

# Sizing up *Septoria*

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**Abstract:** *Septoria* represents a genus of plant pathogenic fungi with a wide geographic distribution, commonly associated with leaf spots and stem cankers of a broad range of plant hosts. A major aim of this study was to resolve the phylogenetic generic limits of *Septoria*, *Stagonospora*, and other related genera such as *Sphaerulina*, *Phaeosphaeria* and *Phaeoseptoria* using sequences of the partial 28S nuclear ribosomal RNA and RPB2 genes of a large set of isolates. Based on these results *Septoria* is shown to be a distinct genus in the *Mycosphaerellaceae*, which has mycosphaerella-like sexual morphs. Several septoria-like species are now accommodated in *Sphaerulina*, a genus previously linked to this complex. *Phaeosphaeria* (based on *P. oryzae*) is shown to be congeneric with *Phaeoseptoria* (based on *P. papayae*), which is reduced to synonymy under the former. *Depazea nodorum* (causal agent of nodorum blotch of cereals) and *Septoria avenae* (causal agent of avenae blotch of barley and rye) are placed in a new genus, *Parastagonospora*, which is shown to be distinct from *Stagonospora* (based on *S. paludosa*) and *Phaeosphaeria*. Partial nucleotide sequence data for five gene loci, ITS, LSU, EF-1 $\alpha$ , RPB2 and Btub were generated for all of these isolates. A total of 47 clades or genera were resolved, leading to the introduction of 14 new genera, 36 new species, and 19 new combinations.

**Key words:** *Capnodiales*, Multi-Locus Sequence Typing (MLST), *Mycosphaerella*, *Mycosphaerellaceae*, *Phaeoseptoria*, *Phaeosphaeria*, *Phaeosphaeriaceae*, *Pleosporales*, *Septoria*, *Sphaerulina*, *Stagonospora*, systematics.

**Taxonomic novelties: New genera** – *Acicuseptoria* Quaedvlieg, Verkley & Crous, *Cylindroseptoria* Quaedvlieg, Verkley & Crous, *Kirstenboschia* Quaedvlieg, Verkley & Crous, *Neoseptoria* Quaedvlieg, Verkley & Crous, *Neostagonospora* Quaedvlieg, Verkley & Crous, *Parastagonospora* Quaedvlieg, Verkley & Crous, *Polyphialoseptoria* Quaedvlieg, R.W. Barreto, Verkley & Crous, *Ruptoseptoria* Quaedvlieg, Verkley & Crous, *Septorioides* Quaedvlieg, Verkley & Crous, *Setoseptoria* Quaedvlieg, Verkley & Crous, *Stromatoseptoria* Quaedvlieg, Verkley & Crous, *Vrystaatia* Quaedvlieg, W.J. Swart, Verkley & Crous, *Xenobotryosphaeria* Quaedvlieg, Verkley & Crous, *Xenoseptoria* Quaedvlieg, H.D. Shin, Verkley & Crous. **New species** – *Acicuseptoria rumicis* Quaedvlieg, Verkley & Crous, *Caryophylloseptoria pseudolychnidis* Quaedvlieg, H.D. Shin, Verkley & Crous, *Coniothyrium sidae* Quaedvlieg, Verkley, R.W. Barreto & Crous, *Corynespora leucadendri* Quaedvlieg, Verkley & Crous, *Cylindroseptoria ceratoniae* Quaedvlieg, Verkley & Crous, *Cylindroseptoria pistaciae* Quaedvlieg, Verkley & Crous, *Kirstenboschia diospyri* Quaedvlieg, Verkley & Crous, *Neoseptoria caricis* Quaedvlieg, Verkley & Crous, *Neostagonospora caricis* Quaedvlieg, Verkley & Crous, *Neostagonospora elegiae* Quaedvlieg, Verkley & Crous, *Paraphoma dioscoreae* Quaedvlieg, H.D. Shin, Verkley & Crous, *Parastagonospora caricis* Quaedvlieg, Verkley & Crous, *Parastagonospora poae* Quaedvlieg, Verkley & Crous, *Phlyctema vincetoxici* Quaedvlieg, Verkley & Crous, *Polyphialoseptoria tabebuiae-serratifoliae* Quaedvlieg, Alfenas & Crous, *Polyphialoseptoria terminaliae* Quaedvlieg, R.W. Barreto, Verkley & Crous, *Pseudoseptoria collariana* Quaedvlieg, Verkley & Crous, *Pseudoseptoria obscura* Quaedvlieg, Verkley & Crous, *Sclerostagonospora phragmiticola* Quaedvlieg, Verkley & Crous, *Septoria cretae* Quaedvlieg, Verkley & Crous, *Septoria glycinicola* Quaedvlieg, H.D. Shin, Verkley & Crous, *Septoria oenanthicola* Quaedvlieg, H.D. Shin, Verkley & Crous, *Septoria pseudonapelli* Quaedvlieg, H.D. Shin, Verkley & Crous, *Setophoma chromolaenae* Quaedvlieg, Verkley, R.W. Barreto & Crous, *Setoseptoria phragmitis* Quaedvlieg, Verkley & Crous, *Sphaerulina amelanchier* Quaedvlieg, Verkley & Crous, *Sphaerulina pseudovirgaureae* Quaedvlieg, Verkley & Crous, *Sphaerulina viciae* Quaedvlieg, H.D. Shin, Verkley & Crous, *Stagonospora duoseptata* Quaedvlieg, Verkley & Crous, *Stagonospora perfecta* Quaedvlieg, Verkley & Crous, *Stagonospora pseudocaricis* Quaedvlieg, Verkley, Gardiennet & Crous, *Stagonospora pseudovitensis* Quaedvlieg, Verkley & Crous, *Stagonospora uniseptata* Quaedvlieg, Verkley & Crous, *Vrystaatia aloecola* Quaedvlieg, Verkley, W.J. Swart & Crous, *Xenobotryosphaeria calamagrostidis* Quaedvlieg, Verkley & Crous, *Xenoseptoria neosaccardi* Quaedvlieg, H.D. Shin, Verkley & Crous. **New combinations** – *Parastagonospora avenae* (A.B. Frank) Quaedvlieg, Verkley & Crous, *Parastagonospora nodorum* (Berk.) Quaedvlieg, Verkley & Crous, *Phaeosphaeria papayae* (Speg.) Quaedvlieg, Verkley & Crous, *Pseudocercospora domingensis* (Petr. & Cif.) Quaedvlieg, Verkley & Crous, *Ruptoseptoria unedonis* (Roberge ex Desm.) Quaedvlieg, Verkley & Crous, *Septorioides pini-thunbergii* (S. Kaneko) Quaedvlieg, Verkley & Crous, *Sphaerulina abeliceae* (Hiray.) Quaedvlieg, Verkley & Crous, *Sphaerulina azaleae* (Voglino) Quaedvlieg, Verkley & Crous, *Sphaerulina berberidis* (Niessl) Quaedvlieg, Verkley & Crous, *Sphaerulina betulae* (Pass.) Quaedvlieg, Verkley & Crous, *Sphaerulina cercidis* (Fr.) Quaedvlieg, Verkley & Crous, *Sphaerulina menispermii* (Thüm.) Quaedvlieg, Verkley & Crous, *Sphaerulina musiva* (Peck) Quaedvlieg, Verkley & Crous, *Sphaerulina oxyacanthae* (Kunze & J.C. Schmidt) Quaedvlieg, Verkley & Crous, *Sphaerulina patriniae* (Miura) Quaedvlieg, Verkley & Crous, *Sphaerulina populicola* (Peck) Quaedvlieg, Verkley & Crous, *Sphaerulina quercicola* (Desm.) Quaedvlieg, Verkley & Crous, *Sphaerulina rhabdoclinis* (Butin) Quaedvlieg, Verkley & Crous, *Stromatoseptoria castaneicola* (Desm.) Quaedvlieg, Verkley & Crous. **Typifications: Epitypifications** – *Phaeosphaeria oryzae* I. Miyake, *Phaeoseptoria papayae* Speg.; **Neotypification** – *Hendersonia paludosa* Sacc. & Speg.

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## INTRODUCTION

Fungal species belonging to *Septoria* are among the most common and widespread leaf-spotting fungi worldwide. *Septoria* Sacc. (*Mycosphaerella*, *Capnodiales*, *Dothideomycetes*) is based on *Septoria cytisi*, which was first described by Desmazières (1847) as a pathogen of *Cytisus laburnum* (= *Laburnum anagyroides*).

The genus *Septoria* is extremely large, and during the past 150 years more than 2000 taxa have been ascribed to this asexual genus (Verkley & Priest 2000, Verkley *et al.* 2004). Presently, *Septoria s.lat.* represents a polyphyletic assembly of genera that cluster mostly in the *Mycosphaerellaceae* (a family incorporating many plant pathogenic coelomycetes), although fungi with septoria-like morphology have also evolved outside this family

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(Crous *et al.* 2009a, c). Although many species of *Septoria* have mycosphaerella-like sexual states, the name *Mycosphaerella* does not apply to them, and should not be used in this context.

Following a proposal accepted by the International Code of Nomenclature for algae, fungi and plants (ICN), the generic name *Septoria* Sacc. was conserved over the older synonym *Septaria* Fr. (original spelling). The arguments preceding the typification of *Septoria* and subsequent proposals for name conservation by Wakefield (1940), Rogers (1949) and Donk (1964) between *Septoria sensu* Saccardo or *Septaria* Fries were various. In the end the committee for fungi appointed by the ICN followed the recommendation of Donk (1964), and decided on *Septoria* Sacc. over *Septaria* Fr., arguing that *Septoria* Sacc. had already been in prevalent use for many years, and should therefore be accepted as the correct name.

After examining several herbarium specimens of *S. cytisi*, Sutton (1980) circumscribed *Septoria* as follows: *Mycelium* immersed, branched, septate, pale brown. *Conidiomata* pycnidial, immersed, separate or aggregated (but not confluent), globose, papillate (or not), brown, thin-walled of pale brown *textura angularis*, often with a smaller-celled inner layer, somewhat darker and more thick-walled around the ostiole. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, either determinate or indeterminate, with a limited number of sympodial proliferations. Each locus has a broad, flat, unthickened scar, discrete, hyaline, smooth, ampulliform, doliiform or lageniform to short cylindrical. *Conidia* hyaline, multiseptate, filiform, smooth and either continuous or constricted at septa. Later work by Constantinescu (1984), Sutton & Pascoe (1987, 1989) and Farr (1991, 1992) augmented Sutton's previous generic circumscription by also including species with sympodial, enteroblastic and percurrent conidial proliferation. Furthermore, based on similarities in conidiomatal development, von Arx (1983) and Braun (1995) adopted an even wider concept of *Septoria* that included the acervular forms normally accommodated in *Phloeospora*.

Morphological traits in *Septoria* are generally conserved, and specific morphological characters by which to describe and identify *Septoria* and septoria-like species are limited. This lack of specific morphological characters caused *Septoria* taxonomy to be largely dependent on associated host data, leading to many of the described species only being identifiable by host plant, and by variation in informative supplementary characters like conidial length, width and septation (Jørstad 1965, 1967, Sutton 1980). Of these supplementary characters, conidial width appears to be the most stable (i.e. it shows the least amount of intraspecific variation) and in most *Septoria* species, intraspecific conidial width rarely varies more than 1 µm (Priest 2006).

This reliance on host data in *Septoria* taxonomy is far from perfect, and should be avoided for identification purposes (see Verkley *et al.* 2013, this volume). Extensive host inoculation experiments by Beach (1919) and Teterevnikova-Babayana (1987) have shown that identification of *Septoria* spp. by host specificity alone is error prone because many *Septoria* species are not restricted to a single specific host (i.e. several taxa have broader host ranges). *Septoria* species like *S. lactucicola* and *S. lycopersici* can not only infect multiple plant species within the same genus, but can also infect plants belonging to closely allied families and genera. In contrast to this, morphologically well distinguishable *Septoria* species can also parasitise the same hosts (e.g. multiple distinct *Septoria* species can be found on both *Chrysanthemum* and *Rubus* hosts) (Demaree & Wilcox 1943, Punithalingam 1976, Shin & Sameva 2004). Because host specificity has been

one of the main criteria used for describing new, morphologically indistinguishable *Septoria* species over the past 150 years, one can expect that a certain number of described taxa are in fact synonyms of species from related hosts.

## Septoria and septoria-like genera in the molecular era

Although it had previously been speculated by Sutton (1980) that *Septoria* was in fact polyphyletic, definitive proof of this hypothesis awaited the introduction of molecular techniques. Cunfer & Ueng (1999) were the first to use rDNA sequence data of the internal transcribed spacer region (ITS) to postulate that *Zymoseptoria tritici* (then known as *Septoria tritici*) and several *Stagonospora* spp. (a morphologically similar genus, previously linked to *Septoria*) actually belonged to two distinct genera. Verkley *et al.* (2004) extended this study by employing a combination of 28S nrDNA (LSU) and ITS data to prove that *Septoria* was in fact both poly- and paraphyletic. Their work showed that septoria-like species such as *Z. tritici* and *Z. passerinii* were more closely related to *Ramularia* than to the majority of the other *Septoria* species used in their datasets.

Feau *et al.* (2006) were the first to use a multi-locus polyphasic sequencing approach to reliably identify *Septoria* spp. Besides ITS and LSU sequence data, they also used β-tubulin (Btub) sequence data to separate closely related species into distinct monophyletic groups that frequently correlated with their respective host families. These results supported the approach of using multi-gene sequence data for studying a large collection of *Septoria* strains at species level.

*Septoria s. str.* was finally demarcated when Quaedvlieg *et al.* (2011) managed to obtain both ITS and LSU sequence data from *S. cytisi* herbarium specimens. Phylogenetic analysis of the obtained *S. cytisi* LSU sequence data clearly proved that *Z. tritici* and *Z. passerinii* [as previously indicated by Cunfer & Ueng (1999) and Verkley *et al.* (2004)] did not belong to *Septoria s. str.*, but in fact belonged to a separate genus, closely related to *Ramularia*. These two species were subsequently split off from *Septoria* and placed in a new genus, *Zymoseptoria* (named for the yeast-like state produced in culture). Since the initial *Zymoseptoria* paper, five additional species from members of *Poaceae* have been described in this genus (Crous *et al.* 2012a, Stukenbrock *et al.* 2012).

## Septoria-like asexual genera

Since the description of *Septoria* by Desmazières (1847), several additional septoria-like genera (pycnidial/acervular/stromatic conidioma with filiform conidia) have been described which could be mistaken for *Septoria s. str.*

The two economically most important septoria-like genera are probably *Zymoseptoria* (sexual morph mycosphaerella-like) and *Parastagonospora* (sexual morph phaeosphaeria-like; see below). Both of these genera are pathogenic on *Poaceae* (grasses) and are directly or indirectly responsible for significant annual crop losses worldwide on cereals such as barley and wheat (Eyal *et al.* 1987). Quaedvlieg *et al.* (2011) determined that *Zymoseptoria* formed a distinct clade in the *Mycosphaerellaceae*, while *Stagonospora* was found to cluster in the *Phaeosphaeriaceae* within the *Pleosporales*, near other genera like *Phoma* and *Phaeosphaeria* (Cunfer & Ueng 1999, Solomon *et al.* 2006) which contain important plant pathogens. However, besides *Zymoseptoria* and *Parastagonospora* there are many other, lesser-known septoria-like genera awaiting

elucidation. The goal of the present study is therefore to conduct an in-depth morphological and molecular analysis of these septoria-like genera, and resolve the affinities of *Stagonospora* and its purported sexual morph, *Phaeosphaeria*. To this end a collection of 370 *Septoria* and septoria-like isolates (Table 1) were subjected to morphological examination and multi-gene DNA analyses.

## MATERIALS AND METHODS

### Isolates

Symptomatic leaves were incubated in moist chambers for up to 1 wk to enhance sporulation before single conidial colonies were established on 2 % malt extract agar (MEA) (Crous *et al.* 2009d). Leaf spots bearing ascospores were soaked in water for approximately 2 h, after which they were attached to the inner surface of Petri dish lids over plates containing MEA. Ascospore germination patterns were examined after 24 h, and single ascospore cultures established as described previously (Crous *et al.* 1991, Crous 1998). Colonies were sub-cultured onto synthetic nutrient-poor agar (SNA) containing sterile *Hordeum vulgare* (barley) and *Urtica dioica* (stinging nettle) stems, potato-dextrose agar (PDA), oatmeal agar (OA), and MEA (Crous *et al.* 2009d), and incubated at 25 °C under continuous near-ultraviolet light to promote sporulation. Isolates were also obtained from the culture collections of the CBS-KNAW Fungal Biodiversity Centre (CBS) in Utrecht, and the working collection of Pedro Crous (CPC). Reference strains were deposited CBS (Table 1).

### DNA extraction, amplification and sequencing

Genomic DNA was extracted from fungal mycelium growing on MEA, using the UltraClean® Microbial DNA Isolation Kit (Mo Bio Laboratories, Inc., Solana Beach, CA, USA). Strains (Table 1) were screened for five loci ( $\beta$ -tubulin (Btub), internal transcribed spacer (ITS), Translation elongation factor 1-alpha (EF-1 $\alpha$ ) 28S rDNA (LSU) and RNA polymerase II second largest subunit (RPB2) using the primer sets listed in Table 2. The PCR amplifications were performed in a total volume of 12.5  $\mu$ L solution containing 10–20 ng of template DNA, 1  $\times$  PCR buffer, 0.7  $\mu$ L DMSO (99.9 %), 2 mM MgCl<sub>2</sub>, 0.4  $\mu$ M of each primer, 25  $\mu$ M of each dNTP and 1.0 U Taq DNA polymerase (GoTaq, Promega). PCR amplification conditions were set as follows: an initial denaturation temperature of 96 °C for 2 min, followed by 40 cycles of denaturation temperature of 96 °C for 45 s, primer annealing at the temperature stipulated in Table 2, primer extension at 72 °C for 90 s and a final extension step at 72 °C for 2 min. The resulting fragments were sequenced using the PCR primers together with a BigDye Terminator Cycle Sequencing Kit v. 3.1 (Applied Biosystems, Foster City, CA). Sequencing reactions were performed as described by Cheewangkoon *et al.* (2008). All novel sequences were deposited in NCBI's GenBank database and alignments and phylogenetic trees in TreeBASE.

