EXF-2287 | | Hypersaline water, saltmarshes (precristalisation pond) | Slovenia | P. Zalar | EF679374 | EF679452 | EF679528 |
| CPC 12756 | | Spinica oleracea | USA: WA | L. du Toit | EF679377 | EF679455 | EF679531 |
| CPC 12757 | | Spinica oleracea | USA: WA | L. du Toit | EF679378 | EF679456 | EF679532 |
| CPC 12758 | | Spinica oleracea | USA: WA | L. du Toit | EF679379 | EF679457 | EF679533 |
| CPC 12759 | | Spinica oleracea | USA: WA | L. du Toit | EF679380 | EF679458 | EF679534 |
| CPC 14305; BA 1704 | | Indoor environment, dust, school | Denmark | B. Andersen | MF473141 | MF473569 | MF473990 |
| CBS 140486*; CPC 17963 | | Pine needles | Mexico | M. de Jesús Yáñez-Mora | KT600406 | KT600504 | KT600602 |
| CPC 15605 | | Taraxacum sp. | Mexico | M. de Jesús Yáñez-Mora | KT600407 | KT600505 | KT600603 |
| CPC 17804 | | Pine needles | Mexico | M. de Jesús Yáñez-Mora | KT600408 | KT600506 | KT600604 |
| Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|-----------------|----------------------------|-----------|---------|-----------|--------------------------|
|                  |                            |           |         |           | 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 1868 | Indoor air sample, office | USA: MA | Z. Jurjević | MF473142 | MF473570 | MF473991 |
| C. neerlandicum sp. nov. cladosporioides CBS 143360*; DTO 086-C5 | Swab sample, archive | Netherlands | M. Meijer | KP701887 | KP701764 | KP702010 |
| C. neoangeroni sp. nov. sphaerospermum CBS 109868 | Mortar of Muro Farnesiano | Netherlands | C. Urzi | DQ780377 | MF473571 | EF101362 |
|                  | CBS 797.97* | Indoor environment | O. Adan | MF473143 | — | — |
|                  | CPC 22236; EMSL 1682 | Indoor air sample, pineapple storage room | | MF473144 | — | — |
|                  | CPC 22262; EMSL 1717 | Outside air sample | | MF473145 | — | — |
|                  | CPC 22263; EMSL 1716 | Indoor air sample | | MF473146 | MF473574 | — |
|                  | CPC 22266; EMSL 1724 | Indoor air sample | | MF473147 | MF473575 | — |
|                  | CPC 22267; EMSL 1725 | Indoor air sample | | MF473148 | MF473576 | — |
|                  | CPC 22314; EMSL 1810 | Indoor air sample | | MF473149 | MF473577 | MF473994 |
|                  | DTO 162-A4 | Wall in a storage room of antiquities with mold growth | | KP701962 | KP701839 | KP702084 |
| C. neopsychothotolerans cladosporioides CGMCC 3.18031* | Saussurea involucrata, rhizosphere soil | China | G. Wang | KX938383 | KX938400 | KX938386 |
|                  | CGMCC 3.18032 | Saussurea involucrata, rhizosphere soil | China | G. Wang | KX938384 | KX938401 | KX938387 |
| 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 14688 | 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 6368; IMI 049626; MUCL 917; NCTC 4097 | — | — | — | HM148120 | HM148364 | HM148609 |
| C. parahalotolerans sp. nov. sphaerospermum CBS 136585*; DTO 161-D3 | Swab sample, apartment | Netherlands | J. Houbraken | KP701965 | KP701832 | KP702077 |
|                  | CPC 22280; EMSL 1754 | Indoor air sample, hotel room | USA: ME | Z. Jurjević | MF473150 | MF473577 | MF473998 |
|                  | CPC 22330; EMSL 1843 | Indoor air sample, family room | USA: NH | Z. Jurjević | MF473151 | — | MF473999 |
|                  | CPC 22336; EMSL 1849 | Indoor air sample | USA: NJ | MF473152 | MF473578 | MF474000 |
|                  | CPC 22342; EMSL 1855 | Indoor air sample, 18th floor | USA: NY | MF473153 | — | MF474001 |
|                  | CPC 22373; EMSL 1886 | Indoor air sample, hospital | USA: NY | MF473154 | — | MF474002 |

(continued on next page)
| Species complex | Culture accession number(s)¹,² | Substrate | Country³ | Collector | GenBank accession numbers⁴ |
|-----------------|-------------------------------|-----------|----------|-----------|---------------------------|
| CPC 22376; EMSL 1889 | Indoor air sample, hospital | USA: NY | Ž. Jurjevi | MF473155 — MF474003 |
| DTO 161-D6 | Swab sample, apartment | Netherlands | J. Houbraken | KP701958 — KP702080 |
| DTO 305-F7; AA07MX-953 | House dust, in a hotel | Mexico | A. Amend | MF473156 — MF474004 |
| DTO 305-F8; AA07MX-935 | House dust, in a hotel | Mexico | A. Amend | MF473157 — MF474005 |
| DTO 305-H5; AA03MX-750 | House dust, in a hardware store | Mexico | A. Amend | MF473158 — MF474006 |
| DTO 306-C1; AA07MX-836 | House dust, in a hotel | Mexico | A. Amend | MF473159 — MF474007 |
| DTO 306-E4; AA02MX-573 | House dust, in a church | Mexico | A. Amend | MF473160 — MF474008 |
| DTO 307-H4; AA03MX-612 | House dust, in a hardware store | Mexico | A. Amend | MF473161 — MF474009 |
| DTO 323-B8 | Indoor air | China | — | MF473162 — MF474010 |
| DTO 323-C1 | Indoor air | China | — | MF473163 — MF474011 |
| DTO 323-C8 | Indoor air | China | — | MF473164 — MF474012 |
| DTO 323-F4 | Indoor air | China | — | MF473165 — MF474013 |
| DTO 323-H2 | Indoor air | China | — | MF473166 — MF474014 |
| DTO 323-H3 | Indoor air | China | — | MF473167 — MF474015 |
| DTO 324-A7 | Indoor air | China | — | MF473168 — MF474016 |
| DTO 324-B7 | Indoor air | China | — | MF473169 — MF474017 |
| C. paralimoniforme herbarum | CGMCC 3.18103* | Thododentron sp., rhizosphere soil | China | J. Zhuang | KX938392 — KX938375 |
| C. paralimoniforme herbarum | CGMCC 3.18104 | — | China | Y. Hao | KX938393 — KX938410 |
| C. parapenidielloides cladosporioides | CBS 140487*; CPC 17193 | Eucalyptus sp. | Australia | P.W. Crous | KT600410 — KT600508 |
| C. parapenidielloides cladosporioides | CBS 143361*; CPC 22332; EMSL 1845 | Indoor air sample, bathroom | USA: NM | Ž. Jurjevi | MF473170 — MF474018 |
| C. parapenidielloides cladosporioides | CPC 22396; EMSL 1924 | Indoor air sample, recreational vehicle | USA: CA | Ž. Jurjevi | MF473171 — MF474019 |
| C. parapenidielloides sphaerospermum | CBS 140498*; CPC 17674 | Acacia verticillata | Australia | P.W. Crous | KT600412 — KT600510 |
| C. perangustum cladosporioides | CBS 125996*; CPC 13815 | Chasmothecia of Phyllactinia guttata on leaves of Corylus avellana | South Africa | P.W. Crous | HM148121 — HM148610 |
| C. perangustum cladosporioides | CBS 126365; CPC 11820 | Chasmothecia of Phyllactinia guttata on leaves of Corylus avellana | USA: WA | D. Glawe | HM148123 — HM148612 |
| CPC 11663 | Oncoba spinosa | New Zealand | C.F. Hill | HM148128 — HM148617 |
| CPC 11815 | Chasmothecia of Phyllactinia guttata on leaves of Corylus sp. | USA: WA | D. Glawe | HM148130 — HM148619 |
| CPC 11819 | Chasmothecia of Phyllactinia guttata on leaves of Corylus sp. | USA: WA | D. Glawe | HM148131 — HM148620 |
| CPC 11821 | Chasmothecia of Phyllactinia guttata on leaves of Corylus sp. | USA: WA | D. Glawe | HM148132 — HM148621 |
| CPC 11831 | Chasmothecia of Phyllactinia guttata on leaves of Corylus sp. | USA: WA | D. Glawe | HM148133 — HM148622 |
| CPC 12216 | Morus rubra | Germany | N. Ale-Agha | HM148135 — HM148624 |
| CPC 13727 | Teratosphaenia maculiformis | South Africa | P.W. Crous | HM148139 — HM148628 |
| CPC 13730 | Protea caffra | South Africa | P.W. Crous | HM148140 — HM148629 |
| Species                  | Species complex              | Culture accession number(s)\(^{1,2}\) | Substrate          | Country\(^3\) | Collector   | GenBank accession numbers\(^4\) |
|-------------------------|------------------------------|-------------------------------------|--------------------|---------------|-------------|---------------------------------|
| 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           | Z. Jurjevič   | MF473172    | MF473595 MF474020               |
| CPC 22237; EMSL 1833     |                              | Indoor air sample                   | USA: ME           | Z. Jurjevič   | MF473173    | —                               |
| CPC 22228; EMSL 1834     |                              | Indoor air sample                   | USA: ME           | Z. Jurjevič   | MF473174    | MF473596 MF474022               |
| CPC 22329; EMSL 1835     |                              | Indoor air sample, library          | USA: CT           | Z. Jurjevič   | MF473175    | MF473597 MF474023               |
| CPC 22331; EMSL 1844     |                              | Indoor air sample, bedroom closet   | USA: CA           | Z. Jurjevič   | MF473176    | MF473598 MF474024               |
| CPC 22375; EMSL 1888     |                              | Indoor air sample, hospital         | USA: NY           | Z. Jurjevič   | MF473177    | MF473599 MF474025               |
| CPC 22378; EMSL 1891     |                              | Indoor air sample, bedroom          | USA: CA           | Z. Jurjevič   | MF473178    | MF473600 MF474026               |
| DTO 127-E1; AR368        |                              | Air sample, bakery                  | USA: GA           | —             | MF473179    | KP701811 KP702056               |
| DTO 127-E2; AR371        |                              | Air sample, bakery                  | USA: GA           | —             | MF473180    | MF473602 MF474027               |
| DTO 323-E4               |                              | Indoor air                          | China              | —             | MF473181    | MF473603 MF474029               |
| DTO 323-E8               |                              | Indoor air                          | China              | —             | MF473182    | MF473604 MF474030               |
| DTO 323-E9               |                              | Indoor air                          | China              | —             | MF473183    | MF473605 MF474031               |
| DTO 324-A2               |                              | Indoor air                          | China              | —             | MF473184    | MF473606 MF474032               |
| DTO 324-A6               |                              | Indoor air                          | China              | —             | MF473185    | MF473607 MF474033               |
| DTO 324-D1               |                              | Indoor air                          | China              | —             | MF473186    | MF473608 MF474034               |
| C. phaeocomaës           | cladosporioides              | CBS 128769*; CPC 18223              | Phaeocoma prolifera| South Africa | K.L. Crous & P.W. Crous | JF499837 JF499875 JF499881       |
| C. phlei                 | herbarum                     | CBS 358.69**                        | Phleum pratense    | Germany       | —           | JN090691 JN090691 JN0907000     |
| C. phyllactiniconëa      | 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 Teratosphaeria proteae-arboresae on Protea arborea | Germany | K. Schubert | HM148154 HM148398 HM148643 |
|                         |                             | CPC 13873                           | South Africa      | P.W. Crous    | HM148155    | HM148399 HM148644               |
| C. pini-ponderosæ        | 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. pseudindis            | herbarum                     | CBS 116463*; LYN 1065               | Iris sp., large leaf lesions | New Zealand | C.F. Hill   | EF679383 EF679461 EF679537     |
| C. pseudochalastosporioides | cladosporioides          | CBS 140490*; CPC 17823              | Pine needles       | Mexico        | M. de Jesús Yáñez-Morales     | KT600415 KT600513 KT600611     |
| C. pseudocladosporioidës | cladosporioidës             | CBS 117134                          | Cloud water        | —            | M. Sancelme | HM148156 HM148400 HM148645     |

