Morphotaxonomic revision of fungicolous *Cladosporium* species (hyphomycetes)

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Abstract: HEUCHERT, B., BRAUN, U. & SCHUBERT, K. (2005): Morphotaxonomic revision of fungicolous *Cladosporium* species (hyphomycetes). Schlechtendalia **13**: 1–78.

The present work is part of a comprehensive monographic examination of the genus *Cladosporium* s. lat., in which all species classified in literature to be fungicolous are treated. By means of light and scanning electron microscopy, it could be demonstrated that most of the taxa concerned are true members of *Cladosporium* s. str. The generic affinity of the excluded species is discussed if known.

Comprehensive descriptions, illustrations and commentaries are provided for the true fungicolous species of *Cladosporium* s. str., characterised by having coronate conidiogenous loci and hila. Known host range and distribution data are added.

Cladosporium gerwasiae sp. nov. and *C. exobasidii* var. *verruculosum* var. nov. are described, and *C. exoasci* is reduced to synonymy with *C. phyllophilum*.

Some common widespread saprobic *Cladosporium* species, which have already been treated in detail by previous authors, are briefly described, and collections and records pertaining to fungi as substrates are critically discussed. Those species which have been little treated in literature are comprehensively described and illustrated. Special attention has been paid to *Cladosporium tenuissimum* since this species has often been considered in literature to be hyperparasitic. For species names lacking association with type, authentic or representative specimens, we have documented or reproduced the original description and supplied commentaries.

The new genera *Digitopodium* and *Parapericoniella* are introduced, with the new combinations *Digitopodium hemileiae* (≡ *Cladosporium hemileiae*) and *Parapericoniella asterinae* (≡ *C. asterinae*). These taxa are also described, illustrated and discussed in detail.

A tabular key to the fungicolous *Cladosporium* species, based on substrates, is provided. A general dichotomous key, based on morphology and ecology, contains fungicolous species and some common saprobic ones often occurring on other fungi.

Zusammenfassung: HEUCHERT, B., BRAUN, U. & SCHUBERT, K. (2005): Morphotaxonomische Revision fungicoler *Cladosporium*-Arten (Hyphomyceten). Schlechtendalia **13**: 1–78.

Vorliegende Arbeit ist Teil einer umfassenden monographischen Bearbeitung der Gattung *Cladosporium* s. lat., in der alle in der Literatur als pilzbewohnend klassifizierte Taxa revidiert werden. Licht- und rasterelektronenmikroskopische Untersuchungen zeigten, dass die meisten Arten echte Cladosporien s. str. sind. Bei auszuschließenden Arten wird die Gattungsverwandtschaft diskutiert, so weit sie geklärt werden konnte.

Umfassende Beschreibungen, Abbildungen und Diskussionen werden für alle echten, durch coronate Loci und Hila gut charakterisierte, fungicole Arten geboten. Angaben zum Wirtsspektrum und zur Verbreitung werden beigefügt.

Cladosporium gerwasiae sp. nov. und *C. exobasidii* var. *verruculosum* var. nov. werden beschrieben, und *C. exoasci* wird als Synonym von *C. phyllophilum* behandelt.

Einige häufige, weit verbreitete saprophytische *Cladosporium*-Arten, die bereits von anderen Autoren umfassend abgehandelt worden sind, werden nur kurz beschrieben und Kollektionen solcher Sippen

von Pilzen als Substrat werden kritisch diskutiert. Arten, die in der Literatur bisher kaum Beachtung gefunden haben, werden ausführlich behandelt. *Cladosporium tenuissimum* wird etwas ausführlicher diskutiert, da diese Art in der Literatur oft als hyperparasitisch angegeben worden ist. Arten, von denen weder Typusmaterial noch andere Kollektionen untersucht werden konnten, werden als unklare Sippen eingestuft (Status unklar). In solchen Fällen werden die Originalbeschreibung und weiterführende Literaturangaben angeführt.

Die neuen Gattungen *Digitopodium* und *Parapericoniella* mit den neuen Kombinationen *Digitopodium hemileiae* (≡ *Cladosporium hemileiae*) und *Parapericoniella asterinae* (≡ *C. asterinae*) werden eingeführt, mit ausführlichen Beschreibungen, Abbildungen und Diskussionen zu diesen Taxa. Ein tabellarischer Schlüssel zu den fungicolen *Cladosporium*-Arten auf Grundlage der Substrate und ein allgemeiner dichotomer Schlüssel nach morphologischen und ökologischen Merkmalen, der fungicole und auch einige oft auch auf Pilzen vorkommende saprophytische Arten enthält, werden beigefügt.

Key words: Anamorphic fungi, taxonomy, new species, new combinations, *Cladosporium gerwasiae* sp. nov., *Digitopodium* gen. nov., *D. hemileiae*, *Parapericoniella* gen. nov., *P. asterinae*.

Contents

1. Introduction

The genus *Cladosporium* Link is one of the largest genera of hyphomycetes. Previous descriptions and delimitations vis-à-vis similar genera have been vague and imprecise. Numerous superficially similar, pigmented hyphomycetes with amero- to phragmosporous conidia formed in acropetal chains have been placed in *Cladosporium* s. lat., which made this genus very heterogeneous. Based on detailed SEM examinations, DAVID (1997) demonstrated that true *Cladosporium* species (incl. *Heterosporium* Klotzsch ex Cooke) are clearly characterised by a uniform structure of coronate conidiogenous scars. The conidiogenous loci and conidial hila are protuberant and possess a central convex dome, surrounded by a raised periclinal rim. Comprehensive molecular analyses of ITS sequence data showed that within a big *Mycosphaerella* Johanson clade true *Cladosporium* anamorphs formed a monophyletic sister group

to *Mycosphaerella* with cercosporoid anamorphs (100 % bootstrap support). The new teleomorph genus *Davidiella* Crous & U. Braun was introduced for teleomorphs having anamorphs of *Cladosporium* s. str. (BRAUN et al. 2003). Human-pathogenic *Cladophialophora* Borelli species and *Venturia* Sacc. anamorphs proved to be non-congeneric with *Cladosporium* s. str.

Based on the morphological reassessment of *Cladosporium* s. str. and the molecular support of its new circumscription, it is now possible to prove the generic affinity of the numerous species assigned to *Cladosporium* s. lat. A *Cladosporium* checklist published by DUGAN et al. (2004) contains 772 names. A comprehensive revision of the taxa concerned, including re-examinations of type collections, is essential and will entail detailed morphological analyses, redescriptions, and molecular-genetic studies. Many *Cladosporium* species are very common cosmopolitan fungi. The minute conidia, usually formed in branched chains, are well adopted to be spread easily over long distances and form the most common component of spores in air (FARR et al. 1989, MULLINS 2001, FLANNIGAN 2001). Many *Cladosporium* anamorphs are plant pathogens, other species spoil food or damage industrial products (HO et al. 1999). The common saprobic members of this genus, like *Cladosporium herbarum* (Pers.: Fr.) Link (type species of the genus) and *C. cladosporioides* (Fresen.) G.A. de Vries, are very common in soil, waste and on fading and dead leaves, and they are also known to be common endophytes (RIESEN & SIEBER 1985, BROWN et al. 1998, EL-MORSY 2000). *C. herbarum* is also a common contaminant in clinical laboratories and causes allergic lung mycoses (DE HOOG et al. 2000).

Fungicolous taxa, which use other fungi as substrate, are a well delineated group within the genus *Cladosporium*. 26 species have been described as confined to fungi. Such fungi have been increasingly used in agriculture and forestry as agents for biological control (SHARMA et al. 2002) since they have a certain influence on the germination rates of their substrates, e.g., in rust fungi (ASSANTE et al. 2004). Up to now only few modern descriptions of the fungicolous *Cladosporium* species have been published. MORGAN-JONES & MCKEMY (1990) examined *Cladosporium uredinicola* Speg. and BRAUN (2001) dealt with *C. exobasidii* Jaap.

It was the aim of the present work to re-examine all fungicolous species of the genus *Cladosporium*, to prove the generic affinity of the taxa concerned and to provide detailed descriptions and illustrations. This work is meant to be a contribution towards a monograph of *Cladosporium* s. lat. Whenever possible, the taxonomic affinity of excluded species has been clarified. Various common cosmopolitan saprobic *Cladosporium* species may occur on fungal fruit bodies or other fungal fructifications, sometimes together with specific fungicolous taxa. In some literature, such species have been termed ‘hyperparasitic’. Therefore, the saprobic species concerned have been taken into consideration and included in the present studies.

Type collections, if available, and additional collections from herbaria as well as new collections made during the course of the present work have been examined by means of light microscopy to circumscribe the variability of the species concerned. In critical cases, SEM has been used to study the structure of the conidiogenous loci and hila, above all to elucidate the generic affinity.

2. Generic history and generic description

2.1. Generic history

The genus *Cladosporium* was introduced in 1816 by Link, who assigned *Dematium herbarum* Pers. and *D. abietinum* Pers. to his new genus, together with two new species. CLEMENTS & SHEAR (1931) proposed *Cladosporium herbarum* as lectotype, and DE VRIES (1952) and HUGHES (1958) followed. LINK (1824) listed seven *Cladosporium* species, RABENHORST (1844) described 23 species, and SACCARDO (1886) treated 110. The genus *Cladosporium* thus encompassed a steadily growing number of species. Up to 1931, 270 species had been listed in the various volumes of Saccardo's 'Sylloge Fungorum'. Most of the diagnoses of the species concerned are very brief and imprecise. Since 1950, more than 130 new species of *Cladosporium* have been introduced (MORGAN-JONES & MCKEMY 1990). PRASIL & DE HOOG (1988) estimated the number of *Cladosporium* to be around 540 species. Uncertainties about the true number of species in *Cladosporium* have been caused by the strong morphological variability of most species, the occurrence of many species on a wide range of substrates, and the imprecise, wide circumscription of this genus in the previous literature. All kinds of superficially similar, unrelated dematiaceous hyphomycetes with amero- to phragmosporous conidia formed in acropetal chains have been assigned to *Cladosporium* s. lat. DE VRIES (1952) examined *Cladosporium* in vitro and described the features of nine species. ELLIS (1971, 1976), who followed a very wide concept of *Cladosporium*, described and depicted 43 species.

All members of the genus *Heterosporium* are phytopathogenic and cause leaf spots. Based on characteristically large conidia, usually formed singly, and mostly rather coarse, fasciculate conidiophores often emerging through stomata, several authors considered *Heterosporium* a genus distinct from *Cladosporium* (e.g., ARX 1983; MCKEMY & MORGAN-JONES 1990). DE VRIES (1952) did not recognise this separation and reduced *Heterosporium* to synonymy with *Cladosporium*. ARX (1981) reintroduced this genus. Comprehensive examinations within the *Mycosphaerella* complex showed that the structure of the conidiogenous loci and conidial hila and the pigmentation of the conidiophores and conidia play an important role for the generic delimitation of their anamorphs. During the course of monographic studies in the genus *Heterosporium*, DAVID (1997) carried out SEM examinations of the structures of the conidiogenous loci and conidial hila which revealed that *Heterosporium* and *Cladosporium* are congeneric. BRAUN et al. (2003) confirmed this result by molecular data. *Heterosporium* was considered a subgenus of *Cladosporium* (DAVID 1997). True species of *Cladosporium* s. str. are easily distinguishable from species of similar genera by a unique scar type, initially described by ARX (1983). ROQUEBERT (1981) carried out detailed SEM studies of these structures. DAVID (1997) followed the terminology of the latter paper and published the first comprehensive circumscription of the conidiogenous loci and conidial hila, which are protuberant, thickened, darkened, with a central convex dome, surrounded by a raised periclinal rim (i.e., they are coronate). BRAUN et al. (2003) simply used the term "*Cladosporium* type" for these scars.

Several authors pointed out that *Cladosporium* s. lat. is heterogeneous and polyphyletic (McKemy & Morgan-Jones 1990, David 1997). Human pathogenic species and *Venturia* anamorphs have been included. Based on differences in the morphology (conidiophores lacking or semi-macronematous, hila not coronate, less pigmented), physiology (inability to liquefy gelatine) and molecular data, human pathogenic taxa of *Cladosporium* have been excluded and assigned to *Cladophialophora* (teleomorph: *Capronia* Sacc., Herpotrichiellaceae) (de Hoog et al. 1995). Several *Cladophialophora* species cause specific mycoses, whereas true *Cladosporium* species, which are occasional opportunists of man, cause a wide clinical spectrum of symptoms (de Hoog et al. 2000). The revision of the genus *Fusicladium* Bonord. (teleomorph: *Venturia*, Venturiaceae) (Schubert et al. 2003), revealed that several species assigned to *Cladosporium* have to be transferred to *Fusicladium*, a conclusion confirmed by molecular results (Beck et al. 2005). Species of the latter genus are well-characterised by having more or less denticle-like, truncate to slightly convex, unthickened, not or slightly darkened conidiogenous loci, which are quite distinct from *Cladosporium* scars. *Fusicladium* species with catenate conidia have often been placed in *Cladosporium*, e.g., *Cladosporium carpophilum* Thüm. [≡ *Fusicladium carpophilum* (Thüm.) Oudem.], *C. caryigenum* (Ellis & Langl.) Gottwald (= *F. effusum* G. Winter) and *C. humile* Davis [≡ *F. humile* (Davis) K. Schub. & U. Braun]. Some species of the genera *Stenella* Syd. and *Passalora* Fr. emend. (teleomorph: *Mycosphaerella*, Mycosphaerellaceae) have previously been referred to *Cladosporium*, e.g., *C. cercestidis* Deighton [≡ *Stenella cercestidis* (Deighton) U. Braun], *C. cinnamomeum* (Racib.) Höhn. [≡ *S. cinnamomea* (Racib.) U. Braun], *C. compactum* Berk. & M.A. Curtis [≡ *Passalora compacta* (Berk. & M.A. Curtis) U. Braun & Crous] and *C. laxum* Kalchbr. & Cooke [≡ *P. laxa* (Kalchbr. & Cooke) U. Braun & Crous] (Dugan et al. 2004). Such species are easily distinguishable from true *Cladosporium* species by non-coronate conidiogenous loci and hila.

Molecular examinations within the *Cladosporium* complex supported the separate position of this genus, well-delimited by its unique scar type as described above, and confirmed its monophyletic position (Braun et al. 2003).

About 23 anamorph genera have been referred to the genus *Mycosphaerella* (Loculoascomycetes: bitunicate asci, formation of fruit bodies ascolocular, pseudothecia and mycelium dark; Dothideales, Mycosphaerellaceae). *Cladosporium* (incl. *Heterosporium*) is considered to be the anamorph of *Mycosphaerella* sect. *Tassiana* [teleomorph of *Cladosporium herbarum*, the type species, is *Mycosphaerella tassiana* (De Not.) Johanson]. Based on the distinctive coronate conidiogenous loci and the separate phylogenetic position (sister group to *Mycosphaerella* with 100 % bootstrap support), the teleomorph of *Cladosporium* has been separated from *Mycosphaerella* and described as *Davidiella* (Braun et al. 2003). The ascomata resemble those of *Mycosphaerella* species, but *Davidiella* is well-distinguished by having the characteristic *Cladosporium* anamorph. Anamorphs have an increasing importance for the classification of fungi, above all in ascomycetes (Sutton & Hennebert 1994). The morphology of the teleomorph is sometimes less variform (e.g., in *Mycosphaerella*), so that numerous anamorphs constitute the informative, distinctive states. On the other

hand, numerous species are only known as anamorphic states. Detailed descriptions of the morphology of conidiophores, conidiogenous cells and conidia are indispensable for the determination of the particular taxa. The treatment of *Cladosporium herbarum* in TULASNE & TULASNE (1863) was the first description of this species with precise measurements of conidiophores and conidia. Based on their measurements, it can be supposed that they dealt with *C. variabile* (Cooke) G.A. de Vries (DAVID 1997).

Due to the strong morphological variability of *Cladosporium* species and morphological changes in culture (MORGAN-JONES & MCKEMY 1990), classification within this genus proved to be very difficult. All previous attempts to divide *Cladosporium* into smaller units have been less practicable (DAVID 1997). SACCARDO (1886) divided *Cladosporium* on the basis of host preferences. KRANGAUZ (1970) introduced three invalidly published subgenera (*'Parasiticum', 'Eucladosporium'* and *'Saprophyticum'*), based on the ecology, morphology and differences in vitro of the species concerned. ARX (1983) proposed a division into four sections (excl. *Heterosporium*), which were also based on ecological differences. On account of morphological differences, DAVID (1997) separated *Cladosporium* into the subgenera *Heterosporium* (conidia solitary or in short, unbranched chains, without ramoconidia, conidia rather uniform), *Bistratosporium* (conidia in branched chains, with ramoconidia, conidia distinctly two-layered) and *Cladosporium* (conidia in chains, ramoconidia present, conidia multiform, wall always one-layered). Whether this morphological grouping can be maintained can only be answered in the context of monographic studies.

2.2. Generic description

Cladosporium Link, Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 7: 37 (1816): Fr., Syst. mycol. 3(2): 370 (1832).

= *Heterosporium* Klotzsch ex Cooke, Grevillea 5: 122 (1877), (additional synonyms – see HUGHES 1958).

Type species: *C. herbarum* (Pers.: Fr.) Link (CLEMENTS & SHEAR 1931: 395, L 910.225-733: lectotype).

Teleomorph: *Davidiella* Crous & U. Braun, in Braun, Crous, Dugan, Groenewald & de Hoog, Mycol. Progr. 2(1): 8 (2003).

Lit.: DAVID (1997).

Mycelium immersed or superficial; hyphae branched, septate, subhyaline to pigmented, smooth. Conidiophores macronematous, mononematous, solitary, in small fascicles or loosely to densely caespitose, septate, erect to decumbent or repent, unbranched or branched, pigmented, proliferation holoblastic, occasionally enteroblastic (after a period when growth has stopped then resumed), usually sympodial, rarely monopodial (sometimes leaving coarse annellations from repeated enteroblastic proliferation). Conidiogenous cells integrated, terminal or intercalary, monoblastic or usually polyblastic, sympodially proliferating, conidiogenous loci conspicuous, protuberant, thickened, refractive to darkened, composed of a central convex dome, surrounded by a raised periclinal rim (coronate); conidial formation holoblastic. Conidia solitary or catenate, in simple or branched acropetal chains (species with solitary conidia are capable to form conidial chains in culture), shape and septation variable,

usually subglobose, ovoid, ellipsoid, oblong-ellipsoid to cylindrical, aseptate or with several eusepta, smooth to verrucose-echinulate; hila protuberant, thickened, darkened-refractive, with a central convex dome, surrounded by a raised periclinal rim (coronate); microcyclic conidiogenesis not uncommon.

3. Material and methods

In some cases, fresh collections could be examined, but the microscopic examinations were mostly carried out based on exsiccatae from the following herbaria: B, BPI, C, DAR, FH, HAL, HBG, IMI, K, KR, LE, LPS, M, NY, PDD, PH, VPRI, WIS (abbreviations according to HOLMGREN et al. 1990).

3.1. Microscopic standard methods

A stereomicroscope was used to select colonised portions of samples, to excise colonies and mount them in water on a slide. Staining was usually not necessary, since *Cladosporium* species are pigmented. To avoid drying of the preparations, permanent slides were prepared by sealing the cover-glasses with Canada balm (SERVA, Heidelberg) and by putting them into a desiccator for 24 hours. Microscopic observations were made with oil immersion (1000×). Twenty conidiophores, conidia and other structures were measured in each collection, and a representative range was depicted. Some collections were very poor, so that only a smaller number of these structures could be measured.

Digital pictures were made with a ZEISS Axioskop 2 with ZEISS AxioCam HR and occasionally optimised with the software ZEISS AxioVision.

3.2. Scanning electron microscopy

SEM examinations were conducted at the Institute of Zoology of the Martin-Luther-University. The samples were sputter-coated with gold using a sputter coater SCD 004 (200 seconds in an argon atmosphere of 20 mA, 30 mm distant from the electrode). The drying process caused occasional changes on surfaces. Observations and micrographs were made with a HITACHI S-2400 scanning electron microscope with integrated camera (film: ILFORD PLUS 125).

4. Morphotaxonomy of the *Cladosporium* species examined

4.1. Species concept

Discrimination between species is based primarily on a range of morphological characters as exhibited on the fungal substrate, since molecular data and studies in vitro are not yet available for the majority of fungicolous taxa.

The mycelium of fungicolous *Cladosporium* species is usually immersed, but often also external, superficial. The hyphae are consistently septate, and particular hyphal cells are often somewhat swollen and form loose aggregations or dense stromata. However, the ability to form stromata is not consistently diagnostic. Conidiophores arising from hyphae or loose stromatic layers are usually formed singly or arranged in loose groups. A few species form conspicuous fascicles of conidiophores, e.g.,

Cladosporium gerwasiae Heuchert, U. Braun & K. Schub. and *C. gallicola* B. Sutton. However, this feature is diagnostic only in combination with other characteristics. The conidiophores are mostly erect, rarely decumbent, and only in a few cases characteristically repent, e.g., in *C. phyllophilum* McAlpine. The conidiophores are mostly more or less cylindrical, subcylindrical, or filiform, but further differentiations are often due to sympodial proliferations causing geniculations or intercalary swellings. The ramification of the conidiophores (degree, topology, etc.) is an additional useful feature. The length of the conidiophores, often strongly influenced by external conditions, is usually variable and of little diagnostic value. However, the width of the conidiophores as well as the thickness of the wall can be used for the discrimination of some species. Thick walls appear often distinctly two-layered under light microscopy, e.g., *C. episclerotiale* Bubák (see Fig. 5). Conidiogenous cells are integrated, terminal or intercalary. A few species are characterised by having conidiogenous cells which are consistently terminal or almost so, e.g., *C. tenuissimum* Cooke. Special features, like conspicuous intercalary swellings of the conidiophores, e.g., in *C. herbarum* and *C. oxysporum* Berk. & M.A. Curtis, are useful for the discrimination of species.

Ramoconidia s. str. are those formed at the base of conidial chains, which can be seen as part of the conidiophore, i.e., as conidiogenous cells. The base of such true ramoconidia is truncate to slightly convex, but without any trace of a dome and raised periclinal rim, which could be confirmed by light and scanning electron microscopy (see Pl. 2, Fig. 12). Due to the structure of the conidial base, ramoconidia s. str. are easily separable from branched conidia within the chains (ramoconidia s. lat.), which have a basal coronate hilum. The presence of ramoconidia s. str. is a feature of limited value for the characterisation of *Cladosporium* species, since these structures are often rarely formed or lacking. If ramoconidia s. str. are present, a combination of length, width and septation of these structures may be useful for the discrimination of particular groups of species. The shape of the conidia is highly variable, ranging from subglobose, ellipsoid to subcylindrical. The conidia of the species here examined are little differentiated, so that conidial size and septation can only be used in combination with other characters. Conidial surface ornamentation is useful. Species with conspicuously verrucose or verruculose conidia (e.g., *C. herbarum* and *C. aecidiicola* Thüm.) are easily distinguishable from those with conidia which are smooth or almost so (e.g., *C. gallicola* and *C. uredinicola*). The conidiogenous loci and conidial hila are consistently coronate in species of *Cladosporium* s. str. The size of these structures is not very variable. However, the location of the loci, e.g., confined to terminal and intercalary swellings of the conidiophores in *C. oxysporum*, may be used as distinctive feature.

<u>The following features proved diagnostic for the differentiation of species:</u>

1. Width of the conidiophores and thickness of the wall.
2. Ramification of the conidiophores (presence, topology, degree).
3. Shape of the conidiophores (geniculate, special features, location of the conidiogenous loci).
4. Conidial surface (sculpture).

The following features are only diagnostic in combination with other features:

1. Arrangement of the conidiophores (in loose to dense fascicles, solitary).
2. Conidia (length, width, septation, shape).
3. Ramoconidia (presence, length, width, septation).
4. Length of the conidiophores.

The following features are of little or no diagnostic value:

1. Formation of stromata.
2. Formation of conidiophores (arising from stromata or hyphae).
3. Conidiogenous loci (generic feature).
4. Location of the mycelium (internal, external).

4.2. Keys

4.2.1. Key to the species based on morphological features and ecology

Beside the fungicolous *Cladosporium* species, this key contains some common, widespread saprobic species which occasionally occur on other fungi.

1 With numerous globose to subglobose terminal conidia, conidia slightly to distinctly verruculose; an unspecific saprobic species ..... ***C. sphaerospermum***
1* Without globose-subglobose terminal conidia, conidia smooth to verruculose **2**
2 Conidia verruculose, rarely few conidia smooth or almost so **3**
2* Conidia smooth, rarely few conidia faintly rough-walled **6**
3 Conidiophores distinctly nodulose, swellings round about the stalks, conidiogenous loci confined to swellings; a common, widespread saprobic species, frequently found on other fungi as secondary invader ..... ***C. herbarum***
3* Conidiophores without swellings, non-nodulose, conidiogenous cells straight, cylindrical to geniculate-sinuous, in the latter case sometimes with small unilateral swellings; specific fungicolous species **4**
4 Conidiophores often dichotomously to irregularly branched; on *Exobasidium vaccinii, E. warmingii* ..... ***C. exobasidii*** var. ***verruculosum***
4* Conidiophores unbranched, rarely with a simple branching; on other hosts **5**
5 On *Epichloë typhina* ..... ***C. epichloës***
5* On Pucciniales (aecia) ..... ***C. aecidiicola***
6 Conidiophores nodulose, with conspicuous multilateral swellings (nodes), swellings with conidiogenous loci **7**
6* Conidiophores not nodulose, without multilateral swellings (nodes), but often with geniculations which may cause unilateral shoulder-like swellings **9**
7 Conidiophores often simply branched; on *Exobasidium vaccinii* ..... ***C. exobasidii*** var. ***exobasidii***
7* Conidiophores consistently unbranched **8**
8 Conidiophores very long, up to 500 µm or even longer, always with conspicuous, remote, regular swellings round about the conidiophores; saprobic, on numerous substrates ..... ***C. oxysporum***

8* Conidiophores much shorter, up to 80 µm, swellings lacking or present, if present not remote and rather irregular; on *Taphrina tosquinetii* ..... '***C. herbarum*** f. ***parasiticum***'

9 Conidiophores very long, up to 550(–800) µm, consistently unbranched, apex cell with conidiogenous loci often slightly swollen, conidia 0–1-septate; unspecific saprobic species with a wide range of substrates (leaf litter, soil, isolated from air, etc.) ..... ***C. tenuissimum***

9* Conidiophores usually much shorter, often branched, rarely unbranched, conidia 0–6-septate; specific fungicolous species **10**

10 Conidiophores frequently branched, often dense, almost periconiella-like, conidiogenous loci very numerous, crowded; on *Cronartium* spp., *Endocronartium* spp. and *Pucciniastrum* spp. ..... ***C. gallicola***

10* Conidiophores irregularly and loosely branched, not dense, not periconiella-like, conidiogenous loci usually not crowded; on other hosts **11**

11 Walls of the conidiophores thick-walled throughout or at least thick-walled towards the base, thick walls conspicuously two-layered under light microscopy, conidia always thick-walled, wall partly two-layered as well **12**

11* Walls of the conidiophores always one-layered under light microscopy, thin to slightly thickened, conidia always one-layered under light microscopy, thin-walled to slightly thick-walled **13**

12 Walls of the conidiophores two-layered throughout, septa often strongly darkened, hila conspicuously protuberant, up to 1.5 µm high, ramoconidia s. str. lacking; on *Monilinia laxa* and hosts of the Boletales ..... ***C. episclerotiale***

12* Walls of the conidiophores only two-layered towards the base, septa not conspicuously darkened, hila less protuberant, lower, ramoconidia s. str. present; on *Gerwasia* sp. ..... ***C. gerwasiae***

13 Colonies on fruit bodies of macromycetes (gill fungi, gasteromycetes, pore fungi) .. **14**

13* Colonies on rust fungi, powdery mildews, downy mildews or *Taphrina* spp. . **15**

14 Ramoconidia s. str. frequent, 33–53 × 4.5–7 µm, 0–6-septate ..... ***C. epimyces***

14* Ramoconidia s. str. very rarely formed, 21–32 × 4.5–5.5 µm, 0–4(–5)-septate ... ***C. lycoperdinum***

15 Conidiophores erect to frequently decumbent, repent, growth characteristically effuse, ramoconidia s. str. present, conidia (0–)1–5(–6)-septate, conidiogenous loci and hila (0.5–)1–3 µm diam.; on *Taphrina* spp. ..... ***C. phyllophilum***

15* Conidiophores usually erect, not repent, growth not effuse, ramoconidia s. str. lacking, conidiogenous loci and hila narrower, 0.5–2 µm diam. **16**

16 Conidia 4–20 µm long, mycelium in asci of *Taphrina coerulescens* ..... ***C. taphrinae***

16* Conidia 3–39 µm long, mycelium in sori of rust fungi, on powdery mildews and downy mildews ..... ***C. uredinicola***

4.2.2. Tabular key based on hosts and substrate species

The taxonomy and systematics of the hosts and substrates follow KIRK et al. (2001).

