A nomenclator for ophiostomoid genera and species in the Ophiostomatales and Microascales

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Abstract: In this updated nomenclator, the names of 646 species proposed for ophiostomoid fungi are considered. The result is 397 accepted species in 12 genera currently classified in the Ophiostomatales and Microascales. The taxonomic status of each species was re-evaluated based on all published details and where available, phylogenetic inferences, and data on typification. The principle of single name nomenclature, as adopted by the 18th International Botanical Congress, Melbourne in July 2011, was applied to all genera and species. Based on these re-assessments, three genera were redefined: Graphilbum in the Ophiostomatales, and Knodxaviaesia (= Gondwanamycyces) and Microascales in the Microascales. Species were reclassified as necessary, resulting in 30 new combinations and one new name. Ophiostoma s.l. now includes 134 accepted species, Ceratocystisipites 16 species, Fragosphearia two, Graphilbum eight, Raffaelea six s.str. 13, and Leptog狄raphium s.l. (including Grossmannia) 94. A further 28 species could not be assigned to any of these six genera with certainty, and seven more species were invalidly described. In the Microascales, Ceratocystis contains 72 accepted species, Graphilbum nine, Knodxaviaesia nine, and Sphaeronaemella seven, while Comuserva and Cuspingophora are both monotypic. Three microascalean species of uncertain status and six invalidly published species remain. Type studies and evaluation of the literature allowed the remaining 144 species described in the classical concept of Graphilbum to be reconsidered. Finally, 19 species previously assigned to Ceratocystis, Ceratostomella, Leptog狄raphium, Ophiostoma, Raffaelea, Sphaeronaemella and/or Sporophilia were excluded from both the Ophiostomatales and Microascales.

Key words: anamorph taxonomy, Ascomycota, one fungus: one name, rDNA-phylogeny, Sordariomycetes.


INTRODUCTION

Presented here is a nomenclatural implementation of the taxonomic concepts for ophiostomoid fungi proposed elsewhere in this volume by De Beer et al. (2013), De Beer & Wingfield (2013) and B. Wingfield et al. (2013). The nomenclator includes all genera and species currently classified in the Ophiostomatales (Ophiostomatales), Ceratocystidaceae, Gondwanamycetaceae and Graphiaceae (Microascales). In this listing, we follow the single name principle accepted at the 18th International Botanical Congress held in Melbourne during July 2011 (Hawksworth 2011, Hawksworth et al. 2011, Norvell 2011). These principles have been incorporated into the newly named International Code of Nomenclature for Algae, Fungi and Plants (ICN) and enforce equal status for taxa (i.e. genera and species) whether they were originally described as either teleomorphic or anamorphic (McNeill et al. 2012). To maintain nomenclatural stability and avoid premature and unnecessary name changes, we followed recommendations explained by De Beer et al. (2013), De Beer & Wingfield (2013) and B. Wingfield et al. (2013).

Genera

In the nomenclator, we apply the generic concepts defined by De Beer & Wingfield (2013) for the Ophiostomatales, and include all genera in that order. Not all fungi in the Microascales are considered ophiostomoid (De Beer et al. 2013). Therefore, we only consider genera of the three ophiostomoid families in that order, the Ceratocystidaceae, Gondwanamycetaceae and Graphiaceae. For the Microascales, we apply generic concepts as defined by B. Wingfield et al. (2013) and De Beer et al. (2013). Sphaeronaemella could not be placed with confidence in a microascalean family (De Beer et al. 2013), but we included it in our list because several of its species were previously classified in Ceratocystis, and were thus considered ophiostomoid.

In cases where a currently accepted genus includes the type species of different genera, priority is given to the genus name that was described first. All other genus names are treated as its synonyms, irrespective of the morph they previously represented.

Species

All species are listed under the genus in which they are currently treated in the accompanying papers by De Beer & Wingfield (2013) and B. Wingfield et al. (2013); this nomenclature has been applied throughout this book. Three genera, Ophiostoma sensu lato (s.l.), Leptog狄raphium s.l., and Ceratocystis s.l., include species with generic names differing from the genus where they are listed. This reflects the taxonomic uncertainties surrounding these species.
usually the consequence of inadequate phylogenetic support and the need for additional multi-gene studies or more intensive sampling. For example, *Leptographium antibioticum* is not part of *Ophiostumum* s.l., but of *Ophiostumum* s.l. on the basis of rDNA phylogenies (De Beer & Wingfield 2013), and is presently listed under the latter genus until its accurate phylogenetic classification can be assured. To improve searchability within these *sensu lato* genera, the species are alphabetically ordered by epithet, rather than their current genus name.

Under the dual nomenclature system, previous monographs and nomenclators distinguished between teleomorph and anamorph binomials. These names now have equal status and we thus treat all names applied to any single species as equal synonyms. These synonyms are listed under the relevant species in order of priority.

### Sections

The nomenclator is subdivided as follows:

**A. The Ophiostomatales**

1. Accepted genera and species
2. Valid species of uncertain status
3. Invalidly published species

**B. The ophiostomatoid genera and species in the Microascales**

1. Accepted genera and species
2. Valid species of uncertain status
3. Invalidly published species

**C. Species excluded from the ophiostomatoid genera in the Ophiostomatales and Microascales**

1. Species described in the classical concept of *Graphium*
2. Excluded species described in other genera

### How to read the nomenclator

**Currently accepted name** (Original author's) Author/s of new combination, Journal Vol: page number of species description or new combination. Year. MycoBank number for new names = Homotypic synonyms (i.e. synonyms based on the same type specimen) (basionyms are indicated when the accepted name is the result of a new combination in this paper) = Heterotypic synonyms (i.e. synonyms based on different types) [square brackets include original, incorrect spelling of epithet if it has been corrected (Arts 23.5, 32.7, 60.1, 60.8, 60.11, Rec. 60G.1) OR it contains an indication whether a name was invalidly or illegitimately described, together with the relevant article of the Melbourne Code (McNeill et al. 2012), (see Text Box)].

**Anamorph:** In accordance with single name nomenclature, separate generic names should no longer be used to classify anamorphs. The format for our designation of anamorphs is as suggested by Cannon & Kirk (2000), as endorsed by Hawksworth (2011). When a species makes two or more morphologically distinct anamorphs, they are referred to as synonymous and then that is used as the heading for the paragraph.

**Descriptions:** References to detailed morphological descriptions and/or illustrations of the species. If the only description is the protologue, this paragraph is not included.

**Phylogenetic data:** References where DNA sequence data for this species and/or its synonyms were used in phylogenetic analyses. If no phylogenetic data presently exists, we have not included a paragraph with this heading.

Notes: Additional information in most cases explaining synonymies and/or uncertainties surrounding the status of species, and the current placement of a species in a species complex based on phylogenetic analyses.

### A.1. ACCEPTED GENERA AND SPECIES IN THE OPHIOSTOMATALES

Genus concepts as defined by De Beer & Wingfield (2013) are applied here. Under *Ophiostoma* and *Leptographium*, we list all species treated respectively in *Ophiostoma* s.l. and *Leptographium* s.l. as defined by De Beer & Wingfield (2013), following their recommendations to ensure nomenclatural stability under the emended Code.

**Ophiostoma Syd., In Sydow & Sydow, Annls mycol. 17: 43. 1919 [type species *O. piliferum*]

<table>
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<th>Synonym</th>
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<tr>
<td>= <em>Sporotrichospora</em> Gugel., In De Beermann &amp; Gougerot, Archs Parasit. 15: 104. 1911, Anamorphic synonym. [type species <em>S. beurmannii</em> nom. inval, Art. 36.1]</td>
</tr>
<tr>
<td>= Linostoma Höhn., Annls mycol. 16: 91. 1918 [nom. illegit., Art. 53.1, see De Beer et al. 2013].</td>
</tr>
<tr>
<td>= Ceratocystis Ellis &amp; Halst. section Ophiostomia (Syd.) H.P. Upadhyay pro parte, Monogr. Ceratocystis &amp; Ceratocystitopsis, p. 85. 1981 [type species <em>O. piliferum</em>]</td>
</tr>
<tr>
<td>= Ceratocystis Ellis &amp; Halst. section (ps H.P. Upadhyay pro parte, Monogr. Ceratocystis &amp; Ceratocystitopsis, p. 70. 1981 [type species <em>O. ulmi</em>]</td>
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<th>Notes</th>
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<td>Notes: In the majority of papers, the authority for <em>Ophiostoma</em> is given as Syd. &amp; Syd., or in some cases H. &amp; P. Sydow. Although the original publication had two authors, the authority of the genus name and new combinations in the paper were explicitly attributed only to Sydow (p. 43, Sydow &amp; Sydow 1919). Von Arx (1952) and von Arx &amp; Müller (1954) were the only authors to date to correctly follow the Code (Art. 46.2) by using only <em>Syd.</em></td>
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<tr>
<td>The genus <em>Sporothrix</em> was initially described without a generic diagnosis (Hektoen &amp; Perkins 1900), which prompted Nicot &amp; Mariat (1973) to provide a Latin diagnosis to validate the name. De Hoog (1974) accepted the emended description of Nicot &amp; Mariat (1973). However, Domsch et al. (1980) regarded the validation unnecessary ‘in view of the rather exhaustive descriptio generico-specifica (Art. 42)’ by Hektoen &amp; Perkins (1900). Under the Melbourne Code, <em>Sporothrix</em>, as the older name will have priority over <em>Ophiostoma</em>, which imply that the latter should be treated as synonym of <em>Sporothrix</em>. However, De Beer &amp; Wingfield (2013) showed that the <em>S. schenckii</em>-O. stenoceras complex forms a lineage distinct from <em>Ophiostoma</em> s.s., which might represent a distinct genus. For the present they suggested that the complex be treated as part of <em>Ophiostoma</em> s.l. The synonyms of <em>Sporotrichospora</em> and <em>Dolichoascus with Sporothrix</em> are discussed under <em>S. schenckii</em>.</td>
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</tbody>
</table>
Excerpts from the Code of Nomenclature referred to in the nomenclator

References in the nomenclator to articles of the ICN (International Code of Nomenclature for Algae, Fungi, and Plants) refer to the Melbourne Code adopted in July 2011 and published in 2012 (McNeill et al. 2012). The numbers of several Articles were changed in the new Code and thus differ from those in the Vienna Code (McNeill et al. 2006). Abbreviations and terminology used in relation to the Code are defined below, followed by a brief interpretation of all articles from the Code to which reference is made in the nomenclator. For taxonomic or technical purposes the reader should consult the latest available version of the Code.

**comb. nov.** A new binomial formed when a species is transferred from one genus to another (Art. 7.3).

**nom. illegit.** The name is illegitimate and cannot be used or corrected (Art. 52.1, 53.1, 53.3).

**nom. invalid.** The name is invalidly described and should not be used until corrected (Art. 41.3, 39.1 or 39.2, 40.1, 40.6, 40.7).

**nom. nov.** A new name replacing an illegitimate name that was otherwise validly published (Art. 7.4).

**nom. prov.** A so-called provisional name published (e.g. in a thesis or a conference abstract) in anticipation that a formal description would be published at a later stage (Art. 36.1).

Art. 9.2. A lectotype is a specimen designated from the original material as the nomenclatural type if no holotype was indicated in the original publication, or if it is missing, or if it is found to belong to more than one taxon.

Art. 9.7. A neotype is a specimen selected to serve as nomenclatural type when the original material has been lost or destroyed, or as long as it is missing.

Art. 9.8. An epitype is a specimen selected to serve as additional material to the type when the holotype, lectotype, or neotype, do not exhibit all the appropriate characters associated with a species. When an epitype is designated, the holotype, lectotype, or neotype that the epitype supports must be explicitly cited.

**Notes:** In the case of fungi, a living culture is often designated as epitype to serve as source of DNA for molecular studies where the holotype is not in suitable condition for DNA extraction. Under the dual nomenclature system, the discovery of the teleomorph for a species only known by its anamorph, usually implied a new species name with its own nomenclatural type. However, under the Melbourne Code it will be possible that material of a newly discovered state, whether sexual or asexual, be designated as epitype to the existing nomenclatural type, without changes to the species name.

Art. 24.3. Infra-specific names with final epithets such as typicus (and others not listed here) purporting to indicate the taxon containing the type of the name of the next higher taxon, are not validly published unless they are autonyms.

Art. 29.1. Before 1 January 2012 publication of a species name is only effective if it was distributed as printed matter to the general public. It was e.g. not effective if merely deposited as a typescript (e.g. a Ph.D. thesis) in a library. According to the Melbourne Code, electronic publication following specific guidelines has been permitted since 1 January 2012 (Knapp et al. 2011).

Art. 41.3. On or after 1 January 1953 a new combination is invalid if the basionym (name-bringing or epithet-bringing synonym) for a new combination was not cited explicitly.

Art. 36.1. A so-called provisional name is not validly published when it is merely proposed in anticipation of the future acceptance of the taxon concerned.

Art. 39.1. The name is invalid if it was described without a Latin diagnosis, or without reference to a Latin diagnosis, between 1 January 1935 and 31 December 2011.

Art. 39.2. Either Latin or English diagnosis are acceptable from 1 January 2012 onwards.

Art. 40.1. A name described after 1 January 1958 is invalid if a type specimen was not explicitly indicated, if the herbarium where it is deposited was not explicitly indicated, or if no species were described in the genus.

Art. 40.6. A name described after 1 January 1990 is invalid if the indication to the type does not include one of the words “typus” or “holotypus”, or its abbreviation, or its equivalent in a modern language.

Art. 40.7. A name described after 1 January 1990 is invalid if the single herbarium or institution where the type is conserved is not specified.

Art. 46.2. A name of a new taxon must be attributed to the author or authors to whom both the name and the validating description or diagnosis was ascribed, even when authorship of the publication is different.

Art. 52.1. The name is illegitimate because it is superfluous, meaning that the name has been used before for another taxon.

Art. 53.1. The name is illegitimate because it is a later homonym, i.e. the same name was already used for another taxon in a group covered by the ICZN. This does not extend to names used for animals or bacteria.

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The uncertain generic status of *Europhium* is a result of the uncertain placement of its type species, *O. trinaciforme* (see section A.2, and De Beer & Wingfield, 2013).

The type species for *Pesotum*, *Hyalopesotum* and *Pachnodium* all group in *Ophiostoma s.str.* (De Beer & Wingfield, 2013), rendering these genera synonyms of *Ophiostoma* under the Melbourne Code.

Upadhyay (1981) designated official sections in *Ceratocystis*.

Apart from two *Sphaeronaemella* spp., all the taxa he included in his Section *Ophiostoma* are at present included in *Ophiostoma s.l.* Similarly, most species in his Section *Ips* are included in *Ophiostoma s.l.*, with four of the species included in *Graphilbum*.

The fungal genus *Ophiostoma* should not be confused with *Ophiostoma* Rudolphi, a genus of parasitic nematodes (Table 1; De Beer et al. 2013).

The numbers of several Articles were changed in the new Code and thus differ from those in the Vienna Code (McNeill et al. 2006). Abbreviations and terminology used in relation to the Code are defined below, followed by a brief interpretation of all articles from the Code to which reference is made in the nomenclator. For taxonomic or technical purposes the reader should consult the latest available version of the Code.
Table 1. Species names from non-fungal genera that are homonyms of ophiostomatoid genera. Ceratocystis Jaekel represents invertebrate fossils, Ophiostoma Rudolphi parasitic nematodes, and Graphium Scopoli swallowtail butterflies. The application of these names to fungal species are permissible because they are dictated by a different nomenclatural Code, but should preferably be avoided (De Beer et al. 2013). Species for which homonyms among the Fungi were already described are marked with *.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Reference</th>
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<tbody>
<tr>
<td>Ceratocystis Jaekel (Echinodermata, Stylopohora)</td>
<td>Jaekel 1901</td>
</tr>
<tr>
<td>Ceratocystis peneri Jaekel</td>
<td>Jaekel 1901</td>
</tr>
<tr>
<td>Ceratocystis prosthiakiadica Rahman, Zamora &amp; Geyer</td>
<td>Rahman et al. 2010</td>
</tr>
<tr>
<td>Ceratocystis spinosa Ubaghs</td>
<td>Ubaghs 1967</td>
</tr>
<tr>
<td>Ceratocystis vizcainoi Ubaghs</td>
<td>Ubaghs 1987</td>
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</table>

Ophiostoma Rudolphi (Nematoda, Metazoa) Rudolphi 1809
Ophiostoma amphicanthium Diesing
Ophiostoma bifidum (Fabricius) Zeder
Ophiostoma cristatum (Froelich, 1802) Rudolphi
Ophiostoma cystidicola Rudolphi
*Ophiostoma denticulatum
Ophiostoma cystidicola Rudolphi
Ophiostoma dispar Rudolphi
Ophiostoma faronitis (Fisch.) Rudolphi
Ophiostoma lepturum Rudolphi
Ophiostoma mucronatum Rudolphi
Ophiostoma nigricarpum Rudolphi
Ophiostoma ophiostriatum Cloquet
Ophiostoma pouterii Cloquet
Ophiostoma rajaee (Müll.) Rudolphi
Ophiostoma sphaerocephalum Rudolphi
*Ophiostoma spinosum

Notes: Considered a synonym of O. ips by Upadhyay (1981) and Hutchison & Reid (1988a), but as distinct from O. ips by Harrington (1987, 1988), Hausner et al. (1993b, 2000), and Zhou et al. (2004b). This fungus belongs to the O. ips species complex based on rDNA phylogenies (De Beer & Wingfield 2013).


Notes: Forms part of the S. schenckii – O. stenoceras species complex (De Beer & Wingfield 2013).

Ophiostoma ainoae H. Solheim, Nord. J. Bot. 6: 201. 1986

Notes: Authentic isolates of O. ainoae from Norway were peripheral to O. piceae and its sibling species (Hausner & Reid 2003, Zipfel et al. 2006), and were treated in the O. ips sensu complex.
lato' complex by Linnakoski et al. (2010). In the analyses of De Beer & Wingfield (2013), the species groups with O. brunneo-ciliatum and O. tapirois, closer to O. floccosum in Ophiostoma s.str. One Japanese isolate (JCM 9356) identified as O. ainoae and grouping with G. cucullata, G. europhioideus and G. penicillata (Okada et al. 1998, Gebhardt et al. 2005), is probably an undescribed species.


Anamorph: hyalorhinocladiella-like.

Descriptions: Ochowecki & Reid (1974, p. 1704, Pl. XVI Fig. 315); Upadhyay (1981, p. 88). Figure numbers cited in the description of C. allantospora by Upadhyay (1981) actually refer to those in the protologue, not his monograph.

Phylogenetic data: Villarreal et al. (2005); Linnakoski et al. (2010); De Beer & Wingfield (2013).

Notes: The species is closely related to O. kryptum and O. minus (De Beer & Wingfield 2013, Linnakoski et al. 2010).


Anamorph: raffaela-like.

Description: Hunt (1956, p. 44).

Phylogenetic data: Hausner et al. (1993b); Hausner & Reid (2003); De Beer & Wingfield (2013).

Notes: Griffin (1968), Upadhyay (1981), Hutchison & Reid (1988a) and Seifert et al. (1993) listed O. ambrosium as synonym of O. piliferum, but Hunt (1956) and de Hoog (1974) treated it as distinct. De Beer & Wingfield (2013) showed that the short LSU sequence from Hausner et al. (1993b) groups in a distinct lineage with O. grande in Ophiostoma s.l.


Anamorph: leptographium-like.


Phylogenetic data: Jacobs et al. (2001d); Masuya et al. (2004); Massoumi Alamouti et al. (2008); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: De Beer & Wingfield (2013) showed that this species is in a clade with L. brachiatum in Ophiostoma s.l., and not in Leptographium as suggested by Jacobs et al. (2001d).


Anamorph: sporothrix-like.


Phylogenetic data: Villarreal et al. (2005); De Beer & Wingfield (2013).

Notes: Villarreal et al. (2005) and De Beer & Wingfield (2013) showed that O. angusticollis groups with O. sejunctum close to, but distinct from, the O. tenellum complex.


Anamorph: pesotum-like.

Descriptions: Ochowecki & Reid (1974, p. 1709); Upadhyay (1981, p. 90, Figs 308–313); de Hoog & Scheffer (1984, pp 293–295, Fig. 1).

Phylogenetic data: Hausner et al. (1993b); Gebhardt et al. (2004, 2005); Zipfel et al. (2006); Linnakoski et al. (2008); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: This species groups in Ophiostoma s.str. (De Beer & Wingfield 2013).


Anamorph: pesotum-like.

Descriptions: Upadhyay (1981, p. 72, Figs 217–222); Seifert & Okada (1993, p. 32, Fig. 3B).

Phylogenetic data: Gebhardt et al. (2004, 2005); Harrington et al. (2010); Matsuda et al. (2010); De Beer et al. (2013).

Notes: This species is closely related to O. bicolor in the O. ips complex based on SSU sequences (Gebhardt et al. 2004, 2005, De Beer et al. 2013). Although the sequence does not come from the ex-type strain, the species is morphologically consistent with the O. ips complex based on its oblong, sheathed ascospores and anamorph, and should be considered in future treatments of that group.


Anamorph: unknown.

Phylogenetic data: Villarreal et al. (2005); Carlier et al. (2006); Kamgan Nkuekam et al. (2008a, 2010); Linnakoski et al. (2008, 2009); De Beer & Wingfield (2013).

Notes: This species groups close to O. distortum, peripheral to the O. ulmi complex (De Beer & Wingfield 2013).


Anamorph: pesotum-like.

Description: Kamgan Nkuekam et al. (2008b, pp 410–412, Fig. 4).


Notes: Known only by its anamorph, this species is part of the O. ulmi complex (De Beer & Wingfield 2013).


Anamorph: sporothrix-like.

Phylogenetic data: Zhou et al. (2006); De Meyer et al. (2008); Roets et al. (2008, 2010); Lu et al. (2009a); De Beer & Wingfield (2013).

Notes: This species is a part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).

Anamorph: hyalorhinocladiella-like.


Phylogenetic data: Hauser et al. (1993b); Villarreal et al. (2005); Carlier et al. (2006); Linnakoski et al. (2009); Kamgan Nkuekam et al. (2010); Paciura et al. (2010b); De Beer & Wingfield (2013).

Notes: This species is part of the O. ulmi complex (De Beer & Wingfield 2013).


Anamorph: hyalorhinocladiella-like.

Descriptions: Kotýnková-Sychrová (1966, pp 47, 52, Fig. 4); Griffith (1968, pp 696–699, Figs 76–79, Pl. I); Ochowec & Reid (1974, p. 1695); Upadhyay (1981, p. 73, Figs 232–235); Yamaoka et al. (1997, p. 1220).

Phylogenetic data: Hauser et al. (1993b); Okada et al. (1998); Schroeder et al. (2001); Gebhardt et al. (2004, 2005); Massoumi-Aramouti et al. (2007, 2009); Lu et al. (2009a); Harrington et al. (2010); Linnakoski et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: Griffin (1968) mentioned three morphotypes of O. bicolor, but no DNA sequence data are available for these. This species is part of the O. ips complex (De Beer et al. 2013, De Beer & Wingfield 2013).


Synanamorphs: pesotum-like, sporothrix-like.

Phylogenetic data: Kamgan Nkuekam et al. (2010); Linnakoski et al. (2010); De Beer & Wingfield (2013).

Notes: Forms part of the O. ulmi complex (De Beer & Wingfield 2013).


Anamorph: pesotum-like.

Notes: This species is morphologically similar to O. allantosporum (Masuya et al. 2003a), but without DNA sequence data it cannot be placed accurately in a clade within Ophiostoma.


Descriptions: Kendrick (1962, pp 786–789, Fig. 6, 9K); Jacobs & Wingfield (2001, pp 70–72, Figs 43–45).

Phylogenetic data: Jacobs et al. (2001d); Kim et al. (2004); Masuya et al. (2004); Massoumi Alamouti et al. (2006); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. De Beer & Wingfield (2013) showed that this species groups with L. antibioticum within Ophiostoma s.l. and not in Leptographium as previously suggested (Jacobs et al. 2001d).


Anamorph: sporothrix-like.

Phylogenetic data: Madrid et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).


Phylogenetic data: Marimon et al. (2007, 2008); De Meyer et al. (2008); Madrid et al. (2010); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. Sporothrix brasiliensis groups in the S. schenckii – O. stenoceras complex as part of Ophiostoma s.l. (Marimon et al. 2007).


Anamorph: pesotum-like.

Phylogenetic data: Chung et al. (2006); Linnakoski et al. (2008, 2009); Bommer et al. (2009); Lu et al. (2009a); Kamgan Nkuekam et al. (2010); Linnakoski et al. (2010); Paciura et al. (2010b); De Beer & Wingfield (2013).

Notes: This species is closely related to O. ssiori in Ophiostoma s.str. (De Beer & Wingfield 2013).


Descriptions: Verrall (1943, pp 142–143, Fig. 5); Batra (1967, pp 1004–1007, Figs 43, 45, 46).

Phylogenetic data: Cassar & Blackwell (1996); Rollins et al. (2001); Gebhardt et al. (2005); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the R. lauricola complex in Ophiostoma s.l. (De Beer & Wingfield 2013). The name should not be confused with Monilia brunnea J.C. Gilman & E.V. Abbott.


Anamorph: pesotum-like (Okada et al. 1998).


Phylogenetic data: Hauser & Reid (2003); Linnakoski et al. (2010); De Beer & Wingfield (2013).

Notes: This species is morphologically similar to O. clavatum but it groups with O. ainoae and O. tapionis close to O. floccosum in Ophiostoma s.str. (De Beer & Wingfield 2013).


Anamorph: pesotum-like (Okada et al. 1998).


Phylogenetic data: Hauser & Reid (2003); Linnakoski et al. (2010); De Beer & Wingfield (2013).

Notes: This species is morphologically similar to O. clavatum but it groups with O. ainoae and O. tapionis close to O. floccosum in Ophiostoma s.str. (De Beer & Wingfield 2013).


Descriptions: Halmschlager & Kowalski (2003, Figs 1–11, as S. inflata); Madrid et al. (2010, pp 1198–1200, Fig. 2).

Phylogenetic data: Aghayeva et al. (2005 as S. inflata Clade IV); Madrid et al. (2010); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. See notes under Sporothrix inflata, below. The species groups with O. fumeum and O. fasciatum in a distinct lineage in Ophiostoma s.l. (De Beer & Wingfield 2013).

*Anamorph:* hyalorinocladiella-like.


*Phylogenetic data:* Hausner & Reid (2003); Villarreal et al. (2005); Linnakoski et al. (2010); De Beer & Wingfield (2013).

*Notes:* Considered closely related to *O. piliferum* by Griffin (1968) and Ochowecki & Reid (1974). Upadhyay (1981) treated it as a doubtful species, but Hausner & Reid (2003) reconfirmed that it is a good species, distinct from *O. piliferum*. It groups close to *O. canum* and *O. piceae* in *Ophiostoma* s.str. (De Beer & Wingfield 2013).


*Anamorph:* sporothrix-like.


*Phylogenetic data:* Hausner et al. (1993b); Hausner & Reid (2003); Zanzotere et al. (2010); De Beer & Wingfield (2013).

*Notes:* Treated as synonym of *O. longirostellatum* by de Hoog (1974), but shown to be a distinct species in the *O. pluriannullatum* complex based on ITS data (Hausner et al. 1993b, Hausner & Reid 2003, De Beer & Wingfield 2013). Thwaites et al. (2005) suggested that two isolates from California that were distinct from *O. pluriannullatum* based on ITS might represent *O. californicum*, but they did not include the ex-type isolate of this species in their study.


*Anamorph:* sporothrix-like.

*Description:* Kamgan Nkuekam et al. (2012a, pp 526–527, Fig. 5).

*Phylogenetic data:* De Beer & Wingfield (2013); Kamgan Nkuekam et al. (2012a).

*Notes:* This species is part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).


*Anamorph:* pesotum-like.

*Descriptions:* Mathiesen (1950, pp 289–296, Figs 3–9); Mathiesen (1951, pp 210–212); Hunt (1956, p. 35); Kotynkova-Sychrová (1966, p. 51); Ochowecki & Reid (1974, p. 1709); Upadhyay (1981, p. 93); Seifert & Okada (1993, p. 32, Fig. 3F); Harrington et al. (2001, pp 119, 122).

*Phylogenetic data:* Hausner et al. (1993b); Harrington et al. (2001); Schroeder et al. (2001); Jacobs et al. (2003c); Jacobs & Kirisits (2003); Masuya et al. (2003b); Villarreal et al. (2005); Carlier et al. (2006); Chung et al. (2006); Zipfel et al. (2006); Linnakoski et al. (2008, 2010); Bommer et al. (2009); Lu et al. (2009a); Massoumi Alamouti et al. (2009); Grobelaar et al. (2010); Kamgan Nkuekam et al. (2010); Paciura et al. (2010b); Zanzotere et al. (2010); De Beer & Wingfield (2013).

*Notes:* The anamorph of *O. canum* is the type species of *Pachnodium* (Upadhyay & Kendrick 1975), currently treated as a synonym of *Ophiostoma*. Ophiostoma canum consists of more than one cryptic species in need of resolution, and groups close to *O. piceae, O. brunneum, O. breviusculum and O. flexuosum* (Linnakoski et al. 2010, De Beer & Wingfield 2013).


*Anamorph:* sporothrix-like.

*Phylogenetic data:* Hausner et al. (1993a) (as ‘*Ceratocystisopsis sp. 1*’); Zipfel et al. (2006); De Beer & Wingfield (2013).

*Notes:* Based on LSU data, *O. carpenteri* forms part of the *O. pluriannullatum* complex together with the morphologically similar *O. retusum* (De Beer & Wingfield 2013). These two species differ markedly from other species in the complex in terms of morphology and biology, and their relationships should be explored further with sequences from more gene regions (Hausner et al. 2003, De Beer & Wingfield 2013).


*Anamorph:* unknown.


*Notes:* Hunt (1956) considered this species inadequately known because he was unable to obtain material, but he noted that the protologue described a fungus that differed from any that he knew. The species is not mentioned by Upadhyay (1981). Ophiostoma bacillosporum is morphologically similar to this species (Bulin & Zimmermann 1972, Upadhyay 1981). The name is valid and could be resurrected by neotypification (Art. 9.7) or epitypification (Art. 9.8). Considering its long perithecial necks (1.1–1.8 mm) (Solovjev 1935), the species could be a member of the *O. pluriannullatum* complex.


*Anamorph:* pesotum- and sporothrix-like.

*Description:* Harrington et al. (2001, p. 126).

*Phylogenetic data:* Harrington et al. (2001); Jacobs et al. (2003c); Jacobs & Kirisits (2003); Masuya et al. (2003b); Villarreal et al. (2005); Carlier et al. (2006); Kamgan Nkuekam et al. (2008b, 2010); Linnakoski et al. (2008, 2009, 2010); Grobelaar et al. (2009, 2011); Paciura et al. (2010b); De Beer & Wingfield (2013).

251

Anamorph: pesotum-like.


Notes: Upadhyay (1981) considered this a nomen dubium because there was no teleomorph on the type specimen. The protologue includes a good illustration and the name could thus be resurrected by epitypification (Art. 9.8). The species is morphologically similar to O. brunneociliatum, and is probably a distinct species of Ophiostoma s.str.


Anamorph: pesotum-like (Okada et al. 1998).

Descriptions: Olchoweci & Reid (1974, pp 1689–1690, Pl. VIII Figs 142–151); Upadhyay (1981, p. 76, Figs 247–252); Seifert & Okada (1993, p. 29, Fig. 1B).

Phylogenetic data: Hausner et al. (1993b); Mullineux et al. (2011) for C. ossiformis; De Beer & Wingfield (2013).

Notes: The suggested synonymy of C. ossiformis with O. columnare (Upadhyay 1981) was accepted by Hausner et al. (1993b). The LSU sequence of O. columnare is identical to that of O. bicolor (Hausner et al. 1993b) and both species are part of the O. ips complex (De Beer & Wingfield 2013).

Ophiostoma conicola Marm. & Butin, Sydowia 42: 195. 1990 [as ‘conicola’]

Anamorph: sporothrix-like.

Description: Marmolejo & Butin (1993, pp 157–158, 166, Figs 5–9).

Phylogenetic data: Hausner et al. (1993b, 2000); Masuya et al. (2004); Villarreal et al. (2005); Zanzot et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of the O. pluriannulatum complex (De Beer & Wingfield 2013).


Anamorph: sporothrix-like (Hutchison & Reid 1988a).

Description: Hutchison & Reid (1988a, p. 66, 68).

Phylogenetic data: Hausner et al. (1993b); Thwaites et al. (2005); Villarreal et al. (2005); Linnakoski et al. (2010); Mullineux et al. (2011); De Beer & Wingfield (2013).

Notes: Upadhyay (1981) considered this species a synonym of O. ulmi, but this was rejected by Hutchison & Reid (1988a) because of differences in the shape of ascospores. ITS sequence data for O. coronatum differ in 5 bp from O. tenellum and the two were treated as distinct species by Villarreal et al. (2005). The two species group close to O. nigricarpum in a lineage now referred to as the O. tenellum complex (De Beer & Wingfield 2013).


Synanamorphs: pesotum- and sporothrix-like.

Description: Paciura et al. (2010b, p. 84, Figs 6, 10, 14, 17).

Phylogenetic data: Harrington et al. (2001); Peciura et al. (2010b); De Beer & Wingfield (2013).

Notes: Harrington et al. (2001) described P. cupulatum as anamorph of O. setosum based on mating compatibility. ITS sequence of the ex-type strains of the two species differ by 12 bp (De Beer & Wingfield 2013). We thus consider the species phylogenetically distinct and transfer P. cupulatum to Ophiostoma. Sequences of isolates from China identified as O. setosum by Peciura et al. (2010b) match those of P. cupulatum and should be ascribed to this species.


Phylogenetic data: Hausner & Reid (2003); Jacobs & Kirisits (2003); Hafez et al. (2012); De Beer & Wingfield (2013).