(continued on next page)
| Species | Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|---------|----------------|-----------------------------|-----------|---------|-----------|--------------------------|
| 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; CPC 14189 | Indoor environment | Germany | — | KP701881, KP701758, KP702004 |
| CBS 139580; DTO 121-H1; CPC 14189 | Bakery | Germany | — | KP701930, KP701807, MF474034 |
| CBS 149.66; NRRL A-14110 | Triticum aestivum | USA: IL | — | HM148161, HM148405, HM148650 |
| CBS 574.78A; VKM F-422 | Pteridium aquilinum | Russia | — | HM148163, HM148407, HM148652 |
| CBS 667.80 | Malus sylvestris | Italy | — | HM148165, HM148409, HM148654 |
| CPC 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 | Vernonia sp. | Italy | — | HM148175, HM148419, HM148663 |
| CPC 13992; CAMS 001160 | Aloe dichotoma | South Africa | — | HM148175, HM148419, HM148663 |
| CPC 14001; MRC 03240 | Oats | South Africa | — | HM148176, HM148420, HM148665 |
| CPC 14010; MRC 10183 | Sorghum sp. | South Africa | — | HM148176, HM148420, HM148665 |
| CPC 14013; MRC 10221 | Triticum aestivum | South Africa | — | HM148183, HM148427, HM148672 |
| CPC 14020; MRC 10814 | Triticum aestivum | South Africa | — | HM148185, HM148429, HM148674 |
| CPC 14193 | Outdaire air | Netherlands | M. Meijer | HM148186, HM148430, HM148675 |
| CPC 22237; ESMI 1683 | Air sample, car air conditioner | USA: FL | Z. Jurjević | MF473196, MF473608, MF474035 |
| CPC 22283; ESMI 1759 | Indoor air sample, hotel room | USA: NJ | Z. Jurjević | MF473187, MF473609, MF474036 |
| CPC 22284; ESMI 1760 | Indoor air sample, hotel room | USA: NJ | Z. Jurjević | MF473188, MF473610, MF474037 |
| CPC 2265; ESMI 1761 | Indoor air sample, airport - control tower | USA: MA | Z. Jurjević | MF473189, MF473611, MF474038 |
| CPC 22922; ESMI 1773 | Indoor air sample, living room | USA: NJ | Z. Jurjević | MF473190, MF473612, MF474039 |
| CPC 22311; ESMI 1807 | Indoor air sample | USA: NJ | Z. Jurjević | MF473191, MF473613, MF474040 |
| CPC 22334; ESMI 1847 | Indoor air sample, bed | USA: OH | Z. Jurjević | MF473192, MF473614, MF474041 |
| CPC 22338; ESMI 1851 | Indoor air sample | USA: NY | Z. Jurjević | MF473193, MF473615, MF474042 |
| CPC 22340; ESMI 1853 | Indoor air sample, 27th floor | USA: NY | Z. Jurjević | MF473194, MF473616, MF474043 |
| CPC 22341; ESMI 1854 | Indoor air sample | USA: NY | Z. Jurjević | MF473195, MF473617, MF474044 |
| CPC 22551; ESMI 1864 | Indoor air sample, bedroom, 2nd floor | USA: NJ | Z. Jurjević | MF473196, MF473618, MF474045 |
| CPC 22556; ESMI 1869 | Indoor air sample, bedroom closet | USA: TN | Z. Jurjević | MF473197, MF473619, MF474046 |
| CPC 22362; ESMI 1875 | Indoor air sample, living room | USA: PA | Z. Jurjević | MF473198, MF473620, MF474047 |
| CPC 22368; ESMI 1881 | Indoor air sample, office | USA: GA | Z. Jurjević | MF473199, MF473621, MF474048 |
| CPC 22369; ESMI 1882 | Sumatra dragonfruit sample | USA: NJ | Z. Jurjević | MF473200, MF473622, MF474049 |
| CPC 22382; ESMI 1895 | Indoor air sample, bathroom | USA: TX | Z. Jurjević | MF473201, MF473623, MF474050 |
| CPC 22386; ESMI 1901 | Indoor air sample, classroom | USA: RI | Z. Jurjević | MF473202, MF473624, MF474051 |
| CPC 22389; ESMI 1904 | Indoor air sample, living room | USA: NJ | Z. Jurjević | MF473203, MF473625, MF474052 |
| CPC 22392; ESMI 1907 | Indoor air sample, hospital | USA: AZ | Z. Jurjević | MF473204, MF473626, MF474053 |
| Species          | Species complex     | Culture accession number(s) | Substrate                  | Country 3 | Collector | GenBank accession numbers  |
|------------------|---------------------|----------------------------|----------------------------|-----------|-----------|---------------------------|
| CPC 22966; EMSL 2014 | Indoor air sample, office | USA: AZ | Ž. Jurjević | Z. Jurjević | MF473205 MF473627 MF474054 |
| DTO 079-F4       | Wallpaper from a house | Netherlands | J. Hooiveld | J. Hooiveld | KP701877 KP701754 KP702000 |
| DTO 150-A7       | Indoor environment   | Portugal           | —             | —         | MF473206 MF473628 MF474055 |
| DTO 150-C1       | Indoor environment   | Portugal           | —             | —         | MF473207 MF473629 MF474056 |
| DTO 150-C7       | 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           | —             | —         | MF473212 MF473634 MF474061 |
| DTO 151-E7       | Indoor environment   | Portugal           | —             | —         | MF473213 MF473635 MF474062 |
| DTO 151-G7       | Indoor environment   | Portugal           | —             | —         | MF473214 MF473636 MF474063 |
| DTO 152-A5       | Indoor environment   | Portugal           | —             | —         | MF473215 MF473637 MF474064 |
| DTO 152-A6       | Indoor environment   | Portugal           | —             | —         | MF473216 MF473638 MF474065 |
| DTO 152-D6       | Indoor environment   | Portugal           | —             | —         | MF473217 MF473639 MF474066 |
| DTO 152-H5       | Indoor environment   | Portugal           | —             | —         | MF473218 MF473640 MF474067 |
| DTO 152-H7       | Indoor environment   | Portugal           | —             | —         | MF473219 MF473641 MF474068 |
| DTO 307-F3; 7330009-34-883 | House dust | Canada | Health Canada | MF473220 MF473642 MF474069 |
| DTO 307-G9; 7050035.81-622 | House dust | Canada | Health Canada | MF473221 MF473643 MF474070 |
| DTO 308-A2; 7330009.24-784 | House dust | Canada | Health Canada | MF473222 MF473644 MF474071 |
| DTO 323-D3       | Indoor air            | China              | —             | —         | MF473223 MF473645 MF474072 |
| C. psychrotolerans sphaerospermum | CBS 119412*: dH 16390; EXF-391 | Hypersaline water | Slovenia | S. Sonjak | DQ780386 JN906992 KJ956632 |
|                  |                     | House dust         | Australia: Tasmania | L. Agustini | MF473223 MF473645 MF474073 |
|                  |                     | House dust         | New Zealand     | T. Atkinson | MF473224 MF473646 MF474074 |
|                  |                     | Hypersaline water, salttern | Slovenia | — | DQ780385 KJ956591 EF101364 |
|                  |                     | Hypersaline water | Dominican Republic | — | DG703984 KJ956502 EF101365 |
| C. pulvericola sp. nov. sphaerooprum | CBS 109788; DAOM 226470 | Indoor air, residence | Canada | — | MF473225 MF473647 MF474074 |
|                  |                     | House dust         | New Zealand     | T.J. Atkinson | MF473226 MF473648 MF474075 |
|                  |                     | House dust         | USA: ME         | Ž. Jurjević | MF473227 MF473649 MF474076 |
|                  |                     | Indoor environment, wooden window frame | Netherlands | M. Meijer | MF473228 MF473650 MF474077 |
|                  |                     | Indoor environment, swab sample | Netherlands | F. Segers | KP701971 KP701848 KP702093 |
|                  |                     | Indoor environment, swab sample | Netherlands | G. Piccolo Maitan-Alfenas | KP701979 KP701856 KP702101 |
|                  |                     | House dust         | Australia: Tasmania | L. Agustini | KP701987 KP701864 KP702109 |
| C. puyae       | herbarum          | CBS 274.80A*       | Puya goudotiana | Colombia | KT600418 KT600516 KT600614 |
| (continued on next page) | | | | | |
| Species                     | Species complex | Culture accession number(s) | Substrate                      | Country | Collector | GenBank accession numbers |
|-----------------------------|-----------------|----------------------------|--------------------------------|---------|-----------|--------------------------|
| C. ramotenellum             | herbarum        | CBS 109031; IBT 13731      | Cheese                         | Denmark | J. Frisvad| KT600419 KT600517 KT600615 |
|                            |                 | CBS 109601; 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       | Paeonia sp.                    | Italy    | —         | KT600421 KT600519 KT600617 |
| CBS 118.24; ATCC 36972; MUCL 10098 |                 | CBS 169.54; CBS 170.54; IMI 025324; NCTC 6740 | Populus tremuloides, leaf spot | UK: England | —         | KT600422 KT600520 KT600618 |
| CBS 133.29; ATCC 36970      |                 | CPC 1126; Hill 1192       | Arundo sp., leaf              | UK: England | —         | AJ300335 MF473652 MF474079 |
| CBS 169.54; CBS 170.54; IMI 025324; NCTC 6740 |                 | CPC 13401 | Dioscorea tenuipes            | South Korea | H.D. Shin | KT600423 KT600522 KT600620 |
| CBS 170.54; CBS 169.54; IMI 025324; NCTC 6740 |                 | CPC 11832 | Weigela subsessilis          | South Korea | H.D. Shin | KT600424 KT600523 KT600621 |
| CBS 261.80                 |                 | CPC 11395 | Chasmothecia of Phyllactinia guttata on leaves of Corylus sp. | USA: WA | D. Glawe  | KT600426 KT600525 KT600623 |
| CPC 11401                  |                 | CPC 11826 | Chasmothecia of Phyllactinia guttata on leaves of Corylus sp. | USA: WA | D. Glawe  | KT600427 KT600526 KT600624 |
| CPC 12126; Hill 1192       |                 | CPC 12313 | Yucca elephantipes, leaf spot | New Zealand | C.F. Hill | KT600428 KT600527 KT600625 |
| CPC 12313                  |                 | CPC 12385 | Rosa sp.                      | Germany  | N. Ale-Agha | KT600429 KT600528 KT600626 |
| CPC 12385                  |                 | CPC 13407 | Eucaalyptus sp.              | Australia | P.W. Crous  | KT600430 KT600529 KT600627 |
| CPC 13407                  |                 | CPC 13789 | Ginkgo biloba                | Portugal | P.W. Crous | KT600431 KT600530 KT600628 |
| CPC 13789                  |                 | CPC 13792 | Protea sp.                   | Spain: Tenerife | P.W. Crous | KT600432 KT600531 KT600629 |
| CPC 13792                  |                 | CPC 13795 | Unknown plant                | Spain: Tenerife | P.W. Crous | KT600433 KT600532 KT600630 |
| CPC 13795                  |                 | CPC 13798 | Leucospernum sp.            | Spain: Tenerife | P.W. Crous | KT600434 KT600533 KT600631 |
| CPC 13798                  |                 | CPC 13801 | Leucadendron sp.            | Spain: Tenerife | P.W. Crous | KT600435 KT600534 KT600632 |
| CPC 13943                  |                 | CPC 13943 | Quercus infectoria          | Cyprus | A. van Iperen | KT600437 KT600536 KT600634 |
| CPC 14300; BA 1699         |                 | CPC 14306 | Indoor building material    | Denmark  | B. Andersen | KT600438 KT600537 KT600635 |
| CPC 14306; BA1705          |                 | CPC 18224 | Food, garfish gill          | Denmark  | B. Andersen | KT600439 KT600538 KT600636 |
| CPC 19119; BA 2033         |                 | CPC 19119 | Phaeococoma proliferla, leaf bracts | South Africa | K.L. Crous & P.W. Crous | JF499839 JF499877 JF499883 |
| CPC 22370; EMLSL 1883      |                 | CPC 22370 | Indoor air                   | Denmark  | B. Andersen | MF473230 MF473653 MF474080 |
| DTO 084-F5                |                 | CPC 13801 | Indoor air sample, hallway  | USA: CA | Z. Jurjević  | MF473231 MF473654 MF474081 |
| DTO 097-H3                |                 | CPC 18224 | Indoor environment          | Germany  | LGA       | MF473232 MF473655 MF474082 |
| DTO 097-H3                |                 | CPC 18224 | Swab sample, indoor environment | Netherlands | G.J. Dolphin | MF473233 MF473656 MF474083 |
| Species | Species complex | Culture accession number(s)1,2 | Substrate | Country3 | Collector | GenBank accession numbers4 |
|---------|----------------|------------------------------|-----------|----------|-----------|--------------------------|
| **C. rectoides** | cladosporioides | DTO 109-F4; BA 1919 | Indoor environment | Denmark | B. Andersen | KP701917 KP701974 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 306-A3; TA10NZ-322 | House dust | New Zealand | T. Atkinson | MF473237 MF473660 MF474087 |
| | | DTO 306-B2; TA10NZ-324 | House dust | New Zealand | T. Atkinson | MF473238 MF473661 MF474088 |
| | | DTO 306-C4; KJ09SA-88 | House dust | South Africa | K. Jacobs | MF473239 MF473662 MF474089 |
| | | 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 |
| | | DTO 307-F2; TA10NZ-297A | House dust | New Zealand | T. Atkinson | MF473245 MF473668 MF474095 |
| | | DTO 307-I2; TA10NZ-296 | House dust | New Zealand | T. Atkinson | MF473246 MF473669 MF474096 |
| | | 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-295 | House dust | New Zealand | T. Atkinson | MF473244 MF473667 MF474094 |
| | | DTO 306-G3; TA10NZ-289 | House dust | New Zealand | T. Atkinson | MF473245 MF473668 MF474095 |
| | | DTO 307-G3; TA10NZ-295 | House dust | New Zealand | T. Atkinson | MF473246 MF473669 MF474096 |
| | | DTO 306-H1; TA10NZ-295 | House dust | New Zealand | T. Atkinson | MF473247 MF473670 MF474097 |
| | | DTO 306-I1; TA10NZ-240 | House dust | New Zealand | T. Atkinson | MF473248 MF473671 MF474098 |
| | | DTO 306-B2; TA10NZ-324 | House dust | New Zealand | T. Atkinson | MF473249 MF473672 MF474099 |
| | | DTO 306-C4; KJ09SA-88 | House dust | South Africa | K. Jacobs | MF473250 MF473673 MF474100 |
| | | DTO 307-F2; TA10NZ-297A | House dust | New Zealand | T. Atkinson | MF473245 MF473668 MF474095 |
| | | DTO 307-I2; TA10NZ-296 | 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 |
| | | DTO 307-F2; TA10NZ-297A | House dust | New Zealand | T. Atkinson | MF473245 MF473668 MF474095 |
| | | DTO 307-I2; TA10NZ-296 | 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 |
| | | DTO 307-F2; TA10NZ-297A | House dust | New Zealand | T. Atkinson | MF473245 MF473668 MF474095 |
| | | DTO 307-I2; TA10NZ-296 | 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 |