Oomycetes

Peronosporales (downy mildews)

Peronospora arborescens, *P. gaeumannii* ..... ***C. uredinicola***

Ascomycetes

Taphrina **(Taphrinomycetidae, Taphrinales)**

1 Conidiophores erect to decumbent, repent, ramoconidia s. str. present ..... ***C. phyllophilum***

1* Conidiophores erect, rarely decumbent, ramoconidia s. str. lacking **2**

2 Conidiophores usually arising from hyphae, 23–150(–200) × 3–5(–7) µm, without intercalary swellings, conidiogenous loci mostly numerous, crowded, denticle-like; confined to asci of *Taphrina coerulescens* ..... ***C. taphrinae***

2* Conidiophores usually arising from stromata, 52–82 × 3.5–5.5 µm, occasionally with intercalary swellings, up to 6 µm wide, swellings with conidiogenous loci, but loci not confined to swellings; on *Taphrina tosquinetii* ..... '***C. herbarum*** f. ***parasiticum***'

Erysiphales (powdery mildew fungi)

Erysiphe euonymi-japonici, *Phyllactinia angulata* ..... ***C. uredinicola***

Heliotiales

Monilinia laxa (*Sclerotinia cinerea*) ..... ***C. episclerotiale***

Hypocreales

Epichloë typhina ..... ***C. epichloës***

Basidiomycetes

Exobasidiales (Ustomycetidae)

Exobasidium vaccinii var. *vaccinii, E. warmingii*

1 Conidia smooth ..... ***C. exobasidii*** var. ***exobasidii***

1* Conidia rough-walled ..... ***C. exobasidii*** var. ***verruculosum***

Uredinomycetidae (rust fungi)

1 Conidia verruculose, rarely some conidia faintly rough-walled; on aecia ..... ***C. aecidiicola***

1* Conidia smooth **2**

2 Conidiophores frequently branched in the upper part, simply branched to several times, dense, periconiella-like; on aecia of *Cronartium comandrae*, *Endocronartium harknessii* (Cronartiaceae) and *Pucciniastrum goeppertianum* (Pucciniaceae) ..... ***C. gallicola***

2* Conidiophores usually unbranched, rarely some conidiophores simply branched ... **3**

3 Conidiophores solitary, arising from hyphae, (5–)21–230(–300) × 2–5 µm, walls of the conidiophores only slightly thickened, 0.5–0.75 µm, ramoconidia s. str. lacking; on species of different families (Cronartiaceae, Melampsoraceae, Phragmidiaceae, Pucciniaceae, Uropyxidaceae, Sphaerophragmiaceae) ..... ***C. uredinicola***

3* Conidiophores in loose to dense fascicles, arising from stromata, larger, 24–366(–630) × 3–8 µm, tips often elongated and narrowed, walls of the conidiophores often strongly thickened towards the base, (0.5–)1–1.5 µm, ramoconidia s. str. present; on *Gerwasia* sp. (Phragmidiaceae) ..... ***C. gerwasiae***

On fruit bodies of macromycetes (Hymenomycetidae) (Agaricales, Boletales, Polyporales, Russulales)

1 Walls of the conidiophores conspicuously two-layered, conidia subglobose, ellipsoid to broadly ellipsoid, often constricted at the septa, septa obviously darkened, walls often two-layered, ramoconidia s. str. lacking; on Boletales ..... ***C. episclerotiale***

1* Walls of the conidiophores not distinctly two-layered (light microscopy), conidia polymorphous, ramoconidia s. str. present (rare to frequently formed) **2**

2 Ramoconidia s. str. frequently formed, 33–53 × 4.5–8 µm, 0–6-septate; on Agaricales, Russulales ..... ***C. epimyces***

2* Ramoconidia s. str. rarely formed, shorter, 11–32 × (4.5–)5–6 µm, 0–4-septate; on Agaricales, Boletales, Polyporales, Russulales ..... ***C. lycoperdinum***

4.3. List of species

In the present work, the morphology of all fungicolous species of *Cladosporium* is described. Saprobic species recorded from fungi, species of uncertain taxonomic position and excluded species are separately listed. Species are comprehensively described and illustrated, based on procedures in BRAUN (1995, 1998). Drawings (1:100) are, if not otherwise stated, based on type material or other authentic collections. The scale bars represent 10 µm. The treatments of the particular species contain the scientific names with bibliographic references, type collections, synonyms, literature references, published illustrations, comprehensive descriptions, host range and geographic distribution, collections examined and notes. Literature references and records of published illustrations usually follow DUGAN et al. (2004).

The morphotaxonomic concepts and circumscriptions of the common saprobic *Cladosporium* species that sometimes occur on other fungi are largely based on ELLIS (1971, 1976), DAVID (1997) and HO et al. (1999).

Host range and geographic distribution are taken from literature and the collections examined. The host fungi and, if known, the host or substrate plants are alphabetically arranged. The names of host fungi have been checked in the database 'indexfungorum'. Under 'collections examined' all specimens seen are cited, arranged in alphabetical order. The abbreviations of herbaria follow HOLMGREN et al. (1990) and the list of KIRK (2003) served as base for the abbreviations of authors. Abbreviations of journals agree with LAWRENCE et al. (1968) and BRIDSON & SMITH (1991).

The names of the particular countries, under geographic distribution, are abbreviated as summarised below. Abbreviations of the particular states of the USA conform to FARR et al. (1989), abbreviations of the Federal States of Germany agree with the system in ROTHMALER (1999).

4.3.1. Abbreviations

General abbreviations: art. = article, f. = forma, fig. = figure, herb. = herbarium, ill. = illustration, incl. = inclusive, Kr. = Kreis (administrative division of a state in Germany, 'county'), Kt. = Kanton (administrative unit in Switzerland, state), lit. = literature, reference, nom. inval. = nomen invalidum, nom. nud. = nomen nudum, pl. = plate, s. lat. = sensu lato, s. str. = sensu stricto, sp. nov. = species novum, syn. = synonym, var. = variety.

Countries: A = Austria, AR = Argentina, AUS = Australia, BR = Brazil, CH = Switzerland, CZ = Czech Republic, D = Germany, DK = Denmark, F = France, GB = Great Britain, H = Hungary, I = Italy, IND = India, LV = Latvia, NZ = New Zealand, PL = Poland, RO = Romania, ROU = Uruguay, RUS = Russia, S = Sweden, SK = Slovakia, TM = Turkmenistan, UA = Ukraine.

Federal states in Germany: An = Sachsen-Anhalt, Ba = Bayern, Br = Brandenburg, He = Hessen, Rh = Rheinland-Pfalz, Sa = Sachsen, Th = Thüringen, We = Nordrhein-Westfalen.

USA: AL = Alabama, AZ = Arizona, CA = California, CO = Colorado, DE = Delaware, NC = North Carolina, NV = Nevada, NY = New York, PA = Pennsylvania, SC = South Carolina, UT = Utah, WA = Washington, WI = Wisconsin.

India: UP = Uttar Pradesh.

Australia: NSW = New South Wales.

Exsiccatae:

Braun, F. sel. exs. = U. Braun, Fungi selecti exsiccati.
Crypt. exs. = Cryptogamae exsiccatae editae Museo Hist. Nat. Vindobonensi.
Crypt. Form. Colorad. = Cryptogamae Formatiorum Coloradensium.
Fl. Prig. = Flora der Prignitz.
Fl. Prov. Br. = Flora Provinz Brandenburg.
Herb. Mycol. Rom. = Herbarium Mycologicum Romanicum.
Herter, Pl. urug. exs. = W.G. Herter, Plantae uruguayense Exsiccatae.
Jaap, F. sel. exs. = Jaap, Fungi selecti exsiccati.
Jaap, Fl. Schweiz = Jaap, Flora der Schweiz.
Petr., Fl. Bohem. Morav. exs. = Petrak, Flora Bohemica et Moravica exsiccata.
Rav., F. amer. exs. = Ravenel, Fungi americanici exsiccati.
Roum., F. sel. gall. exs. = Roumeguère, Fungi selecti gallici exsiccati.
Sacc., Mycoth. Ven. = Saccardo, Mycotheca Veneta.
Shear, F. columb. = Shear, Fungi columbiani.
Syd., Mycoth. germ. = H. & P. Sydow, Mycotheca germanica.
Thüm., Mycoth. univ. = de Thümen, Mycotheca universalis.
Vill, F. bav. = Vill, Fungi bavarici.

4.3.2. Fungicolous *Cladosporium* species

4.3.2.1. *Cladosporium aecidiicola* Thüm. **Fig. 1**

Cladosporium aecidiicola Thüm., Mycoth. univ., Cent. IV, No. 373 (1876).

Syntypes: on aecia on living leaves of *Euphorbia cyparissias* (Euphorbiaceae), Germany, Bavaria, Bayreuth, 1874, Thümen, Thüm., Mycoth. univ. 373 (e.g., B 70-6144, B 70-6146; BPI 426074; HAL; HBG; M-57483).
= *Cladosporium aecidii* Pass., in herb. (B 70-6132).
Lit.: SACCARDO (1886: 368; 1913: 1371), LINDAU (1907: 806–807; 1910: 796), FERRARIS (1912:

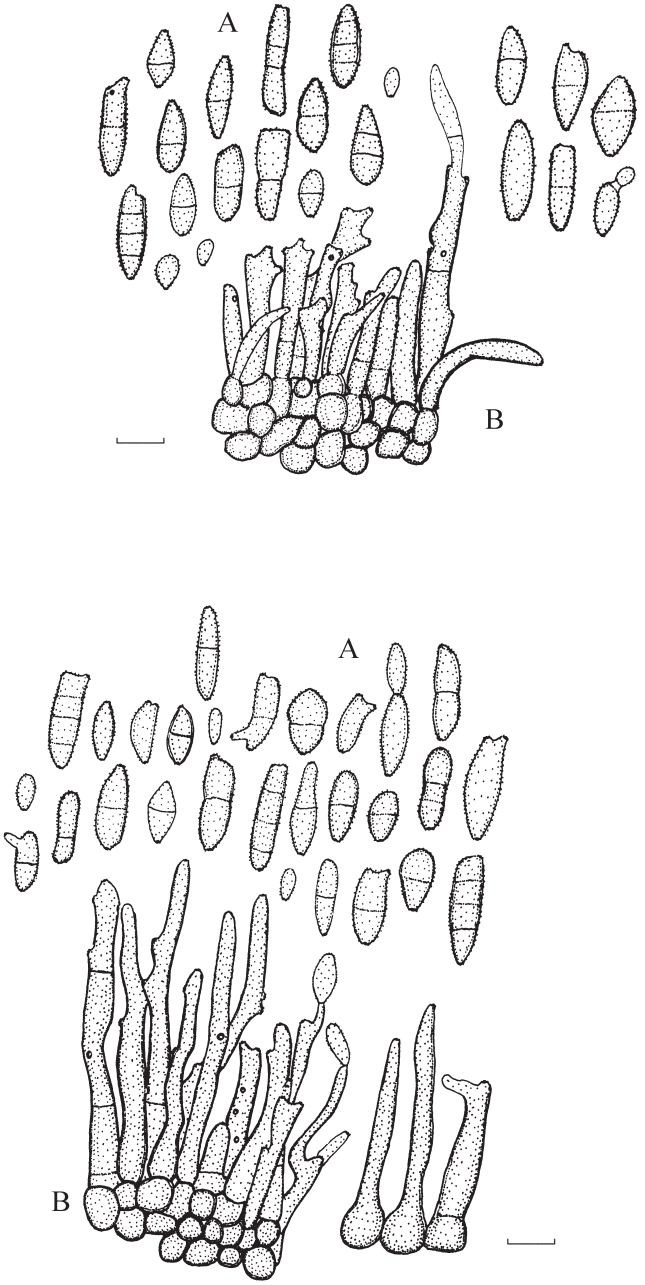


Fig. 1: *Cladosporium aecidiicola*: A – conidia, B – conidiophores in loose to dense fascicles (drawing below from B 70-6207).

350), GONZÁLES-FRAGOSO (1927: 211), ELLIS (1976: 330), ELLIS & ELLIS (1985: 571; 1988), BRAUN & ROGERSON (1995: 142), GUO (2001: 464).
Ill.: ELLIS (1976: 330, Fig. 248), ZHANG et al. (2003: 36, Fig. 11).

Colonies on aecia (usually completely overgrown by the *Cladosporium*) and surrounding leaf tissue (colonies not vein-limited), olivaceous-brown to dark brown, occasionally almost blackish brown, caespitose, velvety, effuse, confluent. Mycelium superficial, hyphae branched, 3.5–6 µm wide, septate, cells 10–15 µm long, often constricted at the septa, often with swellings, subhyaline to pale olivaceous, smooth, walls somewhat thickened. Stromata diffuse, composed of subglobose cells, 4–7 µm diam., pale olivaceous-brown to medium brown, smooth, walls somewhat thickened. Conidiophores in loose to dense fascicles, arising from the diffuse stromatic layers or formed singly, if arising from the attacked surrounding leaf tissue erumpent through the cuticle, erect, straight to geniculate-sinuous, simple, rarely branched, 14–140(–185) × 3–6(–7.5) µm, often swollen at the very base, 6–12 µm wide, 0–5(–7)-septate, not constricted at the septa, pale olivaceous-brown to medium brown, paler towards the apex, smooth, walls somewhat thickened, occasionally intercalary subnodulose. Conidiogenous cells integrated, terminal and intercalary, 10–67 µm long, polyblastic, sympodially proliferating, 1–3 conidiogenous loci per cell, loci sometimes located at small shoulders formed by sympodial proliferation, protuberant, thickened and darkened, 1–2.5 µm diam. Conidia catenate, mostly in branched chains, straight, ovoid, ellipsoid, subglobose, subcylindrical to fusiform, 4–25(–29) × 3–7(–10) µm, 0–3-septate, not constricted at the septa to rarely or slightly constricted, pale olivaceous-brown, verruculose, rarely smooth or almost so, walls unthickened or only slightly thickened, apex rounded to subtruncate, with up to two hila, base truncate to convex, hila protuberant, thickened and darkened, 1–2(–2.5) µm diam., microcyclic conidiogenesis observed.

Host range and distribution: Asia, Europe, North America, on aecia of rust fungi; on *Aecidium carneum* on *Astragalus* sp. (S); *A. cyparissiae* on *Euphorbia cyparissias* (D); *A. euphorbiae* (RO; UA); *A. falcariae* on *Falcaria* sp. (D); *A. lonicerinum* on *Lonicera xylosteum* (A); *A. trollii* on *Trollius* sp. (S); *Aecidium* sp. on *Eleagnus oxycarpa* (Kazakhstan); *Aecidium* sp. on *Evodia* sp. (China); *Coleosporium campanulacearum* on *Campanula* sp. (A); *C. campanulacearum* on *Campanula rapunculoides* (A); on *C. tussilaginis* on *Petasites* sp. (I); *Melampsora helioscopiae* (RO); *Puccinia agropyrina* on *Thalictrum collinum* (Kazakhstan); *P. circaeae* (RO); *P. coronata* (RO); *P. graminis* on *Berberis* sp. (Armenia); *P. grindeliae* on *Chrysothamnus viscidiflorus* var. *lanceolatus* (USA, UT); *P. passerinii* (UA); *P. phragmitis* (GB, China); *P. phragmitis* on *Rumex crispus* (Kazakhstan); *P. smilacearum-digraphidis* on *Polygonatum verticillatum* (D); *P. tragopogi* (Armenia); *P. violae* (RO); *Puccinia* sp. on *Hordeum chilense* (USA); *Uromyces laponicus* on *Hedysarum kopetdaghi* (TM); *U. limonii* (GB); *U. limonii* on *Limonium* sp. (F); *U. pisi* on *Euphorbia cyparissias* (D, RO); *U. pisi* (A, D, RO); *Uromyces* sp. on *Euphorbia cyparissias* (CH); on *Uromyces* sp. on *Limonium vulgare* (DK).

Additional general records without specific host fungi: *Berberis vulgaris* (A, CH); *Euphorbia cyparissias* (A, D, H, I, SK); *E. esula* (RO); *E. hirsuta* (LV); *Frangula alnus* (LV); *Helenium hoopesii* (USA, AZ); *Malus micromalus* (China, Liaoning); *Polygonum aviculare* (Uzbekistan); *Ribes grossularia* (LV); *R. rubrum* (LV); *Salix amygdalina* (LV); *Scorzonera hispanica* (D); *Silene vulgaris* (LV); *Sonchus arvensis* (LV); *Tussilago farfara* (LV).

Collections examined: on aecia on *Berberis vulgaris*, Austria, near Innsbruck, 29 Jun. 1893, P. Magnus (HBG); Switzerland, Kt. Wallis, Zermatt, 26 Jul. 1905, O. Jaap, Jaap, Fl. Schweiz 17 (B 70-6141); Engadin, 22 Aug. 1888, P. Magnus (HBG); on aecia on *Euphorbia cyparissias*, Austria, Graubünden, 1000 m, 13 Jun. 1901, A. Volkart (HBG); Germany, 29 May 1910, ex herb. T. Ohrdruf (B 70-6155); Ba, Bad Reichenhall, 14 May 1918, Schoenau (M-57481); Ba, Oberfranken, Bayreuth, May 1874, ex herb. Körnicke (B 70-6147); Br, Börnicke, 1872, J. Eichelbaum (HBG); Rh, Kr. Altkirchen, between Steneroth and Elkenroth, 26 May 1923, A. Ludwig (B 70-6207); Hungary, Posonii, Aug. 1890, J.A. Bäumler (M-57487); Italy, Emilia Romagna, Parma, Langhirano, Apr. 1873, G. Passerini, ex herb. Natter (B 70-6132); Slovakia, Banská-Štiavnica, 2 Jun. 1897, A. Kmet (HBG); Switzerland, Kt. Wallis, Zermatt, 26 Jul. 1905, O. Jaap, Jaap, Fl. Schweiz 15 (B 70-6140); on aecia on *Scorzonera hispanica*, Germany, Ba, Kr. Schweinfurt, Gerolzhofen, Jun. 1906, A. Vill, Vill, F. bav. 898 (B 70-6148); May 1905 (B 70-6136); on *Aecidium cyparissiae* on *Euphorbia cyparissias*, Germany, Ba, München, 26 Jun. 1893, Allescher (M-57480); on *A. falcariae* on *Falcaria* sp., Germany, Sa, 27 May 1893, P. Magnus (HBG); on *A. lonicerinum* on *Lonicera xylosteum*, Austria, Innsbruck, 19 Aug. 1894, P. Magnus (HBG); on *Coleosporium campanulacearum* on *Campanula* sp., Austria, Innsbruck, 29 Aug. 1908, P. Magnus (HBG); on *C. campanulacearum* on *Campanula rapunculoides*, Austria, Innsbruck, P. Magnus (HBG); on *C. tussilaginis* on *Petasites* sp., Italy, Meran, 2 Nov. 1893, P. Magnus (HBG); on *Puccinia smilacearum-digraphidis* on *Polygonatum verticillatum*, Germany, We, Westfalen, 9 Jul. 1938 (B 70-6152); on *Puccinia* sp. on *Hordeum chilense*, USA, CA, Berkeley, 20 Sept. 1897, P. Magnus (HBG); on *Uromyces pisi*, Austria, Tyrol, near Innsbruck, Jun., V. Litschauer & L. Kreissler, Crypt. exs. 2938 (B 70-6149); Romania, Muntenia, distr. Dâmbovița-Bădulești, 16 Apr. 1944, T. Săvulescu, Herb. Mycol. Rom. 1342 (M-57486); on *Uromyces* sp. on *Limonium vulgare*, Denmark, Lakolk, 21 Jul. 1901, O. Jaap (HBG); on aecia, USA, CO, Manitou, 22 Jun. 1906, F.E. & E.S. Clements, Crypt. Form. Colorad. 270 (B 70-6137).

Notes: This species resembles the cosmopolitan saprobic species *Cladosporium herbarum*. The two species are characterised by having verruculose conidia (rarely a few intermixed conidia may be smooth or almost so). The conidia in *C. herbarum* are usually ovoid-ellipsoid to cylindrical and at the base as well as the apex more or less rounded, whereas the conidia in *C. aecidiicola*, which are more frequently formed in branched chains, are often characteristically attenuated towards the base. *C. herbarum* forms characteristic, regular, intercalary swellings round about the conidiophores, which are not to be found in *C. aecidiicola*. Conidiophores of the latter species are at most provided with unilateral slight swellings caused by the sympodial proliferation. *C. epichloës* Lobik on *Epichloë typhina*, which is also characterised by having conidiophores with slight unilateral swellings and verruculose conidia, is close to *C. aecidiicola* and morphologically barely distinguishable. Since clear morphological differences are lacking, *C. aecidiicola* and *C. epichloës* are only tentatively maintained as two species on the basis of the clearly distinct ecology and the obvious host specialization. Biological (inoculation experiments) and molecular examinations are necessary to prove the affinity and separation of the species concerned. Without giving exact geographic distribution, OUDEMANS (1919–1924) listed *Coleosporium* sp., *Aecidium falcariae* and *Aecidium tussilaginis* (= *Puccinia poarum*) as hosts of *C. aecidiicola.* LINDAU (1907) recorded this species on *Euphorbia palustris, E. verrucosa, Falcaria* sp.*, Lonicera xylosteum, Teucrium scorodonia*, on the host fungus *Coleosporium* sp. on *Petasites* sp. and on *Campanula rapunculoides.*

4.3.2.2. *Cladosporium epichloës* Lobik **Fig. 2**

Cladosporium epichloës Lobik, Bolezni Rast. 17(3–4): 189 (1928).

Holotype: on stromata of *Epichloë typhina* (Clavicipitaceae) on *Bromus inermis* (Poaceae), Russia, Leyss., "Bezirk Piatigorsk, im Walde am Abhange des Berges Maschuk, bei der Lermontowschen Haltestelle", 26 Sept. 1923 (LE 40522).
Ill.: LOBIK (1928: Pl. 8, Fig. 86).

Colonies olivaceous to dark brown, effuse, diffuse to dense, confluent, velvety. Mycelium immersed and external, superficial hyphae creeping, branched, 2.5–6 µm wide, septate, often constricted at the septa, cells irregularly swollen, up to 8 µm wide, subhyaline to pale brown, smooth, walls slightly thickened. True stromata lacking. Conidiophores solitary or in loose groups, arising from hyphae or swollen hyphal cells, erect to decumbent, straight or often curved, subcylindrical, geniculate-sinuous,

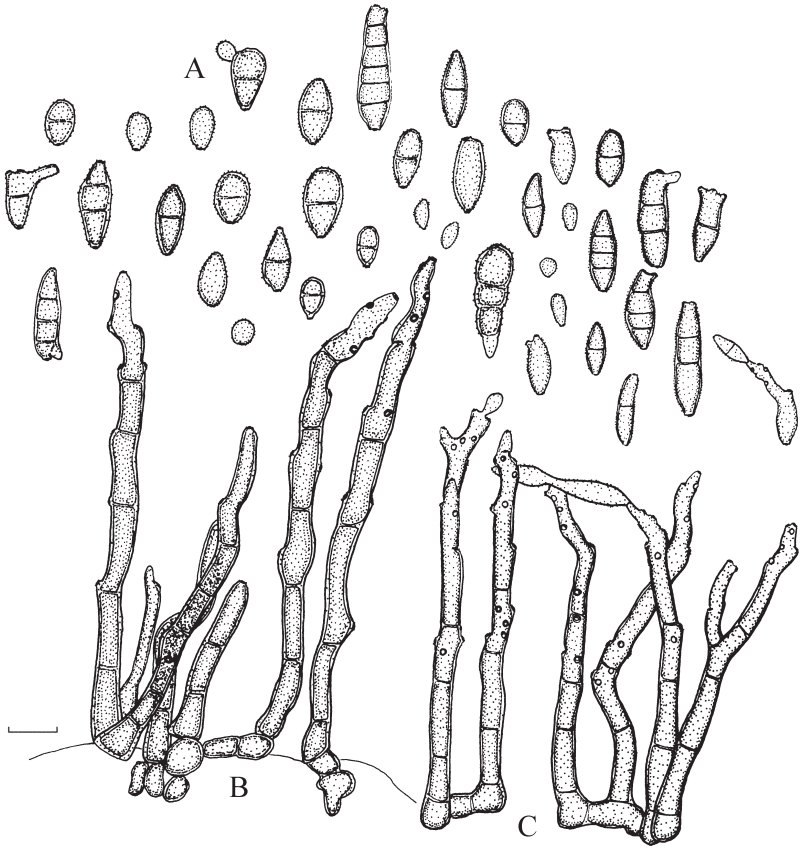


Fig. 2: *Cladosporium epichloës*: A – conidia, B – conidiophores (from type material), C – conidiophores (from HAL 1822).

unbranched or branched, (9–)34–105 × 3–6 µm, slightly swollen at the base, up to 7 µm, 0–7-septate, not constricted at the septa, pale to medium brown, paler towards the apex, smooth, walls slightly thickened, rarely with subnodulose intercalary swellings, up to 7 µm wide, swellings mostly with conidiogenous loci. Conidiogenous cells integrated, terminal and intercalary, 10–44 µm long, polyblastic, proliferation sympodial, with (1–)2–9(–11) conspicuous conidiogenous loci which are sometimes situated on small unilateral swellings ('shoulders'), protuberant, thickened, darkened-refractive, 1.5–2 µm diam. Conidia mainly in branched chains, straight, polymorphous, subglobose, ellipsoid, obovoid, fusiform, subcylindrical, 4–24(–26) × 3–7(–8) µm, 0–3(–5)-septate, usually not constricted at the septa, subhyaline to pale brown, almost smooth to faintly rough-walled, walls slightly to conspicuously thickened, apex rounded, with up to 4 hila, base truncate to convex, occasionally somewhat attenuated, hila protuberant, thickened, darkened, 1–2 µm diam., microcyclic conidiogenesis occurring.

Host range and distribution: Europe; on *Epichloë typhina* on *Bromus inermis* (RUS); *E. typhina* on *Dactylis polygama* (D); *E. typhina* (A).

Collections examined: on *Epichloë typhina* on *Dactylis polygama*, Germany, An, Harz, Kr. Sangerhausen, NNW Grillenberg, N "Kohlenstraße", deciduous forest, alt. c. 379, 9 Nov. 2003, H. Jage (herb. Jage, No. 2967/03; HAL 1822); on *E. typhina*, Austria, Mauerbach near Vienna, Jul., C. Keissler, Crypt. exs. 3392 (M-57568).

Notes: This species, confined to *Epichloë typhina*, is morphologically close to the common, widespread saprobic species *Cladosporium herbarum*, which differs, however, in having characteristic intercalary nodes of 7–9 µm diam., such nodes encompassing the entire circumference of the conidiophore and not just swelling one side of the conidiophore as in 'shoulders'. The conidiophores of *C. epichloës* are often geniculate, with small unilateral shoulders, but multilateral nodes are lacking. *C. epichloës* is morphologically barely distinguished from *C. aecidiicola*. Since the latter species is ecologically clearly discriminated from *C. epichloës* by being confined to aecia of rust fungi, we tentatively prefer to maintain two different species. Inoculation experiments and molecular examinations are necessary to prove the taxonomy of the two species and their relations.

4.3.2.3. *Cladosporium epimyces* Cooke **Figs 3 – 4**

Cladosporium epimyces Cooke, Grevillea 12(61): 31 (1883).

Lectotype (designated here): on a gill of *Armillaria mellea* [*Agaricus melleus*] (Agaricaceae), USA, South Carolina, Aiken, Rav., F. amer. exs. 596 (NY). **Isolectotypes:** Rav., F. amer. exs. 596 (e.g., BPI 426471).