Notes: This species is closely related to O. fasciata based on LSU sequences, in a distinct lineage in Ophiostoma s.l. (Hausner & Reid 2003, De Beer & Wingfield 2013). It also groups separately from other Ophiostoma spp. based on SSU (Hafez et al. 2012). Ophiostoma crenulatum and O. fasciata share some morphological characteristics that are unique within the Ophiostomatales (De Beer & Wingfield 2013).


Synanamorphs: pesotum- and sporothrix-like.

Phylogenetic data: Linnakoski et al. (2009, 2010); Kamgan Nkuekam et al. (2010); Grobelaar et al. (2011); De Beer & Wingfield (2013).

Notes: This species is closely related to O. fasciata based on LSU sequences, in a distinct lineage in Ophiostoma s.l. (Hausner & Reid 2003, De Beer & Wingfield 2013). It also groups separately from other Ophiostoma spp. based on SSU (Hafez et al. 2012). Ophiostoma denticulatum and O. fasciata share some morphological characteristics that are unique within the Ophiostomatales (De Beer & Wingfield 2013).


Anamorph: sporothrix-like.
Notes: The new combination is based on the sporothrix-like anamorph and kidney-shaped ascospores. The species probably belongs in the S. schenckii – O. stenoceras complex and clearly not to Ceratocystis. The name should not be confused with the parasitic nematode, Ophiostoma denticulatum Rudolphi, a name governed by the ICZN (Table 1).


*Anamorph:* sporothrix-like.

*Phylogenetic data:* Aghayeva et al. (2004, 2005); Roets et al. (2006, 2008, 2010); Zhou et al. (2006); De Meyer et al. (2008); Madrid et al. (2010); De Beer & Wingfield (2013).

*Notes:* This is a member of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).


*Descriptions:* Roxon & Jong (1974, pp 517–519, Figs 1–9); Madrid et al. (2010, pp 1199–1201, Fig. 3).

*Phylogenetic data:* Aghayeva et al. (2005) as S. inflata; Madrid et al. (2010); De Beer & Wingfield (2013).

*Notes:* Teleomorph unknown. See notes under *Sporothrix inflata*, below. The species is part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).


*Anamorph:* sporothrix-like.

*Descriptions:* Butin & Zimmermann (1972, p. 285, Fig. 5E); Olchowcki & Reid (1974, p. 1709); Upadhyay (1981, p. 94, Figs 334–338).

*Phylogenetic data:* Hausner et al. (1993b); Hausner & Reid (2003); Villarreal et al. (2005); Zipfel et al. (2006); Linnakoski et al. (2009); De Beer & Wingfield (2013).

*Notes:* Upadhyay (1981) considered the anamorph of this species to be ‘yeast-like’, but the original description by Davidson (which mentions ‘sterigmata’) and Upadhyay’s illustration suggest a sporothrix-like anamorph. This species groups with *O. arduennense*, peripheral to the *O. ulmi* complex in *Ophiostoma* s.str. (De Beer & Wingfield 2013).

**Ophiostoma epigloeum** (Guerrero) de Hoog, Stud. Mycol. 7: 45. 1974 ≡ *Ceratocystis epigloeae* Guerrero, Mycologia 63: 921. 1971 [as ‘epigloeum’]

*Anamorph:* sporothrix-like (de Hoog 1974).

*Descriptions:* de Hoog (1974, pp 45–47, Fig. 17); Upadhyay (1981, p. 95, Figs 339–343).

*Phylogenetic data:* Hausner et al. (1993b).

*Notes:* Based on an LSU sequence (not available in GenBank), *O. epigloeum* groups close to the S. schenckii – O. stenoceras complex (Hausner et al. 1993b).


*Phylogenetic data:* Hausner et al. (1993a); Hausner & Reid (2003); Plattner et al. (2009); De Beer & Wingfield (2013).

*Notes:* *Ophiostoma fasciatum* is closely related to the morphologically similar *O. crenulatum*, in a distinct lineage within *Ophiostoma* s.l. based on LSU sequences. No ITS data is available for *O. crenulatum*, but based on ITS *O. fasciatum* groups with *O. fumeum* and *S. brunneoviolaceae*, but with little statistical support and long branches separating the species (De Beer & Wingfield 2013).


*Anamorph:* hyalorhinocladiella-like.

*Phylogenetic data:* Hausner et al. (1993b); Villarreal et al. (2005); Zipfel et al. (2006); Linnakoski et al. (2009, 2010); Kamgan Nkuekam et al. (2010); De Beer & Wingfield (2013).

*Notes:* This species is closely related to *O. canum* in *Ophiostoma* s.str. (De Beer & Wingfield 2013).


*Anamorph:* pesotum-like.


*Phylogenetic data:* Harrington et al. (2001); Schroeder et al. (2001); De Beer et al. (2003c); Jacobs et al. (2003c); Jacobs & Kirisits (2003); Kim et al. (2003, 2005a); Masuya et al. (2003b); Zhou et al. (2004a, 2006); Thwaites et al. (2005); Villarreal et al. (2005); Carlier et al. (2006); Chung et al. (2006); Zipfel et al. (2006); Romón et al. (2007); Kamgan Nkuekam et al. (2008a, b, 2010); Linnakoski et al. (2008, 2010); Bommer et al. (2009); Lu et al. (2009a, b); Massourni Alamouti et al. (2009); Grobbelaar et al. (2010, 2011); Harrington et al. (2010); Paciura et al. (2010b); Kim et al. (2011); De Beer & Wingfield (2013).

*Notes:* *Ophiostoma floccosum* was treated as a synonym of *O. piceae* by de Hoog (1974), Hutchison & Reid (1988a), Przybyle & de Hoog (1989), and Seifert et al. (1993). Harrington et al. (2001) showed that *O. floccosum* is a distinct species based on morphology and ITS sequences. It groups in *Ophiostoma* s.str., close to the O. ainoae, *O. brunneo-ciliatum* and *O. taponis* (De Beer & Wingfield 2013). Harrington et al. (2001) confirmed that *Graphium aureum* is the anamorph of *O. floccosum* and transferred it to *Pesotum*. The name *P. aureum* should not be confused with *L. aureum*, anamorph of *G. aurea*.


*Anamorph:* sporothrix-like.

*Description:* Kamgan Nkuekam et al. (2012a, pp 527–528, Fig. 6).

*Phylogenetic data:* De Beer & Wingfield (2013); Kamgan Nkuekam et al. (2012a).
Notes: This species groups with S. brunneoviolaceae and O. fasciatum in a distinct lineage in Ophiostoma s.l. (De Beer & Wingfield 2013).

Anamorph: hyalorhinocondiella- to pesotum-like.
Phylogenetic data: Linnakoski et al. (2010); De Beer & Wingfield (2013).
Notes: Although no teleomorph is known for this species, Linnakoski et al. (2010) described it in Ophiostoma. De Beer & Wingfield (2013) confirmed that it is part of the O. ips complex.

Anamorph: sporothrix-like.
Phylogenetic data: Aghayeva et al. (2004, 2005); Zhou et al. (2004b, 2006); Villarreal et al. (2005); Roets et al. (2006, 2008, 2010); Zipf et al. (2006); De Meyer et al. (2008); Lu et al. (2009a); Linnakoski et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).
Notes: This species is part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).

Anamorph: sporothrix-like.
Notes: This species is part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).

Phylogenetic data: Marimon et al. (2007, 2008); De Meyer et al. (2008); Madrid et al. (2010).
Notes: Teleomorph unknown. Sporotrichum tropicale was listed as synonym of S. schenckii by de Hoog (1974), but the ex-type isolate groups with S. globosa (Marimon et al. 2007). Sporothrix globosa is part of the S. schenckii – O. stenoceras complex (Marimon et al. 2007, Madrid et al. 2010).

Anamorph: sporothrix-like.
Phylogenetic data: Hausner et al. (1993b); Hausner & Reid (2003); De Beer & Wingfield (2013).
Notes: Davidson (1971) distinguished O. gossypinum and C. gossypina var. robusta based on perithecium morphology but Upadhyay (1981) treated both as synonyms of O. stenoceras. Hausner & Reid (2003) showed that the LSU sequence of the ex-type isolate (ATCC 18999) of O. gossypinum is distinct from that of O. stenoceras, but the two species group closely together in the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).

Anamorph: sporothrix-like.
Phylogenetic data: Hausner et al. (1993b); Mullineux et al. (2011); De Beer & Wingfield (2013).
Notes: This species groups with O. ambrosium in a distinct lineage in Ophiostoma s.l. (De Beer & Wingfield 2013).

Synanamorphs: pesotum- and sporothrix-like.
Description: Harrington et al. (2001, p. 127).
Phylogenetic data: Brasier et al. (1998); Harrington et al. (2001); Jacobs et al. (2003c); Jacobs & Kirsiits (2003); Masuya et al. (2003b); Gibb & Hausner (2005); Paolletti et al. (2005); Villarreal et al. (2005); Carlier et al. (2006); Kamgan Nkuekam et al. (2008a, b, 2010); Linnakoski et al. (2008, 2009, 2010); Grobbelaar et al. (2010, 2011); Paciura et al. (2010b); De Beer & Wingfield (2013).
Notes: This species is a part of the O. ulmi complex (De Beer & Wingfield 2013).

Description: De Meyer et al. (2008, pp 656–657, Figs 4d–f).
Phylogenetic data: De Meyer et al. (2008); De Beer & Wingfield (2013).
Notes: Teleomorph unknown. This species belongs to the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).

Anamorph: Unknown.
Phylogenetic data: Hausner et al. (1993b); Hausner & Reid (2003); De Beer & Wingfield (2013).
Notes: Ophiostoma hyalothecium belongs to the O. ips complex based on a short LSU sequence (De Beer & Wingfield 2013). Although no anamorph is known, the species has pillow-shaped ascospores similar to other species in the O. ips complex (Davidson 1976, Upadhyay 1981).

**Sporothrix inflata** de Hoog, Stud. Mycol. 7: 34. 1974.
Description: de Hoog (1974, pp 34–36, Fig. 14).
Phylogenetic data: Aghayeva et al. (2005); De Meyer et al. (2005) showed that isolates initially identified as S. lignivora separated into four clades, one representing S. inflata s.str. The second group included the ex-type isolate of Humicola dimorphosphora, which was subsequently transferred to Sporothrix by Madrid et al. (2010), while the same authors described the third group as S. brunneoviolaceae. The fourth group remains undescribed. Sporothrix inflata s.str. is a member of in the S. schenckii – O. stenoceras complex, and part of Ophiostoma s.l. (De Beer & Wingfield 2013).


Anamorph: pesotum-like.


Phylogenetic data: Hausner et al. (1993b); De Beer & Wingfield (2013).

Notes: The anamorph of O. introcitrinum is the type of the anamorph genus Hylaopesotum (Upadhyay & Kendrick 1975) and groups closely with O. minus and O. pseudominus in Ophiostoma s.str. (De Beer & Wingfield 2013). Therefore, Hylaopesotum is treated as synonym of Ophiostoma.


Anamorph: psotum- to hyalorhinocladiella-like.

Descriptions: Niskado & Yamauti (1933, pp 507–515, Figs 3–4); Leach et al. (1934, pp 327–331, Figs 7, 9, 10); Rumbold (1936, pp 420–426, Figs 1–5); Goidanich (1937, pp 251–253); Siemaszko (1939, pp 20, 22–23, Pl. I Figs 1–5); Mathiesen-Käärik (1953, pp 420–426, Figs 1–5); Goidanich (1937, pp 251–253); Siemaszko (1939, pp 20, 22–23, Pl. I Figs 1–5); Mathiesen-Käärik (1953, pp 420–426, Figs 1–5); Hunt (1956, pp 11, 30–32; Griffin (1968, pp 703–704); Ochowcecki & Reid (1974, p. 1692, Pl. VI Fig. 120); Wingfield & Marasas (1980a, pp 66–68, Figs 4–10); Upadhyay (1981, p. 79); Hutchison & Reid (1988a, pp 66, 88–70); Zhao (1992, pp 85–86); Marmolejo & Butin (1993, pp 158, 167, Figs 10–13); Benade et al. (1995, pp 300–301, Figs 2–9).

Phylogenetic data: Hausner et al. (1993a, c, 2000); Hausner & Reid (2003); Kim et al. (2003, 2005a); Zhou et al. (2004b, 2006); Thwaites et al. (2005); Villarreal et al. (2005); Carlier et al. (2006); Zipfel et al. (2006); Romón et al. (2007); Lu et al. (2009a); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Linnakoski et al. (2010); Matsuda et al. (2010); Paciura et al. (2010b); Zanzot et al. (2010); Kim et al. (2011); De Beer & Wingfield (2013).

Notes: The O. ips species complex is characterised by pillow-shaped ascospores and named after O. ips because it was the first species described in this complex (De Beer & Wingfield 2013). Ophiostoma adjuncti and O. montium, both considered synonyms of O. ips by Upadhyay (1981), were considered distinct by Harrington (1987) and Hausner et al. (1993b) respectively. Hausner et al. (2000) further distinguished between O. ips and O. adjuncti, Kim et al. (2003) between O. ips and O. montium, and Zhou et al. (2004b) between O. ips and O. pulvinisporum. Zhou et al. (2002, 2007) applied microsatellite markers to investigate the population diversity of O. ips.


Anamorph: pesotum-like (Harrington et al. 2001).

Phylogenetic data: De Beer & Wingfield (2013); Masuya et al. (2013).

Notes: Ophiostoma japonicum is morphologically similar to O. arborea (Yamaoka et al. 1997) and phylogenetically is part of the O. ips complex (Masuya et al. 2013, De Beer & Wingfield 2013).


Synanamorphs: pesotum- and sporothrix-like.

Phylogenetic data: Linnakoski et al. (2008, 2009, 2010); Kamgang Nkuekam et al. (2010); Zanzot et al. (2010); Grobbelaar et al. (2011); De Beer & Wingfield (2013).

Notes: This species is part of the O. ulmi complex (De Beer & Wingfield 2013).


Anamorph: hyalorhinocladiella- to pesotum-like.

Phylogenetic data: Jacobs & Kirisits (2003); Villarreal et al. (2005); Carlier et al. (2006); Kamgang Nkuekam et al. (2008a, b, 2010); Linnakoski et al. (2008, 2010); Bommer et al. (2009); Grobbelaar et al. (2010); De Beer & Wingfield (2013).

Notes: This species groups in Ophiostoma s.str. (De Beer & Wingfield 2013).


Descriptions: Fraedrich et al. (2008, pp 219–220, Fig. 5).

Phylogenetic data: Fraedrich et al. (2008); Harrington et al. (2008, 2010, 2011); Kim et al. (2009); Massoumi Alamouti et al. (2009); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species forms a clade with R. brunnea to form the R. lauricola complex in Ophiostoma s.l. (De Beer & Wingfield 2013).


Notes: Upadhyay (1981) reported that Davidson informed him that the type material was lost. Fresh cultures of the species were isolated by Ochowcecki & Reid (1974), which were used by Upadhyay (1981). Based on the sporothrix-like anamorph and reniform ascospores, this species was classified by Ochowcecki & Reid (1974) in their ‘Pilifera group’ and by Upadhyay (1981) in section Ophiostoma. Both groups of species are now incorporated in Ophiostoma s.l. as defined here, but no DNA sequences are available to determine its exact placement. The species clearly belongs in Ophiostoma rather than Ceratocystis.


Synanamorphs: pesotum- and sporothrix-like (inferred from protologue).

Notes: Hunt (1956) treated the species as of uncertain status, but suggested that it resembles O. tetropii. Upadhyay (1981) did not consider this species. This species from spruce is validly published, and clearly belongs in Ophiostoma s.l. A neotype would need to designated (Art. 9.7) to enable critical comparisons with other species of Ophiostoma.
   Anamorph: sporothrix-like.
   Notes: The ascospore and anamorph morphology of this species suggest a relationship with species such as O. stenoceras or O. nigricarpum, but sequence data are needed to confirm its correct placement in the Ophiostomatales.

   Anamorph: sporothrix-like.
   Phylogenetic data: Kamgan Nkuekam et al. (2008a); Linnakoski et al. (2009); Zanzot et al. (2010); De Beer & Wingfield (2013).
   Notes: This species is part of the O. pluriannulatum complex (De Beer & Wingfield 2013).

   Anamorph: sporothrix-like.
   Description: de Hoog (1974, pp 61–62, Fig. 23).
   Phylogenetic data: Hausner et al. (1993b, 2000); Masuya et al. (2004); Mullineux et al. (2011); De Beer & Wingfield (2013).
   Notes: This species was treated by Hunt (1956) as a synonym of O. capillifera, and by Upadhyay (1981, as ‘O. longirostratum’) and Hutchison & Reid (1988a) as a synonym of O. piliferum. Hausner et al. (1993b) showed it is distinct from O. piliferum. It is part of the O. pluriannulatum complex (De Beer & Wingfield 2013).

   Anamorph: sporothrix-like.
   Phylogenetic data: Aghayeva et al. (2004, 2005); Zhou et al. (2004b, 2006); Villarreal et al. (2005); Roets et al. (2006, 2008, 2010); Zipfel et al. (2006); De Meyer et al. (2008); Lu et al. (2009a); Linnakoski et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).
   Notes: This species groups between O. fusiiforme in the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).

   Descriptions: Ajello & Kaplan (1969, pp 642–643, Figs 2–20); Marimon et al. (2008, pp 623–624, Fig. 2).
   Phylogenetic data: Marimon et al. (2008); Madrid et al. (2010); De Beer & Wingfield (2013).
   Notes: Teleomorph unknown. This species is part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).

   Anamorph: hyalorhinocadiella- to raffaelea-like.
   Description: Batra (1967, pp 1007–1008, Figs 47, 48).
   Phylogenetic data: Cassar & Blackwell (1996); Rollins et al. (2001); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).
   Notes: Forms a distinct lineage together with O. tingens in Ophiostoma s.str. (De Beer & Wingfield 2013). The arguments for the new combination are outlined under Lineage B in De Beer & Wingfield (2013).

   Notes: The synanamorphs of this species were not illustrated in the protologue, nor by Upadhyay (1981). Morphology of the ascospores and the descriptions of the sporothrix-like anamorph suggest that it might be part of the S. schenckii – O. stenoceras complex, but it should be re-examined and sequenced.

   Description: Marimon et al. (2007, pp 3203–3204, Fig. 2E).
   Phylogenetic data: Marimon et al. (2007, 2008); De Meyer et al. (2008); Madrid et al. (2010).
   Notes: Teleomorph unknown. This species was not considered by De Beer & Wingfield (2013), but according to Madrid et al. (2010) it belongs to the S. schenckii – O. stenoceras complex.

   Anamorph: sporothrix-like.
   Descriptions: Hunt (1956, pp 46–47); Griffin (1968, p. 710); de Hoog (1974, pp 63–64, Fig. 25); Olchowecki & Reid (1974, p. 1709); Upadhyay (1981, p. 50, Figs 104–108); Maekawa et al. (1987, pp 8, 10, Figs 1–6).
   Phylogenetic data: Hausner et al. (1993b); Mullineux et al. (2011); De Beer & Wingfield (2013).
   Notes: The confusing taxonomy of this species (Davidson & Kuhlman 1978) was clarified by Weresub (1979). The LSU sequence for isolate CBS 412.77 generated by Hausner et al. (1993b), is identical to the sequence produced by De Beer & Wingfield (2013) of the ex-neotype isolate (CBS 440.69 = CMW 17152) designated by Davidson & Kuhlman (1978). The species groups between Raffaelea s.str. and Ophiostoma s.str. in its own lineage. Its generic placement remains uncertain (De Beer & Wingfield 2013). The name O. microsporum should not be confused with L. microspora (see under Leptographium), nor Cs. microspora (see section C.2).

Anamorph: hyalorhinocladiella-like.


*Phylogenetic data:* Gorton & Webber (2000); Jacobs & Kirisits et al. (2010); Linnakoski et al. (2007); Lu et al. (2009a); Carlier et al. (2009a); Kamgan Nkuekam et al. (2010); Paciura et al. (2010b); Zanzot et al. (2010); Roe et al. (2011); De Beer & Wingfield (2013).

*Notes:* Hunt (1956), Griffin (1968), Olchowecki & Reid (1973) and Upadhyay (1981) treated *O. exiguum, O. pini,* and *O. pseudotsugae* as synonyms of *O. minus.* However, Gorton & Webber (2000) and Gorton et al. (2004) showed *O. pseudotsugae* to be distinct.

Rumbold (1931) reported *O. pini* from the USA. She distinguished between strains from the east and west coasts, and a third type from Washington, D.C., which she suggested was the same as the European *O. pini.* She considered *O. exiguum* and *O. minus* to be distinct, based on studies of her own isolates. Mathiesen (1950) also differentiated her own *O. pini* isolates from Sweden from those described from the USA by Rumbold (1931). Gorton & Webber (2000), Gorton et al. (2004), Lu et al. (2009a) and Linnakoski et al. (2010) confirmed that *O. minus* consists of at least two phylogenetic species grouping according to geographical origin, a North American species (*O. minus*) and the European species. The two species group closely together in *Ophiostoma s.str.* (De Beer & Wingfield 2013). Epitypification of *O. pini* and *O. exiguum* would be necessary to resolve their status and the appropriate name for the European isolates. Thus, we have treated *O. pini* and *O. exiguum* as synonyms of *O. minus* until that research has been completed.

The name *O. pini* should not be confused with *P. pini,* a synonym of *G. radiaticola.*


Anamorph: pesotum- to hyalorhinocladiella-like.

*Description:* Leach et al. (1934, pp 331–336, Figs 11–12 of Tu. ips); Taylor-Vinje (1940, pp 764–773, Figs 1–30); Rumbold (1941, pp 591–597, Figs 2–5); Hunt (1956, pp 45–46).

*Phylogenetic data:* Hausern et al. (1993b); Cassar & Blackwell (1996); Rollins et al. (2001); Kim et al. (2003); Zhou et al. (2004b); Gebhardt et al. (2005); Zipfel et al. (2006); Lu et al. (2009a); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Linnakoski et al. (2010); Matsuda et al. (2010); Paciura et al. (2010b); Zanzot et al. (2010); Roe et al. (2011); De Beer & Wingfield (2013).

*Notes:* *Ophiostoma montium* was treated as a synonym of *O. ips* by Upadhyay (1981) and Hutchison & Reid (1988a), but Hausern et al. (1993b), Kim et al. (2003) and Zhou et al. (2004b) distinguished between *O. ips* and *O. montium.*

Massoumi Alamouti et al. (2009) suggested that *A. ips* might be the anamorph of *O. montium* based on DNA sequences and morphological similarities. Harrington et al. (2010) then transferred *A. ips* to *Hyalorhinocladiella.* However, SSU, LSU, and β-tubulin sequences of the ex-type isolate of *A. ips* (CBS 435.34) differ by 0, 2 and 1 bp respectively when compared to available sequences of more than 80 isolates of *O. montium* from the studies of Kim et al. (2003), Gebhardt et al. (2005), Massoumi Alamouti et al. (2009), and Roe et al. (2011). We therefore support the synonymy suggested by Massoumi Alamouti et al. (2009). Although the epithet of *Tu. ips* is older than that of *Cs. montium,* the epithet *ips* is already occupied in *Ophiostoma* and transferring *Tu. ips* to *Ophiostoma* would create a later homonym (*nom. illegit.*, Art. 53.1), and therefore the continued use of *O. montium* is necessary.

*Ophiostoma montium* was included in a four gene phylogeographic study, showing that it reproduces sexually in nature (Roe et al. 2011).


Anamorph: sporothrix-like.


*Phylogenetic data:* Villarrreal et al. (2005); Zhou et al. (2006); Zipfel et al. (2006); Kamgan Nkeümak et al. (2008a, b); Linnakoski et al. (2009); Paciura et al. (2010b); Zanzot et al. (2010); De Beer & Wingfield (2013).

*Notes:* This species is part of the *O. plurianulatum* complex (De Beer & Wingfield 2013).


Anamorph: sporothrix-like.

*Description:* Hunt (1956, pp 11, 50); de Hoog (1974, pp 59–60, Fig. 22); Olchowecki & Reid (1974, p. 1707, Pl. XVI Fig. 316); Upadhyay (1981, p. 103).
Phylogenetic data: De Beer et al. (2003b); Hausner & Reid (2003); Jacobs et al. (2003c); Villarreal et al. (2005); Zhou et al. (2006); Linnakoski et al. (2010); De Beer & Wingfield (2013).

Notes: Ophiostoma narcissi is part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).


Anamorph: sporothrix-like.

Descriptions: de Hoog (1974, pp 62–63, Fig. 24); Olchowecki & Reid (1974, p. 1709); Upadhyyay (1981, p. 104 Figs 378–381); Benade et al. (1997, pp 1110–1111, Figs 6–11).

Phylogenetic data: Aghayeva et al. (2004); Zhou et al. (2004b, 2006); Roets et al. (2006, 2008, 2010); Zipfel et al. (2006); De Meyer et al. (2008); Linnakoski et al. (2010); Madrid et al. (2010).

Notes: De Beer et al. (2003b) incorrectly identified several isolates of O. abietinum as O. nigricarpum. Aghayeva et al. (2004) showed that the ex-type strain of O. nigricarpum is distinct from O. abietinum. It is part of the O. tenellum complex (De Beer & Wingfield 2013).


Anamorph: sporothrix-like.

Notes: Listed by Masuya et al. (2013) as part of S. schenckii – O. stenoceras complex, but this should be confirmed based on phylogenetic inference.


Anamorph: pesotum-like.

Phylogenetic data: De Beer & Wingfield (2013); Masuya et al. (2013).

Notes: ITS sequence data place this species with septate conidia in Ophiostoma s.str. (De Beer & Wingfield 2013, Masuya et al. 2013).


Anamorph: sporothrix-like.

Notes: The cultural morphology of this species suggests that it is related to species such as O. piliferum or O. pluriannulatum rather than to the S. schenckii – O. stenoceras complex.


Anamorph: pesotum- and sporothrix-like.

Description: Harrington et al. (2001, p. 127).

Phylogenetic data: Bates et al. (1993a, b); Jeng et al. (1996); Brasier et al. (1998); Harrington et al. (2001); Jacobs et al. (2003c); Jacobs & Kirisits (2003); Masuya et al. (2003b); Hausner et al. (2005); Gibb & Hausner (2005); Paolello et al. (2005); Villarreal et al. (2005); Carlier et al. (2006); Chung et al. (2006); Zipfel et al. (2006); Kamgan Nkuekam et al. (2008a, b, 2010); Linnakoski et al. (2008, 2009, 2010); Bommer et al. (2009); Massoumi Alamouti et al. (2009); Grobbelaar et al. (2010, 2011); Paciura et al. (2010b); De Beer & Wingfield (2013).

Notes: Ophiostoma novo-ulmi is part of the O. ulmi complex (De Beer & Wingfield 2013). According to strict application of Art. 60.9, the epithet for this species should be novouulmi (W. Gams, in litt.). Despite this, we propose to maintain the hyphenated version of the epithet of this very important fungus because of its dominance in the literature, where the formally corrected version has never been used. This hyphenated spelling will be included in the eventual List of Protected Names for the Ophiostomatales, and we hope it will be approved by the Nomenclature Committee for Fungi.

Several studies have shown that two biological groups, termed EAN and NAN races, exist within O. novo-ulmi (Brazier 1979, Bates et al. 1993a, b, Solla et al. 2008). Brasier & Kirk (2001) designated these two groups as subspecies:


Phylogenetic data: Marimon et al. (2007, 2008); Madrid et al. (2010); De Meyer et al. (2008); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. Calcarisporium pallidum and S. albicans were listed as synonyms of S. schenckii by de Hoog (1974). However, De Meyer et al. (2008) showed that these two species and S. nivea group together in a lineage distinct from S. schenckii, based on β-tubulin sequences. They thus synonymised S. albicans and S. nivea with S. pallida. No teleomorph is known for this species, which belongs to the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).


Anamorph: hyalorhinocladiella-like.

Phylogenetic data: Linnakoski et al. (2010); De Beer & Wingfield (2013).

Notes: Teleomorph not observed. The species groups with O. saponioidorum in a distinct lineage within Ophiostoma s.l. (Linnakoski et al. 2010, De Beer & Wingfield 2013).


Anamorph: sporothrix-like.


Notes: This species is part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).


Synanamorphs: pesotum- and sporothrix-like (de Hoog 1974).

A NOMENCLATOR FOR OPHIOSTOMATOIDEA GENERA AND SPECIES IN THE OPHIOSTOMATALES AND MICROASCALLES

Phylogenetic data: Thwaites et al. (2005); Villarreal et al. (2005); Kamgan Nkuekam et al. (2008b); Zanzot et al. (2010).

Notes: This species was considered distinct by de Hoog (1974), Ochowechi & Reid (1974) and Upadhyay (1981). Przybyl & de Hoog (1989) and Seifert et al. (1993) treated it a synonym of O. piceae. Davidson (1958) did not mention a synnematous anamorph in the original description, while de Hoog (1974) described both synnemata and a sporothrix-like anamorph from the ex-type isolate (CBS 636.66). ITS sequences of the same strain generated by different authors do not correspond. Thwaites et al. (2005) showed that it (DQ062970) groups close to O. pluriannullatum, while the sequence of Villarreal et al. (2005) (AY934514) is close to O. floccosum. These observations suggest that the ex-type culture might have been mixed; it should be re-examined to clarify the placement of the species in Ophiostoma s.l.

Ophiostoma persicinum Halmschlager (2005); Kamgan Nkuekam et al. (2006). Neotypification is recommended.


Anamorph: sporothrix-like (de Hoog 1974).

Notes: A broad concept was applied to this species for many years, until mating studies, biological differences and DNA sequence data delineated O. piceae as a conifer-inhabiting species, distinct from hardwood species like O. quercus (Morelet 1992, Brasier & Kirk 1993, Brasier & Stephens 1993, Harrington et al. 2001). De Beer & Wingfield (2013) showed that the conifer clade of the ‘O. piceae complex’ is not monophyletic, but the species previously considered part of this complex all group in Ophiostoma s.str.


Anamorph: sporothrix-like (de Hoog 1974).

Descriptions: Von Schrenk (1903, pp 22–23, Pl. 7 Figs 4–9; Hedgcough (1906, pp 64–67, Pl. 3 Fig. 8, Pl. 4 Figs 5–7); Lagerberg et al. (1927, pp 163–174, Figs 1–8 as C. coerulae); Goldühn (1937, pp 226–242, Figs 1–13); Siemaszko (1939, pp 20, 29–30, Pl. I Figs 6–7); Hunt (1956, pp 11, 15, 41–42); Kotýnková-Sychrová (1966, p. 52); Griffin (1968, pp 711–712); de Hoog (1974, pp 47–50, Fig. 18); Ochowechi & Reid (1974, p. 1707, Pl. XVI Fig. 313); Upadhyay (1981, p. 107, Figs 382–386); Butin & Aquilar (1984, pp 83–84); Hutchison & Reid (1988a, pp 75–77); Marmolejo & Butin (1993, pp 160–161, 168, Figs 23–27); Benade et al. (1998, pp 256–257, Figs 2–4).

Phylogenetic data: Hausner et al. (1993c, 2000, 2005a); Hausner et al. (1994); Kim et al. (1999, 2003, 2005); Okada et al. (1992); Harrington et al. (2001); Kim & Breuil (2001); Schroeder et al. (2001); De Beer et al. (2003c); Hausner & Reid (2003); Jacobs et al. (2003c); Jacobs & Kirisits (2003); Masuya et al. (2003b, 2004); Zhou et al. (2004a); Gebhardt et al. (2005); Thwaites et al. (2005); Villarreal et al. (2005); Carlier et al. (2006); Chung et al. (2006); Zipfel et al. (2006); Romón et al. (2007); Kamgan Nkuekam et al. (2008a, b, 2010); Linnakoski et al. (2008, 2009, 2010); Bommer et al. (2009); Lu et al. (2009a, b); Massoumi Alamouti et al. (2009); Grobelaar et al. (2010, 2011); Harrington et al. (2010); Matsuda et al. (2010); Paciura et al. (2010b); Zanzot et al. (2010); Kim et al. (2011); De Beer & Wingfield (2013).

Notes: Schroeder et al. (2001, 2002) and Hausner & Reid (2003) suggested that infraspecific variation among O. piliferum isolates can be linked to geographic origin (North America versus Europe) or host (hardwoods versus conifers). The exact taxonomic status of these groups, and the synonyms listed above and discussed below thus should be reevaluated.
Ophiostoma capilliferum was considered a distinct species by Sydow & Sydow (1919), Melin & Nannfeldt (1934), Hunt (1956), and Kääärki (1980). De Hoog (1974) could not locate ascospores or conidia on the type material of *O. capilliferum* (BPI) and considered the species doubtful. Upadhyay (1981), Hutchison & Reid (1988a) and Seifert et al. (1993) listed *O. capilliferum* as synonym of *O. piliferum*. *Ophiostoma schenckianum* was also considered a distinct species by Sydow & Sydow (1919), Melin & Nannfeldt (1934) and Hunt (1956). De Hoog (1974) found the teleomorph “indistinguishable from *O. piliferum*” on the type material (BPI), but because no conidia were found, he refrained from treating the two species as synonyms. Griffin (1968), Upadhyay (1981), Hutchison & Reid (1988a) and Seifert et al. (1993) listed *O. schenckianum* as synonym of *O. piliferum*. *Ophiostoma coeruleum* was treated as a distinct species by Sydow & Sydow (1919), Lagerberg et al. (1927), Melin & Nannfeldt (1934) and Mathiesen-Kääärki (1953). However, Goidanich (1936, 1937), Siemaszko (1939), Hunt (1956), Griffin (1968), Olchowecki & Reid (1974), de Hoog (1974), Upadhyay (1981), Hutchison & Reid (1988a) and Seifert et al. (1993) treated it as a synonym of *O. piliferum*.


Anamorph: sporothrix-like.

**Descriptions**: Hedgccock (1906, pp 72–72, Pl. 3 Fig. 7, Pl. 5 Fig. 1–2); Lagerberg et al. (1927, pp 184–189, Figs 14–16); Hunt (1956, pp 15, 39–40); Upadhyay (1981, p. 109, Figs 387–392); Marmolejo & Butin (1993, pp 161, 169, Figs 28–32); Benade et al. (1998, pp 256–257, Figs 5–7).