### Phylogenetic analyses

A basic alignment of the obtained sequence data was first done using MAFFT v. 7 [(<http://mafft.cbrc.jp/alignment/server/index.html>) (Kato *et al.* 2002)] and if necessary, manually improved in BioEdit v. 7.0.5.2 (Hall 1999). To check the congruency of the RPB2 and LSU dataset, a 70 % neighbour-joining (NJ) reciprocal bootstrap

method with maximum likelihood distance was performed (Mason-Gamer & Kellogg 1996, Lombard *et al.* 2010). Bayesian analyses (critical value for the topological convergence diagnostic set to 0.01) were performed on the concatenated loci using MrBayes v. 3.2.1 (Huelsenbeck & Ronquist 2001) as described by Crous *et al.* (2006) using nucleotide substitution models that were selected using MrModeltest v.2.3 (Table 3) (Nylander 2004). In order to keep the trees manageable for publication, two separate Bayesian trees were run. The first tree was run with all the *Septoria* and septoria-like isolates that either belonged to, or where more closely related to the *Mycosphaerellaceae* (Fig. 1) while the second tree contained all the septoria-like isolates either belonging to, or being more closely related to the *Phaeosphaeriaceae* (Fig. 2). *Parastagonospora nodorum* (CBS 259.49) was used as outgroup for the *Mycosphaerellaceae* dataset, while *Dothistroma pini* (CBS 121005) was used as outgroup for the *Phaeosphaeriaceae* dataset. As the novel genera and species described in this study were already clearly distinguishable in the LSU/RPB2 trees, the ITS, EF-1 $\alpha$  and Btub sequence data of these isolates were deposited in GenBank without their subsequent trees being published in this paper.

### Taxonomy

Taxonomic descriptions were based on isolates sporulating in culture. Diseased leaf tissue was viewed under a Zeiss V20 Discovery stereo-microscope, while a Zeiss Axio Imager 2 light microscope with differential interference contrast (DIC) illumination and an AxioCam MRc5 camera with Zen software was used to capture morphological structures. Adobe Photoshop CS3 was used for the final editing of acquired images and photographic preparations. For measurements, 30–50 replicates of all relevant morphological features were made at  $\times$ 1000 magnification. Colony characters and pigment production were noted after 2–4 wk of growth on MEA, PDA and OA (Crous *et al.* 2009d) incubated at 25 °C in the dark. Colony colours (surface and reverse) were rated according to the colour charts of Rayner (1970).

## RESULTS

### DNA sequencing and phylogenetic analysis

The RPB2 and LSU sequence datasets did not show any conflicts in both the *Mycosphaerellaceae* and *Phaeosphaeriaceae* tree topologies for the 70 % reciprocal bootstrap trees, allowing us to combine them in the multigene analyses. For the *Mycosphaerellaceae* tree, the gene boundaries were: 1–327 bp for RPB2 and 332–1120 bp for LSU. For the *Phaeosphaeriaceae* tree (Fig. 2), the gene boundaries were 1–777 bp for LSU and 782–1108 bp for RPB2. During the generation of the *Mycosphaerellaceae* tree (Fig. 1), a total of 57 048 trees were sampled out of the generated 76 062 trees (75 %). During the generation of the *Phaeosphaeriaceae* tree (Fig. 2), a total of 2844 trees were sampled out of the generated 3792 trees (75 %).

### Taxonomy

A total of 347 isolates representing 170 species were subjected to DNA analysis and morphological comparison. Phylogenetic analyses based on the LSU and RPB2 genes resolved a total of 47 clades of

**Table 1.** Collection details and GenBank accession numbers of isolates included in this study.

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
<i>Acicoseptoria rumicis</i>	CBS 522.78	<i>Rumex alpinus</i>	France	H.A. van der Aa	KF253105	KF252643	KF252153	KF251648	KF251144
<i>Boeremia telephii</i>	CBS 135415; S670	<i>Lavatera thuringiaca</i>	Germany	U. Damm	-	KF252644	KF252154	KF251649	KF251145
<i>Canyophylloseptoria lychnidis</i>	CBS 109098	<i>Silene pratensis</i>	Austria	G.J.M. Verkley	KF253234	KF252768	KF252292	KF251790	KF251286
	CBS 109099	<i>Silene pratensis</i>	Austria	G.J.M. Verkley	KF253235	KF252769	KF252293	KF251791	KF251287
	CBS 109101	<i>Silene pratensis</i>	Austria	G.J.M. Verkley	KF253236	KF252770	KF252294	KF251792	KF251288
	CBS 109102	<i>Silene pratensis</i>	Austria	G.J.M. Verkley	KF253237	KF252771	KF252295	KF251793	KF251289
	CBS 128614	<i>Lychnis cognata</i>	South Korea	H.D. Shin	KF253238	KF252772	KF252296	KF251794	KF251290
<i>Car. pseudolychnidis</i>	CBS 128630	<i>Lychnis cognata</i>	South Korea	H.D. Shin	KF253239	KF252773	KF252297	KF251795	KF251291
	CBS 109100	<i>Silene nutans</i>	Austria	G.J.M. Verkley	KF253240	KF252774	KF252298	KF251796	KF251292
<i>Car. silenes</i>	CBS 109103	<i>Silene pratensis</i>	Austria	G.J.M. Verkley	KF253241	KF252775	KF252299	KF251797	KF251293
<i>Car. spergulae</i>	CBS 397.52	<i>Dianthus caryophyllus</i>	Netherlands	Schouten	KF253243	KF252777	KF252301	KF251799	KF251295
	CBS 109010	<i>Spergula morisonii</i>	Netherlands	A. Aprot	KF253242	KF252776	KF252300	KF251798	KF251294
<i>Cercospora beticola</i>	CBS 124.31; CPC 5070	<i>Beta vulgaris</i>	Romania	-	KF253106	KF252645	KF252155	KF251650	KF251146
<i>Cer. capsici</i>	CBS 118712	-	Fiji	P. Tyler	KF253244	KF252778	KF252302	KF251800	KF251296
<i>Cer. zebrina</i>	CBS 137.56	<i>Hedysarum coronarium</i>	Italy	M. Ribaldi	KF253245	KF252779	KF252303	KF251801	KF251297
<i>Chaetosphaeronema hispidulum</i>	CBS 118790; IMI 262766	<i>Trifolium subterraneum</i>	Australia	M.J. Barbetti	KF253107	KF252646	KF252156	KF251651	KF251147
	CBS 216.75	<i>Anthyllus vulneraria</i>	Germany	R. Schneider	KF253108	KF252647	KF252157	KF251652	KF251148
<i>Coniothyrium carteri</i>	CBS 105.91	<i>Quercus robur</i>	Germany	H. Schill	KF253165	KF252700	KF252214	KF251712	KF251209
<i>Con. glycinicola</i>	CBS 101633	<i>Quercus sp.</i>	Netherlands	-	KF253166	KF252701	KF252215	KF251713	KF251210
	CBS 124141	<i>Glycine max</i>	Zimbabwe	C. Lavy	KF253167	KF252702	KF252216	KF251714	KF251211
<i>Con. sidae</i>	CBS 135108; CPC 19602	<i>Sida sp.</i>	Brazil	R.W. Barreto	KF253109	KF252648	KF252158	KF251653	KF251149
<i>Corynespora leucadendri</i>	CBS 135133; CPC 19345	<i>Leucadendron sp.</i>	South Africa	S. Lee	KF253110	KF252639	KF252159	KF251654	KF251150
<i>Cylindrosporia ceratoniae</i>	CBS 477.69	<i>Ceratonia siliqua</i>	Spain	H.A. van der Aa	KF253111	KF252649	KF252160	KF251655	KF251151
<i>Cyl. pistaciae</i>	CBS 471.69	<i>Pistacia lentiscus</i>	Spain	H.A. van der Aa	KF253112	KF252650	KF252161	KF251656	KF251152
<i>Cyrtogonospora martiniana</i>	CBS 135102; CPC 17727	<i>Acacia pycnantha</i>	Australia	P.W. Crous	KF253113	KF252651	KF252162	KF251657	KF251153
<i>Dissocoonium commune</i>	CPC 12397	<i>Eucalyptus globulus</i>	Australia	I. Smith	KF253190	KF252724	KF252242	KF251740	KF251237
<i>Dothiostroma pini</i>	CBS 116484	<i>Pinus nigra</i>	USA	G. Adams	JX901622	JX902193	JX901948	JX901824	JX901736
<i>Dothiostroma pini</i>	CBS 116485	<i>Pinus nigra</i>	USA	G. Adams	JX901625	JX902196	JX901951	JX901827	JX901739
	CBS 116487	<i>Pinus nigra</i>	USA	G. Adams	JX901620	JX902191	JX901946	JX901822	GU214532
<i>Dot. septosporum</i>	CBS 121005	<i>Pinus pallasiiana</i>	Russia	T. S. Bulgakov	KF253115	KF252653	-	KF251659	KF251155
	CBS 121011	<i>Pinus pallasiiana</i>	Russia	A. C. Usichenko	KF253250	-	KF252307	KF251806	KF251302
	CBS 383.74	<i>Pinus coulteri</i>	France	M. Morelet	KF253251	-	KF252308	KF251807	KF251303

Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	EF-1α	Btub	GenBank accession no. <sup>2</sup>			ITS
							RPB2	LSU	ITS	
	CPC 16798	<i>Pinus mugo</i> 'Rostrata'	Netherlands	W. Quaedvlieg	JX901627	JX902198	JX901963	JX901829	JX901741	
	CPC 16799	<i>Pinus mugo</i>	Netherlands	W. Quaedvlieg	JX901628	JX902199	JX901954	JX901830	JX901742	
<i>Kristenboschia diospyri</i>	CBS 134911; CPC 19869	<i>Diospyros whyteana</i>	South Africa	P.W. Crous	KF253116	KF252640	KF252164	KF251660	KF251156	
	CPC 19870	<i>Diospyros whyteana</i>	South Africa	P.W. Crous	KF253117	KF252641	KF252165	KF251661	KF251157	
<i>Lecanosticta acicola</i>	CBS 322.33	–	–	P.V. Siggers	JX901639	JX902213	JX901968	JX901844	JX901755	
	CBS 133791	<i>Pinus strobus</i>	USA	B. Ostrofsky	KC013002	KC013008	KC013014	KC013017	KC012999	
<i>Lec. brevispora</i>	CBS 133601	<i>Pinus</i> sp.	Mexico	J.Y. Morales	JX901649	JX902224	JX901979	JX901855	JX901763	
<i>Lec. guatemalensis</i>	IMI 281598	<i>Pinus oocarpa</i>	Guatemala	H.C. Evans	JX901650	JX902225	JX901980	JX901856	JX901764	
<i>Lec. longispora</i>	CBS 133602	<i>Pinus</i> sp.	Mexico	J.Y. Morales	JX901651	JX902227	JX901982	JX901858	JX901766	
<i>Leptosphaeria albopunctata</i>	CBS 254.64	<i>Spartina alterniflora</i>	USA	J. Kohlmeyer	KF253118	KF252654	KF252166	KF251662	KF251158	
<i>Mycosphaerella brassicicola</i>	CBS 228.32	<i>Brassica oleracea</i>	Denmark	C.A. Jörgensen	KF253252	KF252783	KF252309	KF251808	KF251304	
	CBS 267.53	<i>Brassica oleracea</i>	Netherlands	F. Quak	KF253253	KF252784	KF252310	KF251809	KF251305	
<i>Mycosphaerella</i> sp.	CBS 135464; CPC 11677	<i>Draba nemorosa</i> var. <i>hebecarpa</i>	South Korea	H.D. Shin	–	KF252786	KF252312	KF251811	KF251307	
<i>Neoseptoria caricis</i>	CBS 135097; S653	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	–	–	KF252167	KF251663	KF251159	
<i>Neoseptophoma samaranorum</i>	CBS 138.96	<i>Phlox paniculata</i>	Netherlands	–	KF253119	KF252655	KF252168	KF251664	KF251160	
	CBS 139.96	<i>Poa</i> sp.	Netherlands	–	KF253120	KF252656	KF252169	KF251665	KF251161	
	CBS 568.94	<i>Urtica dioica</i>	Netherlands	G.J.M. Verkey	KF253121	KF252657	KF252170	KF251666	KF251162	
<i>Neoseptogonospora caricis</i>	CBS 135092; S616	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	–	KF252658	KF252171	KF251667	KF251163	
<i>Neost. elegiae</i>	CBS 135101; CPC 16977	<i>Elegia cuspidata</i>	South Africa	S. Lee	KF253122	KF252659	KF252172	KF251668	KF251164	
<i>Paraphoma chrysanthemicola</i>	CBS 172.70	<i>Chrysanthemum morifolium</i>	Netherlands	R. Schneider	KF253123	KF252660	KF252173	KF251669	KF251165	
	CBS 522.66	<i>Chrysanthemum morifolium</i>	UK	–	KF253124	KF252661	KF252174	KF251670	KF251166	
<i>Parap. dioscoreae</i>	CBS 135100; CPC 11357	<i>Dioscorea tokoro</i>	South Korea	H.D. Shin	KF253125	KF252662	KF252175	KF251671	KF251167	
	CPC 11355	<i>Dioscorea tokoro</i>	South Korea	H.D. Shin	KF253126	KF252663	KF252176	KF251672	KF251168	
	CPC 11361	<i>Dioscorea tokoro</i>	South Korea	H.D. Shin	KF253127	KF252664	KF252177	KF251673	KF251169	
<i>Parap. firmeti</i>	CBS 170.70	<i>Apium graveolens</i>	Netherlands	M.A. de Waard	KF253128	KF252665	KF252178	KF251674	KF251170	
	CBS 368.91	<i>Juniperus communis</i>	Switzerland	–	KF253129	KF252666	KF252179	KF251675	KF251171	
<i>Parap. radicina</i>	CBS 111.79	<i>Malus sylvestris</i>	Netherlands	G.H. Boerema	KF253130	KF252667	KF252180	KF251676	KF251172	
	CBS 102875	<i>Lycopersicon esculentum</i>	Germany	–	KF253131	KF252668	KF252181	KF251677	KF251173	
<i>Parastagonospora avenae</i>	CBS 289.69	<i>Lolium perenne</i>	Germany	U.G. Schlösser	KF253132	KF252669	KF252182	KF251678	KF251174	
	CBS 290.69	<i>Lolium perenne</i>	Germany	U.G. Schlösser	KF253133	KF252670	KF252183	KF251679	KF251175	
<i>Paras. caricis</i>	CBS 135671; S615	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253134	KF252671	KF252184	KF251680	KF251176	

Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
<i>Paras. nodorum</i>	CBS 110109	<i>Lolium perenne</i>	Denmark	M.P.S. Câmara	KF253135	KF252672	KF252185	KF251681	KF251177
<i>Paras. "nodorum"</i>	CBS 259.49	<i>Triticum</i> sp.	Canada	-	KF253143	KF252679	KF252192	KF251688	KF251185
<i>Paras. poae</i>	CBS 135089; S606	<i>Poa</i> sp.	Netherlands	S.I.R. Videira	KF253136	KF252673	KF252186	KF251682	KF251178
	CBS 135091; S613	<i>Poa</i> sp.	Netherlands	S.I.R. Videira	KF253137	KF252674	KF252187	KF251683	KF251179
<i>Passalora depressa</i>	CPC 14915	<i>Angelica gigas</i>	South Korea	H.D. Shin	KF253256	KF252788	KF252314	KF251813	KF251309
<i>Pas. dioscoreae</i>	CBS 135460; CPC 10855	<i>Dioscorea tokoro</i>	South Korea	H.D. Shin	KF253257	KF252789	KF252315	KF251814	KF251310
	CBS 135463; CPC 11513	<i>Dioscorea tenuipes</i>	South Korea	H.D. Shin	KF253258	KF252790	KF252316	KF251815	KF251311
<i>Phaeophleospora eugeniae</i>	CPC 15143	<i>Eugenia uniflora</i>	Brazil	A.C. Alfenas	KF253138	KF252642	-	JX901875	KF251180
	CPC 15159	<i>Eugenia uniflora</i>	Brazil	A.C. Alfenas	JX901667	JX902245	JX901999	JX901876	FJ493189
<i>"Phaeosphaeria" alpina</i>	CBS 456.84	<i>Phleum alpinum</i>	Switzerland	A. Leuchtmann	KF253139	KF252675	KF252188	KF251684	KF251181
<i>Phaeos. caricicola</i>	CBS 603.86	<i>Carex pendula</i>	Switzerland	A. Leuchtmann	KF253140	KF252676	KF252189	KF251685	KF251182
<i>Phaeos. juncicola</i>	CBS 110108	<i>Phlox</i> sp.	Netherlands	M.P.S. Câmara	KF253141	KF252677	KF252190	KF251686	KF251183
<i>Phaeos. nigrans</i>	CBS 307.79	<i>Zea mays</i>	Switzerland	-	KF253142	KF252678	KF252191	KF251687	KF251184
<i>Phaeos. oryzae</i>	CBS 110110	<i>Oryza sativa</i>	South Korea	L. Hausch	-	KF252680	KF252193	KF251689	KF251186
<i>Phaeos. papayae</i>	CBS 135416	<i>Carica papaya</i>	Brazil	A.C. Alfenas	-	KF252681	KF252194	KF251690	KF251187
<i>"Phaeos." phragmiticola</i>	CBS 459.84	<i>Phragmites australis</i>	Switzerland	A. Leuchtmann	KF253144	KF252682	KF252195	KF251691	KF251188
<i>"Phaeos." pontiformis</i>	CBS 117487	-	Netherlands	J. Harrak	KF253145	KF252683	KF252196	KF251692	KF251189
<i>Phaeosphaeria</i> sp.	CBS 206.87	<i>Zea mays</i>	Gabon	J.L. Notteghem	KF253146	KF252684	KF252197	KF251693	KF251190
	CBS 135465; CPC 11894	<i>Zea mays</i>	South Africa	P.W. Crous	KF253147	KF252685	KF252198	KF251694	KF251191
<i>"Phaeos." typharum</i>	CBS 296.54	<i>Nardus stricta</i>	Switzerland	L.E. Wehmeyer	KF253148	KF252686	KF252199	KF251695	KF251192
<i>"Phaeos." vagans</i>	CBS 604.86	<i>Calamagrostis arundinacea</i>	Sweden	A. Leuchtmann	KF253149	KF252687	KF252200	KF251696	KF251193
<i>phaeosphaeria</i> -like sp.	CBS 123.76	<i>Prunus domestica</i>	Serbia	M. Arsejevic	KF253150	KF252688	KF252201	KF251697	KF251194
	CBS 135461; CPC 11231	<i>Musa</i> sp.	Mauritius	Y. Jaufeerally-Fakim	KF253151	KF252689	KF252202	KF251698	KF251195
	CBS 135466; CPC 12131	<i>Acacia crassicaarpa</i>	Thailand	W. Himmaman	KF253153	KF252691	KF252204	KF251700	KF251197
	CBS 135469; CPC 12881	<i>Pinus monticola</i>	USA	G. Newcombe & R.G. Ganley	KF253154	KF252692	KF252205	KF251701	KF251198
<i>Phaeosphaeriopsis glaucopunctata</i>	CPC 12130	<i>Acacia crassicaarpa</i>	Thailand	W. Himmaman	KF253152	KF252690	KF252203	KF251699	KF251196
<i>Phloeospora ulmi</i>	CBS 653.86	<i>Ruscus aculeatus</i>	Switzerland	A. Leuchtmann	KF253155	KF252693	KF252206	KF251702	KF251199
	CBS 344.97	<i>Ulmus glabra</i>	Austria	W. Gams	KF253158	KF252696	-	KF251705	KF251202
	CBS 613.81	<i>Ulmus</i> sp.	Austria	H.A. van der Aa	KF253159	KF252697	KF252208	KF251706	KF251203
	CBS 101564	<i>Ulmus</i> sp.	Netherlands	H.A. van der Aa	KF253156	KF252694	KF252207	KF251703	KF251200
	CBS 109835	<i>Ulmus</i> sp.	Netherlands	G.J.M. Verkley	KF253157	KF252695	-	KF251704	KF251201
<i>Phlogicylindrium eucalyptorum</i>	CBS 111680	<i>Eucalyptus nitens</i>	Australia	P.W. Crous	KF253160	KF252698	KF252209	KF251707	KF251204

Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
<i>Phlyctema vincetoxici</i>	CBS 111689	<i>Eucalyptus nitens</i>	Australia	P.W. Crous	KF253161	–	KF252210	KF251708	KF251205
	CBS 123726	<i>Vincetoxicum officinale</i>	Czech Republic	G.J.M. Verkley	KF253162	KF252699	KF252211	KF251709	KF251206
	CBS 123727	<i>Vincetoxicum officinale</i>	Czech Republic	G.J.M. Verkley	KF253163	–	KF252212	KF251710	KF251207
	CBS 123743	<i>Vincetoxicum officinale</i>	Czech Republic	G.J.M. Verkley	KF253164	–	KF252213	KF251711	KF251208
<i>Phoma herbarum</i>	CBS 615.75	<i>Rosa multiflora</i>	Netherlands	G.H. Boerema	KF253168	KF252703	KF252217	KF251715	KF251212
<i>Polyplooseptoria tabebuiaae-serratifoliae</i>	CBS 112650	<i>Tabebuia serratifolia</i>	Brazil	A.C. Alfenas	KF253169	KF252704	KF252218	KF251716	KF251213
<i>Pol. terminaliae</i>	CBS 135106; CPC 19611	<i>Terminalia catappa</i>	Brazil	R.W. Barreto	KF253170	KF252705	KF252219	KF251717	KF251214
	CBS 135475; CPC 19487	<i>Terminalia catappa</i>	Brazil	R.W. Barreto	KF253171	–	KF252220	KF251718	KF251215
<i>Pseudoceroospora chiangmaiensis</i>	CBS 123244	<i>Eucalyptus camaldulensis</i>	Thailand	R. Cheewangkoon	JX901676	JX902254	JX902008	JX901885	JX901781
<i>Pse. eucalyptorum</i>	CBS 116303	<i>Eucalyptus nitens</i>	South Africa	P.W. Crous	KF253172	KF252706	KF252221	KF251719	KF251216
	CPC 13816	<i>Eucalyptus glaucescens</i>	UK	S. Denman	KF253230	KF252764	KF252288	KF251786	KF251282
<i>Pse. madagascariensis</i>	CBS 124155	<i>Eucalyptus camaldulensis</i>	Madagascar	M.J. Wingfield	KF253265	–	KF252322	KF251822	KF251318
<i>Pse. natalensis</i>	CBS 111069	<i>Eucalyptus nitens</i>	South Africa	T. Coutinho	KF302389	KF302384	KF302393	KF302405	KF302399
<i>Pse. norchiensis</i>	CBS 120738	<i>Eucalyptus sp.</i>	Italy	W. Gams	JX901684	JX902263	JX902017	JX901894	JX901785
<i>Pse. robusta</i>	CBS 111175	<i>Eucalyptus robur</i>	Malaysia	M.J. Wingfield	JX901694	JX902273	JX902027	JX901904	DQ303081
<i>Pse. schizolobii</i>	CBS 120029	<i>Schizolobium parahybum</i>	Ecuador	M.J. Wingfield	KF253269	KF252798	KF252326	KF251826	KF251322
<i>Pse. tereticomis</i>	CPC 13299	<i>Eucalyptus tereticomis</i>	Australia	P.W. Crous	JX901701	JX902280	JX902034	JX901911	GQ852770
<i>Pseudocercospora capsellae</i>	CBS 127.29	–	–	K. Togashi	KF253273	KF252801	KF252330	KF251830	KF251326
	CBS 112032	<i>Brassica sp.</i>	UK	R. Evans	KF253267	KF252797	KF252324	KF251824	KF251320
	CBS 112033	<i>Brassica sp.</i>	UK	R. Evans	KF253254	KF252785	KF252311	KF251810	KF251306
	CBS 118412	<i>Brassica sp.</i>	New Zealand	C.F. Hill	KF253272	KF252800	KF252329	KF251829	KF251325
"Pella." <i>magnusiana</i>	CBS 114735	<i>Geranium silvaticum</i>	Sweden	E. Gunnerbeck	KF253274	KF252802	–	KF251831	KF251327
<i>Pella. pastinacae</i>	CBS 114116	<i>Laserpitium latifolium</i>	Sweden	L. Holm	KF253275	KF252803	KF252331	KF251832	KF251328
<i>Pseudoseptoria collariana</i>	CBS 135104; CPC 18119	<i>Bambusoideae sp.</i>	Iran	A. Mirzadi Gohari	KF253174	KF252707	KF252223	KF251721	KF251218
<i>Pseudos. obscura</i>	CBS 135103; CPC 18118	<i>Bambusoideae sp.</i>	Iran	A. Mirzadi Gohari	KF253175	KF252708	KF252224	KF251722	KF251219
<i>Ramularia endophylla</i>	CBS 113265	<i>Quercus robur</i>	Netherlands	G.J.M. Verkley	KF253176	KF252709	KF252225	KF251723	KF251220
<i>Ram. eucalypti</i>	CBS 120726	<i>Eucalyptus grandis</i> var. <i>grandiflora</i> Maiden	Italy	W. Gams	KF253177	KF252710	KF252226	KF251724	KF251221
<i>Ram. lamii</i>	CPC 11312	<i>Leonurus sibiricus</i>	South Korea	H.D. Shin	KF253178	KF252711	KF252227	KF251725	KF251222
<i>Ram. pratensis</i>	CPC 11294	<i>Rumex crispus</i>	South Korea	–	KF253179	KF252712	KF252228	KF251726	KF251223
<i>Ramularia sp.</i>	CBS 115913	<i>Cerastium semidecandrum</i>	Netherlands	A. Aptroot	KF253180	–	KF252229	KF251727	KF251224
<i>Readerella angustia</i>	CBS 124998	<i>Eucalyptus delegatensis</i>	Australia	B.A. Summerell	KF253181	KF252713	KF252230	KF251728	KF251225
<i>Rea. eucalypti</i>	CPC 13401	<i>Eucalyptus sp.</i>	Portugal	P.W. Crous	KF253173	–	KF252222	KF251720	KF251217

Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
<i>Rea. readeriellophora</i>	CPC 12920	<i>Eucalyptus</i> sp.	Australia	A. Carnegie	KF253114	KF252652	KF252163	KF251658	KF251154
<i>Ruptoseptoria unedonis</i>	CBS 355.86	<i>Arbutus unedo</i>	France	H.A. van der Aa	–	KF252715	KF252233	KF251731	KF251228
	CBS 755.70	<i>Arbutus unedo</i>	Croatia	J.A. von Arx	–	KF252716	KF252234	KF251732	KF251229
<i>Sclerotostogonospora phragmiticola</i>	CBS 338.86	<i>Phragmites australis</i>	France	H.A. van der Aa	KF253184	KF252717	KF252235	KF251733	KF251230
<i>Septoria abei</i>	CBS 128598	<i>Hibiscus syriacus</i>	South Korea	H.D. Shin	KF253280	KF252805	KF252336	KF251837	KF251333
<i>Sep. "agropyrina"</i>	CBS 387.64	–	Japan	–	KF302392	KF302387	KF302398	KF302410	KF302404
<i>Sep. anthrisci</i>	CBS 109020	<i>Anthriscus</i> sp.	Austria	G.J.M. Verkley	KF253286	KF252811	KF252340	KF251843	KF251339
<i>Sep. anthurii</i>	CBS 346.58	<i>Anthurium scherzerianum</i>	Germany	R. Schneider	KF253288	KF252813	KF252342	KF251845	KF251341
<i>Sep. apicola</i>	CBS 400.54	<i>Apium graveolens</i>	Netherlands	J.A. von Arx	KF253292	KF252817	KF252346	KF251849	KF251345
" <i>Sep. "arundinacea</i>	CBS 133.68	<i>Phragmites australis</i>	Netherlands	H.A. van der Aa	KF253185	KF252718	KF252236	KF251734	KF251231
<i>Sep. astericola</i>	CBS 281.72	<i>Phragmites australis</i>	Netherlands	J.W. Veerbaas-Rijks	KF253186	KF252719	KF252237	KF251735	KF251232
<i>Sep. 128593</i>	CBS 128593	<i>Aster yomena</i>	South Korea	H.D. Shin	KF253294	KF252819	KF252348	KF251851	KF251347
<i>Sep. astragali</i>	CBS 109116	<i>Astragalus</i> sp.	Austria	G.J.M. Verkley	KF253298	KF252823	KF252352	KF251855	KF251351
	CBS 123878	<i>Astragalus glycyphyllos</i>	Czech Republic	G.J.M. Verkley	KF253297	KF252822	KF252351	KF251854	KF251350
<i>Sep. atropurpurea</i>	CBS 348.58	<i>Aster canus</i>	Germany	R. Schneider	KF253299	KF252824	KF252353	KF251856	KF251352
<i>Sep. bothriospermi</i>	CBS 128599	<i>Bothriospermum tenellum</i>	South Korea	H.D. Shin	KF253301	KF252826	KF252355	KF251858	KF251354
<i>Sep. bupleuricola</i>	CBS 128603	<i>Bupleurum falcatum</i>	South Korea	H.D. Shin	KF253303	KF252828	KF252357	KF251860	KF251356
<i>Sep. calendulae</i>	CBS 349.58	<i>Calendula anensis</i>	Italy	R. Schneider	KF253304	KF252829	KF252358	KF251861	KF251357
<i>Sep. callistephi</i>	CBS 128590	<i>Callistephus chinensis</i>	South Korea	H.D. Shin	KF253305	KF252830	KF252359	KF251862	KF251358
<i>Sep. campanulae</i>	CBS 128604	<i>Campanula takesimana</i>	South Korea	H.D. Shin	KF253308	KF252833	KF252362	KF251865	KF251361
<i>Sep. cerastii</i>	CBS 128612	<i>Cerastium holosteoides</i>	South Korea	H.D. Shin	KF253311	KF252836	KF252365	KF251868	KF251364
<i>Sep. cf. agrimonnicola</i>	CBS 128585	<i>Agrimonia pilosa</i>	South Korea	H.D. Shin	KF253283	KF252808	KF252337	KF251840	KF251336
	CBS 128602	<i>Agrimonia pilosa</i>	South Korea	H.D. Shin	KF253284	KF252809	KF252338	KF251841	KF251337
<i>Sep. cf. rubi</i>	CBS 128646	<i>Rubus crataegifolius</i>	South Korea	H.D. Shin	KF253314	KF252839	KF252368	KF251871	KF251367
<i>Sep. cf. stachydicola</i>	CBS 128668	<i>Stachys riedereri</i> var. <i>japonica</i>	South Korea	H.D. Shin	KF253512	KF253033	KF252558	KF252070	KF251565
<i>Sep. cheilidonii</i>	CBS 128607	<i>Cheilidonium majus</i>	South Korea	H.D. Shin	KF253319	KF252844	KF252373	KF251876	KF251372
<i>Sep. chromolaenae</i>	CBS 113373	<i>Chromolaena odorata</i>	Cuba	S. Nesser	KF253321	KF252846	KF252375	KF251878	KF251374
<i>Sep. chrysanthemella</i>	CBS 128622	<i>Chrysanthemum boreale</i>	South Korea	H.D. Shin	KF253323	KF252848	KF252377	KF251880	KF251376
	CBS 128716	–	South Africa	E. Oh	KF253325	KF252850	KF252379	KF251882	KF251378
<i>Sep. cirsii</i>	CBS 128621	<i>Cirsium setidens</i>	South Korea	H.D. Shin	KF253328	KF252853	KF252382	KF251885	KF251381
<i>Sep. citricola</i>	CBS 356.36	<i>Citrus sinensis</i>	Italy	G. Ruggieri	KF253329	KF252854	KF252383	KF251886	KF251382
<i>Sep. clematidis</i>	CBS 108983	<i>Clematis vitalba</i>	Germany	G.J.M. Verkley	KF253330	KF252855	KF252384	KF251887	KF251383
<i>Sep. codonopistis</i>	CBS 128620	<i>Codonopsis lanceolata</i>	South Korea	H.D. Shin	KF253333	KF252858	KF252387	KF251890	KF251386



Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
<i>Sep. convolvuli</i>	CBS 128627	<i>Calyptegia soldanella</i>	South Korea	H.D. Shin	KF253336	KF252861	KF252390	KF251893	KF251389
<i>Sep. coprosma</i>	CBS 113391	<i>Coprosma robusta</i>	New Zealand	G.J.M. Verkley	KF253255	KF252787	KF252313	KF251812	KF251308
<i>Sep. crepidis</i>	CBS 128608	<i>Youngia japonica</i>	South Korea	H.D. Shin	KF253337	KF252862	KF252391	KF251894	KF251390
<i>Sep. cretae</i>	CBS 128619	<i>Youngia japonica</i>	South Korea	H.D. Shin	KF253338	KF252863	KF252392	KF251895	KF251391
<i>Sep. cruciatae</i>	CBS 135095; CPC 651	<i>Nerium oleander</i>	Greece	U. Damm	–	KF252720	KF252238	KF251736	KF251233
<i>Sep. cucubali</i>	CBS 123747	<i>Galium odoratum</i>	Czech Republic	G.J.M. Verkley	KF253340	KF252865	KF252394	KF251897	KF251393
<i>Sep. cucurbitacearum</i>	CBS 102386	<i>Saponaria officinalis</i>	Netherlands	G.J.M. Verkley	KF253344	KF252869	KF252398	KF251901	KF251397
<i>Sep. dearnessii</i>	CBS 178.77	<i>Cucurbita maxima</i>	New Zealand	H.J. Boesewinkel	KF253346	–	KF252400	KF251903	KF251399
<i>Sep. digitalis</i>	CBS 128624	<i>Angelica dahurica</i>	South Korea	H.D. Shin	KF253347	KF252871	KF252401	KF251904	KF251400
<i>Sep. dysentericae</i>	CBS 391.63	<i>Digitalis lanata</i>	Czech Republic	V. Holubová	KF253349	KF252873	KF252403	KF251906	KF251402
<i>Sep. epambrosiae</i>	CBS 131892; CPC 12328	<i>Inula britannica</i>	South Korea	H.D. Shin	KF253353	KF252877	KF252406	KF251910	KF251406
<i>Sep. epilobii</i>	CBS 128629	<i>Ambrosia trifida</i>	South Korea	H.D. Shin	KF253356	KF252880	KF252407	KF251913	KF251409
<i>Sep. erigerontis</i>	CBS 109084	<i>Epilobium fleischeri</i>	Austria	G.J.M. Verkley	KF253358	KF252882	KF252409	KF251915	KF251411
	CBS 109085	<i>Epilobium fleischeri</i>	Austria	G.J.M. Verkley	KF253359	KF252883	KF252410	KF251916	KF251412
	CBS 186.93	<i>Erigeron annuus</i>	Italy	M. Vurro	KF253364	KF252887	KF252537	KF252048	KF251543
	CBS 109094	<i>Erigeron annuus</i>	Austria	G.J.M. Verkley	KF253360	KF252884	KF252411	KF251917	KF251413
<i>Sep. eucalyptorum</i>	CBS 131893; CPC 12340	<i>Erigeron annuus</i>	South Korea	H.D. Shin	KF253363	KF252888	KF252414	KF251920	KF251416
<i>Sep. exolica</i>	CBS 118505	<i>Eucalyptus</i> sp.	India	W. Gams	KF253365	KF252889	KF252415	KF251921	KF251417
<i>Sep. galeopsidis</i>	CBS 163.78	<i>Hebe speciosa</i>	New Zealand	H.J. Boesewinkel	KF253366	KF252890	KF252416	KF251922	KF251418
	CBS 191.26	<i>Galeopsis</i> sp.	–	C. Killian	KF253370	KF252894	KF252420	KF251926	KF251422
	CBS 102314	<i>Galeopsis tetrahit</i>	Netherlands	G.J.M. Verkley	KF253371	KF252895	KF252421	KF251927	KF251423
<i>Sep. gentianae</i>	CBS 102411	<i>Galeopsis tetrahit</i>	Netherlands	G.J.M. Verkley	KF253372	KF252896	KF252422	KF251928	KF251424
" <i>Sep. " gladioli</i> "	CBS 128633	<i>Gentiana scabra</i>	South Korea	H.D. Shin	KF253374	KF252898	KF252424	KF251930	KF251426
	CBS 121.20	–	–	W.J. Kaiser	KF253375	KF252899	KF252425	KF251931	KF251427
<i>Sep. glycinicola</i>	CBS 353.29	–	Netherlands	J.C. Went	KF253376	KF252900	KF252426	KF251932	KF251428
<i>Sep. helianthi</i>	CBS 128618	<i>Glycine max</i>	South Korea	H.D. Shin	KF253378	KF252902	KF252427	KF251934	KF251430
<i>Sep. hibiscicola</i>	CBS 123.81	<i>Helianthus annuus</i>	–	M. Muntañola	KF253379	KF252903	KF252428	KF251935	KF251431
<i>Sep. hippocastani</i>	CBS 128615	<i>Hibiscus syriacus</i>	South Korea	H.D. Shin	KF253382	KF252906	KF252431	KF251938	KF251434
	CBS 411.61	<i>Aesculus hippocastanum</i>	Germany	W. Gerlach	KF253383	KF252907	KF252432	KF251939	KF251435
<i>Sep. justiciae</i>	CPC 23103; MP11	<i>Aesculus</i> sp.	Netherlands	S.I.R. Videira	KF253510	KF253031	KF252556	KF252068	KF251563
	CBS 128625	<i>Justicia procumbens</i>	South Korea	H.D. Shin	KF253385	KF252909	KF252434	KF251941	KF251437
<i>Sep. lactucae</i>	CBS 352.58	<i>Lactuca sativa</i>	Germany	G. Sörgel	KF253388	KF252912	KF252437	KF251944	KF251440

Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
<i>Sep. laniticola</i>	CBS 108943	<i>Lactuca sativa</i>	Netherlands	P. Grooteman	KF253387	KF252911	KF252436	KF251943	KF251439
<i>Sep. lepidoicola</i>	CBS 123884	<i>Lamium</i> sp.	Czech Republic	G.J.M. Verkley	KF253397	KF252921	KF252446	KF251953	KF251449
<i>Sep. leptostachyae</i>	CBS 128635	<i>Lepidium virginicum</i>	South Korea	H.D. Shin	KF253398	KF252922	KF252447	KF251954	KF251450
	CBS 128613	<i>Phryma leptostachya</i>	South Korea	H.D. Shin	KF253399	KF252923	KF252448	KF251955	KF251451
	CBS 128628	<i>Phryma leptostachya</i>	South Korea	H.D. Shin	KF253400	KF252924	KF252449	KF251956	KF251452
<i>Sep. leucantheri</i>	CBS 109090	<i>Chrysanthemum leucantherum</i>	Austria	G.J.M. Verkley	KF253403	KF252927	KF252452	KF251959	KF251455
<i>Sep. limonum</i>	CBS 419.51	<i>Citrus limonum</i>	Italy	G. Goidánich	KF253407	KF252931	KF252456	KF251963	KF251459
<i>Sep. linicola</i>	CBS 316.37	<i>Linum usitatissimum</i>	–	H.W. Hollenweber	KF253408	KF252932	KF252457	KF251964	KF251460
<i>Sep. lycocconi</i>	CBS 109089	<i>Aconitum vulparia</i>	Austria	G.J.M. Verkley	KF253409	KF252933	KF252458	KF251965	KF251461
<i>Sep. lycopersici</i>	CBS 128654	<i>Lycopersicon esculentum</i>	South Korea	H.D. Shin	KF253410	KF252934	KF252459	KF251966	KF251462
<i>Sep. lycopicola</i>	CBS 128651	<i>Lycopus ramosissimus</i>	South Korea	H.D. Shin	KF253412	KF252936	KF252461	KF251968	KF251464
<i>Sep. lysimachiae</i>	CBS 102315	<i>Lysimachia vulgaris</i>	Netherlands	G.J.M. Verkley	KF253413	KF252937	KF252462	KF251969	KF251465
	CBS 123795	<i>Lysimachia</i> sp.	Czech Republic	G.J.M. Verkley	KF253417	KF252941	KF252466	KF251973	KF251469
<i>Sep. malagutii</i>	CBS 106.80	<i>Solanum</i> sp.	Peru	G.H. Boerema	KF253418	–	KF252467	KF251974	KF251470
<i>Sep. matricariae</i>	CBS 109001	<i>Matricaria discoidea</i>	Netherlands	G.J.M. Verkley	KF253420	KF252943	KF252469	KF251976	KF251472
<i>Sep. mazi</i>	CBS 128755	<i>Mazus japonicus</i>	South Korea	H.D. Shin	KF253422	KF252945	KF252471	KF251978	KF251474
<i>Sep. melissae</i>	CBS 109097	<i>Melissa officinalis</i>	Netherlands	H.A. van der Aa	KF253423	KF252946	KF252472	KF251979	KF251475
<i>Sep. napelli</i>	CBS 109105	<i>Aconitum napellus</i>	Austria	G.J.M. Verkley	KF253426	KF252949	KF252474	KF251982	KF251478
<i>Sep. obesa</i>	CBS 354.58	<i>Chrysanthemum indicum</i>	Germany	R. Schneider	KF253431	–	KF252479	KF251987	KF251483
	CBS 128588	<i>Artemisia lavandulaefolia</i>	South Korea	H.D. Shin	KF253428	KF252951	KF252476	KF251984	KF251480
	CBS 128623	<i>Chrysanthemum indicum</i>	South Korea	H.D. Shin	KF253429	KF252952	KF252477	KF251985	KF251481
<i>Sep. oenanthicola</i>	CBS 128649	<i>Oenanthe javanica</i>	South Korea	H.D. Shin	KF253187	KF252721	KF252239	KF251737	KF251234
<i>Sep. oenanthis</i>	CBS 128667	<i>Cicuta virosa</i>	South Korea	H.D. Shin	KF253432	KF252953	KF252481	KF251989	KF251485
<i>Sep. orchidearum</i>	CBS 457.78	<i>Listera ovata</i>	France	H.A. van der Aa	KF253435	KF252956	KF252483	KF251991	KF251487
	CBS 128631	<i>Cyclamen fatrense</i>	South Korea	H.D. Shin	KF253434	KF252955	KF252482	KF251990	KF251486
<i>Sep. pachyspora</i>	CBS 128652	<i>Zyathoxylum schinifolium</i>	South Korea	H.D. Shin	KF253437	KF252958	KF252485	KF251993	KF251488
<i>Sep. parisiis</i>	CBS 109108	<i>Viola</i> sp.	Austria	G.J.M. Verkley	KF253440	KF252961	KF252488	KF251996	KF251491
	CBS 109111	<i>Paris quadrifolia</i>	Austria	G.J.M. Verkley	KF253438	KF252959	KF252486	KF251994	KF251489
<i>Sep. passiflorae</i>	CBS 102701	<i>Passiflora edulis</i>	New Zealand	C.F. Hill	KF253442	KF252963	KF252490	KF251998	KF251493
<i>Sep. perillae</i>	CBS 128655	<i>Perilla frutescens</i>	South Korea	H.D. Shin	KF253444	KF252965	KF252491	KF252000	KF251495
<i>Sep. petroselinii</i>	CBS 182.44	<i>Petroselinum sativum</i>	Netherlands	S.D. de Wit	KF253446	KF252967	KF252493	KF252002	KF251497
<i>Sep. phlogis</i>	CBS 128663	<i>Phlox paniculata</i>	South Korea	H.D. Shin	KF253448	KF252969	KF252495	KF252004	KF251499

Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
<i>Sep. polygonorum</i>	CBS 347.67	<i>Polygonum persicaria</i>	Netherlands	H.A. van der Aa	KF252976	KF252976	KF252502	KF252011	KF251506
	CBS 109834	<i>Polygonum persicaria</i>	Netherlands	G.J.M. Verkley	KF252974	KF252974	KF252500	KF252009	KF251504
<i>Sep. posoniensis</i>	CBS 128645	<i>Chrysosplenium japonicum</i>	South Korea	H.D. Shin	KF252977	KF252977	KF252503	KF252012	KF251507
<i>Sep. protearum</i>	CBS 177.77	<i>Fragaria</i> sp.	New Zealand	H.J. Boesewinkel	KF253463	KF253463	KF252509	KF252019	KF251514
	CBS 390.59	<i>Ligusticum vulgare</i>	Italy	M. Ribaldi	KF252987	KF252987	KF252513	KF252023	KF251518
	CBS 566.88	<i>Hedera helix</i>	France	H.A. van der Aa	KF252990	KF252990	KF252515	KF252026	KF251521
	CBS 778.97	<i>Protea cynaroides</i>	South Africa	L. Viljoen	KF252992	KF252992	KF252517	KF252028	KF251523
	CBS 135477; CPC 19675	<i>Zantedeschia aethiopica</i>	South Africa	P.W. Crous	KF252993	KF252993	KF252518	KF252029	KF251524
<i>Sep. pseudonapelli</i>	CBS 128664	<i>Aconitum pseudolaeve</i> var. <i>erectum</i>	South Korea	H.D. Shin	KF252995	KF252995	KF252520	KF252031	KF251526
<i>Sep. putrida</i>	CBS 109088	<i>Senecio nemorensis</i>	Austria	G.J.M. Verkley	KF253477	KF252997	KF252522	KF252033	KF251528
<i>Sep. ruminum</i>	CBS 503.76	<i>Rumex acetosa</i>	France	H.A. van der Aa	KF253478	KF252998	KF252523	KF252034	KF251529
<i>Sep. saacardi</i>	CBS 128756	<i>Lysimachia vulgaris</i>	South Korea	H.D. Shin	KF253479	KF252999	KF252524	KF252035	KF251530
<i>Sep. scabiosicola</i>	CBS 102334	<i>Knaulia anvensis</i>	Netherlands	G.J.M. Verkley	KF253481	KF253001	KF252526	KF252037	KF251532
	CBS 102336	<i>Knaulia anvensis</i>	Netherlands	G.J.M. Verkley	KF253483	KF253003	KF252528	KF252039	KF251534
	CBS 108981	<i>Knaulia anvensis</i>	Germany	G.J.M. Verkley	KF253484	KF253004	KF252529	KF252040	KF251535
<i>Sep. senecionis</i>	CBS 109093	<i>Knaulia dipsacifolia</i>	Austria	G.J.M. Verkley	KF253487	KF253007	KF252532	KF252043	KF251538
	CBS 102366	<i>Senecio fluvialis</i>	Netherlands	G.J.M. Verkley	KF253492	KF253012	KF252538	KF252049	KF251544
	CBS 102381	<i>Senecio fluvialis</i>	Netherlands	G.J.M. Verkley	KF253493	KF253013	KF252539	KF252050	KF251545
<i>Sep. siegesbeckiae</i>	CBS 128659	<i>Siegesbeckia glabrescens</i>	South Korea	H.D. Shin	KF253494	KF253014	KF252540	KF252051	KF251546
	CBS 128661	<i>Siegesbeckia pubescens</i>	South Korea	H.D. Shin	KF253495	KF253015	KF252541	KF252052	KF251547
<i>Sep. sil</i>	CBS 102370	<i>Berula erecta</i>	Netherlands	G.J.M. Verkley	KF253497	KF253017	KF252543	KF252054	KF251549
<i>Sep. sisyriuchii</i>	CBS 112096	<i>Systirinchium</i> sp.	New Zealand	C.F. Hill	KF253499	KF253019	KF252545	KF252056	KF251551
<i>Septoria</i> sp.	CBS 128650	<i>Taraxacum officinale</i>	South Korea	H.D. Shin	KF253504	KF253024	KF252550	KF252061	KF251556
	CBS 128658	<i>Chrysosplenium japonicum</i>	South Korea	H.D. Shin	KF253505	KF253025	KF252551	KF252062	KF251557
	CBS 128757	<i>Sonchus asper</i>	South Korea	H.D. Shin	KF253500	KF253020	KF252546	KF252057	KF251552
	CBS 135472; CPC 19304	<i>Vigna unguiculata</i> ssp. <i>sesquipedalis</i>	Austria	P.W. Crous	KF253506	KF253026	KF252552	KF252063	KF251558
	CBS 135474; CPC 19485	<i>Conyza canadensis</i>	Brazil	R.W. Barreto	KF253507	KF253027	KF252553	KF252064	KF251559
	CBS 135478; CPC 19716	<i>Eucalyptus</i> sp.	India	W. Gams	KF252722	KF252722	KF252240	KF251738	KF251235
	CBS 135479; CPC 19793	<i>Syzygium cordatum</i>	South Africa	P.W. Crous	-	KF253029	KF252555	KF252066	KF251561
	CPC 19976	<i>Feijoa sellowiana</i>	Italy	G. Polizzi	KF253030	KF253030	-	KF252067	KF251562

Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
	CPC 21105	<i>Clivia</i> sp.	South Africa	P.W. Crous	–	–	KF302396	KF302408	KF302402
	CPC 23104	–	Italy	E. van Agtmaal	KF253511	KF253032	KF252557	KF252069	KF251564
<i>Sep. stachydoides</i>	CBS 347.58	<i>Aster canus</i>	Germany	R. Schneider	KF253295	KF252820	KF252349	KF251852	KF251348
	CBS 102326	<i>Stachys sylvatica</i>	Netherlands	G.J.M. Verkley	KF253514	KF253035	KF252560	KF252072	KF251567
	CBS 109115	<i>Campanula glomerata</i>	Austria	G.J.M. Verkley	KF253502	KF253022	KF252548	KF252059	KF251554
	CBS 109127	<i>Stachys sylvatica</i>	Austria	G.J.M. Verkley	KF253517	KF253038	KF252563	KF252075	KF251570
<i>Sep. stellariae</i>	CBS 102376	<i>Stellaria media</i>	Netherlands	G.J.M. Verkley	KF253521	KF253042	KF252567	KF252079	KF251574
" <i>Sep.</i> " <i>steviae</i>	CBS 120132	<i>Stevia rebaudiana</i>	Japan	J. Ishiba	KF253191	–	KF252243	KF251741	KF251238
" <i>Sep.</i> " <i>tanacetii</i>	CBS 358.58	<i>Tanacetum vulgare</i>	Germany	R. Schneider	KF253192	–	KF252244	KF251742	KF251239
<i>Sep. taraxaci</i>	CBS 567.75	<i>Taraxacum</i> sp.	Armenia	H.A. van der Aa	KF253524	KF253045	KF252570	KF252082	KF251577
	CBS 129154	<i>Serratula coronata</i>	South Korea	H.D. Shin	KF253525	KF253046	KF252571	KF252083	KF251578
<i>Sep. tormentillae</i>	CBS 128643	<i>Potentilla fragarioides</i>	South Korea	H.D. Shin	KF253526	KF253047	KF252572	KF252084	KF251579
	CBS 128647	<i>Potentilla fragarioides</i>	South Korea	H.D. Shin	KF253527	KF253048	KF252573	KF252085	KF251580
<i>Sep. urticae</i>	CBS 102316	<i>Glechoma hederacea</i>	Netherlands	G.J.M. Verkley	KF253528	KF253049	KF252574	KF252086	KF251581
	CBS 102375	<i>Urtica dioica</i>	Netherlands	G.J.M. Verkley	KF253530	KF253051	KF252576	KF252088	KF251583
<i>Sep. verbascicola</i>	CBS 102401	<i>Verbascum nigrum</i>	Netherlands	G.J.M. Verkley	KF253531	KF253052	KF252577	KF252089	KF251584
<i>Sep. verbenae</i>	CBS 113438	<i>Verbena officinalis</i>	New Zealand	G.J.M. Verkley	KF253532	KF253053	KF252578	KF252090	KF251585
<i>Sep. villarsiae</i>	CBS 514.78	<i>Nymphoides peltata</i>	Netherlands	H.A. van der Aa	KF253534	KF253055	KF252580	KF252092	KF251587
<i>Sep. violae-palustris</i>	CBS 128644	<i>Viola selkirkii</i>	South Korea	H.D. Shin	KF253537	KF253058	KF252583	KF252095	KF251590
	CBS 128660	<i>Viola yedoensis</i>	South Korea	H.D. Shin	KF253538	KF253059	KF252584	KF252096	KF251591
<i>septoria-like</i> sp.	CBS 134910; CPC 19500	<i>Tibouchina herbacea</i>	Brazil	D.F. Paireira	KF302391	KF302386	KF302397	KF302409	KF302403
	CBS 135471; CPC 19294	<i>Corymbia gummifera</i>	Australia	P.W. Crous	KF253193	KF252725	KF252245	KF251743	KF251240
	CBS 135473; CPC 19311	<i>Phragmites</i> sp.	USA	–	KF253194	KF252726	KF252246	KF251744	KF251241
	CBS 135481; CPC 22154; S672	<i>Polygonatum</i> sp.	Netherlands	U. Damm	–	–	KF252247	KF251745	KF251242
<i>Septorioidea pini-thunbergii</i>	CBS 473.91	<i>Pinus thunbergii</i>	Japan	S. Kaneko & Y. Zinno	–	KF252727	KF252248	KF251746	KF251243
<i>Setophoma chromolaenae</i>	CBS 135105; CPC 18553	<i>Chromolaena odorata</i>	Brazil	R.W. Barreto	KF253195	KF252728	KF252249	KF251747	KF251244
<i>Setop. sacchari</i>	CBS 333.39	<i>Saccharum officinarum</i>	Brazil	A.A. Bitancourt	–	–	KF252250	KF251748	KF251245
<i>Setop. terrestris</i>	CBS 335.29	<i>Allium sativum</i>	USA	H.N. Hansen	KF253196	KF252729	KF252251	KF251749	KF251246
	CBS 335.87	<i>Allium cepa</i>	Senegal	–	KF253197	KF252730	KF252252	KF251750	KF251247
	CBS 377.52	<i>Allium cepa</i>	–	R.H. Larson	KF253198	KF252731	KF252253	KF251751	KF251248
	CBS 135470; CPC 18417	<i>Zea mays</i>	South Africa	S. Lamprecht	KF253189	KF252723	KF252241	KF251739	KF251236

Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
<i>Setoseptoria phragmitis</i>	CBS 114802	<i>Phragmites australis</i>	Hong Kong	K.D. Hyde	KF253199	KF252732	KF252254	KF251752	KF251249
	CBS 114966	<i>Phragmites australis</i>	Hong Kong	K.D. Hyde	KF253200	KF252733	KF252255	KF251753	KF251250
<i>Sphaerulina abeliceae</i>	CBS 128591	<i>Zeilkova serrata</i>	South Korea	H.D. Shin	KF253539	–	KF252585	KF252097	KF251592
<i>Sph. aceris</i>	CBS 687.94	<i>Acer pseudoplatanus</i>	Netherlands	G.J.M. Verkley	KF253542	KF253061	KF252588	KF252100	KF251595
<i>Sph. amelanchier</i>	CBS 102063	<i>Actinidia deliciosa</i>	New Zealand	C.F. Hill	KF253581	KF253096	KF252627	KF252140	KF251635
	CBS 135110; MP8	<i>Amelanchier</i> sp.	Netherlands	S.I.R. Videira	KF253543	KF253062	KF252589	KF252101	KF251596
	CPC 23105; MP22	<i>Quercus</i> sp.	Netherlands	S.I.R. Videira	KF253544	KF253063	KF252590	KF252102	KF251597
	CPC 23106; MP7	<i>Castanea</i> sp.	Netherlands	S.I.R. Videira	KF253545	KF253064	KF252591	KF252103	KF251598
	CPC 23107; MP9	<i>Betula</i> sp.	Netherlands	S.I.R. Videira	KF253583	KF253098	KF252626	KF252139	KF251634
<i>Sph. azaleae</i>	CBS 352.49	<i>Rhododendron</i> sp.	Belgium	J. van Holder	KF253547	KF253066	KF252593	KF252105	KF251600
	CBS 128605	<i>Rhododendron</i> sp.	South Korea	H.D. Shin	KF253546	KF253065	KF252592	KF252104	KF251599
<i>Sph. berberidis</i>	CBS 324.52	<i>Berberis vulgaris</i>	Switzerland	E. Müller	KF253548	KF253067	KF252594	KF252106	KF251601
<i>Sph. betulae</i>	CBS 116724	<i>Betula pubescens</i>	Netherlands	S. Green	KF253549	KF253068	KF252595	KF252107	KF251602
	CBS 128600	<i>Betula platyphylla</i> var. <i>japonica</i>	South Korea	H.D. Shin	KF253552	KF253071	KF252598	KF252110	KF251605
<i>Sph. cercidis</i>	CBS 501.50	<i>Cercis siliquastrum</i>	Netherlands	G. van den Ende	KF253556	KF253075	KF252601	KF252113	KF251608
	CBS 118910	<i>Eucalyptus</i> sp.	France	P.W. Crous	KF253553	KF253072	KF252602	KF252114	KF251609
	CBS 128634	<i>Cercis siliquastrum</i>	Argentina	H.D. Shin	KF253554	KF253073	KF252599	KF252111	KF251606
	CBS 129151	<i>Cercis siliquastrum</i>	Argentina	H.D. Shin	KF253555	KF253074	KF252600	KF252112	KF251607
<i>Sph. cornicola</i>	CBS 102324	<i>Cornus</i> sp.	Netherlands	A. van Iperen	KF253557	KF253076	KF252603	KF252115	KF251610
	CBS 102332	<i>Cornus</i> sp.	Netherlands	A. van Iperen	KF253558	KF253077	KF252604	KF252116	KF251611
<i>Sph. frondicola</i>	CBS 391.59	<i>Populus pyramidalis</i>	Germany	R. Schneider	KF253572	–	KF252617	KF252130	KF251625
<i>Sph. gei</i>	CBS 102318	<i>Geum urbanum</i>	Netherlands	G.J.M. Verkley	KF253560	KF253079	KF252605	KF252118	KF251613
	CBS 128632	<i>Geum japonicum</i>	South Korea	H.D. Shin	KF253562	KF253081	KF252607	KF252120	KF251615
<i>Sph. hyperici</i>	CBS 102313	<i>Hypericum</i> sp.	Netherlands	G.J.M. Verkley	KF253563	KF253082	KF252608	KF252121	KF251616
<i>Sph. menispermii</i>	CBS 128666	<i>Menispermum dauricum</i>	South Korea	H.D. Shin	KF253564	KF253083	KF252609	KF252122	KF251617
	CBS 128761	<i>Menispermum dauricum</i>	South Korea	H.D. Shin	KF253565	KF253084	KF252610	KF252123	KF251618
<i>Sph. musiva</i>	CBS 130570	<i>Populus deltoides</i>	Canada	J. LeBoldus	JX901725	JX902304	JX902068	JX901935	JX901812
<i>Sph. myriadea</i>	CBS 124646	<i>Quercus dentata</i>	Japan	K. Tanaka	KF253201	KF252734	KF252256	KF251754	KF251251
<i>Sph. oxycanthae</i>	CBS 135098; S654	<i>Crataegus</i> sp.	Netherlands	W. Quaedvlieg	KF253202	KF252735	KF252257	KF251755	KF251252
<i>Sph. patriniae</i>	CBS 128653	<i>Patrinia scabiosaefolia</i>	South Korea	H.D. Shin	KF253570	KF253087	KF252615	KF252128	KF251623
<i>Sph. populicola</i>	CBS 100042	<i>Populus trichocarpa</i>	USA	G. Newcombe	KF253573	–	KF252618	KF252131	KF251626
<i>Sph. pseudovirgaureae</i>	CBS 135109; S669	<i>Solidago gigantea</i>	Netherlands	S.I.R. Videira	KF253203	KF252736	KF252258	KF251756	KF251253

Table 1. (Continued).

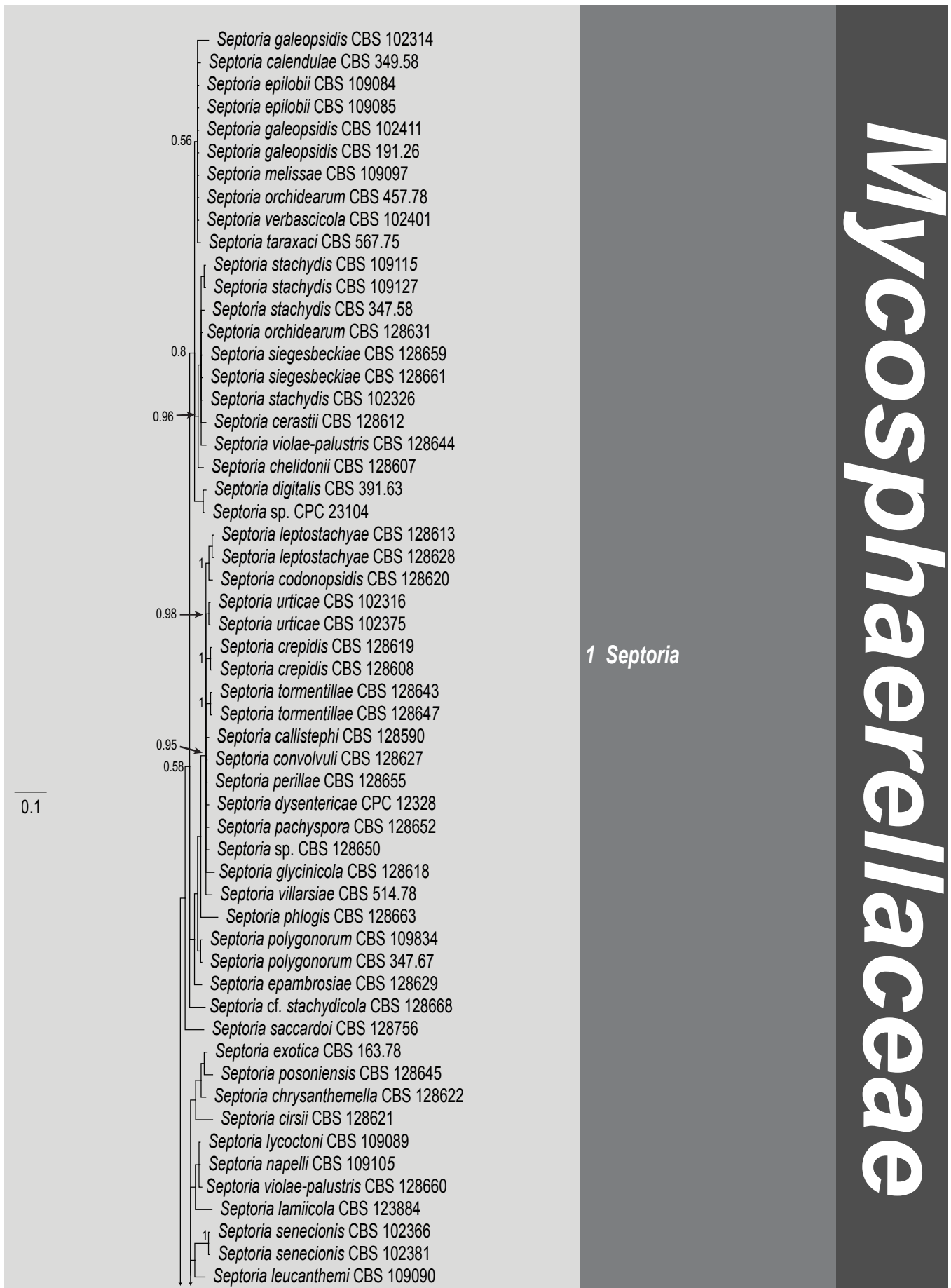
Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1α	Btub	RPB2	LSU	ITS
<i>Sph. quercicola</i>	CBS 663.94	<i>Quercus robur</i>	Netherlands	H.A. van der Aa	KF253577	KF253092	KF252622	KF252135	KF251630
	CBS 109009	<i>Quercus rubra</i>	Netherlands	G.J.M. Verkley	KF253574	KF253089	KF252619	KF252132	KF251627
	CBS 115016	<i>Quercus robur</i>	Netherlands	G.J.M. Verkley	KF253575	KF253090	KF252620	KF252133	KF251628
	CBS 115136	<i>Quercus robur</i>	Netherlands	G.J.M. Verkley	KF253576	KF253091	KF252621	KF252134	KF251629
	CBS 115137	<i>Quercus robur</i>	Netherlands	G.J.M. Verkley	KF302390	KF302385	KF302394	KF302406	KF302400
<i>Sph. socia</i>	CBS 355.58	<i>Rosa</i> sp.	-	-	KF253579	KF253094	KF252624	KF252137	KF251632
	CBS 357.58	<i>Chrysanthemum leucanthemum</i>	Germany	R. Schneider	KF253580	KF253095	KF252625	KF252138	KF251633
<i>Sph. firiolensis</i>	CBS 109017	<i>Rubus idaeus</i>	Austria	G.J.M. Verkley	KF253584	KF253099	KF252629	KF252142	KF251637
	CBS 109018	<i>Rubus idaeus</i>	Austria	G.J.M. Verkley	KF253585	KF253100	KF252630	KF252143	KF251638
<i>Sph. viciae</i>	CBS 131898	<i>Vicia amurensis</i>	South Korea	H.D. Shin	KF253586	KF253101	KF252631	KF252144	KF251639
<i>Sph. westendorpii</i>	CBS 117478	<i>Rubus fruticosus</i>	Netherlands	G.J.M. Verkley	KF253589	KF253104	KF252634	KF252147	KF251642
<i>Stagonospora</i> cf. <i>paludosa</i>	CBS 130005	<i>Carex</i> sp.	Russia	-	KF253204	KF252737	KF252559	KF251757	KF251254
<i>Sta. dioseptata</i>	CBS 135093; S618	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253205	KF252738	KF252260	KF251758	KF251255
" <i>Sta.</i> " <i>foliicola</i>	CBS 110111	<i>Phalaris arundinacea</i>	USA	N. O'Neil	KF253206	KF252739	KF252261	KF251759	KF251256
<i>Sta. paludosa</i>	CBS 135088; S601	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253207	KF252740	KF252262	KF251760	KF251257
<i>Sta. perfecta</i>	CBS 135099; S656	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253208	-	KF252263	KF251761	KF251258
<i>Sta. pseudocaricis</i>	CBS 135132; S610	<i>Carex acutiformis</i>	France	A. Gardiennet	KF253210	KF252742	KF252265	KF251763	KF251260
	CBS 135414; S609	<i>Carex acutiformis</i>	France	A. Gardiennet	-	KF302383	KF302395	KF302407	KF302401
<i>Sta. pseudovitiensis</i>	CBS 135094; S620	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253211	KF252743	KF252266	KF251764	KF251261
	S602	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253212	KF252744	KF252267	KF251765	KF251262
<i>Stagonospora</i> sp.	CBS 135096; 652	<i>Carex acutiformis</i>	France	A. Gardiennet	-	-	KF252268	KF251766	KF251263
<i>Sta. uniseptata</i>	CBS 135090; S611	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	-	KF252745	KF252269	KF251767	KF251264
	CPC 22150; S608	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253214	KF252747	KF252271	KF251769	KF251266
	CPC 22151; S607	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253213	KF252746	KF252270	KF251768	KF251265
<i>stagonospora</i> -like sp.	CBS 516.74	<i>Triticum aestivum</i>	Brazil	Y.R. Mehta	KF253215	KF252748	KF252272	KF251770	KF251267
	CBS 135482; CPC 22155; S626	<i>Poa</i> sp.	Netherlands	W. Quaedvlieg	KF253216	KF252749	KF252273	KF251771	KF251268
	CBS 135483; CPC 22157; S617	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253217	KF252750	KF252274	KF251772	KF251269
	S619	<i>Carex acutiformis</i>	Netherlands	W. Quaedvlieg	KF253218	KF252751	KF252275	KF251773	KF251270
<i>Stromatoseptoria castaneicola</i>	CBS 102322	<i>Castanea sativa</i>	Netherlands	G.J.M. Verkley	KF253219	KF252752	KF252276	KF251774	KF251271
	CBS 102377	<i>Castanea sativa</i>	Netherlands	G.J.M. Verkley	KF253220	KF252753	KF252277	KF251775	KF251272
<i>Teratosphaeria juvenalis</i>	CBS 111149	<i>Eucalyptus cladocalyx</i>	South Africa	P.W. Crous	KF253221	KF252754	KF252278	KF251776	KF251273

Table 1. (Continued).

Species	Isolate no. <sup>1</sup>	Host	Location	Collector	GenBank accession no. <sup>2</sup>				
					EF-1 $\alpha$	Btub	RPB2	LSU	ITS
<i>Ter. molleriana</i>	CBS 111164	<i>Eucalyptus globulus</i>	Portugal	M.J. Wingfield	KF253222	KF252755	KF252279	KF251777	KF251274
<i>Ter. parva</i>	CBS 119901	<i>Eucalyptus globulus</i>	Ethiopia	A. Gezahgne	KF253223	KF252756	KF252280	KF251778	KF251275
<i>Ter. pseudoeucalypti</i>	CBS 124577	<i>Eucalyptus grandis</i> × <i>E. camaldulensis</i>	Australia	V. Andjic	KF253224	KF252757	KF252281	KF251779	KF251276
<i>Ter. suberosa</i>	CPC 13106	<i>Eucalyptus dunnii</i>	Australia	A.J. Carnegie	KF253183	–	KF252232	KF251730	KF251227
<i>Ter. toledana</i>	CBS 113313	<i>Eucalyptus</i> sp.	Spain	P.W. Crous & G. Bills	KF253225	KF252758	KF252282	KF251780	KF251277
<i>Vrystaatia albicola</i>	CBS 135107; CPC 20617	<i>Aloe maculata</i>	South Africa	P.W. Crous & W.J. Swart	–	KF252759	KF252283	KF251781	KF251278
<i>Xenobotryosphaeria calamagrostidis</i>	CBS 303.71	<i>Calamagrostis</i> sp.	Italy	G.A. Hedjaroude	KF253226	KF252760	KF252284	KF251782	KF251279
<i>Xenoseptoria neosaccardi</i>	CBS 120.43	<i>Cyclamen persicum</i>	Netherlands	Roodenburg	KF253227	KF252761	KF252285	KF251783	KF251280
	CBS 128665	<i>Lysimachia vulgaris</i> var. <i>davurica</i>	South Korea	H.D. Shin	KF253228	KF252762	KF252286	KF251784	KF251281
<i>Zasmidium anthuricola</i>	CBS 118742	<i>Anthurium</i> sp.	Thailand	C.F. Hill	KF253229	KF252763	KF252287	KF251785	FJ689626
<i>Zas. citri</i>	CPC 13467	<i>Eucalyptus</i> sp.	Thailand	W. Himaman	KF253182	KF252714	KF252231	KF251729	KF251226
<i>Zas. lonicericola</i>	CBS 125008	<i>Lonicera japonica</i>	South Korea	H.D. Shin	KF253231	KF252765	KF252289	KF251787	KF251283
<i>Zas. nocxi</i>	CBS 125009	Twig debris	USA	P.W. Crous	KF253232	KF252766	KF252290	KF251788	KF251284
<i>Zas. scaevolicola</i>	CBS 127009	<i>Scaevola taccada</i>	Australia	R.G. Shivas & P.W. Crous	KF253233	KF252767	KF252291	KF251789	KF251285
<i>Zymoseptoria brevis</i>	CBS 128853	<i>Phalaris minor</i>	Iran	–	JQ739777	JF700968	JF700799	JQ739833	JF700867
	CPC 18109	<i>Phalaris paradoxa</i>	Iran	–	JQ739779	JF700970	JF700801	JQ739835	JF700869
	CPC 18112	<i>Phalaris paradoxa</i>	Iran	–	JQ739782	JF700973	JF700804	JQ739838	JF700872
<i>Zym. halophila</i>	CBS 128854; CPC 18105	<i>Hordeum glaucum</i>	Iran	M. Razavi	KF253592	–	JF700808	KF252150	KF251645
<i>Zym. passerinii</i>	CBS 120384	<i>Hordeum vulgare</i>	USA	S. Ware	JQ739788	JF700878	JF700979	JQ739844	JF700810
	CBS 120385	<i>Hordeum vulgare</i>	USA	S. Ware	JQ739789	JF700980	JF700811	JQ739845	JF700879
<i>Zym. pseudotritici</i>	CBS 130976	<i>Dactylis glomerata</i>	Iran	M. Javan-Nikkhah	JQ739772	JN982484	JN982482	JQ739828	JN982480
<i>Zym. tritici</i>	CPC 18117	<i>Avena</i> sp.	Iran	–	JQ739801	JF700986	JF700817	JQ739857	JF700885

<sup>1</sup>CBS: CBS-KNAW Fungal Biodiversity Centre, Utrecht, The Netherlands; CPC: Culture collection of Pedro Crous, housed at CBS; IMI: International Mycological Institute, CABI-Bioscience, Egham, Basingstoke, U.K.; MP: Working collection of Sandra Videira; S: Working collection of William Quaedvlieg.

<sup>2</sup>Btub:  $\beta$ -tubulin; EF-1 $\alpha$ : Translation elongation factor 1-alpha; ITS: internal transcribed spacers and intervening 5.8S nrDNA; LSU: 28S large subunit of the nrRNA gene; RPB2: RNA polymerase II second largest subunit.



**Fig. 1.** A Bayesian 50% majority rule RPB2/LSU consensus tree containing all *Septoria* and septoria-like taxa available at the CBS, which cluster in or near the *Mycosphaerellaceae*. Bayesian posterior probabilities support values for the respective nodes are displayed in the tree. A stop rule (set to 0.01) for the critical value for the topological convergence diagnostic was used for the Bayesian analysis. The tree was rooted to *Phaeosphaeria nodorum* (CBS 259.49). The scalebar indicates 0.1 expected changes per site.