Colonies light to dark brown, effuse, caespitose, velvety, erect structures delicate, thin. Mycelium immersed and superficial, hyphae branched, 4–6 µm wide, cells 7–14 µm long, with constrictions at the septa, pale olivaceous-brown, occasionally subhyaline, smooth, walls somewhat thickened. Stromata diffuse, composed of subglobose to rectangular cells, 4–14 µm diam., subhyaline to pale brown, smooth, walls somewhat thickened. Conidiophores in loose to dense fascicles, arising from stromata or formed singly, arising from repent hyphae, erect, sometimes curved, subcylindrical to geniculate-sinuous, unbranched to branched, several times, 23–250(–280) × 3–5.5(–7) µm, sometimes swollen at the very base, up to 9 µm, rarely with some slight intercalary swellings, up to 7 µm, 0–8(–12)-septate, not or only slightly con-

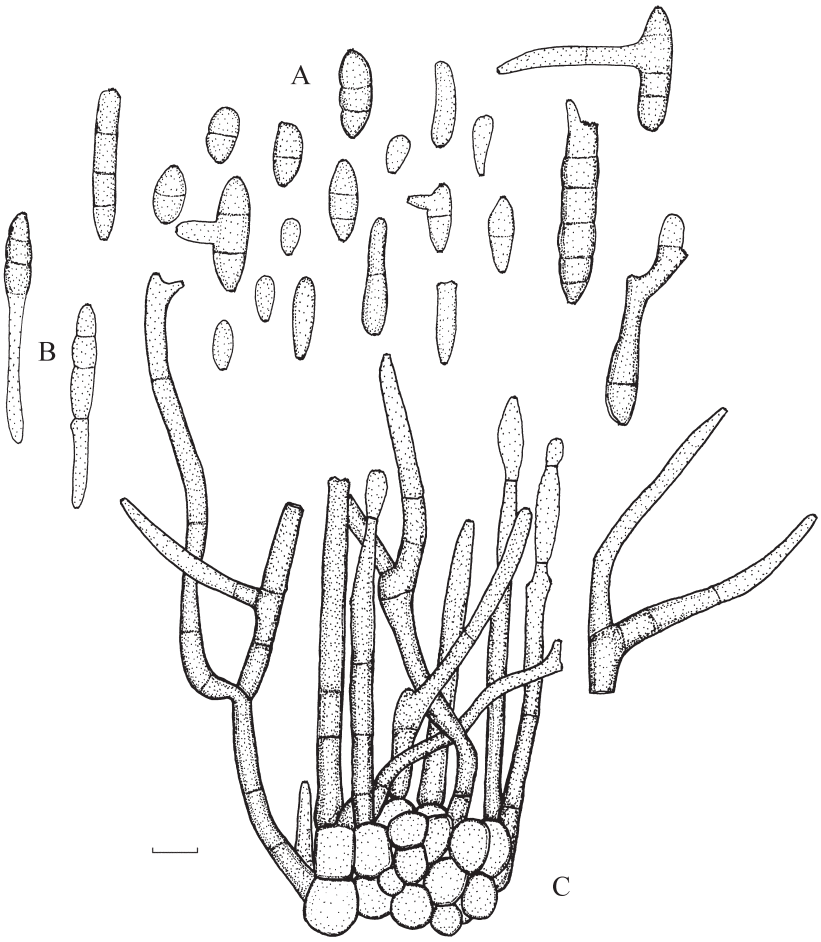


Fig. 3: *Cladosporium epimyces*: A – conidia, B – microcyclic conidiogenesis, C – conidiophores, arising from stromata.

stricted at the septa, pale brown, at the base pigmentation stronger, paler towards the apex, smooth or almost so, young conidiophores and conidiophores with attached conidia often irregularly rough-walled, walls slightly thickened, tips and ultimate branchlets often unthickened. Conidiogenous cells integrated, terminal and inter-

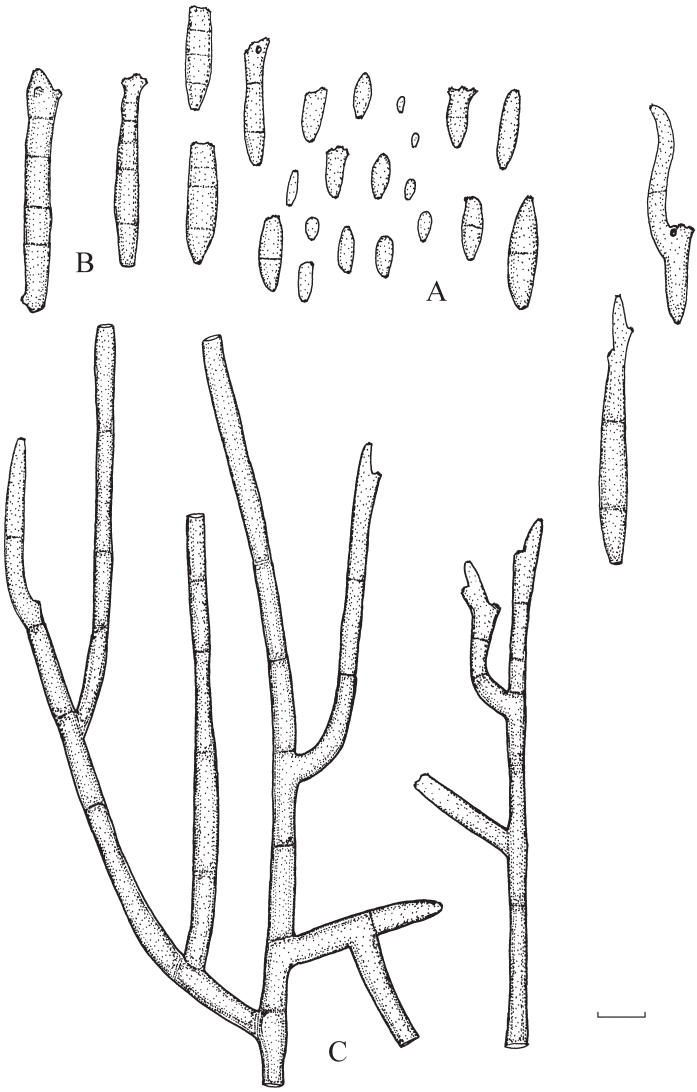


Fig. 4: *Cladosporium epimyces*: A – conidia, B – ramoconidia s. str., C – branched conidiophore (from a single collection from PH).

calary, 9–52 µm long, polyblastic, with up to six conidiogenous loci, sympodially proliferating, conidio-genous loci somewhat protuberant, thickened, darkened-refractive, 1.5–3 µm diam. Ramoconidia s. str. straight, subcylindrical, 33–53 × 4.5–7 µm, 0–6-septate, occasionally constricted at the septa, basal hilum slightly convex, with-

out convex dome and surrounding raised rim, 2–3 µm diam. Conidia catenate, usually in branched chains, straight to slightly curved, ellipsoid, fusiform, subcylindrical, 4–36(–44) × 4–7(–8) µm, 0–3-septate, sometimes constricted at the septa, subhyaline to pale brown, smooth or almost so, young conidia still attached to the conidiophores sometimes irregularly rough-walled, walls slightly thickened, sometimes thin-walled, apex with up to four hila, base truncate to convex, occasionally attenuated towards the base, hila protuberant, thickened, darkened-refractive, 1–2 µm diam., microcyclic conidiogenesis seen.

Host range and distribution: Europe, North America; on gills of *Armillaria mellea* (USA, SC); *Hypholoma sublatentum* (USA, PA); *Lactarius* sp. (PL), *Leucopaxillus gentianeus* (USA, WA).

Collections examined: on *Hypholoma sublatentum* (Agaricales), USA, PA, 2 Aug. 1953, G.T. Reese (PH); on *Lactarius* sp. (Russulales), PL, Prószków, Arboretum d. Pom. Institutes, Sept. 1901 (HBG); on *Leucopaxillus gentianeus* (= *Leucopaxillus amarus*) (Agaricales), USA, WA, Spokane County, [*Pseudotsuga taxifolia* Association, Douglas Fir Zone, Dense near-climax forest, bottom of east facing slope and adjacent level, 8.2. miles north of N.P. Ry, overpass north of spangle on west side of U.S. 195, 2300 feet, T. 24N, R. 43E., S. 17.] 10 Feb. 1948, W.B. & V.G. Cooke (NY).

Notes: COOKE (1883) described lanceolate, aseptate, hyaline conidia, 15–20 × 4 µm. The examination of type material and additional collections showed that the original description of *C. epimyces* is very poor and that this species is much more variable.

AARNAES (2000) recorded this species from Norway, but without any details about hosts.

4.3.2.4. *Cladosporium episclerotiale* Bubák **Fig. 5, Pl. 2, Fig. 9**

Cladosporium episclerotiale Bubák, Ann. Mycol. 12: 213 (1914).

Holotype: on sclerotia of *Monilinia laxa* (= *Sclerotinia cinerea*) (Sclerotiniaceae) on mummified fruits of *Prunus domestica* (Rosaceae), Italy, Tyrol, Arco, Mar. 1913, E. Diettrich-Kalkhoff (BPI 426531).
Lit.: SACCARDO (1931: 797).

Colonies blackish brown, diffuse to dense, confluent, caespitose, velvety. Mycelium immersed and external, superficial; hyphae 3.5–7 µm wide, closely septate (with eu- and pseudosepta), often constricted at the septa, hyphal cells irregularly swollen, medium olivaceous-brown, smooth or almost so, walls thickened, conspicuously two-layered, outer layer slightly pigmented to subhyaline. Stromata diffuse, loose to dense, composed of swollen hyphal cells, subglobose, 3–10 µm diam., medium olivaceous-brown to dark brown, thick-walled, stromatic and hyphal cells with oil droplets. Conidiophores solitary, arising from hyphal cells, aggregations or from stromata, erect, straight to curved, subcylindrical, more or less geniculate-sinuous, unbranched or branched, (22–)97–295(–322) × 5–8(–10) µm, enlarged at the base, sometimes conspicuously swollen, 8–13 µm wide, somewhat attenuated towards the apex, 3–21-septate (with eusepta as well as pseudosepta), cells 10–20 µm long, olivaceous-brown to medium brown, pigmentation often stronger near the base, paler towards the apex, smooth or almost so, walls thickened below, less thickened towards the apex, wall near the tip often unthickened, occasionally with slightly intercalary swellings, up to 10 µm diam., often with conidiogenous loci, wall composed of two distinct layers,

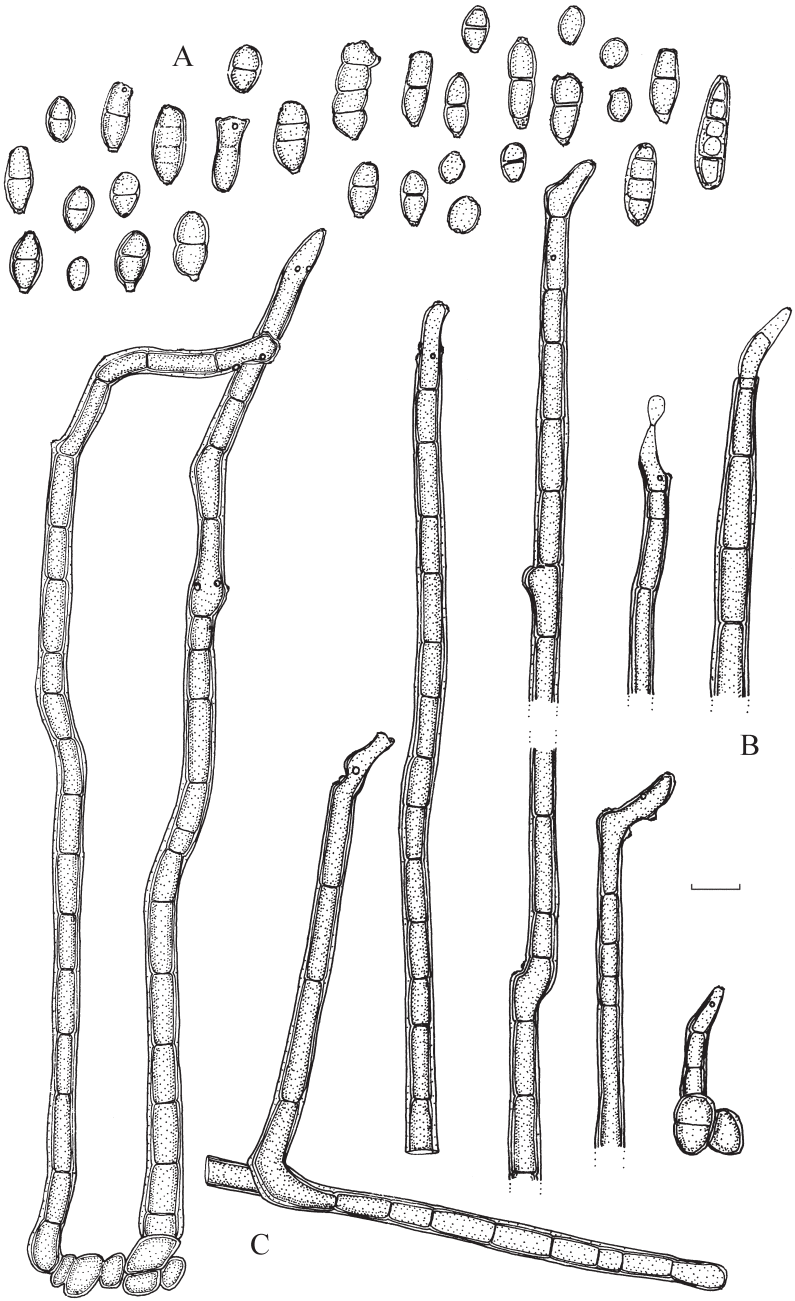


Fig. 5: *Cladosporium episclerotiale*: A – conidia, B – tips of conidiophores, C – solitary conidiophores.

outer layer paler, often with an irregular surface, not constricted at the septa, conidiophores occasionally with oil droplets. Conidiogenous cells integrated, terminal and intercalary, 10–55 µm long, polyblastic, with 1–7 conidiogenous loci, proliferation sympodial, loci non- to slightly protuberant, sometimes on small shoulders, formed by sympodial geniculation, truncate, thickened, darkened-refractive, 1–2(–3) µm diam., convex dome and periclinal rim often not very conspicuous under light microscopy. Conidia usually in branched chains, straight, subglobose, ellipsoid, broadly ellipsoid, 6.5–23(–30) × 4–8 µm, 0–4-septate, often slightly constricted at the septa, cells often distinctly rounded, septa often thickened and darkened, occasionally with distosepta, olivaceous to dark brown, smooth to irregularly verruculose, walls thickened, mostly distinctly two-layered, apex rounded or truncate to convex, with up to 4 hila, base truncate to convex, hila mostly somewhat protuberant, 1–2.5(–3) µm diam. and up to 1.5 µm high, thickened and mostly distinctly darkened, occasionally not darkened, i.e., hila paler than the surrounding conidial base, microcyclic conidiogenesis occasionally occurring.

Host range and distribution: Europe; on *Monilinia laxa* on *Prunus domestica* (I); *Prunus spinosa* (D); *Suillus bovinus* (D).

Collections examined: on dried fruits of *Prunus spinosa*, Germany, Ba, Gerolzhofen, Apr. 1912, A. Vill (HBG) (as *C. herbarum*); on a dead gill of a mushroom in a pine forest, Germany, Br, Kr. Prignitz, Triglitz, 4 Oct. 1905, O. Jaap, Jaap, F. sel. exs. 175 (B 70-6384) (as *C. fuligineum* Bonord.); on decaying gills of *Boletus bovinus* (= *Suillus bovinus*), Germany, Br, Kr. Nieder-Barnim, forest between Sophienstädt and Ruhlsdorf, 7 Nov. 1917, P. Sydow, Syd., Mycoth. germ. 1781 (M-57567, HBG) (as *C. fuligineum*) [mixed collection with *C. herbarum*].

Notes: The generic affinity of this species, based on the structure of the conidiogenous loci, was not clearly discernable by means of light microscopy since the central dome and periclinal raised rim are often not very distinct. However, it could clearly be demonstrated by SEM that *C. episclerotiale* belongs in *Cladosporium* s. str. (Pl. 1, Fig. 9).

The substrates of two of the examined collections are not quite certain. The collection 'F. sel. exs. 175' (B 70-6384), on a dry gill of a mushroom, is totally overgrown with *C. herbarum*, but a few blackish brown, caespitose, effuse colonies proved to be morphologically indistinguishable from *C. episclerotiale*. In a collection on dried fruits of *Prunus spinosa* (HBG), it was not possible to ascertain if sclerotia were present.

4.3.2.5.1. *Cladosporium exobasidii* Jaap **var**. *exobasidii* **Fig. 6**

Cladosporium exobasidii Jaap, Verh. Bot. Vereins Prov. Brandenburg 49: 29 (1907).

Lectotype (designated here): on galls of *Exobasidium vaccinii* var. *vaccinii* (Exobasidiales) on *Vaccinium uliginosum* (Ericaceae), Germany, Rhön, Gersfeld, Rotes Moor, 30 Jul. 1906, O. Jaap (B 70-6339). **Isolectotypes:** Jaap, F. sel. exs. 200 (e.g., HAL, M-57603). **Paratype**: on galls of *Exobasidium vaccinii* var. *vaccinii* on *Vaccinium uliginosum*, Germany, Brandenburg, Kr. Prignitz, Putlitzer Heide near Putlitz, 1 Sept. 1900, O. Jaap (B 70-6340).
Lit.: LINDAU (1907: 808; 1910: 796), LIND (1913: 522), SACCARDO (1913: 1371), BRAUN (2001: 57).
Ill.: BRAUN (2001: 55, Fig. 3).

Colonies on galls, olivaceous-brown to dark brown, occasionally greyish, loosely to densely caespitose, effuse, erect structures slightly shiny. Mycelium immersed; hy-

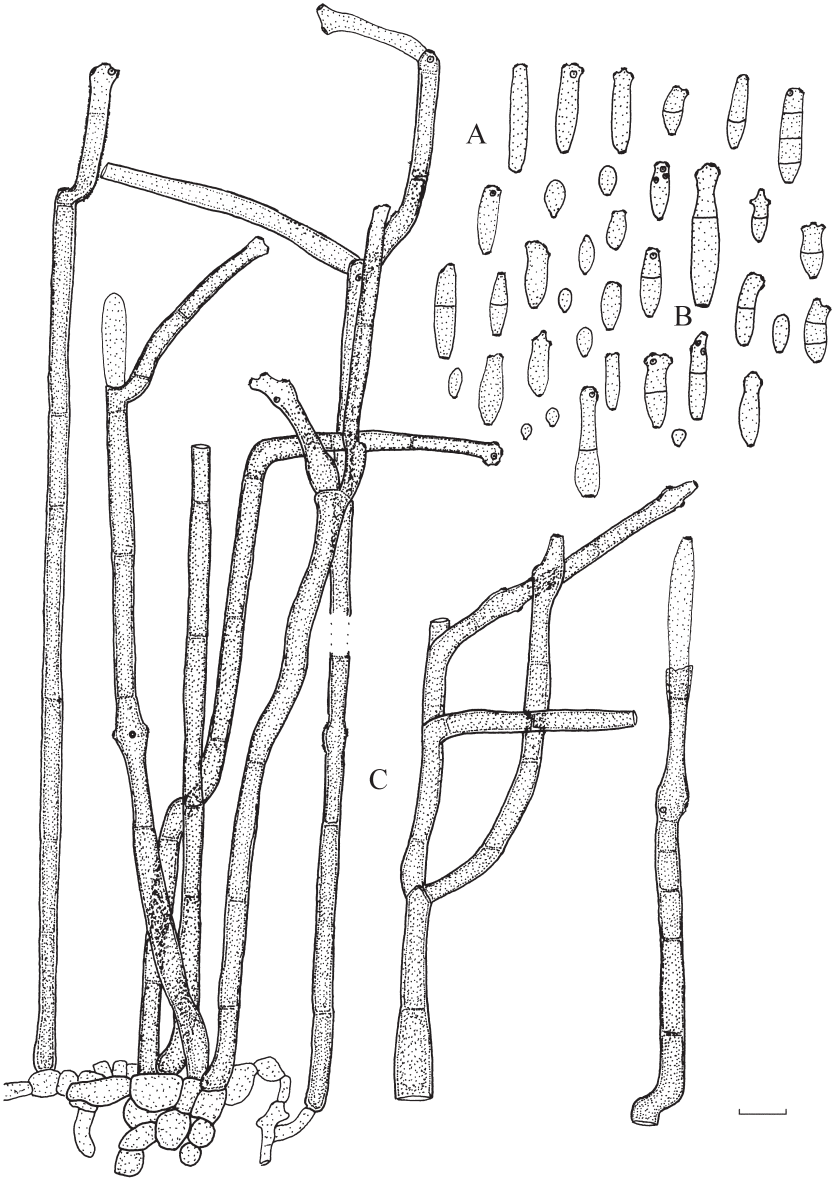


Fig. 6: *Cladosporium exobasidii* var. *exobasidii*: A – conidia, B – ramoconidia s. str., C – conidiophores.

phae branched, 2–9 µm wide, cells 3–14 µm long, often constricted at the septa, subhyaline to olivaceous-brown, cells smooth, walls unthickened or only slightly thickened, swollen hyphal cells 3–13 µm diam., forming loose to dense aggregations. Conidiophores solitary or in loose to dense fascicles, arising from hyphal aggregations, erect to decumbent, straight to curved, subcylindrical, slightly geniculate-sinuous, usually unbranched, rarely branched in the upper third, 25–400 × 3.5–6.5(–8) µm, occasionally longer, sometimes somewhat swollen at the base, 6–11 µm wide, 3–11-septate, not constricted at the septa, pale to medium olivaceous-brown, paler towards the apex, tips often subhyaline, smooth, but occasionally rough-walled in the upper third, walls thickened, but often thin-walled near the tips, occasionally enteroblastically proliferating, monopodial, sometimes with intercalary swellings, 5–9 µm diam., swellings often with numerous conidiogenous loci, tips often somewhat capitate and provided with numerous conspicuous loci. Conidiogenous cells integrated, terminal and intercalary, subcylindrical, 14–108 µm long, polyblastic, sympodially proliferating, conidiogenous loci crowded, usually conspicuously protuberant, thickened and darkened, 1.5–2.5 µm diam. Ramoconidia s. str. clavate, subcylindrical, 14–29(–30) × 4–5.5 µm, 0–1(–3)-septate, without any constrictions, base slightly convex, without dome and raised rim, 2.5–3 µm diam. Conidia numerous, usually in branched chains, straight, occasionally slightly curved, subglobose, obovoid, ellipsoid, subcylindrical, 2–19 × 2–6 µm, 0–1(–2)-septate, without any constrictions, subhyaline to pale olivaceous, smooth, wall unthickened to slightly thickened, apex rounded, somewhat attenuated to truncate, with up to 5 hila, base truncate, convex or slightly attenuated, hila protuberant, thickened and darkened, 1–2 µm diam., microcyclic conidiogenesis occurring.

Host range and distribution: Europe; on *Exobasidium rhododendri* (A); *E. vaccinii* on *Andromeda poliifolia* (S); *E. vaccinii* on *Vaccinium uliginosum* (D; DK); *E. vaccinii* on *V. vitis-idaea* (D); *E. vaccinii* on *Vaccinium* sp. (UA).

Collections examined: on *Exobasidium rhododendri*, Austria, Kärnten, Oberseeland in the Karawanken, 31 Jul. 1907, O. Jaap (HBG); on *E. vaccinii* on *Vaccinium uliginosum*, Denmark, Jütland, Wilborg, 14 Jun. 1906, J. Lind (B 70-6341); on *E. vaccinii* on *Vaccinium vitis-idaea*, Germany, Ba, Mittelfranken, near Girndorf, 29 Jun. 1898, A. Schwarz (HBG); Ba, 'Föhrenwald auf Diluvialsand', E of Nürnberg, 3 Jul. 1898, A. Schwarz (HBG); Ba, between Schwarzenbach and Unterburg near Nürnberg, 9 Jul. 1907, A. Schwarz (HBG); Br, forster´s house Briese near Birkenwerder, 8 Jun. 1901, P. Röseler (HBG) (as *C. fuligineum*).

Notes: The collection on *Exobasidium vaccinii* var. *vaccinii* on *Vaccinium uliginosum* from Denmark (B 70-6341) cannot be considered a paratype as cited by Braun (2001: 57) since this collection was not cited by O. Jaap in the protologue of the original description. Another original collection from the Herbarium in Berlin-Dahlem (B 70-6339), cited by Jaap, is selected as lectotype (this sample cannot be considered the holotype since Jaap listed several original collections, but did note designate any types). Duplicates of the lectotype, distributed in Jaap "Fungi selecti exsiccati" are isolectotypes.

De Vries (1952) and Ho et al. (1999) cited *C. exobasidii* as a synonym of *Cladosporium cladosporioides*, although in the latter species the conidiophores are characterised by lacking swellings and geniculations, and the conidiogenous loci are not crowded (Braun 2001). Oudemans (1919) and Lind (1934) regarded *C. exobasidii* to be a synonym of *Cladosporium fuligineum* (= *C. herbarum*), although the latter species is clearly distinguished by having verruculose to verrucose conidia. A

collection on *Exobasidium rhododendri* (HBG) has been examined, but was too old and scarce to be provable.

4.3.2.5.2. *Cladosporium exobasidii* [Jaap] var. *verruculosum* **Fig. 7**

Cladosporium exobasidii [Jaap] var. ***verruculosum*** Heuchert, U. Braun & K. Schub., **var. nov.**

Differt a var. *exobasidii* conidiis verruculosis.

Holotype: on *Exobasidium vaccinii* var. *vaccinii*, Czech Republic, near Pontresina, 3 Sept. 1899, P. Magnus (HBG).

Colonies olivaceous, loose to dense, effuse, caespitose. Mycelium immersed; hyphae branched, 2–5 µm wide, cells 5–20 µm long, not constricted at the septa or only slightly so, olivaceous-brown, smooth, walls unthickened. True stromata lacking. Conidiophores solitary, arising from hyphae, often densely arranged, erect to de-

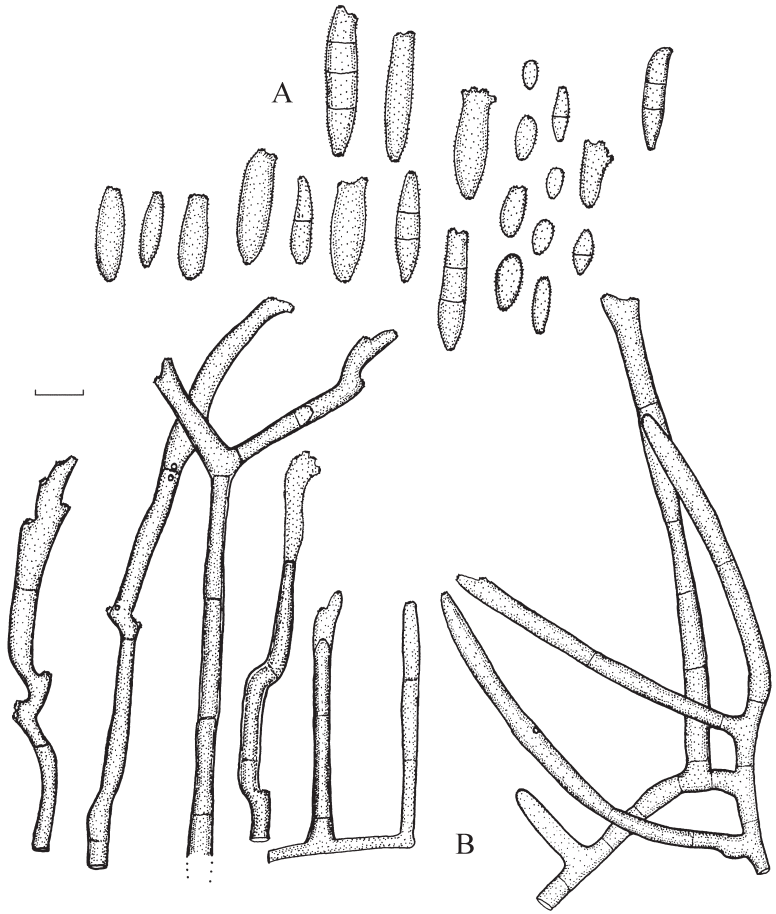


Fig. 7: *Cladosporium exobasidii* var. *verruculosum*: A – conidia, B – conidiophores.

cumbent, geniculate-sinuous, mostly unbranched, occasionally branched in the upper third, 2–217 × 2–6 µm, slightly enlarged at the base, up to 7 µm, 1–6-septate, without any constrictions, pale to dark olivaceous-brown, rarely subhyaline, usually paler towards the apex, smooth, walls slightly thickened. Conidiogenous cells integrated, terminal and intercalary, 14–53 µm long, polyblastic, conspicuously geniculate-sinuous, occasionally slightly widened, conidiogenous loci protuberant, thickened, darkened, 1–2 µm diam. Ramoconidia s. lat. broadly ellipsoid, subcylindrical, 10–38 × 4–7 µm, 0–2(–3)-septate, at the apex with up to 4 hila. Conidia usually in branched chains, rarely slightly curved, broadly ellipsoid, fusiform, obovoid, 5–23 × 3–7 µm, 0–1(–2)-septate, without any constrictions, pale olivaceous-brown to medium brown, verruculose, walls unthickened, apex rounded, truncate or somewhat attenuated, convex, base truncate to convex, hila conspicuously protuberant, thickened and darkened, 1–2 µm diam., microcyclic conidiogenesis not observed.

Host range and distribution: Europe; on *Exobasidium vaccinii* var. *vaccinii* (CZ); on *E. warmingii* (CH).

Collection examined: on *Exobasidium warmingii* on *Saxifraga aizoon*, Switzerland, near Davos, 22 Jul. 1901, Travel (HBG).

Notes: This variety is distinguished from var. *exobasidii* by having verruculose conidia. Conidiophores with nodulose swellings and true ramoconidia are lacking in var. *verruculosum*, but swellings are also not consistently formed in var. *exobasidii*. Otherwise the two varieties are congruent.

4.3.2.6. *Cladosporium gallicola* B. Sutton **Figs 8–9, Pl. 1, Fig. 5, Pl. 2, Fig. 8**

Cladosporium gallicola B. Sutton, Mycol. Pap. 132: 37 (1973).

Holotype: on galls of *Endocronartium harknessii* (Cronartiaceae) on twigs of *Pinus banksiana* (Pinaceae), Canada, Saskatchewan, 27´S. Meadow Lake, 25 May 1967, C. Rentz, WINF (M) 6898e (IMI 145204).
= *Cladosporium peridermiicola*, in herb. (BPI).
Lit.: ELLIS (1976: 329).
Ill.: SUTTON (1973: 38–39, Figs 17, 18), ELLIS (1976: 329, Fig. 247).

Colonies on galls and intact as well as empty aecia, medium olivaceous-brown to dark brown, in loose to dense fascicles or solitary, spreading to the surrounding tissue of the host plant, effuse, caespitose, velvety, confluent, affected needles discoloured, reddish brown. Mycelium immersed and external, superficial; hyphae branched, 1–4(–8) µm wide, cells 7–15 µm long, often irregularly swollen, 5–7 µm diam., pale to medium brown, occasionally subhyaline. Stromata hemisphaerical, 45–130 × 30–90 µm, composed of subglobose to subangular cells, 4–12 µm diam., dark brown, smooth. Conidiophores solitary, arising from hyphae, or mostly formed in loose to dense fascicles, mostly more than 10, arising from stromata, erumpent, erect, straight to slightly curved, subcylindrical, 34–260 × (3.5–)6–9 µm, at the base up to 10 µm wide, somewhat attenuated towards the apex, up to 15-septate, usually not constricted at the septa, medium to dark brown, paler towards the apex, smooth to faintly verruculose, walls thickened, less thickened or unthickened towards the apex, occasionally enteroblastically proliferating, monopodial, usually branched in the upper third, branchlets 11–43(–65) × 4–5(–7) µm, 0–3(–5)-septate, subhyaline to pale brown.