**continued on next page**
| Species complex | Culture accession number(s)1,2 | Substrate | Country3 | Collector | GenBank accession numbers4 |
|-----------------|-------------------------------|-----------|----------|-----------|--------------------------|
| Fuchsia excorticata | CBS 121629*, CPC 11839; Hill 1134A; ICMP 15819 | Air | New Zealand | A. Blouin | EF679386 EF679464 EF679540 |
| Triticum aestivum | CPC 14000; MRC 02998 | Indoor environment | South Africa | — | KT600442 KT600541 KT600639 |
| Crocus sativus | CPC 15454 | Indoor environment | New Zealand | — | KT600443 KT600542 KT600640 |
| Eryngium maritimum | CPC 17652 | Indoor environment | Germany | J. Rennie | KT600444 KT600543 KT600641 |
| Iris pseudacorus | CPC 18365 | Indoor environment | Netherlands | U. Damm | KT600445 KT600544 KT600642 |
| C. sloanii sp. nov. sphaerospermum | DTO 109-12: BA 1896 | Swab sample, food plant | Denmark | B. Andersen | KP701919 KP701796 KP702042 |
| C. soldanellae herbarum | CBS 143364*; DTO 130-D5 | Swab sample, food plant | Netherlands | M. Meyer | MF473253 MF473676 MF474103 |
| C. sp. herbarum | CBS 132188*; CPC 13153 | Soldanelia alpina | Germany | K. Bensch | JN906982 JN906994 JN907001 |
| C. sphaerospermum sphaerospermum | CPC 20045; EXF-2524; MZKI B-1066 | Hypersaline water | Spain | P. Zalar | DQ780351 EU702562 EF101378 |
| C. sphaerospermum | CBS 117728; ATCC 38493; CPC 12098; NRRL 8131 | Wood | USA | — | AF393709 EU702568 EU570275 |
| C. sphaerospermum | CBS 139567; DTO 084-F4 | Indoor environment | Germany | — | KPT01884 KPT01761 KPT02007 |
| C. sphaerospermum | CBS 133684; DTO 150-H8 | Indoor environment | Portugal | — | KPT01844 KPT01821 KPT02066 |
| C. sphaerospermum | CBS 109.14; ATCC 36950; MUCL 10093 | Caryya illinoisensis, leaf scale | USA | — | DQ780350 EU702600 EF101384 |
| C. sphaerospermum | CBS 193.54*; ATCC 11289; IMI 49637 | L. man, nails | Netherlands | G.A. de Vries | DQ780343 EU702601 EU570269 |
| C. sphaerospermum | CPC 11822 | Phylactinia guttata on Corylus avellana | USA | D. Glawe | EU570254 EU702563 EU570270 |
| C. sphaerospermum | CPC 12476 | Ambrosia artemisiifolia | Germany | J. Nitschke | EU570255 EU702564 EU570271 |
| C. sphaerospermum | CPC 13368 | Phaseolus lunatus | Germany | N. Ale-Agha | EU570256 EU702565 EU570272 |
| C. sphaerospermum | CPC 13995 | Thatch | South Africa | G. Marais | EU570257 EU702566 EU570273 |
| C. sphaerospermum | CPC 14016; MRC 10263 | Triticum aestivum | South Africa | — | EU570258 EU702567 EU570274 |
| C. sphaerospermum | CPC 22270; EMSL 1728 | Indoor air sample | USA: MN | Z. Jurjević | MF473254 MF473677 MF474104 |
| C. sphaerospermum | CPC 22301; EMSL 1789 | Indoor air sample, bathroom | USA: CA | Z. Jurjević | MF473255 MF473678 MF474105 |
| C. sphaerospermum | CPC 22302; EMSL 1790 | Indoor air sample, bathroom | USA: CA | Z. Jurjević | MF473256 MF473679 MF474106 |
| C. sphaerospermum | CPC 22317; EMSL 1820 | Indoor air sample | USA: MS | Z. Jurjević | MF473257 MF473680 MF474107 |
| C. sphaerospermum | CPC 22339; EMSL 1852 | Indoor air sample, warehouse | USA: NY | Z. Jurjević | MF473258 MF473681 MF474108 |
| C. sphaerospermum | CPC 22357; EMSL 1870 | Indoor air sample | UK: England | Z. Jurjević | MF473259 MF473682 MF474109 |
| C. sphaerospermum | CPC 22361; EMSL 1874 | Indoor air sample, bedroom | USA: VT | Z. Jurjević | MF473260 MF473683 MF474110 |
| C. sphaerospermum | CPC 22379; EMSL 1892 | Indoor air sample, family room | USA: CA | Z. Jurjević | MF473261 MF473684 MF474111 |
| C. sphaerospermum | DTO 017-C7 | Swab sample, bathroom | Netherlands | J. Hoobraken | KPT01867 KPT01744 KPT01990 |
| C. sphaerospermum | DTO 049-H5 | Indoor environment | Netherlands | J. Hoobraken & M. Meijer | KPT01870 KPT01747 KPT01993 |
| C. sphaerospermum | DTO 086-E7 | Air filter | Netherlands | I.J. Vlug | KPT01889 KPT01766 KPT02012 |
| C. sphaerospermum | DTO 086-E8 | Air filter | Netherlands | I.J. Vlug | KPT01890 KPT01767 KPT02013 |
| C. sphaerospermum | DTO 089-E9 | Indoor air, living room | Netherlands | J. Hoobraken | KPT01893 KPT01770 KPT02016 |
| C. sphaerospermum | DTO 090-A1 | Indoor air sample, kitchen | Netherlands | J. Hoobraken | KPT01897 KPT01774 KPT02020 |
| C. sphaerospermum | DTO 090-H9 | Swab sample, archive | Netherlands | M. Meijer | MF473262 MF473685 MF474112 |
| Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|-----------------|-----------------------------|-----------|---------|-----------|--------------------------|
|                |                             |           |         |           |                          |
| DTO 090-I1     |                             | Swab sample, archive | Netherlands | M. Meijer | KP701902 KP701779 KP702025 |
| DTO 106-D4     |                             | Indoor air, butterfly area of zoo | Netherlands | B. Dichts | 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 | — | MF473265 MF473688 MF474115 |
| DTO 153-B7     |                             | Indoor air sample, bathroom | Netherlands | F. Hagen | MF473266 MF473690 MF474117 |
| DTO 153-C1     |                             | Indoor air sample, bathroom | Netherlands | F. Hagen | MF473267 MF473691 MF474118 |
| DTO 160-I4     |                             | Black spots in bathroom | Netherlands | — | MF473268 MF473692 MF474119 |
| DTO 161-D4     |                             | Swab sample, wall in apartment | Netherlands | J. Houbreken | KP701954 KP701831 KP702076 |
| DTO 161-D7     |                             | Swab sample, apartment | Netherlands | J. Houbreken | KP701959 KP701836 KP702081 |
| DTO 161-D8     |                             | Swab sample, wall near window in apartment | Netherlands | J. Houbreken | KP701960 KP701837 KP702082 |
| DTO 161-D9     |                             | Swab sample, wall near window in apartment | Netherlands | J. Houbreken | KP701961 KP701838 KP702083 |
| DTO 161-E1     |                             | Swab sample, wall near window in apartment | Netherlands | J. Houbreken | 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; AAO3US-373 |                | House dust, basement HVAC room | USA: CA | A. Amend | MF473268 MF473691 MF474118 |
| DTO 306-E3; AAO3US-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; AAO3US-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 KJ966600 EF101375 |
| ExF-458        |                             | Hypersaline water, saltern | Slovenia | — | DQ780345 — EF101374 |
| ExF-738        |                             | Bathroom | Slovenia | — | DQ780348 — EF101383 |
| ExF-739        |                             | Bathroom | Slovenia | — | DQ780344 KJ966601 EF101381 |
| ExF-962        |                             | Bathroom | Slovenia | — | DQ780347 — EF101382 |
| C. spinulosum   | CBS 119907*; EXF-334; MZKI B-1067 | Hypersaline water | Slovenia | S. Sonjak | EF679388 EF679466 EF679542 |
| C. subcinereum | CBS 119907*; EXF-334; MZKI B-1067 | Hypersaline water | Slovenia | S. Sonjak | EF679388 EF679466 EF679542 |
| C. subinflatum | CBS 119907*; EXF-334; MZKI B-1067 | Hypersaline water | Slovenia | S. Sonjak | EF679388 EF679466 EF679542 |
| Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|-----------------|-----------------------------|-----------|---------|-----------|-------------------------|
| C. substilisimum | 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. substilisimum | 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   | CBS 126500*; CPC 13735; FIH 401 | Chamaerea metallica | Thailand | I. Hidayat & J. Meeboon | HM148196 HM148441 HM148866 |
|                 | 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   | CBS 140466*; FMR 13375; UTHSC Di-13-262 | Dolphin, bronchus | USA: FL | D.A. Sutton | LN834434 LN834530 LN834618 |
| C. tenellum      | 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                   | Phylactinia sp. on leaves of Corylus sp. | USA: WA | D. Glawe | EF679399 EF679477 EF679553 |
| C. tenissimum    | CPC 22200; 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. subuliforme   | CBS 125995*; CPC 14253      | Lagerstroemia sp. | USA: LA | P.W. Crous | HM148197 HM148442 HM148867 |
|                 | CBS 126359; CPC 12794       | Musa sp. | USA: HI | I. Budenhagen | HM148196 HM148443 HM148888 |
|                 | CBS 126501; CPC 14410       | Musa sp. | Ivory Coast | K. Daouda | HM148199 HM148444 HM148889 |
|                 | CBS 117.79                  | Fruit | Burundi | J. Rammelo | HM148200 HM148445 HM148890 |
|                 | CBS 262.80                  | Fruit | Nigeria | — | HM148201 HM148446 HM148891 |
|                 | CPC 10538                   | Musa sp. | Mozambique | A. Viljoen | HM148202 HM148447 HM148892 |
|                 | CPC 10882                   | Gnaphalium affine | South Korea | H.D. Shin | HM148204 HM148449 HM148894 |
| C. tenissimum    | CPC 11521                   | Acacia mangium | Thailand | W. Himan | HM148214 HM148459 HM148704 |
|                 | CPC 11612                   | Musa sp. | Indonesia | M. Arzanlou | HM148206 HM148451 HM148896 |
|                 | CPC 11929                   | Acacia mangium | Thailand | W. Himan | HM148215 HM148460 HM148705 |
|                 | CPC 12223                   | Unidentified rust fungus | Brazil | U. Braun | HM148208 HM148453 HM148898 |
|                 | CPC 12795                   | Musa sp. | Polynesia | I. Budenhagen | HM148209 HM148454 HM148899 |
|                 | CPC 13252                   | Rock | Australia | P.W. Crous | HM148216 HM148461 HM148706 |
|                 | CPC 13732                   | Shorea siamensis | Laos | P. Phengs弥漫 | HM148217 HM148462 HM148707 |
|                 | CPC 14196                   | Basella alba (=B. rubra), leaves | Laos | P. Phengs弥漫 | 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        | Chilli pepper sample | Mexico | Ž. Jurjević | MF473281 MF473704 MF474131 |
| Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|-----------------|-----------------------------|-----------|---------|-----------|-------------------------|
| CPC 22320; EMSL 1823 | Indoor air sample | Bermuda | Z. Jurjevi | MF473282 MF473705 MF474132 |
| CPC 22344; EMSL 1857 | Indoor air sample, bedroom | USA: AZ | Z. Jurjevi | MF473283 MF473706 MF474133 |
| CPC 22383; EMSL 1896 | Indoor air sample, bathroom | USA: TX | Z. Jurjevi | MF473284 MF473707 MF474144 |
| CPC 22398; EMSL 1926 | Indoor air sample, classroom | USA: TX | Z. Jurjevi | MF473285 MF473708 MF474145 |
| D TO 109-A1 | Bathroom ceiling | Thailand | P. Noonim | KP701910 KP701787 KP702033 |
| D TO 109-C4 | Mycolab door | Thailand | P. Noonim | MF473286 MF473709 MF474136 |
| D TO 109-C7 | Indoor air, open Petri-dish | Thailand | P. Noonim | MF473287 MF473710 MF474137 |
| D TO 131-A4 | Indoor air, open Petri-dish | Thailand | P. Noonim | MF473288 MF473711 MF474138 |
| D TO 323-C5 | Indoor air | China | — | MF473289 MF473712 MF474139 |
| D TO 323-C9 | Indoor air | China | — | MF473290 MF473713 MF474140 |
| D TO 323-G3 | Indoor air | China | — | MF473292 MF473715 MF474142 |
| D TO 323-G4 | Indoor air | China | — | MF473293 MF473716 MF474143 |
| D TO 323-G8 | Indoor air | China | — | MF473294 MF473717 MF474144 |
| D TO 323-I4 | Indoor air | China | — | MF473295 MF473718 MF474145 |
| D TO 323-I6 | Indoor air | China | — | MF473296 MF473719 MF474146 |
| D TO 323-I8 | Indoor air | China | — | MF473297 MF473720 MF474147 |
| D TO 323-I9 | Indoor air | China | — | MF473298 MF473721 MF474148 |
| D TO 324-A1 | Indoor air | China | — | MF473299 MF473722 MF474149 |
| D TO 324-A3 | Indoor air | China | — | MF473300 MF473723 MF474150 |
| D TO 324-C2 | Indoor air | China | — | MF473301 MF473724 MF474151 |
| D TO 324-C3 | Indoor air | China | — | MF473302 MF473725 MF474152 |
| D TO 324-C5 | Indoor air | China | — | MF473303 MF473726 MF474153 |
| D TO 324-C6 | Indoor air | China | — | MF473304 MF473727 MF474154 |
| D TO 324-C9 | Indoor air | China | — | MF473305 MF473728 MF474155 |
| D TO 324-I4 | Indoor air | China | — | MF473306 MF473729 MF474156 |
| D TO 324-I6 | Indoor air | China | — | MF473307 MF473730 MF474157 |