**Phylogenetic data**: Hausner & Reid (2003); Thwaites et al. (2005); Villarreal et al. (2005); Zhou et al. (2006); Zipfel et al. (2006); Romón et al. (2007); Kamgan Nkuekam et al. (2008a, b); Linnakoski et al. (2009); Paciura et al. (2010b); Zanzot et al. (2010); De Beer & Wingfield (2013).

**Notes**: Ophiostoma pluriannulatum is the oldest known and thus the name-bearing species of the *O. pluriannulatum* species complex in *Ophiostoma s.str.* (De Beer & Wingfield 2013). Griffin (1968) treated *O. pluriannulatum* as synonym of *O. piliferum*. The separation of the two species was confirmed in several of the phylogenetic studies cited above. Thwaites et al. (2005) suggested that the type material of *O. novae-zelandiae* was a mixture containing *O. pluriannulatum* and *O. piceae* or *O. quercus*. They showed that the available cultures of *O. novae-zelandiae* are sexually compatible with and have ITS sequences identical to those of *O. pluriannulatum*, and suggested the synonymy of the two species.

**Ophiostoma polyoporica** Constant. & Ryman, Mycologist 34: 637. 1989.

Anamorph: sporothrix-like.

**Phylogenetic data**: Hausner et al. (1993b).

**Notes**: This species groups close to *O. abietinum* according to Hausner et al. (1993b), but the LSU sequence they used is unavailable in GenBank, and could not be included in the larger phylogeny by De Beer & Wingfield (2013).


Anamorph: sporothrix-like.


**Notes**: The new combination is based on the sporothrix-like anamorph and morphology of ascospores, as described by Oichowecki & Reid (1974) and Upadhyay (1981). The name should not be confused with *Ceratocystis populincola* J.A. Johnson & T.C. Harr. [nom. illegit., Art. 53.1], see under *Ceratocystis harringtonii*.


Anamorph: sporothrix-like.


**Phylogenetic data**: Hausner et al. (1993b); De Beer & Wingfield (2013).

**Notes**: Cultural, anamorph and ascospore morphology all suggest placement of *O. populinum* in the *S. schenckii* – *O. stenoceras* complex. However, annulations on the ascomatal necks resemble those present in species of the *O. pluriannulatum* complex.


Anamorph: sporothrix-like.

**Phylogenetic data**: Viljoen et al. (1999); Wingfield et al. (1999); Roets et al. (2006, 2008, 2010, 2013); Zipfel et al. (2006); De Meyer et al. (2008); Harrington et al. (2010); De Beer & Wingfield (2013).

**Notes**: This species is part of the *S. schenckii* – *S. stenoceras* complex (De Beer & Wingfield 2013).


Anamorph: sporothrix-like.

**Phylogenetic data**: Roets et al. (2010, 2013); De Beer & Wingfield (2013).

**Notes**: This species is part of the *S. schenckii* – *O. stenoceras* complex (De Beer & Wingfield 2013).


Anamorph: hyalorhinocladiella-like.
A nomenclator for ophiostomatoid genera and species in the Ophiostomatales and Microascales

Phylogenetic data: Hausner et al. (1993b); De Beer & Wingfield (2013).

Notes: The LSU sequence of O. pseudomimus generated by Hausner et al. (1993b) differs only by one bp from that of O. minus (De Beer & Wingfield 2013).

Anamorph: hyalorhinocladiella-like.
Phylogenetic data: Hausner & Reid (2003); Mullineux et al. (2011).

Notes: This species was treated by Upadhyay (1981) as synonym of O. nigrum, but shown to be distinct by Hausner & Reid (2003). A short LSU sequence places this species in its own lineage in Ophiostoma s.l. (Hausner & Reid 2003, De Beer & Wingfield 2013). Ascospore and anamorph morphology resemble those of species of the O. ips complex, and therefore the phylogenetic placement of O. pseudonigrum should be explored further.

Phylogenetic data: Gorton & Webber (2000); Gorton et al. (2004); Linnakoski et al. (2008, 2010); Bommer et al. (2009); Lu et al. (2009a); De Beer & Wingfield (2013).

Notes: Hunt (1956) and Upadhyay (1981) both treated O. pseudotsugae as a synonym of O. minus, but Gorton & Webber (2000) and Gorton et al. (2004) later showed that O. pseudotsugae represents a distinct species, grouping close to O. piliferum (De Beer & Wingfield 2013).

Anamorph: hyalorhinocladiella-like.
Phylogenetic data: Zhou et al. (2004b); Zipfel et al. (2006); Massoumi Alamouti et al. (2009); Linnakoski et al. (2010); Paciura et al. (2010b); Zanzot et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of the O. ips complex (De Beer & Wingfield 2013).

Anamorph: hyalorhinocladiella-like.
Notes: Ophiostoma pusillum was described as morphologically similar to O. nigrum and O. tubicolis (Masuya et al. 2003a), and was treated by Masuya et al. (2013) in the O. ips complex based on morphology. However, the morphological similarity of O. pusillum with O. nigrum (Masuya et al. 2003a) also suggests that this species might belong in Graphilbum (De Beer & Wingfield 2013). The name should not be confused with S. pusilla U. Braun & Crous [= Quambalaria pusilla (U. Braun & Crous) J.A.Simpson] (De Beer et al. 2006).


Synanamorphs: pesotum- and sporothrix-like.

Phylogenetic data: Halmschlager et al. (1994); Kim et al. (1999, 2003, 2005a); Uzunovic et al. (2000); Harrington et al. (2001); Kim & Breuil (2001); Schroeder et al. (2001); De Beer et al. (2003c); Jacobs et al. (2003c); Jacobs & Kirisits (2003); Lin et al. (2003); Masuya et al. (2003b); Gebhardt et al. (2004); Geldenhuis et al. (2004); Zhou et al. (2004a, 2006); Thwaites et al. (2005); Villarreal et al. (2005); Carlier et al. (2006); Chung et al. (2006); Zipfel et al. (2006); Romón et al. (2007); Kamgan Nkuekam et al. (2008a, b, 2010); Linnakoski et al. (2008, 2009, 2010); Bommer et al. (2009); Grobbelaar et al. (2009, 2010, 2011); Massoumi Alamouti et al. (2009); Matsuda et al. (2010); Paciura et al. (2010b); Zanzot et al. (2010); Kim et al. (2011).


Ophiostoma fagi was treated as an uncertain status by Hunt (1956), and as a synonym of O. piceae by de Hoog (1974),

The pesotum- and sporothrix-like synanamorphs of O. quercus were never supplied with binary names, while those of O. roboris were. When Grobelaar et al. (2009) synonymized O. roboris with O. quercus, the binary names of O. roboris became available for application to the anamorphs of O. quercus, and new combinations were proposed. Under the Melbourne Code, these are now considered synonyms of O. quercus.


Anamorph: pesotum- and sporothrix-like.

*Phylogenetic data:* Linnakoski et al. (2010); De Beer & Wingfield (2013).

*Notes:* This species groups in Ophiostoma s.str. (De Beer & Wingfield 2013).


Anamorph: sporothrix-like (Seifert et al. 1993, Benade et al. 1998).


*Phylogenetic data:* Hausner et al. (1993a); Hausner & Reid (2003); Hafez et al. (2012); De Beer & Wingfield (2013).

*Notes:* Ophiostoma retusum is part of the O. pluriannulatum complex (De Beer & Wingfield 2013). See note under O. carpenteri.


Anamorph: sporothrix-like.


*Phylogenetic data:* Hausner et al. (1993b); Jacobs et al. (2003c); Villarreal et al. (2005); Linnakoski et al. (2010); De Beer & Wingfield (2013).

*Notes:* Ophiostoma rostrocoronatum groups in the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013). Upadhyay (1981) listed Figs 399–402 as representing both O. rostrocoronatum and Ceratocystis pseudominor. The plate itself is labelled with the latter name, and Seifert et al. (1993) concluded that the former species was not illustrated.


Synanamorphs: pesotum- and hyalorinocladiella-like.

*Phylogenetic data:* Linnakoski et al. (2010); De Beer & Wingfield (2013).

*Notes:* This species groups with O. pallidulum in a distinct lineage within Ophiostoma s.l. (Linnakoski et al. 2010, De Beer & Wingfield 2013).


*Descriptions:* De Beurmann & Gougerot (1911, pp 25–32, Figs 1–5, Pl. I–V); de Hoog (1974, pp 36–44, Fig. 16); De Meyer et al. (2008, p. 655, Figs 4j–i); Matsushima (1975, p. 143, Pl. 163).

*Phylogenetic data:* Berbee & Taylor (1992a, b); Marimon et al. (2007, 2008); De Meyer et al. (2008); Roets et al. (2008); Madrid et al. (2010); De Beer & Wingfield (2013).

*Notes:* Sporothrix schenckii is the type species of Sporothrix, and groups with several other species in a distinct lineage, referred to as the S. schenckii – O. stenoceras complex, within Ophiostoma s.l. (De Beer & Wingfield 2013). For some years, S. schenckii was considered the anamorph of O. stenoceras (Taylor 1970, Mariat 1971, de Hoog 1974), but Summerbell et al. (1993) first suggested that the two species were distinct, later confirmed by De Beer et al. (2003b) using ITS sequences. No teleomorph is currently known for S. schenckii. Several recent phylogenetic studies of S. schenckii show that the human and animal pathogens form several closely related lineages (Marimon et al. 2007). Three lineages are already described as distinct species, namely S. brasiliensis, S. globosa, and S. luniei (Marimon et al. 2007, 2008). The status of the other lineages remains to be clarified.

Several synonyms for S. schenckii, all originating from the medical literature predating 1940, are listed by de Hoog (1974) and in MycoBank. We did not list these here, except for S. beurmannii and D. schenckii for the reasons discussed below. Sporothrix beurmannii is the type species of Sporotrichosis Guégu., published only as a provisional name (De Beurmann & Gougerot 1911) that is invalid (Art. 36.1). The generic name is now occupied by Ophiostoma s.l. (De Beer & Wingfield 2013). For some years, S. schenckii was considered the anamorph of O. stenoceras (Taylor 1970, Mariat 1971, de Hoog 1974), but Summerbell et al. (1993) first suggested that the two species were distinct, later confirmed by De Beer et al. (2003b) using ITS sequences. No teleomorph is currently known for S. schenckii. Several recent phylogenetic studies of S. schenckii show that the human and animal pathogens form several closely related lineages (Marimon et al. 2007). Three lineages are already described as distinct species, namely S. brasiliensis, S. globosa, and S. luniei (Marimon et al. 2007, 2008). The status of the other lineages remains to be clarified.
(1971) studied the strain (CBS 938.72) of Ansel & Thibaut (1970) and argued that the ‘ascospores’ were actually endoconidia. According to de Hoog (1974), the name Dolicioascus could thus not be used for an anamorph genus. However, the D. schenckii isolate is still viable and therefore lectotypification (Art. 9.2) and validation of the species and genus would be possible. Furthermore, the Melbourne Code allows the use of Dolicioascus whether a teleomorph is present or not. However, Marimon et al. (2007) produced a calmodulin sequence for the D. schenckii isolate which placed it among S. schenckii isolates. Despite this, there is no need for lectotypification or validation of Dolicioascus, because it would only become a synonym of Sporothrix.

The remaining synonyms for S. schenckii should all be reconsidered in future studies delimiting phylogenetic species in this complex.


**Anamorph:** hyalorhinocladiella-like.

**Phylogenetic data:** Villarreal et al. (2005); De Beer & Wingfield (2013).

**Notes:** This species groups with O. angusticollis in a distinct lineage close to the O. tenellum complex (De Beer & Wingfield 2013).


**Anamorph:** pesotum- and sporothrix-like.

**Descriptions:** Harrington et al. (2001, pp 121, 123–124); Paciura et al. (2010b, p. 84, Figs 6, 10, 14, 17).

**Phylogenetic data:** Uzunovic et al. (2000); Harrington et al. (2001); Schroeder et al. (2001); Jacobs et al. (2003c); Jacobs & Kirisits (2003); Masuya et al. (2003b); Kim et al. (2005a); Carlier et al. (2006); Chung et al. (2006); Kamgan Nkuekam et al. (2008b, 2010); Linnakoski et al. (2008, 2009, 2010); Bommer et al. (2009); Lu et al. (2009a, b); Massoumi Alamouti et al. (2009); Groblelara et al. (2010, 2011); Paciura et al. (2010b); Zanot et al. (2010); De Beer & Wingfield (2013).

**Notes:** Harrington et al. (2001) described *P. cupulatum* as the anamorph of *O. setosum* based on mating compatibility, but did not include sequences of the ex-type of *O. setosum* in their analyses. ITS sequences of the ex-types of *O. setosum* (Uzunovic et al. 2000) and *P. cupulatum* differ by 12 bp (De Beer & Wingfield 2013). We thus consider the two species distinct.


**Anamorph:** sporothrix-like.

**Phylogenetic data:** Zanot et al. (2010); De Beer & Wingfield (2013).

**Notes:** ITS sequences of *O. sparsianulatum* are identical to those of *O. plurianulatum*, but the species have very different β-tubulin sequences (Zanot et al. 2010, De Beer & Wingfield 2013). It is part of the *O. plurianulatum* complex (De Beer & Wingfield 2013).


**Anamorph:** Not observed.

**Notes:** *Ophiostoma spinosum* is characterized by relatively short Ceratocystiopsis-like ascocoma, with pigmented setae surrounding the ostiole, and short bacilliform ascospores lacking sheaths (Cannon 1997). These unique characters and the lack of a known anamorph or a living culture, prevents an accurate placement of the species within the Ophiostomatales. The name should not be confused with Ophiostoma spinosum Willemoes-Suhm, a parasitic nematode, or Ceratocystis spinosa Ubags, an invertebrate fossil (Table 1).


**Anamorph:** sporothrix-like.


**Phylogenetic data:** Vlijoen et al. (1999); Wingfield et al. (1999); Roets et al. (2006, 2008, 2010); Zipfel et al. (2006); De Meyer et al. (2008); Harrington et al. (2010); De Beer & Wingfield (2013).

**Notes:** This species is part of the S. schenckii – O. stenoceras complex (De Beer & Wingfield 2013).


**Synanamorphs:** pesotum- and sporothrix-like.

**Phylogenetic data:** Masuya et al. (2003b); Villarreal et al. (2005); Linnakoski et al. (2008); Kamgan Nkuekam et al. (2010); De Beer & Wingfield (2013).

**Notes:** *Ophiostoma ssiiori* groups close to *O. subalpinum* in Ophiostoma s.str. (De Beer & Wingfield 2013).


**Anamorph:** sporothrix-like.


**Phylogenetic data:** Berbee & Taylor (1992a, b); Okada et al. (1998); Hauser et al. (2000); De Beer et al. (2003b); Hauser & Reid (2003); Jacobs et al. (2003c); Aghayeva et al. (2004, 2005); Zhou et al. (2004b, 2006); Gebhardt et al. (2005); Thwaites et al. (2005); Villarreal et al. (2005); Roets et al. (2006, 2008, 2010); Zipfel et al. (2006); Romón et al. (2007); De Meyer et al. (2008); Linnakoski et al. (2009); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Madrid et al. (2010); Paciura et al. (2010b); Kim et al. (2011).

**Notes:** The anamorph of *O. stenoceras* has often been referred to as *S. schenckii*, but the two species are distinct (see under *S. schenckii*), forming the core of the *S. schenckii* – O. stenoceras complex (De Beer et al. 2003b, De Beer & Wingfield 2013).

*Ophiostoma albidum* was treated as a distinct species by Hunt (1956), Griffin (1968), and Olchowiecki & Reid (1974). De Hoog
(1974), Upadhyay (1981) and Seifert et al. (1993) treated it as synonym of *O. stenoceras*. Hausner & Reid (2003) and De Beer et al. (2003b) respectively showed that LSU and ITS sequences of *O. albidum* are identical to those of *O. stenoceras*, supporting the synonymy of the two species.

The distinction between *O. gossypinum* and *C. gossypina var. robusta* by Davidson (1971) was based only on perithecial morphology. Subsequent authors treated both species as synonyms of *O. stenoceras* (Upadhyay 1981, Seifert et al. 1993). Hausner & Reid (2003) showed that *O. gossypinum* is distinct from *O. stenoceras*, while Villarreal (2005) showed the ITS sequence of the ex-type isolate of *C. gossypina var. robusta* to be identical to that of *O. stenoceras*.

De Beer et al. (2003b) showed that the ex-type of *O. ponderosae* (ATCC 26665 = RWD 900) has an identical ITS sequence to *O. stenoceras*. An LSU sequence produced by Hausner et al. (1993b, not in GenBank) of another *O. ponderosae* isolate (CBS 496.77 = RWD 899) from the study of Hinds and Davidson (1975), groups in the *O. plurianulatum* complex, but we accept the synonymy with *O. stenoceras* by De Beer et al. (2003b) based on the ex-type.

Ceratocystis eucastaneae was suggested as a synonym of *O. stenoceras* by Upadhyay (1981), and this was accepted by Seifert et al. (1993).


*Description*: De Meyer et al. (2008, p. 656, Figs 4a–c).

*Phylogenetic data*: De Meyer et al. (2008); Madrid et al. (2010); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. This species is part of the *S. schenckii* – *O. stenoceras* complex (De Beer & Wingfield 2013).


*Anamorph*: pesotum-like.

*Phylogenetic data*: Masaya et al. (2003b); Villarreal et al. (2005); Chung et al. (2006); Bommer et al. (2009); Linnakoski et al. (2009); Lu et al. (2009a); Kamgan Nkuekam et al. (2010); Linnakoski et al. (2010); De Beer & Wingfield (2013).

*Notes*: This species is part of *Ophiostoma s.str.* (De Beer & Wingfield 2013).


*Anamorph*: sporothrix-like.

*Phylogenetic data*: Hausner & Reid (2003); Villarreal et al. (2005); Zipfel et al. (2006); Kamgan Nkuekam et al. (2008a, b); Linnakoski et al. (2009); Paciura et al. (2010b); Zanzot et al. (2010); De Beer & Wingfield (2013).

*Notes*: *Ophiostoma subannulatum* is part of the *O. plurianulatum* complex (Zanzot et al. 2010, De Beer & Wingfield 2013).


*Anamorph*: hyalorhinocladiella-like.

*Phylogenetic data*: Linnakoski et al. (2010); De Beer & Wingfield (2013).

*Notes*: A species known only by its anamorph. Groups with *O. brunneo-ciliatum* and *O. ainoae*, close to *O. floccosum* in *Ophiostoma s.str.* (De Beer & Wingfield 2013).


*Anamorph*: pesotum-like.

*Phylogenetic data*: Kamgang Nkuekam et al. (2011); De Beer & Wingfield (2013).

*Notes*: This species is part of the *O. ulmi* complex (Kamgang Nkuekam et al. 2011, De Beer & Wingfield 2013).


*Anamorph*: sporothrix-like.


*Phylogenetic data*: Villarreal et al. (2005); Linnakoski et al. (2010); De Beer & Wingfield (2013).

*Notes*: *Ophiostoma tenellum* groups together with *O. nigricarpum* and *O. coronatum* in a distinct lineage peripheral to the *S. schenckii* – *O. stenoceras* complex (Linnakoski et al. 2010, De Beer & Wingfield 2013). *Ceratocystis capitata* was treated as a distinct species by Olchowecki and Reid (1974), but as a synonym of *O. tenellum* by Upadhyay (1981) and Villarreal et al. (2005).


*Anamorph*: leptographium- to hyalorhinocladiella-like (Jacobs et al. 2003c, Jacobs & Seifert 2004a).


*Phylogenetic data*: Hausner et al. (1993b, 2000); Jacobs et al. (2003c); Jacobs & Kirisits (2003); Masaya et al. (2004); Villarreal et al. (2005); Carlier et al. (2006); Kamgan Nkuekam et al. (2008b, 2010); Linnakoski et al. (2008, 2010); Bommer et al. (2009); De Beer & Wingfield (2013).

*Notes*: Jacobs et al. (2003c) clarified the confusion surrounding the atypical ex-type culture of *O. tetropii* and designated both a lectotype and an epitype for the species. Linnakoski et al. (2010) treated *O. tetropii* as part of the *O. minus* complex, but in the analyses of De Beer & Wingfield (2013), the species is placed separately from *O. minus* in *Ophiostoma s.str*.


*Anamorph*: hyalorhinocladiella- to raffaelea-like.

*Description*: Lagerberg et al. (1927, pp 233–238, Figs 43–47).

264
A nomenclator for ophiostomoid genera and species in the Ophiostomatales and microascales

Phylogenetic data: Rollins et al. (2001); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species forms a distinct lineage together with *O. macrosporum* in Ophiostoma s.str. (De Beer & Wingfield 2013). The arguments for the new combination are presented under Lineage B in De Beer & Wingfield (2013).


Anamorph: pesotum-like (Okada et al. 1998).

Descriptions: Olchowcki & Reid (1974, pp 1701–1702, Pl. XII Figs 239–250); Upadhyay (1981, p. 61, Figs 172–177); Seifert & Okada (1993, p. 33, Fig. 4B).

Notes: *Ophiostoma torticiliata* is morphologically similar to *O. clavatum* (Olchowcki & Reid 1974). Its sheathed ascospores suggest a possible relationship with *Grossmannia*.


Anamorph: sporotrich- to hyalorhinocladiella-like.

Phylogenetic data: Hausner et al. (1993b, 2000); Gebhardt et al. (2004); Masuya et al. (2004); De Beer et al. (2013); De Beer & Wingfield (2013).

Notes: Treated as synonym of *O. distortum* by Upadhyay (1981), but Hausner et al. (1993b) showed that *O. torulosum* is distinct. It groups near *O. ulmi* based on SSU (De Beer et al. 2013) and LSU data (De Beer & Wingfield 2013). Its position in the *O. ulmi* complex needs confirmation with ITS data because it does not produce a synnematous anamorph, characteristic of all other species in the complex.


Descriptions: Olchowcki & Reid (1974, p. 1709, Pl. XVI Fig. 317); Upadhyay (1981, p. 115, Figs 418–421).

Phylogenetic data: Hausner & Reid (2003); De Beer et al. (2013); De Beer & Wingfield (2013).

Notes: The LSU sequence of the ex-type isolate (CBS 361.65) produced by Hausner & Reid (2003) places *O. tremulo-aureum* in the *O. ips* complex (De Beer & Wingfield 2013). However, the ascospore shape and hardwood origin of this species suggest a placement in the *O. ulmi* complex. A careful re-assessment of the ex-type culture and additional material is needed to confirm the placement in this species complex.


Phylogenetic data: Hausner & Reid (2003); Villarreal et al. (2005); Linnakoski et al. (2010); De Beer & Wingfield (2013).

Notes: This species is peripheral to the *O. ulmi* complex (De Beer & Wingfield 2013). This relationship needs confirmation with more sequences because ascospores of this species have unique, triangular sheaths, different from other species in the *O. ulmi* complex (De Beer & Wingfield 2013).


Synanamorphs: pesotum- and sporothrix-like.

Phylogenetic data: Grobbelaar et al. (2010, 2011); Linnakoski et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of the *O. ulmi* complex (De Beer & Wingfield 2013).


Synanamorphs: pesotum- and sporothrix-like (de Hoog 1974).

Descriptions: Siemanszko (1939, pp 36–37, Pl. V Figs 8–9); Hunt (1956, pp 38–39); Griffith (1968, pp 715–716, Fig. 84 Pl. I); Booth & Gibson (1973, pp 1–2, Figs A–F); Olchowcki & Reid (1974, p. 1709); de Hoog (1974, pp 50–53, Fig. 19); Upadhyay (1981, p. 117, Figs 422–427); Potájcuk & Sekuchonová (1985, p. 155); Harrington et al. (2001, pp 126–127). Of pesotum-like anamorph: Schwarz (1928, English translation of original, German description of *Gr. ulmi*); Crane & Schoknecht (1973, pp 347–348, Figs 1–13); Mouton et al. (1993, pp 372–375, Figs 5–8, 13); Seifert & Okada (1993, p. 33, Fig. 4A).

Phylogenetic data: Berbee & Taylor (1992a, b); Bates et al. (1993a, b); Hausner et al. (1993b, 2000); Jeng et al. (1996); Brasier et al. (1998); Okada et al. (1998); Harrington et al. (2001); Schroeder et al. (2001); Hausner & Reid (2003); Jacobs et al. (2003c); Jacobs & Kirisits (2003); Masuya et al. (2003b, 2004); Gebhardt et al. (2005); Gibb & Hausner (2005); Paololetti et al. (2005); Villarreal et al. (2005); Carlier et al. (2006); Zipfel et al. (2006); Tang et al. (2007); Kamgang Nkuekam et al. (2008a, b, 2010); Linnakoski et al. (2008); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); Paciura et al. (2010b); De Beer & Wingfield (2013).

Notes: *Pesotum ulmi* is the type species of *Pesotum* (Crane & Schoknecht 1973), currently treated as synonym of *Ophiostoma*. *Ophiostoma ulmi* is the oldest and thus nominal species of the *O. ulmi* complex (De Beer & Wingfield 2013).


Anamorph: sporothrix-like.

Phylogenetic data: Kamgang Nkuekam et al. (2011).

Notes: This species is part of the *O. ulmi* complex (Kamgang Nkuekam et al. 2011, De Beer & Wingfield 2013).


**Anamorph:** sporothrix-like (Przybyl & de Hoog 1989).

**Descriptions:** Szerbin-Parfenenko (1953, pp 47–48); Potlajczuk & Schekunova (1985, p. 155).

**Notes:** Ophiostoma valachicum was treated as a nomen dubium by Upadhyay (1981), while others considered it a possible synonym of *O. piceae* (Przybyl & de Hoog 1989) or *O. quercus* (Harrington et al. 2001). Authentic material was unavailable for these studies. Georgescu et al. (1948) mentioned only a sporothrix-like anamorph (as *Rhinitrichium*). Szerbin-Parfenenko (1953) also stated that no other anamorphs are known. Grobbelaar et al. (2009) suggested that the confusion with *O. piceae* originated from Potlajczuk & Schekunova (1985) who mentioned, but did not describe, a *Graphium* state. However, they also described the ascospores as ‘a little curved’, while Georgescu et al. (1948) and Szerbin-Parfenenko (1953) described and illustrated the ascospores as *semilunaria* and crescent-shaped, respectively. Therefore, it seems likely that the material described by Potlajczuk & Schekunova (1985) did not represent *O. valachicum*. For these reasons, Grobbelaar et al. (2009) concluded that although no material is currently available for this species, it is distinct. Recollection followed by neotypification (Art. 9.7) are prerequisites for determining the correct phylogenetic placement of the species.


**Description:** Roets (2008, p. 506, Fig. 6).


**Notes:** Teleomorph unknown. This species belongs to the *S. schenckii* – *O. stenoceras* complex (De Beer & Wingfield 2013).


**Anamorph:** sporothrix-like.

**Phylogenetic data:** Roets et al. (2010, 2013); De Beer & Wingfield (2013).

**Notes:** This species groups with other Protea-infesting species of the *S. schenckii* – *O. stenoceras* complex (De Beer & Wingfield 2013).


**Notes:** For a discussion of this genus, see De Beer et al. (2013) and De Beer & Wingfield (2013). The anamorph of *Cop. minuta-bicolor* is the type of *Hyalorhinocladiella*; the species groups within *Ceratocystiopsis* (De Beer & Wingfield 2013), rendering *Hyalorhinocladiella* a synonym of *Ceratocystiopsis*.


**Anamorph:** sporothrix-like.

**Phylogenetic data:** Hsiau & Harrington (1997); Six & Paine (1999); Plattner et al. (2009); Hafez et al. (2012); De Beer & Wingfield (2013).


**Anamorph:** sporothrix-like.

**Description:** Marmolejo & Butin (1993, pp 162, 169, Figs 33–37).

**Phylogenetic data:** Hausner et al. (1993a, 2000); Hausner & Reid (2003); Mullineux & Hausner (2009); Plattner et al. (2009); Hafez et al. (2012); De Beer & Wingfield (2013).

**Notes:** LSU data place Cop. *colliferum* in Ceratocystiopsis (Hausner et al. 1993a, Plattner et al. 2009), but published ITS and β-tubulin data of the same isolate (Plattner et al. 2009) correspond closely with those of *O. abietinum* in the *S. schenckii* – *O. stenoceras* complex. We suggest careful reconsideration of the ex-type strain (CBS 126.89) to confirm these unlikely results, which might be the result of a mixed culture.


**Anamorph:** hyalorhinocladiella-like (de Hoog 1993).

**Description:** Upadhyay (1981, p. 121, Figs 432–435).

**Phylogenetic data:** Réblová & Winka (2000); Hausner & Reid (2003); Hafez et al. (2012); De Beer & Wingfield (2013).


**Anamorph:** hyalorhinocladiella-like (Upadhyay 1981).

**Description:** Upadhyay (1981, p. 122, Figs 436–439).


**Anamorph:** hyalorhinocladiella- to sporothrix-like.


**Phylogenetic data:** Hausner et al. (1993a); Hausner & Reid (2003); Plattner et al. (2009); Hafez et al. (2012); De Beer & Wingfield (2013).

**Notes:** The morphology of *O. longisporum*, especially the falcate ascospores, resembles other *Ceratocystiopsis* species. DNA sequences suggest this species is slightly distinct from, but always in a monophyletic lineage with significant support values. Together with other species of *Ceratocystiopsis* (Hausner et al. 1993a, Hausner & Reid 2003, Plattner et al. 2009, Hafez et al. 2012, De Beer & Wingfield 2013), confirming the classification suggested by Upadhyay (1981).

Anamorph: hyalorhinocladiella-like.

Phylogenetic data: Hauser et al. (1993a) (as ‘Ceratocystis minima’); Zipfel et al. (2006); Massoumi-Alamouti et al. (2007, 2009); Plattner et al. (2009); Hafez et al. (2012); De Beer & Wingfield (2013).

Notes: Phylogenetic analyses by Plattner et al. (2009) show two lineages within Cop. manitobensis, possibly representing distinct taxa and worthy of further exploration.


Phylogenetic data: Hausner et al. (1993a); Hausner & Reid (2003); Zipfel et al. (2006); Plattner et al. (2009); Hafez et al. (2012); De Beer & Wingfield (2013).


Phylogenetic data: Hausner et al. (1993a); Hausner & Reid (2003); Zipfel et al. (2006); Massoumi-Alamouti et al. (2007, 2009); Plattner et al. (2009); Hafez et al. (2012); De Beer & Wingfield (2013).

Notes: The anamorph of Cop. minuta-bicolor is the type of *Hyalorhinocladiella*, treated under the Melbourne Code as a synonym of *Ceratocystiopsis* (De Beer & Wingfield 2013). The synonymy of _C. pallida_ with _C. minuta-bicolor_ was suggested by Upadhyay (1981). The name _C. pallida_ should not be confused with _S. pallida_ (Tubaki) Matsush. (Matsushima 1975).


Anamorph: hyalorhinocladiella-like.


Notes: DNA sequence data produced by De Beer & Wingfield (2013) for the ex-type isolate (CBS 100596) confirmed that this species belongs to *Ceratocystiopsis*. The sheathed ascospores, although shorter than typical for *Ceratocystis*, and the hyalorhinocladiella-like anamorph with some penicillately branched conidiophores, are consistent with those of other species. The name should not be confused with *Ceratocystis neglecta* M. van Wyk, Jol. Roux & C. Rodas.


Anamorph: unknown.

Descriptions: Olchowecki & Reid (1974, p. 1688, Pl I, Fig. 21); Upadhyay (1981, p. 132, Figs 499–501).


Anamorph: hyalorhinocladiella-like (de Hoog 1993).


Phylogenetic data: Hausner & Reid (2003); Plattner et al. (2009); Hafez et al. (2012); De Beer & Wingfield (2013).


Anamorph: hyalohorinocladiella-like, based on the protologue.
Phylogenetic data: Hausner et al. (1993a); Hafez et al. (2012); De Beer & Wingfield (2013).

Notes: Upadhyay (1981) treated this species as a synonym of Cop. minima, but Hausner et al. (1993c) showed that it is distinct from both Cop. minima and Cop. minuta. Plattner et al. (2009) were unable to amplify some markers for Cop. parva.


Anamorph: sporotricho-like.
Phylogenetic data: Hausner et al. (1993a, c, 2000); Gorton & Webber (2000); Hausner & Reid (2003); Gorton et al. (2004); Zipfel et al. (2006); Massoumi-Alamouti et al. (2007); Plattner et al. (2009); Hafez et al. (2012); De Beer & Wingfield (2013).


Anamorph: hyalohorinocladiella-like.
Phylogenetic data: Hausner et al. (1993a) (as ‘Ceratocystiopsis sp. 2’); Zipfel et al. (2006); Plattner et al. (2009); Hafez et al. (2012); De Beer & Wingfield (2013).

Notes: The two ITS sequences produced for this species by Plattner et al. (2009) are identical and group near G. galeiformis (De Beer & Wingfield 2013), while the LSU, SSU and β-tubulin sequences group within Ceratocystiopsis, which is probably correct (Plattner et al. 2009, Hafez et al. 2012, De Beer & Wingfield 2013).


**Fragosphaeria** Shear, *Mycologia* 15: 124. 1923 [type species *F. purpurea*]

Notes: For a discussion of this genus, see De Beer et al. (2013) and De Beer & Wingfield (2013).


Anamorph: sporothrix-like, based on description by Chesters (1935).
Description: Chesters (1935).
Phylogenetic data: Suh & Blackwell (1999); Kolařík & Hulcr (2004); Harrington et al. (2010); De Beer et al. (2013); De Beer & Wingfield (2013).


Anamorph: sporothrix-like, based on description by Chesters (1935).
Description: Chesters (1935).
Phylogenetic data: Suh & Blackwell (1999); Kolařík & Hulcr (2004); Harrington et al. (2010); De Beer et al. (2013); De Beer & Wingfield (2013).