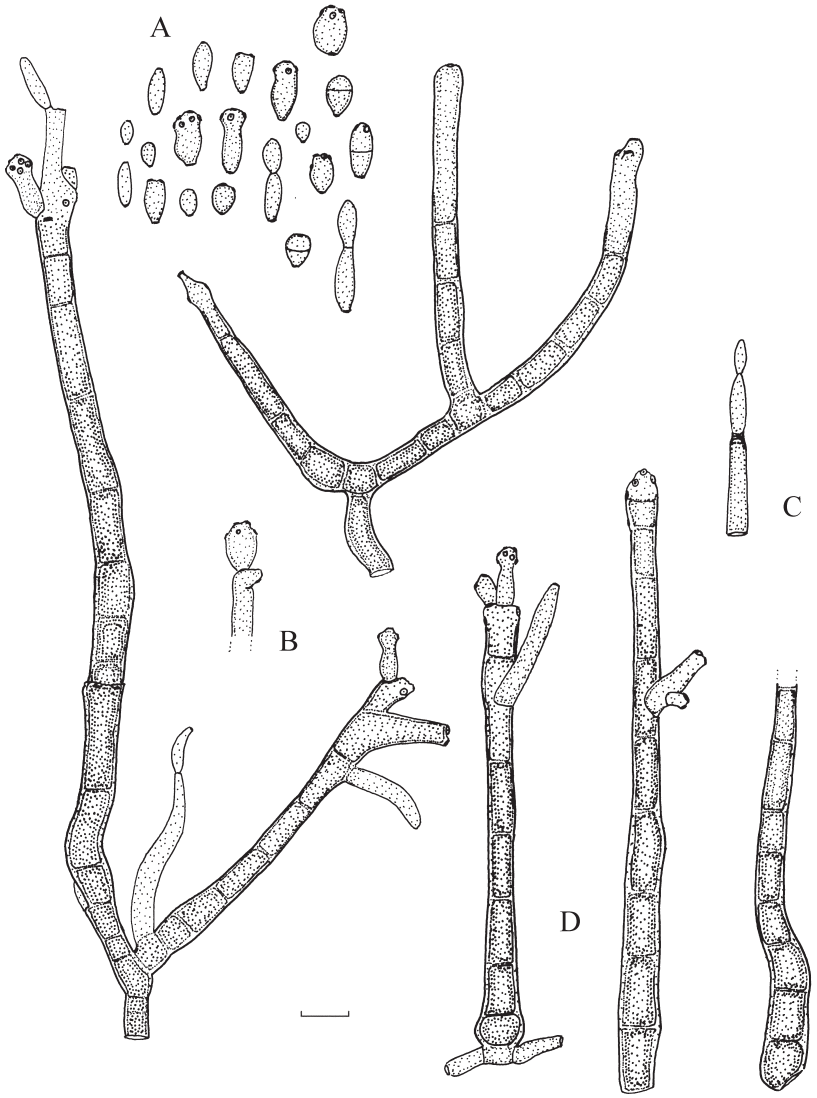


Fig. 8: *Cladosporium gallicola*: A – conidia, B – conidiogenous cell with attached conidium, C – conidiogenesis, D – conidiophores.

Conidiogenous cells integrated, terminal and intercalary, subcylindrical or somewhat attenuated towards the tip, 6–35 µm long, polyblastic, with numerous conspicuous conidiogenous loci (up to 10 or even more), proliferation sympodial, appearing to be coarsely verrucose by numerous densely arranged protuberant conidiogenous scars,

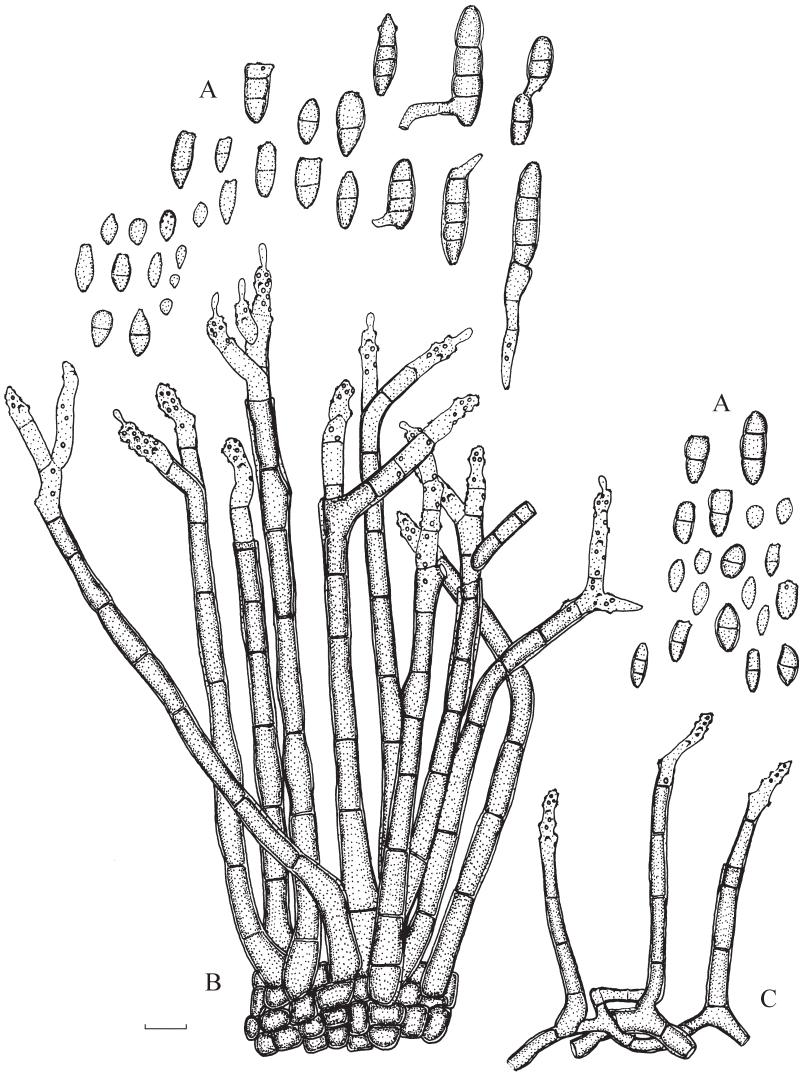


Fig. 9: *Cladosporium gallicola*: A – conidia, B – dense fascicle, conidiophores arising from stromata, C – conidiophores arising from hyphae (from several collections from BPI determinated as '*C. peridermiicola*').

loci slightly to conspicuously protuberant, truncate, denticle-like, somewhat thickened and refractive, 1–3 µm diam., convex dome sometimes indistinct. Ramoconidia s. str. lacking. Conidia usually in branched chains, straight, small conidia subglobose, obovoid, limoniform, ellipsoid, fusiform to broadly subcylindrical, 3–17 × 2–6(–7)

µm, 0(–1)-septate, without any constrictions, subhyaline to pale brown, smooth, walls thin to slightly thickened, large conidia broadly ellipsoid to subcylindrical, 12–29 × 6–8 µm, 2–3(–4)-septate, occasionally constricted at the septa, medium brown, smooth, walls thickened, apex rounded or provided with up to 6 hila, base rounded to attenuated, truncate, more or less protuberant, slightly thickened and refractive, convex dome sometimes not very distinct, (0.5–)1–2.5 µm diam., microcyclic conidiogenesis occurring.

Host range and distribution: North America; on *Cronartium comandrae* on *Pinus contorta* var. *latifolia* (Canada, widespread); *Endocronartium harknessii* on *Pinus banksiana* (Canada, widespread); *Pucciniastrum goeppertianum* on *Abies grandis* (USA, WA).

Collections examined: on *Peridermium columnare* (= *Pucciniastrum goeppertianum*) on *Abies grandis*, USA, WA, Sullivan Lake, 9 Jun. 1930, G.G. Hedgcock (BPI 427385); 5 Jul. 1929 (BPI 427383); USA, WA, Metalline Falls, 6 Jun. 1930, G.G. Hedgcock (BPI 427386) (deposited as *C. peridermiicola* in herb.).

Notes: Under light microscopy, the cladosporioid structure of the conidiogenous loci with distinct central dome and periclinal raised rim was not quite evident, but SEM (Pl. 2, Fig. 8) conclusively showed that *C. gallicola* belongs in *Cladosporium* s. str. Strongly branched conidiophores, as described and depicted by SUTTON (1973), could be found in the type collection, but were less branched in the other specimens examined. Several specimens deposited at BPI under the herbarium name *C. peridermiicola* proved to be identical with *C. gallicola*. Stromata are present and the conidia are broadly ellipsoid-subcylindrical, 12–29 × 6–8 µm, 2–3(–4)-septate, occasionally somewhat constricted at the septa, but otherwise these collections agree well with *C. gallicola.* Records of *Cladosporium* sp. on *Cronartium conigenum* and *C. coleosporioides* from Canada, Alberta, by POWELL (1971) possibly belong to *C. gallicola*.

4.3.2.7. *Cladosporium gerwasiae* sp. nov. Fig. 10, Pl. 1, Figs 1–2

Cladosporium gerwasiae Heuchert, U. Braun & K. Schub., **sp. nov**.

Differt a *C. uredinicola* conidiophoris fasciculatis, 4–7 µm latis, parietibus (0.5–)1–1.25 µm latis, ad basim saepe bistratis.

Holotype: on *Gerwasia* sp. (Uredinales) on leaves of *Rubus urticifolius* (Rosaceae), Guatemala, Chimaltenango, Tecpan, Xecoxol, 'plantation ex *Rubus* cf. *urticifolius*', 4 Dec. 2003, G.A. Alvarez [N 140°51.8'; W 90°59'] (KR-5684).

Colonies confined to epiphyllous sori of *Gerwasia* sp. and the surrounding deformed leaf tissue, but not spreading onto green leaf tissue which is not affected by the rust, dark olivaceous-brown, visible (at 10–50×) as diffuse to mostly dense tufts. Mycelium immersed and external, superficial; hyphae sparingly branched, 2–6 µm wide, septate, often slightly constricted at the septa, pale brown, smooth, walls slightly thickened or unthickened. Stromata formed by swollen hyphal cells, subglobose to somewhat angular, 4–9 µm diam., pale to medium brown, walls slightly thickened. Conidiophores in loose to dense fascicles, arising from stromata, or solitary, arising from swollen hyphal cells, erect, straight to curved, cylindrical, unbranched or branched at the base as well as near the tips, 24–366(–630) × (3–)4–7(–8) µm, often somewhat wider near the base, tips often elongated and narrowed, only 2.5 µm wide, 1–22-septate, not or only slightly constricted at the base, pale to medium brown, tips paler, occasionally subhyaline, smooth, occasionally minutely rough-walled near the base, pigmented

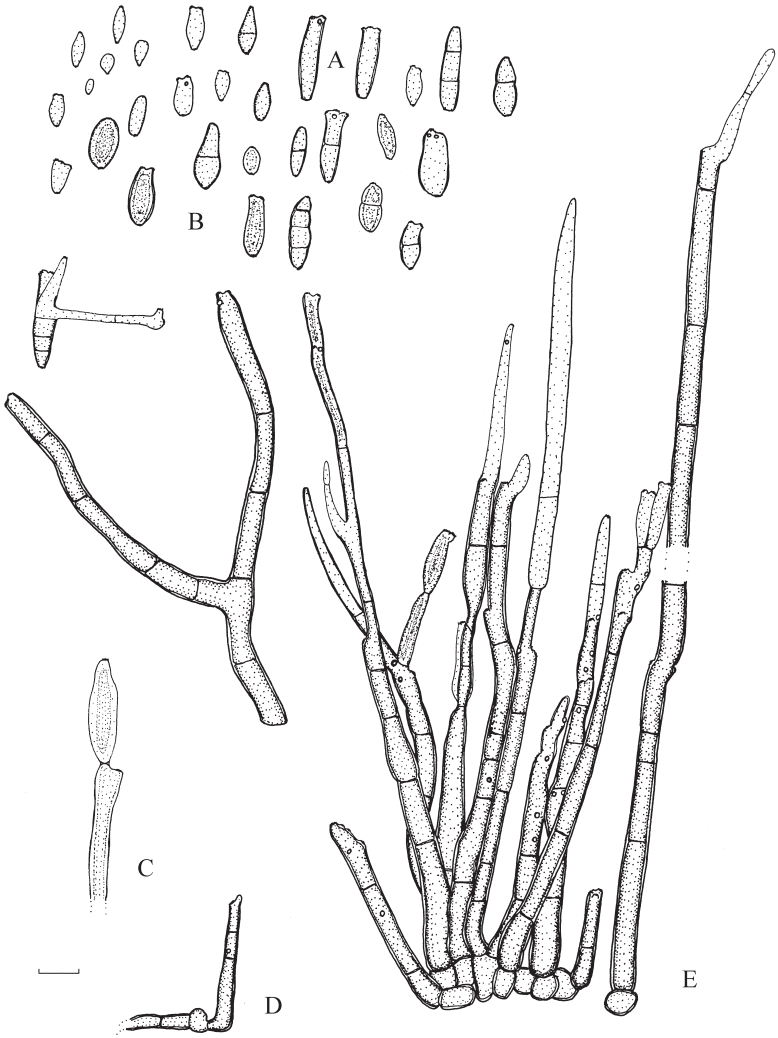


Fig. 10: *Cladosporium gerwasiae*: A – ramoconidia s. str., B – conidia, C – conidiogenous cell with attached conidium, D – conidiophore arising from swollen hyphal cells, E – conidiophores in loose to dense fascicles, arising from stromata.

walls thickened, (0.5–)1–1.25 µm wide, often distinctly two-layered towards the base, unthickened and one-layered above, lumen often appearing shrivelled, granular, surrounded by a wide, colourless to greyish layer (under phase-contrast), giving a very thick-walled appearance, some cells of the conidiophores conspicuously attenuated.

Conidiogenous cells integrated, terminal and intercalary, cylindrical, 7–50 µm long, polyblastic, proliferation subtly to markedly sympodial, conidiogenous loci protuberant, almost denticle-like, more or less thickened, darkened-refractive, 1.5–2.5 µm diam. Ramoconidia s. str. 14–26 × 3–5 µm, 0–2(–3)-septate, base slightly convex, without a cladosporioid hilum, up to 3 µm diam. Conidia usually in branched chains, ellipsoid, obovoid, subcylindrical, 4–24 × 2.5–8 µm, 0–1(–3)-septate, not or only slightly constricted at the septa, very pale brown, smooth, external pigmented wall layer slightly thickened, with phase contrast showing a granular lumen surrounded by a distinct hyaline to greyish layer, giving a thick-walled appearance, apex rounded to slightly attenuated, with up to 4 hila, base truncate to convex, occasionally somewhat attenuated, hila protuberant, more or less thickened and conspicuously darkened-refractive, 0.5–2.5 µm diam., microcyclic conidiogenesis observed.

Host range and distribution: only known from the type collection.

Notes: The new species is easily distinguishable from *Cladosporium uredinicola* by its obviously fasciculate habit, usually wider conidiophores, 4–7 µm, with thicker, often two-layered walls, (0.5–)1–1.25 µm broad. Colonies of *C. uredinicola* are effuse, consistently non-fasciculate, the conidiophores are 2–5 µm wide, thin-walled, 0.5–0.75 µm, and not two-layered. *C. gallicola*, also occurring on rust fungi, differs in having strongly branched conidiophores with conidiogenous cells which are seemingly coarsely verrucose by being densely covered with numerous conidiogenous loci. *C. aecidiicola* has verruculose conidia.

4.3.2.8. *Cladosporium lycoperdinum* Cooke **Figs 11–12**

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

Lectotype (designated here): on *Lycoperdon* sp. (Agaricales), USA, South Carolina, Aiken, Rav., F. amer. exs. 595 (K 121561). **Isolectotypes:** Rav., F. amer. exs. 595 (e.g., BPI 427244, NY).
Lit.: SACCARDO (1886: 368).

Colonies olivaceous to dark brown, effuse, loose to dense, caespitose, velvety. Mycelium external, superficial; hyphae branched, 3–12 µm wide, cells 5–10 µm long, often subglobose, angular to irregularly swollen by constrictions at the septa, swollen cells sometimes aggregated, pale olivaceous to olivaceous-brown, occasionally subhyaline, smooth. Stromata effuse, composed of swollen hyphal cells, 5–12 µm diam., dark olivaceous-brown or medium brown, smooth, walls thickened. Conidiophores solitary, arising from swollen hyphal cells, or in loose to dense fascicles, arising from stromata, erect to decumbent, straight to curved, subcylindrical, slightly geniculate-sinuous, unbranched to branched, 39–265 × 3–6(–8) µm, 6–9 µm wide at the base, occasionally somewhat attenuated towards the apex (up to 3.5 µm), 4–12-septate, at the base septa often closely spaced, occasionally slightly constricted at the septa, pale to medium olivaceous, sometimes paler towards the tips, occasionally subhyaline, smooth or almost so at 400–1000×, walls slightly thickened, thin-walled towards the apex, rarely enteroblastically proliferating, monopodial. Conidiogenous cells integrated, terminal or intercalary, cylindrical, 8–53 µm long, polyblastic, proliferation sympodial, with up to 4 scars, conidiogenous loci not or only slightly protuberant, only occasionally denticle-like or situated on small lateral shoulders, thickened and darkened-refractive, 1–2(–3) µm diam., intercalary conidiogenous cells sometimes

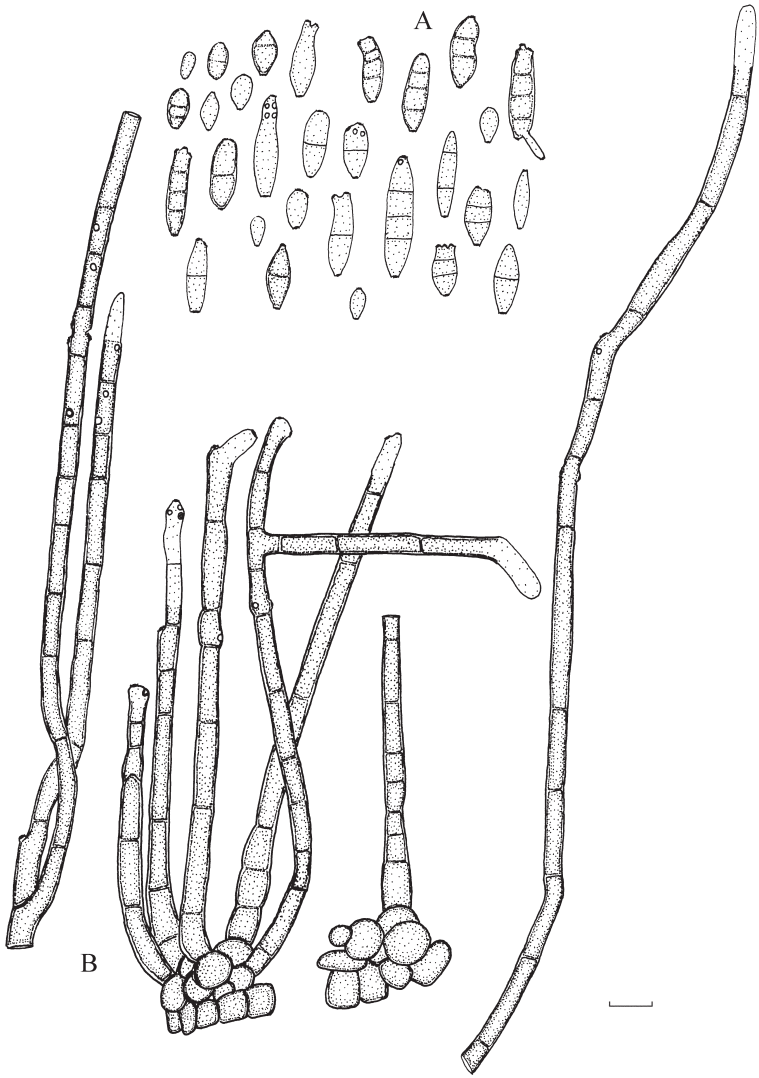


Fig. 11: *Cladosporium lycoperdinum*: A – conidia, B – conidiophores in loose fascicles, arising from stromata.

somewhat swollen. Ramoconidia s. str. occasionally formed, subcylindrical to ampulliform, 21–32 × 4.5–5.5 µm, 0–5-septate, usually not constricted at the septa, smooth or rarely irregularly minutely verruculose, walls thickened, base convex without a cladosporioid hilum, 2–3 µm diam., apex with up to 5 hila. Conidia usually in

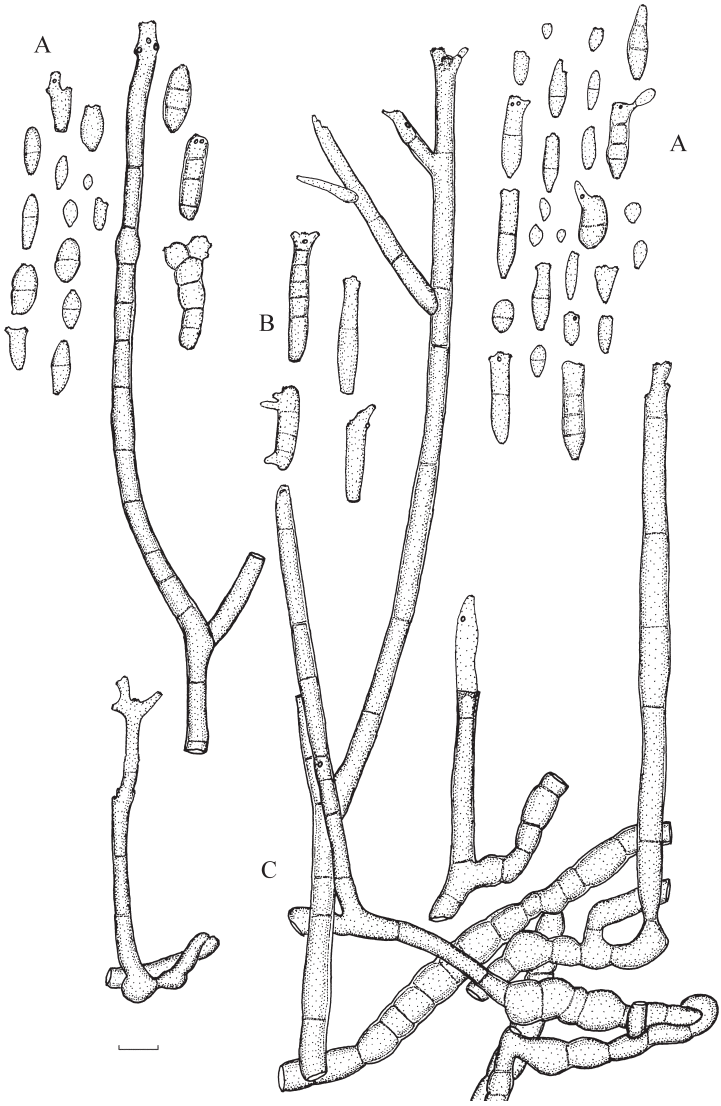


Fig. 12: *Cladosporium lycoperdinum*: A – conidia, B – ramoconidia s. str., C – conidiophores arising from swollen hyphal cells (from B 70-6387 and a collection from PH).

branched chains, straight, rarely curved, variable in shape and size, fusiform, obovoid, limoniform, narrowly to broadly ellipsoid, (2–)6–28 × 2.5–7(–10) µm, 0–3-septate, without any constrictions, pale olivaceous, occasionally subhyaline, smooth, walls unthickened or almost so, apex rounded, with up to 4 hila, base truncate to convex,

sometimes attenuated, hila slightly protuberant, denticle-like, thickened, darkened-refractive, (0.5–)1–2(–2.5) µm diam., microcyclic conidiogenesis observed.

Host range and distribution: Europe, North and South America; on gills of *Gomphidius viscidus* (D); *Lactarius volemus* (USA, NY); *Lepiota procera* (D); *Lycoperdon* sp. (USA, SC); *Piptoporus betulinus* (D); *Polyporus* sp. (USA, DE); *Scleroderma tuberoideum* (South America, ROU); *Suillus bovinus* (D); unknown ascomycete (USA, WA).

Collections examined: on decaying gills of *Boletus bovinus* (= *Suillus bovinus*), Germany, Br, Kr. Nieder-Barnim, forest between Sophienstädt and Ruhlsdorf, 7 Nov. 1917, P. Sydow, Syd., Mycoth. germ. 1781 (HBG) (as *C. fuligineum*) [mixed collection with *C. episclerotiale* and *C. herbarum*]; on *Gomphidius viscidus* (Boletales), Germany, Br, Kr. Prignitz, Triglitz, 5 Oct. 1905, O. Jaap, Fl. Prig. 74 (B 70-6245) [originally as *C. fuligineum*, later re-identified by U. Braun (BRAUN 2001) as *C. diaphanum* Thüm., mixed collection together with *C. herbarum*]; on *Lactarius volemus* (Russulales), USA, NY, Newfield, Sept. 1897 (NY) (as *C. epimyces*); on *Lepiota procera* (Agaricales), Germany, Br (probably Triglitz), 4 Oct. 1905, O. Jaap, Fl. Prov. Br. 102 (B 70-6246) [originally as *C. fuligineum*, later revised by U. Braun (BRAUN 2001) as *C. diaphanum*, mixed infection together with *C. herbarum*]; *Polyporus betulinus* (= *Piptoporus betulinus*) (Polyporales), Germany, We, Kr. Olpe, near Silberg, Sellenbruch, 20 Jun. 1947, A. Ludwig (B 70-6387) (as *C. fuligineum*); on *Polyporus* sp., USA, DE, Wilmington, 26 Oct. 1891, herb. A. Commons Nr. 1879 (PH) (as *C. epimyces*); on *Scleroderma tuberoideum* (Boletales), Uruguay, Dep. de San José, 5 Oct. 1939, W.G. Herter, Herter, Pl. urug. exs. 1452 (NY) (as *C. epimyces*); on an unknown ascomycete on *Abies grandis*, USA, WA, Metalline Falls, 31 Aug. 1930, G.G. Hedgcock (BPI 427384) (as *C. peridermiicola* in herb.).

Notes: The conidia of the lectotype, which have been examined and measured, are, in comparison with the original description of this species (10–20 × 3.5 µm, 1–2-septate), mostly wider and possess up to 3 septa. *C. lycoperdinum* was hitherto only known from the type collection but seems to be more common since several collections from various fungal fruit bodies, deposited under different names, proved to be identical with this species. A collection of '*Cladosporium epimyces*' on *Scleroderma tuberoideum* (NY) is tentatively assigned to *C. lycoperdinum*, although a few conidiophores with swellings (up to 10 µm) have been observed. Furthermore, in this collection the colonies overgrow basidiospores. '*Peridermium columnare*' (BPI 427384) [deposited under '*C. peridermiicola*' in herb.], inhabiting stromata of an unknown ascomycete, is morphologically indistinguishable from *C. lycoperdinum*. In a specimen on *Lactarius volemus* (NY), some broadly ellipsoid to subcylindrical, darker conidia, 13–20 × 5.5–8.5 µm, 1–3-septate, with constrictions at the septa, have been seen, but it is not clear if they belonged to *C. lycoperdinum* or if a mixed infection was involved. *Cladosporium epimyces*, also occurring on fungal fruit bodies, possesses much larger, subcylindrical ramoconidia s. str., 33–53 × 4.5–6 µm, 0–6-septate. The conidiophores are, in comparison with *C. lycoperdinum*, frequently dichotomously to irregularly branched.

4.3.2.9. *Cladosporium phyllophilum* McAlpine **Figs 13–14, Pl. 2, Fig. 12**

Cladosporium phyllophilum McAlpine, Agric. Gaz. New South Wales 7: 153 (1896).

Lectotype: on leaves and twigs of *Prunus persica* (= *Persica vulgaris*) (Rosaceae) infected with and deformed by *Taphrina deformans* (= *Exoascus deformans*), Australia, Victoria, Armadale, 16 Feb. 1896, D. McAlpine (VPRI 2490).

= *Cladosporium exoasci* Ellis & Barthol., in Shear, F. columb., Cent. XV, No. 1493 (1901), nom. nud.

= *Cladosporium exoasci* Lindau, in Rabenhorst, Krypt.-Fl., ed. 2, 1(8): 808 (1907), **syn. nov.** [lectotype: on *Taphrina pruni* (=*Exoascus rostrupianus*) on *Prunus spinosa*, Germany, He-Nassau, Rhön, near Gersfeld, c. 500 m, 31 Jul. 1906, O. Jaap, Jaap, F. sel. exs. 248 (B 70-6327); isolectotypes: Jaap, F. sel. exs. 248].