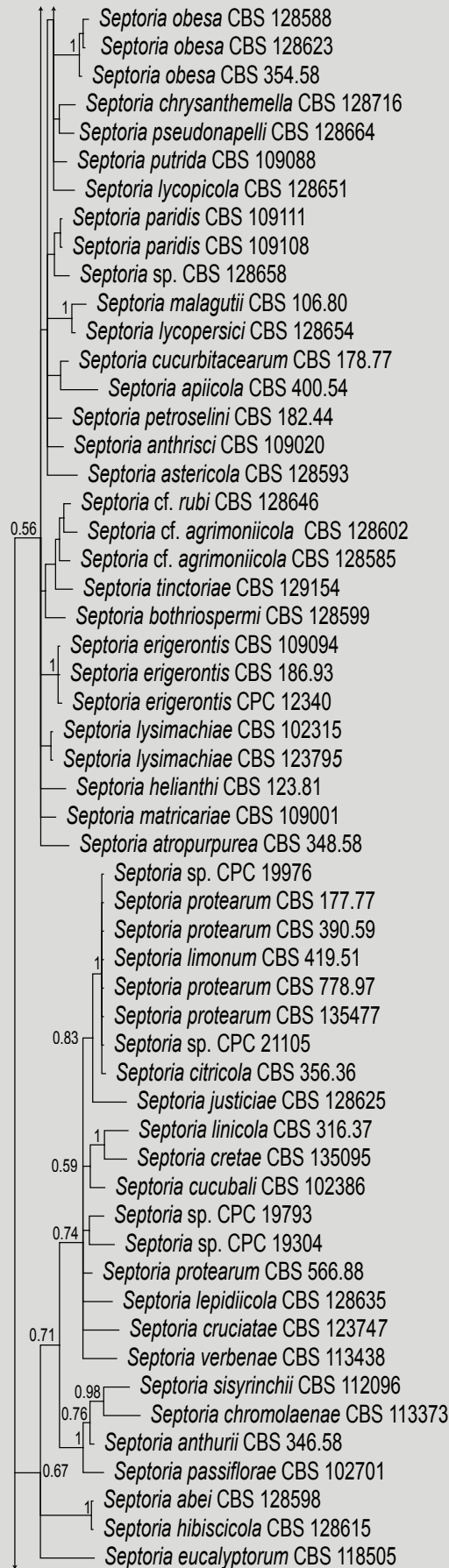
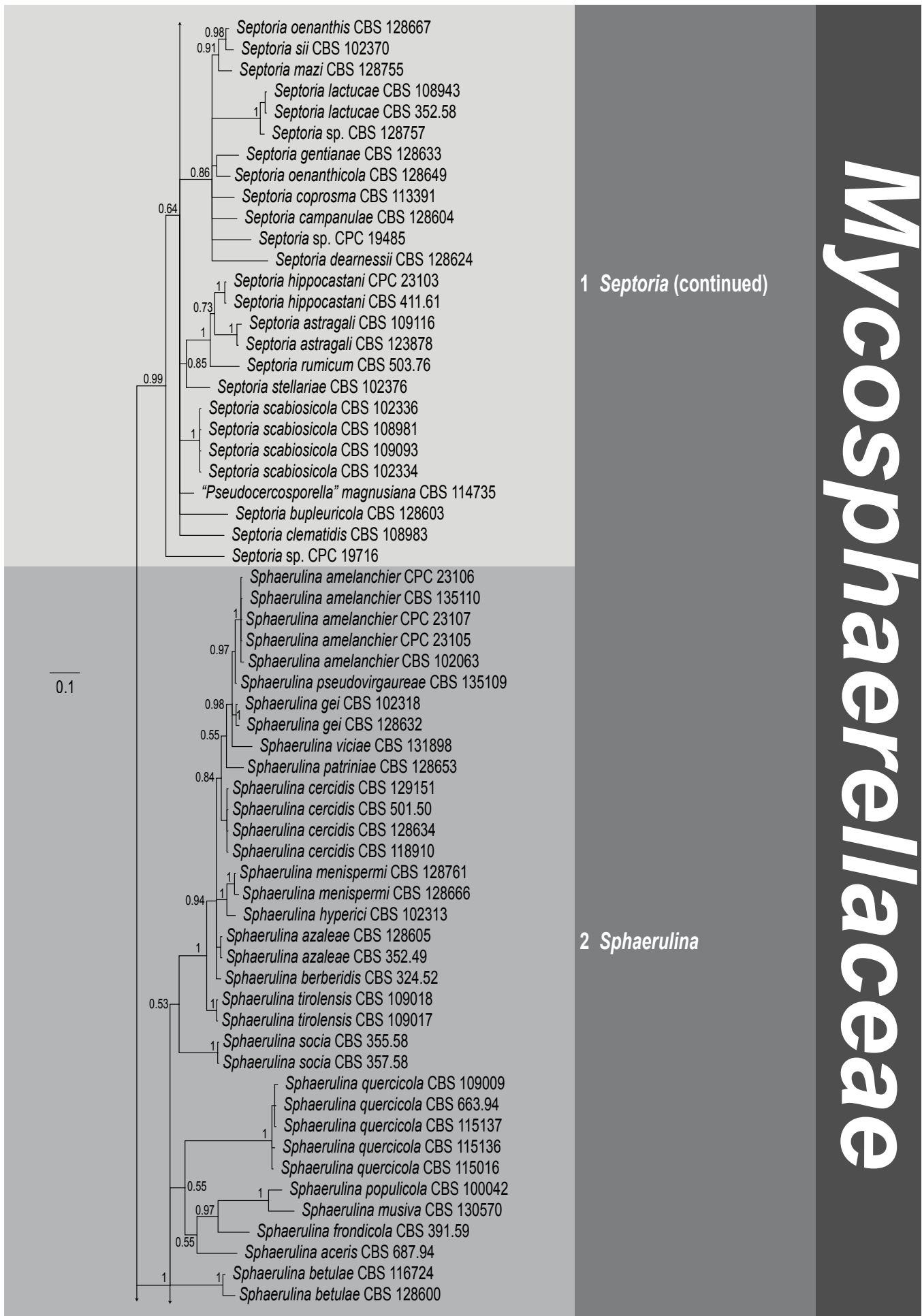
1 *Septoria* (continued)**Mycosphaerellaceae**

Fig. 1. (Continued).



# Mycosphaerellaceae

Fig. 1. (Continued).

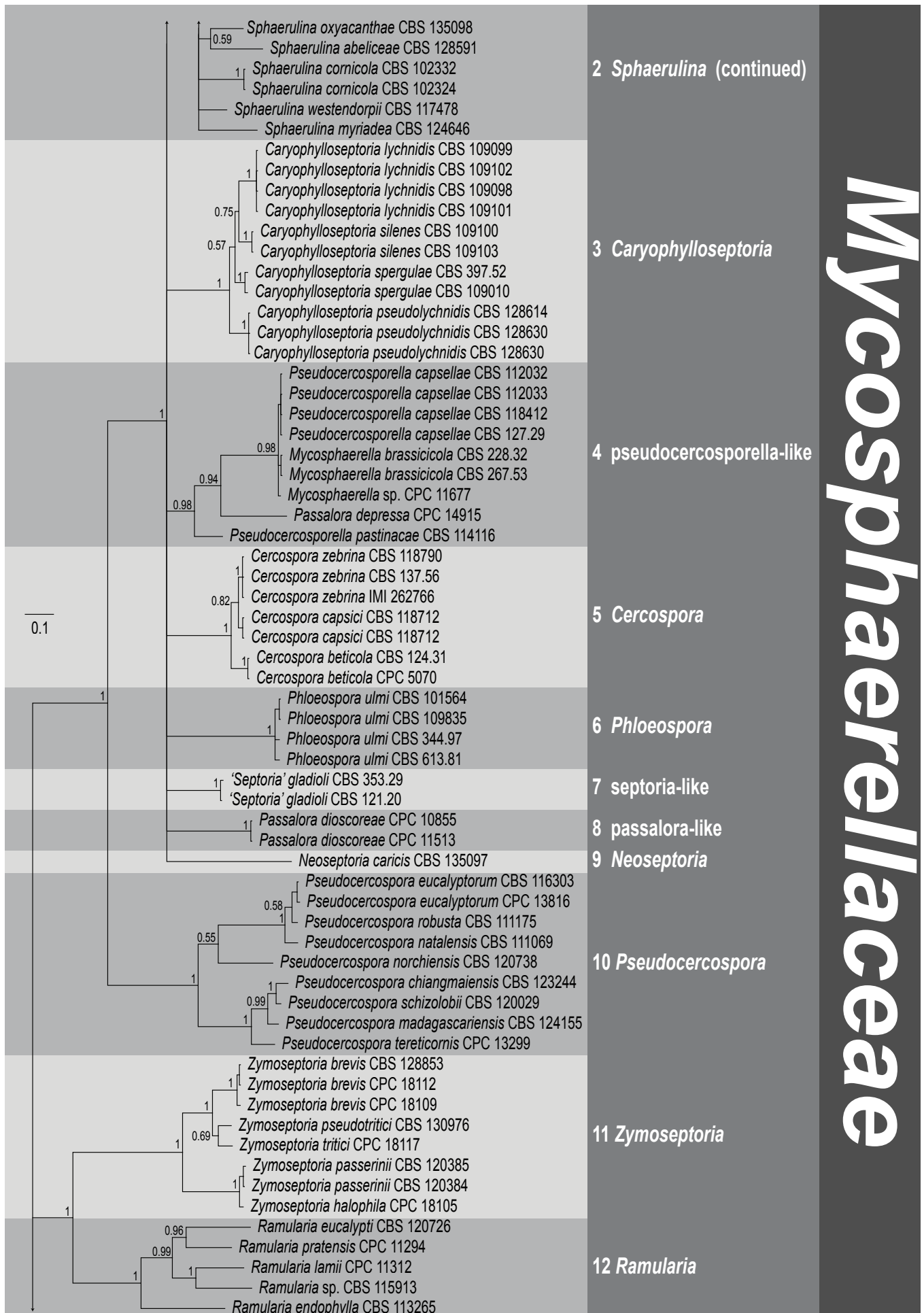


Fig. 1. (Continued).

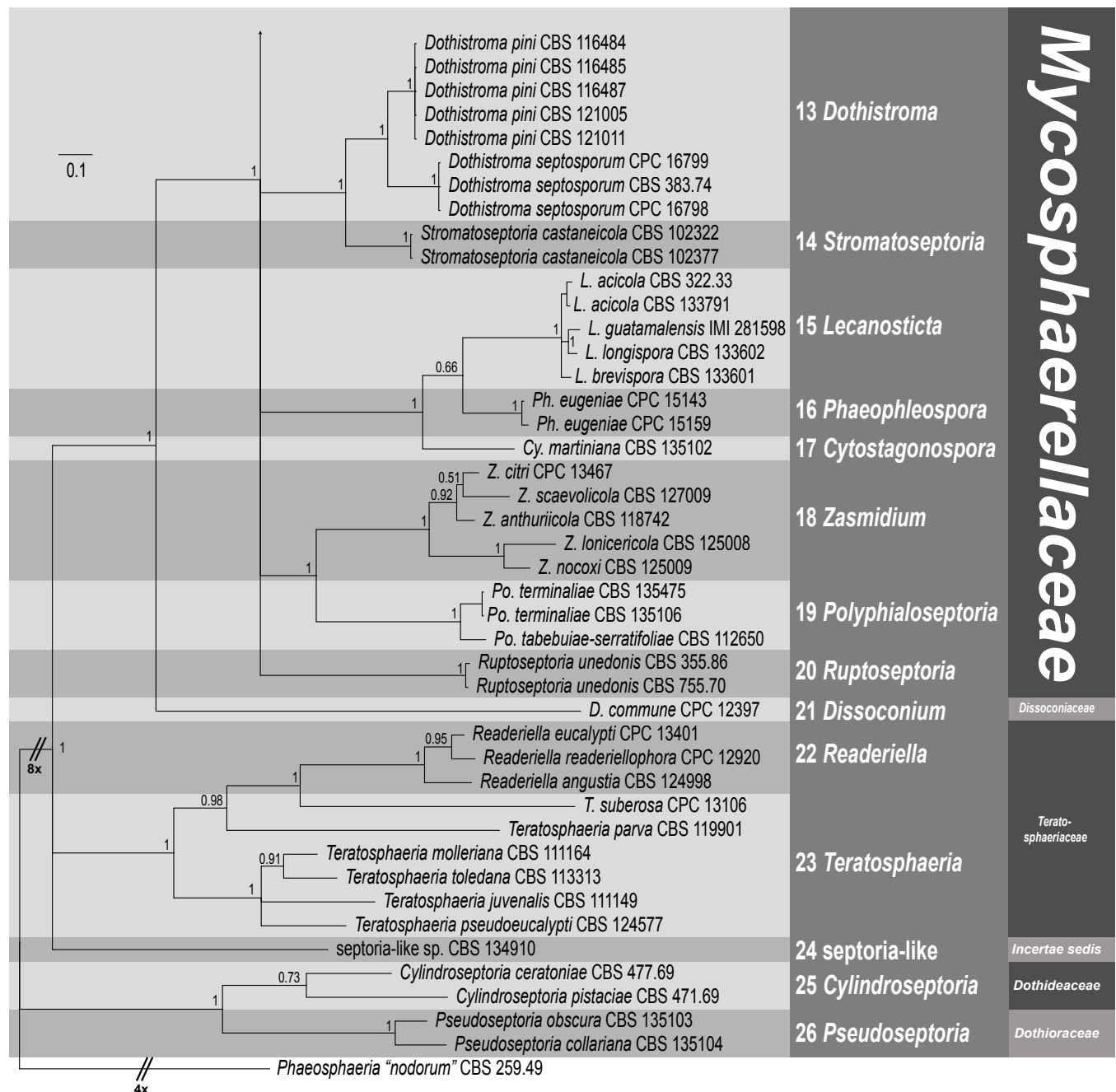


Fig. 1. (Continued).

**Table 2.** Primer combinations used during this study for generic amplification and sequencing.

Locus	Primer	Primer sequence 5' to 3'	Annealing temperature (°C)	Orientation	Reference
Translation elongation factor-1α	EF1-728F	CATCGAGAAGTTCGAGAAGG	52	Forward	Carbone & Kohn (1999)
	EF-2	GGARGTACCAGTSATCATGTT	52	Reverse	O'Donnell <i>et al.</i> (1998)
β-tubulin	T1	AACATGCGTGAGATTGTAAGT	52	Forward	O'Donnell & Cigelnik (1997)
	β-Sandy-R	GCRGNGGVACRTACTTGTT	52	Reverse	Stukenbrock <i>et al.</i> (2012)
RNA polymerase II second largest subunit	frPB2-5F	GAYGAYMGWGATCAYTTYGG	49	Forward	Liu <i>et al.</i> (1999)
	frPB2-414R	ACMANNCCCCARTGNGWRTRTRTG	49	Reverse	Quaedvlieg <i>et al.</i> (2011)
LSU	LSU1Fd	GRATCAGGTAGGRATACCCG	52	Forward	Crous <i>et al.</i> (2009a)
	LR5	TCCTGAGGGAAACTTCG	52	Reverse	Vilgalys & Hester (1990)
ITS	ITS5	GGAAGTAAAAGTCGTAACAAGG	52	Forward	White <i>et al.</i> (1990)
	ITS4	TCCTCCGCTTATTGATATGC	52	Reverse	White <i>et al.</i> (1990)

**Table 3.** Amplification success, phylogenetic data and the substitution models used in the phylogenetic analysis, per locus.

Locus	RPB2	LSU
Amplification success (%)	99.20 %	100 %
Number of characters	327	792
Unique site patterns	197	216
Substitution model used	GTR-I-gamma	GTR-I-gamma
Number of generations (1000×)		2575
Total number of trees (n)		5152
Sampled trees (n)		3864

which 26 contained species belonging to the *Septoria* (-like) complex. These 47 resolved clades belong to a multitude of different families within the *Dothidiomycetes* ranging from the *Mycosphaerellaceae* in the *Capnodiales* to the *Lentitheciaceae* in the *Pleosporales*. It is still unclear within the *Dothidiomycetes* where the phylogenetic family borders are located, or even how many phylogenetically sustainable families there actually are. The family annotation in the phylogenetic trees (Figs 1, 2) is therefore based on the closest LSU neighbour that was available in GenBank, with clades treated as *incertae sedis* if no closer relationship than 97 % could be found.

### Septoria and septoria-like genera

In addition to *Septoria s. str.*, numerous septoria-like genera (pycnidial/acervular/stromatic conidioma with filiform conidia) have since been described. Although the majority of these have no ex-type culture available for DNA analysis, many have type material deposited in herbaria, which were available for morphological examination. A summary of these genera is provided below.

### Pycnidial forms

***Cytostagonospora*** Bubák, Ann. Mycol. 14: 150. 1916. Fig. 3.

*Mycelium* immersed, dark brown, branched, septate. *Conidiomata* pycnidial, amphigenous, separate, globose, dark brown to black, immersed, unilocular, thick-walled, clypeate; walls of dark brown, thick-walled *textura angularis* to *textura globulosa*, becoming hyaline towards the conidiogenous region, extending in the upper part to become a circular clypeus of similar thickness to the wall. *Ostiole* central, circular, papillate to shortly rostrate, depressed, situated immersed within the clypeus. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, determinate, discrete, lageniform, hyaline, smooth, formed from the inner cells of the pycnidial wall. *Conidia* hyaline, 0–2-euseptate, not constricted at septa, base truncate, apex obtuse, thin-walled, eguttulate, smooth, filiform, often curved (Sutton 1980).

*Type species:* *C. photiniicola* Bubák, Ann. Mycol. 14(3–4): 150. 1916.

*Notes:* Von Arx (1983) and Sutton (1980) disagreed about the link of *Cytostagonospora* to *Septoria*. Von Arx treated it as a synonym of *Septoria*, while Sutton retained it as a separate genus.

***Dearnessia*** Bubák, Hedwigia 58: 25. 1916.

*Mycelium* hyaline to brown, branched, septate. *Conidiomata* pycnidial, amphigenous, separate, globose, immersed, brown; wall of thin-walled *textura angularis*. *Ostiole* central, circular, papillate. *Setae* ostiolar, approximately straight, unbranched, tapered towards apex, dark brown, smooth, thin-walled, septate. *Conidiogenous cells* holoblastic, determinate, discrete, doliiform to ampulliform, hyaline, smooth and formed from the inner layer of the pycnidial wall. *Conidia* cylindrical to irregular, hyaline, 1–multi-transversely euseptate, rarely with 1–2 longitudinal eusepta, continuous or constricted, often tapered at the apex, base truncate, thin-walled, smooth, guttulate or not (Sutton 1980).

*Type species:* *D. apocyni* Bubák, Hedwigia 58: 25. 1916.