Ascocarps dark brown to black, bases globose; necks dark brown to black, straight or slightly curved, cylindrical to tapered, less than 500 μm long; ostiole sometimes surrounded by ostiolar hyphae. Asci evanescent. Ascospores hyaline, aseptate, cylindrical to oblong, surrounded with a hyaline, gelatinous, oossoforn to rectangular sheath. Synnematous anamorphs, when present, pesutom-like, stipes pale to darkly pigmented, conidiophores more or less biverticillate, conidigenous cells extending percurrently, often with delayed conidial dehiscence giving the impression of sympodial extension, conidia aseptate, oblong or ellipsoidal, base truncate, in slimy masses. Mononematous anamorphs, when present, hyalohorinocladiella-like, with unbranched or sparingly branched conidiophores, conidigenous cells and conidia similar to those of the synnematous anamorph. Phylogenetically classified in the *Ophiostomatales*. Associated with conifer-infesting bark beetles.

Notes: De Beer & Wingfield (2013) showed that Gra. sparsum and the other species listed below formed a well-supported, distinct lineage within the *Ophiostomatatales*. *Graphilbum* is thus re-introduced and redefined here to accommodate these taxa.

Upadhyay (1981) designated formal sections in Ceratocystis. Most species in his Section *ips* are included in *Ophiostoma s.l.*, but four of the species are included here in *Graphilbum*.


Anamorph: hyalohorinocladiella-like.

Notes: The morphology of the anamorph, ascospores and perithecia of Gra. tubicolle closely resemble those of Gra. nigrom and other *Graphilbum* spp. Although no DNA sequences are available for this species, it clearly does not belong in *Ceratocystis* but in *Graphilbum*.


Anamorph: pesotum-like.


Phylogenetic data: Okada et al. (1998); Harrington et al. (2001); Jacobs et al. (2003c); Kim et al. (2003, 2007); Thwaites et al. (2005); Zhou et al. (2006); Romón et al. (2007); Kamgan Nkuekam et al. (2008a); Lu et al. (2009a); Jankowiak & Kolařík (2010); Piaciura et al. (2010b); Hafig et al. (2012).

Notes: This species seems to consist of several cryptic species (De Beer & Wingfield 2013). Harrington et al. (2001) showed that an isolate (CBS 219.83) considered authentic for P. fragrans by Okada et al. (1998), and recently also Hafig et al. (2012), actually represented another species. They suggested that CBS 279.54 should instead be treated as authentic for the type of P. fragrans (Harrington et al. 2001).


Anamorph: pesotum-like.

Phylogenetic data: De Beer & Wingfield (2013); Masuya et al. (2013).

Notes: An ITS sequence produced by Masuya et al. (2013) groups clearly within Graphilbum (De Beer & Wingfield 2013). The name should not be confused with Ceratostomella microcarpa (= Ceratocystis microcarpa) (see Section C.1).


Anamorph: hyalorhinocladiella-like.


Phylogenetic data: Hausner et al. (1993b); Hausner & Reid (2003).

Notes: An LSU sequence places this species in Graphilbum (De Beer & Wingfield 2013).


Anamorph: not observed.

Phylogenetic data: Ohtaka et al. (2006, pp 290–292, Fig. 5).

Notes: This species groups within Graphilbum based on LSU and ITS sequences (De Beer & Wingfield 2013).


Anamorph: pesotum-like.

Descriptions: Upadhyay (1981, p. 83, Figs 290–294); Seifert & Okada (1993, p. 32, Fig. 3A).

Phylogenetic data: Hausner & Reid (2003).

Notes: Graphilbum sparsum is the type species of the genus (Upadhyay & Kendrick 1975), re-introduced here to accommodate species previously treated in the P. fragrans complex (De Beer & Wingfield 2013).


Notes: The morphology of the anamorph, ascospores and perithecia of Gra. tubicollle closely resemble those of Gra. nigrum and other Graphilbum spp. Although no DNA sequences are available for this species, it clearly should not be classified in Ceratocystis but in Graphilbum.


≡ Scopularia Preuss, Linnaea 24: 133. 1851 [nom. illegit., Art. 52.1] [type species Sc. venusta, see L. lundbergii]


Notes: De Beer & Wingfield (2013) showed that Leptographium s.l. is not a well supported monophyletic clade. The type species of Grosmannia forms a strong monophyletic lineage designated as the G. penicillata complex in Leptographium s.l., the generic status of this lineage needs reconsideration. For the interim, Grosmannia is listed as possible synonym for Leptographium.

The synonymy of Europhium with Grosmannia as suggested by Zipfel et al. (2006) was questioned by De Beer & Wingfield (2013) because the generic placement of O. trinaciforme remains uncertain.

Upadhyay & Kendrick (1974, 1975) and Upadhyay (1981) separated the synnematous anamorphs of the Ophiostomatales in several distinct genera based on morphological differences, but Okada et al. (1998) treated all these genera as synonyms of Pesotum. Pesotum is now a synonym of Ophiostoma s.str. (see under Ophiostoma above), and the type species of two of these genera, Phialographium and Graphiocladiella, group in Leptographium s.l. (De Beer & Wingfield 2013). Because the delineation of genera within Leptographium s.l. needs further study, the current status of these two genera is presently uncertain.

Upadhyay (1981) designated official sections in Ceratocystis. Most species in its Section Ceratocystis are here included in Leptographium s.l.

The type species of the monotypic nematophagous genus, Esteya, groups peripherally to the R. sulphurea complex in Leptographium s.l. This complex also contains the type species of the ambrosial genus, Dryadomyces, and three Raffaelea spp. The generic status of both Dryadomyces and Esteya needs to be reassessed (De Beer & Wingfield 2013).


**Anamorph:** pesotum-like.

**Description:** Masuya et al. (2013). Notes: This species groups peripherally to the G. penicillata complex based on rDNA sequences (De Beer & Wingfield 2013, Masuya et al. 2013). The name should not be confused with L. abieticola.


**Description:** Jacobs & Wingfield (2001, pp 46–48, Figs 19–21).

**Phylogenetic data:** Jacobs et al. (2001d); Kim et al. (2004, 2005c); Masuya et al. (2004); Massoumi Alamouti et al. (2006); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. Leptographium abieticola is part of the G. penicillata complex (Six et al. 2011, De Beer & Wingfield 2013). The name should not be confused with G. abieticola.


**Descriptions:** Kendrick (1962, pp 773–776, Fig. 1, 9A–C); Jacobs et al. (1998, p. 1662, Figs 2, 4, 6); Jacobs & Wingfield (2001, pp 48–51, Figs 22–24).

**Phylogenetic data:** Jacobs et al. (2001d, 2005, 2006, 2010); Kim et al. (2004, 2005c, d); Masuya et al. (2004); Massoumi Alamouti et al. (2006, 2009); Zhou et al. (2008); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. Leptographium abietinum is part of the G. penicillata complex (Six et al. 2011, Linnakoski et al. 2012, De Beer & Wingfield 2013). Jacobs et al. (1998) and Jacobs & Wingfield (2001) suggested that L. engelmannii is a synonym of L. abietinum. This species name should not be confused with O. abietinum.


**Anamorph:** leptographium-like (Upadhyay 1981).


**Phylogenetic data:** Jacobs et al. (2001d); Masuya et al. (2004); Greif et al. (2006); Massoumi Alamouti et al. (2006, 2007, 2009); Harrington et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Grosmannia abiocarpa is part of the G. penicillata complex (Six et al. 2011, Linnakoski et al. 2012, De Beer & Wingfield 2013).


**Anamorph:** leptographium-like.


**Phylogenetic data:** Jacobs et al. (2004, 2005, 2006, 2010); Masuya et al. (2005); Massoumi Alamouti et al. (2006); Zipfel et al. (2006); Zhou et al. (2008); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013); Jacobs et al. (2013).

Notes: This species is part of the G. piceiperda complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


**Anamorph:** leptographium-like.

**Descriptions:** Wingfield & Marasas (1980b, pp 22–25, Figs 1–26); Duong et al. (2012, pp 723–724, Fig. 6).

**Phylogenetic data:** Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).
A nomenclator for ophiostomoid genera and species in the Ophiostomatales and Microascales

Notes: Wingfield & Marasas (1981) suggested the synonymy of L. alacre with L. serpens, which was accepted in subsequent studies (Harrington 1988, Jacobs & Wingfield 2001). Duong et al. (2012) showed that the two species were distinct based on a five gene phylogeny, and they discovered and described the teleomorph of the species. Their data confirmed that to date the true G. serpens has only been found in Italy, and that most other reports of G. serpens actually represent G. alacris, implying that G. alacris has the widest distribution in the G. serpens complex.


Phylogenetic data: Jacobs et al. (2001d); Masuya et al. (2004); Massoumi Alamouti et al. (2006); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).


Phylogenetic data: Jacobs et al. (2001d, 2004); Kim et al. (2004, 2005d); Masuya et al. (2004); Massoumi Alamouti et al. (2006); Lu et al. (2009b); Paciura et al. (2010a); Six et al. (2011); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. Leptographium alethinum forms a distinct lineage close to, but distinct from, the L. lundbergii and G. clavigera species complexes in Leptographium s.l. (Six et al. 2011, De Beer & Wingfield 2013).


Description: Paciura et al. (2010a, p. 106, Fig. 7h–m).

Phylogenetic data: Paciura et al. (2010a); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the G. penicillata complex (Paciura et al. 2010a, Linnakoski et al. 2012, De Beer & Wingfield 2013).


Description: Gebhardt et al. (2005, pp 690–694, Figs 5–7).

Phylogenetic data: Gebhardt et al. (2005); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. Raffaelea amasae is the type species of Dryadomyces (Gebhardt et al. 2005). It is part of the R. sulphurea complex in Leptographium s.l. and does not belong in Raffaelea s.str. (De Beer & Wingfield 2013).


Anamorph: leptographium-like.


Phylogenetic data: Jacobs et al. (2001a, d, 2005, 2006, 2010); Kim et al. (2004, 2005d); Masuya et al. (2004); Greif et al. (2006); Massoumi Alamouti et al. (2006); Zhou et al. (2008); Lu et al. (2009a); Mullineux & Hausner (2009); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013); Jacobs et al. (2013).

Notes: Grosmannia americana is part of the G. penicillata complex (Six et al. 2011, Linnakoski et al. 2012, De Beer & Wingfield 2013).


Anamorph: unknown.

Descriptions: Aoshima (1965, p. 12, Figs 40–41); Masuya et al. (2013).

Phylogenetic data: Ohtaka et al. (2006); De Beer & Wingfield (2013); Masuya et al. (2013).

Notes: This species is part of G. penicillata complex based on ITS sequence (De Beer & Wingfield 2013). Ohtaka et al. (2006) suggested that the description of the invalid species C. polygrapha corresponds with that of G. aoshimae.


Anamorph: leptographium-like.


Phylogenetic data: Hausner et al. (1992b, 2000, 2005); Jacobs et al. (2001d, 2004, 2005, 2006, 2010); Lee et al. (2003, 2005); Lim et al. (2004); Kim et al. (2005d); Masuya et al. (2004, 2005); Massoumi Alamouti et al. (2006); Zipfel et al. (2006); Zhou et al. (2008); Lu et al. (2009a, b); Mullineux & Hausner (2009); Matsuda et al. (2010); Paciura et al. (2010a); Roe et al. (2010); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013); Jacobs et al. (2013).

Notes: Hausner et al. (2005) suggested that L. wingfieldii and L. terebrantis are possible synonyms of L. aureum. However, Roe et al. (2010) and Six et al. (2011) showed that these species are distinct members of the G. clavigera complex.


*Phylogenetic data*: Zhou et al. (2008); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. This species is part of the *L. procerum* complex (Six et al. 2011, Linnakoski et al. 2012, De Beer & Wingfield 2013).


*Description*: Kim et al. (2004, pp 701–72, Figs 1–3).

*Phylogenetic data*: Kim et al. (2004); Massoumi Alamouti et al. (2006); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).


*Anamorph*: pesotum-like.

*Descriptions*: Upadhyay (1981, p. 39, Figs 43–47); Seifert & Okada (1993, p. 32, Fig. 3D).

*Phylogenetic data*: Hausner et al. (2000); Masuya et al. (2004); Kim et al. (2005d); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

*Notes*: *Grosmannia cainii* forms a lineage of its own, distinct from other species complexes in *Leptographium* s.l. (De Beer & Wingfield 2013).


*Descriptions*: Wiehe (1949, pp 3–5, Figs 2–50); Webber et al. (1999, pp 1589–1592, Figs 1–12); Jacobs & Wingfield (2001, pp 76–78, Figs 49–51).

*Notes*: Teleomorph unknown. The morphology of *L. calophylli* differs from that of all other *Leptographium* spp. In the absence of DNA sequences, it is not possible to assign this species to a complex.


*Description*: Duong et al. (2012, pp 726–727, Fig. 9).

*Phylogenetic data*: Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. This species is part of the *G. serpens* complex (Duong et al. 2012, De Beer & Wingfield 2013).


*Description*: Paciura et al. (2010a, pp 100–102, Fig. 4g–i).

*Phylogenetic data*: Paciura et al. (2010a); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. In common with *L. celere* groups in the *L. procerum* complex based on rDNA, but in the *L. lundbergii* complex based on β-tubulin and EF-1α sequences (Paciura et al. 2010a, Linnakoski et al. 2012, De Beer & Wingfield 2013).


*Description*: Jacobs et al. (2010, pp 73–74, Figs 2–3).

*Phylogenetic data*: Jacobs et al. (2010); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. This species is part of the *G. penicillata* complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


*Anamorph*: pesotum-like.


*Phylogenetic data*: Hausner et al. (1992b); Six et al. (2003); Lee et al. (2003, 2005); Kim et al. (2004, 2005d); Lim et al. (2004, 2005); Greif et al. (2006); Masuya et al. (2005); Massoumi Alamouti (2006, 2009, 2011); Lu et al. (2009a, b); Paciura et al. (2010a); Roe et al. (2010, 2011); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes*: The anamorph of *G. clavigera* is the type species of *Graphiocladiella* (Upadhyay 1981). Lee et al. (2007) and Massoumi Alamouti et al. (2011) showed that the *G. clavigera* population in British Columbia, Canada consists of two distinct groups, representing sibling species. One species remains to be described as new. The complete genome of *G. clavigera* has been sequenced, making it the first ophiostomatoïd genome published (Di Giustini et al. 2009, 2011). Roe et al. (2010, 2011) conducted a population and phylogeographic study based on five gene regions on *G. clavigera*, showing that recombination in this species is rare, which suggests that it reproduces sexually infrequently in nature.


*Description*: Paciura et al. (2010a, pp 99–100, Fig. 4a–f).

*Phylogenetic data*: Paciura et al. (2010a); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).
Notes: Teleomorph unknown. This species is part of the $L. \text{lundbergii}$ complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


**Anamorph:** leptomorph-like.

**Descriptions:** Olchowecki & Reid (1974, p. 1679, Pl. I Fig. 16); Upadhyay (1981, p. 123, Figs 440–444); Jacobs & Wingfield (2001, pp 81–84, Figs 55–57).

**Phylogenetic data:** Hausner et al. (1993c, 2000); Jacobs et al. (2001d); Hausner & Reid (2003); Masuya et al. (2004); Kim et al. (2005d); Massoumi Alamouti et al. (2006); Zipfel et al. (2006); Paciura et al. (2010a); Mullineux et al. (2011); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: This species groups in a lineage with $L. \text{piniforme}$, distinct from other species complexes in Leptographium s.l. (De Beer & Wingfield 2013).


**Anamorph:** pesotum-like.


**Phylogenetic data:** Hausner et al. (1992b, 1993b, 2000); Okada et al. (1998); Harrington et al. (2001); Schroeder et al. (2001); Gebhardt et al. (2004, 2005); Zhou et al. (2004c); Greif et al. (2006); Massoumi Alamouti et al. (2009); Mullineux & Hausner (2009); Harrington et al. (2010); Matsuda et al. (2010); Paciura et al. (2010a); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Harrington et al. (2001) suggested that $P. \text{erubescens}$ represented the anamorph of $G. \text{cucullata}$ based on ITS sequences from the ex-type isolates of the two species, which differed by only two bp. However, the SSU sequences of the same two isolates from Hausner et al. (2000) and Okada et al. (2000) differ in 11 bp positions (see Fig. 2, De Beer et al. 2013). Furthermore, the SSU sequence of a Japanese isolate labelled as ‘$O. \text{cucullatum}$’ by Okada et al. (1998), differ respectively in 5 and 19 bp from the ex-types of $G. \text{cucullata}$ and $P. \text{erubescens}$. Linnakoski et al. (2012) did not include the ex-type of $P. \text{erubescens}$ in their study, but showed that the species distinction of $G. \text{cucullata}$ and $G. \text{olivacea}\text{pini}$ in the $G. \text{olivacea}$ complex is problematic. We thus suggest a reconsideration of the synonymy of $G. \text{cucullata}$ and $P. \text{erubescens}$, and the status of the Japanese isolate and $G. \text{olivacea}\text{pini}$, using authentic isolates of all species and sequences from more gene regions.


**Description:** Paciura et al. (2010a, pp 104–105, Figs 7a–g).

**Phylogenetic data:** Paciura et al. (2010a); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the $G. \text{penicillata}$ complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


**Description:** Jacobs et al. (2010, pp 74–75, Figs 4–5).

**Phylogenetic data:** Jacobs et al. (2010); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. Leptographium curvisporum is part of the $G. \text{penicillata}$ complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


**Anamorph:** pesotum-like.


**Phylogenetic data:** Hausner et al. (2000); Masuya et al. (2004); Mullineux & Hausner (2009); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: This species is part of the $G. \text{olivacea}$ species complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


**Phylogenetic data:** Jacobs et al. (2001d, 2004, 2005); Massoumi Alamouti et al. (2006); Zhou et al. (2008); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species groups in the $G. \text{wageneri}$ complex (Six et al. 2011, De Beer & Wingfield 2013). The name $L. \text{douglasii}$ should not be confused with $C. \text{douglasii}$ (see under Ceratocystis, section B.1).


**Anamorph:** leptomorph-like.


**Phylogenetic data:** Hausner et al. (1993d, 2000); Jacobs et al. (2001a, d); Masuya et al. (2004); Kim et al. (2005d); Greif
et al. (2006); Massoumi Alamouti et al. (2006); Mullineux & Hausner (2009); Harrington et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: The ITS sequence (AF224333) of the ex-type strain of G. dryococis (CMW 442), deposited by Jacobs et al. (2001a) is a chimeric sequence: the ITS 1 region is a 91 % BLAST match of and aligns fairly well with a G. laircis sequence (GU134163), while the ITS 2 region is 98 % similar to AJ538340, an unpublished sequence by Villarreal et al. of the ex-type isolate (CBS 376.66) of G. dryococis. The latter is thus the more reliable sequence and it places the species in the G. penicillata complex (Six et al. 2011, Duong et al. 2012, De Beer & Wingfield 2013).


*Phylogenetic data*: Jacobs et al. (2001d); Kim et al. (2004, 2005c); Masuya et al. (2004); Massoumi Alamouti et al. (2006); Six et al. (2011); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. *Leptographium elegans* forms a lineage between *Esteya vermicola* and the *R. sulphurea* complex in *Leptographium* s.l., and is quite distinct from other *Leptographium* spp. (Six et al. 2011, De Beer & Wingfield 2013).


*Phylogenetic data*: Jacobs et al. (2001d); Kim et al. (2004, 2005d); Massoumi Alamouti et al. (2006); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the *G. penicillata* complex (Six et al. 2011, De Beer & Wingfield 2013).


*Phylogenetic data*: Jacobs et al. (2001d); Kim et al. (2004, 2005d); Masuya et al. (2004); Massoumi Alamouti et al. (2006); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. *Leptographium euphyes* is part of the *G. penicillata* complex (Six et al. 2011, De Beer & Wingfield 2013).


Anamorph: leptographium-like (Solheim 1986).

*Descriptions*: Davidson et al. (1967, pp 929–930); Griffin (1968, pp 709, 713); Olchowcki & Reid (1974, p. 1699, Pl. XIII Figs 259–261); de Hoog & Scheffer (1984, p. 295, Fig. 2); Yamaoka et al. (1997, pp 1221–1222); Jacobs et al. (1998, pp 290–291); Jacobs et al. (2000b, p. 239).

*Phylogenetic data*: Hausner et al. (1993b, 2000); Okada et al. (1998); Schroeder et al. (2001); Masuya et al. (2004); Greif et al. (2006); Mullineux & Hausner (2009); Matsuura et al. (2010); Paciura et al. (2010a); Six et al. (2011); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Upadhyay (1981) and Hutchison & Reid (1988a) treated *G. europhioides* as a synonym of *G. piceiperda*, but Solheim (1986), Harrington (1988), Yamaoka et al. (1997) and Jacobs et al. (1998) considered it distinct. Harrington (1988) considered *G. pseudoeurophioides* a synonym of *G. europhioides*. Jacobs et al. (2000b) and Jacobs & Wingfield (2001) treated the latter two species as synonyms of *G. piceiperda*, but Hausner et al. (1993b, 2000) suggested that they are distinct from *G. europhioides*. Linnakoski et al. (2012) showed that isolates previously assigned to *G. piceiperda* represent at least five lineages. The status of these lineages should be reconsidered together with *G. europhioides* and *G. pseudoeurophioides*. Yamaoka et al. (1997) suggested that *C. shikotsuensis*, invalidly described by Aoshima (1965), was identical with *G. europhioides*. Masuya et al. (2013) suggested that the status of *G. europhioides* isolates from Japan needs reconsideration. All the lineages now represented by the name *G. europhioides* are part of the *G. piceiperda* complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


Anamorph: leptographium-like.


*Phylogenetic data*: Hausner et al. (2000); Jacobs et al. (2001d); Masuya et al. (2004); Kim et al. (2005d); Massoumi Alamouti et al. (2006); Zipfel et al. (2006); Mullineux & Hausner (2009); Matsuura et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. 2012, De Beer & Wingfield 2013.

Notes: LSU sequences of *G. franco-grosmanniae* from the studies of Hausner et al. (2000) (ex-type ATCC 22061), Jacobs et al. (2001a, d) (ex-type CMW 445), and Zipfel et al. (2006) (CMW 2975), do not correspond. According to De Beer & Wingfield (2013), the sequence produced by Hausner et al. (2000) groups somewhere between the *L. lundbergii* and *G. olivacea* complexes, while that by Jacobs et al. (2001a, d) groups in the *G. penicillata* complex, and the one by Zipfel et al. (2006) close to *G. serpens* complex. An ITS sequence of ATCC 22061 produced by Mullineux & Hausner (2009) also groups in the *G. olivacea* complex (De Beer & Wingfield 2013). Although the treatment of the species in *Grosannia* by Zipfel et al. (2006) is acceptable for the present, its exact placement within *Leptographium* s.l. needs to be determined.


Phylogenetic data: Massoumi Alamouti et al. (2006, 2009); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the G. penicillata complex (Six et al. 2011, Linnakoski et al. 2012, De Beer & Wingfield 2013).


Anamorph: leptographium- to pesotum-like.

Descriptions: Mathiesen-Käärik (1953, pp 47–50); Hunt (1956, p. 33); Wingfield (1993, p. 48, Fig. 8); Zhou et al. (2004c, pp 1309–1311, Fig. 2).

Phylogenetic data: Hauser et al. (2000); Zhou et al. (2004c); Kim et al. (2005d, 2011); Thwaites et al. (2005); Greif et al. (2006); Zipfel et al. (2006); Lu et al. (2009b); Mullineux & Hausner (2009); Harrington et al. (2010); Matsuda et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: An epitype was designated for G. galeiformis by Zhou et al. (2004c). Thwaites et al. (2005) treated G. radiaticola as synonym of G. galeiformis based on ITS sequences, but Kim et al. (2005d) showed with actin and β-tubulin sequences, and by mating behaviour, that the two species are distinct. Linnakoski et al. (2012) redefined the G. galeiformis complex and showed that two more lineages, probably representing undescribed species, exist within the complex. De Beer & Wingfield (2013) showed that G. galeiformis forms a well-supported lineage together with G. radiaticola within Leptogaphrium s.l.


Description: Duong et al. (2012, p. 725, Fig. 7).

Phylogenetic data: Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the G. serpens complex (Duong et al. 2012, De Beer & Wingfield 2013).


Description: Paciura et al. (2010a, pp 103–104, Figs 5h-m).

Phylogenetic data: Paciura et al. (2010a); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the L. procercum complex (Paciura et al. 2010a, Linnakoski et al. 2012, De Beer & Wingfield 2013).


Anamorph: leptographium-like.


Phylogenetic data: Hauser et al. (2000); Jacobs et al. (2001d); Masuya et al. (2004); Massoumi Alamouti et al. (2006); Zipfel et al. (2006); Matsuda et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: This species forms a distinct lineage separate from other species complexes in Leptogaphrium s.l. (Six et al. 2011, De Beer & Wingfield 2013). In some analyses, it groups with L. pruni (Massoumi Alamouti et al. 2006, Duong et al. 2012).


Phylogenetic data: Jacobs et al. (2001a, d); Masuya et al. (2004); Zhou et al. (2004c); Greif et al. (2006); Paciura et al. (2010a); Six et al. (2011); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the G. penicillata complex (Six et al. 2011, De Beer & Wingfield 2013).


Phylogenetic data: Jacobs et al. (2001d); Masuya et al. (2004); Kim et al. (2005d); Massoumi Alamouti et al. (2006); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the G. penicillata complex (Six et al. 2011, De Beer & Wingfield 2013).


Anamorph: leptographium-like.

Descriptions: Robinson-Jeffrey & Grinchenko (1964, pp 528–531, Figs 1–17); Griffin (1968, pp 710, 713); Ochowiecki & Reid (1974, p. 1699, Pl. XIII Figs 252, 256); Upadhyay (1981, p. 47, Figs 85–90); Wingfield (1993, p. 46, Fig. 3); Jacobs et al. (1998, pp 290–291); Jacobs & Wingfield (2001, pp 111–115, Figs 85–87).

Phylogenetic data: Jacobs et al. (2001d, 2004, 2006); Kim et al. (2004); Masuya et al. (2004, 2005); Kim et al. (2005a, c, d, 2011); Lee et al. (2005); Thwaites et al. (2005); Massoumi Alamouti et al. (2006); Zipfel et al. (2006); Zhou et al. (2008); Mullineux & Hausner (2009); Harrington et al. (2010); Matsuda et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013); Jacobs et al. (2013).


Anamorph: leptomorph-like.

Phylogenetic data: Kim et al. (2005c); Masuya et al. (2005, 2013); Massoumi Alamouti et al. (2006); Lu et al. (2009b); Paciura et al. (2010a); Roe et al. (2010); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013); Jacobs et al. (2013).

Notes: This species is part of the L. lundbergii complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


Anamorph: leptomorph-like.


*Phylogenetic data:* Jacobs et al. (2001a, d, 2005, 2006, 2010); Masuya et al. (2004, 2005); Greif et al. (2006); Zipfel et al. (2006); Zhou et al. (2008); Mullineux & Hausner (2009); Harrington et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013); Jacobs et al. (2013).

Notes: Yamaoka et al. (1998) suggested that C. macrospora is the same fungus as G. larici, which forms part of the G. piceiperda complex (Linnakoski et al. 2012, De Beer & Wingfield 2013). This name should not be confused with Graphium larici, which is a member of the Microscales (Jacobs et al. 2003b).


*Description:* Paciura et al. (2010a, p. 104, Figs 6a-f).

*Phylogenetic data:* Paciura et al. (2010a); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the L. procerum complex (Paciura et al. 2010a, Linnakoski et al. 2012, De Beer & Wingfield 2013).


Anamorph: leptomorph-like.


*Phylogenetic data:* Jacobs et al. (2001d); Kim et al. (2005d); Zipfel et al. (2006); Matsuda et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); De Beer & Wingfield (2013).

Notes: This species forms a distinct lineage from other species complexes in Leptographium s.l. (Paciura et al. 2010a, Six et al. 2011, Duong et al. 2012, De Beer & Wingfield 2013).


*Description:* Lee et al. (2005, pp 1165–1167, Figs 1–13).

*Phylogenetic data:* Lee et al. (2005); Lu et al. (2009b); Massoumi Alamouti (2009, 2011); Paciura et al. (2010a); Roe et al. (2010, 2011); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the G. clavigera complex (Six et al. 2011, De Beer & Wingfield 2013). The results of population study by Roe et al. (2010, 2011) suggest that this species does not reproduce sexually.


*Description:* Lagerberg et al. (1927, pp 248–257, Figs 54–59); Barron (1972, pp 215–216, Fig. 129); Wingfield (1993, pp 46, 48, Figs 2, 8); Jacobs & Wingfield (2001, pp 121–123, Figs 94–96); Jacobs et al. (2005, pp 1153–1155, Figs 2–13).

*Phylogenetic data:* Jacobs et al. (2001d, 2004, 2005, 2006, 2010); Kim et al. (2004, 2005c, d); Massoumi Alamouti et al. (2006, 2009); Zhou et al. (2008); Lu et al. (2009a, b); Mullineux & Hausner (2009); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Leptographium lundbergii is the type of Leptographium and the nominal species of the L. lundbergii complex (Linnakoski et al. 2012, De Beer & Wingfield 2013). Jacobs et al. (2005) designated a neotype. No teleomorph has been observed for L. lundbergii. Kendrick (1964a) suggested that S. venusta was a possible synonym of L. lundbergii, but the condition of the type material was so poor that it was impossible to make a definite conclusion.


*Description:* Paciura et al. (2010a, p. 102, Figs 5a-g).

*Phylogenetic data:* Paciura et al. (2010a); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. In common with L. celere, L. manifestum groups in the L. procerum complex based on rDNA, but in the L. lundbergii complex based on β-tubulin and EF-1α sequences (Paciura et al. 2010a, Linnakoski et al. 2012, De Beer & Wingfield 2013).


*Description:* Davidson (1935, pp 804–805, Figs 4A–C).

Notes: Teleomorph unknown. Jacobs & Wingfield (2001) could not locate any authentic cultures or herbarium specimens for this species, but the name is validly published. Davidson (1935) considered L. microsorum similar to L. penicillatum, but
this comparison should be interpreted with care considering that *L. penicillatum* and *L. lundbergii* were the only two known species at the time. Harrington (1988) suggested that Davidson’s (1935) illustrations and the dimensions of the conidia resembled *L. procurren*. We thus treat the species as possibly distinct within *Leptographium*, but suggest neotypification using isolates from red gum and/or beech in the southern USA (Davidson 1935). The name *L. microsporum* should not be confused with *O. microsporum* (see under *Ophiostoma*) or *Cs. microspora* (see section C.2).


*Description*: Morelet (1998, pp 189–191, Fig. A).

*Phylogenetic data*: Gebhardt et al. (2005); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. *Raffaelea montetyi* is part of the *R. sulphurea* complex in *Leptographium s.l.*, and is not part of *Raffaelea s.str.* (De Beer & Wingfield 2013).


*Phylogenetic data*: Jacobs et al. (2004, 2005, 2006, 2010); Massoumi Alamouti et al. (2006); Zhou et al. (2008); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species groups in the *G. wageneri* complex (Six et al. 2011, Linnakoski et al. 2012, De Beer & Wingfield 2013).


*Anamorph*: leptomorph- to pesotum-like (Davidson 1935, Hunt 1956).

*Description*: Hunt (1956, pp 11, 30).

Notes: Hunt (1956) stated that perithecia formed in the ex-type culture (CBS 125.39) and compared their morphology with those of *G. olivacea*. Wright & Cain (1961) distinguished *L. obscurum* from *G. sagmatospora* based on ascospore size and *G. olivacea* based on ascospore shape. Upadhay (1981) suggested *L. obscurum* might be a synonym of *G. sagmatospora*, but did not find the teleomorph on the type specimen and treated it as a doubtful species. The species seems to be distinct, and clearly does not belong in *Ophiostoma* but in *Leptographium s.l.*, although its exact placement should be clarified by sequencing of the ex-type culture. Following the recommendations for nomenclatural stability explained by De Beer & Wingfield (2013), we propose this new combination.


*Anamorph*: pesotum-like.

*Descriptions*: Mathiesen (1950, p. 298); Hunt (1956, pp 29–30); Griffin (1968, pp 707–708, Fig. 82 Pl. I); Ochowewek & Reid (1974, p. 1699, Pl. XII Fig. 262); Upadhay (1981, p. 52, Figs 116–121); Mouton et al. (1993, pp 376–377, Figs 19–22); Romón et al. (2007).

*Phylogenetic data*: Hauser et al. (1993b, 2000); Masuya et al. (2004); Gebhardt et al. (2005); Greif et al. (2006); Massoumi Alamouti et al. (2006, 2007, 2009); Zipfel et al. (2006); Mullineux & Hausner (2009); Harrington et al. (2010); Matsuda et al. (2010); Paciura et al. (2010a); Mullineux et al. (2011); Six et al. (2011); De Beer et al. (2012); De Beer & Wingfield (2013).


*Anamorph*: pesotum-like.


*Phylogenetic data*: Greif et al. (2006); Harrington et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: This species groups with five other known species to form the *G. olivacea* complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


*Anamorph*: leptomorph-like.


*Phylogenetic data*: Hauser et al. (1993b, 2000, 2005); Okada et al. (1998); Jacobs et al. (2001a, d); Masuya et al. (2004); Gebhardt et al. (2005); Greif et al. (2006); Massoumi Alamouti et al. (2006, 2007, 2009); Zipfel et al. (2006); Mullineux & Hausner (2009); Harrington et al. (2010); Matsuda et al. (2010); Paciura et al. (2010a); Mullineux et al. (2011); Six et al. (2011); De Beer et al. (2011); De Beer & Wingfield (2013).
Notes: *Grosmannia penicillata* is the type species of *Grosmannia*. Solheim (1986) designated a neotype for this species, which forms a well-supported lineage with 17 other species of *Leptographium* s.l., designated as the *G. penicillata* complex (Six et al. 2011, Linnakoski 2012, De Beer & Wingfield 2013).


Notes: Teleomorph unknown. This species was described in *Hyalorhinocladiella*, currently treated as a synonym of *Ceratocystis* (De Beer & Wingfield 2013). It is part of the *L. Lundbergii* complex, and was thus transferred to *Leptographium* by Linnakoski et al. (2012). The name should not be confused with *O. pinicola* or *C. pinicola*.