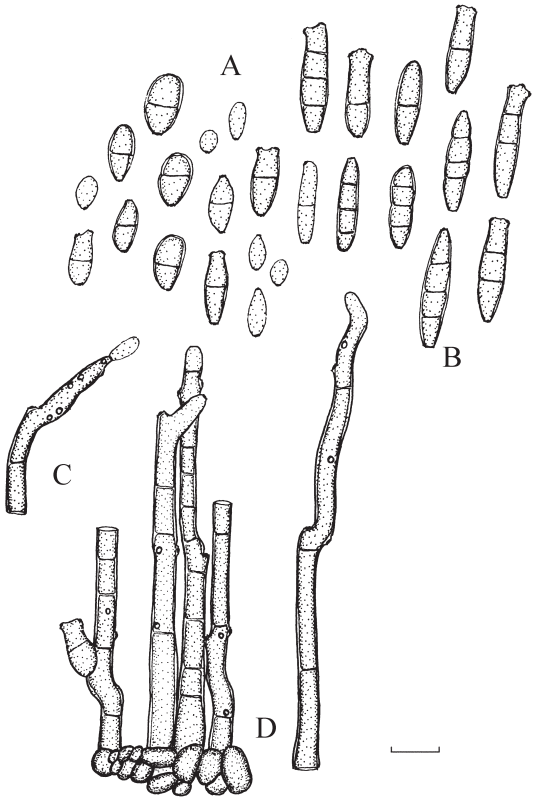


Fig. 13: *Cladosporium phyllophilum*: A – conidia, B – ramoconidia s. str., C – conidiogenous cell, D – erect conidiophores arising from stromata.

Lit.: MCALPINE (1902: 100), SACCARDO (1906: 575; 1913: 1370), LINDAU (1910: 796), BRAUN (2001: 53–56).
Ill.: MCALPINE (1902: Figs 87, 88), BRAUN (2001: 55, Fig. 1).

Colonies on fruits, leaves, rarely also twigs, usually on deformations caused by *Taphrina* spp., olivaceous-brown to dark brown, occasionally yellowish brown or greyish olivaceous, loose to dense, confluent, caespitose, effuse, velvety. Mycelium immersed and external, superficial; hyphae creeping, interwoven, branched, 2–7(–10) µm wide, cells 4–15 µm long, septate, often constricted at the septa, with swellings, olivaceous-brown or pale brown, occasionally subhyaline. Stromata diffuse, immersed, loose to dense, confluent, composed of swollen hyphal cells, subglobose, 2–13 µm diam., olivaceous to medium brown, smooth, walls slightly thickened. Conidiophores solitary, arising from hyphae or swollen hyphal cells, or in loose to dense groups, arising from stromata, erect to decumbent, creeping, straight to curved, geniculate-sinuous, simple to often multibranched, (6–)20–233(–250) × 3–8 µm, occasionally even

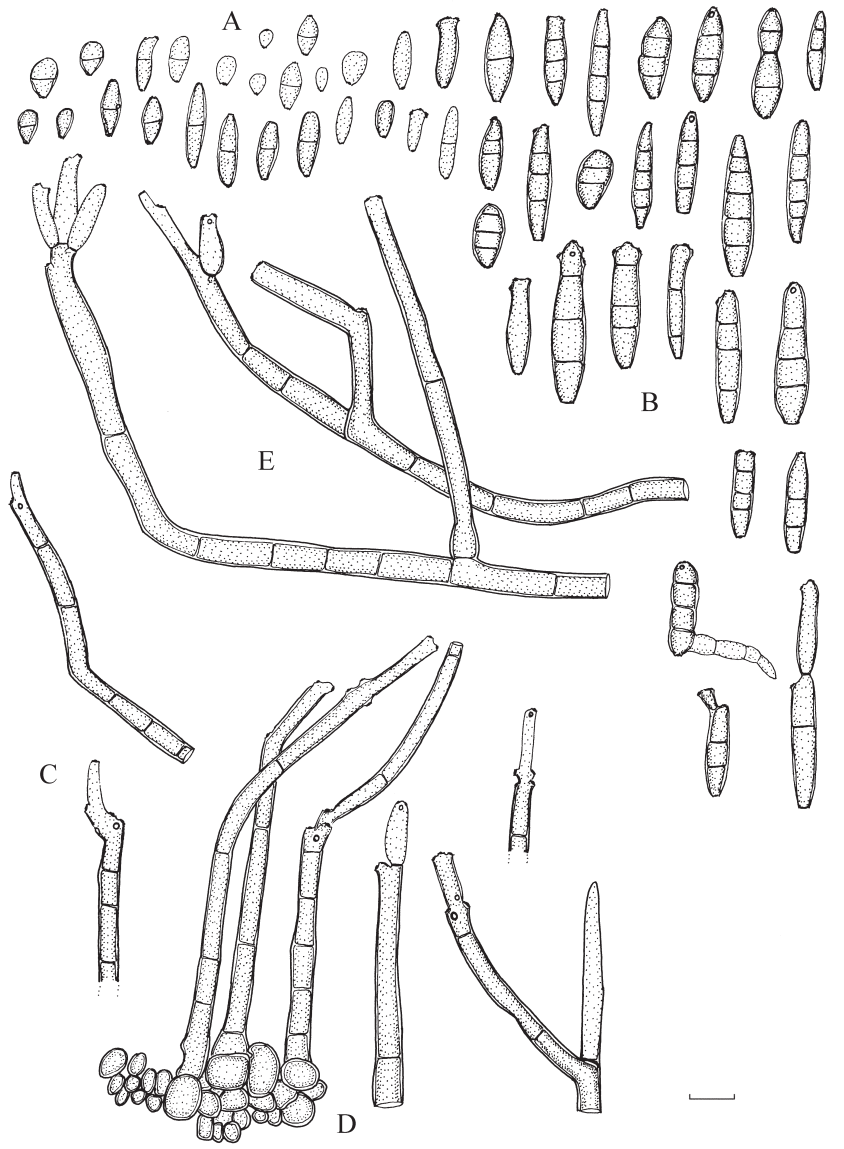


Fig. 14: *Cladosporium phyllophilum*: A – conidia, B – ramoconidia s. str., C – conidiogenous cell, D – erect conidiophores arising from stromata, E – creeping conidiophores (from B 70-6334, B 70-6335, lectoparatypes of *C. exoasci* Lindau).

longer, sometimes swollen at the base, 7–11 µm wide, densely 4–14-septate, cells 10–15 µm long, usually not constricted at the septa, olivaceous to medium brown, occasionally paler, usually paler towards the apex, sometimes subhyaline at the tip, smooth to faintly rough-walled, wall slightly thickened, above all near the base, but thin-walled towards the apex, rarely with enteroblastic, monopodial proliferation. Conidiogenous loci integrated, terminal and intercalary, occasionally pleurogenous, subcylindrical, 7–63 µm long, polyblastic, proliferation sympodial, conidiogenous loci protuberant, thickened, darkened, 1.5–3 µm diam. Ramoconidia s. str. clavate, ellipsoid, subcylindrical, fusiform, 13–35(–38) × 3–10 µm, (0–)1–5(–6)-septate, occasionally constricted at the septa, base truncate to convex, 2–3.5 µm diam., without a cladosporioid hilum. Conidia usually in branched chains, straight to slightly curved, subglobose, ellipsoid-ovoid, obovoid, 3.5–18(–26) × 2–6(–7) µm, 0–1-septate, usually without any constrictions, subhyaline to pale brown, smooth, walls unthickened to slightly thickened, apex rounded to somewhat attenuated, with up to 5 hila, base truncate to convex, occasionally slightly attenuated, hila protuberant, thickened and darkened, (0.5–)1–2.5 µm diam., microcyclic conidiogenesis occurring.

Host range and distribution: Australia, Caucasus, Central Asia, Europe, North America; on *Taphrina cerasi* on *Prunus cerasus* (D, Kazakhstan); *T. communis* on *Prunus americana* (USA, CO); *T. deformans* on *Prunus persica* (AUS, D, Uzbekistan); *T. pruni* on *Prunus americana* (USA, WI ?); *T. pruni* on *Prunus avium* (CH); *T. pruni* on *Prunus cerasus* (D); *T. pruni* on *Prunus domestica* (D, Kazakhstan); *T. pruni* on *Prunus* sp. (Armenia, CZ, F); ?*Taphrina* sp. on *Malus* ×*zumi* (D); *Taphrina* sp. on *Prunus armeniaca* (AUS); *Taphrina* sp. on *Prunus persica* (AUS); *Taphrina* sp. on *Prunus spinosa* (D, RO); host unknown (Georgia).

Collections examined: on *Prunus spinosa*, Germany, Ba, Jun. 1909, A. Vill (HBG); on *Taphrina cerasi* on *Prunus cerasus*, Germany, Br, Rangsdorf near Zossen, 24 Jun. 1919, H. Sydow, Syd., Mycoth. germ. 1780 (PH); on *T. communis* on *Prunus americana*, USA, CO, Walsenberg, Jul. 1900, C.L. Shear, Shear, F. columb. 1493 (B 70-6330: syntype of *C. exoasci* Ellis & Barthol.); on *T. deformans* on *Prunus persica*, Germany, Ba, Jun. 1909, A. Vill (HBG); on *T. pruni* on *Prunus americana*, USA, Pope (WI ?), 1 Jul. 1929 (NY); on *T. pruni* on *Prunus avium*, Switzerland, Kt. Bern, Berner Oberland, Kandersteg, 19 Jul. 1905, O. Jaap, Jaap, Fl. Schweiz 16 (B 70-6334: lectoparatype of *C. exoasci* Lindau); on *T. pruni* on *Prunus cerasus*, Germany, An, Halle, Botanical Garden, 11 Jun. 2004, B. Heuchert (HAL 1823); on *T. pruni* on *Prunus domestica*, Germany, Ba, Gerolzhofen, 7 Jul. 1909, A. Vill (HBG); Br, Kr. Prignitz, Triglitz, 1 Oct. 1904, O. Jaap (B 70-6335: lectoparatype of *C. exoasci*); He, Dillkreis, Donsbach, 21 Jun. 1936, A. Ludwig (B 70-6331); Sa, Kirchberg, Alte Hartmannsdorfer Str., garden Bensch, 25 Jul. 2004, K. Schubert (HAL); France, Lothringen, Forbach, Kreuzberg, 25 Jun. 1916, A. Ludwig (B 70-6333); on *T. pruni*, Czech Republic, Mähren, Eisgrub, Grenzteiche, 7 Jun. 1911, H. Zimmermann, Petr., Fl. Bohem. Morav. exs. 556 (HBG, M-57605); on ?*Taphrina* sp. on *Malus* ×*zumi*, Germany, An, Halle, Botanical Garden, 14 Jun. 2004, U. Braun, Braun, F. sel. exs. 51 (HAL 1821); on *Taphrina* sp. on *Prunus* sp., Germany, Ba, Kr. Freising, Freising/Weihenstephan, Jun. 1918, Bons (B 70-6336).

Notes: The lectotype material of *Cladosporium phyllophilum* (VPRI 2490) has been re-examined and proved to be conspecific with *C. exoasci* Lindau. In the type collection of the latter species (B 70-6327), with relatively short [14–99 × 3–5(–6) µm], unbranched, non-decumbent conidiophores, the otherwise characteristic dimorphism of the conidia could not be observed, and typical ramoconidia were lacking. A sample on *Taphrina pruni* on *Prunus domestica* from France (B 70-6333) was characterised by having

relatively short conidiophores, 18–100 × 3.5–8 µm, which are densely arranged in palisade-like layers, arising from stromata. Branched, decumbent conidiophores could not be observed. Abundant microcyclic conidiogenesis caused very dense colonies. Another collection from B (70-6336) was noticeable by having large ramoconidia, up to 40 µm, with few septa. The shortest conidiophores (only 6 µm in length) were measured in a specimen on *Taphrina pruni* on *Prunus domestica* (HBG). A collection recently found on fruits of the unusual host *Malus ×zumi* in Germany (HAL) is morphologically indistinguishable from *C. phyllophilum*. Infections of the fruits by *Taphrina* could not be proven with certainty.

4.3.2.10. *Cladosporium taphrinae* Bubák **Fig. 15, Pl. 2, Figs 10–11**

Cladosporium taphrinae Bubák, Bot. Közlem. 15(3–4): 81 (1915).

Holotype: on *Taphrina coerulescens* on *Quercus cerris* (Fagaceae), Montenegro, Šavnik, 30 Sept. 1911, L. Vlach (BPI 427506).
Lit.: SACCARDO (1931: 797).

Colonies olivaceous to dark brown, loose to dense, subcircular in outline, later extended, confluent, caespitose, velvety. Mycelium on, in and between asci; hyphae strongly branched, 2–6 µm wide, septate, usually not constricted at the septa, subhyaline, pale olivaceous to medium brown, forming dense hyphal nets, cells sometimes swollen, 4–10 µm diam., occasionally forming small stromata, pale brown, smooth, walls thickened. Conidiophores solitary, arising from hyphae, or in loose fascicles, arising from stromata, erumpent through asci, erect, straight to curved, subcylindrical, rarely slightly geniculate-sinuous, usually unbranched, rarely branched, 23–150(–200) × 3–5(–7) µm, occasionally longer and up to 8 µm wide, 1–7-septate, without any constrictions, medium brown, paler towards the apex, tips often subhyaline, smooth or almost so, faintly rough-walled at the base, walls somewhat thickened, but thinner towards the apex, occasionally enteroblastically proliferating and monopodial. Conidiogenous cells integrated, terminal and intercalary, 9–48 µm long, polyblastic, proliferation sympodial, near the apex with numerous conspicuous conidiogenous loci (up to 14), numerous densely arranged loci often giving an impression to be slightly inflated and denticulate, conidiogenous loci protuberant, denticle-like, thickened and darkened, 1–1.5(–2) µm diam. Conidia mostly in branched chains, straight, subglobose, obovoid, ellipsoid, 4–20 × 2.5–6 µm, 0–2(–3)-septate, without any constrictions at the septa, pale olivaceous to olivaceous-brown, smooth or almost so, occasionally subechinulate, walls slightly thickened, small conidia usually thin-walled, apex rounded to slightly attenuated, with up to 4 hila, base truncate to convex, occasionally somewhat attenuated, hila protuberant, thickened and darkened, 0.5–1.5(–2) µm diam., basal hilum of branched conidia convex, without a cladosporioid hilum, up to 2 µm diam., microcyclic conidiogenesis not observed.

Host range and distribution: Europe, North America; on *Taphrina coerulescens* on *Quercus cerris* (Montenegro); *T. coerulescens* (USA, NV).

Collection examined: on *Taphrina coerulescens*, USA, NV, Lincoln County, dirt road toward Highland Peak 5.6 miles from junction with Route 93, west of Pioche, 37°54.30´N 114°33.12´W, 17 Aug. 1993, C.T. Rogerson (Fungi of Nevada) (NY) (as *C. exoasci*).

Notes: In contrast to *Cladosporium phyllophilum* (= *C. exoasci*), the second *Cladosporium* species on *Taphrina* spp., *C. taphrinae,* grows on and between asci of *Taphrina coerulescens*. The conidiophores arise from hyphae, are minutely verruculose at the base and the tips are often somewhat swollen and

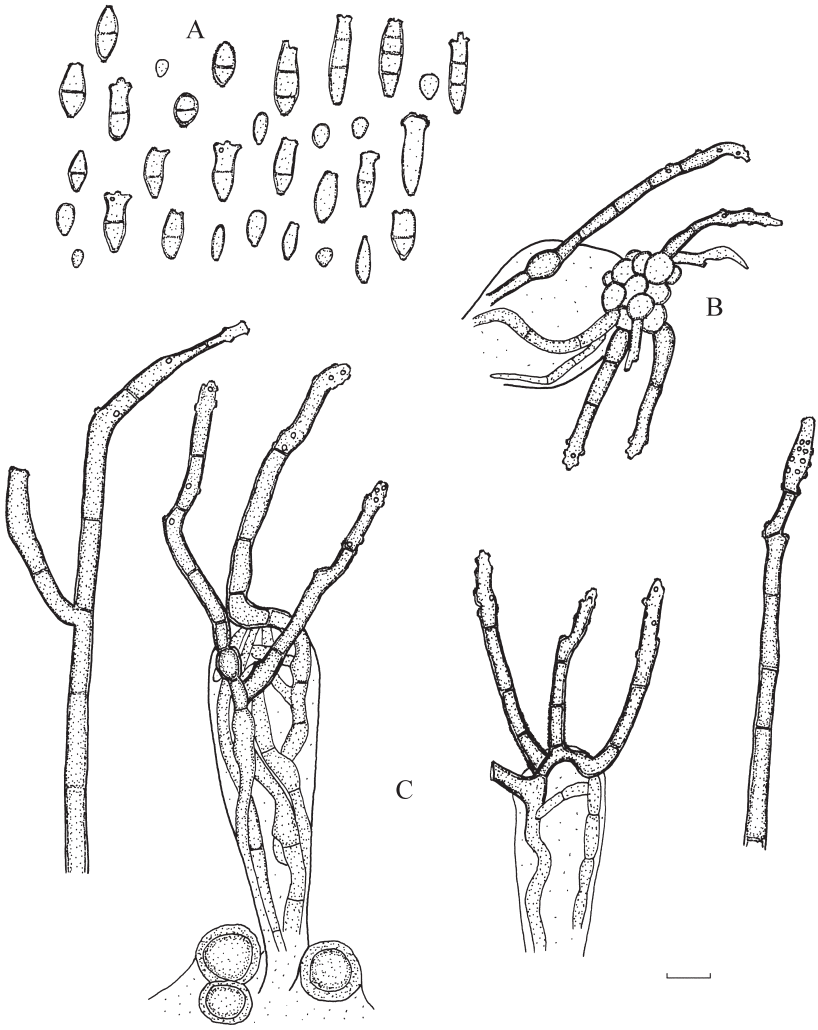


Fig. 15: *Cladosporium taphrinae*: A – conidia, B – conidiophores arising from stromata (rarely), C – conidiophores arising from hyphae, erumpent through asci.

appear coarsely verrucose by densely arranged denticle-like scars. Stromata are usually lacking, and the conidiogenous loci and conidial hila are smaller. The conidia are uniform, without obvious dimorphism. A collection on *Taphrina coerulescens* deposited at NY could be identified as *C. taphrinae* and represents the first record for North America.

4.3.2.11. *Cladosporium uredinicola* Speg. **Figs 16–18**

Cladosporium uredinicola Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 23: 122–123 (1912).

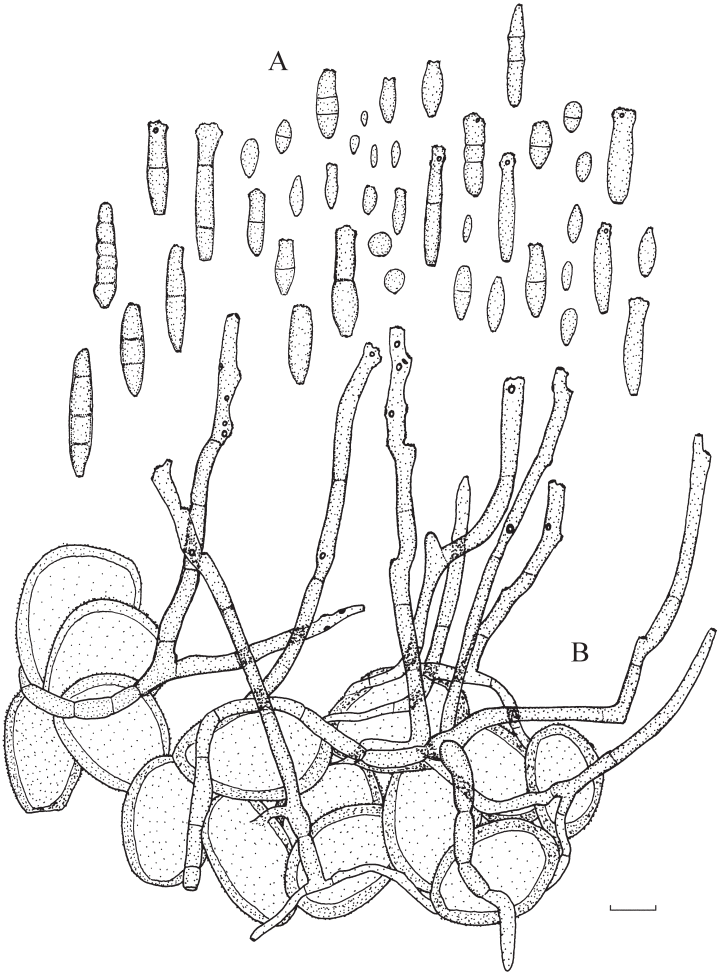


Fig. 16: *Cladosporium uredinicola*: A – conidia, B – conidiophores arising from hyphae (from IMI 254519).

Holotype: on sori of *Puccinia cestri* (Pucciniaceae) on *Cestrum pubescens* (Solanaceae), Argentina, Salta, near Calilegua, Nov. 1911, C. Spegazzini (LPS 13073). Permanent slides: AUA, IMI 87162a.
Lit.: SACCARDO (1931: 798), SUTTON (1973: 40), ELLIS (1976: 330), ELLIS & ELLIS (1985: 571; 1988), MORGAN-JONES & MCKEMY (1990), HO et al. (1999: 142).
Ill.: SUTTON (1973: 41, Fig. 19A), ELLIS (1976: 331, Fig. 249), MORGAN-JONES & MCKEMY (1990: 189, Pl. 1; 191, Fig. 1; 193, Fig. 2; 195, Fig. 3; 197, Pl. 2; 199, Pl. 3), HO et al. (1999: 143, Fig. 49).

Colonies pale olivaceous, loose to dense, caespitose, floccose, effuse. Mycelium superficial, occasionally immersed; hyphae branched, 2–5(–7) µm wide, septate, often

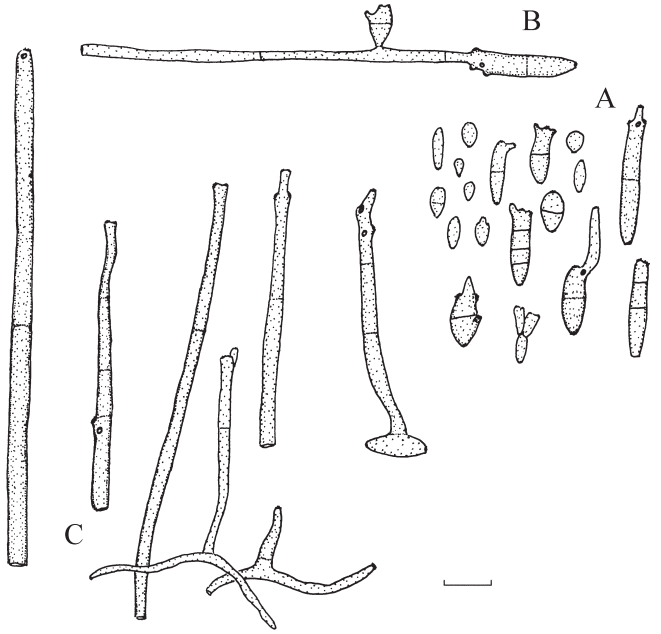


Fig. 17: *Cladosporium uredinicola*, at the lower limit of the variability of the species, on *Puccinia recondita* on *Triticum* sp.: A – conidia, B – microcyclic conidiogenesis, C – conidiophores arising from hyphae (from IMI 171548).

constricted at the septa, some cells swollen, up to 8 µm diam., sometimes aggregated, forming dense hyphal nets, pale olivaceous-brown, occasionally subhyaline, smooth or sometimes faintly rough-walled, walls unthickened to slightly thickened. True stromata lacking. Conidiophores solitary, arising from hyphae, lateral and terminal, or aggregated in loose groups, erect, rarely decumbent, straight to curved, often somewhat geniculate-sinuous, unbranched or occasionally branched (at an acute angle of about 30°), (5–)21–230(–300) × 2–5.5 µm, narrowed towards the apex, 0–8-septate, without any constrictions, pale to medium olivaceous-brown, paler towards the apex, sometimes even subhyaline at the tips, smooth to faintly verruculose, walls slightly thickened, 0.5–0.75 µm wide, tips unthickened. Conidiogenous cells integrated, terminal and intercalary, cylindrical or occasionally subclavate, 9–59(–75) µm long, polyblastic, proliferation sympodial, with up to 11 conidiogenous loci per cell, sometimes aggregated, slightly protuberant, often on small shoulders or swellings caused by sympodial proliferation, 1–2 µm diam. Ramoconidia s. str. rare. Conidia usually in branched chains, straight, rarely somewhat curved, subglobose, obovoid, limoniform, narrowly ellipsoid, fusiform, subcylindrical, subclavate, 3–39 × 2–6.5(–8) µm, 0–2(–3)-septate, rarely with up to 5 septa, without any constrictions, pale olivaceous-brown, often paler than the conidiophores, occasionally subhyaline, apex and base rounded, occasionally

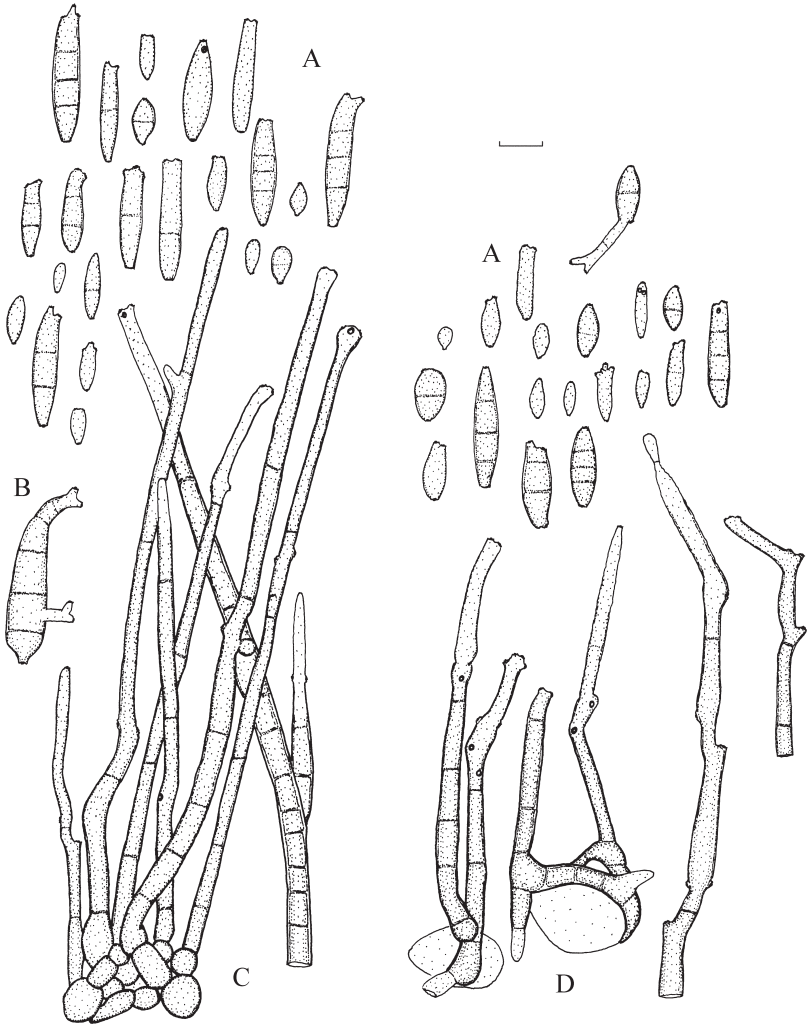


Fig. 18: *Cladosporium uredinicola*: A – conidia, B – microcyclic conidiogenesis, C – conidiophores aggregated in loose groups, on *Peronospora arborescens* (from IMI 183695), D – conidiophores arising from hyphae, on *Peronospora gaeumannii* (from IMI 183694).

somewhat wider at the apex, with up to 7 hila, smooth or almost so, walls uniformly thin or only very slightly thickened, hila slightly protuberant, rarely denticle-like, darkened-refractive, 0.5–1.5 µm diam., basal hila of larger conidia usually somewhat wider, 2–3 µm diam., occasionally with microcyclic conidiogenesis.

Host range and distribution: Asia, Australia, Caribbean, Europe, New Zealand, North and South America, on rust fungi, downy mildews and powdery mildew fungi; *Chrysocyclus cestri* (South America); *Cronartium fusiforme* f. sp. *quercum* (USA, AL); *Erysiphe euonymi-japonici* on *Euonymus japonicus* (Iran); *Gymnosporangium nelsoni* on *Amelanchier florida* (Canada, BC); *G. sabinae* on *Pyrus communis* (D); *Melampsora coleosporides* on *Salix babylonica* (AUS, NSW); *M. laricis-populina* on *Populus deltoides* (AUS, NSW); *M. laricis-populina* on *Populus gelrica* (AUS, NSW); *Peronospora arborescens* on *Papaver somniferum* (IND, UP); *P. gaeumannii* on *Argemone mexicana* (IND, UP); *Phragmidium* sp. on *Rubus allegheniensis* (USA, NY); *Phyllactinia angulata* on *Quercus* (USA, NY); *Puccinia artemisiicola* on *Artemisia campestris* (D), *P. cestri* on *Cestrum pubescens* (AR); *P. coprosmae* on *Coprosma macrocarpa* (NZ); *P. horiana* on *Chrysanthemum* ssp. (BR); *P. jaceae* on *Grossheimia macrocephala* (D); *P. malvacearum* on *Alcea rosea* (D); *P. melanocephala* on *Saccharum officinarum* (AUS); *P. melanocephala* on *Saccharum* sp. (IND); *P. recondita* on *Triticum* sp. (GB); *Tranzschelia pruni-spinosae* (Hong Kong); *Triphragmium ulmariae* (GB).

Records without particular rust fungi: *Pulsatilla dahurica* (China: Heilongjiang, Jilin).

