Outlineoffungi.org - Note 994 *Ceratobasidiaceae*

Web-links: Index Fungorum, Facesoffungi, MycoBank, GenBank

Note: issues around the names *Ceratobasidium* and *Ceratobasidiaceae*

Ceratobasidiaceae Martin (1948) was established based on the genus *Ceratobasidium* D.P. Rogers as typified by the species *C. calosporum* D.P. Rogers (1935). More than 40 species have been described subsequently in *Ceratobasidium*. The family *Ceratobasidiaceae* was treated by Jülich (1982) as also including *Koleroga* Donk, *Oliveonia* Donk, *Scotomyces* Jülich, *Thanatephorus* Donk, *Uthatobasidium* Donk and *Ypsilonidium* Donk. In the 2021 (Outline of Fungi), Wijayawardene et al. (2022) listed the following genera under *Ceratobasidiaceae*: *Ceratobasidium*, *Ceratoporia* Ryvarden & de Meijer, *Ceratorhiza* R.T. Moore, *Rhizoctonia* DC, *Scotomyces* and *Thanatephorus* Donk.

Oberwinkler et al. (2013) examined the holotype of *Ceratobasidium calosporum* and revealed several discordant ultrastructural and micromorphological characters. *Ceratobasidium calosporum* exhibits partially to completely longitudinally septate basidia, long vermiform basidiospores, and dolipores with continuous parenthesomes. In contrast, all other species described as *Ceratobasidium* have aseptate basidia, globose to ellipsoid basidiospores, and dolipores with discontinuous parenthesomes (Oberwinkler et al. 2013; Roberts 1999). Oberwinkler et al. (2013) concluded that *Ceratobasidium* should only be applied to *C. calosporum*, and the genus was more appropriately placed in the *Sebacinaceae* K. Wells & Oberw. based on shared characters between *C. calosporum* and *Sebacina calospora* (Bourdot & Galzin) Bourdot & Galzin, also known as *Ceratosebacina calospora* (Bourdot & Galzin) P. Roberts. Based on morphological characteristics, including hyphal diameter and branching pattern along with basidial shape, Roberts (1999) recognized both *Ceratobasidium* and *Thanatephorus*, placing a number of genera under *Thanatephorus*, including *Cejpomyces, Aquathanatephorus* C.C. Tu & Kimbr., *Oncobasidium*, *Tofispora* G. Langer, *Uthatobasidium* and *Ypsilonidium*; and placing *Koleroga* under *Ceratobasidium*. Roberts (1999) recognized the asexual states of *Ceratobasidium* and *Thanatephorus* as *Ceratorhiza* and *Rhizoctonia* respectively.

In contrast to the morphological distinction between *Ceratobasidium* and *Thanatephorus*, phylogenetic analyses of molecular data have repeatedly demonstrated that there is a single lineage that contains many species described in *Ceratobasidium* (other than the type) along with the type species of *Rhizoctonia* and *Thanatephorus*, and despite their placement within this lineage, there are not monophyletic groups corresponding to the morphologically-defined genera (Cruz et al. 2022; de Melo et al. 2018; Diederich et al. 2014; Gonzalez et al. 2001; Oberwinkler et al. 2013; Veldre et al. 2013). Thus, it is necessary to recognize a single genus in which *Rhizoctonia* is the earliest name, and *Thanatephorus* a synonym, as accepted by Stalpers et al. (2021). Sequence data confirms the synonymy of the following genera under a broadly circumscribed *Rhizoctonia*: *Aquathanatephorus* (Vu et al. 2019, under *Thanatephorus*), *Ceratorhiza* (Taylor et al. 2003, as "*Ceratobasidium goodyerae-repentis*", nom. inval.; Xu et al. 2010a), *Koleroga* (Ceresini et al. 2012, under *Ceratobasidum*), *Oncobasidium* (Samuels et al. 2012, under *Ceratobasidium*) and *Uthatobasidium* (Roberts 1999, under *Thanatephorus*; Hibbett & Binder 2002). Morphology remains the rationale for accepting the placement under *Rhizoctonia* of *Cejpomyces*, *Tofispora* and *Ypsilonidium*. We note that despite the fact that *Ceratobasidium* is not an appropriate genus for members of the *Rhizoctonia* clade, new species continue to be described under this outdated generic name (Cruz et al. 2022; de Melo et al. 2018; Diederich et al. 2014).