Descriptions: Masuya et al. (2000, pp 426–429, Figs 1–11); Jacobs & Wingfield (2001, pp 138–140, Figs 109–111); Yamaoka et al. (2007, p. 101, Figs 1–3). Phylogenetic data: Jacobs et al. (2005, 2006); Kim et al. (2005c); Masuya et al. (2005); Massoumi Alamouti et al. (2006); Zhou et al. (2008); Lu et al. (2009a, b); Paciura et al. (2010a, b; Six et al. 2011; Duong et al. 2012; Linnakoski et al. 2012; De Beer & Wingfield 2013).

Notes: Teleomorph unknown. This species is part of the *L. procerum* complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).

**Leptographium piniforme** Greif, Givas & Currah, Mycologia 98: 772. 2006.

Descriptions: Greif et al. (2006, pp 772–775, Figs 1–15); Jankowiak & Kolařík (2010, pp 755–756, Fig. 1). Phylogenetic data: Greif et al. (2006); Jankowiak & Kolařík (2010); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species groups with *G. crassivaginata* in a distinct lineage in *Leptographium* s.l. (De Beer & Wingfield 2013).


Description: Paciura et al. (2010a, p. 104, Figs 6g–l). Phylogenetic data: Paciura et al. (2010a, b); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).


Descriptions: Jacobs et al. (2001c, pp 495–497, Figs 8–14); Jacobs & Wingfield (2001, pp 143–145, Figs 115–117). Phylogenetic data: Jacobs et al. (2001d); Masuya et al. (2004); Massoumi Alamouti et al. (2006); Paciura et al. (2010a, b; Six et al. 2011; Duong et al. 2012; De Beer & Wingfield 2013).

Notes: Teleomorph unknown. This species groups peripherally to the *G. olivacea* complex (Six et al. 2011, Duong et al. 2012, De Beer & Wingfield 2013).

*Description:* Kendrick (1962, pp 783–786, Fig. 5, 9D–G); Wingfield (1993, p. 46, Fig. 4); Jacobs & Wingfield (2001, pp 144–150, Figs 118–120).

*Phylogenetic data:* Jacobs et al. (2001a, d); Kim et al. (2004, 2005a, c, d); Masuya et al. (2004); Hausner et al. (2005); Greif et al. (2006); Massoumi Alamouti et al. (2006); Zhou et al. (2008); Lu et al. (2009a, b); Mullineux & Hausner (2009); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes:* Teleomorph unknown. *Leptographium procerum* groups with eight other species to form the *L. procerus* complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


*Description:* Jacobs et al. (2006, pp 762–763, Figs 2–9).

*Phylogenetic data:* Jacobs et al. (2006); Zhou et al. (2008); Lu et al. (2009a, b); Peciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes:* Teleomorph unknown. This species is part of the *L. procerus* complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


*Phylogenetic data:* Masuya et al. (2004, 2013); Massoumi Alamouti et al. (2006); Matsuda et al. (2010); Duong et al. (2012); De Beer & Wingfield (2013).

*Notes:* Teleomorph unknown. This species, grouping relatively close to *G. grandifoliae* in *Leptographium s.l.* (Massoumi Alamouti et al. 2006, Duong et al. 2012, De Beer & Wingfield 2013), is unique in this genus because it produces a sporothrix-like synanamorph (Masuya et al. 2004).


*Anamorph:* leptomartigium-like (Hausner et al. 1993a).

*Phylogenetic data:* Hausner et al. (1993b, 2000); Masuya et al. (2004); Mullineux & Hausner (2009); Mullineux et al. (2011); De Beer & Wingfield (2013).

*Notes:* This species was considered a synonym of *G. penicillata* (Upadhyay 1981), of *G. europhioides* (Harrington 1988), and of *G. piceiperda* (Jacobs et al. 1998, 2000b, Jacobs & Wingfield 2001). Phylogenetic data of the ex-type isolate by Hausner et al. (1993b, 2000), suggested that *G. pseudoeurophioides* is distinct from all three of the above-mentioned species and placed it in the *G. penicillata* complex (De Beer & Wingfield 2013). Based on the distinct ascospore shape (Olchowecki & Reid 1974), the species does not fit with the *G. penicillata* complex, but rather in the *G. piceiperda* complex. De Beer & Wingfield (2013) recommended reconsideration of the species with fresh material and more sequences.


*Description:* Davidson (1978, p. 39, Figs 1, 2, 8); Jacobs & Wingfield (2001, pp 150–152, Figs 121–123).

*Phylogenetic data:* Jacobs et al. (2001d, 2004, 2005, 2006, 2010); Lee et al. (2003, 2005); Kim et al. (2004, 2005c, d); Lim et al. (2004); Masuya et al. (2004, 2005); Massoumi Alamouti et al. (2006); Zhou et al. (2008); Lu et al. (2009a, b); Paciura et al. (2010a); Roe et al. (2010); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes:* Teleomorph unknown. The taxonomy of this species is confused, as reflected by the conflicting sequences from various studies listed above under ‘Phylogenetic data’. Six et al. (2011) clarified some of the uncertainties and confirmed that *L. pyrinum* is part of the *G. clavigera* complex, but sequences of more genes are needed to conclusively resolve its status.


*Phylogenetic data:* Kim et al. (2009); Seeo et al. (2010); Matsuda et al. (2010); Endoh et al. (2011).

*Notes:* *Raffaelea quercivorata* forms part of the *R. sulphurea* complex in *Leptographium s.l.,* and is not part of *Raffaelea s.str.* (De Beer & Wingfield 2013).


*Description:* Kim et al. (2009, pp 193–195, Fig. 2).

*Phylogenetic data:* Kim et al. (2009); Seeo et al. (2010).

*Notes:* Teleomorph unknown. This species is part of the *R. sulphurea* complex in *Leptographium s.l.,* and is not part of *Raffaelea s.str.* (De Beer & Wingfield 2013).


*Anamorph:* pesotum-like.


*Phylogenetic data:* Masuya et al. (2004); Kim et al. (2005a, d); Thwaites et al. (2005); Zipfel et al. (2006); Lu et al. (2009b); Mullineux & Hausner (2009); Peciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes:* Linnakoski et al. (2012) and De Beer & Wingfield (2013) showed that *G. radiaticola* is part of the *G. galeiformis* complex together with two undescribed species.

Thwaites et al. (2005) treated *G. radiaticola* as synonym of *G. galeiformis* based on ITS sequences, but Kim et al. (2005d) showed with actin and β-tubulin sequences and mating behaviour that the two species are distinct, and that *Hy. pini* is the anamorph of *G. radiaticola.* The name *Hy. pini* should not to be confused with the anamorph of *O. pini,* treated above as a synonym of *O. minus.*
Leptographium reconditum


Phylogenetic data: Jacobs et al. (2001d, 2004, 2005, 2006, 2010); Kim et al. (2004, 2005c, d); Masuya et al. (2004); Massoumi Alamouti et al. (2006); Zhou et al. (2008); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species belongs to the G. wageneri complex (Six et al. 2011, Linnakoski et al. 2012, De Beer & Wingfield 2013).

Grosmannia robusta


Anamorph: leptomorph-like.


Phylogenetic data: Jacobs et al. (2001d, 2004, 2005, 2006, 2010); Lee et al. (2003, 2005); Lim et al. (2004); Kim et al. (2005d); Masuya et al. (2005); Massoumi Alamouti et al. (2008); Zipfel et al. (2006); Zhou et al. (2008); Lu et al. (2009a, b); Matsuda et al. (2010); Paciura et al. (2010a); Roe et al. (2010); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013); Jacobs et al. (2013).

Notes: The taxonomy of this species was confused as a consequence of conflicting sequences from various studies listed above. Six et al. (2011) clarified the uncertainties and confirmed that it forms part of the G. clavigera complex.

Leptographium rostrocylindricum


Anamorph: leptomorph-like.


Notes: In the original description, Davidson (1942) referred to ‘Ceratostomella (Grosmannia) rostrocylindrica’. He recognised Ophiostoma, Grosmannia and Endoconidiophora (= Ceratocystis) as distinct groups, and concluded that, “no doubt the Leptographium forms should also constitute a separate genus, as was concluded by Goidanich”. Despite this comment, Davidson (1942) treated all these species in Ceratostomella. Hunt (1956), Upadhyay (1981) and Harrington (1988) considered C. rostrocylindrica a distinct species, but Jacobs & Wingfield (2001) treated it as doubtful because no type material was designated. Hunt (1956) and Upadhyay (1981) referred to an ex-type culture and lectotype (microscope slides) deposited in BPI, which no longer exist. Zipfel et al. (2006) did not transfer the species to Grosmannia because no DNA sequences or cultures were available. Even in the absence of material, the species is distinct and clearly inappropriately treated in Ophiostoma. Based on descriptions of the leptographium-like anamorph and cucullate ascospores in the protologue and by Upadhyay (1981), as well as Davidson’s (1942) own treatment of this species in the ‘Grosmannia group’, we transfer Cs. rostrocylindrica to Leptographium s.l. in accordance to the recommendations by De Beer & Wingfield (2013). To confirm the precise placement in a species complex within the genus, neotypification would be necessary (Art. 9.7).

Grosmannia sagmatospora


Anamorph: pseustum-like.

Descriptions: Griffin (1968, pp 708, 712–713); Olchowecki & Reid (1974, p. 1701, Pl. XIII Figs 254, 257); Upadhyay (1981, p. 60, Figs 167–171); Seift & Okada (1993, p. 32, Fig. 3E).

Phylogenetic data: Kim et al. (2005d); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: This species groups in the G. olivacea complex (Six et al. 2011, Linnakoski et al. 2012, De Beer & Wingfield 2013). The symnematous anamorph of G. sagmatospora is the type species of Phialographium (Upadhyay & Kendrick 1974), currently treated as a possible synonym of Leptographium s.l.

Grosmannia serpens


Anamorph: leptomorph-like.

Descriptions: Goidanich (1937, pp 253–255, Figs 24–25); Siemasko (1939, p. 34, Pl. V Fig 3 as L. serpens); Hunt (1956, pp 15, 25–26); Kendrick (1962, pp 781–783, Fig. 4, 9H); Kotýnková-Sychrová (1966, pp 47, 52, Fig. 2); Jacobs & Wingfield (2001, pp 157–162, Figs 130–132); Duong et al. (2012, pp 722–723, Fig. 5).

Phylogenetic data: Gebhardt et al. (2004); Jacobs et al. (2004, 2005, 2006, 2010); Kim et al. (2005c, 2011); Zipfel et al. (2006); Massoumi Alamouti (2006, 2009); Zhou et al. (2008); Lu et al. (2009b); Mullineux & Hausner (2009); Harrington et al. (2010); Matsuda et al. (2010); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013); Jacobs et al. (2013).

Notes: See discussion under G. alacris above.


*Phylogenetic data*: De Beer & Wingfield (2013); Linnakoski et al. (2012).

*Notes*: Teleomorph unknown. This species is part of the *L. procerum* complex (Linnakoski et al., 2012, De Beer & Wingfield 2013).

**Leptographium sinoprocerum** O. Lu, Decock & Maraite, In Lu et al., Mycologia 100: 283. 2008.


*Phylogenetic data*: Lu et al. (2008, 2009a, b); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. This species is part of the *L. procerum* complex (Linnakoski et al., 2012, De Beer & Wingfield 2013).


*Phylogenetic data*: Cassar & Blackwell (1996); Rollins et al. (2001); Gebhardt et al. (2005); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. *Raffaelea sulphurea* forms a monophyletic lineage in *Leptographium s.l.* with four other *Raffaelea* spp., and thus is not part of *Raffaelea s.str.* (De Beer & Wingfield 2013).


*Description*: Linnakoski et al. (2012, pp 387–388, Fig. 7).

*Phylogenetic data*: Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. This species does not group near any other *Leptographium* species, but is part of *Leptographium s.l.* (Linnakoski et al., 2012, De Beer & Wingfield 2013).


*Phylogenetic data*: Jacobs et al. (2001d, 2004); Lee et al. (2003, 2005); Six et al. (2003, 2011); Kim et al. (2004, 2005c, d); Lim et al. (2004); Masuzya et al. (2005, 2004); Hausner et al. (2005); Greif et al. (2006); Massoumi Alamouti et al. (2006, 2009); Zhou et al. (2008); Lu et al. (2008, 2009a, b); Mullineux & Hausner (2009); Paciura et al. (2010a); Roe et al. (2010); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).


**Leptographium tereforme** S. Kim & T.C. Harr., In Kim et al., Mycologia 103: 156. 2011.

*Description*: Kim et al. (2011, pp 155–158, Fig. 1).

*Phylogenetic data*: Kim et al. (2011); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. Kim et al. (2011) based the description of this species on a single ITS sequence without any phylogenetic analyses. De Beer & Wingfield (2013) showed that this sequence groups in the *G. clavigera* complex (Kim et al. 2011, De Beer & Wingfield 2013), but sequences of more genes are needed to confirm its status as a distinct species.


*Descriptions*: Wingfield & Marasas (1983, pp 232–235, Figs 1–18); Wingfield (1993, p. 46, Fig. 1); Jacobs et al. (2005, pp 1155–1156, Figs 14–18).

*Phylogenetic data*: Hausner et al. (2005); Jacobs et al. (2005, 2006, 2010); Masuzya et al. (2005); Zipfel et al. (2006); Zhou et al. (2008); Lu et al. (2009a, b); Mullineux & Hausner (2009); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

*Notes*: Teleomorph unknown. Jacobs & Wingfield (2001) treated *L. truncatum* as synonym of *L. lundbergii*, but Jacobs et al. (2005) showed that the two species are distinct. Nevertheless, *L. truncatum* is part of the *L. lundbergii* complex (Linnakoski et al., 2012, De Beer & Wingfield 2013).


*Anamorph*: pesotum-like.

*Descriptions*: Davidson (1955, pp 62–63, Fig. 2); Griffin (1968, pp 710, 713; Fig. 89 Pl. III).

*Notes*: Upadhyay (1981) and Seifert et al. (1993) listed *O. truncicolor* as a synonym of *O. penicillatum*. The species was not included under *O. penicillatum* in the monograph of *Leptographium* (Jacobs & Wingfield 2001), because it has a synnematous anamorph, which distinguishes it from *O. penicillatum*. However, based on the morphology of the sheathed, cucullate ascospores, Griffin (1968) treated this species in the *G. penicillata* complex (as *C. penicillata*). The cleistothecial ascomata resemble those of *G. aurea*, *G. clavigera*, and *G. yunnanensis*, and several Grosmannia species (e.g. *G. canii*, *G. galeiformis*, *G. cucullata*, etc.) also produce synnematous anamorphs. The species is distinct and clearly does not belong in *Ophiostoma* s.l.; even in the absence of DNA sequences, these morphological characters clearly support the placement of this species in *Leptographium s.l.* following the recommendations of De Beer & Wingfield (2013).

Description: Liou et al. (1999, pp 243–246, Figs 1–10).

Phylogenetic data: Wang et al. (2008); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. Although there are similarities between the morphology of Esteya and Leptographium, the nematophagous ecology of this species and morphology of its infectious conidia are very different from other species of Leptographium s.l. It is clear that this species belong in the Ophiostomatales and groups in Leptographium s.l., but its generic placement and thus the status of the genus Esteya remains unresolved (De Beer & Wingfield 2013).


Anamorph: hyalorhinocladiella-like.

Description: Gebhardt et al. (2002, pp 378–381, Figs 1–9).


Notes: Based on LSU sequences, this species can be placed in Leptographium s.l., but not in any particular species complex (De Beer & Wingfield 2013). Its treatment in Leptographium rather than Grosmannia is based on the recommendations of De Beer & Wingfield (2013).


Anamorph: pesutom-like.

Descriptions: Davidson (1958, p. 666); de Hoog & Scheffer (1984, p. 295, Fig. 2); Samuels (1993, p. 16, Figs 1C–F).

Phylogenetic data: Hausner et al. (1992b, 1993a, 2000); Masuya et al. (2004); De Beer & Wingfield (2013).

Notes: Grosmannia vesca was treated as a synonym of G. olivacea (Griffin 1968, Olchowecki & Reid 1974, Upadhyay 1981), but is now considered distinct (Hausner et al. 1992a, 2000). De Beer & Wingfield (2013) confirmed its placement in the G. olivacea complex.


Anamorph: leptographium-like.


Phylogenetic data: Jacobs et al. (2001d); Masuya et al. (2004); Greif et al. (2006); Massoumi Alamouti et al. (2006); Zipfel et al. (2006); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph structures for G. wageneri were observed only once, associated with L. wageneri var. ponderosae (Harrington 1988). Teleomorphs have never been observed for L. wageneri var. wageneri or L. wageneri var. pseudotsugae (Jacobs & Wingfield 2001, Zipfel et al. 2006). Grosmannia wageneri groups with five other species to form the G. wageneri complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


Phylogenetic data: Jacobs et al. (2001d); Kim et al. (2004, 2005c, d); Masuya et al. (2004); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. The taxonomic status of this host-specific variety in the G. wageneri complex should be reconsidered using multigene analyses (Witthuhn et al. 1997, Linnakoski et al. 2012).


Phylogenetic data: Jacobs et al. (2001d); Masuya et al. (2004); Hausner et al. (2005); Zipfel et al. (2006); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. The taxonomic status of this host-specific variety in the G. wageneri complex should be reconsidered using multigene analyses (Witthuhn et al. 1997, Linnakoski et al. 2012).


Phylogenetic data: Jacobs et al. (2001d, 2004, 2005, 2006, 2010); Kim et al. (2004, 2005c); Masuya et al. (2004, 2005); Hausner et al. (2005); Greif et al. (2006); Massoumi Alamouti et al. (2006); Zhou et al. (2008); Lu et al. (2009a, b); Mullineux & Hausner (2009); Paciura et al. (2010a); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the G. clavigera complex (Six et al. 2011, De Beer & Wingfield 2013).


Description: Duong et al. (2012, pp 725–726, Fig. 8).

Phylogenetic data: Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species is part of the G. serpens complex (Duong et al. 2012, De Beer & Wingfield 2013).

Anamorph: leptographium-like.


Phylogenetic data: Jacobs et al. (2004, 2005, 2006, 2010); Kim et al. (2005c); Masuya et al. (2005, 2013); Massoumi Alamouti et al. (2006); Zipfel et al. (2006); Zhou et al. (2008); Lu et al. (2009a, b); Paciura et al. (2010a); Roe et al. (2010); Six et al. (2011); Duong et al. (2012); Linnakoski et al. (2012); De Beer & Wingfield (2013); Jacobs et al. (2013).

Notes: This species groups in the L. lundbergii complex (Linnakoski et al. 2012, De Beer & Wingfield 2013).


Notes: We accept the emended description for Raffaelea by Harrington et al. (2008), De Beer & Wingfield (2013) showed that some species included in Raffaelea by Harrington et al. (2008, 2010) group in the R. lauricola and R. sulphurea complexes. Those species are excluded from Raffaelea s.str here and are listed under Ophiostoma s.l and Leptographium s.l respectively. One of the species in the R. sulphurea complex (Leptographium s.l) is R. amasae, the type species of Dryadomyces. Dryadomyces is thus not a synonym of Raffaelea as suggested by Harrington et al. (2008, 2010). At present no teleomorphs are known for any species of Raffaelea.


Description: Scott & Du Toit (1970, pp 181–182, Fig. 1, Pl. 20).

Phylogenetic data: Jones & Blackwell (1998); Gebhardt et al. (2005); Kim et al. (2009); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


Descriptions: Von Arb & Hennebert (1965, pp 310–312, Fig. 1); Batra (1967, pp 1011–1013, Figs 35–39).

Phylogenetic data: Jones & Blackwell (1998); Gebhardt et al. (2005); Kim et al. (2009); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


Description: Scott & Du Toit (1970, pp 184–185, Fig. 3, Pl. 20).

Phylogenetic data: Jones & Blackwell (1998); Kim et al. (2009); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


Description: Funk (1965, pp 1445–1447, Figs 1, 3–5, 11, 12).

Phylogenetic data: Cassar & Blackwell (1996); Jones & Blackwell (1998); Rollins et al. (2001); Gebhardt et al. (2005); Kim et al. (2009); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: Batra (1967) transferred Tu. ambrosiae to Raffaelea but because the name R. ambrosiae Arb & Hennebert already existed, he used a new epithet ‘canadensis.’ Harrington et al. (2010) suggested that A. sulcata is a synonym of R. canadensis. This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


Description: Harrington et al. (2010, pp 347–348, Figs 3C, 4C, D).


Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


Description: Harrington et al. (2010, pp 347, 349, Figs 3D, 4E, F).


Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


Description: Batra (1967, pp 986–990, Figs 4, 5, 8, 9).

Phylogenetic data: Cassar & Blackwell (1996); Rollins et al. (2001); Gebhardt et al. (2005); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


Description: Guerrero (1966, pp 100–102, Figs 1–2).

Phylogenetic data: Jones & Blackwell (1998); Gebhardt et al. (2005); Kim et al. (2009); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: Sutton (1975) did not consider this species appropriately classified in Raffaelea, but suggested an affinity with Sporothrix based on its catenate conidia. Jones & Blackwell (1998) confirmed that it grouped with other Raffaelea spp. in the Ophiostomatales, and De Beer & Wingfield (2013) showed it is part of Raffaelea s.str.


**Phylogenetic data:** Kolařík & Hulcr (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


**Description:** Harrington et al. (2010, pp 346–348, Figs 3B, 4A, B).

**Phylogenetic data:** Harrington et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


**Description:** Harrington et al. (2010, pp 347–350, Figs 3E, 4G, H).

**Phylogenetic data:** Harrington et al. (2010, 2011); De Beer & Wingfield (2013).

Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).


**Description:** Funk (1970, 1447, Figs 2, 6–9, 13, 14).

**Phylogenetic data:** Jones & Blackwell (1998); Gebhardt et al. (2005); Kim et al. (2009); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013). The name R. sulcata should not be confused with A. sulcata, a synonym of R. canadensis (see above).


**Description:** Batra (1967, pp 1013–1014, Fig. 6).

**Phylogenetic data:** Jones & Blackwell (1998); Kim et al. (2009); Massoumi Alamouti et al. (2009); Harrington et al. (2010); Matsuda et al. (2010); De Beer & Wingfield (2013).

Notes: This species is part of Raffaelea s.str. (De Beer & Wingfield 2013).

**A.2. SPECIES OF UNCERTAIN STATUS (OPIHOSTOMATALES)**


Anamorph: unknown.


Notes: Treated in the Firnbiata Group by Olchowecki & Reid (1974) and Section Ceratocystis by Upadhyay (1981), both of which included mixtures of what we now consider Ceratocystis and Leptographium s.l. species. The morphology of the perithecia and sheathed, orange section shaped ascospores resemble those of some Ophiostoma and Grosnannia species, rather than Ceratocystis. However, the absence of a known anamorph and DNA sequences leaves the correct systematic position of this species uncertain.


Anamorph: pesotum-like (Moreau 1952).


Notes: Material of this species could not be obtained by Hunt (1956). Dr Vadim A. Mel’nik (Komarov Botanical Institute, St. Petersburg, in litt. to WDB) confirmed that no material of the species exists in Russian collections. From the description it is clearly a good species of Ophiostoma with pesotum-like anamorph and cylindrical ascospores. For an accurate phylogenetic placement, it would be necessary to neotypify and sequence the species (Art. 9.7).


Notes: The sheathed ascospores suggest that this species probably belongs to Leptographium s.l., but DNA sequences are needed for an accurate placement.


Description: Upadhyay (1981, p. 120, Figs 428–431).

**Phylogenetic data:** Hausner et al. (1993a).

Notes: Ceratocystiopsis alba seems to be phylogenetically distantly related to genera in the Ophiostomatales (Hausner et al. 1993a). The LSU sequence BLASTs closest to G. abicarpa and other Grosnannia spp., but with less than 55 % similarity. The SSU (V9 region) BLASTs show similarities with any ophiostomatalean fungus, and 97 % similarity with Tricladium and Cladosporium spp. We prefer to treat the species as uncertain until additional sequence data become available. The name should not be confused with Gr. album or S. alba.


Description: de Hoog (1974, pp 22–23, Fig. 7).

Notes: Teleomorph unknown. No culture is available for this species. The type specimen, found growing on a Cordyceps fruiting body on an insect (de Hoog 1974), should be re-investigated carefully and compared with Beauveria and similar entomopathogenic species to confirm its generic placement. The name should not be confused with Gr. album or Cop. alba.


Anamorph: leptographium-like.
A nomenclator for ophiostomatoid genera and species in the Ophiostomatales and Microascales


Phylogenetic data: Hausner et al. (2000); Jacobs et al. (2001d); Masuya et al. (2004); Massouni Alamouti et al. (2006); Mullineux & Hausner (2009).

Notes: See the discussion of the contradictory generic placements for O. brevicolle based on sequence data by De Beer & Wingfield (2013, as Species 3). Further study is required to establish an accurate generic placement for this species.

Ceratostomella comata V.V. Miller & Cernzow, Sammlung der Arbeiten des Laboratoriums der Erhaltweg des Holzten, Moscow, p. 120. 1934 ≡ Ceratocystis comata (V.V. Miller & Cernzow) C. Moreau, Rev. Mycol. (Paris) Suppl. Col. 17: 120. 1952.


Notes: Material of this species could not be located by Hunt (1956), but he considered the species to be close to G. olivacea, L. obscurum, and G. leptographioides. Dr Vadim A. Mel’nik (Komarov Botanical Institute, St. Petersburg, in litt. to WDB) confirmed that no material of this species exists. To make an accurate generic placement, it would be necessary to neotypify and sequence it (Art. 9.7).


Description: de Hoog (1974, pp 32–33, Fig. 13).

Notes: Teleomorph unknown. This species contains rhamnose in its cell walls, suggesting a classification in the Ophiostomatales (Weijman & de Hoog 1975, 1985), but its generic position needs to be ascertained with DNA sequences.


Notes: Although this species is validly described, apparently no material is available. The fact that no ascii were observed in the original description, and that it was compared with O. piliferum and other species currently treated in Ophiostoma s.str. (Naumov 1920), suggests that it probably is a species of Ophiostoma as circumscribed here. However, the description is rather vague, so we suggest neotypification (Art. 9.7) and sequencing prior to making a new combination. This is the only Ophiostomatalean species with a reported coelomyelous anamorph, classified in Sphaeroagraphium. Verkley (2002) did not examine the type, but excluded the species in his revision of Sphaeroagraphium, an anamorph genus that seems to be associated with the Dematicaceae, Helotiales based on rDNA sequences in GenBank.


Anamorph: hyalorhinocladiella-like.


Phylogenetic data: Hausner et al. (1993b); Mullineux & Hausner (2009).

Notes: A short LSU sequence of Hausner et al. (1993b), retyped from their publication but not deposited in GenBank, places this species in Raffaelea s.str. (De Beer & Wingfield 2013), together with the morphologically similar O. seticolle. Similarly, an ITS sequence of O. deltoideosporum produced by Mullineux & Hausner (2009) is placed in a lineage with R. canadensis, the only species of Raffaelea s.str. for which ITS sequence data is currently available (De Beer & Wingfield 2013). Together with O. seticolle, the generic placement of this species needs to be explored further with more extensive sequencing of more strains.


Description: de Hoog (1974, pp 30–31, Fig. 12).

Notes: Teleomorph unknown. The origin of the type culture, recorded as isolated by the multinational company Unilever, is unknown, but the illustrations of the conidiogenous cells of this species by de Hoog (1974) suggest some deviation from the typical morphology for true Sporothrix spp. If the culture is still viable, DNA sequences should be determined for it to confirm its generic placement.


Anamorph: sporothrix-like.

Phylogenetic data: Villarreal et al. (2005); De Beer & Wingfield (2013).

Notes: Although Kowalski & Butin (1989) reported two synanamorphs in their cultures of this species, these appear to represent the noncatenate and catenate forms of a sporothrix-like anamorph (Seifert et al. 1993). Based on ITS sequences, this species forms a distinct lineage of uncertain generic affiliation in the Ophiostomatales, but the sequences do not represent the type (De Beer & Wingfield 2013).


Phylogenetic data: Jones & Blackwell (1998); Kim et al. (2009).

Notes: Teleomorph unknown. Jones & Blackwell (1998) found that the SSU sequence of the ex-type isolate of R. hennebertii (CBS 272.70) grouped close to Melanospora (Melanosporales), and although the colony morphology corresponded with the original description, the culture did not sporulate. Presently, the isolate is not listed in the CBS database. If the culture no longer exists, neotypification (Art. 9.7) would be necessary to resolve the generic classification of the species.


Description: de Hoog (1974, pp 27–28, Fig. 10).

Notes: Teleomorph unknown. This species was isolated from spider eggs. As with the other reportedly entomopathogenic Sporothrix spp., it should be re-investigated carefully and compared with Beauveria and similar entomopathogenic species to confirm its generic placement.

Ceratostomella imperfecta V.V. Miller & Cernzow, Sammlung der Arbeiten des Laboratoriums der Erhaltweg

Anamorph: leptographium-like (Hunt 1956).


Notes: Material of this species could not be obtained by Hunt (1956), but based on the protologue, he suggested that it could be a synonym of G. penicillata. Kendrick (1962), Upadhyay (1981) and Harrington (1988) also listed C. imperfecta as synonym of G. penicillata, apparently based on Hunt’s suggestion. The species was not mentioned by Jacobs & Wingfield (2001). Dr Vadim A. Mel'nik (Komarov Botanical Institue, St. Petersburg, in litt. to WDB) confirmed that no material of this species exists in Russian collections. To make a new combination, it would be necessary to neotypify (Art. 9.7) and sequence the species.


Description: de Hoog (1974, pp 25–26, Fig. 9).

Notes: Teleomorph unknown. This species was isolated from insects. As with the other seemingly entomopathogenic Sporothrix spp., it should be re-investigated and compared with Beauveria and other entomopathogenic species to determine its generic classification.


Description: de Hoog (1974, pp 23–25, Fig. 8).

Notes: Teleomorph unknown. No culture is available for this species. It was found growing on a Cordyceps fructing body growing on an insect (de Hoog 1974). De Hoog (1974) designated a lectotype and suggested some synonyms not listed here. The lectotype should be re-investigated carefully and compared with Beauveria and other entomopathogenic genera to confirm its classification.


Description: De Meyer et al. (2008, p. 657, Figs 4g-i).

Phylogenetic data: De Meyer et al. (2008); De Beer & Wingfield (2013).

Notes: Teleomorph unknown. This species groups in a lineage with some undescribed taxa, distinct from Ophiostoma s.l. and was considered incertae sedis in the Ophiostomatina by De Beer & Wingfield (2013).


Anamorph: unknown.


Notes: This species was treated in the Fimbriata Group by Olchowecki & Reid (1974) and Section Ceratocystis by Upadhyay (1981), both of which included Ceratocystis and Leptographium s.l. species. The ascospore shape resembles that of O. stenoceras, although they are somewhat smaller in size, suggesting that this might be a species of Ophiostoma, rather than a species of Grosmannia or Ceratocystis. The absence of a known anamorph and the lack of cultures leave the generic classification of this species in question.


Description: de Hoog (1974, pp 28–30, Fig. 11).

Notes: Teleomorph unknown. This species was isolated from moist wood and differs morphologically from other Sporothrix spp. by branched conidiogenous cells (de Hoog 1974). Only herbarium material exists for this species, which requires more study to confirm its generic placement.


Synanamorphs: sporothrix-like and a sporodochial anamorph with septate macroconidia.

Phylogenetic data: Hausner et al. (1993b).

Notes: The ex-type isolate of O. roraimense (CBS 351.78) does not belong to either the Ophiostomatinales or Microascinales based on LSU and SSU data (Hausner et al. 1993b). When the short LSU sequence published for the ex-type isolate (CBS 351.78) was retyped from Hausner et al. (1993b, unavailable in GenBank), it BLASTed with high similarity to several Pseudozyma isolates (Ustilaginales) in GenBank. Furthermore, the sporodochia with septate macroconidia found on the ascomatal wall (Samuels & Müller, 1978) set this species apart from all known Ophiostoma species. Until a re-examination of the holotype and/or ex-type culture proves otherwise, we consider the status of this species uncertain.


Anamorph: hyalorhinocladiella-like.


Phylogenetic data: Hausner & Reid (2003); Jacobs et al. (2003c).

Notes: The contradictory DNA sequences for this species are discussed as Species 1 by De Beer & Wingfield (2013).


Description: Deighton & Piroznyski (1972, pp 100–101, Fig. 52); de Hoog (1974, p. 32).

Notes: Teleomorph unknown. No culture exists for this species, which was found growing a Meliola fructing body (de Hoog 1974). Its type should be compared to other fungicolous Sporothrix spp.


Anamorph: pesotum-like.

Description: Jacobs et al. (1997a, pp 333–337, Figs 1–14).

Notes: The hat-shaped ascospores suggest that this species belongs in Leptographium or Grosmannia. DNA sequences are needed for an accurate generic placement.

Anamorph: unknown.

Description: Neither Griffin (1968) nor Upadhyay (1981) described an anamorph for this species. However, in Fig. 215 (Upadhyay, 1981), a structure resembling a sporothrix-like anamorph with conidia is clearly visible at the apex of a perithecial neck from the type. Griffin (1968) mentioned that the sheathed ascospores resemble those of O. minus. It thus seems likely that this species belongs in either Ophiostoma or Leptographium s.l., but the type should be re-investigated for confirmation.


Phylogenetic data: Hausner et al. (1992b, 2000); Jacobs et al. (2001d); Masuya et al. (2004); Massoumi Alamoui et al. (2006); De Beer et al. (2013); De Beer & Wingfield (2013).

Notes: The discrepancies between sequences for this species in the studies of Hausner et al. (1992b, 2000) and Jacobs et al. (2001d), are discussed in detail by De Beer & Wingfield (2013, as Species 2), who concluded that the generic placement of the species remains uncertain. Because O. trinacriforme is the type species of Europhium (Parker 1957), these ambiguous results confound a final decision of a synonymy of this genus with either Ophiostoma or Leptographium.