Records without any hosts: Cuba, NZ.

Collections examined: on *Erysiphe euonymi-japonici* on *Euonymus japonicus*, Iran, Guilan, Rasht, 25 Jul. 2004, S.A. Khodaparast (HAL); on *Gymnosporangium nelsoni* on *Amelanchier florida*, Canada, BC, Sarno, 11 Jul. 1935, G.G. Hedgcock (BPI 427380) (as *C. peridermiicola*); W of Nellway, 24 Jul. 1936, G.G. Hedgcock (BPI 427381) (as *C. peridermiicola*); on *G. sabinae* on *Pyrus communis,* Germany, He, Schöneck near Frankfurt/Main, 11 Jul. 2004, J. Gossmann (herb. R. Kirschner, HAL); on *Melampsora coleosporides* on *Salix babylonica*, Australia, NSW, 10 km N of Kyogle, 26 Feb. 1979, C.A. Nicholson (DAR 33593); on *M. laricis-populina* on *Populus deltoides*, Australia, NSW, Snowy Mountains Authority Plantation, Tumur, 4 Mar. 1974, R.C. Nielsen (DAR 24066); on *M. laricis-populina* on *Populus gelrica*, Australia, NSW, Snowy Mountains Authority Plantation, Tumur, 5 Mar. 1974, R.C. Nielsen (DAR 24060); on *Peronospora arborescens* on *Papaver somniferum*, India, UP, Ghazipur, 10 Feb. 1974, S.L. Singh (IMI 183695); on *P. gaeumannii* on *Argemone mexicana*, India, UP, Ghazipur, 10 Feb. 1974, S.L. Singh (IMI 183694); on *Phragmidium* sp. on *Rubus allegheniensis*, USA, NY, Bronx County, southwest of azalea plantings, The New York Botanical Garden, 28 Nov. 1979, C.T. Rogerson (NY) (as *C. tenuissimum*); on *Phyllactinia angulata* on *Quercus* sp., USA, NY, Bronx County, west of North Bridge, The New York Botanical Garden, 6 Oct. 1986, C.T. Rogerson (NY) (as *C. tenuissimum*); on *Puccinia artemisiicola* on *Artemisia campestris*, Germany, An, Kr. Wittenberg, Kemberg, 30 Aug. 2002, H. Jage (herb. Jage, Nr. 2690/02); on *P. coprosmae* on *Coprosma macrocarpa*, New Zealand, Auckland, Wattle Bay, 5 Jul. 1982, P.A. Maddison (PDD 43020) (as *C. cladosporioides*); on *P. jaceae* on *Grossheimia macrocephala*, Germany, An, Halle, Botanical Garden, 16 Jul. 2004, U. Braun (HAL); on *P. malvacearum* on *Alcea rosea*, Germany, Br, Kr. Prignitz, Triglitz, 3 Oct. 1898, O. Jaap (HBG) (as *C. aecidiicola*); Germany, An, Halle, Botanical Garden, 22 Apr. 2004, B. Heuchert (HAL); He, Frankfurt/Main, Botanical Garden, 7 Oct. 2004, R. Kirschner 2221 (HAL); on *P. melanocephala* on *Saccharum officinarum*, Australia, Brisbane, BSES Eight Mile Plains Sugar Exp. Stn., 5 Nov. 1980, O.W. Sturgess (IMI 254519, permanent slide); on *P. melanocephala* on *Saccharum* sp., India, Udaipur University, K.L. Kothari (IMI 245023); on *P. recondita* on *Triticum* sp., Great Britain, Dec. 1972, D.J. Allen (IMI 171548).

Notes: The type material of this species is in poor condition (SUTTON 1973) and was, therefore, not re-examined. SUTTON (l.c.) examined the holotype and deposited a permanent slide at IMI. He stated that most conidiophores were broken. The given shape, size and septation of the conidia (4–12.5 ×

2.5–5.5 µm, 2–3-septate) were comparable with those of *C. gallicola*, but the latter species, known from galls of *Endocronartium harknessii*, is easily distinguishable by having wider conidiophores, 6–9 µm, with darker and thicker walls and frequently branched apices. They are often formed in dense fascicles arising from stromata. The conidiogenous loci are up to 3 µm diam., and the central dome is often less conspicuous. The conidia are subglobose to broadly ellipsoid (often subcylindrical in *C. uredinicola*).

The discrimination between *C. uredinicola* and the new species *C. gerwasiae*, described in this paper, is discussed under notes to the latter species.

In literature, various collections with slightly deviating characteristics have been discussed, e.g., two samples from *Tranzschelia pruni-spinosae* which were only tentatively assigned to *C. uredinicola* by SUTTON (1973) since most conidiophores were shorter than 100 µm and narrower than 3.5 µm, whereas MORGAN-JONES & MCKEMY (1990) considered these collections to be conspecific with *C. uredinicola*, based on the morphology of the conidiophores and conidia. Our own examinations have shown that *C. uredinicola* is fairly variable, i.e., some specimens are very delicate (colonies barely visible under stereomicroscopy), and then the conidiophores and conidia are often at the lower limit of the variability (see Fig. 17, in which the collection on *Puccinia recondita* on *Triticum* sp. displays conidiophores simple in structure and conidia with a restricted range of size and septation). These results support the inclusion of the samples from *Tranzschelia pruni-spinosae* in *C. uredinicola*.

Two collections on downy mildews (*Peronospora* spp., deposited at IMI, Fig. 18) have been studied and proved to be morphologically indistinguishable from *C. uredinicola*, which is in agreement with MORGAN-JONES & MCKEMY (1990), who examined these samples as well. Records of *C. uredinicola* on powdery mildew fungi, viz., *Erysiphe euonymi-japonici* on *Euonymus japonicus* (HAL) and *Phyllactinia angulata* on *Quercus* sp. (NY), are new and also surprising, but morphologically the collections concerned are not separable from collection on rust fungi.

HO et al. (1999) und MORGAN-JONES & MCKEMY (1990) examined *C. uredinicola* in culture and published detailed descriptions of its features in vitro. The latter authors showed that growths and morphology are dependent on the particular substrates and that the conidiophores are usually much shorter, less branched and darker in nature. The conidia are usually shorter and have only few septa.

4.3.3. Saprobic *Cladosporium* species

In this chapter, saprobic *Cladosporium* species, often common and widespread, which are also known to use other fungi as substrates are summarily re-described and discussed. Since comprehensive treatments of these species have already been published, detailed descriptions and illustrations of the species concerned have not been included in this work. The characteristic features of the particular species are only briefly summarised at the beginning of the notes. Our own observations and records of these species on fungi are integrated into the discussions. *C. pannosum* Cooke, a taxon of uncertain ecology is described and illustrated in detail. *C. tenuissimum* is also described and depicted since this species has often been recorded in literature as a hyperparasitic species which is morphologically close to *C. uredinicola*, a more specialised, fungicolous fungus usually documented on rusts (MORRICCA et al. 1999). Complete lists of the numerous synonyms of the saprobic species are given in DUGAN et al. (2004).

4.3.3.1. *Cladosporium cladosporioides* (Fresen.) G.A. de Vries

Cladosporium cladosporioides (Fresen.) G.A. de Vries, Contribution to the knowledge of the genus *Cladosporium*: 57 (1952).

Type: on overwintered leaves of *Hydrangea* sp. (Hydrangeaceae), Germany (not preserved).
Lit.: YAMAMOTO (1959: 3), ELLIS (1971: 319), SUBRAMANIAN (1971: 285), DOMSCH et al. (1980:

202), HO et al. (1999: 121), DE HOOG et al. (2000: 583).
Ill.: FRESENIUS (1850: Pl. 3, Figs 23–28), DE VRIES (1952: 58–59, Figs 10–11), YAMAMOTO (1959: 4, Figs 9–12), ELLIS (1971: 318, Fig. 219 C), DOMSCH et al. (1980: 203, Fig. 82), HO et al. (1999: 122, Figs 8–9), DE HOOG et al. (2000: 583–584, Figs.).

Notes: This species, usually a secondary invader on necrotic parts of numerous plants, is also known to occur on living green leaves. *C. cladosporioides* is a cosmopolitan saprobic fungus isolated from air, soil, tissue and numerous other matters (ELLIS 1971), but it is also a common endophytic fungus (RIESEN & SIEBER 1985, BROWN et al. 1998, EL-MORSY 2000, KUMARESAN & SURYANARAYANAN 2002) The pale to medium olivaceous-brown, smooth to finely verruculose conidiophores are up to 350 µm long and 2–6 µm wide. The ramoconidia s. lat. are 0–1-septate, up to 30 µm long and 2–5 µm wide, smooth or occasionally faintly rough-walled. The conidia, formed in long, branched chains, are mostly aseptate, limoniform or ellipsoid, 3–11 × 2–5 µm (mostly 3–7 × 2–4 µm), pale olivaceous-brown, usually smooth, but faintly rough-walled in some strains.

In literature, there are several records of this species on fungi. BILGRAMI et al. (1991) recorded it as hyperparasite on the mycelium of *Rhizopus oryzae* (Mucorales) in India. DE VRIES (1952) isolated it in the Netherlands from living fruit bodies of *Cantharellus cibarius* (Cantharellaceae). Furthermore, it was recorded from India on the powdery mildew *Golovinomyces cichoracearum* (MATHUR & MUKERJI 1981, KISS 2003). However, we have not yet seen any collections of *C. cladosporioides* from fungi, so that we could not confirm the records cited.

4.3.3.2. *Cladosporium herbarum* (Pers.: Fr.) Link

Cladosporium herbarum (Pers.: Fr.) Link, Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 7: 37 (1816): Fr., Syst. mycol. 3(2): 370 (1832).

Lectotype: ex herb. Persoon (L 910.225-733).
Teleomorph: *Davidiella tassiana* (De Not.) Crous & U. Braun, in Braun, Crous, Dugan, Groenewald & de Hoog, Mycol. Progr. 2(1): 8 (2003).
Lit.: COOKE (1871: 582), SACCARDO (1886: 350; 1972: 327, 1304), LINDAU (1907: 800; 1910: 795), FERRARIS (1912: 331), GONZÁLES-FRAGOSO (1927: 194), DE VRIES (1952: 71), ELLIS (1971: 313), DOMSCH et al. (1980: 204), SIVANESAN (1984: 225), PRASIL & DE HOOG (1988), MCKEMY & MORGAN-JONES (1991a), DUGAN & ROBERTS (1994), DAVID (1997: 59), HO et al. (1999: 129), DE HOOG et al. (2000: 587).
Ill.: FERRARIS (1912: 327, Fig. 101), DE VRIES (1952: 73, Fig. 15), YAMAMOTO (1959: 2, Figs 1–4), ELLIS (1971: 314, Fig. 217 A), DOMSCH et al. (1980: 206, Fig. 83), VON ARX (1987: 57, Fig. 27), PRASIL & DE HOOG (1988: 51, Fig. 3), MCKEMY & MORGAN-JONES (1991a: 311, Pl. 1; 313, Fig. 1), DUGAN & ROBERTS (1994: 516, Figs. 4–7), DAVID (1997: 62, Fig. 17 F, G, I), HO et al. (1999: 130, Figs 21–22), DE HOOG et al. (2000: 587–588, Figs).

Collections examined (on fungi): on *Agaricus* sp., Jun. 1924, Prof. Lehmwanger (M-57570) (as *C. fuligineum*); Germany, Ba, near Wilzhofen, 28 Oct. 1925, Schoman (M-57565) (as *C. fuligineum*); on *Amanita muscaria*, Germany, We, Kr. Siegen, near Gernsdorf, 22 Sept. 1935, A. Ludwig (B 70-6385) (as *C. fuligineum*); on decaying gills of *Boletus bovinus* (= *Suillus bovinus*), Germany, Br, Kr. Nieder-Barnim, forest between Sophienstädt and Ruhlsdorf, 7 Nov. 1917, P. Sydow, Syd., Mycoth. germ. 1781 (M-57567) (as *C. fuligineum*) [mixed collection with *C. episclerotiale*]; (HBG) (as *C. fuligineum*) [mixed collection with *C. lycoperdinum*]; on *Boletus subtomentosus*, Germany, We, Kr. Siegen-Wittgenstein, near Wasserburg, Hainchen, 16 Jul. 1922, A. Ludwig (B 70-6382, neotype of *C. fuligineum*); on *Hypholoma fasciculare*, 21 Jun. 1905, O. Jaap (HBG) (as *C. fuligineum*); mould lawn on decaying gills of *Pholiota adiposa* on pastures, Germany, Br, Kr. Prignitz, Triglitz, 27 Dec. 1897, O. Jaap (HBG) (as *C. fuligineum*); on *Polyporus squamosus*, UK, London, Highgate, Millfield Lane, 14 Oct. 1864, ex herb. Cooke (K 121555, syntype of *Heterosporium epimyces* Cooke & Massee); on *Russula* sp., France, Lothringen, Forbach, Behrener Wald, 15 Sept. 1918, A. Ludwig (B 70-6386); USA, NY, Saratoga Luke, Apr. 1944, H.D. House (M-57569) (as *C. fuligineum*).

Notes: *Cladosporium herbarum* is characterised by having erect conidiophores, often geniculate-sin-

uous to nodulose in the upper half, rarely branched at the base, 50–250(–285) × 4–6(–7) µm, reddish brown to dark brown. The conidiogenous loci are terminal and intercalary, often with nodulose swellings round about the cells (7–9 µm diam.), with 2–3(–5) conidiogenous loci, (1–)1.5–2 µm diam., protuberant, with conspicuous convex central dome and raised periclinal rim. The conidia are formed in branched chains, ellipsoid-ovoid, (8–)10–20(–25) × (3–)4–7(–8) µm, 0–1(–2)-septate; ramoconidia s. lat. are oblong, ellipsoid-subclavate, 0–3-septate, with up to 3 hila at the apex. Microcyclic conidiogenesis has been observed.

This common, cosmopolitan saprobic species has been described in detail by numerous authors. It is known from all kinds of organic matter, ranging from leaf litter, rotten wood to necrotic leaf lesions caused by other fungi. It is a common soil fungus, occurs on old carpophores of mushrooms and other fungi, and has been isolated from humans. Under favourite climatic conditions, this species can also germinate and sporulate on the surface of green plants without causing any symptoms.

Collections on old carpophores of mushrooms have previously often been referred to *Cladosporium fuligineum*, which is, however, a synonym of *C. herbarum* (Braun 2001). *C. herbarum* may occasionally occur together with other fungicolous *Cladosporium* species, e.g., with *C. aecidiicola* and *C. episclerotiale*. *C. herbarum* has been recorded on *Lenzites applanata* (South America), *Mitophora semilibera* (Romania), *Amantia rubescens*, *Scleroderma* sp., *Clitocybe* sp., *Cantharellus cibarius* and *Laccaria* sp. (Ukraine). Oudemans (1919) listed *Gomphidius* sp., *Hypholoma* sp., *Lepiota* sp., *Panus conchatus*, *Boletus* sp., *Polyporus* sp. as well as *Exobasidium rhododendri*, *E. vaccinii* and *E. warmingii* as substrates of *C. herbarum*. The records on *Exobasidium* spp. probably belong to *C. exobasidii*, which was considered a synonym of *C. herbarum* by Oudemans (1919). However, it could be demonstrated that *C. exobasidii* and *C. herbarum* are two quite distinct species (Braun 2001). Sharma & Heather (1981) published that they isolated *Cladosporium herbarum* from *Melampsora laricis-populina*. Unfortunately, the morphology of the collections concerned was not described and herbarium samples or cultures are not preserved, so that the published data could not be verified.

4.3.3.3. *Cladosporium oxysporum* Berk. & M.A. Curtis

Cladosporium oxysporum Berk. & M.A. Curtis, in Berkeley, J. Linn. Soc., Bot. 10: 362 (1869).

Holotype: on dead leaves of *Passiflora* sp. (Passifloraceae), Cuba, C. Wright, Fungi cubensis Wrightiani, Nr. 489 (K 121562).
Lit.: Saccardo (1886: 363), Ellis (1971: 312), McKemy & Morgan-Jones (1991b), David (1997: 81), Ho et al. (1999: 137), de Hoog et al. (2000: 589).
Ill.: Ellis (1971: 313, Fig. 216 A), McKemy & Morgan-Jones (1991b: 399, Pl. 1; 401, Fig. 1; 403, Fig. 2), David (1997: 62, Fig. 17 A–E), Ho et al. (1999: 138, Fig. 39), de Hoog et al. (2000: 589–590, Figs).

Notes: *Cladosporium oxysporum* is well-characterised by having erect, unbranched, pale to medium brown conidiophores, up to 400 µm long, 4–5 µm wide, with distinct terminal and intercalary nodulose swellings, 6–8 µm diam., which are provided with conspicuous coronate conidiogenous loci. Ramoconidia s. lat. are subcylindrical to subclavate or ampulliform, up to 25 µm long and 5–6 µm wide, 0–3-septate, smooth, pale olivaceous-brown; conidia are ellipsoid-ovoid, limoniform, fusiform, oblong, up to 20 µm long and 3–8 µm wide, terminal conidia mostly subglobose and 3–5 µm diam.

This species is common and widespread, above all in subtropical and tropical areas, mainly found on leaf litter, old stems and other organic matter. *C. oxysporum* was recorded as hyperparasite on *Phyllactinia moricola* (as *P. corylea*) [Erysiphales] on *Morus alba* from India (Raghavendra Rao & Pavgi 1978, Bilgrami et al. 1991, Kiss 2003). Sharma et al. (2002) discussed the impact of *C. oxysporum* on the germination, parasitism and viability of uredo-spores of *Melampsora ciliata*. *C. oxysporum* was isolated from *Melampsora ciliata* on *Populus deltoides*. Unfortunately, a varification of the identity of the fungus concerned, based on the illustrations in Sharma et al. (2002), was not possible, and herbarium material and cultures could not be traced. During the course of our own monographic studies, all specimens examined on various *Melampsora* spp. proved to belong to *Cladosporium uredinicola*, which is easily distinguishable from *C. oxysporum* by having non-nodu-

lose conidiophores.

4.3.3.4. *Cladosporium pannosum* Cooke **Fig. 19**

Cladosporium pannosum Cooke, Grevillea 12(61): 24 (1883), sub '*Chaetophoma musae* Cooke'.

Holotype: on *Musa* sp. (Musaceae), USA, South Carolina, H.W. Ravenel, No. 3056 (K 121564).
Lit.: SACCARDO (1884: 201).

Original diagnosis (COOKE 1883): Effusa, atro-fusca, pannosa. Hyphis intertextis, cladosporoides (*Cladosporium pannosum*, Cooke). Peritheciis globoso-depressis, membrenaceis, fuscis (.08 mm. diam). Sporis ellipticis, hyalinis (.004 × .002 mm).

Colonies medium brown, effuse, confluent, velvety, also on the necrotic leaf tissue of the host plant. Mycelium internal and external; hyphae 2–5 µm wide, septate, often constricted at the septa, hyphal cells occasionally swollen, up to 10 µm wide, medium to dark brown, forming dense hyphal aggregations or stromata, which are composed of swollen subglobose hyphal cells, 5–10 µm diam., medium brown, smooth. Conidiophores solitary or in loose groups, arising from swollen hyphal

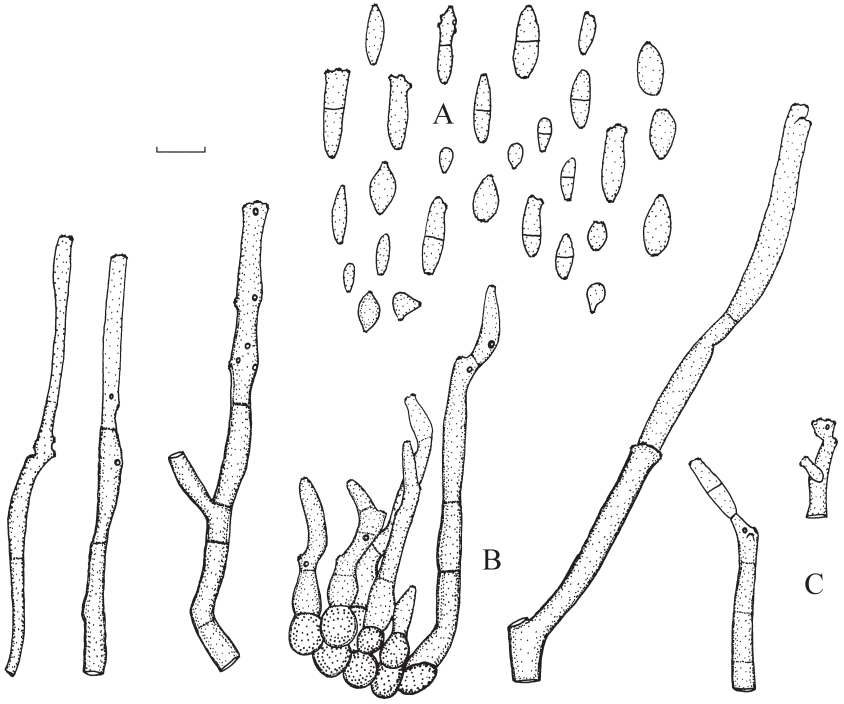


Fig. 19: *Cladosporium pannosum*: A – conidia, B – conidiophores solitary or in loose groups, arising from swollen hyphal cells or stromata, C – conidiogenous cells.

cells or stromata, erect, straight to slightly curved, geniculate-sinuous, unbranched or only rarely branched, 7–126 × 3–5 µm, up to 6 µm wide at the very base, 0–4-septate, without any constrictions at the septa, pale to medium brown, somewhat paler towards the apex, smooth to faintly rough-walled, walls slightly thickened, unthickened near the tips. Conidiogenous cells integrated, terminal and intercalary, 5–45 µm long, polyblastic, proliferation sympodial, with several more or less protuberant, thickened and somewhat darkened-refractive conidiogenous loci, 1–2 µm diam. Conidia usually in branched chains, straight, obovoid, ellipsoid, subcylindrical, limoniform, 5–18 × 2–6 µm, 0–1-septate, non-constricted at the septa, pale olivaceous-brown to medium brown, smooth or almost so, rarely faintly rough-walled, apex rounded to somewhat attenuated, with up to 5 hila, base truncate to convex, hila more or less protuberant, thickened, refractive, 1–2 µm diam., microcyclic conidiogenesis observed.

Host range and distribution: only known from the type collection.

Notes: The name *Cladosporium pannosum* was introduced by Cooke in connection with the ascomycete *Chaetophoma musae* and meant to be its possible conidial form (anamorph). However, this association is undoubtedly wrong since *C. pannosum* is a true member of *Cladosporium* s. str., which is an anamorphic genus confined to *Davidiella*, Mycosphaerellaceae (Braun et al. 2003). The ecology of *C. pannosum* is unclear. An association with other fungi has not been observed. It is probably a saprobic fungus, which was found together with *Chaetophoma musae* on the same leaves by accident.

4.3.3.5. *Cladosporium sphaerospermum* Penz.

Cladosporium sphaerospermum Penz., Michelia 2(8): 473 (1882).

Type: on faded leaves and stems of *Citrus* sp. (Rutaceae), Italy, Padova, Feb. 1882, O. Penzig (not preserved).
Lit.: Saccardo (1886: 355), Lindau (1907: 826), Ferraris (1912: 345), de Vries (1952: 81), Yamamoto (1959: 3), Ellis (1971: 315), Hawksworth (1979: 287), Domsch et al. (1980: 209), Ho et al. (1999: 139), de Hoog et al. (2000: 591).
Ill.: de Vries (1952: 82, Fig. 18), Yamamoto (1959: 2, Figs 5–8), Minoura (1966: 141, Fig. 5C), Ellis (1971: 316, Fig. 218 A), Domsch et al. (1980: 209, Fig. 85), Ho et al. (1999: 141, Figs 42–43), de Hoog et al. (2000: 591–592, Figs).

Notes: This species is a common, cosmopolitan, saprobic hyphomycete often isolated from soil, plant debris, food, tissue and occasionally man and animal, which is easily recognisable by having long conidiophores, up to 300 µm, 3–5 µm wide, ramoconidia up to 33 µm long and 3–5 µm wide, and, above all, globose to subglobose conidia, 3–5 µm diam., medium to dark olivaceous-brown, verruculose.

The only record of this species in connection with a fungal substrate was published by Hawksworth (1979) who reduced *Torula lichenopsis* Höhn., described from a crustose lichen, to synonymy with *C. sphaerospermum*.

4.3.3.6. *Cladosporium tenuissimum* Cooke **Fig. 20**

Cladosporium tenuissimum Cooke, Grevillea 6(40): 140 (1878).

Lectotype (designated here): on leaf sheets of *Zea mays* (Poaceae), USA, South Carolina, Aiken, H.W. Ravenel, Rav., F. amer. exs. 160 (NY). **Isolectotypes:** Rav., F. amer. exs. 160 (e.g., K).
Lit.: Saccardo (1886: 365), Oudemans (1919), Ellis (1976: 326), Ho et al. (1999: 140).
Ill.: Ellis (1976: 327, Fig. 245 A), Ho et al. (1999: 143, Figs 46–47).

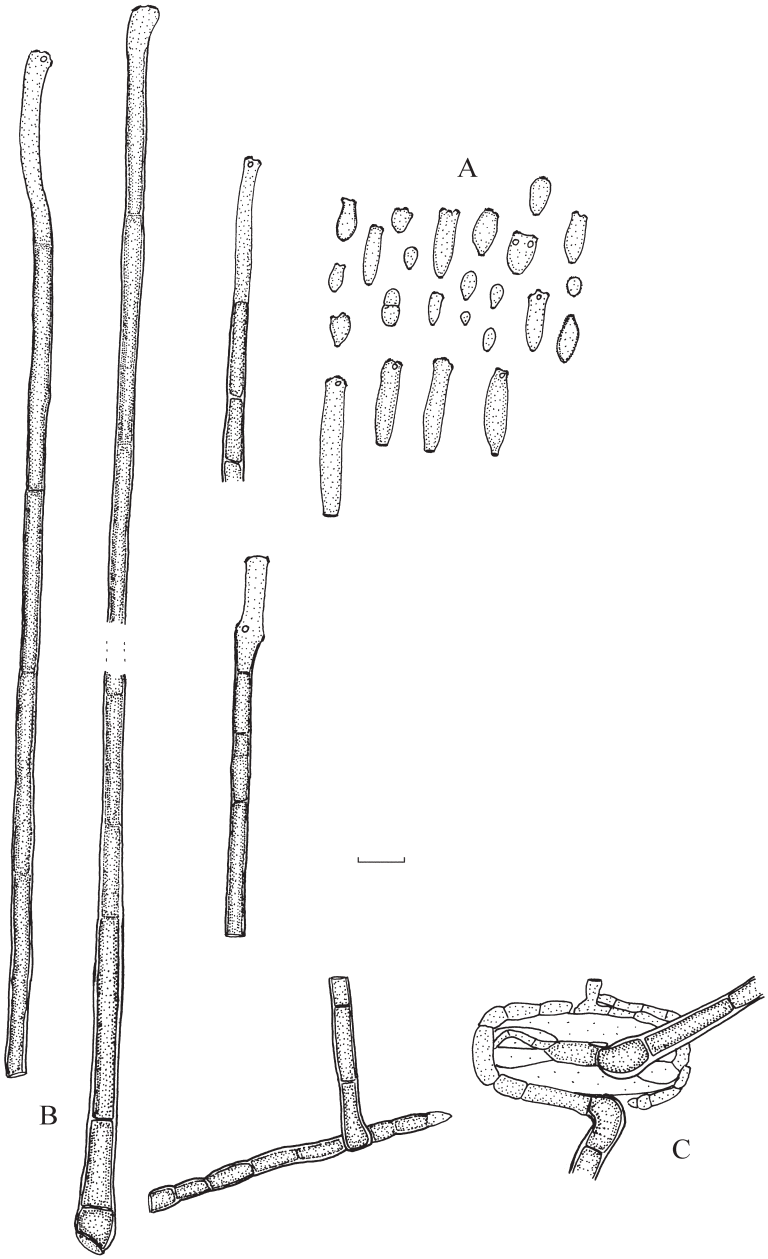


Fig. 20: *Cladosporium tenuissimum*: A – conidia, B – conidiophores, C – conidiophores emerging through stomata.

Colonies greyish to dark brown, confluent, conidiophores erect, solitary or in loose tufts (visible at 10–50×), villose. Mycelium immersed; hyphae branched, 2–7 µm wide, septate, with constrictions at the septa, hyphal cells sometimes irregularly swollen, sometimes irregularly lobed, subhyaline to pale olivaceous-brown, hyphae giving rise to conidiophores, darker, medium to dark brown, walls somewhat thickened. True stromata lacking. Conidiophores solitary or in loose groups, mostly two or three, arising from hyphae, on leaves and stems erumpent through the cuticle or emerging through stomata, erect, straight to slightly curved, subcylindrical, unbranched, 49–542(–800) × (3–)4–7 µm, at the base often wider, 9–17 µm, somewhat attenuated towards the tip, 3–13-septate, non-constricted at the septa, medium to dark brown, paler towards the tip, smooth, occasionally faintly rough-walled, wall somewhat thickened, but tips usually unthickened, occasionally with unilateral slight swellings. Conidiogenous cells integrated, terminal and intercalary, subcylindrical to subclavate, 27–76 µm long, polyblastic, with 2–5 conidiogenous loci, sympodially proliferating, conidiogenous loci conspicuous, protuberant, thickened and darkened, 1.5–2.5 µm diam. Ramoconidia s. lat. subcylindrical, 15–31 × 4–5 µm, aseptate, basal hilum 2–3.5 µm diam. Conidia usually in branched chains, straight, variable, subglobose, ellipsoid-ovoid, limoniform, 3–13 × 2–6 µm, 0(–1)-septate, slightly or non-constricted at the septa, pale olivaceous to olivaceous, smooth, occasionally faintly rough-walled, wall unthickened to slightly thickened, apex rounded or somewhat irregular by having up to 4 protuberant hila, base truncate to convex or often somewhat attenuated, hila thickened, darkened, 0.5–1.5(–2) µm diam., microcyclic conidiogenesis not observed.