(continued on next page)
| Species                | Species complex | Culture accession number(s) | Substrate                        | Country | Collector    | GenBank accession numbers | 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 11154 |                 | Spinacia oleracea          | Leaf debris                      | India   | W. Gams      | HM148223 HM148469 HM148714 |          |           |          |
| CBS 126362*; CPC 13658 |                 | Calafpa bungei             |                                  | Russia  | V.A. Meink   | HM148224 HM148470 HM148715 |          |           |          |
| CBS 2061 F            |                 |                            |                                  |         |              |                           |          |           |          |
| C. velox              | sphaerospermum  | CBS 119417*; CPC 11224     | Bambusa sp.                      | India   | W. Gams      | DQ780361 JN906995 EF101388 |          |           |          |
| CPC 18450             |                 | Zea mays                   | Indoor air sample                | USA: MA | Ž. Jurjević  | KT600457 KT600556 KT600654 |          |           |          |
| CPC 22359; EMSL 1872  |                 | Indoor air                 | China                            |         | —            | 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 KJ96597 EF101388  |          |           |          |
| EXF-471               |                 | Hypersaline water, saltern | Slovenia                         |         | —            | DQ780360 KJ96599 EF101387  |          |           |          |
| C. verruculodosporioides |                 | 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            |                 | Uredinospores of Puccinia allii | UK: England                    | G.S. Taylor |         | HM148057 HM148299 HM148544 |          |           |          |
| CPC 11664; Hill 1076-2 |                 | Oncoboa 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. Aitkinson |         | 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. westerdjikiae sp. nov. | cladosporioides | CBS 113746*               | Bing cherry fruits               | USA: WA | R.G. Roberts | HM148061 HM148303 HM148548 |          |           |          |
| CPC 10150             |                 | Fabuus 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      |         | KP701915 KP701972 KP702038 |          |           |          |
| DTO 109-F2; BA 1911   |                 | Indoor environment         | Denmark                          | B. Andersen |         | KP701915 KP701972 KP702038 |          |           |          |
| DTO 152-A9            |                 | Indoor environment         | Portugal                         | —        |         | MF473313 MF473736 MF474163 |          |           |          |
| DTO 152-H9            |                 | Indoor environment         | Portugal                         | —        |         | MF473313 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 |          |           |          |
| Species | Species complex | Culture accession number(s) | Substrate | Country | Collector | GenBank accession numbers |
|---------|-----------------|-----------------------------|-----------|---------|-----------|------------------------|
| CBS 140691*; UTHSC DI-13-211; FMR 13324 | Man, bronchoalveolar lavage fluid | USA: TX | D.A. Sutton | L834415 L834511 L834599 |
| 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 | Eucalyptus sp. | India | W. Gams | HM148128 HM148370 HM148615 |
| CPC 11153 | — | — | — | HM148129 HM148373 HM148618 |
| CPC 11609 | Musa sp. | India | M. Arzanlou | EF679356 EF679431 EF679508 |
| CPC 11806 | Strelitzia sp. | South Africa | W. Gams | HM148129 HM148373 HM148618 |
| CPC 11866 | 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 | — | HM148144 HM148380 HM148635 |
| CPC 14256 | Pecan tree, leaves | USA | P.W. Crous | MF473316 MF473379 MF474166 |
| CPC 14911 | Strelitzia sp. | South Africa | P.W. Crous | HM148148 HM148382 HM148637 |
| CPC 22239; EMSL 1686 | Indoor air sample, bedroom | USA: CO | Z. Jurjević | MF473317 MF473379 MF474166 |
| CPC 22321; EMSL 1824 | Indoor air sample, Bermuda | — | Z. Jurjević | MF473317 MF473379 MF474167 |
| DTO 108-G8 | Indoor air, open Petri-dish | Thailand | P. Noonim | KP701909 KP701786 KP702032 |
| DTO 317-12 | Indoor air | China | — | MF473318 MF473374 MF474168 |
| DTO 323-E2 | Indoor air | China | — | MF473319 MF473372 MF474169 |
| DTO 323-E3 | Indoor air | China | — | MF473320 MF473373 MF474170 |
| DTO 323-E5 | Indoor air | China | — | MF473321 MF473374 MF474171 |
| DTO 323-E6 | Indoor air | China | — | MF473322 MF473375 MF474172 |
| DTO 323-E7 | Indoor air | China | — | MF473323 MF473376 MF474173 |

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 Z. Jurjević, EMSL Analytical, Inc., Cinnaminson, New Jersey, USA; EXF: Culture Collection of Extremopholic Fungi, Biotechnical Faculty, Ljubljana, Slovenia; FMR: Facultad 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; IFO: Institute for Fermentation, Osaka, Japan; 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 Laboratory voor Microbiologie en Microbiële Genetica, Gent, Belgium; IMI: International Mycological Institute, CABI-Bioscience, Egham, Bakingham Lane, UK; JCM: Japan Collection of Microorganism, RIKEN BioResource Center, Japan; LinyiF: Private culture collection and herbarium of Frank Hill, New Zealand; NPCF: 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                                      | Substitution models | Statistics for Bayesian analyses | Statistics for the parsimony analyses | Statistics for the maximum-likelihood analyses |
|----------------------------------------------|--------------------|---------------------------------|---------------------------------------|-----------------------------------------------|
|                                              | act                | tef1                            | unique site patterns                  | number of trees sampled                        |
| C. cladosporioides complex                   | HKY+G              | HKY+G                           | 145                                   | 235                                           | 963 978 |
| C. herbarum complex                         | HKY+G              | HKY+G                           | 124                                   | 186                                           | 286 952 |
| C. sphaerospermum complex                   | HKY+G              | HKY+G                           | 155                                   | 296                                           | 137 928 |

| C. cladosporioides complex                   | number of strains  | number of included characters   | number of parsimony-informative characters | number of parsimony-uninformative characters | number of constant characters |
|----------------------------------------------|--------------------|---------------------------------|---------------------------------------------|-----------------------------------------------|-------------------------------|
| (incl. outgroup(s))                          |                    |                                 |                                             |                                               |                               |
| 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                         |

| Tree length | Alpha parameter value | Invar parameter value | Final ML Optimisation Likelihood |
|-------------|-----------------------|-----------------------|---------------------------------|
| C. cladosporioides complex                   | 14.177192             | 1.200382              | 0.194323                       | −12952.10072                       |
| C. herbarum complex                          | 7.591637              | 1.015297              | 0.163303                       | −6775.467992                       |
| C. sphaerospermum complex                    | 6.896787              | 1.904976              | 0.151042                       | −7017.365135                       |

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 between sequences of the C. cladosporioides species complex while it belongs to the C. sphaerospermum species complex and C. basiinflatum is

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 between sequences of the C. cladosporioides species complex while it belongs to the C. sphaerospermum species complex and C. basiinflatum is
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 found in between 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.

---

**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).
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 outgrowths 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,
Fig. 1. (Continued).

**INDOOR CLADOSPORIUM SPECIES**

| CBS 109082 | Silene maritima - UK | C. sienes | 36 |
|------------|----------------------|-----------|----|
| CGMCC 3.18096 | Soil - China | C. sinatum | 37 |
| CGMCC 3.18097 | Soil - China | C. monticolanum | 38 |
| CGMCC 3.18098 | Soil - China | C. acalypheae | 39 |
| CBS 140486 | Pine needles - Mexico | C. neerlandicum | 40 |
| CPC 15605 | Taxacum sp. - Mexico | C. neerlandicum | 40 |
| CPC 17604 | Pine needles - Mexico | C. neerlandicum | 40 |
| CBS 129582 | Acalypha australis - South Korea | C. neerlandicum | 40 |
| CGMCC 3.18031 | Saussurea involucrate, rhizosphere soil - China | C. neerlandicum | 40 |
| CGMCC 3.18032 | Saussurea involucrate, rhizosphere soil - China | C. neerlandicum | 40 |
| CPC 11818 | Phylactinia gultata chasmothecia on Corlylus sp. - USA | C. inversicolor | 42 |
| CPC 22289 | Indoor air sample, living room - USA | C. inversicolor | 42 |
| CPC 22300 | Indoor air sample, living room - USA | C. inversicolor | 42 |
| CPC 22385 | Indoor air sample, bedroom - USA | C. inversicolor | 42 |
| DTO 072-C9 | Indoor air, archive - Netherlands | C. inversicolor | 42 |
| DTO 109-E9 | Indoor environment - Denmark | C. inversicolor | 42 |
| CBS 401.80 | Triticum aestivum, leaf - Netherlands | C. inversicolor | 42 |
| CBS 484.80 | Cortaderia sp. - Colombia | C. inversicolor | 42 |
| CPC 14190 | Outside air - Netherlands | C. inversicolor | 42 |
| CPC 14191 | Outside air - Netherlands | C. inversicolor | 42 |
| CPC 14241 | Sambucus nigra, fruit - Netherlands | C. inversicolor | 42 |
| CPC 14368 | School dust - Denmark | C. inversicolor | 42 |
| CPC 19108 | Indoor air - Denmark | C. inversicolor | 42 |
| DTO 108-F8 | Indoor environment - France | C. inversicolor | 42 |
| DTO 084-F2 | Indoor environment - Germany | C. inversicolor | 42 |
| DTO 152-A9 | Indoor environment - Portugal | C. inversicolor | 42 |
| CPC 13378 | Pinus ponderosa, needles - Argentina | C. inversicolor | 42 |
| CPC 13362 | Paorea ovata - Germany | C. inversicolor | 42 |
| DTO 152-H9 | Indoor environment - Portugal | C. inversicolor | 42 |
| CBS 113746 | Bing cherry fruits - USA | C. inversicolor | 42 |
| CPC 10150 | Fatoua villosa - South Korea | C. inversicolor | 42 |
| CPC 14284 | Triticum sp., grain - Germany | C. inversicolor | 42 |
| DTO 109-F2 | Indoor environment - Denmark | C. inversicolor | 42 |
| DTO 305-49 | House dust - New Zealand | C. inversicolor | 42 |
| CBS 126342 | Tilia cordata, leaves - Germany | C. inversicolor | 42 |
| CBS 126344 | Tilia cordata, leaves - Germany | C. inversicolor | 42 |
| CPC 14285 | Indoor air - Denmark | C. inversicolor | 42 |
| CPC 14287 | Indoor air - Denmark | C. inversicolor | 42 |
| CPC 14289 | Door frame - Denmark | C. inversicolor | 42 |
| CPC 14360 | Indoor air - Denmark | C. inversicolor | 42 |
| CPC 14362 | Indoor air - Denmark | C. inversicolor | 42 |
| CPC 14372 | Dust, school - Denmark | C. inversicolor | 42 |
| DTO 082-F3 | Indoor air, living room - Netherlands | C. inversicolor | 42 |
| DTO 090-F4 | Swab sample, archive - Netherlands | C. inversicolor | 42 |
| DTO 134-D3 | Indoor environment - Algeria | C. inversicolor | 42 |
| DTO 134-D4 | Indoor environment, apartment building - Algeria | C. inversicolor | 42 |
| DTO 134-D5 | Indoor environment, apartment building - Algeria | C. inversicolor | 42 |
| DTO 134-D6 | Indoor environment - Algeria | C. inversicolor | 42 |
| DTO 134-D7 | Indoor environment - Algeria | C. inversicolor | 42 |
| DTO 134-D8 | Indoor environment - Algeria | C. inversicolor | 42 |
| DTO 145-C4 | Indoor environment - Germany | C. inversicolor | 42 |
| DTO 167-H5 | Indoor air, poultry houses - Poland | C. inversicolor | 42 |
| DTO 168-F8 | Indoor air, poultry houses - Poland | C. inversicolor | 42 |
| DTO 305-H7 | House dust - New Zealand | C. inversicolor | 42 |
| CBS 126343 | Building material - Denmark | C. inversicolor | 42 |
| CPC 14286 | Indoor air - Denmark | C. inversicolor | 42 |
| CPC 14299 | Building material - Denmark | C. inversicolor | 42 |
| CBS 125994 | Vitis flexuosa - South Korea | C. rectoides | 45 |
| CBS 126357 | Plectranthus sp. - South Korea | C. rectoides | 45 |
| CBS 113756 | Bing cherry fruits - USA | C. rectoides | 45 |
| CPC 113749 | Bing cherry fruits - USA | C. rectoides | 45 |
| CBS 125997 | Picea abies, dead wood - Russia | C. rectoides | 45 |
| CBS 125999 | Strelitzia sp. - South Africa | C. rectoides | 45 |
| CPC 126363 | Rhus chinensis - South Korea | C. rectoides | 45 |
| CPC 22353 | Indoor air sample, office - USA | C. rectoides | 45 |
| CBS 125979 | Phaeocoma prolifera - South Africa | C. rectoides | 45 |
| CBS 125994 | Eucalyptus moluccana - Australia | C. rectoides | 45 |
| DTO 109-E8 | Indoor environment - Denmark | C. rectoides | 45 |
| DTO 090-D2 | Swab sample, archive - Netherlands | C. rectoides | 45 |
| DTO 082-E3 | Indoor air, archive - Netherlands | C. rectoides | 45 |
| CBS 139572 | Indoor air, archive - Netherlands | C. rectoides | 45 |
| DTO 072-D8 | Indoor air, archive - Netherlands | C. rectoides | 45 |
| DTO 305-H9 | House dust - New Zealand | C. rectoides | 45 |
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...
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.
Fig. 1. (Continued).
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).