Synanamorphs: leptographium- and sporothrix-like.

Notes: Jacobs & Wingfield (2001) considered this a dubious species because no type material or cultures were available. However, an ex-type culture exists (CBS 454.83), and the type was deposited in ZT. The species is probably distinct, but its generic placement should be reconsidered, because it may belong to Leptographium s.l.

Raffaelea variabilis B. Sutton, Antonie van Leeuwenhoek 41: 179. 1975.

Description: Sutton (1975, pp 179–181, Fig. 1).

Notes: Teleomorph unknown. This species was isolated from Lannea grandis (Anacardiaceae), with no reported beetle association (Sutton 1975). Jones & Blackwell (1998) reported that a SSU sequence supported the classification of this species with other Raffaelea spp. in the Ophiostomatidae. However, the sequence is not in GenBank, and we could not confirm the placement of this species in the Ophiostomatidae.

A.3. INVALIDLY PUBLISHED SPECIES (OPHIOSTOMATALES)


Anamorph: hyalorhinocladiella-like.


Anamorph: leptographium-like.


Notes: De Ana Magán (1982, 1983) described both a teleomorph and anamorph for L. galleciae, but because they could not induce a teleomorph in cultures, they described the new species in Leptographium. Jacobs & Wingfield (2001) suggested a synonymy of L. galleciae with L. serpens. However, Duong et al. (2012) concluded that the descriptions of De Ana Magán (1982, 1983) overlap significantly with the two species of the G. serpens complex known from Spain, G. alacris and L. castellanum; small differences make it impossible to synonymize L. galleciae conclusively with either. The name can be validated by precise typification.


Notes: Przybyl & de Hoog (1989) considered this species a possible synonym of O. piceae, and Harrington et al. (2001) of O. quercus, but neither examined authentic material. A culture representing O. kubanicum (VKM-F 3181) was a Fusarium species (De Beer, unpublished data). Since no other authentic material is available, validation of the species is presently not possible (Grobelaar et al. 2009).


Notes: Upadhyay (1981) rejected the name because of a lack of ascocarp material, a distinction that is no longer critical as we move away from dual nomenclature. However, Harrington & Zambino (1990) also treated it as a nomen dubium and showed that the only existing culture from the original study represented Cop. ranaculosa.


Anamorph: Description and figures in protologue not clear.

Notes: The name should not be confused with L. pinicola or C. pinicola.

Notes: This species was isolated from the bark beetle Dendroctonus armandi on Pinus armandi in China, and its validation should be considered if similar material is obtained from the same vector and host.

B.1. ACCEPTED OPHIOSTATOID GENERA AND SPECIES IN THE MICROSCALEs

Only genera of the three families in the Microscales that contain ophiostomatoid species, namely Ceratocystidaceae, Graphiaceae and Gondwanamycetaceae (De Beer et al. 2013), are listed here.

Ceratocystis Ellis & Halst., In Halsted, Bull. N.J. Agric. Sta. 76: 14. 1890 [type species C. fimbriata]

Phylogenetic data: De Beer et al. (2013a).

Notes: This species includes several distinct phylogenetic lineages. Three are well defined and are exemplified by C. fimbriata, C. coerulescens and C. moniliformis (Harrington 2009, B. Wingfield et al. 2013). These lineages are in the process of being accorded generic status (B. Wingfield et al. 2013). This means that species in the C. coerulescens and C. moniliformis complexes that are now accommodated in Ceratocystis s.l. will soon be transferred to new or resurrected genera. All species in the C. fimbriata complex will remain in Ceratocystis because the genus is typified by C. fimbriata sensu stricto. In the current phylogenies some Ceratocystis species (e.g. C. adiposa, C. fagacearum, C. paradoxa, and C. radicicola) group beyond the three well-resolved complexes (B. Wingfield et al. 2013). These would probably be accommodated in Ceratocystis until more data becomes available to resolve their positions.

For a long time, anamorphs of Ceratocystis were treated as Chalara (Siemaszko 1939, Nag Raj & Kendrick 1975, Upadhyay 1981), until it was shown that the type species of Chalara is actually related to the Helotiales (Paulin & Harrington 2000, Gemandt et al. 2001). Paulin-Mahady et al. (2002) amended Thielaviopsis to include all chalara-like species with affinities to Ceratocystis. They also suggested Chalaropsis and Hughesiella be treated as synonyms of Thielaviopsis. However, species currently treated in Thielaviopsis do not form a monophyletic group in Ceratocystis s.l. and it is unclear whether this name will be adopted in a single name nomenclature in this family (Harrington 2009, B. Wingfield et al. 2013).

Bakshi (1951) suggested that Rostrella coffeae is synonymous with C. fimbriata, a treatment that has become widely accepted, together with the resulting synonymy of Rostrella with Ceratocystis.

Bakshi (1951) treated Endoconiidiophora as synonym of Ceratocystis, which was widely accepted. The name Endoconiidiophora could be re-instated to accommodate species in the C. coerulescens complex.

The anamorphic ambrosial genus Ambrosiella is phylogenetically placed within Ceratocystis s.l. and in common with Thielaviopsis, species classified in this genus do not form a monophyletic group (Massoumi Alamouti et al. 2009, Six et al. 2009, Harrington et al. 2010, De Beer et al. 2013). The type species for Phialophoropsis was transferred to Ambrosiella by Harrington et al. (2010), implying that this genus should be treated as synonym of Ambrosiella (Seifert et al. 2011).

Upadhyay (1981) designated formal taxonomic sections within Ceratocystis. Although most of the species he included in section Ceratocystis are currently treated in Leptographium s.l., three of the species, including C. fimbriata, are species of Ceratocystis s.l. All the taxa included in his section Endoconiidiophora are here included in Ceratocystis s.l. apart from one species of uncertain status, C. stenospora.

The name of the fungal genus Ceratocystis should not be confused with Ceratostigma Jaekel, a genus of echinoderm fossils (this chapter Table 1; De Beer et al. 2013).


Anamorph: thielaviopsis-like.

Phylogenetic data: Tarigan et al. (2011); Van Wyk et al. (2011a); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the C. fimbriata species complex (B. Wingfield et al. 2013).


Anamorph: thielaviopsis-like.

Descriptions: Sartoris (1927, pp 578–585, Figs 1–4); Davidson (1935, pp 801–802); Hunt (1956, pp 10–13); Upadhyay (1981, p. 35, Figs 26–30); Moreau (1952, pp 17–20, Fig. 1); Nag Raj & Kendrick (1975, p.104, 140, Fig. 37).

Phylogenetic data: Hauser et al. (1993c); Witthuhn et al. (1999); Roux et al. (2000); Baker et al. (2003); Loppnau & Breuil
A nomenclator for ophiostomatoid genera and species in the Ophiostomatales and Microascales

(2003); Johnson et al. (2005); Thorpe et al. (2005); Harrington (2009); Kolářík & Hulcr (2009); Massoumi Alamouti et al. (2009); Six et al. (2009); Sakayaroj et al. (2011).

Notes: Ceratocystis adiposa groups outside of the three major species complexes defined in Ceratocystis (Harrington 2009, B. Wingfield et al. 2013). Hunt (1956), Moreau (1952), Griffin (1968), Olchowiecki & Reid (1974), and Nag Raj & Kendrick (1975), all treated C. major and C. adiposa as distinct. The synonymy of C. major with C. adiposa was suggested by Upadhyay (1981). Identical SSU sequences for the two species (Hausner et al. 1993c) suggest that the synonymy is sound, although sequencing of more variable regions would be advisable to confirm this.


Anamorph: thieliaviopsis-like.

Phylogenetic data: Wingfield et al. (1996); Witthuhn et al. (1999); Roux et al. (2000, 2004); Barnes et al. (2003a, b); Van Wyk et al. (2004a, 2007a, b, 2009a, b, 2010, 2011a, b); Kamgan Nkuekam et al. (2008a, 2011); Rodas et al. (2008); Harrington (2009); Heath et al. (2009); Six et al. (2009); Tarigan et al. (2011).

Notes: This species is a member of the *C. fimbriata* species complex and was the first to be recognized as a discrete taxon in the group (Harrington 2009, B. Wingfield et al. 2013).

**Ceratocystis atrox** M. van Wyk & M.J. Wingf., In Van Wyk et al., Australasian Plant Pathol. 36: 411. 2007.

Anamorph: thieliaviopsis-like.

Phylogenetic data: Van Wyk et al. (2007a, b, 2009a, b, 2010, 2011a, b); Rodas et al. (2008); Heath et al. (2009); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the *C. fimbriata* species complex (B. Wingfield et al. 2013).


Anamorph: thieliaviopsis-like.

Description: Kile & Walker (1987, pp 7–14, Figs 4–11).

Phylogenetic data: Paulin-Mahady et al. (2002); Harrington (2009); Six et al. (2009); B. Wingfield et al. (2013).

Notes: Teleomorph unknown. This species groups in the *C. coerulescens* complex (Harrington 2009, B. Wingfield et al. 2013).


Anamorph: thieliaviopsis-like.


Phylogenetic data: Paulin-Mahady et al. (2002); Harrington (2009); Heath et al. (2009); Six et al. (2009); B. Wingfield et al. (2013).

Notes: Teleomorph unknown. This species groups with *T. thielavioides* in a clade that is distinct from the major lineages of Ceratocystis (Harrington 2009, B. Wingfield et al. 2013).
Phylogenetic data: Hausner et al. (1993c); Witthuhn et al. (1998, 2000); Roux et al. (2000); Paulin-Mahady et al. (2002); Barnes et al. (2003a, b); Loppnau & Breuil (2003); Harrington (2009); Kolafik & Hulcr (2009); Massoumi Alamouti et al. (2009); Six et al. (2009); B. Wingfield et al. (2013).

Notes: Harrington & Wingfield (1998) designated a neotype for C. coerulescens, while Nag Raj & Kendrick (1975) did the same for Ca. ungeri. Nag Raj & Kendrick (1975) accepted the suggestion by Münch (1907) that Ca. ungeri represented the anamorph of C. coerulescens. Witthuhn et al. (1998) showed that isolates identified as C. coerulescens formed three distinct clades based on ITS data. These were later described as C. coerulescens sensu stricto, C. pinicola, and C. resinifera (Harrington & Wingfield 1998). Ceratocystis coerulescens is the type species of Endoconiophora and exemplifies the C. coerulescens species complex, for which the name Endoconiophora will probably be re-instated (Harrington 2009, B. Wingfield et al. 2013).

Anamorph: thieliaviosis-like.
Phylogenetic data: Van Wyk et al. (2010, 2011a, b); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).
Notes: This species is a member of the C. fimbríata species complex (B. Wingfield et al. 2013).

Anamorph: thieliaviosis-like.
Phylogenetic data: Kamgan Nkuekam et al. (2012b).
Notes: This species is a member of the C. fimbríata species complex (Kamgan Nkuekam et al. 2012b).

Anamorph: thieliaviosis-like.
Phylogenetic data: Van Wyk et al. (2011a, b).
Notes: This species is a member of the C. fimbríata species complex (Van Wyk et al. 2011b).

Anamorph: thieliaviosis-like.
Phylogenetic data: Van Wyk et al. (2011a, b).
Notes: This species is a member of the C. fimbríata species complex (Van Wyk et al. 2011b).

Anamorph: thieliaviosis-like.
Phylogenetic data: Witthuhn et al. (1998, 2000); Barnes et al. (2003a); Loppnau & Breuil (2003); Harrington (2009); Kolafik & Hulcr (2009); Six et al. (2009).
Notes: Endoconiophora coerulescens f. douglasi was considered a synonym of C. coerulescens by Upadhyay (1981). Wingfield et al. (1997) showed C. douglasi is distinct and elevated it to species level. It is now considered as a member of the C. coerulescens species complex (Harrington 2009, B. Wingfield et al. 2013). The name should not be confused with Leptographium douglasi.

Anamorph: thieliaviosis-like.
Phylogenetic data: Van Wyk et al. (2011a, b).
Notes: This species is a member of the C. fimbríata species complex (Van Wyk et al. 2011b).

Anamorph: thieliaviosis-like.
Notes: The morphology described in the protologue suggests that this species might be a member of the C. coerulescens complex.

Anamorph: thieliaviosis-like.
Description: Kile et al. (1996, pp 573–575, Figs 1–8).
Phylogenetic data: Witthuhn et al. (1998, 2000); Roux et al. (2000); Barnes et al. (2003a, b); Paulin-Mahady et al. (2002); Harrington (2009); Six et al. (2009); B. Wingfield et al. (2013).
Notes: This is a member of the C. coerulescens species complex (Harrington 2009, B. Wingfield et al. 2013).

Phylogenetic data: Paulin-Mahady et al. (2002); Harrington (2009); B. Wingfield et al. (2013).
Notes: Teleomorph unknown. This species is the type species of the genus Hughesiella and groups in the C. paradoxo complex (Harrington 2009).

Anamorph: thieliaviosis-like.
Descriptions: Hunt (1956, p. 21); Nag Raj & Kendrick (1975, pp 94, 131, Fig. 32A); Upadhyay (1981, p. 66); Potlajczuk & Schechkunova (1985, p. 150); Kolafik & Hulcr (2009).
Phylogenetic data: Hausner et al. (1993c); Witthuhn et al. (1999); Roux et al. (2000); Paulin-Mahady et al. (2002); Barnes et al. (2003b); Masuya et al. (2004); Jensen-Tracy et al. (2009); Harrington (2009); Six et al. (2009); B. Wingfield et al. (2013).
Notes: Ceratocystis fagacearum groups outside the three major species complexes defined by B. Wingfield et al. (2013), but close to A. ferruginea (Harrington 2009, Six et al. 2009).

A nomenclator for ophiostomatoid genera and species in the Ophiostomatales and Microascales

43: 57. 1953 [nom. illegit., Art. 53.1, non M. ferruginea Pers. 1822]


Phylogenetic data: Cassar & Blackwell (1996); Rollins et al. (2001); Paulin-Mahady et al. (2002); Gebhardt et al. (2005); Harrington (2009); Massoumi Alamouti et al. (2009); Six et al. (2009); Matsuda et al. (2010).

Notes: Teleomorph unknown. This species does not group in the same lineage as A. xylebori and its relatives in Ceratocystis s.l., and also has a different β-tubulin intron arrangement than these species (Massoumi Alamouti et al. 2009, Six et al. 2009).

Ceratocystis fimbriata


Anamorph: thielaviopsis-like.

Phylogenetic data: Kajitani & Masuya (2011).

Notes: This is a member of the C. fimbriata species complex (Kajitani & Masuya 2011).

Ceratocystis fimbriata


Anamorph: thielaviopsis-like.

Descriptions: Davidson (1935, pp 799–800); Hunt (1956, pp 11–16); Webster & Butler (1967, pp 1459–1463, Pl. I–VI); Griffin (1968, p. 703); Morgan-Jones (1967a, Figs A–G); Ochowiacki & Reid (1974, p. 1699, Pl. XIII Fig. 258); Matsushima (1975, p. 169, Pl. 382, 383); Nag Raj & Kendrick (1975, pp 118, 141, Fig. 45); Upadhyay (1981, p. 44, Figs 69–72); Potlajczuk & Schekunova (1985, p. 150); Engelbrecht & Harrington (2005, pp 63–64).

Phylogenetic data: Hausern et al. (1992a, 1992b, c),; Wingfield et al. (1996); Witthuhn et al. (1998, 1999, 2000); Rěbolová & Winka (2000); Roux et al. (2000, 2004); Baker et al. (2003); Barnes et al. (2003a, b), Marin et al. (2003); Hauser & Reid (2004); Van Wyk et al. (2004a, 2005, 2007a, b, 2009a, b, 2010, 2011a, b); Johnson et al. (2005); Thorpe et al. (2005); Schoch et al. (2007); Kamgan Nkuekam et al. (2008a, 2011); Rodas et al. (2008); Harrington (2009); Heath et al. (2009); Kolařík & Hulcr (2009); Six et al. (2009); Matsuda et al. (2010); Sakayaroj et al. (2011); Tarigan et al. (2011); B. Wingfield et al. (2013).

Notes: Ceratocystis fimbriata is the type species of the genus, and the nominal species of the C. fimbriata species complex. Pontis (1951) considered Ro. coffeae a synonym of C. fimbriata, although he noted biological differences between the sweet potato and coffee tree isolates. Recent studies distinguished between geographical and host specific populations, including populations from coffee, in the C. fimbriata species complex, based on DNA sequence comparisons for multiple gene regions (Harrington 2000, Barnes et al. 2001, 2003b, Baker et al. 2003, Marin et al. 2003, Engelbrecht et al. 2004, Steimel et al. 2004, Johnson et al. 2005).

Van Wyk et al. (2010) described two of these host specific groups as new species from coffee in Colombia, but did consider the possibility that one of them might represent Ro. coffeae, probably because the latter was originally described from coffee in Java (Indonesia). For the time being, we treat Ro. coffeae as a synonym of C. fimbriata, until future studies with fresh isolates from coffee in Java provide more insight.

Microsatellite markers were developed for the exploration of population diversity within C. fimbriata (Van Wyk et al. 2006b, Rizzato et al. 2010).

Ceratocystis fimbratominima


Anamorph: thielaviopsis-like.

Phylogenetic data: Van Wyk et al. (2009a, 2010, 2011a, b); Tarigan et al. (2012); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the C. fimбриата species complex (B. Wingfield et al. 2013).

Ceratocystis fujienensis


Anamorph: thielaviopsis-like.

Phylogenetic data: Marin et al. (2005); Kolařík & Hulcr (2009).

Notes: Ceratocystis fujienensis is a member of the C. coerulescens species complex (B. Wingfield et al. 2013).

Ceratocystis harringtonii


Anamorph: thielaviopsis-like.

Phylogenetic data: Johnson et al. (2005); Van Wyk et al. (2007a, b, 2009a, b, 2010, 2011b); Rodas et al. (2008); Harrington (2009); Heath et al. (2009); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).

Notes: This species was validly published by Johnson et al. (2005), but the name was a later homonym for Ceratocystis populicola Ochow. & J. Reid (= Ophiostoma populicola) and, therefore, illegitimate. We thus provided it with a new, legitimate name here. It is a member of the C. fimbriata species complex (Harrington 2009, B. Wingfield et al. 2013).

Ambrosiella hartigii


Description: Batra (1967, pp 997–1000, Figs 12, 13, 32–34).

Phylogenetic data: Cassar & Blackwell (1996); Rollins et al. (2001); Paulin-Mahady et al. (2002); Gebhardt et al. (2005); Harrington (2009); Massoumi Alamouti et al. (2009); Matsuda et al. (2010); Six et al. (2009).

Notes: Teleomorph unknown. This species groups with A. xylebori and A. beaveri in a distinct lineage in Ceratocystis s.l., and has the same β-tubulin intron arrangement than these two species (Six et al. 2009).

Ceratocystis inquinans


Anamorph: thielaviopsis-like.

Phylogenetic data: Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the C. moniliiformis species complex (B. Wingfield et al. 2013).

291

Anamorph: thieliaviposis-like.


Phylogenetic data: Witthuhn et al. (1998, 1999, 2000); Barnes et al. (2003a); Marin et al. (2005); Harrington (2009); Six et al. (2009).

Notes: *Ceratocystis lariccola* was distinguished from the morphologically similar *C. polonica* by Witthuhn et al. (2000) and Harrington et al. (2002) by the different bark beetle associate and conifer host. This species is a member of the *C. coerulescens* species complex (Harrington 2009, B. Wingfield et al. 2013).


Anamorph: thieliaviposis-like.

Description and phylogenetic data: Van Wyk et al. (2009a, 2011a).

Notes: This species is a member of the *C. fimбриata* species complex (B. Wingfield et al. 2013).


Anamorph: thieliaviposis-like.

Phylogenetic data: Van Wyk et al. (2011a).

Notes: This species is a member of the *C. fimбриata* species complex (Van Wyk et al. 2011a).


Anamorph: thieliaviposis-like.

Phylogenetic data: Van Wyk et al. (2007a, 2009a, b, 2010, 2011a, b); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the *C. fimбриata* species complex (B. Wingfield et al. 2013).


Anamorph: thieliaviposis-like.

Phylogenetic data: Van Wyk et al. (2011a).

Notes: This species is a member of the *C. fimбриata* species complex (Van Wyk et al. 2011a).


Anamorph: thieliaviposis-like.

Phylogenetic data: Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the *C. moniliformis* species complex (B. Wingfield et al. 2013).


Anamorph: thieliaviposis-like.

Descriptions: Hedgccock (1906, pp 78–80, Pl. 3 Fig. 5, Pl. 5 Figs 3–5); Davidson (1935, pp 799–800); Moreau & Moreau (1952, Figs 1–4); Luc (1952, p.12–15, Figs 1–2); Hunt (1956, pp 13, 17–19); Morgan-Jones (1967b, Figs A-H); Nag Raj & Kendrick (1975, pp 116, 141–142, Fig. 43A); Upadhyay (1981, p. 51, Figs 109–115); Maekawa et al. (1987, pp 8–10, Figs 7–18); Kowalski & Butin (1989, pp 238–241).

Phylogenetic data: Hausner et al. (1992b, 1993c); Witthuhn et al. (1999); Barnes et al. (2003a, b); Hausner & Reid (2004); Masuya et al. (2004); Roux et al. (2004); Van Wyk et al. (2004a, 2006, 2011b); Al-Subhi et al. (2006); Kamgan Nkuekam et al. (2008a, 2012b); Harrington (2009); Heath et al. (2009); Kolafik & Hulcr (2009); Massoumi Alamouti et al. (2009); Six et al. (2009); Tarigan et al. (2011).

Notes: Luc (1952) invalidly described four varieties of *C. moniliformis*. Moreau (1952) reduced a further two species, *C. wilsonii* and *C. variospora* (now considered a distinct species), to *formae* of *C. moniliformis*, and treated *Ro. coffeae* as a synonym (see above under *C. fimбриata*). Moreau & Moreau (1952) synonymised *O. moniliforme* f. theobromae, and Hunt (1956) *En. bunae* and *C. wilsonii*, with *C. moniliformis*. Nag Raj & Kendrick (1975) and Upadhyay (1981) listed *C. filiformis* as synonym of *C. moniliformis*. The tenability of all these synonyms should be carefully reconsidered with DNA sequence data and fresh isolates. *Ceratocystis moniliformis* defines a discrete group of cryptic species in *Ceratocystis sensu lato* that will assume generic status (B. Wingfield et al. 2013).


Anamorph: thieliaviposis-like.

Phylogenetic data: Van Wyk et al. (2004b, 2006a, 2011b); Al-Subhi et al. (2006); Kamgan Nkuekam et al. (2008a, 2012b); Harrington (2009); Heath et al. (2009); Kolařík & Hulcr (2009); Massoumi Alamouti et al. (2009); Six et al. (2009); Tarigan et al. (2011).

Notes: This is a member of the *C. moniliformis* species complex (Harrington 2009, B. Wingfield et al. 2013).

A nomenclator for ophiostomoid genera and species in the Ophiostomatales and Microasccales


Anamorph: thielaviopsis-like.

Phylogenetic data: Harrington (unpublished in GenBank).

Notes: Upadhyay (1981) proposed C. musarum as a synonym of C. paradoxa, but Harrington (2009) included an EF-1α sequence (HM569629) for an isolate (C1753), presumably from banana and labelled as 'C. musarum', in his analyses. The sequence differs substantially from other C. paradoxa sequences, suggesting that it is a distinct species in the C. paradoxa clade (Harrington 2009).


Anamorph: thielaviopsis-like.

Phylogenetic data: Rodas et al. (2008); Van Wyk et al. (2009a, 2010, 2011a, b); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the C. fimбриata species complex (B. Wingfield et al. 2013). The name should not be confused with Cop. neglecta.


Phylogenetic data: Paulin-Mahady et al. (2002); Harrington (2009); Six et al. (2009); B. Wingfield et al. (2013).

Notes: This species is a member of the C. coerulescens complex (Harrington 2009, B. Wingfield et al. 2013). The name should not to be confused with Cop. neglecta.

Ceratocystis norvegica J. Reid & Hausner, Botany 88: 977. 2010.

Anamorph: not observed.

Phylogenetic data: Reid et al. (2010).

Notes: This species is a member of the C. coerulescens species complex (Reid et al. 2010).


Anamorph: thielaviopsis-like.

Phylogenetic data: Heath et al. (2009); Tarigan et al. (2011); Van Wyk et al. (2011b); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the C. moniliformis species complex (B. Wingfield et al. 2013).


Anamorph: thielaviopsis-like.

Phylogenetic data: Heath et al. (2009); Van Wyk et al. (2009a, 2011a, b); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the C. fimбриata species complex (B. Wingfield et al. 2013).


Anamorph: thielaviopsis-like.

Phylogenetic data: Al-Subhi et al. (2006); Kamgan Nkuekam et al. (2008a, 2012b); Heath et al. (2009); Tarigan et al. (2011); Van Wyk et al. (2011b).

Notes: This species is a member of Ceratocystis moniliformis species complex (B. Wingfield et al. 2013).


Phylogenetic data: Paulin-Mahady et al. (2002); Heath et al. (2009); Six et al. (2009); B. Wingfield et al. (2013).

Notes: Teleomorph unknown. This species groups with T. thielavioides and T. basicia (Harrington 2009, B. Wingfield et al. 2013).


Anamorph: thielaviopsis-like.

Phylogenetic data: Van Wyk et al. (2010, 2011a, b); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the C. fimбриata species complex (B. Wingfield et al. 2013).


Anamorph: thielaviopsis-like.


Phylogenetic data: Hausner et al. (1993c); Witthuhn et al. (1999); Roux et al. (2000); Paulin-Mahady et al. (2002); Barnes et al. (2003a); Harrington (2009); Six et al. (2009); B. Wingfield et al. (2013).

Notes: Synonymies of T. ethacetica, En. fragrans and St. dimorpha with C. paradoxa were suggested by Nag Raj & Kendrick (1975) and Paulin-Mahady et al. (2002). Ceratocystis paradoxa groups outside the three major species complexes defined by B. Wingfield et al. (2013), forming the core of the C. paradoxa clade as defined by Harrington (2009). Thielaviopsis ethacetica is the type species of Thielaviopsis, and species in this clade will probably be classified in this genus in the future. The taxon apparently consists of several cryptic species in need of description (Harrington 2009).

Anamorph: thielaviopsis-like.
Notes: This is a member of C. coerulescens species complex (Harrington 2009, B. Wingfield et al. 2013). The name should not to be confused with L. pinicola or O. pinicola.

Anamorph: thielaviopsis-like.
Phylogenetic data: Barnes et al. (2003a); Roux et al. (2004); Van Wyk et al. (2004b, 2007a, b, 2009a, b, 2010, 2011a, b); Thorpe et al. (2005); Kamgan Nkuekam et al. (2008a, 2012b); Rodas et al. (2008); Heath et al. (2009); Kolařík & Hulcr (2009); Tarigan et al. (2011).
Notes: This is a cryptic species in the C. fimbriata species complex (B. Wingfield et al. 2013).

Anamorph: thielaviopsis-like.
Phylogenetic data: Baker et al. (2003); Engelbrecht & Harrington (2005); Van Wyk et al. (2007a, b, 2009a, b, 2010, 2011a, b); Rodas et al. (2008); Harrington (2009); Heath et al. (2009); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).
Notes: This species was treated as the sycamore (Platanus) population of C. fimbriata in earlier studies (Santini & Capretti 2000, Barnes et al. 2001, Baker et al. 2003, Engelbrecht et al. 2004, Thorpe et al. 2005). It is a member of the C. fimbriata species complex (Harrington 2009, B. Wingfield et al. 2013).

Anamorph: thielaviopsis-like (Marin et al. 2005).
Phylogenetic data: Witthuhn et al. (1998, 1999, 2000); Loppnau & Breuil (2003); Marin et al. (2005); Harrington (2009); Heath et al. (2009); Six et al. (2009).
Notes: Siemaszko (1939) erroneously connected a leptographium-like anamorph to this species, leading Upadhyay (1981) to treat it as a synonym of O. penicillatum. Solheim (1986) and Harrington (1988) considered C. polonica distinct and Visser et al. (1995) confirmed its classification in Ceratocystis with DNA sequences. A neotype was designated by Harrington & Wingfield (1998). Ceratocystis polonica was distinguished from the morphologically similar C. laricicola by Witthuhn et al. (2000) and Harrington et al. (2002), based primarily on the different conifer host and bark beetle associate, and is considered part of the C. coerulescens species complex (Harrington 2009, B. Wingfield et al. 2013). Marin et al. (2009) showed that European and Japanese populations of C. polonica are genetically isolated and possibly in the process of speciation.

Anamorph: thielaviopsis-like.
Phylogenetic data: Van Wyk et al. (2004b, 2007a, b, 2009a, b, 2010, 2011a, b); Kamgan Nkuekam et al. (2008a, 2012b); Rodas et al. (2008); Heath et al. (2009).
Notes: This is a cryptic species in the C. fimbriata species complex (B. Wingfield et al. 2013).

Anamorph: thielaviopsis-like.
Phylogenetic data: Heath et al. (2009); Van Wyk et al. (2009a, 2011a, b); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).
Notes: This species is a member of the C. fimbriata species complex (B. Wingfield et al. 2013).

Phylogenetic data: Paulin-Mahady et al. (2002); Harrington (2009); Heath et al. (2009); Six et al. (2009); B. Wingfield et al. (2013).
Notes: Teleomorph unknown. This species groups with T. thieliavioidei and T. basicola (Harrington 2009, B. Wingfield et al. 2013).

Anamorph: thielaviopsis-like.
Descriptions: Hunt (1956, pp 11, 17, 20); Nag Raj & Kendrick (1975, pp 106, 142, Fig. 38); Upadhyay (1981, p. 69, Figs 205–213).
Phylogenetic data: Hausner et al. (1993c); Witthuhn et al. (1999); Paulin-Mahady et al. (2002); B. Wingfield et al. (2013).
Notes: Ceratocystis radicicola groups outside of the three major species complexes defined in Ceratocystis, but peripherally to the C. paradoxa clade (Harrington 2009, B. Wingfield et al. 2013). Paulin-Mahady et al. (2002) confirmed the synonymy of T. punctulata and C. radicicola based on identical ITS sequences.

Anamorph: thielaviopsis-like.
Phylogenetic data: Witthuhn et al. (2000); Barnes et al. (2003a); Loppnau & Breuil (2003); Harrington (2009); Heath et al. (2009); Six et al. (2009).
Notes: Ceratocystis resinifera is a member of C. coerulescens species complex (Harrington 2009, B. Wingfield et al. 2013).
Anamorph: thieliaviopsis-like.
Notes: This is a member of C. coeruleascens species complex (Harrington 2009, B. Wingfield et al. 2013).

Anamorph: thieliaviopsis-like.
Phylogenetic data: Kamgan Nkuekam et al. (2008a, 2012b); Heath et al. (2009); Tariag et al. (2011); Van Wyk et al. (2011b).
Notes: This species belongs to the C. moniliformis species complex (B. Wingfield et al. 2013).

Anamorph: thieliaviopsis-like.
Phylogenetic data: Johnson et al. (2005); Van Wyk et al. (2007a, b, 2009a, b, 2010, 2011a, b); Rodas et al. (2008); Harrington (2009); Heath et al. (2009); Tariag et al. (2011); Kamgan Nkuekam et al. (2012b).
Notes: This species is a member of the C. fimbriata species complex (Harrington 2009, B. Wingfield et al. 2013).

Anamorph: thieliaviopsis-like.
Phylogenetic data: Van Wyk et al. (2011b).
Notes: This species is a member of the C. moniliformis species complex (Van Wyk et al. 2011b).

Ceratocystis sumatranav Tarigan, M. van Wyk & M.J. Wingf., Mycoscience 51: 60. 2010.
Anamorph: thieliaviopsis-like.
Phylogenetic data: Tarigan et al. (2011).
Notes: This species is a member of the C. moniliformis species complex (Tarigan et al. 2011).

Anamorph: thieliaviopsis-like.
Phylogenetic data: Heath et al. (2009); Van Wyk et al. (2009a, b, 2010, 2011a, b); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).
Notes: This species is a member of the C. fimbriata species complex (Tarigan et al. 2011).

Description: Nag Raj & Kendrick (1975, pp 117, 136–137, Fig. 44).
Phylogenetic data: Paulin-Mahady et al. (2002); Harrington (2009), Six et al. (2009); B. Wingfield et al. (2013).
Notes: Teleomorph unknown. Thielaviopsis thielavioides is the type species of Chalaropsis and belongs to a clade within Ceratocystis s.l. with species such as T. basicola (Paulin-Mahady et al. 2002, B. Wingfield et al. 2013).

Anamorph: thieliaviopsis-like.
Phylogenetic data: Van Wyk et al. (2006a, 2011b); Kamgan Nkuekam et al. (2008a, 2012b); Heath et al. (2009); Tariag et al. (2011).
Notes: Ceratocystis tribiliformis is a member of the C. moniliformis species complex (B. Wingfield et al. 2013).

Description: Batra (1967, pp 1008–1009, Figs 3, 24, 25).
Notes: Teleomorph unknown. Ambrosiella trypodendri is the type species of Phialophoropsis (Batra 1967). Although no cultures or material are available for this species, Harrington et al. (2010) argued that it is morphologically similar to Ambrosiella and provided a new combination for it. Seifert (unpublished) has also examined the type, which formed the basis for the drawing of this species in The Genera of Hyphomycetes (Seifert et al. 2011). Harrington et al. (2010) did not mention that their new combination implied that Phialophoropsis should be treated as synonym of Ambrosiella.

Anamorph: thieliaviopsis-like.
Phylogenetic data: Kamgan Nkuekam et al. (2008a, 2012b); Heath et al. (2009); Van Wyk et al. (2009a, 2010, 2011a, b); Tariag et al. (2011).
Notes: This species belongs to the C. fimbriata species complex (Tariag et al. 2011).

Anamorph: thieliaviopsis-like.
Phylogenetic data: Kamgan Nkuekam et al. (2012b).
Notes: This species is a member of the C. moniliformis species complex (Kamgan Nkuekam et al. 2012b).