Notes: Type material of *C. tenuissimum* has been re-examined. Various collections of *Cladosporium* species hyperparasitic on rust fungi, deposited in herbaria under '*C. tenuissimum*', have been examined and all of them proved to be identical with *C. uredinicola*. SHARMA & HEATHER (1981, 1988) isolated *C. tenuissimum* and *C. herbarum* from *Melampsora laricis-populina* und *M. medusae* and examined the impact of these fungi on the epidemiology of their host fungi. Morphological data and illustrations have not been published, and cultures could not be traced, so that a verification of the identity of the fungi concerned was not possible. MORICCA et al. (1999) dealt with cultures of '*C. tenuissimum*' isolated from *Cronartium flaccidum* and *Peridermium pini*, and examined them morphologically and molecularly. The description is very close to *C. uredinicola* (conidiophores frequently geniculate-sinuous, and, compared with non-fungicolous samples of *C. tenuissimum*, relatively short and narrow, up to 300 µm long and 2–5 µm wide, occasionally branched, and conidiogenous cells also intercalary). ASSANTE et al. (2004) selected one strain of *C. tenuissimum* out of the material studied by MORICCA et al. (1999) and carried out detailed histological examinations by means of TEM. They found close interactions between *Cladosporium* hyphae and uredo-spores, indicating that the fungus examined was a true hyperparasite. It cannot be excluded that MORICCA et al. (1999) and ASSANTE et al. (2004) actually dealt with *C. tenuissimum*, but it is also possible that the fungus examined was confused with *C. uredinicola*. The cultures concerned should be morphologically re-examined, and the molecular data have to be compared with other data obtained from non-fungicolous samples.

4.3.4. Uncertain and doubtful *Cladosporium* species, species with ambigous ecological roles and species with problematic literature records

The taxonomic status of the following taxa is unclear. The examination of type material was either not sufficient to elucidate the affinity and status of the taxa concerned or type material could not be traced. Original descriptions are reproduced in such case. The ecology of some other taxa is still unclear, i.e., it is unknown if they are fungicolous, hyperparasitic or saprobic. Problematic literature records are also listed.

4.3.4.1. *Cladosporium argillaceum* Minoura

Cladosporium argillaceum Minoura, J. Ferment. Technol. 44: 140 (1966).

Type: isolated from a decaying myxomycete, Japan, Yaku, 21 Oct. 1961, K. Tubaki (Dept. Fermentation Technology, Faculty Engineering, Osaka, Japan).
Ill.: MINOURA (1966: 142, Fig. 6 E).

Original diagnosis (MINOURA 1966): Coloniae in cultur in agar-agar carotae tarde effusae, velutinis, "Cinnamon-Buff", "Clay Color" vel "Tawny-Olive". Cultura in agarico maltato albae vel pallide cremeus, velutinis cum mycelo albo superficide. Hyphae tenuipartietalibus, hyalinae, irregulariter ramosae, septatae, 1.5–2 µm crassae. Conidiophora e hyphis aerialis oriunda, argillacea, erecta simplius vel lateraliter ramosa, septata, levia, 3–5 µm in diam. Blastosporae clavatae, ellipsoidea vel cylindricis, levia vel paule verruculosus, subhyalino, 8–13 µm longa, 3–4 µm crassa.
In medio mineral, kalium nitrosum non assimilantur.

4.3.4.2. *Cladosporium fungorum* (Pers.) Roum. **Fig. 21**

Cladosporium fungorum (Pers.) Roum., F. sel. gall. exs., Cent. XXXIII, No. 3293 (1885), as 'Pers.'.

Holotype: on an old gill of a mushroom (L 910.225-732).
≡ *Dematium herbarum* [Pers.] γ *fungorum* Pers., Syn. meth. fung. 2: 699 (1801).
≡ *Dematium vulgare* [Pers.] γ *fungorum* (Pers.) Pers., Mycol. eur. 1: 14 (1822).
≡ *Cladosporium herbarum* [(Pers.: Fr.) Link] β *fungorum* (Pers.) Chevall., Fl. gén. env. Paris 1: 36 (1826).
= ***Cladosporium herbarum*** (Pers.: Fr.) Link, Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 7: 37 (1816).
Lit.: OUDEMANS (1919: 49), PRASIL & DE HOOG (1988: 52).

Notes: *Cladosporium fungorum* is a saprobic, non-fungicolous species. Type material of *Dematium herbarum* γ *fungorum* (L 910.225-732) was examined by PRASIL & DE HOOG (1988: 52) and found to be identical with *Cladosporium herbarum*.

The samples collected by Roumeguère, which he identified as *C. fungorum* [on *Agaricus* (= *Pleurotus*) *ostreatus*, France, environments of Toulouse, Feb. 1855, M. Despar., Roum., F. sel. gall. exs. 3293 (FH)], and on which he based his indirect combination, proved to be distinct from *C. herbarum*, and is possibly a mixed collection composed of two different *Cladosporium* species. Most conidiophores are relatively short (type 1), 23–147 × 4.5–5(–6) µm, sometimes branched, other conidiophores are longer and narrower (type 2), up to 182 × 4 µm. The long conidiophores resemble those of *Cladosporium cladosporioides*. Ramoconidia s. str. are 21–47 × 4–7 µm, 0–3-septate, conidia 6–23(–35) × 4–6.5 µm, 0–3-septate. An assignment of particular conidia to the two types of conidiophores was impossible. The branched conidiophores, ramoconidia and conidia are similar to those of *C. epimyces*, which also occurs on old gills of agarics.

4.3.4.3. *Cladosporium herbarum* [(Pers.: Fr.) Link] f. *parasiticum* Sacc. **Fig. 22**

Cladosporium herbarum [(Pers.: Fr.) Link] f. *parasiticum* Sacc., Ann. Mycol. 13(2): 133 (1915), as '*parasitica*'.

Holotype: on *Taphrina tosquinetii* (= *Exoascus tosquinetii*) on leaves of *Alnus glutinosa* (Betulaceae), M. Weisskirchen (PAD).
Lit.: SACCARDO (1931: 797), PRASIL & DE HOOG (1988: 54).

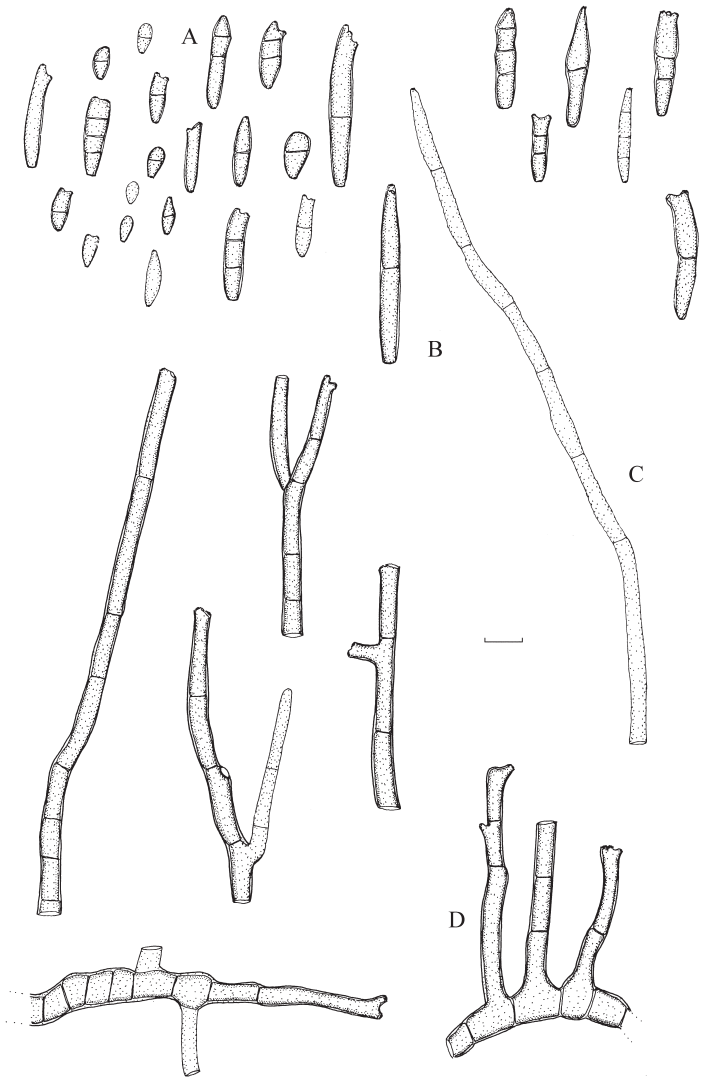


Fig. 21: *Cladosporium* sp., determinated as '*C. fungorum*': A – conidia, B – ramoconidia, C – conidiophores (type 2), D – conidiophores (type 1).

Colonies medium brown, effuse, confluent, caespitose. Mycelium immersed and superficial; hyphae 3–5 µm wide, septate, not or only rarely constricted at the septa, subhyaline to pale brown, smooth, walls thickened, often somewhat swollen, 6–7 µm wide, swollen hyphal cells forming loose to dense aggregations. Conidiophores

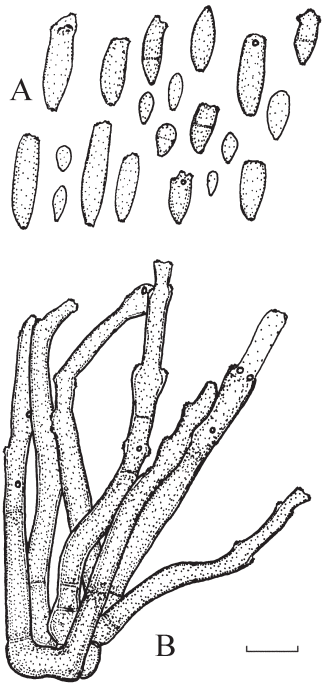


Fig. 22: *Cladosporium herbarum* f. *parasiticum*: A – conidia, B – conidiophores.

solitary, arising from hyphae, or forming loose fascicles arising from hyphal aggregations, erumpent, erect to almost decumbent, straight to curved, more or less geniculate-sinuous, unbranched, 52–82 × 3.5–5.5 µm, slightly swollen at the very base, up to 7 µm, 0–3-septate, not constricted at the septa, pale to medium brown, paler towards the apex, walls somewhat thickened, occasionally with intercalary swellings, up to 6 µm wide, swellings with conidiogenous loci, but loci not confined to swellings. Conidiogenous cells integrated, terminal and intercalary, 31–48 µm long, polyblastic, sympodially proliferating, conidiogenous loci protuberant, thickened and darkened-refractive, 1–2 µm diam. Conidia catenate, mostly in branched chains, straight, subglobose, obovoid, ellipsoid, subcylindrical, 5–20 × 3–5 µm, 0–1-septate, not constricted at the septa, pale medium brown, smooth, walls unthickened to slightly thickened, apex rounded to slightly attenuated, with up to four hila, base truncate to convex, occasionally attenuated, hila protuberant, thickened, darkened-refractive, 0.5–1.5 µm diam., basal hilum up to 2 µm diam., microcyclic conidiogenesis not observed.

Notes: PRASIL & DE HOOG (1988) examined the type material of this forma and described it to be a mixed collection of *Cladosporium herbarum* and *C. cladosporioides*. In the course of our own examinations, we have not found any verruculose conidia which are characteristic for *C. herbarum.* Furthermore, the conidia in this collection deviate from *C. herbarum* in shape and width (*C. herbarum* conidia 4–7 µm wide). The conidiophores in f. *parasiticum* are also characterised by being nodulose with conidiogenous cells as in *C. herbarum*, but they are less consistent. Conidiophores and conidia agreeing with those of *C. cladosporioides* have not been found in the type collection.

Cladosporium taphrinae, also occurring on *Taphrina* spp., inhabits the asci of *Taphrina coerulescens*, but the conidiophores do not have any swellings and the apex is rugose-subdenticulate by having numerous densely crowded conidiogenous loci. The conidia are 0–2(–3)-septate. The conidiophores of *Cladosporium phyllophilum* (= *C. exoasci*), which are also known from *Taphrina* spp., are often decumbent to repent, but they are somewhat wider and intercalary swellings are lacking. Furthermore, true ramoconidia (s. str.), 13–35(–38) × 3–10 µm, mostly 1–5-septate, are formed.

This fungus is only known from the type specimen; additional collections have not been seen. Therefore, a final conclusion about its taxonomic status is not yet possible.

4.3.4.4. *Cladosporium lichenicola* Linds., nom. inval. (ICBN, Art. 34)

Cladosporium lichenicola Linds., Quart. J. Microscop. Sci., N.S., 11: 42 (1871), as '*lichenicolum*'.

Type: on thalli of *Peltigera aphthosa* (Peltigeraceae), Great Britain, Scotland, S. Aberdeenshire, Falls of the Garrawalt, Aug. 1856, W.L. Lindsay.
Lit.: HAWKSWORTH (1979: 269).

Notes: The original description of this species is insufficient and type material is not preserved so the generic affinity of this species remains unknown. HAWKSWORTH (1979) considered this name as probably invalid, according to ICBN, Art. 34, a conclusion confirmed by examination of the original description.

4.3.4.5. *Cladosporium lophodermii* Georgescu & Tutunaru

Cladosporium lophodermii Georgescu & Tutunaru, Rev. Biol. (Bucharest) 3(1): 61 (1958).

Type: on apothecia of *Lophodermium pinastrum* (Rhytismataceae) on needles of *Pinus sylvestris* (Pinaceae), Romania, Poiana Stalin at Postăvaru, Jun. 1956.
Ill.: GEORGESCU & TUTUNARU (1958: 60, Fig. 14).

Original diagnosis (GEORGESCU & TUTUNARU 1958): Tapeta supra discum, velutosa, bruneo, nigricantia et interdum fasciculis hypharum bruneis ad basis et lateralia apotheciorum praedita. Mycelium ante hypothecium e plectenchymo cellularum rotundarum, ante hymenium ascarum hyphis solitarii, erectis irregulariter curvatis, parce oblique sursum ramosis cum cellulis clavulatis. Supra hymenium e his hyphis duo vel plures conidiophori erecti irregulariter curvati atque geniculati flavobrunnei, hyalini, septis sparsis, 110–130 µm longis et 4–5 µm crassis, cellula terminali 30–40 µm longa, apice ± clavuta evadunt. Conidia formiis variis, irregulariter ellipsoidea et ovoidea brunnea vel ægre verrucata, apice sæpe rotundata frequenter unicellularia 5–15 µm longa, 5–6 µm lata, bicellularia 10–18 × 5–8 µm, raro tricellularia 18–21 × 5.5 µm et quadricellularia 20–26 × 5.5–6 µm, ad septa non constricta. In apothecii *Lophodermii pinastri* (Schrad.) Chev.

Notes: Type material of this species was not available for a re-examination. The status of this species is unclear. According to the original description and illustration, it is possibly a true member of *Cladosporium* s. str. JÄRVA & PARMASTO (1980) recorded this species from Estonia, but without any details.

4.3.4.6. *Cladosporium penicilloides* Preuss

Cladosporium penicilloides Preuss, in Sturm, Deutschl. Fl. 3(26): 31 (1848).

Holotype: on *Tubercularia granulata* and *T. vulgaris* (anamorphic fungi), Germany, C.G.T. Preuss, Nr. 396 (B 70-6672).
Lit.: SACCARDO (1886: 369), LINDAU (1907: 807), FERRARIS (1912: 351), OUDEMANS (1920; 1921), NANNIZZI (1934: 407).
Ill.: PREUSS (1848: Pl. 16).

Original diagnosis (SACCARDO 1886): Cæspitus effusis, olivaceis, crassis; hyphis erectis, longis, irregulariter ramosis ramulisque intricatis, fuscis, septatis, polymorphis; conidiis ovatis, obovatis, oblongis, rotundis bisulcisve multiformibus; episporio hyalino, hilo basilari sæpe instructo; nucleo firmiusculo diaphano.

Collection examined: on *Prunus domestica*, Italy, Veneto, Prov. di Treviso, Selva di Cadore, Sept. 1875, P.A. Saccardo, Sacc., Mycoth. Ven. 587 (B 70-6671).

Notes: Type material and an additional collection from Italy have been examined, but proved to be in very poor condition, not allowing a final conclusion about the taxonomic status of this species. NANNIZZI (1934) considered *Cladosporium madagascarense* Sartory a synonym of *C. penicilloides*. *C. madagascarense*, described as isolated from a human, is, however, a doubtful, excluded name (DUGAN et al. 2004). SACCARDO (1886) cited *C. penicilloides* as found on chrysalises at still attached leaves of *Prunus domestica* in north Italy. OUDEMANS (1920) listed *Betula verrucosa* and (1921) *Prunus domestica* as hosts. BONTEA (1985, 1986) reported it from Romania on *Calycanthus floridus,*

C. laevigatus and *C. occidentalis*.

4.3.4.7. *Cladosporium phyllachorae* M.B. Ellis

Cladosporium phyllachorae M.B. Ellis, More Dematiaceous Hyphomycetes: 332 (1976).

Type: on *Catacauma apoensis* (= *Phyllachora*) (Phyllachoraceae) on leaves of *Ficus nervosa* (Moraceae), Philippines, Samar, Mar.–Apr. 1914, M. Ramos ('Bur. Sc. 17616').

≡ *Monotospora parasitica* Syd. & P. Syd., Ann. Mycol. 15: 263 (1917), non *Cladosporium parasiticum* Sorokīn, 1891.

Ill.: ELLIS (1976: 333, Fig. 251).

Original diagnosis (SYDOW & SYDOW 1917): Caespituli stromata Catacaumatid et Phyllachorae dense obtegentes, plus minus confluentes, subvelutini, atro-brunnei; mycelium sterile ex hyphis repentibus fuscidulis 2.5–3 µm latis compositum; hyphae conidiophorae ascendentes, subrectae vel flexuosae aut leniter curvatae, simplices, septatae (articulis 20–40 µm longis), usque 1.5 mm longae, 8–11 µm latae, fuscae; conidia ovata, ellipsoidea vel citriformia, continua, pallide fuscidula, levia, 12–16 × 8–10 µm.

Notes: Type material of this species or any other collections could not be traced. It is unclear on which material the combination, description and illustration published by ELLIS (1976) had been based.

4.3.4.8. *Cladosporium spongiosum* Berk. & M.A. Curtis

Cladosporium spongiosum Berk. & M.A. Curtis, in Berkeley, J. Linn. Soc., Bot. 10(46): 362 (1869).

Holotype: on fruits of *Cenchrus* sp. and inflorescences of *Setaria* sp. (Poaceae), Cuba, C. Wright, No. 287 (K 121570).

≡ *Helminthosporium spongiosum* (Berk. & M.A. Curtis) Cif., Atti Ist. Bot. Lab. Crittog. Univ. Pavia, Ser. 5, 19: 109 (1962).

Lit.: SACCARDO (1886: 365), ELLIS (1971: 317).

Ill.: ELLIS (1971: 316, Fig. 218 B).

Notes: The examination of type material has shown that *C. spongiosum* is a member of *Cladosporium* s. str. BILGRAMI et al. (1991) listed this species from India as hyperparasite on *Acrosporium* (= *Oidium*) *dendrophthoae* (Erysiphales), and MATHUR & MUKERJI (1981) published two additional Indian records on *Phyllactinia dalbergiae* and *P. moricola* [as *P. corylea*] (KISS 2003). Collections of *C. spongiosum* on fungi have not been seen. Therefore, it could not be verified if this species may occur on powdery mildews and if the fungi recorded by MATHUR & MUKERJI (1981) and BILGRAMI et al. (1991) were correctly identified. All collections on downy and powdery mildews that we have examined belonged to *Cladosporium uredinicola*.

4.3.4.9. *Cladosporium stromatum* Preuss

Cladosporium stromatum Preuss, in Sturm, Deutschl. Fl. 3(26): 25 (1848).

Holotype: on wood of *Pinus* sp. (Pinaceae), Germany, Hoyerswerda (B 70-6714).

Lit.: SACCARDO (1886: 352, 355), LINDAU (1907: 811), FERRARIS (1912: 339).

Ill.: PREUSS (1848: Pl. 13).

Notes: OUDEMANS (1919) reported this species from *Eutypa lejoplaca* (Xylariales). The taxonomic status of this species remains unclear.

4.3.4.10. *Cladosporium tuberculatum* Fr.

Cladosporium tuberculatum Fr., Summa veg. Scand. 2: 499 (1849).

Type: on ostioli of *Cytospora leucosperma* (anamorphic fungi), Scandinavia.

Lit.: SACCARDO (1886: 368).

Original diagnosis (FRIES 1849): *C. tuberculatum* sistit minuta, hemisphaerica tubercula, colorae griseofusco, fibris tenellis curtis pellucidis sursum septatis, sporidiis simplicibus l. uniseptatis.

Notes: No material seen; status quite unclear.

4.3.4.11. *Cladosporium umbrinum* Fr.

Cladosporium umbrinum Fr., Syst. mycol. 3(2): 372 (1832).

Type: on *Agaricus olearius* (Agaricales), France, Montagne.
= ? *Botrytis pulvinata* Link, in Willd., Sp. pl. 6(1): 61 (1824).
= ? *Cladosporium herbarum* (Pers.: Fr.) Link, Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 7: 37 (1816).
Lit.: SACCARDO (1886: 369), LINDAU (1907: 807), OUDEMANS (1919).
Original diagnosis (FRIES 1832): *C. umbrinum*, caespitibus effusis, contiguis tenuibus velutinis umbrinis, fibris brevibus flexis, sporidiis glomeratis. Densa et contigua sericea tela fungos obducit forte huic debetur phosphorescenti *Ag. olearius*. Fibrae contiguae, simplices l. ramosae, colore peculiari olivaceo-umbrino insignes. Sporidia conglomerata ut in Botrytide, sed certe hujus generis est species. Synonymon dubium, ill. Auctor ipse de genere dubiat. Ad *Agaricum olearium* in Gallis meridionali, Montagne (v. s.).

Collection examined: Germany, original label: '*Botrytis pulvinata*, Persoon', ex herb. Link (B 70-6764, holotype of *Botrytis pulvinata*).

Notes: In the original description of *C. umbrinum*, FRIES (1832) cited *Botrytis pulvinata* as possible synonym (with question mark). SACCARDO (1886) listed *C. umbrinum*, but cited *Botrytis pulvinata* as synonym without question mark. Type material of *B. pulvinata* has been examined and proved to be synonymous with *Cladosporium herbarum*. *C. umbrinum* is very probably a synonym of the latter species as well. SACCARDO (1886) and LINDAU (1907) recorded *C. umbrinum* on *Pleurotus olearius*, fruit bodies of other mushrooms and honeycombs of wasps from Belgium, France and Germany. *Agrocybe praecox* was listed as host of this species from Armenia and the Ukraine (OSIPJAN 1975). On the web-side 'biodiversity.ac.psiweb.com', *C. umbrinum* has been listed from the Ukraine on 'Agaricales (Fam. indet.)' and *Lactarius* sp.

4.3.4.12. *Cladosporium urediniphilum* Speg.

Cladosporium urediniphilum Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 31: 438–439 (1923).

Holotype: on sori of *Uredo cyclotrauma* (Uredinales) on leaves of *Pithecolobium cauliflorum*, Paraguay, Asunción, Puerto Sajonia, Oct. 1919, C. Spegazzini (LPS). Permanent slide: IMI 87163b.
Lit.: DEIGHTON (1969), SACCARDO (1972: 1340), FARR (1973: 252), SUTTON (1973: 40).
Ill.: SUTTON (1973: 41, Fig. 19 B).

Original diagnosis (SPEGAZZINI 1923b): Velutinum olivaceum mycelio in acervulis procurrente, hyphis tenuibus sursum, ad acervulorum margines praecipue, exertis pluriseptatis, olivaceis, simplicibus vix flexuosis, articulo supremo obsolete alterneque denticulato, denticulis conidiiferis: conidia elliptica v. subcylindracea, parva, utrimque plus minusve rotundata, continua v. 1-septata, laevia, hyalina v. vix fumosa.

Notes: In additional notes SPEGAZZINI (1923b) described the conidiophores and conidia as follows: Conidiophores 100–200 × 4–5 µm, 4–10-septate, without any constrictions at the septa; conidia 6–10 × 4–5 µm.

SUTTON (1973) examined the type material of this species and deposited a permanent slide at IMI. He described a species with verruculose surface sculpture, more conspicuous than in *C. gallicola*, and he stressed that the type collection was very meagre, without any intact conidiophores and only few conidia. Additional specimens of *Cladosporium urediniphilum* are not known, and the type material is too scarce for a final conclusion about the status of this species and its relation to *C. uredinicola* and other uredinicolous *Cladosporium* species.

4.3.5. Excluded species

4.3.5.1. *Cladosporium arthoniae* M.S. Christ. & D. Hawksw.

Cladosporium arthoniae M.S. Christ. & D. Hawksw., in Hawksworth, Bull. Brit. Mus. (Nat. Hist.), Bot. 6(3): 210 (1979).

Holotype: on apothecia of *Arthonia impolita* (Arthoniaceae) on *Quercus* sp. (Fagaceae), Sweden, Skåne, Genarp, Häckeberga, 24 Apr. 1946, M.S. Christiansen (C).
Ill.: HAWKSWORTH (1979: 211, Fig. 10).

Notes: HAWKSWORTH (1979) stressed that the shape of the conidiophores, the polyblastic conidiogenesis and the verrucose conidia indicate a relation of this species to *Cladosporium*, although conspicuous conidiogenous scars are lacking. Type material of this species and additional collections from herb. P. Diederich (Luxembourg) have been examined. True species of *Cladosporium* s. str. are well-characterised by having coronate conidiogenous loci, i.e., with a central convex dome, surrounded by a raised periclinal rim. The loci in *C. arthoniae* are, however, truncate to slightly convex, broad, unthickened and not darker than the surrounding walls of the conidiogenous cells. Hence, this species has to be excluded from *Cladosporium* s. str. *C. arthoniae* is close to various lichenicolous species of the genus *Taeniolella* S. Hughes, but differs in having apically frequently branched conidiophores and integrated, terminal as well as intercalary, sympodially proliferating conidiogenous cells. This species will be treated and reassessed in a separate paper.

4.3.5.2. *Cladosporium asterinae* Deighton **Fig. 23, Pl. 1, Fig. 6, Pl. 2, Fig. 13**

Parapericoniella U. Braun, Heuchert & K. Schub., **gen. nov.**

Etymology: Para- (Greek prefix, similar), *Periconiella* (hyphomycetous genus).

Differt a Cladosporio et *Periconiella* cicatricibus conidialibus non coronatis, non incrassatis et non fuscatis.

Differs from *Cladosporium* and *Periconiella* in having non-coronate (non-cladosporioid) and unthickened, not darkened conidiogenous loci.

Type species: *Cladosporium asterinae* Deighton.

Notes: On account of the structure of the conidiogenous loci (unthickened, non-pigmented, non-coronate), *Cladosporium asterinae* has to be excluded from *Cladosporium* s. str. Among the species of *Cladosporium* s. lat., *C. musae* E.W. Mason, occurring on banana leaves, a species which must also be excluded from *Cladosporium* s. str., is rather similar. However, the conidiogenous cells in the latter species are subcylindrical, not swollen, not constricted at the septa and mostly subhyaline. The conidiogenous loci are somewhat pigmented. Furthermore, *C. musae* is not hyperparasitic, but causes a distinct leaf spot disease.

Parapericoniella is morphologically close to *Periconiella* Sacc., which is also characterised by apically strongly, densely branched conidiophores. Hyperparasitic species have also been placed in the latter genus, e.g., *Periconiella ellisii* Merny & Huguenin ex M.B. Ellis on *Asteridiella* sp. in Africa (ELLIS 1971). However, species of *Periconiella* are easily distinguishable by having conspicuously thickened, darkened conidiogenous loci. Other genera of hyperparasitic hyphomycetes are not periconiella-like (DEIGHTON 1969, DEIGHTON & PIROZYNSKI 1972). Various other hyphomycete genera with similar conidiogenesis (Phaeoblastosporae) are characterised by branched conidiophores, e.g., *Haplotrichum* Link (PARTRIDGE et al. 2001a), *Parahaplotrichum* W.A. Baker & Partridge (PARTRIDGE et al. 2001b), *Phaeoblastospora* Partridge & Morgan-Jones (PARTRIDGE & MORGAN-JONES 2002), *Polyscytalum* Ries (ELLIS 1971), *Sorocybe* Fr. (PARTRIDGE & MORGAN-JONES 2002), *Subramaniomyces* Varghese & V.G. Rao (VARGHESE & RAO 1979), *Websteromyces* W.A. Baker & Partridge (PARTRIDGE et al. 2000). However, the apically densely branched, periconiella-like conidiophores are lacking in these genera.