***Dearnessia apocyni*** Bubák, Hedwigia 58: 25. 1916. Figs 4, 5.

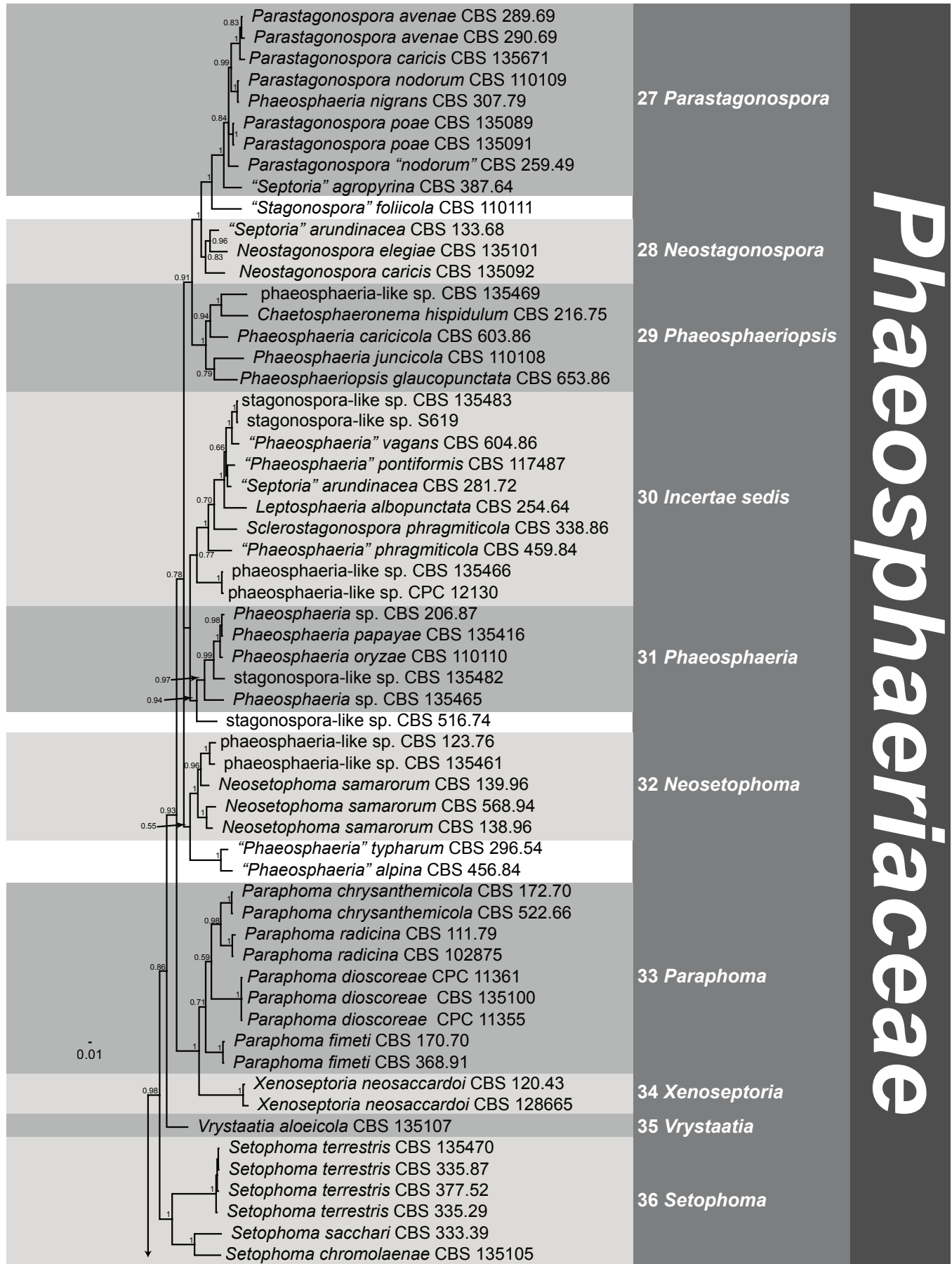
*Leaf spots* amphigenous, irregular, feathery to angular, dark brown, 3–6 mm diam, surrounded by a wide chlorotic zone up to 3 mm diam. *Conidiomata* epiphyllous, pycnidial, erumpent, up to 150 µm diam, with central ostiole; wall of 3–6 layers of brown *textura angularis*. *Conidiogenous cells* doliiform, globose to subcylindrical, hyaline, smooth, thin-walled, mode of proliferation obscure, 5–10 × 4–6 µm. *Conidia* hyaline, smooth, subcylindrical to obclavate, apex obtuse, base truncate to subobtuse, straight to irregular (lateral swellings?), 1–4-septate, 16–33 × 5–8 µm.

*Specimen examined:* Canada, Ontario, London, on leaves of *Apocynum androsaemifolium* (*Apocynaceae*), 11 Aug. 1910, J. Dearness, **holotype** F43227.

*Notes:* Because the specimen is in poor condition, no definite conclusion could be reached about its potential relationships. However, *D. apocyni* does appear septoria-like in general morphology.

***Jahniella*** Petr., Ann. Mycol. 18: 123. 1921. [1920]. Figs 6, 7.

*Mycelium* branched, immersed, septate, brown. *Conidiomata* pycnidial, superficial on epidermis, immersed, separate, globose, papillate, dark brown, thick-walled, sclerenchymatic; wall consisting of an outer layer of dark brown, thick-walled *textura angularis*, a middle layer of 8 cells thick, of hyaline to pale brown, thick-walled cells, and an inner layer of thin-walled, hyaline, irregular cells. *Ostiole* single, circular, with a distinct channel and hyaline



**Fig. 2.** A Bayesian 50% majority rule RPB2/LSU consensus tree containing all *Septoria* and septoria-like taxa available at the CBS, which cluster in or near the *Phaeosphaeriaceae*. Bayesian posterior probabilities support values for the respective nodes are displayed in the tree. A stop rule (set to 0.01) for the critical value for the topological convergence diagnostic was used for the Bayesian analysis. The tree was rooted to *Dothistroma pini* (CBS 121005). The scalebar indicates 0.01 expected changes per site.

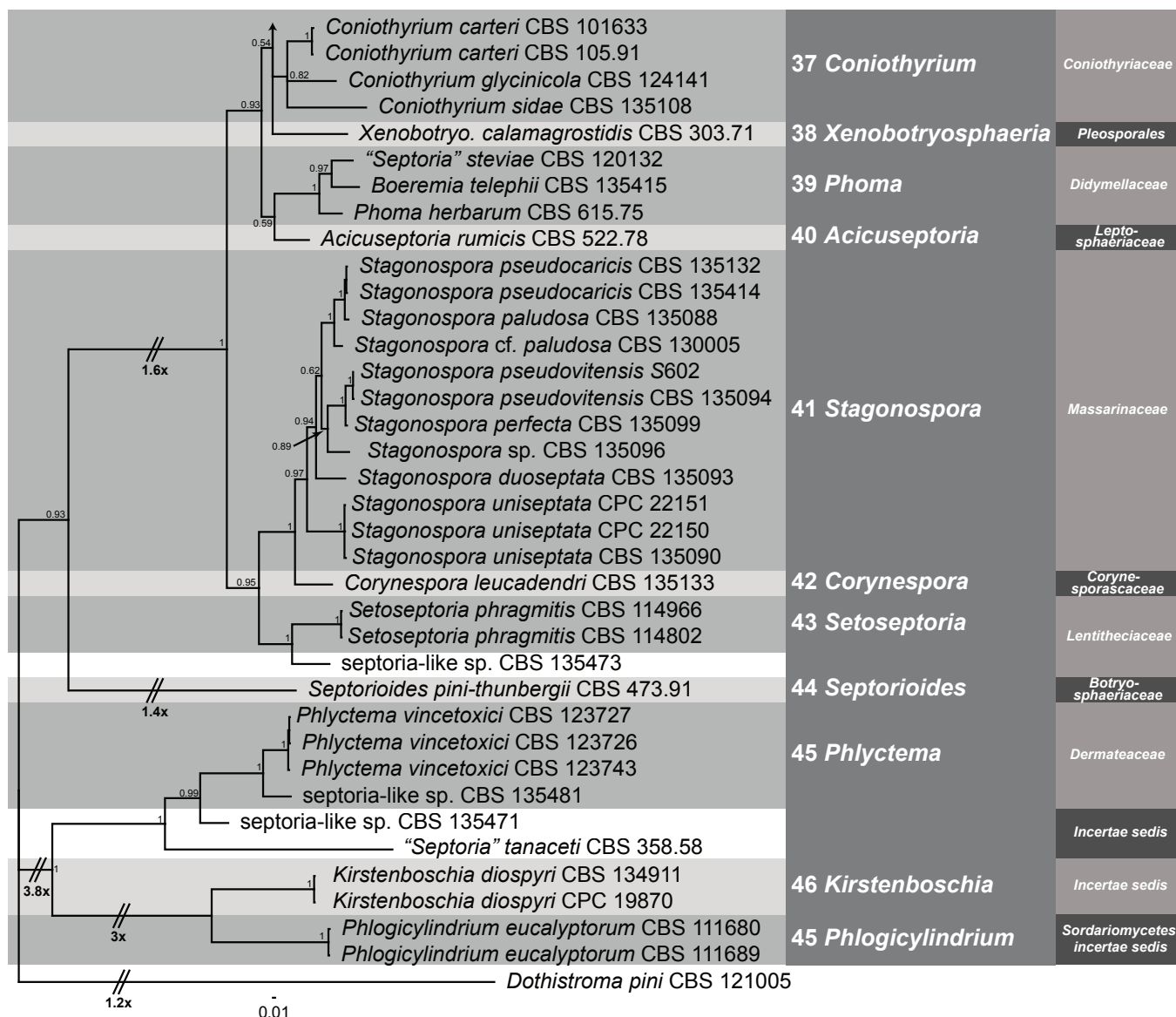


Fig. 2. (Continued).

periphysoid cells. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, determinate, discrete, hyaline, ampulliform, lining the wall of the pycnidium. *Conidia* straight or slightly curved, hyaline, thin-walled, smooth, 3–4-euseptate, eguttulate, truncate at the base, slightly tapered to the apex (Sutton 1980).

*Type species*: *J. bohémica* Petr., Ann. Mycol. 18(4–6): 123. 1921. [1920]

*Specimen examined*: Czech Republic, Bohemia, on stems of *Scrophularia nodosa* (*Scrophulariaceae*), 18 Mar. 1916, J. Jahn, holotype K(M) 180917, slides ex BPI.

*Note*: The specimen correlates closely with the description provided by Sutton (1980), except that the conidiomata are superficial, not immersed in the epidermis.

***Megaloseptoria*** Naumov, Morbi Plantarum 14: 144. 1925. Figs 8, 9.

*Mycelium* immersed, branched, septate, brown. *Conidiomata* pycnidial, separate, globose, slightly papillate, dark brown to

black, superficial, sessile, often aggregated in groups, unilocular, thick-walled; wall of several cell layers of brown *textura angularis*, more darkly pigmented on the outside. *Ostiole* single, circular. *Conidiophores* hyaline, branched, septate (mainly at the base), smooth, straight or irregular, formed from the inner cells of the pycnidial wall. *Conidiogenous cells* enteroblastic, determinate, discrete or integrated, doliiform, ampulliform or irregularly cylindrical, hyaline, smooth, collarette evident, channel wide, periclinal thickening present. *Conidia* hyaline to pale brown with several transverse eusepta, continuous, tapered near the obtuse apex and truncate base, thin-walled, smooth, cylindrical, straight or slightly curved, often with 2 guttules in each cell (Sutton 1980).

*Type species*: *M. mirabilis* Naumov, Morbi Plant. Script. Sect. Phytopath. Hort. Bot. Prince. USSR 14: 144. 1925.

***Megaloseptoria mirabilis*** Naumov, Morbi Plantarum 14: 144. 1925.

*Conidiomata* aggregated in a black stroma at the ends of branchlets, globose, black, smooth, with central ostiole, up to 600 µm diam, papillate; wall of 3–8 layers of dark brown *textura*

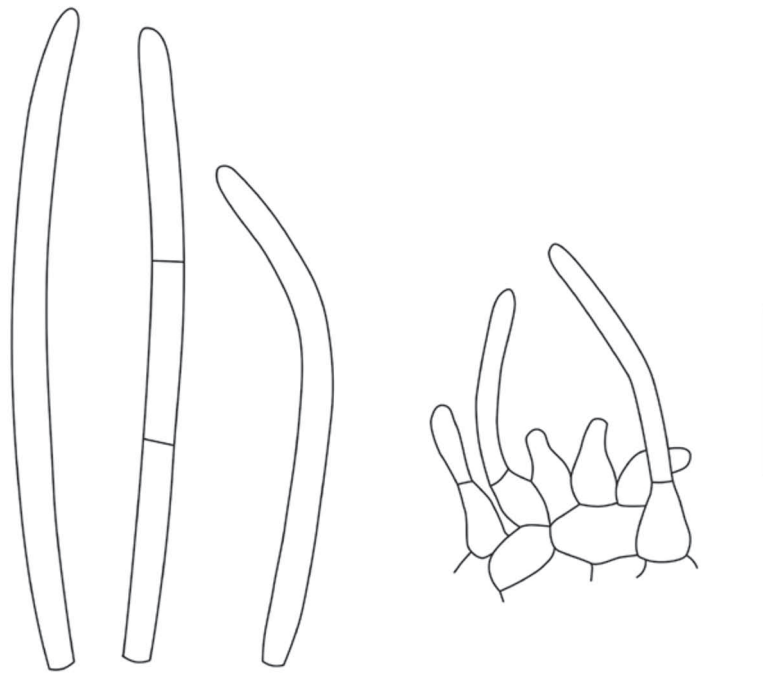


Fig. 3. Conidia and conidiogenous cells of *Cytostagonospora photiniicola* (redrawn from Sutton 1980). Scale bar = 10  $\mu$ m.

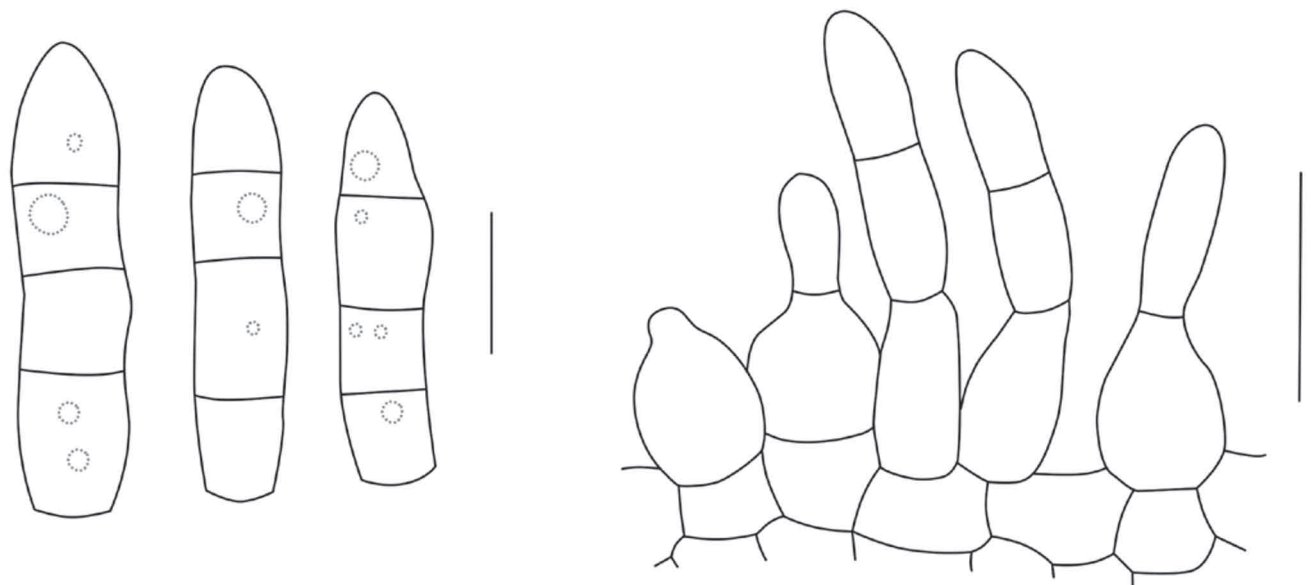


Fig. 4. Conidia and conidiogenous cells of *Dearnessia apocyni* (F43227). Scale bars = 10  $\mu$ m.

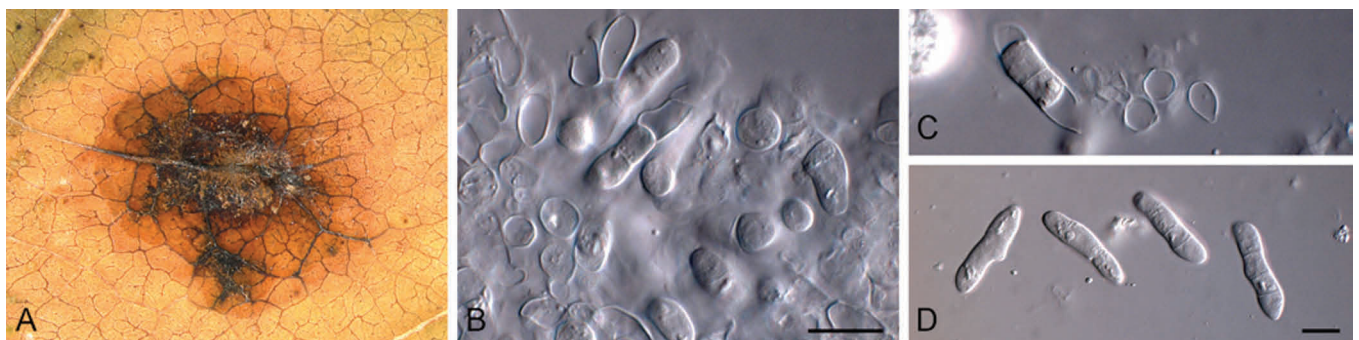


Fig. 5. *Dearnessia apocyni* (F43227). A. Leaf spot. B, C. Conidiogenous cells. D. Conidia. Scale bars = 10  $\mu$ m.