---

**www.studiesinmycology.org 215**
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-feltly, 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.
Fig. 2. (Continued).
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 co-nidiophores 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 allii* (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 brunheii* (designated in Schubert et al. 2007b): *Belgium*, Kampenhout, isol. from *Hordeum vulgare* (*Poaceae*),...
Mycelium superficial, hyphae branched, 1.5–8 μm wide, pluri-septate, 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 micromematous, 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
| Location | Category | Country/Region |
|----------|----------|---------------|
| CPC 22225 | Indoor air sample, air conditioner | USA |
| CPC 22226 | Indoor air sample, living room | USA |
| CPC 22307 | Indoor air sample | USA |
| CPC 22318 | Indoor air sample | USA |
| CPC 22402 | Indoor air sample, classroom | USA |
| CPC 22408 | Indoor air sample | USA |
| CPC 22413 | Indoor air sample, wood flooring sample | USA |
| DTO 305-H | House dust, basement HVAC room | USA |
| DTO 306-B | House dust, basement HVAC room | USA |
| DTO 307-E | House dust, basement HVAC room | USA |
| DTO 307-H | House dust, basement HVAC room | USA |
| DTO 308-B | House dust, basement HVAC room | USA |
| DTO 308-F | House dust, in a hotel | Mexico |
| DTO 306-C | House dust, in a hotel | Mexico |
| DTO 323-H | Indoor air | China |
| DTO 305-F | House dust, in a hotel | Mexico |
| DTO 306-E | House dust, in a church | Mexico |
| DTO 307-H | House dust, in a hardware store | Mexico |
| CBS 139585 | Swab sample, apartment | Netherlands |
| DTO 161-D | Swab sample, apartment | Netherlands |
| DTO 323-B | Indoor air | China |
| DTO 323-C | Indoor air | China |
| DTO 323-8 | Indoor air | China |
| DTO 324-A | Indoor air | China |
| DTO 324-B | Indoor air | China |
| CPC 22330 | Indoor air sample, family room | USA |
| CPC 22342 | Indoor air sample, 18th floor | USA |
| CPC 22373 | Indoor air sample, hospital | USA |
| CPC 22280 | Indoor air sample, hotel room | USA |
| CPC 22335 | Indoor air sample | USA |
| CPC 22376 | Indoor air sample, hospital | USA |
| DTO 305-B | House dust, in a hardware store | Mexico |
| DTO 323-F | Indoor air | China |
| CBS 119416 | Hypersaline water, salt pans | Namibia |
| CPC 22308 | Indoor air sample | USA |
| DTO 130-C | Swab sample, food plant | Netherlands |
| DTO 147-B | Indoor environment | Hungary |
| DTO 160-I | Fungal growth in living room | Netherlands |
| DTO 160-J | Black spots in bathroom | Netherlands |
| DTO 305-E | House dust, rental studio | Mexico |
| DTO 305-G | House dust, basement HVAC room | USA |
| DTO 305-H | House dust, basement HVAC room | USA |
| DTO 306-C | House dust, basement HVAC room | USA |
| DTO 306-D | House dust, South Africa |
| DTO 306-A | House dust, small apartment | South Africa |
| DTO 307-F | House dust, South Africa |
| DTO 307-I | House dust, basement HVAC room | USA |
| DTO 307-K | House dust, basement HVAC room | USA |
| DTO 308-B | House dust, rental studio | Mexico |
| CPC 22281 | Indoor air sample, pineapple storage room | USA |
| DTO 305-E | House dust, small apartment | South Africa |
| CPC 22355 | Indoor air sample, bedroom | USA |
| CPC 22366 | Indoor air sample, living room | USA |
| CPC 22381 | Indoor air sample, bathroom | USA |
| DTO 049-E | Swab sample, house | Netherlands |
| DTO 153-C | Bathroom | Netherlands |
| DTO 305-G | House dust, basement HVAC room | USA |
| DTO 305-H | House dust, basement HVAC room | USA |
| DTO 306-B | House dust, basement HVAC room | USA |
| DTO 306-E | House dust, basement HVAC room | USA |
| DTO 306-F | House dust, South Africa |
| DTO 307-F | House dust, basement HVAC room | USA |
| DTO 307-G | House dust, basement HVAC room | USA |
| DTO 308-A | House dust, basement HVAC room | USA |
| DTO 308-A | House dust, basement HVAC room | USA |
| CPC 22337 | Indoor air sample, 11th floor | USA |
| DTO 305-F | House dust, basement HVAC room | USA |
| DTO 305-F | House dust, basement HVAC room | USA |
| DTO 306-A | House dust, basement HVAC room | USA |
| DTO 306-B | House dust, basement HVAC room | USA |
| DTO 306-B | House dust, basement HVAC room | USA |
| DTO 306-C | House dust, basement HVAC room | USA |
| DTO 306-C | House dust, basement HVAC room | USA |
| DTO 306-F | House dust, basement HVAC room | USA |
| DTO 307-G | House dust, basement HVAC room | USA |
| DTO 307-H | House dust, basement HVAC room | USA |
| DTO 307-H | House dust, basement HVAC room | USA |
| DTO 308-B | House dust, basement HVAC room | USA |
| DTO 308-A | House dust, basement HVAC room | USA |
| DTO 308-B | House dust, basement HVAC room | USA |

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 ºC, 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, felly, growth flat, without prominent exudates, sporulation profuse.
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, 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, G. Fischer, DTO 005-E8; isol. from floor under curtain, DTO 101-I8; isol. from indoor environment, DTO 101-I8. Hungary, isol. from floor under curtain, DTO 101-I8; isol. from indoor environment, DTO 101-I8. 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 an air sample, bedroom, J. Houbraken, DTO 089-G4, DTO 089-G6, DTO 089-H5; ‘s Hertogenbosch, from swab sample archive, M. Meijer, DTO 089-D5; Rijksen, 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, Ditchling, isol. from indoor air sample, Dec. 2012, Z. Jurjević, EMSL 1871 = CPC 22358. USA, California, Modesto, isol. from an indoor air sample, bedroom, Dec. 2012. Z. Jurjević, EMSL 1862 = CPC 22349; Georgia, Tucker, isol. from an air sample, bakery, DTO 127-E4 = AR377; Minnesota, isol. from indoor air sample, Z. Jurjević, EMSL 1726 = CPC 22266; New Jersey, Chatman, isol. from indoor air sample, Oct. 2012. Z. Jurjević, EMSL 1808 = CPC 22312; Z. Jurjević, EMSL 1809 = CPC 22313; New York, isol. from indoor air sample, bedroom, Dec. 2012. Z. Jurjević, EMSL 1856 = CPC 22343; isol. from indoor air sample, bedroom, 15th floor, Jan. 2013. Z. 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. pseudocladosporoides (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–J. 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 or 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, somewhat refractive. Ramoconidia subcylindrical, straight, 24.5−46 × 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, branching in all directions, often forming loose to dense ropes. Erect, straight to slightly flexuous, narrowly cylindrical-oblong, non-nodulose, usually not geniculate, unbranched or once branched, sometimes two types of ramoconidia, short and long ones, 220–280 × (1.5)−2–4 μm, pleuroseptate, 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 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, branching in all directions, often forming loose to dense ropes. Conidia subglobose or obovoid, 2.5−4.5 × 3−4 × 2.5(−3) μm, aseptate; intercalary conidia ovoid, limoniform or ellipsoidal, 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 ellipsoidal 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 umberate 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 fluffly, 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 fluffly-felt, 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), Australia (Australia), Central America (Panama), North America (USA).

Additional materials examined: Australia, Emerald Spring, isol. from Corymbia felsicheana, 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 diffusible 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 Anaros 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 willkhamii (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 verrulose 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, pleuroseptate, 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, subdentilicate, conspicuous, 1–1.5(−2) μm diam, thickened and darkened-refractive. Ramoconidia cylindrical, 18–42(−55) μm long, 0(−1)-septate, concolourous 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, subdentiulate, 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 leader-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 velvety or woolly-velvety or grey to pale greenish-grey, velvety to woolly-fluffy, margin whitish, leader-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 leader-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; Africa (South Africa, Uganda), Asia (China, India, Indonesia, Israel, Japan, South Korea, Thailand), Australasia (Australia), North America (USA).

Additional materials examined: USA, Alabama, Mobile, isol. from outside air sample, Dec. 2012, Z. Jurjević, EMSL 1858 = CPC 22345; Florida, Miami, isol. from indoor air sample, office, Jan. 2013, Z. Jurjević, EMSL 1884 = CPC 22371; Wisconsin, Oak Creek, isol. from air sample, bakery, DTO 127-E8 = AR387.

Notes: Cladosporium anthophilum (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. Phylogeogenetically, C. anthophilum is allied to C. subuliforme (Fig. 1, clade 59) but the latter species is morphologically distinguishing in having slightly wider terminal and intercalary conidia and often awl-shaped conidiphores with a wider base and an attenuated apex (Bensch et al. 2010).

Until now C. anthophilum was only known 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 anthophilum 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 conidiphores, thick-walled, anastomosing. Conidiphores 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 conidiphores 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, subdentiulate, crowded, 1–2.5 μm diam, thickened and somewhat darkened. Ramoconidia cylindrical, 20–51 × 2–5 μm, 0(–)2-septate, pale olivaceous, smooth, with conidiol 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; microcial 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-felt, margin regular, radially furrowed or wrinkled, aerial mycelium diffuse or more abundant in colony centre, flUFFy-felt. 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-felt, 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 317-17, DTO 316-E3, DTO 323-C2, DTO 323-D6, DTO 323-C7, DTO 323-D2, DTO 323-D8, DTO 323-D9, DTO 324-C4, DTO 324-D3, India, isol. from Dalibergia 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, Babert, Laeveld Coop, isol. from Trichitis aestivum, CPC 14009. South Korea, isol. from Phytolacca americana, H.D. Shin, CPC 11122; from Ricinus communis, 2003, H.D. Shin, CPC 11119. Uganda, Mbunde, isol. from food, coffee leaf, B. Anderson, CPC 14356 = BA 1678. USA, Arizona, Tucson, isol. from indoor air sample, hospital, Jan. 2013, Z. Jurjević, EMSL 1908 = CPC 22393; Georgia, isol. from air sample, bakery, DTO 127-E8 = AR409; McDonough, isol. from indoor air sample, living room, Nov. 2012, Z. Jurjević, EMSL 1818 = CPC 22315.

Notes: Cladosporium anthophilum 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. anthropophillum (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 conidigenous loci at the apex and subglobose to limoniform, 3−6(−7) μm long terminal conidia with an irregularly reticulate or striped wall. Cladosporium anthropophillum also resembles C. pseudocladosporioides and C. tenuissimum, but they are genetically well differentiated (Fig. 1, clades 65, 56 and 64, respectively) and morphologically, C. anthropophillum 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.

III.: 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, plurisepitate 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-sinusous 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, concolourous 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 obvoid, 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 conidigenesis 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-felt 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, Z. Jurjević, EMSL 1877 = CPC 22364.

Notes: Cladosporium asperulatum (Fig. 1, clade 28) is phylogenetically close to but distinct from C. myraceaeum (Fig. 1, clade 26; see Bensch et al. 2010) and C. angustimerinale (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 austrohemisphaericae 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.

III.: Bensch et al. (2015: 46, fig. 10).
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. Ranoconica 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, subglobulo to obvoid 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 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, 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 ranoconica 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; micromycetous 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 black 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 24–44 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 = TAU0SNZ-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 plagirotropous hyphae, straight to somewhat flexuous, narrowly cylindrical to cylindrical-oblong, sometimes filiform, non-nodulose, usually not geniculate-sinusuous, 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, plurisepatate, usually not constricted at septa, sometimes slightly constricted and one of the upper septa slightly darkened where ranoconica are formed, pale to medium olivaceous brown or brown, smooth to minutely verruculose or verrucose 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 integrated, usually terminal, sometimes

Cladosporium cladosporioides...
in long branched chains, up to 10 conidia in the upper unbranched part, branching in all directions, small terminal conidia subglobose, ovoid, 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-felt, 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-felt, 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; sporation 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-H4 = BA 1698, DTO 109-H6 = 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, Z. Jurjević, EMSL 1893 = CPC 22380; Florida, St. Augustine,isol. from indoor air sample, kitchen, Dec. 2012, Z. Jurjević, EMSL 1861 = CPC 22348; Georgia,isol. from indoor air sample, Aug. 2012, Z. Jurjević, EMSL 1722 = CPC 22264; Michigan, Dryden,isol. from indoor air sample, bedroom, Dec. 2012, Z. Jurjević, EMSL 1860 = CPC 22347; Minnesota,isol. from indoor air sample, Aug. 2012, Z. Jurjević, EMSL 1723 = CPC 22265; Vermont, Williston,isol. from indoor air sample, bedroom, Dec. 2012, Z. Jurjević, EMSL 1878 = CPC 22365; Virginia, Arlington,isol. from indoor air sample, living room, Jan. 2013, Z. 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-Moray 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 conidigenous loci crowded at or towards the apex and avoid 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, Z. 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.