Cladosporium balladynae Deighton is a species with a similar structure of the conidiophores, which

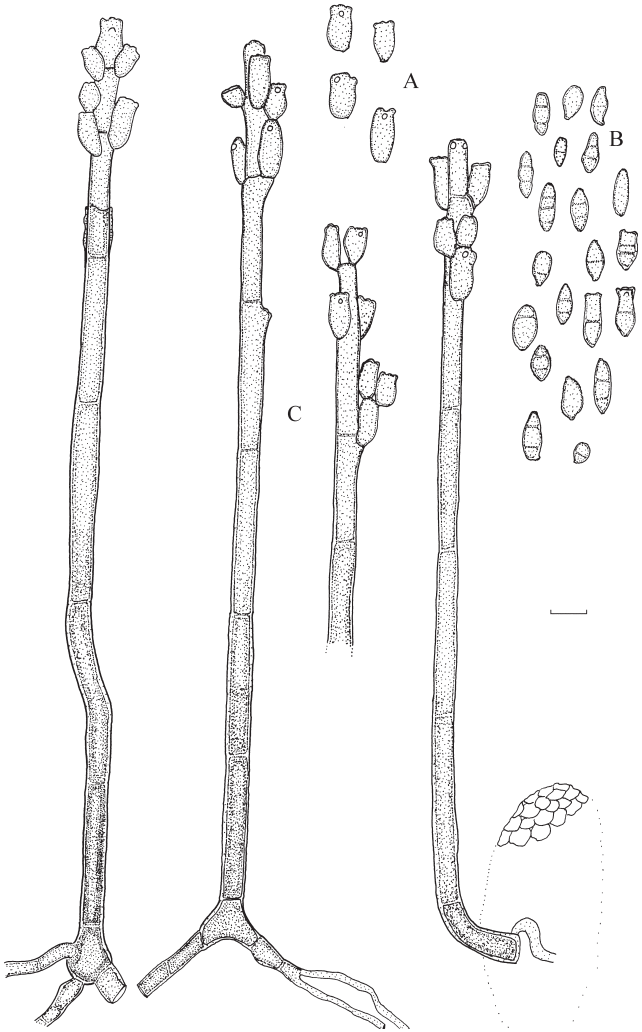


Fig. 23: *Parapericoniella asterinae*: A – detached 'branchlets', B – conidia, C – conidiophores with branched apices and lateral branchlets.

is possibly congeneric with *Parapericoniella*. However, the conidiophores and conidia are very pale, almost colourless. It was only possible to examine the sparingly developed type collection of the latter species, which was insufficient for a final conclusion.

Parapericoniella asterinae (Deighton) U. Braun, Heuchert & K. Schub., **comb. nov.**

Holotype: on colonies of *Asterina contigua* (Asterinaceae) on leaves of *Dialium dinklagei*

(Caesalpiniaceae), Sierra Leone, Kenema (Nongowa), 6 Dec. 1937, F.C. Deighton (IMI 11851b).
≡ *Cladosporium asterinae* Deighton, Mycol. Pap. 118: 30 (1969).

Lit.: ELLIS (1976: 331).
Ill.: DEIGHTON (1969: 31, Fig. 17), ELLIS (1976: 332, Fig. 250 A).

On colonies of *Asterina* spp., dark olivaceous to dark brown, scattered, extended, often confluent, spreading onto the surrounding green tissue of the host leaves, loosely to densely caespitose or tomentose, velvety. Mycelium external; hyphae superficial, creeping, branched, septate, without constrictions at the septa or only slightly constricted, 1.5–4 µm wide, subhyaline to pale olivaceous, smooth to faintly rough-walled, wall unthickened, hyphal cells around swollen cells 4–7 µm wide, swollen cells 8–14 µm diam., medium to dark brown, smooth, walls thickened. True stromata lacking. Conidiophores solitary, arising from swollen hyphal cells, erect, straight, subcylindrical, main axis unbranched, but apex branched, with lateral branchlets, (90–)170–250 × 7–8 µm, somewhat attenuated towards the tip, 5–6 µm wide, 5–7-septate, cells mostly 40–45 µm long, without any constrictions, dark olivaceous-brown to brown, paler towards the apex, loosely to dense verruculose, wall conspicuously thickened, up to 1.5 µm, less thickened near the tip, occasionally enteroblastically proliferating, monopodial. Conidiogenous cells integrated, terminal and lateral (forming the short branchlets of the branched apical portion), in pairs or whorls of 3–4, separated by a basal septum which is often constricted, broadly cylindrical to doliiform, 9–16 × 5.5–7 µm, usually aseptate, occasionally two-celled (two-celled conidiogenous branchlets occasionally intercalary), light olivaceous-brown, concolourous with the tips of the conidiophores, polyblastic, subtly sympodially proliferating, with (1–)2–4 conidiogenous loci at the tip, loci truncate to slightly convex, unthickened and not darkened, but somewhat refractive, 1–1.5(–2) µm diam. Conidia usually in branched chains, straight to slightly curved, subglobose, ellipsoid to fusiform, 6–15 × 4–6.5 µm, (0–)1–2(–3)-septate, occasionally constricted at the septa, pale olivaceous-brown, verruculose, rarely smooth, wall somewhat thickened, apex rounded or slightly attenuated, occasionally truncate, with up to 4 hila, base rounded to somewhat attenuated, hila truncate to slightly convex, peg-like, unthickened, slightly refractive, 1–1.5 µm diam., microcyclic conidiogenesis not observed.

Notes: DEIGHTON (1969) described the conidiogenous cells ('branchlets') to be persistent, i.e., persistently attached to the conidiophores. However, during the course of the re-examination of the type material detached conidiogenous cells possibly acting like conidia have been observed. In this case, they have to be classified as true ramoconidia. The base of these cells differs from the apical hila in structure and size. It is possible that conidiogenous cells have been shed due to age or mechanical impacts. The distinct constrictions at the septa indicate an adaptation for a more efficient dispersal of these structures.

ZHANG et al. (2003) described *C. asterinae* on *Asterina* sp. on *Machilus* sp. (Lauraceae) from China. KHAN & SHAMSI (1986) recorded this species on *Asterina permphioides* on *Eugenia* sp. (Myrtaceae) from Bangladesh. In contrast to the type collection with (0–)1–2(–3)-septate conidia, the conidia in the collections from China and Bangladesh have been described to be aseptate. However, the latter collections could not be examined. Therefore, it was not possible to prove if the determinations were correct. On the web-side 'biodiversity.ac.psiweb.com', the present species has been recorded from Georgia, but without any additional details.

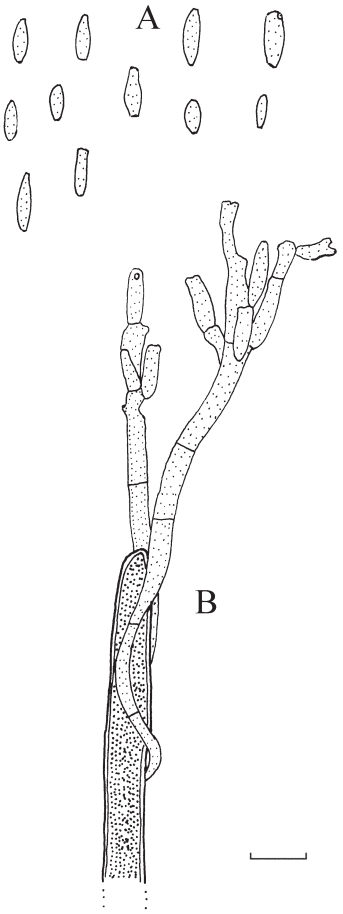


Fig. 24: *Cladosporium balladynae*: A – conidia, B – conidiophores.

4.3.5.3. *Cladosporium balladynae* Deighton **Fig. 24, Pl. 1, Fig. 3**

Cladosporium balladynae Deighton, Mycol. Pap. 118: 32 (1969).

Holotype: on *Balladyna magnifica* (Parodiopsidaceae) on leaves of *Canthium vulgare* (Rubiaceae), Uganda, Masaka, May 1962, C.L.A. Leakey (IMI 98798i).

Lit.: ELLIS (1976: 331), ZHANG et al. (2003: 51).

Ill.: DEIGHTON (1969: 33, Fig. 18), ELLIS (1976: 332, Fig. 250 B), ZHANG et al. (2003: 51, Fig. 25).

Colonies at the tips of dark setae of *Balladyna* spp., in small, delicate tufts, pale olivaceous. Mycelium superficial, on and between the hyphae of the host fungus, climbing setae; hyphae branched, 1.5–4 µm wide, septate, not or only slightly constricted at the septa, pale olivaceous, smooth. Conidiophores arising from hyphae, lateral and terminal, usually at tips of setae in groups of 2–9, erect, straight, subcylindrical, unbranched or branched, 45–75(–90) × (2.5–)3–5 µm, septate, cells 10–13 µm long, pale olivaceous, paler towards the apex, often even subhyaline, smooth, walls slightly thickened. Conidiogenous cells integrated, terminal and pleurogenous, usually with whorls of conidiogenous cells near the tips, which are mostly distinctly constricted at the basal septa and prone to be detached, shape subcylindrical to ellipsoid, up to 20 µm long, polyblastic, sympodially proliferating, conidiogenous loci truncate to somewhat convex, subdenticulate, unthickened, not darkened, at most slightly refractive, 1–1.5 µm diam. Conidia in branched chains, often in whorls, straight, ellipsoid, fusiform, (5–)6–10 × 2–4 µm, aseptate, subhyaline to very pale olivaceous, smooth, wall unthickened, apex rounded, base rounded to subtruncate, hila truncate to convex, slightly peg-like, unthickened, not darkened, at most somewhat refractive, 0.5–1.5(–2) µm diam., microcyclic conidiogenesis not observed.

Host range and distribution: Africa, Asia; on *Balladyna magnifica* on *Canthium vulgare* (Uganda); *B. tenuis* (Uganda); *Balladyna* sp. on *Rubus idaeus* (China, Shaanxi).

Notes: The meagre type material was the only collection of this fungus which could be examined. On account of the structure of the conidiophores, conidiogenous cells and conidiogenous loci, the conidiogenesis and the formation of the conidia, *Cladosporium balladynae* has to be excluded from *Cladosporium* s. str. and seems to be congeneric with *Cladosporium asterinae*, but we hesitate to carry out a formal assignment to the new genus *Parapericoniella* since the material examined is too meagre for a final conclusion. Furthermore, the hyphae, conidiophores and conidia of this species are very pale, often even subhyaline. Additional collections and, if possible, molecular data are necessary to verify the generic affinity of this species. The specimen recorded from China has not yet been available, so that its identity could not be confirmed.

4.3.5.4. *Cladosporium cyttariicola* Speg.

Cladosporium cyttariicola Speg., Physis (Buenos Aires) 7(23): 20 (1923), as '*cyttariicolum*'.

Holotype: on *Cyttaria harioti* (Cyttariaceae, Ascomycetes), Argentina, Tierra del Fuego, Puerto Garibaldi (LPS 13.078).
Lit.: FARR (1973: 251), GUARRERA et al. (1977: 40).
Ill.: GUARRERA et al. (1977: 39, Pl. VII)

Original diagnosis (SPEGAZZINI 1923a): Effusum subcrustaceum, dense velutinum, intenseviridi-olivaceum; hyphae steriles repentes dense intricatae ramoso-intertextae olivaceae; hyphae fertiles numerosae erectae simplices breviusculae pluriseptatae virescentes, articulis superis sensim abbreviatis, conidiis secedentibus irregulariter vestitis; conidia typice ellipsoidea continua chlorina laevia parvula aliis polymorphis plus minusve numerosis concomitata.

Notes: In additional notes, SPEGAZZINI (1923a) described unbranched conidiophores, 50–150 × 4–5 µm, with 5–10 septa and ellipsoid conidia, 4–10 × 3.5–6 µm. There is an original drawing made by Spegazzini on the envelope of the type collection, showing pleurogenous conidial formation which is atypical for true *Cladosporium* species. The type specimen is very meagre; conidiophores have not been found, but a few conidia agreeing with the original description could be examined. The loci are quite distinct from those of *Cladosporium* s. str., i.e., they are not coronate, so that *C. cyttariicola* can clearly be excluded from the latter genus. A final conclusion about the generic affinity of this species is, however, not yet possible. New collections are necessary.

4.3.5.5. *Cladosporium elsinoes* H.C. Greene **Fig. 25**

Cladosporium elsinoes H.C. Greene, Trans. Wisconsin Acad. Sci. 47: 127 (1958), **syn. nov.** of *Dendryphiella infuscans*.

Lectotype (designated here): on *Elsinoe wisconsinensis* (Elsinoaceae) on *Desmodium illinoense* (Fabaceae), USA, Wisconsin, Lafayette Co., Ipswich near Platteville, 16 Aug. 1951, H.C. Greene (WIS). **Isolectotypes:** BPI 426465A, BPI 426465B.
= ***Dendryphiella infuscans*** (Thüm.) M.B. Ellis, Dematiaceous Hyphomycetes: 500 (1971).
≡ *Cladosporium infuscans* Thüm., Rev. Mycol. (Toulouse) 1: 59 (1879).
Lit.: SACCARDO (1886: 361).
Ill.: ELLIS (1971: 500, Fig. 359).

Colonies olivaceous to dark brown, loose to dense, effuse, caespitose to floccose, confined to the host fungus. Mycelium immersed; hyphae branched, 2–6 µm wide, septate, often constricted at the septa, subhyaline to pale olivaceous. True stromata lacking. Conidiophores solitary or in loose groups, arising from hyphae, terminal and lateral, erumpent, erect, straight to slightly curved, slightly geniculate, subcylindrical, often branched, 94–165(–300) × 4–5.5(–7) µm, sometimes swollen at the very base, up to 10 µm, 4–7-septate, often with constrictions at the septa, olivaceous to medium

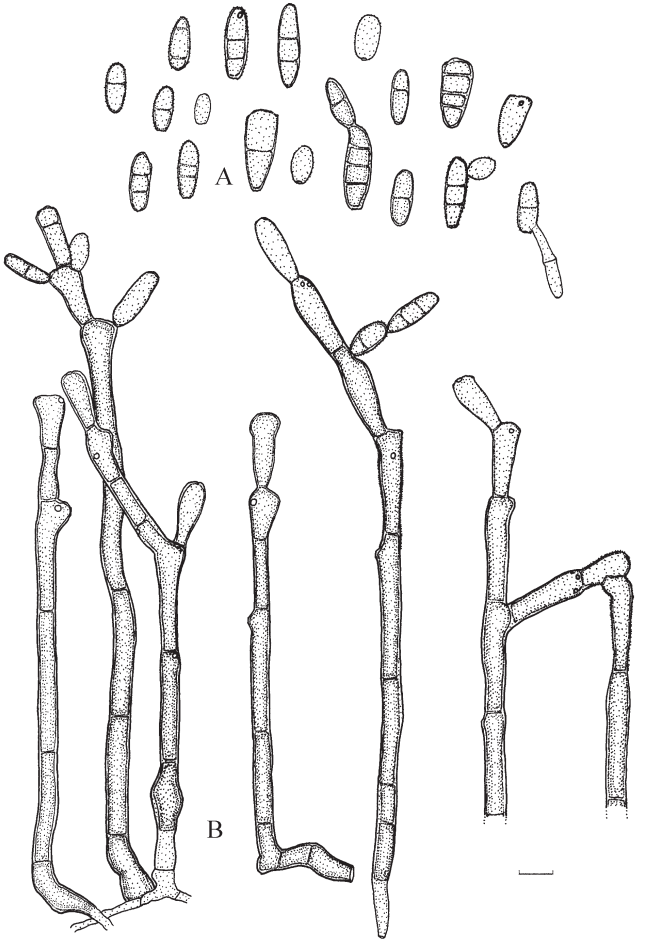


Fig. 25: *Cladosporium elsinoes*: A – conidia, B – conidiophores.

brown, paler towards the apex, smooth, occasionally faintly verruculose, walls somewhat thickened, thinner towards the apex, with intercalary swellings, 7–8 µm diam., swellings mostly with conidiogenous loci. Conidiogenous loci integrated, terminal and intercalary, subcylindrical to distinctly clavate, 12–23 µm long, enteroblastic, polytretic, terminal conidiogenous cells often constricted at the basal septum and enlarged at the apex, up to 8 µm wide, loci inconspicuous, slightly thickened, not darkened, but slightly refractive, slightly convex, with a pale central pore, 1–2 µm diam. Conidia catenate, mostly in branched chains, straight, cylindrical, broadly cylindrical, sometimes obovoid, 7–21 × 4.5–6.5 µm, 0–2(–3)-septate, mostly with a single not

quite median septum, pale olivaceous to olivaceous-brown, smooth to faintly rough-walled, wall thin to slightly thickened, ends more or less rounded, hila not very conspicuous, slightly convex, 1–2 µm diam.

Collections examined: on stems of *Desmodium strictum*, USA, SC, Aiken, H.W. Ravenel, Thüm., Mycoth. univ. 1573 (M-57612, syntype of *C. infuscans*); on *Elsinoe wisconsinensis* on *Desmodium illinoense*, USA, WI, Madison, Univ. Wisc. Arboretum, 12 Aug. 1961, H.C. Greene (WIS); 25 Jul. 1962, H.C. Greene (WIS); Prairie 81-10, 30 Aug. 1958, H.C. Greene (WIS).

Notes: The conidiogenesis in *Cladosporium elsinoes* is tretic and the conidiogenous loci are quite distinct from those of true *Cladosporium* (s. str.) species. A comparison of type collections of *C. elsinoes* and *Dendryphiella infuscans* showed that the two taxa are conspecific.

4.3.5.6. *Cladosporium hemileiae* Steyaert **Fig. 26, Pl. 1, Figs 4, 7**

Digitopodium U. Braun, Heuchert & K. Schub., **gen. nov.**

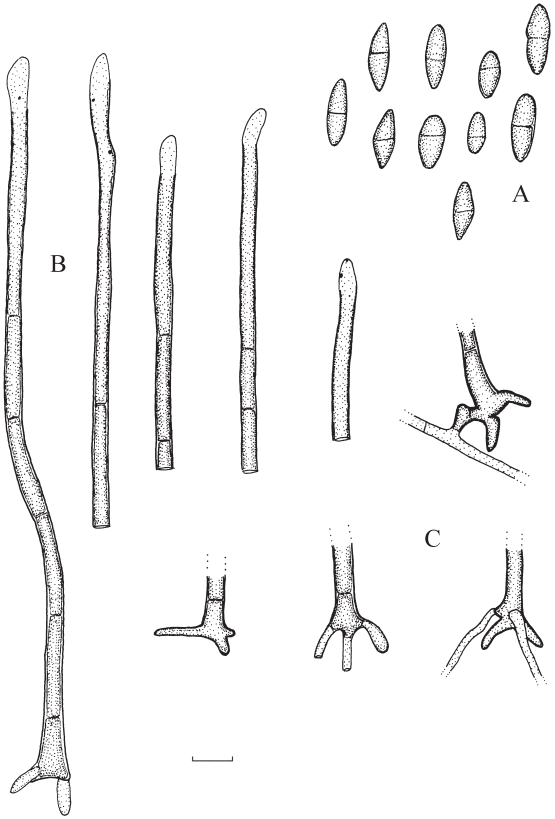


Fig. 26: *Digitopodium hemileiae*: A – conidia, B – conidiophores, C – digitate or rhizoid protuberances.

Etymology: Digito- (digitus, finger), -podium (podium, foot).

Differt a Cladosporio cicatricibus conidialibus inconspicuis vel subconspicuis, non coronatis, non incrassatis, cellulis conidiogenis non geniculatis et basibus conidiophoris digitatis.

This genus differs from *Cladosporium* by having inconspicuous or subconspicuous conidiogenous scars (loci) on the conidiogenous cells, which are unthickened, at most slightly darkened or refractive, i.e., they are not coronate as in *Cladosporium* s. str. The conidiogenous cells are not conspicuously sympodial (not geniculate) and the base of the conidiophores is characterised by having short digitate or rhizoid protuberances.

Type species: *Cladosporium hemileiae* Steyaert.

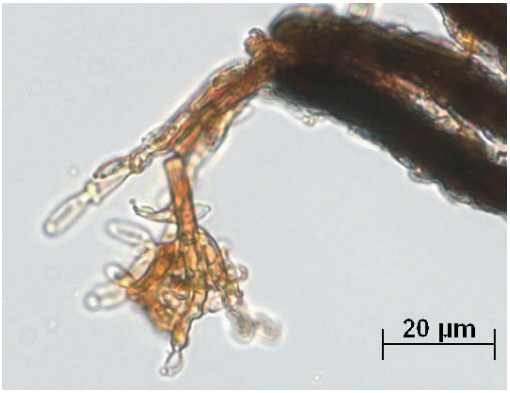
Notes: Due to the strongly deviating structure of the conidiogenous loci (inconspicuous or almost so, unthickened, not or only slightly darkened), which is quite distinct from true *Cladosporium* scars, *C. hemileiae* has to be excluded from the latter genus. The conidiogenous cells are not distinctly sympodial (i.e., not geniculate-sinuous), and the base of the conidiophores is characterised by having typical digitate or rhizoid protuberances. The combination of these features distinguishes *Digitopodium* from all hyperparasitic and other hyphomycetous genera with pigmented conidiophores and similar conidiogenesis (Phaeoblastosporae) [DEIGHTON 1969; DEIGHTON & PIROZYNSKY 1972; ELLIS 1971, 1976; KIFFER & MORELET 1999].

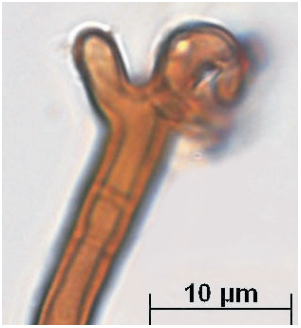
Digitopodium hemileiae (Steyaert) U. Braun, Heuchert & K. Schub., **comb. nov.**

Holotype: on uredo-sori of *Hemileia vastatrix* (Uredinales) on *Coffea robusta* (Rubiaceae), Zaire, Prov. Orientale, Biaro, Kisangani (Stanleyville), Oct. 1929, R.L. Steyaert (BPI 426854).
≡ *Cladosporium hemileiae* Steyaert, Bull. Soc. Roy. Bot. Belgique 63(1): 47 (1930).
Lit.: SACCARDO (1972: 1337), SUTTON (1973: 40).
Ill.: STEYAERT (1930: Pl. 4–5).

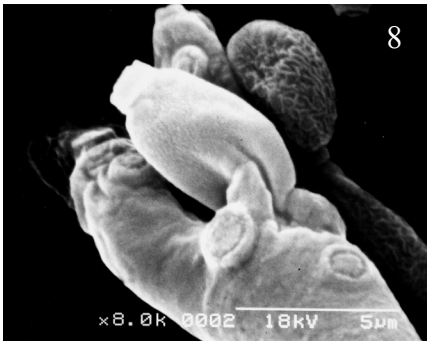
Colonies hypophyllous, on leaf spots caused by *Hemileia vastatrix*, blackish brown, loose to dense, villose, confluent. Mycelium external, superficial; hyphae often branched, 2.5–4 µm wide, septate, occasionally constricted at the septa, medium olivaceous-brown or paler, smooth, walls thickened. True stromata lacking. Conidiophores solitary or in loose groups, arising from hyphae, straight to slightly curved, unbranched, up to 177(–330) × 3.5–7 µm or even longer, pluriseptate, cells 10–17 µm long, not constricted at the septa, medium to dark brown, darker below, paler towards the apex, smooth or almost so, but often somewhat verruculose at the tip, enlarged at the very base, up to 12 µm, with digitate or rhizoid outgrowths, 2–15 × 2–5 µm, often somewhat paler than the base of the conidiophores, but darker than the hyphae, walls of the outgrowths somewhat thickened. Conidiogenous cells integrated, terminal, subcylindrical, tips mainly unilaterally swollen or somewhat curved, not geniculate-sinuous, polyblastic, with up to two fairly inconspicuous lateral conidiogenous loci, sympodial proliferation inconspicuous, loci unthickened, barely to very slightly darkened, 0.5–0.7(–1) µm diam. Conidia solitary, rarely in short chains, straight, ellipsoid, 12–17.5 × 5–7 µm, 1-septate, usually not constricted at the septa, pale brownish, smooth, walls unthickened or almost so, base and apex rounded to slightly attenuated-truncate, hila truncate to convex, unthickened, somewhat darkened-refractive, 0.5–1 µm diam., microcyclic conidiogenesis not observed.

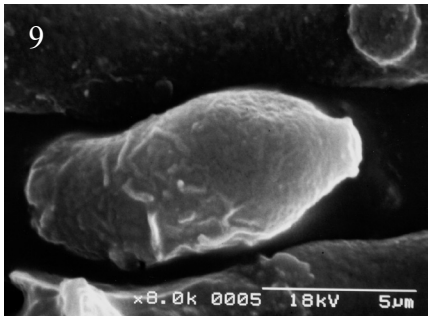
Host range and distribution: only known from the type collection.

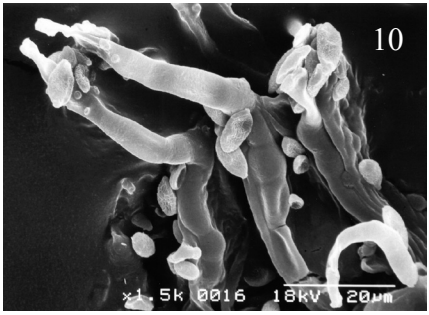


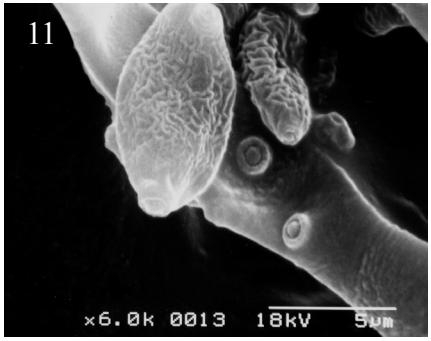


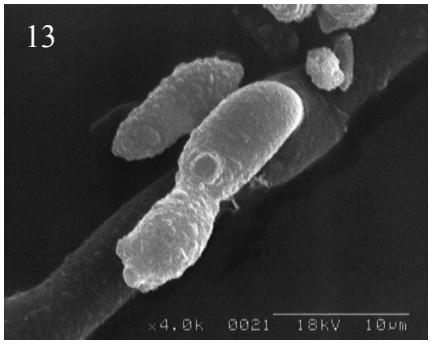
Pl. 1, Figs 1–7 (text on page 68).











Pl. 1, Figs 1–7 (p. 67):
1, 2: *Cladosporium gerwasiae*: **1** – overview, **2** – conidiophore with attached conidia.
3: *C. balladynae*, overview.
4, 7: *Digitopodium hemileiae*, digitate or rhizoid outgrowth.
5: *C. gallicola*, conidiophore with darkened-refractive conidiogenous loci.
6: *Parapericoniella asterinae*, conidiophore, conidiogenous cells (branchlets).
Pl. 2, Figs 8–13:
8: *Cladosporium gallicola*, conidiophore, conidia.
9: *C. episclerotiale*, conidium.
10, 11: *C. taphrinae*: **10** – overview, **11** – conidiogenous loci and hila.
12: *C. phyllophilum*, ramoconidium s. str.
13: *Parapericoniella asterinae*, conidiophore, conidiogenous cells (branchlets).

Notes: STEYAERT (1930) described in the original diagnosis that the hyphae of this species overgrow uredospores which become aggregated in diffuse masses. Furthermore, he described that the appendages of the conidiophore bases ('pseudopodia') may penetrate uredospores, and he mentioned 3-septate conidia.

Beside conidia agreeing with the original description, some other conidia have been observed in the type collection: formed singly or in chains, straight, ellipsoid, fusiform, 10–16 × 3–4.5 µm, 1–5-septate, often constricted at the septa, subhyaline to pale brown, smooth, walls unthickened, apex and base rounded, conidiogenous hila unthickened, but darkened, 0.5–1 µm diam. These conidia belong very probably to a second fungus with conidiophores arising from hyphae, in small fascicles, 35–45 × 3–4 µm, ash-brown to olivaceous, but basal protuberances are lacking. Furthermore, numerous small, subglobose conidia, 3–5 × 2–3.5 µm, without any conspicuous hilum structures, which could not be assigned to any fungus, have been observed.

4.3.5.7. *Cladosporium lichenum* Keissl.

Cladosporium lichenum Keissl., Centralbl. Bakteriol., 2. Abth., 37: 389 (1913).

Holotype: on apothecia of *Haematomma cismonicum* (Haematommataceae), Austria, Steiermark, Valle See-Aü at Leopoldsteiner See near Eisenerz, alt. 700 m, Jul. 1912, K. von Keissler (W 1912/117).

≡ *Pseudocercospora lichenum* (Keissl.) D. Hawksw., Bull. Brit. Mus. (Nat. Hist.), Bot. 6(3): 246 (1979).

Lit.: SACCARDO (1931: 796).

Ill.: HAWKSWORTH (1979: 247, Fig. 31).

Notes: HAWKSWORTH (1979) revised type material of this species and, due to inconspicuous, unthickened conidiogenous loci, placed it into the genus *Pseudocercospora* Speg. Since coronate cladosporioid scars are lacking, *Cladosporium lichenum* has to be excluded from *Cladosporium* s. str. Although the pigmentation, the conidiogenesis and the structure of the conidiogenous loci are broadly similar to *Pseudocercospora*, the true generic affinity of the lichenicolous *C. lichenum* remains unclear in the absence of molecular data.

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7. Index of scientific names