Anamorph: thieliaviopsis-like.
Description: Hunt (1956, pp 16–18); Johnson et al. (2005, pp 1082–1084, Figs 8–16).
Phylogenetic data: Johnson et al. (2005); Van Wyk et al. (2007a, b, 2009a, b, 2010, 2011a, b); Rodas et al. (2008); Harrington (2009); Heath et al. (2009); Tariag et al. (2011); Kamgan Nkuekam et al. (2012b).
Notes: Moreau (1952) invalidly reduced C. variospora to a formae of C. moniliformis. Webster & Butler (1967), Upadhyay (1981), and Seifert et al. (1993) all treated C. variospora as
synonym of C. fimbriata. Johnson et al. (2005) showed that it is a phylogenetically distinct species in the C. fimbriata complex (Harrington 2009, B. Wingfield et al. 2013).


Anamorph: thielaviopsis-like.

Description: Samuels (1993, p. 16, Figs 1A–B).

Phylogenetic data: Withthuhn et al. (1998, 1999, 2000); Rêblova & Winka (2000); Roux et al. (2000); Barnes et al. (2003a); Van Wyk et al. (2004a, b, 2007a, b, 2009a, b, 2010, 2011a, b); Al-Subhi et al. (2006); Kamgan Nkuekam et al. (2008a, 2012b); Rodas et al. (2008); Heath et al. (2009); Kolařík & Hulcr (2009); Six et al. (2009); Matsuda et al. (2010); Tarigan et al. (2010, 2011); Sakayarao et al. (2011).

Notes: This species was considered a synonym of *C. coerulescens* by Hunt (1956), Olchoweci & Reid (1974), and Upadhyay (1981), but Nag Raj & Kendrick (1975), Gibbs (1993), Kile (1993), and Seifert et al. (1993) considered the two species distinct. The separation of the two species was confirmed by Withthun et al. (1998). Harrington et al. (1998), Withthun et al. (2000) and Harrington (2009) showed that C. virens isolates separate into two groups based on phylogeny and host specificity, and these “should be recognized as distinct species” (Withthun et al. 2000). The two groups comprise a monophyletic lineage within the *C. coerulescens* complex (Withthun et al. 2000, Harrington 2009, B. Wingfield et al. 2013).


Descriptions: Brader (1964, pp 40–42); von Arx & Hennebert (1965, pp 312–315, Fig. 2); Batra (1967, pp 990–992, Figs 14–19).

Phylogenetic data: Cassar & Blackwell (1996); Rollins et al. (2001); Paulin-Mahady et al. (2002); Gebhardt et al. (2005); Harrington (2009); Massoumi Alamouti et al. (2009); Six et al. (2009); Matsuda et al. (2010).

Notes: Teleomorph unknown. This is the type species of Ambrosiella. The genus and species were invalidly described by Brader (1964) [Art. 40.1], but von Arx & Hennebert (1965) redescribed and validated both. *Ambrosiella xylebori* is part of a distinct lineage in Ceratocystis s.l. together with *A. hartigii* and *A. beaveri* (Paulin-Mahady et al. 2002, Harrington 2009, Massoumi Alamouti et al. 2009, Six et al. 2009).


Anamorph: thielaviopsis-like.

Phylogenetic data: Heath et al. (2009); Van Wyk et al. (2009a, 2011a, b); Tarigan et al. (2011); Kamgan Nkuekam et al. (2012b).

Notes: This species is a member of the *C. fimbriata* species complex (Tarigan et al. 2011).

**Cornuvesica vijoenii** M.J. Wingf. & Jacobs, Mycological Research 104: 366. 2000 [type species *Cor. falcata*]

Notes: The inclusion of this monotypic genus in the Ceratocystidaceae is discussed by De Beer et al. (2013).


Anamorph: thielaviopsis-like.

Descriptions: Olchowcki & Reid (1974, p. 1688); Rayner & Hudson (1977, pp 315–316, Fig. 1); Upadhyay (1981, p. 125, Figs 449–453); Hutchison & Reid (1988a, pp 65–68); Hausner et al. (2003, pp 46–48).

Phylogenetic data: Hausner et al. (1993a, c, 2000); Hausner & Reid (2004); Hausner & Wang (2005).

**Custiningophora** Stolk, Hennebert & Klopotek, Persoonia 5: 195. 1968 [type species *Cus. olivacea*]

Notes: *Custiningophora* is presently known only from its anamorph. The anamorphs of Knoxdaviesia (= Gondwanamycoses) were treated in *Custiningophora* by Rêblova & Winka (2000) and Kolařík & Hulcr (2009), but both Viljoen et al. (1999) and Van der Linde et al. (2012) considered Custiningophora and Knoxdaviesia as separate genera. We consider Custiningophora as distinct from Knoxdaviesia based on their phylogenetic distance, its much smaller conidia and the straight rather than sinuous conidiophores.

The anamorphs of Chaetosphaeria aterrima (Fuckel) Rêblova (Rêblova 1998) and Cha. aspergilloides M.E. Barr & J.L. Crane were referred to as unnamed Custiningophora spp. Cha. aterrima belongs to the Hypocreales (Rêblova & Winka 2000). No sequence data exist for Cha. aspergilloides, but its anamorph has some substantial differences from *Cus. olivacea* (Barr & Crane 1979), suggesting that it is probably related to *Cha. aterrima* and not to *Custiningophora*.

**Custiningophora olivacea** Stolk, Hennebert & Klopotek, In Stolk & Hennebert, Persoonia 5: 197. 1968.


Phylogenetic data: Viljoen et al. (1999); Rêblova & Winka (2000); Kolařík & Hulcr (2009); Van der Linde et al. (2012).

**Graphium** Corda, Icon. Fung. 1: 16. 1837. emend. Z.W. de Beer, Seifert & M.J. Wingf. [type species *Gr. penicillioides*]


Teleomorphs unknown. Conidiodama macronematous, synnematous, determinate, with dematiaceous stipes. Hyphae of stipe pigmented, simple septate. Conidiophores penicillately branched, with two or three levels of branching, metulae often present. Conidiogenous cells in whorls of two to six, conidiogenesis enteroblastic, with percurrent, annelidic extension. Conidia mass a transparent, slimy droplet, darkening with age. Conidia hyaline, aseptate, cylindrical to obovoid, sometimes curved with age, bases truncate, often with distinct basal frill. In rare cases, a synanamorph with monoblastic, obovoid, pigmented chlamydospore-like conidia is formed. Phylogenetically classified in the Microascales.

Notes: The emended genus description is based on Gr. penicillioides and the seven other known species for which DNA sequence data are available (Cruywagen et al. 2010). We include only those species known to be classified with the Graphiaceae here; others are considered in an extended nomenclator of described Graphium species in Section C1. Jacobs et al. (2003b)
showed that *Rh. fimbrisporum* belongs in *Graphium* and we thus treat *Rh. graphioides* as a synonym.

The name of the fungal genus *Graphium* should not be confused with *Graphium* Scopoli, a genus of swallowtail butterflies (this chapter Table 1; De Beer et al. 2013).

*Description and phylogenetic data*: Cruywagen et al. (2010, p. 67, Figs 6a–d).

*Description*: Okada et al. (2000, p. 184, Figs 21, 24).  
*Phylogenetic data*: Okada et al. (1998, 2000); Jacobs et al. (2003b); Cruywagen et al. (2010); Paciura et al. (2010b); Lackner & de Hoog (2011).  
*Notes*: This species was treated as synonym of *Gr. penicillioides* by Matsushima (1989), but Okada et al. (2000) showed that the species is distinct.

*Phylogenetic data*: Paciura et al. (2003a); Cruywagen et al. (2010); Paciura et al. (2010b).

*Description and phylogenetic data*: Cruywagen et al. (2010, p. 69, Figs 6e–h).

*Phylogenetic data*: Jacobs et al. (2003a); Cruywagen et al. (2010); Paciura et al. (2010b); Lackner & de Hoog (2011).

*Phylogenetic data*: Jacobs et al. (2003a); Cruywagen et al. (2010); Paciura et al. (2010b); Lackner & de Hoog (2011).

*Description and phylogenetic data*: Cruywagen et al. (2010, p. 67, Figs 6i–j).

*Descriptions*: Corda (1837, p. 18, Pl. 5 Fig. 25); Seifert & Okada (1993, pp 28–30, Figs 1A–B, 2); Okada et al. (2000, pp 175–177, Figs 3–20).  
*Phylogenetic data*: Okada et al. (1998, 2000); Rainer et al. (2000); Jacobs et al. (2003a); Cruywagen et al. (2010); Paciura et al. (2010b); Lackner & de Hoog (2011).  
*Notes*: This is the type species of *Graphium*. An epitope was designated and the species delineated based on DNA sequences by Okada et al. (2000).

*Descriptions*: Mouton et al. (1994, 1273–1275, Figs 1–11); Paciura et al. (2010b, pp 84–85, Figs 19, 23, 27).  
*Phylogenetic data*: Okada et al. (2000), Jacobs et al. (2003a); Cruywagen et al. (2010); Paciura et al. (2010b); Lackner & de Hoog (2011).

*Phylogenetic data*: Marais et al. (1999), Viljoen et al. (1998, 2000); Rainer et al. (2000); Jacobs et al. (2003a); Cruywagen et al. (2010); Paciura et al. (2010b); Lackner & de Hoog (2011).  
*Notes*: The genus *Knoxdaviesia* was described as *K. proteae*, the anamorph of a species described at the same time as *Cop. proteae* (Wingfield et al. 1998). Marais et al. (1998) eventually proposed the teleomorphic genus *Gondwanamyces* with *Go. proteae* as type species. Viljoen et al. (1999) showed that the anamorph genus *Custingophora* was closely related to *Gondwanamyces*, and Kolařík & Hulcr (2009) subsequently suggested that *Knoxdaviesia* and *Custingophora* should be treated as synonyms. This suggestion was rejected by Van der Linde et al. (2012). We concur with the separate treatment of these genera. Under the Melbourne Code the oldest name, *Knoxdaviesia*, has priority over *Gondwanamyces*. We thus redefine this genus to accommodate teleomorphic species and provide new combinations where needed.

*Phylogenetic data*: Marais et al. (1998); Viljoen et al. (1999); Wingfield et al. (1999); Harrington (2009); Kolařík & Hulcr (2009); Six et al. (2009); Van der Linde et al. (2012).

Description: Kolařík & Hulcr (2009, p. 50, Figs 5, 6D-E).
Phylogenetic data: Kolařík & Hulcr (2009); Van der Linde et al. (2012).
Notes: Teleomorph unknown.


Phylogenetic data: Hausner et al. (1993a, c, 2000); Marais et al. (1998); Viljoen et al. (1999); Wingfield et al. (1999); Réblová & Winka (2000); Gibb & Hausner (2003); Hausner & Reid (2004); Hausner & Wang (2005); Kolařík & Hulcr (2009); Six et al. (2009); Van der Linde et al. (2012).


Description: Kolařík & Hulcr (2009, pp 50–56, Figs 4, 6A–C).
Phylogenetic data: Kolařík & Hulcr (2009); Van der Linde et al. (2012).
Notes: Teleomorph unknown.


Description: Van der Linde et al. (2012, pp 578–579, Fig. 3).
Phylogenetic data: Van der Linde et al. (2012).
Notes: Teleomorph unknown.


Description: Morgan-Jones & Sinclair (1980, pp 443–445, Fig. 1).
Notes: Teleomorph unknown. This species, originally described from decaying wood in South Africa (Morgan-Jones & Sinclair 1980), is morphologically very similar to the K. undulatistipes (Pinnoi et al. 2003), K. serotectus and K. ubusi (Van der Linde et al. 2012). It has conspicuously sinuous conidiophores, not present in Cus. olivacea, and clearly belongs in Knoxdaviesia. However, the conidiophores of K. suidafrikana are almost double the length (230 μm) of those of K. serotectus and K. ubusi, and longer than those of all other species in the genus apart from K. undulatistipes.


Description: Van der Linde et al. (2012, pp 579–582, Fig. 4).
Phylogenetic data: Van der Linde et al. (2012).
Notes: Teleomorph unknown.


Description: Pinnoi et al. (2003, pp 214–217, Figs 1–5).
Notes: Teleomorph unknown. This species, described from the petiole of a dead palm leaf in Thailand (Pinnoi et al. 2003), resembles K. suidafrikana (Morgan-Jones & Sinclair 1980), K. serotectus and K. ubusi (Van der Linde et al. 2012). In particular, the pronounced sinuation on the stipes that confirms its treatment in Knoxdaviesia rather than Custingophora. The conidiophores are the longest (210–520 μm) in the genus.


Description: Crous et al. (2012, pp 144–145).
Phylogenetic data: Crous et al. (2012).


Notes: The uncertain placement of Sphaeronaemella in the Microscales is discussed by De Beer et al. (2013). Malloch (1974) and Cannon & Hawksworth (1982) recognized four, and Hausner & Reid (2004) five species of Sphaeronaemella. We list those five species below, and include Sph. horanzsklyi, described in 1975, because there is reportedly material available for this species. However, 22 additional Sphaeronaemella spp. described prior to 1950 are listed in Index Fungorum (www.indexfungorum.org) and are not considered further here; they should be considered in future treatments of the genus. Malloch (1974) suggested the synonymy of Viennotidia with Sphaeronaemella, supported by Hutchinson & Reid (1988a) and then confirmed using molecular data by Hausner & Reid (2004). Hausner & Reid (2004) and De Beer et al. (2013) showed that Ga. betae groups within Sphaeronaemella, rendering Gabarnaudia a synonym of Sphaeronaemella under the Melbourne Code. Upadhyay (1981) designated formal sections in Ceratocystis. Although most of the taxa he included in his section Ophiostoma are now included in Ophiostoma s.l., he also treated Sph. helvellae and Sph. fimbriolata in this section.


**Anamorph:** gabarnaudia-like.

**Description:** Samson (1974, pp 94–96, Fig. 41, Pl. 2).

**Notes:** This species differs from other Sphaeronaemella spp. because the ascomata do not produce necks or ostioles, and it has ellipsoidal rather than allantoid or orange-section shaped ascospores. *Sphaeronaemella humicola* was not included in *Ceratocystis* with *Sph. helvellae* and *Sph. fimicola* by Upadhyay (1981). The ex-type culture (CBS 115.72) no longer represents the correct fungus (Hausner & Reid 2004), and its placement in *Sphaeronaemella* needs reconsideration.


**Anamorph:** gabarnaudia-like.

**Description:** Samson (1974, pp 94–96, Fig. 41, Pl. 2).

**Notes:** This species differs from other *Sphaeronaemella* spp. because the ascomata do not produce necks or ostioles, and it has ellipsoidal rather than allantoid or orange-section shaped ascospores. *Sphaeronaemella humicola* was not included in *Ceratocystis* with *Sph. helvellae* and *Sph. fimicola* by Upadhyay (1981). The ex-type culture (CBS 115.72) no longer represents the correct fungus (Hausner & Reid 2004), and its placement in *Sphaeronaemella* needs reconsideration.


**Anamorph:** not observed.

**Notes:** Upadhyay (1981) considered this a *nomen dubium*. Cannon & Hawksworth (1982) reported that there was no type material but transferred the species to *Viennotidia* because they believed the fungus could be recognized from the protologue.


**Anamorph:** not observed.

**Notes:** Cannon & Hawksworth (1982) reported that there was no type material but transferred the species to *Viennotidia* because they believed the fungus could be recognized from the protologue.

**B.2. Valid species of uncertain status (Microascales)**

**Ceratocystis autographa** Bakshi, Ann. Bot. n.s. 15: 55. 1951.

**Synanamorphs:** theilaviopsis- and sporothrix-like.

**Descriptions:** Bakshi (1951, pp 55–60, Pl. VI Figs 4–7); Hunt (1956, pp 11, 13, 23); Olchowecki & Reid (1974, p. 1695); Nag Raj & Kendrick (1975, pp 86, 140–141 Fig. 28C); Upadhyay (1981, p. 73, Figs 223–231); Wingfield et al. (1995, pp 1290, 1292, Figs 1–10).

**Phylogenetic data:** Hausner et al. (1993c).

**Notes:** *Ceratocystis autographa* groups distantly from Ophiostoma and Ceratocystis according to Hausner et al. (1993c), who suggested, “the disposition of this species must await the availability of strains from fresh teleomorph material.” We agree that the generic placement of this species requires careful consideration.
in light of its two unlikely synanamorphs. Wingfield et al. (1995) and Coetsee et al. (2000) also treated it as a doubtful species.


**Description** Saccardo (1892, p. 513).

**Notes** De Hoog et al. (1986) transferred this species to Gabarnaudia based on the original description, but also remarked, ‘we therefore do not doubt that Peck’s fungus is identical to G. betae...’. In view of the cryptic descriptions for this species, we consider the status of this species uncertain.


**Description** Samson (1974, pp 96–97, Figs 38c–e, 39f–g).

**Notes** The morphology of this species differs somewhat from that of other *Sphaeronaemella* spp. (Samson 1974). We thus prefer not to include it in the genus without DNA sequence data.

### B.3. INVALIDLY PUBLISHED SPECIES (MICROASCALES)


**Anamorph** thielaviopsis-like.

**Notes** Although Nag Raj & Kendrick (1975) considered this name illegitimate because the species was described as a species of *Ceratocystis* when no teleomorph structures were present, such an interpretation was only relevant for a brief period of time in the progressive versions of the ICBN. With the advent of the Melbourne Code it would be possible to validate the name by neotypification (Art. 9.7) if this fungus was rediscovered.


**Synanamorphs** thielaviopsis-like and synnematal (Roldan 1962).

**Notes** This combination of synanamorphs is atypical for *Ceratocystis* species and may indicate that the name was based on a mixed culture. Otherwise, the situation for this species is identical to that noted for *C. antennaroidospora* (see above).

**Ceratocystis heveae** G.H. Zhao, J. *Nanjing Forestry University* 16: 82. 1992 [nom. inval., Art. 40.6]

**Anamorph** thielaviopsis-like.

**Notes** Although a Latin description was supplied and microscope slides were deposited at Nanjing Forestry University (NFU-WAH), the material was not assigned numbers or explicitly indicated as the holotype. The species is thus invalidly published (Art. 40.6). To validate the species, a lectotype should be designated (Art. 9.2), and this is most appropriately done by someone who can examine the original material.


**Anamorph** thielaviopsis-like.

**Notes** This species was invalidly described, isolated from both *Ips typographus* f. *japonicus* infesting spruce, and *Ips subelongatus* (as *I. cembrae*) infesting larch in Japan (Aoshima 1965). The collection of isolates of Aoshima probably represented two morphologically similar, but host-specific species, *C. polonica* and *C. fujimensis* (Yamaoka et al. 1997, 1998, Marin et al. 2005).


**Anamorph** thielaviopsis-like.

**Description** Potljajczuk & Schekunova (1985, p. 150).

**Notes** According to the original description, the ascomata and ascospores resemble those of *Cop. minuta*, while the anamorph is clearly thielaviopsis-like, with phialidic conidiogenesis, also producing chlamydospores.


**Notes** Kiffer & Delon (1983) first pointed out the problems with the typification of this species, named for the appearance of its chlamydospores, which mimic *Wallemia*. If necessary, the name could be validated by accurate typification.

### C. SPECIES EXCLUDED FROM THE OPHIOSTOMATALES GENERA IN THE OPHIOSTOMATALES AND MICROASCALES

#### C.1. SPECIES DESCRIBED IN THE CLASSICAL CONCEPT OF GRAPHIUM

As noted by Okada et al. (1998, 2000) and discussed further in the accompanying paper by De Beer & Wingfield (2013), the historical concept of *Graphium* has evolved in the 180 years since its description. Conceptual revisions were offered by Saccardo (1886), Hedgcock (1906), Goidánich (1935b), and Crane & Schocknecht (1973), before the genus was conclusively removed from the group we now call the Ophiostomatales (Okada et al. 2000). The accepted species of *Graphium sensu stricto* in the Microascales are listed above. Most other species are considered here, largely based on type studies undertaken during monographic revision of *Stilbella* (Seifert 1985), though most of it not published in that work.

As noted elsewhere in this volume by De Beer et al. (2013), the classical concept of *Graphium* included all darkly pigmented synnematous fungus, and thus included species with dry, aseptate conidia that would now be classified in genera such as *Cephalotrichum*, *Phaeoisaria*, *Nodulisporium* or *Dematophora* (the latter two now likely to be subsumed under their respective teleomorphs in *Hypoxylon* or *Rosellinia*), or ceroisporid genera of the Capnodiales with phragmoconidia, such as *Phaeoisariopsis*, *Phacellium*, or *Graphiothecium*. Species with slimy ameroconidia occur in several groups, and Seifert & Okada (1993) and Okada et al. (2000) found that such species with percurrent conidiogenous cells occurred in several different lineages, including *Europheila* (*Eurotiomycetes*), *Graphium* and now *Parascedosporium* (Lackner & de Hoog 2011), the latter two representing distinct lineages in the
Microascales. Similar fungi with conidia produced from phialides can be distributed among Stilbocrea, Crinula, Dendrostilbella and other genera.

**Graphium adustum** Grosmann, Z. Parasitenk. 3: 95. 1931.

*Notes:* This species is reported as a common associate of Dryocoetes autographus on *Picea excelsa*. The protologue is very brief and includes no illustration. As with *Gr. pyenocephalum*, noted below, the initially hyaline synnemata and subglobose conidia do not suggest either a member of the Ophiostomatales or of *Graphium s.str.* We were unsuccessful at finding a type in ZT.


**Notes:**

- 1448: 1913
- 1886: 1834
- 1837: Fr., Syst. mycol. 3: 303. 1832
- 1830: Fr., Syst. mycol. 8: 401. 1910.


Lindau, Rabenhorst Krypt. Fl., *Gr. album*.

**Notes:**

- 1855: Fr., Syst. mycol. 3: 303. 1832
- 1830: Fr., Syst. mycol. 3: 303. 1832
- 1832: Fr., Syst. mycol. 8: 401. 1910.

**Graphium altissimum** Strasser, Verh. zool.-bot. Ges. Wien 73: 233. 1924 (“1923”)

*Notes:* Authentic material (W14904, W15060) is very similar to *Stilbocrea aterrima* (see below). Conidia are slightly smaller, and the ornamenting cells on the synnema stipe are less distinct, indicating that this might represent a different species. Neither specimen conforms to the collecting dates noted in the protologue, but we refrain from lectotypifying the species pending searches in other herbaria. There are no cultures or DNA sequences for *Gr. aterrimum*, thus this synonymy can be tentatively proposed for now.


*Notes:* This species was included by Goidanich (1935b) in his broader concept of *Graphium* that included ophiostomatalean species with sporothrix-like anamorphs. Harrington *et al.* (2001) suggested that it did not belong in the Ophiostomatales, but found the type material (BPI) to be in such poor condition that they could not conclusively place it in *Graphium s.str.* or any other genus.


*Notes:* The protologue of this species has good illustrations showing light brown, almost hyaline synnemata with elongated conidia with basal frills. The conidiogenous cells are not clearly visible, making it difficult to decide whether this species belongs to *Graphium s.str.* or the Ophiostomatales, but the former seems quite likely to KAS. The type material will have to be investigated to confirm its generic placement.

**Graphium anomalum** (Berk.) Sacc., Syll. fung. 4: 618. 1886

≡ *Stilbum anomalum* (Berk.) Sacc. 1886


*Notes:* Seifert (1985) did not locate a type in B, nor is it recorded in the BPI database. A culture isolated from the same host genus by Grosmann, Z. Parasitenk. 3: 95. 1900. (see below), the initially hyaline synnemata and subglobose conidia with basal frills. The conidiogenous cells are not clearly visible, making it difficult to decide whether this species belongs to *Graphium s.str.* or the Ophiostomatales, but the former seems quite likely to KAS. The type material will have to be investigated to confirm its generic placement.


*Notes:* Seifert (1985) did not locate a type in B, nor is it recorded in the BPI database. A culture isolated from the same host genus by Grosmann, Z. Parasitenk. 3: 95. 1900. (see below), the initially hyaline synnemata and subglobose conidia with basal frills. The conidiogenous cells are not clearly visible, making it difficult to decide whether this species belongs to *Graphium s.str.* or the Ophiostomatales, but the former seems quite likely to KAS. The type material will have to be investigated to confirm its generic placement.


*Notes:* Lindau created this superfluous name for *Graphium leucocephalum* (Berk. & Curt.) Sacc. [non *Gr. leucocephalum* (Wallr.) Sacc.]. Saccardo had earlier proposed the new name *Gr. curtisi* Sacc. to replace the Berkeley & Curtis epithet. As noted by Seifert (1985, as *Stilbella*), the fungus is facultative synonym of Stilbocrea aterrima (see below).

**Graphium album** (Corda) Sacc., Syll. fung. 4: 618. 1886

≡ *Ceratopodium album* Corda, Icon. Fung. 1: 19. 1837.

*Notes:* No authentic material of this fungus is in the Corda herbarium in PR. The original description of black synnemata with a white capitulum, and the illustration by Corda, gives no clue to its identity. The species description for *Gr. album* was emended by Hedcock (1906), an act that has no nomenclatural significance. An isolate identified by Mathiesen-Käärik as *Gr. album* (CBS 278.54 = JCM 9744 = C 1225) and treated as such by Okada *et al.* (2000) and Jacobs *et al.* (2003b), was shown by Harrington *et al.* (2001) to be identical to the ex-type isolate of *P. rubescens* (CBS 278.54 = JCM 9747 = C1222), now treated as anamorph of *G. cucullata*. The actual identity of *Gr. album* remains unknown, and unless authentic material is eventually discovered, there is no point in considering this name any further.


*Notes:* Authentic material (W14904, W15060) is very similar to *Stilbocrea aterrima* (see below). Conidia are slightly smaller, and the ornamenting cells on the synnema stipe are less distinct, indicating that this might represent a different species. Neither specimen conforms to the collecting dates noted in the protologue, but we refrain from lectotypifying the species pending searches in other herbaria. There are no cultures or DNA sequences for *Gr. aterrimum*, thus this synonymy can be tentatively proposed for now.


*Notes:* This species was included by Goidanich (1935b) in his broader concept of *Graphium* that included ophiostomatalean species with sporothrix-like anamorphs. Harrington *et al.* (2001) suggested that it did not belong in the Ophiostomatales, but found the type material (BPI) to be in such poor condition that they could not conclusively place it in *Graphium s.str.* or any other genus.


*Notes:* The protologue of this species has good illustrations showing light brown, almost hyaline synnemata with elongated conidia with basal frills. The conidiogenous cells are not clearly visible, making it difficult to decide whether this species belongs to *Graphium s.str.* or the Ophiostomatales, but the former seems quite likely to KAS. The type material will have to be investigated to confirm its generic placement.

**Graphium anomalum** (Berk.) Sacc., Syll. fung. 4: 618. 1886


*Notes:* There is no properly labelled type in K. There is a specimen labelled with the unpublished name “*Isaria anomala* B. & Br.”, with an annotation “*Stilbum*” in the Graphium folder in K, which could represent the type, but the habitat appears to be dung instead of the plant material suggested in the protologue. The illustration in the protologue is perhaps more suggestive of a myxostelid. There seems to be little point in considering this name further.

**Graphium anomalum** Masssee, Kew Bulletin 1908: 218. nom. illegit., Art. 53 [non *Gr. anomalum* (Berk.) Sacc. 1886].

*Notes:* The type specimen (K) is an anamorphic *Poronia* sp. (*Xylariales*), which would have been classified in the genus *Lindquestia* Subram. & Chandrash. under dual nomenclature (Seifert *et al.* 2011). Because the name is illegitimate, there is no reason to reintroduce it as a *Poronia* species.


*Notes:* This species is associated with lichens and produces its conidia in chains (Alstrup & Hawksworth 1990). Neither character corresponds with species of *Graphium s.str.* Otherwise, the species is similar to *Gr. samogiticum* (see below). We exclude it from...
Graphium s.str. and the Ophiostomatales, and the species will have to be reevaluated to determine its appropriate classification.


Notes: The type is not in LPS or PAD, as noted by Rao & Sutton (1973). This is the type species of Papilionespora, which produces peculiar butterfly-like conidia resulting from the anastomosis of adjacent ameroconidia originating on adjacent denticles on sympodial conidiogenous cells. Its phylogenetic affinities are unknown. Rao & Sutton (1973) did not address typification conclusively. No illustration accompanies the protologue of Gr. aspergilloides, and because there are no authentic specimens, there are no known supplementary illustrations of the type Sppegazzini often drew on herbarium packets. Thus, we designate the material studied by Rao & Sutton (1973), the specimen IMI 177253, as the neotype for Gr. aspergilloides, and thus as the neotype of the genus Papilionespora.


Notes: Because Stilbocrea, formerly considered a teleomorphic genus, predates Graclistilbella Seifert 2000, this anamorphic species is transferred here to this genus in the Bionectriaceae, Hypocreales. The species is described and illustrated by Seifert (1985); see further notes below under Gr. clavulatum.


Notes: According to Hedgcock (1906), this species bears its conidia in a typical slimy head, and has a sporothrix-like synanamorph. It seems likely to be a member of Ophiostoma s.l. It was included in Graphium by Goldanich (1935b), who treated all pesotum-like anamorphs of Ophiostoma s.l. in this genus. Hedgcock distributed exsiccati to several herbaria, mostly dried cultures on wood wafers that appear to have been prepared in an overheated oven; they are usually almost impossible to interpret morphologically (Seifert, unpublished data). The holotype (BPI 448682) and other specimens from Hedgcock are available and careful study should be undertaken to determine if generic placement is possible.


Notes: Seifert (1985) and Seifert et al. (2011) considered this species correctly classified in Phaeostilbella. See below under Gr. nigrum.


Notes: This is a synonym of Phaeoisaria clematidis, according to de Hoog & Papendorf (1976), who examined the holotype (FH). We examined an isotype (K), which lacked diagnostic characters.


Notes: The holotype is not in K or UPS, and was not examined by Morton & Smith (1963). The description of a dark, branched synnematous fungus with catenate, fusoid conidia 15 x 5 μm, growing on the pileus of an unidentified polypore may be explicit enough to allow this fungus to be recognized if recollected. It is unlikely to be either a true Graphium or a member of the Ophiostomatales.


Notes: There is no specimen of Stilbicum bicolor in Persoon’s herbarium (L). Seifert (1985) noted that the name had been applied to a variety of synnematous fungi with bicoloured synnemata. The uncertainty about its correct application suggests that the name should be rejected.


Notes: We have not located the type of this fungus, described as producing yellow synnemata on rotten stems of tomato. The description is reminiscent of the synnematous anamorphs of Sphaerostilbella spp., or possibly Volutella citronella (Cooke & Massée) Seifert.

Graphium bulbicola Henn., Hedwigia 44: 177. 1905.

Notes: The holotype (S) is a member of the Parascedosporium putredinis complex, but the name was not considered by Lackner & de Hoog (2011). Its delimitation or synonymy should be considered in future studies of the complex.


Notes: The description and illustration suggest that this may be a synonym of Phaeostilbella nigra (see below under Gr. nigrum). We have not seen the type.


Notes: This is a synonym of Phaeostilbella nigra (see below under Gr. nigrum). We have not seen the type.

Notes: Mason & Ellis (1953) considered this a synonym of Pachnocybe ferruginea Berk., (Pachnocybes, Pucciniomycetes), which makes synnema-like basidiomata, and explained the circumstances that lead van Beyma to describe this species in Graphium. The ex-type culture is CBS 123.41. The synonymy is now generally accepted.


Notes: The type is not in the Oudemans herbarium in L. The description and published illustration, which features a submersed globose base, and coprophilous habit, suggest the fungus is identical with Sphaeronaemella fimicola Marchal.


Notes: The holotype (LPS 33.133), contains no synnemata, but the drawing on the packet suggests a species of Phaeoisaria. De Hoog and Papendorf (1976), also examined the type, and considered Spegazzini's species a synonym of Phaeoisaria clematidis (Fuckel) Hughes.


Notes: Based on study of the holotype (LPS 33.141), this is a facultative synonym of Stromatographium stromaticum (Berk.) Höhn. (Seifert 1987).


Notes: The type specimen (LPS 12.273) is Purpureocillium lilacinum (Thom) Luangsda-ard, Houbranken, Hywel-Jones & Samson, and was also examined by Samson (1974), who first proposed the synonymy (as Paecilomyces).


Notes: A specimen and a drawing are available from Spegazzini's herbarium. We here designate the drawing (LPS 33.134) as the lectotype for Gr. cinerellum; it suggests Cephalostrichum microsorum (Sacc.) P.M. Kirk. The herbarium material (LPS 12.270) contains only broken synnemata with no conidiogenous cells or conidia.


Notes: The holotype is not in B (Seifert 1985). The protologue does not contain enough detail to meaningfully neotypify this name, which should probably be considered for rejection.


Notes: The type specimen (K, Car. Inf. #1813) confirms that this is a synonym of Pseudocerospora vittata (Lév.) Spec., as suggested by Jong & Morris (1970).


Notes: In dual name nomenclature, this was the oldest epithet available for the anamorph of Stilbocrea gracilipes (Tul. & Tul.) Samuels & Seifert. The latter represents both the oldest genus name and species epithet, and now is the correct name for the species. This species, and the very similar Stilbocrea aterrima, are both common in subtropical and tropical areas and produce dark synnemata with slimy conidial heads, and were often confused with the classical concept of Graphium. The conidiogenous cells are obviously phialidic, however, and the synnemata also feature conspicuously warty ornamenting cells (Seifert 1985).


Notes: The holotype is not in B or BO. We have not seen the original publication, which included an illustration, and cannot comment on the possible identity of this fungus.


Notes: No type or authentic material could be located in K. The habitat on dung and the drawing published with the protologue are consistent with the present concept of Parascodosporium putredinis (Corda) M. Lackner & de Hoog, although no conidiogenous cells are figured. We designate Figs. 69–91 in the protologue as the lectotype for this name.


Notes: Rifai (1968) clarified the confusion that led to the transfer of C. coralloides to Graphium. The discomycete referred to by this name is not the same fungus as the anamorph observed by Höhn (1909), and thus this epithet cannot be applied to that anamorph. Dennisographium ustulinae (Pat.) Seifert is the appropriate name
for this anamorph, and although *Gr. coralloides* sensu Höhnel is the same fungus, it is not technically a synonym.