Superfacial 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 micromeratus, 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. Conidigenous 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, numerous 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 ellipsoidal, 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 ellipsoidal, 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 conidigenous 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 Hobson, 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; micromenatous conidiophores narrower and pale olivaceous, 19–75(–100) × (1.5–)2–2.5 μm. **Conidigenous 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. **Ramoconidium** 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 obvoid, subglobe 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 ramoconidium 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
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. Belhocine, 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 cupboard, water damaged room, 2000, B. Andersen, BA 1718 = CPC 14360; Valetcoed, isol. from dust, school, 2000, B. Andersen, BA 1740 = CPC 14372; Weert, isol. from indoor air.

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.
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-f = TA0SNZ-340. Poland, isol. from indoor air in poultry houses, K. Plewa, DTO 167-H5, DTO 168-F6.

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 ramosconidia, only a few conidia in the terminal unbranched part of conidial chains, shorter often slightly geniculate conidiophores and shorter secondary ramosconidia. Cladosporium westertijikiae (Fig. 1, clade 43) is the closest relative in the tree but can be distinguished from C. delicatulum by usually aseptate and somewhat longer ramosconid and secondary ramosconid. Cladosporium inversicolor (Fig. 1, clade 42) is distinct by its longer conidial chains, longer small terminal and intercalary conidia, wider intercalary conidia and secondary ramosconidia, longer ramosconidia 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, Z. Jurjević, CBS H-23250. Ex-type culture: CBS 143358 = CPC 222307 = EMSL 1803.

Diagnosis: Differ from C. halotolerans by its 0–2-septate ramosconidia (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 ramosconidia 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 or minutely verruculose especially those giving rise to conidiophores, often forming ropes of several hyphae, occasionally swollen hyphal cells or dense hyphal aggregations, swelling cells globose, doliform or irregular in outline. Conidiophores macro-, semimacro- or micromenato, 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 ramosconidia and secondary ramosconidia 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)–2.5(–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 ramosconidia ellipsoid or subcylindrical, (6)–9(–12) × (1.5)–2(–3) 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 diffused 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 material examined: USA, isol. from house dust, DTO 305-H2 = AA03US-480, DTO 306-B6 = AA03US-525, DTO 307-E8 = AA03US-368, DTO 307-H5 = AA03US-402, DTO 308-B1 = AA03US-387; Florida, Oldsmar, isol. from indoor air sample, Nov. 2012, Z. Jurjević, EMSL 1821 = CPC 23218; New Jersey, Trenton, isol. from indoor air sample, Oct. 2012, Z. Jurjević, EMSL 1803 = CPC 222307; isol. from indoor air sample, 1st floor, Jan. 2013, Z. Jurjević, EMSL 1936 = CPC 22408; Pennsylvania, isol. from attic wood roofing sample, Jan. 2012, Z. Jurjević, EMSL 1962 = CPC 22413; Huntington Valley, isol. from indoor air sample, air conditioner, May 2012, Z. Jurjević, EMSL 1698 = CPC 22225; Texas, Georgetown, isol. from indoor air sample, classroom, Jan. 2013, Z. 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.
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 verrucose to irregularly rough-walled, walls unthickened or almost so, protoplasm somewhat aggregated in the centre of the cells.

---

**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.
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-oblance, usually neither geniculate nor nodulose, unbranched or branched, once or several times, branches as short lateral prolongations below a septum, \((5–)10–100(–200) \times (1–)2–2.5(–3.5) \mu m\), aseptate or with few septa, pale olivaceous brown, smooth to minutely verruculose, walls thin-walled to slightly thickened; micronematous conidiophores often only as short denticile- 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 \mu m diam, thickened and darkened-refractive. Ramoconidia occasionally formed, up to 40 \mu m long, base about 2 \mu m 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 verrucose, intercalary conidia ovoid, limoniform to ellipsoidal, (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 verrucose, 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 green to greynish green, reverse greenish grey, velvety to hairy or felty, margin regular, white, abundant sporulation, glaucous grey to greenish 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)temperate 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, Z. Jutjević, EML 1897 = CPC 22244. Bermuda, Samerset, isol. from indoor air sample, Nov. 2012, Z. Jutjević, EML 1922 = CPC 22319. USA, Colorado, Denver, isol. from outside air sample, Jun. 2012, Z. Jutjević, EML 1687, 1688 = CPC 22240, 22241.

Notes: Cultures of C. dominicanum (Fig. 3, clade 4) sporulate less abundantly than C. sphærosporum (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 (Razafirinano 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 verrucose or rough-walled. Conidiophores macronematos, sometimes micronematos, 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 verrucose or rough-walled at the base; micronematos conidiophores about 2 μm wide. Conidigenous cells integratored, 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 ellipsoidal, 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 ellipsoidal 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-feltty aerial mycelium, reverse iron-grey or leaden-grey, powdery or fluffy-feltty, 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. Peft, 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 Coriaria vulgare (Aceraceae), CBS 125.80; Millingenwards, 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 europeum (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 %) producing shorter, 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-oidovoid, obovoid, rarely subglobose, sometimes subcilindrical, 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 ellipsoidovoid or sub-cylindrical, 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, conidigenous hila conspicuous, 1−2 µm diam, sometimes situated on small stalk-like prolongations, somewhat thickened and darkened-refractive; microcyclic conidogenesis 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-feltty, 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-feltty, 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 Vázquez-Morales, as “Pandelia”, CPC 17892. Ukraine, Kharkov district, Zolochewy, Chepeliv village, isol. from Allium sativum (Alliaceae), 5 Jul. 2008, A. Akulov, stored as “Stemphylium versicoloratum”, CPC 15522. USA, Colorado, Fort Collins, isol. from indoor air sample, living room, Dec. 2012, Z. Jurijevič, EMSL 1867 = CPC 22354; Minnesota, isol. from indoor air sample, Aug. 2012, Z. Jurijevič, EMSL 1715 = CPC 22280; Missouri, Fort Leonard Wood, isol. from indoor air sample bedoom, Jan. 2013, Z. Jurijevič, EMSL 1927 = CPC 22399; Tennessee, isol. from indoor air sample, Oct. 2012, Z. Jurijevič, EMSL 1856 = CPC 22309; Utah Draper, isol. from indoor air sample, basement, Feb. 2013, Z. Jurijevič, 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. aeurium (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. aeurium 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.
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.

Holotype: Japan, isol. from leaves of Vigna umbellata [=Phaseolus chrysanthus] (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 basally, 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)–2.5–3(–3) μm (av. ± SD: 5.3 ± 1.6 × 2.3 ± 0.3), asceptate, 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(–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 reulate, walls unthickened, slightly to distinctly attenuated towards apex and base, hila conspicuous, subdenticulate, 0.5–2 μm diam, somewhat thickened and darkened-refractive; microcyst 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-felted, margin white to olivaceous, regular, aerial mycelium abundant, floccose to villose, low to high, growth effusive 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, velvet or floccose to feltly, margin white, glabrous to feathery, aerial mycelium abundant, covering most of the colony surface, floccose to feltly, 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 feltly, 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, Z. Jurjević, EMSL 1705 = CPC 22247; Massachusetts, Lakville, isol. from indoor air sample, office, Oct. 2012, Z. Jurjević, EMSL 1782 = CPC 22298; New Jersey, isol. from indoor air sample, Z. Jurjević, EMSL 1756 = CPC 22282; Manasquan, isol. from indoor air sample, bedroom, Jan. 2013, Z. 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 “fungulusum” 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 fungulusum** 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 fungulusum** (Fig. 1, clad 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 microconidiatous, 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, microconidiatous 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 ovoid, 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) × 3–4(–5) μm (av. ± SD: 6.8 ± 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, 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

www.studiesinmycology.org 245
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.
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 salters, 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** partly 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, micromacronematous erect, straight to somewhat semimacronematous, arising laterally and terminally from hyphae, 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, micromacronematous 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, micromacronematous 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 numerous, 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, ellipsoid or ellipsoidoid, 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 verrucose, *secondary ramoconidia* ellipsoidoid, fusiform or cylindrical, 7–25(–31) × 2–3.5(–6.5) μm (av. ± SD: 16.2 ± 6 ± 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, unthickened 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 sub-tropical climates, Arctic ice and biomes, contaminant in lesions of humans and animals, plants, rocks, soil, confier wood and mycorrhizal roots; probably circumboreal, 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. parahalotolerans* (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).

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 verrucose, walls unthickened. Conidiophores macronematous, solitary, arising terminally and laterally from hyphae, erect, straight to somewhat flexuous, cladosporioides-like, cylindrical-oblung, 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 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, feltly, 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 108–E9 = BA 1909. France,isol. from indoor environment, J. Dijksterhuis, DTO 108–FI. 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, Z. Jurjević, EMSL 1806 = CPC 22300; Salem, isol. from indoor air sample, bedroom, Sep. 2012, Z. Jurjević, EMSL 1763 = CPC 22287;Washington, Tacoma,isol. from indoor air sample, bedroom, Jan. 2013, Z. 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 ramosoconidia, secondary ramosoconidia and conidioiphores, which is unique and distinctive among Cladosporum species of this complex.

Cladosporum 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, somewhat 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, feltly-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, feltly, growth flat. Sporulation profuse and without prominent exudates on all media.
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 langeroni (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 19112. Ireland, Dublin, isol. from indoor air sample, washroom, Nov. 2012, Z. Jurjević, EMSL 1831, 1832 = CPC 22325, 22326. The Netherlands, Eindhoven, isol. from a swab sample, house, J. Houbreken, DTO 004-C3; Hertogenbosch, indoor air archive, M. Meijer, DTO 085-H6; Ospel, air sample indoor air storage sample, Pineapple room, June 2012, Z. Jurjević, EMSL 1681 = CPC 22235, Minnesota, isol. from indoor air sample, Aug. 2012, Z. Jurjević, EMSL 1716 = CPC 22261; Pennsylvania, Kulitstown, isol. from indoor air sample, Oct. 2012, Z. Jurjević, EMSL 1763 = CPC 22239.

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 biomas 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 acuminate (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 cateenate, 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 obvoid 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), asceptate, 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), asceptate, 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, isolated from house dust, DTO 305-G4 = BH02AU-115. Cyprus, Polis, isolated from Eucalyptus sp. (Myrtaceae), 18 Mar. 2007, coll. A. van Iperen, P.W. Crous, CPC 13923. Israel, Dead Sea, Ein Bokek, isol. from hypersaline water, 2004, P. Zalar, EXF-1062 = CPC 12049; Ein Gedii, 31.45, 35.3833, isol. from hypersaline water, 2004, P. Zalar, EXF-1060 = CPC 12048, EXF-1081 = CPC 12050. The Netherlands, Utrecht, swab sample, archiver, M. Meijer, DTO 090-H8; Weert, isol. from indoor air living room, B. Favie, DTO 082-F2. USA, isolated from grape berry, F.M. Dugan lab, CBS 113737; Arizona, Tucson, isol. from indoor air sample, hospital, Jan 2013, Z. Jurjević, EMSL 1909, 1910 = CPC 22394, 22395; California, Indo, isol. from under kitchen sink sample, Jan 2013, Z. Jurjević, EMSL 1899 = CPC 22384; La Mesa, isol. from indoor air sample, bedroom, Dec. 2012, Z. 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 micromenotous 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. aggregatotricaricatum (Fig. 2, clade 34). The latter species clearly differs in having much longer macromenotous 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 lycopodermis Cooke, Grevillea 12(61): 32. 1883. MycoBank MB217533.

Lectotype (designated in Heuchert et al. 2005): USA, South Carolina, Aiken, on Lycopodion sp. (Araucariales), 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 micromenotous, solitary, arising terminally and laterally from hyphae, erect, straight or slightly flexuous, macromenotous conidiophores cylindrical-oblong or filiform, non-nodulose, 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; micromenotous 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, conidigenous 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 ramosclonia, 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 obvoid or narrowly ellipsoid, (2−)3.5−5 × (1.5−)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 doliform, 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 ramosclonia sometimes formed in dense whirls at the conidiogenous cells or secondary ramosclonia, 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 grey 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. Z. 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 epitope 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 186–199).

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 somewhat thickened or slightly thickened. Conidiophores micronematous and macro- nematous, solitary, arising terminally from plagiotropic 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 μm × (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. Micronematous 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 subglabose, obvoido- oval, oval, lipo- niform, 4–11 μm × (3–)4–6 μm [av. ± SD, 7.6 (± 1.9) × 5.0 (± 0.8) μm], aseptate, intercalary conidia broadly ovoid-ellipsoidal, 10–17 × (4.5–)5–9 μm [av. ± SD, 12.7 (± 2.1) × 6.8 (± 0.8) μm], 0–1-septate; secondary ramoconidia broadly ellipsoidal 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 macroconidemates conidiophores, conidia often germinating with long hyphae. Conidia formed by micronematous conidiophores usually smaller, narrower and paler, catenate, in short unbranched or branched chains, sub- globose, obvoid to limoniform, ellipsoidal 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 felly, 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 felly, 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, felly, white to smoke-grey or grey-olivaceous, felly, 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, soil, 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, Z. Jurjević, CBS H-23252. Ex-type culture: CBS 143359 = CPC 222333 = EMSL 1866.