Because the type species of the type genus of *Ceratobasidiaceae* does not fall in the *Rhizoctonia* lineage, technically the name *Ceratobasidiaceae* cannot be applied to it and the correct family name is *Cejpomycetaceae* Jülich (1982), which was created to accommodate the genus *Cejpomyces* Svrček & Pouzar (1970), a synonym of *Rhizoctonia* (Langer 1994; Oberwinkler et al. 2013; Roberts 1999). However, *Cejpomycetaceae* has been used very rarely — a Google Scholar search gives only two hits compared to more than 5,000 hits for *Ceratobasidiaceae*. A further consequence of the placement of *Ceratobasidium* (in the sense of the type) in *Sebacinaceae*, is that the name for that family should technically be *Ceratobasidiaceae* as this name was introduced in 1948 while *Sebacinaceae* dates from 1982.

It would be highly confusing to replace the widely used family name *Sebacinaceae* with *Ceratobasidiaceae*, a family name that until recently was used in a quite different sense (i.e. for what is now technically *Cejpomycetaceae*). In order to retain the use of *Ceratobasidiaceae* for most species described within it and to avoid replacement of *Sebacinaceae*, the conservation of *Ceratobasidium* with a conserved type will avoid disadvantageous nomenclatural changes and a proposal to that end will be submitted shortly. *Ceratobasidium sphaerosporum* Warcup & P.H.B. Talbot [now *Rhizoctonia sphaerospora* (Warcup & P.H.B. Talbot) Oberw., R. Bauer, Garnica, R. Kirschner] would be an appropriate type, as there is a sequence available that confirms its position inside the *Rhizoctonia* clade (Gónzalez et al. 2016). Should a proposal to conserve *Ceratobasidium* with *C. sphaerosporum* as a type be successful, *C. calosporum* will need to be placed in another genus. Of the other genera one time included in the *Ceratobasidiaceae*, *Oliveonia* is placed in the *Oliveoniaceae* in molecular phylogeny (Cao et al. 2021), within the *Auriculariales* J. Schröt. (Cao et al. 2021; Olariaga 2021; Roberts 1998). Reliable sequence data is lacking for *Ceratoporia* and *Scotomyces*. Descriptions for these latter two genera state that both genera have clamp connections, while *Ceratobasidiaceae* is circumscribed as not having clamp connections (Jülich 1982; Roberts 1999). On this basis, *Ceratoporia* and *Scotomyces* should be excluded from *Ceratobasidiaceae* but their systematic position within *Cantharellales* is uncertain at this time.

References

Cao T, Hu YP, Yu JR, Wei TZ, Yuan HS. 2021 – A phylogenetic overview of the Hydnaceae (*Cantharellales*, *Basidiomycota*) with new taxa from China. Studies in Mycology 99, 100121. https://doi.org/10.1016/j.simyco.2021.100121

Ceresini PC, Costa-Souza E, Zala M, Furtado EL, Souza NL. 2012 – Evidence that the *Ceratobasidium*-like white-thread blight and black rot fungal pathogens from persimmon and tea crops in the Brazilian Atlantic Forest agroecosystem are two distinct phylospecies. Genetics and Molecular Biology 35(2), 480–497. https://doi.org/10.1590/S1415-47572012005000032

Cruz EDS, Freitas EFS, Silva MD, Pereira OL, Kasuya MCM. 2022 – A new mycorrhizal species of *Ceratobasidium* (*Ceratobasidiaceae*) associated with roots of the epiphytic orchid *Gomesa recurva* from Brazilian Atlantic Forest. Phytotaxa 550(3), 224–32. https://doi.org/10.11646/phytotaxa.550.3.2

de Melo MP, Matos KS, Moreira SI, Silva FF et al. 2018 – Two new *Ceratobasidium* species causing white thread blight on tropical plants in Brazil. Tropical Plant Pathology 43(6), 559–571. https://doi.org/10.1007/s40858-018-0237-x

Diederich P, Lawrey J, Capdet M, Pereira S et al. 2014 – New lichen-associated bulbil-forming species of Cantharellales (*Basidiomycetes*). The Lichenologist 46, 333–347. https://doi.org/10.1017/S0024282913000583

Gonzalez D, Carling, DE, Kuninaga S, Vilgalys R,Cubeta MA. 2001 – Ribosomal DNA Systematics of *Ceratobasidium* and *Thanatephorus* with *Rhizoctonia* anamorphs. Mycologia 93(6), 1138–1150. https://doi.org/10.2307/3761674

Gónzalez D, Rodriguez-Carres M, Boekhout T, Stalpers J et al. 2016 – Phylogenetic relationships of *Rhizoctonia* fungi within the Cantharellales. Fungal Biology 120(4), 603–619. https://doi.org/10.1016/j.funbio.2016.01.012

Hibbett DS, Binder M. 2002 – Evolution of complex fruiting–body morphologies in homobasidiomycetes. Proceedings of the Royal Society of London. Series B: Biological Sciences 269(1504), 1963–1969. https://doi.org/10.1098/rspb.2002.2123

Jülich W. 1982 – Higher Taxa of Basidiomycetes (Vol. 85). J. Cramer.