*Notes:* A facultative synonym of *Stilbocrea gracilipes* (Tul. & Tul.) Samuels & Seifert. according to Seifert (1985, as *Stilbella*). See additional notes under *Gr. clavulatum* above.


**Notes:** This new name was proposed by Saccardo for *Sporocybe curvulum* (Ellis & Everh.) Sacc., Syll. fung. 4: 606. 1886 ≡ *Cephalotrichum cuneiferum* (Berk. & Broome) Kurtze, Rev. Gen. Pl. 3: 453. 1898.

*Notes:* Seifert (1985) examined the holotype (K) and considered this a synonym of the fungus known as *Parascedosporium putredinis* (Corda) M. Lackner & de Hoog (Lackner & de Hoog 2011). However, the type also has scattered perithecia of what may be a species of *Petriella*; if this is the teleomorph, then the synonymy should be reconsidered.


*Notes:* Petch (1924) located the type of this fungus (Thwaites 342) under the name *Thelephora pedicellata* in K, where it was still filed when KAS visited in 1983. There are no synnemata on the type. The protologue describes 6–7 septate conidia; we observed one pigmented, rostrate, 6-distoseptate conidium, 27 x 5.5 μm. Clearly this is not a species of *Graphium s.str.* or of *Ophiostoma s.l.* and it should be reconsidered, if necessary, in any future revisions of *Arthrobotryum* Ces.


*Notes:* The holotype in K is a synnematous *Nodulisporium* sp. Many described species of *Graphium* are synnematous anamorphs of the *Xylariaceae*, which would until recently have been described in *Nodulisporium* Preuss or *Dematophora* Hartig. Modern species concepts in this family have been derived mostly from teleomorphic characters, and it is generally impossible to correlate these anamorphs with known species of *Hypoxylon*, *Rosellinia* or other teleomorph-defined genera in the family. For this reason, new combinations are not proposed and it is left for future taxonomists studying this family whether any of these anamorph names should be retained.


*Notes:* Described as the anamorph of *Rosellinia desmazerii* (Berk. & Broome) Sacc., this species was distributed in Saccardo’s Mycotheca Venata under number 1574; copies in BR and K are a species of *Dematophora* Hartig. The name was apparently never transferred to *Dematophora*, the genus used for synnematous anamorphs of *Rosellinia*. See notes under *Gr. cylindricum*.


*Notes:* The holotype (ILL 16378) matches the illustration in the protologue, and represents a fasciculate cercosporoid fungus reminiscent of *Phacellum* and similar genera. It is neither a true *Graphium* nor a member of the *Ophiostomatales*.


*Notes:* Hughes (1958) considered this a synonym of *Phaeoisaria clematidis*.


*Notes:* Although the catalogue of Saccardo’s herbarium (Gola 1930) indicates that the type of *Sporocybe eumorphum* exists, we did not receive it when requested in 1983. The protologue includes a drawing generally similar to *Parascedosporium putredinis*, although conidiogenous cells are not shown. Hedgcock (1906) identified some collections from wood in the USA as this species, and described a synanamorph that could either represent the sporothrix-like synanamorph of a species of *Ophiostoma* s.l., or the mononematous, sympodial synanamorphs originally represented by the name *Parascedosporium* (Gilgado et al. 2007). No mention was made of a synanamorph in the original descriptions (Saccardo 1882, 1886), and we doubt that Hedgcock’s specimens actually represented the same species. Fráñger & Hejzlar (1973) identified strains causing human disease with this name and deposited an isolate as CBS 987.73 (= JCM 9753). This was included as a representative for the species by Okada et al. (2000), who showed it grouped in the *‘G. putredinis aggregate’*, and Lackner & de Hoog (2011) noted that the isolate had an identical ITS sequence to the ex-type isolate of *Pseudallescheria apiosperma*. This true identity of *Gr. eumorphum sensu* Saccardo can only be ascertained if the holotype is relocated and re-examined.


*Notes:* The unpublished drawing accompanying the authentic specimens in K suggests a synnematous *Nodulisporium* sp. See notes under *Gr. cylindricum*.

**Graphium fasciculatum** Sacc., Michelia 1: 76. 1877 ≡ *Harpographium fasciculatum* (Sacc.) Sacc., Michelia 2: 33. 1880.

*Notes:* This species is well accepted as the type of *Harpographium* Sacc. (Seifert et al. 2011).

Notes: The holotype (PAD) is not a species of Graphium, and is possibly a species of the synnematous hyphomycete genus Paathramaya Subram.


Notes: De Hoog & Papendorf (1976) examined the holotype (B), and observed percurrent conidiogenous cells and mucoid conidial masses, without providing additional details. An identification with Graphium s.str. or the anamorph of a member of the Ophiostomatales is at least possible. See also Gr. dulcamarae above.


Notes: The holotype is not in PH or BPI. Seifert (1985) considered this a *nomen dubium*. The illustration with the protologue is suggestive of a species of *Cephalotrichum* Link, but the name was not considered in the only modern revision of this genus (Morton & Smith 1963, as Doratomyces).


Notes: The holotype could not be located in Massee’s herbaria in K (Mason & Ellis 1953) or NY (Seifert 1985). Mason & Ellis (1953) examined several specimens identified with this name collected in Great Britain by contemporaries of Massee, and considered them identical with *Exophiala calicicoides* (Fr.) G. Okada & Seifert (as *Graphium*). The synonymy was tentatively accepted by Hughes (1958).


Notes: We were unsuccessful at finding authentic material during a visit to BR in 1983, nor is the type in Gemblix. An SSU sequence of an isolate identified with this name (CBS 107.68 = JCM 9748, not authentic) labelled as *Gr. fructicola* groups within the *Parascedosporium putredinis* complex (Okada et al. 2000). Lackner & de Hoog (2011) did not include this isolate in their study, but suggested that it might represent a species of *Pseudallescheria*.


Notes: The type specimen (LPS 33.135) contains only sterile dematiaceous fascicles of hyphae. Höhnell believed it could be the same as *Stromatographium stromaticum* (Berk.) Höhnell (1909), but this seem unlikely because of the conspicuous, waxy stroma produced by the latter species (Seifert 1987).


Notes: The holotype (PAD) contains no structures matching the protologue, although necrotic leaf spots are present as described. The illustration with the protologue is consistent with the current classification of this species in the synnematous genus Phacellium Bonord.


Notes: Seifert (1985) examined the holotype (NYS) and considered this species a synonym of *Crinula caliciformis* Fr. Because it was published in the same year as Spegazzini’s fungus (below), *Gr. magnum* was introduced as a new name for Peck’s in *Graphium*, although the original description in Stilbium was legitimate.


Notes: The type specimen (LPS 15.262) is a synnematous species of *Nodulisporium*. See notes under *Gr. cylindricum*.


Notes: The holotype is not in Corda’s herbaria in PRM or K. The illustration with the protologue is clearly a synnematous fungus. This, and the occurrence of the species on stems of *Urtica* is suggestive of a member of the *Parascedosporium putredinis* complex. If a member of this complex is shown to have a preference for this substrate, it may be appropriate to take up this name.

Graphium glaucum Preuss, Linnaea 24: 133. 1851.

Notes: The holotype was not received when requested from B in 1984, although it is listed in the catalogue of Preuss’s herbarium (Jülich 1974). The protologue is too vague to allow this fungus to be recognized without examination of the type, if still extant.

Graphium gordoniae Sawada, Special Publication College of Agriculture, National Taiwan University 8: 233. 1959 [nom. inval., Art. 39.1 or 39.2].

Notes: We have not examined the type. The protologue describes, but does not illustrate, a synnematous fungus causing leaf spots on *Gordonia axillaris* in Taiwan. This species clearly does not belong to *Graphium s.str.* or *Ophiostoma* s.l. Validation and reclassification of the name would be an option if a synnematous fungus causing the same symptoms were to be recollected.

Graphium gracile Preuss, Linnaea 24: 56. 1851.

Notes: The holotype (NYS!), on leaves of *Rubus strigosus*, is probably a species of Phacellium. None of the species accepted in the monograph by Braun (1998) are reported from *Rubus*. The species should be reconsidered in future revisions of Phacellium.
**Graphium graminum** Cooke & Massee, Grevillea 16: 11. 1887.

**Notes:** As mentioned previously by Morton & Smith (1963), our examination of the type of *Gr. graminum* (K) confirms the synonymy of this name with *Cephalotrichum microsporum* (Sacc.) P.M. Kirk.


**Notes:** The holotype in Berkeley’s herbarium (K, King’s Cliff, May 1841) is identical with *Cephalotrichum purpureofuscum* (Schw.) S. Hughes, as stated by Morton & Smith (1963).


**Notes:** Saccardo renamed Grove’s species when he transferred it to *Graphium*, because the epithet clavulatum was already occupied by *Graphium clavulatum* (Mont.) Sacc. Mason & Hughes (in Mason & Ellis 1953) transferred Grove’s species to *Phaeoisaria*, where it is now known as *P. clavulata*. The holotype (K) is in very poor condition, but probably represents the fungus now known as *P. clavulata*.


**Notes:** We have not seen the holotype. The species was described from common millet, *Panicum miliaceum*, with graphium-like synnemata and oblong conidia 4–10.5 x 2–3 μm.


**Notes:** The type was not examined by Seifert (1985), but it seems likely that this is a synonym of *Gonatobotryum apiculatum* (Peck) S. Hughes.


**Notes:** We have not seen specimens or the original publication of this species, and cannot comment on its possible identity.


**Notes:** Gams et al. (2010) lectotypified the entomogenous hyphomycete genus *Nematographium* Goid. with this species, after examining the holotype (B).

**Graphium indicum** Chouhan & Panwar, Indian Phytopath. 33: 289. 1980.

**Notes:** The type specimen, IMI 187995, is the fungus renamed above as *Stilbocrea aterrima*, as noted by Seifert (1985, as *Stilbella*).


**Notes:** We have not seen the holotype. Petrak’s detailed description does not refer to a mucoid or liquid conidial mass, which would exclude the species from *Graphium s.str.*


**Notes:** No material could be found in Oudemans’s herbarium (L). The illustration, with its setose capitulum, is suggestive of the synnematous anamorph of *Ophiostoma setosum*, but the illustrated allantoid conidia do not match. There does not seem to be any reason to further consider this name, and we recommend that it be placed on the ‘rejected list’ for the Microascales.


**Notes:** Ellis (1971) considered this is a synonym of *P. griseola* (Sacc.) Ferraris, now known as *Pseudocercospora griseola* (Sacc.) Crous & U. Braun. Our examination of the type specimen of *Gr. laxum* in NY (Harris no. 1363) corroborates this conclusion.

**Graphium leguminum** Cooke, Grevillea 16: 71. 1888.

**Notes:** The holotype of this species (K) on *Rhynchosia tomentosa* is similar to *Phaeccellum carneum* (Oud.) U. Braun as described by Braun (1998), which grows on *Lathyurus pratensis*, a member of the same host family. It should be considered in future revisions of *Phacellum*.


**Notes:** This species was shown to be a synonym of *Parascedosporium putredinis* (Corda) M. Lackner & de Hoog, based on morphological examination and ITS sequencing of the ex-type strain, CBS 108.10 (Lackner & de Hoog 2011).


**Notes:** Morton & Smith (1963) considered this a synonym of *Cephalotrichum purpureofuscum* (Schw.) S. Hughes, although Wallroth’s type has apparently not been re-examined by a modern author.


**Notes:** The holotype in K (and an isotype in NY) demonstrate the synonymy of this species with *Stilbocrea aterrima* (Seifert 1985). See notes under *Gr. curtissii* and *Gr. clavulatum* above.

Notes: The holotype (BO 3486) contains only decapitated synnemata, but the few conidia seen and the presence of collapsed ornamenting cells on the stipes stipulate that this is a synonym of Stilbocrea gracilipes (see above under Gr. clavulata).


Notes: The holotype (BUCM 36807) was examined by Braun (1993b) and the reclassification in Phacellium is accepted here. An isotype is deposited as BPI 448760.


Notes: Our observations of the holotype (NY), and of supplementary authentic material (North American Fungi no. 1384) are consistent with the description by Jong & Morris (1968). The species is clearly not a member of Graphium or a member of the Ophiostomatales, and should probably be classified in Spiropes Cif.


Notes: This is the currently used name for the type species of Sterigmatobotrys Oudem. The holotype (PRM 155517) and the epitype (PRM 915682) extend the species and generic concept to include a teleomorph, were included in the description by Rěblová & Seifert (2011).


Graphium pallescens (Fuckel) P. Magn, Hedwigia 44: 375. 1905 \equiv Stysanus pallescens Fuckel, Symb. p 102. 1869 \equiv Harpographium pallescens (Fuckel) Magnus, l.c., p. 374.

Notes: Specimens distributed by Fuckel in Herb. Fuckel 1894, and Fungi rhenani are of an inconspicuous, hyaline synnematal fungus with Cercospora-like conidiogenous cells and chains of ameroconidia. Morton & Smith (1963) considered the name a nomen dubium after failing to find anything other than an Aspergillus sp. on the type specimen. Their failure to find the fungus was not surprising given its inconspicuous nature. Braun (1993b) considered this species a synonym of Phacellium epispheariae (Desm.) U. Braun, and we accept this synonymy here.
Notes: An isotype specimen in BR is of a symnematous *Nodulisporium*. See notes under *Gr. cylindricum*.


*Notes:* We have not seen material or the original publication of this species, and cannot comment on its identity.


*Notes:* Saccardo (1886) created this superfluous name because he wanted to create the name *Gr. subulatum* based on *Periconia subulata* Nees (see below).


*Notes:* Sefiert (1985) examined the holotype (PRM 155672) but was unable to completely characterize the fungus; it is neither a true *Graphium* nor a member of the *Ophiostomatidae* and may be a basidiomycete similar to *Gr. subinconspicuum*, discussed below.

**Graphium perpusillum** Sacc. & Traverso, Syll. fung. 19: 796. 1910.

*Notes:* See *Graphium pusillum* Sacc. [non (Wallroth) Sacc.] below.


*Notes:* The lectotype (DAOM 34098) and several isotype specimens (BR, K) that we examined of *Graphium* *subinconspicuum*, as revised by Braun (1993a). Based on DNA sequences, Jacobs et al. (2001b) erected a new genus, *Kendrickiella*, with *L. phyllogeum* as type species.


*Notes:* Our examination of an isotype specimen (Fungi Gall. Exs. no. 1781, BR) supports the classification of this species in *Graphiothecium Fückel*, as revised by Braun (1993a).


*Notes:* Contrary to the statement by Seifert (1985), the holotype is in Persoon’s herbarium (L.910.263.994), but it is in very poor condition and contains no synnemata representing the original fungus. Although the name was used by early 19th century mycologists, there is little point in reintroducing it to the modern literature through neotypification, and is should be considered for rejection.


*Notes:* Seifert (1985) was unable to locate the type in PC or G; the diagnosis contains no microscopic measurements. There is little point in reintroducing this name to the modern literature through neotypification, and should be considered for rejection.


*Notes:* The holotype material (LPS 33.136) is identical with *Cephalotrichum microsporum* (Sacc.) P.M. Kirk, and the name is thus a taxonomic synonym of that species.


*Notes:* Seifert (1985) considered this a synonym of *Stilbella flavipes* (Peck) Seifert, based on a study of the holotype (NYS).


*Notes:* The holotype (NY) is in poor condition, and cannot be accurately characterized. However, this fungus seems to be a well known pathogen of *Smilax*, and the illustration with the protologue is consistent with the concept of Ellis (1976).


*Notes:* The type is unavailable from STR, but a slide prepared from it (DAOM 44965) is identical with *Cephalotrichum stemonitis* (Pers.) Nees, as noted by Hughes (1958).


*Notes:* Type material (PAD) contains only the *Brachysporium* sp. mentioned as a cohabitant in the protologue. The figure accompanying the protologue is suggestive of a *Graphium* sp., although the conidia are rather large. It would be difficult to convincingly epitypify this name, and we suggest that the name be rejected.


Descriptions: Grossmann (1931, p. 94); Siemaszko (1939, p. 36, Pl. II Figs 8–9).

Notes: This species is reported as a common associate of Ips typographus and other conifer-inesting bark beetles from Northern Europe (Grossmann 1931, Siemaszko 1939, Mathiesen 1950, Mathiesen-Käärik 1953, Kotýnková-Sychrová 1966, Jankowiak 2006, Jankowiak et al. 2009). Grossman (1931) did not illustrate his species and the illustrations by Siemaszko (1939) show only undetailed microphotographs of synnemata. The hyaline stipe and yellow spore mass reported by Grossman (1931) are not suggestive of either the Ophiostomatales or Graphium s.str. The holotype is not in ZT.


Notes: We have not seen the exsiccatus of this fungus, which should be widely distributed. The published diagnosis is too vague to be helpful at suggesting the identity of this species.


Notes: Seifert (1985) examined Cesati’s holotype (RO), confirming the application of this name as the current name for the type species of Pseudographiella E.F. Morris.


Notes: Based on studies of the holotype (FH) by Seifert (1985), this is a synonym of Cirnula byssogena (Berk. & Broome) Seifert.


Notes: Examination of the holotype (BR) by Seifert (1985) demonstrated that this name is a synonym of Stilbocereus gracilipes (see above under Gr. clavulatum).

Graphium rhodophaeum var. elatius Sacc., Ann. mycol. 9: 257. 1911.

Notes: As reported by Seifert (1985, as Stilbella), the holotype (PAD) is identical with Stilbocereus gracilipes (see above under Gr. clavulatum).


Notes: Although Seifert (1985) reported that he could find no type material of this species in Persoon’s herbarium (L), a slide derived from the type by Hughes (1958) is deposited as DAOM 50951, ex. L 910.264-589. The slide is in poor condition and we could not find conidiogenous cells; the size and shape of the conidia and the length of the synnemata are suggestive of the fungus now known as Exophiala calicoides (see above). The synonymy will have to remain tentative until the type specimen itself is relocated at L. This name, widely reported in the 19th century literature, was used for a variety of species. The emended concept of Hedgcock (1906), represented by BPI 448820, possibly represents more than one fungus, according to Harrington et al. (2001). There is no reason to reintroduce this name into the modern literature by neotypification, and it should probably be proposed for rejection.


Notes: The type is not in PAD. This is the type of the hyphomycete genus Cladographium, described for a graphium-like fungus with highly penicillate conidiophores. The genus was considered of uncertain status by Seifert et al. (2011).

Graphium rubrum Rumbold, Phytopathology 24: 300. 1934.

Notes: SSU sequences from the ex-type strain (CBS 210.34) of this red-spored species, which no longer produces synnemata, placed it among the Leotiomycetes (Okada et al. 2000, Harrington et al. 2001). Harrington et al. (2001) considered BPI 448830 to represent the holotype, but did not provide a description or suggest a reclassification for this species. The only other graphium-like anamorphs in the discomycetes are now classified in Dendrostilbella (see under Gr. smaragdinum below).


Notes: The holotype is not in PAD. The fungus was isolated on agar from the air; it cannot be recognized from the description, and the name should not be taken up unless the type can be located.


Notes: The holotype (LPS 33.137) is identical with Phaeoisaria clematidis, as noted by de Hoog and Papendorf (1976).

Notes: Like Gr. aphpthaeae, noted above, this species is associated with lichens and probably does not belong to *Graphium s.str.* or the Ophiostomatæae. The type will need to be re-examined, and the species will probably be treated in another genus. Its cuneiform, and almost triangular, conidia are distinctive.

**Graphium sessile** Dearn. & House, Circ. N.Y. St. Mus. 24: 59. 1940 [nom. inval., Art. 39.1 or 39.2].

Notes: This species from leaf spots was validated by Braun (1994), but because it clearly does not belong in *Graphium s.str.*, he described it as *Phacellium sessile* U. Braun.


Notes: SSU sequences from an isolate from the original collection (CBS 206.37) of this species are very similar to those of *Gr. rubrum*, placing it among the Leotiomycetes (Okada et al. 2000). However, Harrington et al. (2001), whose ITS sequence suggests Cadophora, were unconvinced that this isolate actually represented the original material of Goidanich (1937), and the status of the species is thus very uncertain.


Notes: This relatively common species is currently classified as Dendrostilbella smaragdina (Helotiales), based on the discovery of a putative undescribed Claussenomyces teleomorph (Okada et al. 2000).


Notes: There is no holotype in BO or PAD. Although the original description mentions Gr. socium as the anamorph of *Peziza stilbum* Fuckel, the later renaming of the fungus as Gr. tjibodense mentioned a similarity with "Gr. desmaziërii" but with globose conidia, reminiscent of *Drumopama girisa* Subram. The contradictory associations reported for Gr. socium with both a discomycete and a pyrenomycete confuse any speculation about its actual identity in the absence of a type.


Notes: The holotype (NYS) is as described by Ouellette & Cauchon (1972); it is a cecosphoroid fungus, perhaps more appropriately classified in Phacellium. The designation of a neotype by Ouellette & Cauchon (1972) was unjustified, because the species is fully recognizable from the holotype.

**Graphium sorbi** House, Bull. N.Y. St. Mus.: 63. 1920 [nom. illegit., Art. 53.1, non Peck 1887]

Notes: We have not seen the holotype of this illegitimate name, described as the cause of a leaf spot on *Pyrus americana*. The habitat and the description make it very unlikely that this is either a true *Graphium* species or a member of the Ophiostomatæae.


Notes: We have not seen the original publication or specimens of this fungus, and cannot comment on its identity.

**Graphium squarrosum** Ellis & Langl., J. Mycol. 6: 36. 1890.

Notes: We have not examined the holotype, which is in BPI. The protologue is suggestive of a species of Phaeoisaria or Harpographium.


Notes: The holotype is not in BR or Gembloux. The habit of this species on dung, and the illustration accompanying the original publication, suggest that it is probably a synonym of Parascedosporium putredinis.


Notes: Seifert (1985) was unable to accurately characterize the fungus from the holotype (K); it is neither a true *Graphium* nor a member of the Ophiostomatæae.


Notes: No authentic material could be traced in PRM or K. The illustration with the protologue is very suggestive of a member of the Parascedosporium putredinis complex.


Notes: There is no type in B, and none is listed by Jülich (1974). The diagnosis is too scanty to allow speculation on the identity of this fungus, and we recommend that the name be rejected rather than neotypified.


Notes: As stated by Seifert (1985), there is no type in Corda’s herbaria (PRM, K). Corda’s illustration is consistent with the usage of this species name by Matsushima (1975), possibly representing one of a complex of common lignicolous species similar to the basidiomycetous teleomorph genus Stilbotulasnella Oberw. & Bandoni or the similar anamorph genus Basidiocynides J. Reid, Eyjólfsd. & G. Hausner. See also Gr. pelitnopsis.
Graphium subtle Berl., Bull. mycol. Soc. Fr. 8: 111. 1892.

Notes: The holotype is not in PAD and we have not seen the original publication, which includes an illustration. We cannot comment on its possible identity.


Notes: The holotype is not in PAD. The fungus was described from immature pear fruit from Italy and, if recollected, should be recognizable by its synnemata about 1100 μm tall, and obovate conidia 6–7 x 3–3.5 μm.


Notes: Although there are specimens with this name in the herbaria of Cooke and Grove (K), none are authentic, and we have not found a holotype. No microscopic details are part of the protologue of this fungus found on stalks of Rubus, but the subulate stipe terminating with free conidiophores is more suggestive of a Phaeosaria than of a species of true Graphium. Saccardo's superfluous name is discussed above.


Notes: This can be inferred as a synonym of Cephalotrichum stemonitis, based on a statement by Corda (1829) that his Doratomyces neessii, now considered a synonym of C. stemonitis (Morton & Smith 1963), was the same as Nees's P. subulata. To our knowledge, the holotype of Nees has not been re-examined by a modern author.


Notes: This species was considered a synonym of Parascedosporium putredinis (Corda) M. Lackner & de Hoog (Lackner & de Hoog 2011), based on ITS sequences and examination of the ex-type culture (CBS 127.84). We examined the holotype (IMI 95673d) and agree with this conclusion.


Notes: The holotype (PRM 155520) contains only a fungus similar to Cephalotrichum purpureofuscum (Fr.) S. Hughes. This does not correspond with Corda's original illustration, which is of a mononematous fungus. This fungus is clearly not a member of Graphium s.str.


Notes: Authentic material (IMI 161970) is in very poor condition, and the original culture was apparently not preserved. The synnemata are extremely tiny and although the oblong conidia are similar to those of the Gr. penicillioides complex, no conidiogenous cells were observed. The soil habitat would be unusual for a member of Graphium in the strict sense.


Notes: See under Gr. socium above.


Notes: Our observations from the holotype (HBG) are consistent with the redisposition of the species in Phacellium.


Notes: The holotype was unavailable from STR, but slides derived from it (DAOM 49092) are Cephalotrichum stemonitis (Pers.) Nees, as stated by Hughes (1958).


Notes: Authentic material distributed by Rabenhorst (Herb. myc., ed. 1, no. 1750, BR!) is of an unidentifiable species of Ophiostoma or Ceratocystis. The name has become entangled with Cenangium umbellatum Ces., which is a coincidental epithet based on a different exsiccatum.

Graphium ungeri Sacc., Syll. fung. 15: 53 ≡ Graphium penicillioides var. ungeri Sacc., Syll. fung. 4: 610. 1886.

Notes: We have not seen the type of this fungus. Saccardo (1886) based his variety on a drawing by Unger (1847), which shows a synnema with dark brown, seta-like hyphae on the outside of the stipe, growing towards the capitulum, reminiscent of the anamorph of Ophiostoma setosum or O. cupulatum. Examination of Unger’s specimen would be required to determine whether this provides an earlier name for one of these species, or whether it is something different.


Notes: The type specimen (LPS 26.842) contains no identifiable synnematosus fungi but the unpublished drawing on the packet suggests a synnematosus Nodulisporium sp. See notes under Gr. cylindricum.


Notes: The type specimen (LPS 26.833) is a synnematosus Nodulisporium sp. See notes under Gr. cylindricum. Hedgcock (1906) emended the species, but Harrington et al. (2001) found that the material (BPI 448820) on which Hedgcock (1906) based his emended species description might consist of more than one fungus. Because Spegazzini’s material is still available, Hedgcock’s emendation is irrelevant and the species should be considered in any future revision of Nodulisporium.

Notes: Our observations from the holotype (HBG) are consistent with the reclassification of this species in Phacellium by Braun (1983b).


Notes: The holotype is not in B (Seifert 1985). The fungus cannot be recognized from the protologue. There is no point in reintroducing this name to the modern literature, and it should be considered for rejection.

C.2. EXCLUDED SPECIES DESCRIBED IN OTHER GENERA


Notes: Harrington et al. (2010) suggested that this fungus is best treated in Fusarium (Hypocreales), which it was initially described (Ellis & Everhart 1888), but it is not treated in any of the modern literature on that genus. The illustration by Hawksworth (1979) shows sinate apices on the conidiogenous cells, perhaps suggestive of species of Plectophaerella Kleb.


Notes: According to Hunt (1956), the description of this species is similar to those of G. penicillata and G. serpens. However, the protologue does not describe any anamorph and shows persistent ascis, suggesting this species does not belong to either Ceratocystis or any of the genera in the Ophiostomatales, but perhaps in Ceratostomella where it was initially described.


Notes: Excluded from Raffaelea by Sutton (1975) and Harrington et al. (2010). An ITS sequence (AM492786) produced for this ex-type of this species (CBS 100.26) by Gilgado et al. (2008) BLASTs to unknown basidiomycetes, while the ITS (HQ185356) and β-tubulin (HQ231813) sequences of the isolate produced by Lackner & de Hoog (2011), match with those of several isolates of Scedosporium dehoogii Gilgado, Cano, Gené & Guarro. The isolate is also stored in MUCL (MUCL 15755), and LSU (EU984260) and SSU (EU294300) sequences produced by Massoumi Alamouti et al. (2009) BLAST with more than 97 % similarity to Heleiopsis (Pleosporales), while the β-tubulin sequence from the same isolate BLASTs with 90 % (HQ231813) to L. elegans and other Ophiostoma spp. Both isolates thus need to be re-assessed to determine whether they still represent the type of R. castellanii.


Notes: The first phylogeny produced for Leptographium based on DNA sequences showed that L. costaricense grouped somewhat distant from other Leptographium spp. (Jacobs et al. 2001d). We found that the LSU and ITS2 sequences for L. costaricense from that study closely resemble those of Phialocephala humicola and Ph. fusca. Grünig et al. (2002) produced an ITS phylogeny showing that Phialocephala is polyphyletic, and that Ph. fusca and Ph. humicola do not group with the type species of the genus, Ph. dimorphospora, in the Helotiales (Wang et al. 2006), but in a lineage that they tentatively assigned to the Lasiosphaeriaceae. In a more extensive study, Jacobs et al. (2003a) suggested with LSU and SSU data that Ph. fusca and Ph. humicola grouped in the Ophiostomatales. However, BLAST results and preliminary analyses of the ITS2 and LSU regions (data not shown) suggest that these three species belong in the Chaetosphaeriaceae with Ph. fusca grouping closely to the type species for Chaetosphaeria, Chaetosphaeria innumera. The sequences of L. costaricense and Ph. humicola differ only in a few bp and they might actually be one species. If further study confirms this, L. costaricense will become a synonym of Ph. humicola, the older of the two names (Jong & Davis 1972).


Notes: Currently treated as a species of Quambalaria (De Beer et al. 2006).

Ophiostoma echinellum (Ellis & Everh.) Syd., In Sydow & Sydow, Annls mycol. 17: 43. 1919 ≡ Ceratostomella echinella Ellis & Everh., N. Amer. Pyren., p. 195. 1892.

Descriptions: Hedgcock (1906, pp 69–71, Pl. 3 Fig. 3, Pl. 6 Fig. 1); Danilova (1979, p. 137, Fig. 5).

Notes: The species concept was emended by Hedgcock (1906), but it was treated as synonym of O. piliiferum by Griffin (1968), Ochoweczi & Reid (1974), Upadhay (1981), Hutchison & Reid (1988a) and Seifert et al. (1993). Hunt (1956) studied the authentic material (BPI) and concluded that it has persistent ascis and thus excluded it from Ceratocystis. Danilova (1979) reported Ceratostomella echinella from Russia, and also described it with persistent ascis. The species was not mentioned in the studies on Ceratostomella by Réblóva (2006) and Réblóva & Stepánek (2009).


Notes: S. flocculosa is the anamorph of Pseudozyma flocculosa (Traquair, L.A. Shaw & Jarvis) Boekhout & Traquair (≡ Stephanoascus flocculosus Traquair, L.A. Shaw & Jarvis) in the Ustilaginales (Boekhout 1995).


Notes: The teleomorph of this species has never been described (Stevens & Peterson 1916). According to Hausner & Reid (2004), Maas (1998) suggested that Sph. fragariae is a synonym of Phomopsis obscurans (Ellis & Everh.) B. Sutton. Sequence data of
the syntype (CBS 118.16) showed that it groups in the Diaporthales (Hausner & Reid 2004, De Beer et al. 2013).


**Notes:** Currently treated as *Togninia fraxinopennsylvania* (T.E. Hinds) Hausner, Eyjólfsdóttir & J. Reid in the Calosphaeriales (Hausner et al. 1992a, Mostert et al. 2003).


**Notes:** The ex-type isolate of this species was shown to produce asci with ascospores in yeasty culture, and it was thus suggested to be the anamorph of *Stephanosascus farinosus* de Hoog, Randl.-Leht. & M.T. Sm. (Traquair et al. 1988).

**Viennotidia gliocladiopsifera** Matsush., Matsush. Mycol. Mem. 10: 118. 2003 [as *Vieennotidea*]

**Notes:** Matsushima (2003) described this species as the teleomorphic *Gliocladiopsis tenuis* (Buginic.) Crous & M.J. Wingf. Lombard & Crous (2012) showed that the latter species groups in the *Gliocladiopsis* (Nectriaceae, Hypocreales). *V.gliocladiopsifera* should be treated under the Melbourne Code a synonym of *Gl. tenuis*, and is as such excluded from *Viennotidia*, which is a synonym of *Sphaeronaemella*.

**Leptographium hymenaeae** A. Ram & C. Ram, Broteria 41: 94. 1972.

**Notes:** Both Harrington (1988) and Jacobs & Wingfield (2001) questioned the treatment of this species from *Hymenaea* in Brazil in Leptographium. It produces chlamydospores, seta-like structures at the base of the conidiophores, and phialidic conidigenous cells, all characters not typically associated with *Leptographium* spp.


**Notes:** De Hoog (1974) validated this species but treated it in the genus *Nodulisporium*.

**ACKNOWLEDGEMENTS**

We thank the following colleagues and friends who provided us with invaluable assistance in searching for and/or supplying copies or translations of rare publications: Alex Akulov, Annamarie Bezuidenhout, Hanneliette Boshoff, Arturo Goldarazena, Miroslav Kolarik, Francina Laka, Rikka Linnakoski, Rachel Mahlangu, Hayato Masuya, Vladimir Milnik, Josephine Modiba, Tuomo Niemelä, Guillemo Perez, Pedro Romon, Evgeny Sidorov, Maríê Theron, Mareleize van Wyk, and Annie Yart. We acknowledge funding from the National Research Foundation, the DST/NRF Centre of Excellence in Tree Health Biotechnology (CTHB), South Africa, as well as the South Africa/Norway bilateral research agreement. Many of the notes on excluded Graphium species resulted from the doctoral research of KAS in the early 1980s, and he expresses warm thanks to Rob Samson, Walter Gams and Sybren de Hoog for many discussions on synnematous fungi, and the entire staff of CBS for their contributions to his work for the past three decades. He also thanks Gen Okada, now of the Japan Collection of Microorganisms, for similar collaboration over the same time period. The curators of B, BO, BP, BRI, BUCM, C, DAOM, FH, HBG, ILL, IMI, K, L, LPS, NYS, PAD, PC, PRM, RO, S, STR, UPS, W and ZT are acknowledged for providing authentic and type specimens on loan.

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