Diagnosis: Differs from C. uvebrauniam 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, plicate-septate, 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, numerousy 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 outgrowths 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 numerousy formed in densely branched chains, with 1–6(–8) conidia in the terminal unbranched part of the conidial chain, small terminal conidia obvoid, 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-felt, 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 leader-grey and olivaceous grey, velvety or fluffy-felt. 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 interetween C. verruculadosporioides (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 verruculadosporioides 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 uvebrauniam (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 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 MB822224. 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. acalyphe 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 obvoid 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–)3.5–3.5 μm (av. ± SD: 7.4 ± 2.0 × 3.1 ± 0.3), asceptate, with 1–4 distal hila crowded at the apex, secondary ramoconidia ellipsoid or subcylindrical, (8–)9.5–18(–23) × 3–5.5(–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,
Conidia often germinating, germ tubes up to 80 μm long or even longer, sepalate, 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(–840) × (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, plurisepitate, 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 focus situated on small lateral prolongations or subdenticle 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(–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, subdentulate, 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 grey 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 Famesion; Europe (Italy, The Netherlands), North America (USA).

Additional materials examined: Italy, Parma,isol. from mortar of Muro Famesion, 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 162-44. **USA**, Delaware, isol. from indoor air storage sample, pineapple room, Jun. 2012, Z. Jurjević, EML 1682 = CPC 22236; Minnesota, isol. from indoor air sample, Aug. 2012, Z. Jurjević, EML 1724, 1725 = CPC 22266, 22267; isol. from outside air sample, Aug. 2012, Z. Jurjević, EML 1717 = CPC 22262, 22263; New Jersey, Chatman, isol. from indoor air sample, Oct. 2012, Z. Jurjević, EML 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 MB822244. 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 × 2.3–4.5 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 conidigenous 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 subdentulate, 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-cladosporioidei 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) μm (av. ± SD: 6.4 ± 1.6 × 4.0 ± 0.4), pale olivaceous to often medium olivaceous brown, sparse 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 subcylindric, (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 felt-y-wooly, 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 felt-y-wooly, margin colourless to white, glabrous or feathery, radially furrowed, aerial mycelium feltly, 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, isolated from indoor air, DTO 323-B8, DTO 332-C1, DTO 322-C8, DTO 332-F4, DTO 325-H2, DTO 323-H3, DTO 324-A7, DTO 324-B7. Mexico, isolated from house dust, DTO 305-F7 = AA07MX-953, DTO 305-F6 = AA07MX-935, DTO 305-I5 = AA03MX-750, DTO 306-C1 = AA07MX-836, DTO 306-E4 = AA02MX-573, DTO 307-H4; AA03MX-612.

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

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

**Holotype:** USA, New Mexico, Albuquerque, isolated from indoor air sample, bathroom, Nov. 2012, Z. 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, septe, septe 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, macro-nematous 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. Conidiophorons cells terminal 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 obvold or ellipsoid, sometimes subglobose, 3.45(–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 whirs, 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-feltly, margin regular to undulate, somewhat feathery, radially furrowed, aerial mycelium loose, diffuse to dense, low to high, fluffy-feltly, 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-feltly 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, isolated from indoor air sample, recreational vehicle, Jan. 2013, Z. 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 micromatous 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).

Myceillum 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 45 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. Ramoconi-dia cylindrical-oblong, 25–45 × 2.5–3(–4) μm, 0(–1)–2(–3)-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 ellipsoidal 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 turgo 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 felfy, 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 felfy, 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 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, Essien, botanical garden, 51.45, 7.0167, isol. from Morus rubra (Moraceae), 2005, N. Ale-ahga, CPC 12216, New Zealand, Auckland, Auckland University campus, isol. from leaves of onocca sp. (Salicaceae), Sep. 2004, C.F. Hill, Hill 1076-1 = CPC 11163, South Africa, Pretoria, Walter Sisulu park, isol. from Protea caffra (ascospor 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, Jonker- Shonek Nature Reserve, isol. from Teratosphaeria fibrosa (Teratosphaeriaceae), 30 Mar. 2007, P.W. Crous, CPC 13870; Western Cape, Bellies 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, Z. Jurjevi, EMSL 1844 = CPC 22331; Thousand Oaks, isol. from indoor air sample, bedroom, Jan. 2013, Z. Jurjevi, EMSL 1891 = CPC 22378; Connecticut, Manchester, isol. from indoor air, library, Nov. 2012, Z. Jurjevi, EMSL 1835 = CPC 22329; Georgia, Tucker, isol. from indoor sample, bakery, DTO 127-E1 = AR386, DTO 127-E2 = AR371; Louisiana, Baton Rouge, isol. from Magnolia sp. (Magnoliaceae), 8 Sep. 2007, P.W. Crous, CPC 14327; Maine, Westbrook, isol. from indoor air sample, Nov. 2012, Z. Jurjevi, EMSL 1833 = CPC 22327, CPC 22328; New York, New York, isol. from indoor air sample, hospital, Jan. 2013, Z. Jurjevi, EMSL 1888 = CPC 22375; Pennsylvania, Chaddes Ford, isol. from indoor air sample, Oct. 2012, Z. Jurjevi, EMSL 1781 = CPC 22297; Washington, Seattle, University of Washington campus, isol. from chasmotheca of Phylachalinia guttata (Erysiaphila) 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 1.5 μm wide. *Conidigenous 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, 1.5(–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* vary 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* ovoid, ovoid to limoniform or ellipsoidal, 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 ellipsoidal 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, growth effuse to low convex, few small prominent exudates formed, sporulation profuse. Colonies on MEA attaining 52–78 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 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 fely, 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. Hooivelt, DTO 079-F4, USA, Arizona, Tucson, isol. from indoor air sample, office, Feb. 2013, Z. Jurjević, EMSL 2014 = CPC 22396; isol. from indoor air sample, hospital, Jan. 2013, Z. Jurjević, EMSL 1907 = CPC 22392; Florida, Coral Springs, isol. from air sample, car air conditioner, Jun. 2012, Z. Jurjević, EMSL 1683 = CPC 22237; Georgia, Carrollton, isol. from indoor air sample, office, Jan. 2013, Z. Jurjević, EMSL 1891 = CPC 22368; New Jersey, Bridgeport, isol. from indoor air sample, bedroom, 2nd floor, Dec. 2012, Z. Jurjević, EMSL 1864 = CPC 22351; Maranaquin, isol. from indoor air sample, living room, Jan. 2013, Z. Jurjević, EMSL 1904 = CPC 22389; New York, New York, isol. from indoor air sample, 2nd floor, Dec. 2012, Z. Jurjević, EMSL 1853 = CPC 22340; Ohio, Columbus, isol. from indoor air sample, bedroom, Dec. 2012, Z. Jurjević, EMSL 1847 = CPC 22334; Pennsylvania, Chalfont, isol. from indoor air sample, living room, Dec. 2012, Z. Jurjević, EMSL 1875 = CPC 22362; Rhode Island, North Providence, isol. from indoor air sample, classroom, Jan. 2013, Z. Jurjević, EMSL 1901 = CPC 22386; Texas, Haltom City, isol. from indoor air sample, bathroom, Jan. 2013, Z. 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 conidigenous 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 conidigenous 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 crousi 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. crousi 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. Šečovje salterns, isolated from hypersaline water, May 1999, S. Sonjak, CBS H-19730. Ex-type culture: EF-391 = CBS 119412.

Lit.: Bensch et al. (2012: 229–230).

iii.: 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 verruclose, thin-walled. Conidiophores macro- and micronematous, arising terminally and laterally from hyphae, erect or ascending, straight or somewhat flexuous, neither geniculate nor nodulose, cylindrical-oblung, unbranched or branched, once or few times, 20–220 × (2–)3–4(–5) μm, micromatous 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 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 verruclose, rounded at the apex, attenuated towards the base, hila 0.5–0.8 μm diam, intercalary conidia ovoid, limoniform to ellipsoid, 5–9(–13) × 2.5–3.5(–3.5) μm (av. ± SD: 7.2 ± 1.9 X 3.2 ± 0.5), 0(–1)-septate, pale brown, smooth to minutely verruclose, 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 μm 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-543.

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. sloani (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 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 sloani 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-23256. 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), asperate, 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 (0.5–10.8–1 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, D07-E7 = BH10AU-183. Canada, isol. from air in a residence, 2001, isol. by J. Bissett, deposited as C. sphaerosperrum, 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, Z. Jurjevici, EMSL 1931 = CPC 22403.

Notes: Cladosporium pulvericola (Fig. 3, clade 1) is a typical taxon of the C. sphaerosperrum 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 sphaerosperrum (Fig. 3, clade 20) is distinguishable by its slightly wider co-nidiophores 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, Secovlje, isolated from hypersaline water from reverse ponds, salterns, 2005, P. Zalar, CBS H-19862. Isotype: HAL 2026 F. Ex-type culture: CBS 121698 = 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,
smooth, sometimes irregularly rough-walled, walls unthickened. Conidiophores solitary, macro- and micronematous, arising as lateral branches of plagiotropic 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–(3)–7-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)–7-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, verylety, 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-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 = KJ005A-98. The Netherlands, swab sample indoor environment, G.J. Dolphyn, DTO 097-H1; Rijssen, air sample kitchen, M. Meijer, CBS 139577 = DTO 089-C1. USA, isol. from indoor air sample, hallway, Jan. 2013, Z. Jurjević, EMLL 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 basiinatum 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 tefl and 180/219 (82 %) similar on act to the closest C. ramotenellum sequences included in our phylogeny.

Cladosporium sinense Bensch & Samson, sp. nov. MycoBank MB822277. 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. aggregatocentricatum 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 macrosetomatus, 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-cladosporoid 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.
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 from only 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 excortica (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** fimbriiform 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, plurisepitate, 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, obvoid to broadly ellipsoid or doliform, (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-oidoid 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-felt, 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-felt, 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-felt, margins crenate, aerial mycelium abundant, covering almost the whole colony, woolly-felt, dense, low to high, growth flat, sporulation profuse.

**Substrate and distribution:** Isolated from various plants and mossaes, 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 excortica 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 sloani (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, subglobulous, obvoid 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 conidio genesis not occurring.

**Culture characteristics:** Colonies on DG18 reaching 8–9 mm diam after 14 d at 25 °C, olivaceous grey, reverse olivaceous to darkened-refractive; microcyclic conidiogenesis not occurring.

**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 elongated 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 submersed, 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. *Ramoconidio phores* micro- and macroconematous, arising terminally and laterally from hyphae, erect or ascending, straight to slightly flexuous. *Macroconematous 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. *Microconematous conidiophores* filiform to narrowly cylindrical-oblong, up to 80 μm long or even longer, 1–2 μm wide, pluriseptate, not that densely septate as macroconematous 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 subglobulous, sometimes ovoid, (2–)3–5(–7) × (2–)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 subglobulous, 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, oblate, subbrostrate (not observed when cultivated on SNA after 7 d, but on PDA and MEA), thickened and darkened-refractive; microcyclic conidio genesis 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
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.
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.

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 150-43; DTO 150-B. 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. Z. 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. Z. Jurjević, EMSL 1789, 1790 = CPC 22301, 22302; San Francisco, isol. from indoor air sample, family room, Jan. 2013. Z. Jurjević, EMSL 1892 = CPC 22379; Minnesota, isol. from indoor air sample, Aug. 2012. Z. Jurjević, EMSL 1728 = CPC 22270; Mississippi, Ridge- land, isol. from indoor air sample, Nov. 2012. Z. Jurjević, EMSL 1820 = CPC 22317; New York, Hamlet, isol. from indoor air sample, warehouse, Dec. 2012. Z. Jurjević, EMSL 1852 = CPC 22339; Vermont, Williston, isol. from indoor air sample, bedroom, Dec. 2012. Z. Jurjević, EMSL 1874 = CPC 22361; Wisconsin, Oak Creek, isol. from indoor 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 halot- 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, Potín 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, salters, 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 plagiotorpous hyphae, erect or subdecumbent, straight or flexuous, sometimes bent, cylindrical, noduloise, 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; macronematous conidiophores narrower, paler and shorter, mostly without capitulate apex, short narrowly cylindrical, up to 35 μm long, 2–3 μm wide. Conidigenous cells integrated, usually terminal or conidiophores reduced to conidigenous cells, cylindrical, noduloise, 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 cylin- drical, 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 sub- cylindrical, (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 mucrate 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; micromycelial conidiogenesis observed.

Culture characteristics: Colonies on PDA attaining 26–60 mm diam after 14 d at 25 °C, 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.
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 conidiphores, narrower conidigenous 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 (Arecales), 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-Garcia 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 micromacronematous, 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 conidigenous loci, branches occasionally longer, up to 20 μm, 9–330 × (1.5–)2–4 μm, often wider towards the base, plurisepate, 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. *Conidigenous 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, broady 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, glaucescent grey at margins, reverse olivaceous grey, floccose to flocculose, 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, Suri 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).

Mycesporium 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, cylindric, sometimes geniculate towards the apex, but not nodulose, sometimes with short lateral protrusions 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 conidigenous 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 protrusions, 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 (mucitate, 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 conidio genesis sometimes occurring.