Langer G. 1994 – Die gattung Botryobasidium Donk (*Corticiaceae*, *Basidiomycetes*). Schweizerbart Science Publishers. http://www.schweizerbart.de//publications/detail/isbn/9783443590604/Bibliotheca_Mycologica_Band_158

Martin GW. 1948 – New or noteworthy tropical fungi IV. Lloydia, 11, 111–122.

Oberwinkler F, Riess K, Bauer R, Kirschner R, Garnica S. 2013 – Taxonomic re-evaluation of the *Ceratobasidium-Rhizoctonia* complex and *Rhizoctonia butinii*, a new species attacking spruce. Mycological Progress 12(4), 763–776. https://doi.org/10.1007/s11557-013-0936-0

Olariaga I. 2021 – Cantharellales Gäum. In Ó. Zaragoza & A. Casadevall (Eds.), Encyclopedia of Mycology (pp. 320–328). Elsevier. https://doi.org/10.1016/B978-0-12-819990-9.00056-1

Roberts P. 1998 – *Oliveonia* and the origin of the *holobasidiomycetes*. Folia Cryptogamica Estonia 33, 127–132.

Roberts P. 1999 – *Rhizoctonia*-forming Fungi: A Taxonomic Guide. Herbarium, Royal Botanic Gardens Kew.

Rogers DP. 1935 – Notes on the lower basidiomycetes. Studies in Natural History, Iowa University, 17(1), 1–43.

Samuels GJ, Ismaiel A, Rosmana A, Junaid M et al. 2012 – Vascular Streak Dieback of cacao in Southeast Asia and Melanesia: In planta detection of the pathogen and a new taxonomy. Fungal Biology 116(1), 11–23. https://doi.org/10.1016/j.funbio.2011.07.009

Stalpers JA, Redhead SA, May TW, Rossman AY et al. 2021 – Competing sexual-asexual generic names in *Agaricomycotina* (*Basidiomycota*) with recommendations for use. IMA Fungus 12(1), 22. https://doi.org/10.1186/s43008-021-00061-3

Svrček M, Pouzar Z. 1970 – *Cejpomyces* gen. nov., a new genus of resupinate *Hymenomycetes* (*Corticiaceae*). Česka Mykologie 24(1), 5–11.

Veldre V, Abarenkov K, Bahram M, Martos F et al. 2013 – Evolution of nutritional modes of *Ceratobasidiaceae* (*Cantharellales*, *Basidiomycota*) as revealed from publicly available ITS sequences. Fungal Ecology 6(4), 256–268. https://doi.org/10.1016/j.funeco.2013.03.004

Vu D, Groenewald M, de Vries M, Gehrmann T et al. 2019 – Large-scale generation and analysis of filamentous fungal DNA barcodes boosts coverage for kingdom fungi and reveals thresholds for fungal species and higher taxon delimitation. Studies in Mycology 92, 135–154. https://doi.org/10.1016/j.simyco.2018.05.001

Wijayawardene N, Hyde K, Dai DQ, Sanchez-Garcia M et al. 2022 – Outline of Fungi and fungus-like taxa – 2021. Mycosphere 13, 53–453. https://doi.org/10.5943/mycosphere/13/1/2

Xu Z, Harrington TC, Gleason ML, Batzer JC. 2010 – Phylogenetic placement of plant pathogenic *Sclerotium* species among teleomorph genera. Mycologia 102(2), 337–346. https://doi.org/10.3852/08-189.

Entry by
Ryan P. O'Donnell Division of Ecology & Evolution, Research School of Biology, Australian National University, Canberra ACT, 2612, Australia
Tom W. May Royal Botanic Gardens Victoria, Melbourne VIC 3004, Australia

(Edited by: **Kevin D. Hyde** & **Maryam Tavakol Noorabadi**)

Published online 5 April 2024