Culture characteristics: Colonies on PDA reaching 27–34 mm diam after 14 d at 25 °C, smoke-grey, grey olivaceous to olivaceous grey, olivaceous grey to iron-grey reverse, velvety or powdery, margin regular, entire edge, narrow, colourless to white, aerial mycelium absent or sparingly formed, felty, white, 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 °C, 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 °C, 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-D = AR295; Michigan, Big rapids, isol. from indoor air sample, classroom, Jan. 2013, Z. Jurjević, EMSL 1419 = CPC 22410; Okemos, isol. from indoor air sample, bathroom, Sep. 2012, Z. Jurjević, EMSL 1771 = CPC 22290; Oregon, Salem, isol. from indoor air sample, bedroom, Sep. 2012, Z. 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).
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

---

**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.

III.: 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).
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 semicracinematic 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 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. Ramocordia 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, subobvoid, 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 ramocordia ellipsoid, fusiform to subcylindrical or cylindrical, (6–)7–25(–31) × (2–)2.5(–4) μm (av. ± SD: 15.0 ± 5.8 × 3.2 ± 0.5), with (1–)2(–6) 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, Z. Jurjevič, EMSL 1823 = CPC 22320. China, isol. from indoor air, DTO 323-C5, DTO 323-C9, DTO 323-G, DTO 323-C3, 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, Z. Jurjevič, EMSL 1748 = CPC 22277. Thailand, Surat Thani, isol. from bathroom ceiling, P. Nooin, DTO 109-A1; from indoor environments (mycelial door), P. Nooin, DTO 109-C4; isol. from indoor air (open Petri-dish), P. Nooin, DTO 109-C7; Trang, isol. from indoor air (open Petri-dish), P. Nooin, DTO 131-M4. USA, Arizona, Casa Grande, isol. from indoor air sample, bedroom, Dec. 2012, Z. Jurjevič, EMSL 1857 = CPC 22344. Texas, Georgetown, isol. from indoor air sample, classroom, Jan. 2013, Z. Jurjevič, EMSL 1926 = CPC 22988.

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 stanhoepeae, a species described on Stanhoepea (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: Diffsers 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 micromenatosum, 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 micromenatous conidiophores, 2.5–4 μm wide in macromenatous conidiophores, unbranched or branched, branches 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 terminal 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* numerous in 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* obvoid, 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 = TAN10Z-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 conidia chains with only 2–4 (–5) conidia in the terminal part of the chain (Bensch et al. 2010). *Cladosporium fusicolusum* (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).

**Holotype:** *India*, Charijdi, 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 superficially 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 plagirotous 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) × 2–3 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, of- fice, Dec. 2012; Z. Jurjević, EMSL E1872 = 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 saltlerns 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, Z. 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. Macronematous conidiophores narrower and paler, filiform or narrowly cylindrical-oblong, 23–75(–125) × (1(–)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. Ramoconidium 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 subsphical, 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 ramosconidia 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 11684. South Africa, isol. from Leptosphaeria sp., P.W. Crous, CPC 13867. UK, Manchester, isol. fromured spores of Puccinia allii, May 1984, G.S. Taylor, CBS 308.84.

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. var 0–1(−3)-septate in C. vicinum. Cladosporium europeum (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. europeum 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 MB822233. Etyymology: 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 conidioidal 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 fealty-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 Fatana vitiosa, 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. Etyymology: 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, Z. 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 growing 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 oliveaceous or pale olivaceous brown, smooth or almost so, asperulate or minutely verruculose, walls slightly thickened; micromerous conidiophores shorter, narrower, 1.5−2μm 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, 1−2μmdiam, thickened and darkened-refractive; in micromerous conidiogenous cells usually without swellings and geniculations, with 1−2loci at the apex, about 1μmdiam. 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 subglobule, 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 × 4−5μm (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 oliveaceous or medium olive olivaceous brown, hila conspicuous, (0.5)−0.8−2μmdiam, thickened and darkened; microcyclic conidigenesis not observed.

**Culture characteristics:** Colonies on PDA reaching up to 60 mm diam after 14 d at 25 °C, olivaceous grey and pale oliveaceous grey, dull-green towards margins, reverse leaden-grey, dull green towards margins, fluffy-felt, margin broad, white, feathery, somewhat undulate, aerial mycelium abundant, loose to dense, low to high, without prominent exudates, sporulating. Colonies on MEA attaining up to 60 mm diam after 14 d at 25 °C; smoke-grey, pale oliveaceous grey, oliveaceous grey at margins where sporulation is profuse, reverse oliveaceous 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 oliveaceous grey, fluffy-felt, margin slightly undulate, aerial mycelium low to high, often fel- ted, 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. angustisphaerum* (Fig. 2, lineage 13), *C. phlei* (Fig. 2, clad 12), *C. herbarum* (Fig. 2, clad 15) and *C. macrocarpum* (Fig. 2, clad 16) but differs in having shorter and narrower conidiophores and slightly shorter and narrower conidia (Bensch et al. 2012). Morphologically it resembles *C. angustisphaerum* (Fig. 2, lineage 13) but the latter species possesses narrower conidigenous loci and conidiial 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.

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

**Mycelium** superficial and immersed, hyphae branched, 1−3μm wide, septate, subhyaline, pale oliveaceous 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 micromerous, 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−)2−4μm wide, septate, pale brown, pale oliveaceous or olive brown, usually smooth and thin-walled. Conidiogenous cells terminal, sometimes also intercalary, cylindrical, sometimes geniculate, 12−37×3−4μm, bearing up to three conidiogenous loci of 1−1.5μmdiam, darkened and refractive. *Ramoconidia* subcylindrical to cylindrical, 17−42(−50)×2−3.5(−4)μm, 0−1-septate, smooth or finely roughened, base about 2−2.5−3.5μm wide. Conidia forming branched chains, with 2−6(−7) conidia in the terminal unbranched part, small terminal conidia obvoid, limoniform or short ellipsoid (2.5−)3−5(−3)×(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−)2.5−4μm (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, 0.5−1.5μmdiam conidial hila; microcyclic conidigenesis occasionally occurring.

**Culture characteristics:** Colonies on PDA attaining 60−75 mm diam after 14 d at 25 °C, grey oliveaceous or olivaceous, reverse grey oliveaceous, oliveaceous grey or oliveaceous, oliveaceous buff towards margins, sometimes with a light yellow, grey-yellow or citrine-green diffusible pigment released into the agar, velvety, floccose or felly, 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 oliveaceous, whitish and smoke grey due to aerial mycelium, reverse oliveaceous grey, leaden-grey or leaden-black, floccose or fluffy-felt, 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 data, isol. by C.H. Hassall, No. 4-1940, iden. 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.
Summerrell, CBS 126364 = CPC 14532. Bermuda, Samernet, isol. from indoor air sample, Nov. 2012, Z. Jurjević, EMSL 1824 = CPC 22321. China, isol. from indoor air sample, DTO 317-12, 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. Arzaniou, CPC 11609. Polynesia, reserve Pun Kuki in forest, isol. from banana ‘Eka ulu’, 2006, coll. I. Budenhagen, isol. P.W. Crous, CPC 12792, 12793. South Africa, Allkmar, Laveeld Coop. isol. from wheat, 1988, CPC 14008 = MRC 10135. Durban, botanical garden Durban near Reunion, -29.85, 31.0167, isol. from Sterlitizia sp. (Sterlitizae), 2005, coll. W. Gams, isol. P.W. Crous, CPC 11806; Free State, Danielrus, isol. from oats, 1983, CPC 14004 = MRC 03367. Transkei, Mazeppa Bay, isol. from Sterlitizia sp., growing on fruiting structures, 1 June 2008, P.W. Crous, CPC 14911. Thailand, isol. from Aracacia mangium (Fabaceae), 2005, coll. W. Himaman, isol. P.W. Crous, CPC 11526, 11856; Surat Thani, isol from indoor air sample, Nov. 2012, M. Arzanlou, CPC 11609. China, isol. from banana ‘Eka ulu’, Musa sp. (Musaeeae), Nov. 2012, M. Arzanlou, CPC 323-E7.

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 conidiocinid 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 ramosconidin 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 ramosconidin 3–5(–7) μm wide……………..………………….C. allicinum

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

4 Conidia minutely verruculose, small terminal conidia sub-globose or obovoid, conidial septa not darkened……………………………………….C. ramotenellum

4 Small terminal and intercalary conidia usually globose, minutely verruculose to distinctly verrucose, but secondary ramosconidin 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; ramosconidin 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); ramosconidin 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 this fungus is dominant in outdoor air and as the complexity are also important and in the selection used in this study predominates in indoor fungus. This fungus is dominant in outdoor air and as the 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 habitat 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 iters 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 changing temperature, dew formation, sunlight, and rain. It is interesting that the indoor environment is also characterized by changing 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. cladosporoides 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. europeum (“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.

ACKNOWLEDGEMENTS

This research was supported by a grant from the Alfred P. Sloan Foundation Program on the Microbiology of the Built Environment (Grant No. G-2014-14529). The authors thank the technical staff, Mieke Stannik-Willemsen and Patrick Arensman (DNA isolation and sequencing), Ariën van IJperen (cultures), Trix Merkx (deposit of strains) and Marjan Vermaas (photo plates) for their invaluable assistance. We are grateful to A. Amend, T. Atkinson, M. Bidartondo, K. Jacobs, P. Noonim and all others who assisted with collections from indoor environments. Shaun Pennycook is thanked for giving nomenclatural advice.

APPENDIX A. SUPPLEMENTARY DATA

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

REFERENCES

Bensch K, Braun U, Groenewald JZ, et al. (2012). The genus Cladosporium. Studies in Mycology 72: 1–401.
Bensch K, Groenewald JZ, Braun U, et al. (2015). Common but different: The expanding realm of Cladosporium. Mycological Progress 14: 175–207.
Bensch K, Groenewald JZ, Dijkstra HJ, et al. (2010). Species and ecological diversity within the Cladosporium cladosporioides complex (Davidiellaceae, Capnodiales). Studies in Mycology 67: 1–94.
Bezerra JDP, Sandoval-Denis M, Paiva LM, et al. (2017). New endophytic Toxicoledosporium species from cacti in Brazil, and description of Neo-cladosporium gen. nov. IMA Fungus 8(1): 77–97.
Braun U, Crous PW, Dugan FM, et al. (2003). Phylogeny and taxonomy of cladosporium-like hypomyctetes, including Davidiella gen. nov., the teleomorph of Cladosporum s.str. Mycological Progress 2(1): 3–18.
Braun U, Crous PW, Nakashima C (2015). Cercosporoid fungi (Mycosphaerellaceae). 3. Species on monocots (Poaceae, true grasses). IMA Fungus 6: 25–97.
Braun U, Crous PW, Schubert K (2008). Taxonomic revision of the genus Cladosporum s. lat. 8. Reintroduction of Graphiopsis (= Dichosporium) with further reassessments of cladosporioid hypomyctetes. Mycotaxon 103: 207–216.
Breitenbach M (2008). The spectrum of fungal allergy. International Archives of Allergy and Immunology 145(1): 58–68.
Buzina W, Braun H, Freedenschuss K, et al. (2003). Fungal biodiversity as found in nasal mucus. Medical Mycology 41: 149–161.
Crous PW, Braun U, Groenewald JZ (2007a). Mycosphaerella is polyphyletic. Studies in Mycology 58: 1–32.
Crous PW, Braun U, Schubert K, et al. (2007b). Delimiting Cladosporium from morphologically similar genera. Studies in Mycology 58: 33–56.
Crous PW, Braun U, Wingfield MJ, et al. (2009). Phylogeny and taxonomy of obscure genera of microfungi. Persoonia 22: 139–161.
Crous PW, Gams W, Stalpers JA, et al. (2004). MycoBank: an online initiative to launch mycology into the 21st century. Studies in Mycology 50: 19–22.
Crous PW, Groenewald JZ (2011). Why everlastings don’t last. Persoonia 26: 70–84.
Crous PW, Schroers H-J, Groenewald JZ, et al. (2006). Metulocladosporiella gen. nov. for the causal organism of Cladosporium speckle disease of banana. Mycological Research 110: 264–275.
Crous PW, Shivas RG, Quaedvlieg W, et al. (2014). Fungal Plant description sheets: 214–280. Persoonia 32: 184–306.
Crous PW, Tanaka K, Sommerell BA, et al. (2011). Additions to the Mycosphaerellaceae. IMA Fungus 2(1): 49–64.
Crous PW, Wingfield MJ, Burgess TI, et al. (2017). Fungal Plant description sheets: 558–624. Persoonia 38: 240–384.
David JC (1997). A contribution to the systematics of Cladosporium. Revision of the fungi previously referred to Heterosporum. Mycological Papers 172: 1–157.
De Hoog GS, Guarro J, Gené J, et al. (2000). Atlas of clinical fungi; 2nd ed. CBS, Utrecht, The Netherlands and Universitat rovina I virgili, Reus, Spain.
De Vries GA (1962). Contribution to the knowledge of the genus Cladosporium Link ex Fr. CBS, Baarn.
Domisch KH, Gams W, Anderson TH (1980). Compendium of soil fungi. Vols 1 & 2. Academic Press, London, UK.
Dugan FM, Braun U, Groenewald JZ, et al. (2008). Morphological plasticity in Cladosporum sphaerospermum. Persoonia 21: 9–16.
Dugan FM, Schubert K, Braun U (2004). Check-list of Cladosporium names. Schlechtendalia 11: 1–103.
Ellis MB (1971). Dematiaceous hypomyctetes. CMI, Kew, UK.
Ellis MB (1976). More dematiaceous hypomyctetes. CMI, Kew, UK.
El-Morsy EM (2000). Fungi isolated from the endorhizosphere of halophytic plants from the Red Sea Coast of Egypt. Fungal Diversity 7: 43–54.
Flannigan B, (2001). Microorganisms in indoor air. In: Microorganisms in Home and Indoor Work Environments: Diversity, Health Impacts, Investigation and Control (Flannigan B, Samson R, Miller D, eds), 2nd ed. CRC Press, USA: 17–31.