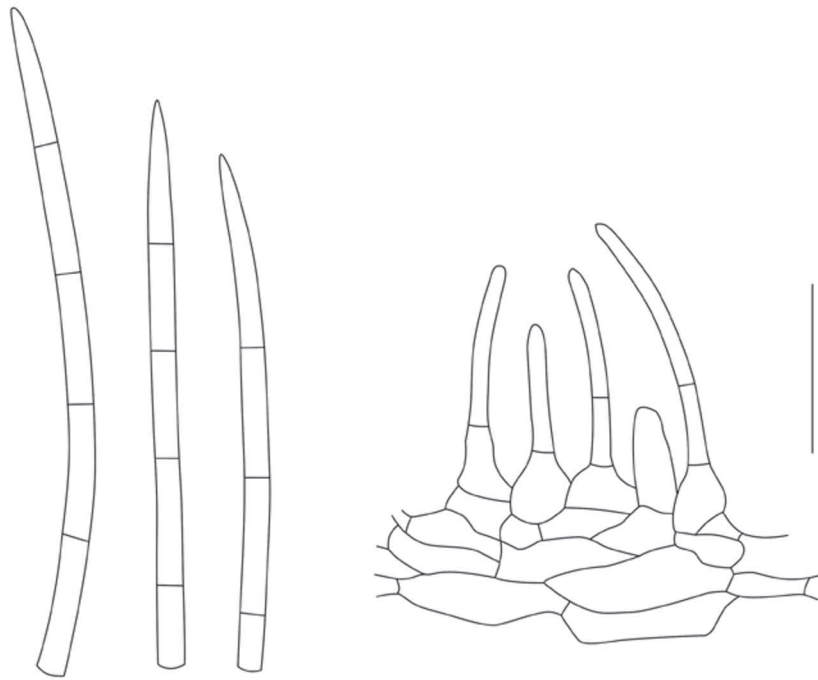


Fig. 6. Conidia and conidiogenous cells of *Jahniella bohemia* (redrawn from Sutton 1980). Scale bar = 10  $\mu$ m.

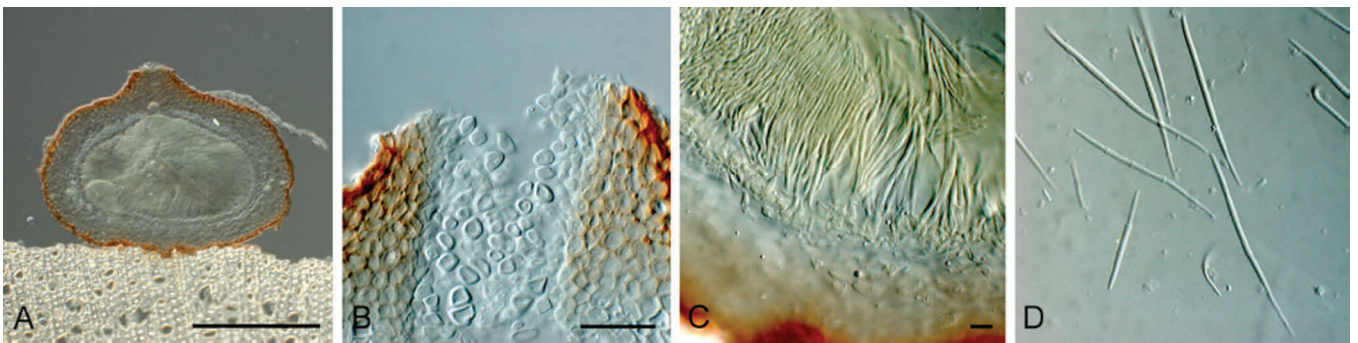


Fig. 7. *Jahniella bohemia* [K(M) 180917]. A. Vertical section through conidioma. B. Ostiolar region with loose cells. C. Conidiogenous cells. D. Conidia. Scale bars = 10  $\mu$ m.

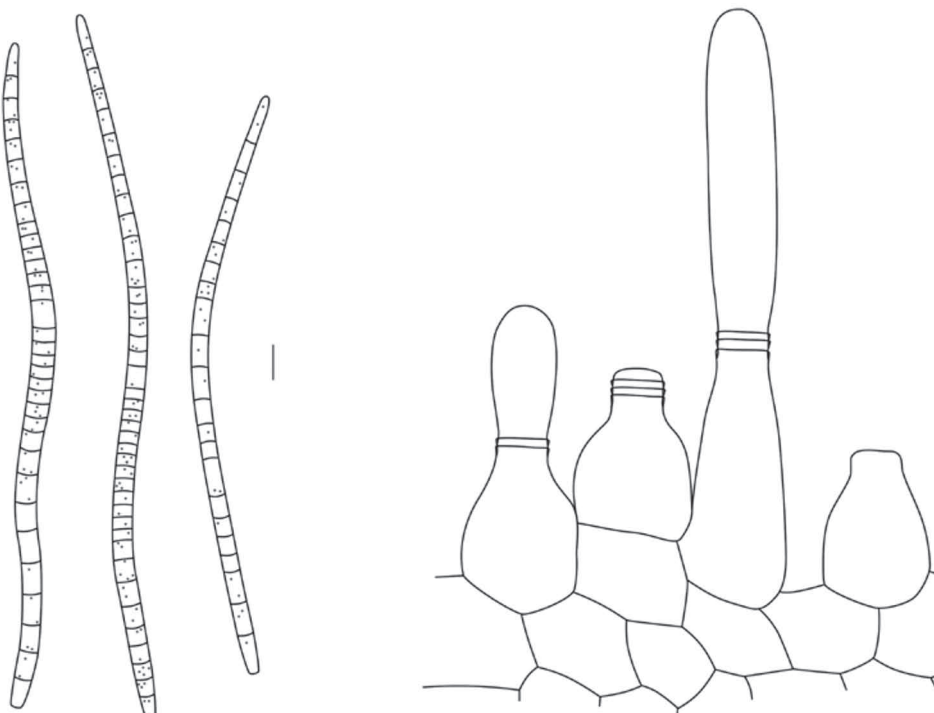


Fig. 8. Conidia and conidiogenous cells of *Megaloseptoria mirabilis* (MA-Fungi 6978-1). Scale bars = 10  $\mu$ m.

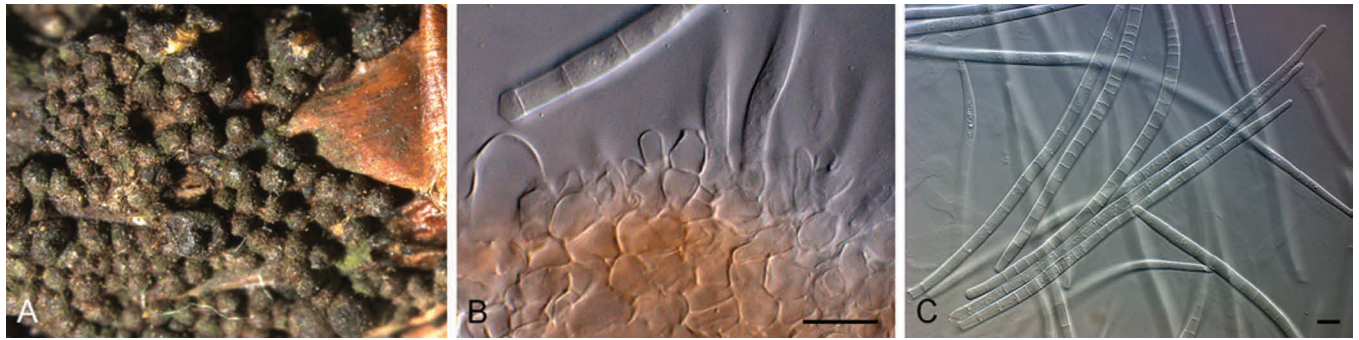


Fig. 9. *Megaloseptoria mirabilis* (MA-Fungi 6978-1). A. Conidiomata on host tissue. B. Conidiogenous cells. C. Conidia. Scale bars = 10  $\mu$ m.

*angularis*. Conidiogenous cells lining the cavity, subcylindrical to ampulliform, hyaline, smooth, 7–15  $\times$  4–8  $\mu$ m; proliferating percurrently near apex. Conidia solitary, scolecosporous, variously curved, subcylindrical, tapering in upper third to obtuse apex, base truncate, 3–4  $\mu$ m diam, transversely 30–40-septate, (170–)200–250  $\times$  (5–)6(–7)  $\mu$ m.

Specimen examined: Switzerland, Zürich, St. Schnach., on branchlets of *Pinus pungens* var. *glauca* (Pinaceae), 10 July 1951, E. Müller, holotype MA-Fungi 6978-1.

Note: *Megaloseptoria* differs from *Septoria* in that the conidiomata are aggregated in a black stroma, which is not the case in *Septoria* s. str.

**Phaeoseptoria** Speg., Revista Mus. La Plata 15(2): 39. 1908.

Leaf spots angular-subcircular, 0.5–3 mm diam, becoming confluent. Conidiomata pycnidial, epiphyllous, subepidermal, black, 60–90  $\mu$ m diam. Conidiogenesis cells hyaline, smooth, holoblastic (?). Conidia filiform, obclavate, smooth, 1–3-euseptate, medium brown, 30  $\times$  3  $\mu$ m (Saccardo & Trotter 1913, Walker et al. 1992, Crous et al. 1997).

Type species: *P. papayae* Speg., Revista Mus. La Plata 15(2): 39. 1908.

Notes: *Phaeoseptoria papayae* was originally described from leaf spots on *Carica papaya* collected in the São Paulo Botanical Garden, Brazil. Presently there are numerous clades that contain isolates conforming to this morphology, and this matter can only be resolved once fresh material of *P. papayae* has been recollected to clarify its phylogeny (see below).

**Pseudoseptoria** Speg., Ann. Mus. Nac. B. Aires, Ser. 3 13: 388. 1910.

Mycelium immersed, branched, septate, pale brown. Conidiomata pycnidial, solitary or linearly aggregated, immersed, brown, globose, unilocular; walls thin, of pale brown *textura angularis*. Ostiole distinct, central, circular. Conidiophores reduced to conidiogenous cells. Conidiogenous cells discrete, determinate or indeterminate, hyaline, smooth, ampulliform with a prominent cylindrical papilla with several percurrent proliferations at the apex. Conidia falcate, fusoid, acutely rounded at each end, hyaline, aseptate, guttulate, smooth, thin-walled (Sutton 1980).

Type species: *P. donacicola* Speg., Ann. Mus. Nac. B. Aires, Ser. 3 13: 388. 1910.

Note: Species of *Pseudoseptoria* are plant pathogenic to members of *Poaceae*.

**Rhabdospora** (Durieu & Mont. ex Sacc.) Sacc., Syll. Fung. (Abellini) 3: 578. 1884. nom. cons.

Basionym: *Septoria* sect. *Rhabdospora* Durieu & Mont., in Durieu, Expl. Sci. Alg. 1 (livr. 15): 592. 1849. [1846–1849].

Type species: *R. oleandri* Durieu & Mont., in Durieu, Expl. Sci. Alg. 1 (livr. 15): 593. 1849 [1846–1849].

Notes: *Rhabdospora* is a poorly defined genus, originally established to accommodate septoria-like species occurring on stems (Priest 2006). Of the 11 species treated by Sutton (1980), most are currently placed in *Septoria*. This genus is in need of revision pending the recollection of fresh material (on *Nerium oleander* from Algeria).

**Sclerostagonospora** Höhn., Hedwigia 59: 252. 1917.

Conidiomata pycnidial, immersed, separate, dark brown to black, globose, unilocular; walls thin, composed of thick-walled, dark brown *textura angularis*; ostiole single, circular, central, papillate. Conidiophores reduced to conidiogenous cells. Conidiogenous cells holoblastic, determinate, discrete, hyaline, smooth, ampulliform to irregular, formed from the inner cells of the pycnidial wall. Conidia subcylindrical, pale brown, thin-walled, minutely verruculose, 3-euseptate, sometimes slightly constricted at the septa (from Sutton 1980).

Type species: *S. heraclei* (Sacc.) Höhn., Hedwigia 59: 252. 1917.

Note: *Sclerostagonospora* differs from *Stagonospora* in having pigmented conidia.

**Septoria** (Sacc.) Sacc., Syll. Fung 3: 474. 1884. nom. cons. Figs 10, 11.

= *Septaria* Fr., Novit. Fl. Svec. 5: 78. 1819. nom. rejic.

Mycelium slow-growing, pale brown, septate, immersed. Conidiomata pycnidial, immersed, separate or aggregated (but not confluent), globose, papillate (or not), brown, wall of thin, pale

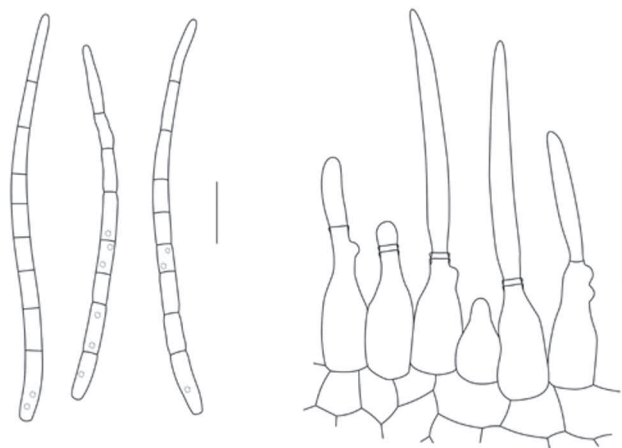


Fig. 10. Conidia and conidiogenous cells of *Septoria cytisi* (BPI USO 378994). Scale bars = 10  $\mu$ m.

brown *textura angularis*, inner layer of flattened, hyaline *textura angularis*, frequently somewhat darker and more thick-walled around the ostiole. *Ostiole* single, circular, central. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* holoblastic, either determinate or indeterminate, proliferating sympodially and/or percurrently, hyaline, smooth, ampulliform, dolliiform or lageniform to short cylindrical; scars unthickened. *Conidia* hyaline, multiseptate, filiform, smooth, continuous or constricted at septa. Sexual states are mycosphaerella-like.

*Type species*: *S. cytisi* Desm., Ann. Sci. Nat. Bot. 8: 24. 1847.

*Specimen examined*: Slovakia, Muehlthal near Bratislava (Pressburg), on leaves of *Laburnum anagyroides* (Leguminosae), 1884, J.A. Baeumler, BPI USO 378994.

*Note*: The ITS and LSU sequences of this specimen were published respectively under GenBank accession numbers JF700932 and JF700954.

***Stagonospora*** (Sacc.) Sacc., Syll. Fung. (Abellini) 3: 445. 1884. nom. cons.

*Basionym*: *Hendersonia* subgen. *Stagonospora* Sacc., Michelia 2 (no. 6): 8. 1880.

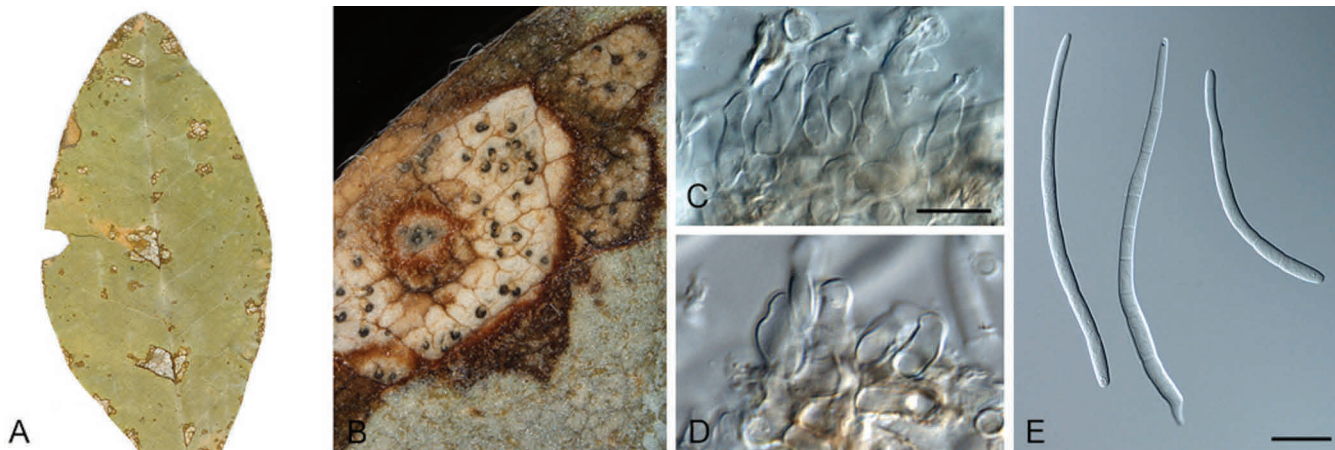


Fig. 11. *Septoria cytisi* (BPI USO 378994). A. Leaf with symptoms. B. Close-up of leaf spot with conidiomata. C, D. Conidiogenous cells giving rise to conidia. E. Conidia. Scale bars = 10  $\mu$ m.

*Conidiomata* pycnidial, immersed, unilocular, globose, separate, ostiolate; walls of dark brown, thick-walled *textura angularis*, and on the inside of hyaline, thin-walled, flattened cells. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* dolliiform, hyaline, with several percurrent proliferations at the apex, formed from the inner cells of the pycnidial wall. *Conidia* hyaline, smooth to finely verruculose, 1–multiseptate, cylindrical or fusoid-ellipsoidal, straight or slightly curved, often guttulate, constricted or not at septa.

*Type species*: *S. paludosa* (Sacc. & Speg.) Sacc., Syll. Fung. (Abellini) 3: 453. 1884.

***Stenocarpella*** Syd. & P. Syd., Ann. Mycol. 15(3–4): 258. 1917. Fig. 12.

*Mycelium* immersed, brown, branched, septate. *Conidiomata* pycnidial, separate or sometimes confluent, globose or elongated, dark brown, subepidermal, unilocular, thick-walled; walls composed of dark brown, thick-walled *textura angularis*. *Ostiole* single, circular, papillate, protruding. *Conidiophores* usually absent. *Conidiogenous cells* cylindrical, hyaline, determinate, discrete, phialidic, with collarette and minute periclinal thickening, lining the inner layer of the pycnidial wall. *Conidia* subcylindrical, straight or curved, fusiform, apex obtuse, base tapered, truncate, thick-walled, smooth-walled, granular, pale to medium brown, 0–3-euseptate. Beta conidia hyaline, scolecosporous, curved (Crous *et al.* 2006, Lamprecht *et al.* 2011).

*Type species*: *S. zeae* Syd. & P. Syd., Ann. Mycol. 15(3–4): 258. 1917. [= *S. macrospora* (Earle) B. Sutton]

*Specimens examined*: South Africa, KwaZulu-Natal, Hlabisa, rain-damaged Bt *Zea mays* hybrid (*Poaceae*), 2003–04 season, J. Rheeder (**ex-epitype**, CBS 117560 = MRC 8615, designated in Crous *et al.* 2006); KwaZulu-Natal, *Zea mays* kernels, 2005, P. Caldwell, CPC 11863 = CBS 128560.

*Notes*: *Stenocarpella* presently contains two species, *S. macrospora* and *S. maydis*, both causing “Diplodia ear rot of maize”. These two taxa were previously assigned to *Diplodia* and *Macrodiplodia*, respectively (Petraik & Sydow 1927, Sutton 1964). Several years later, Sutton re-examining these taxa and placed them in their own genus, *Stenocarpella* (Sutton 1977, 1980). Recent phylogenetic studies confirmed that these taxa indeed cluster by themselves

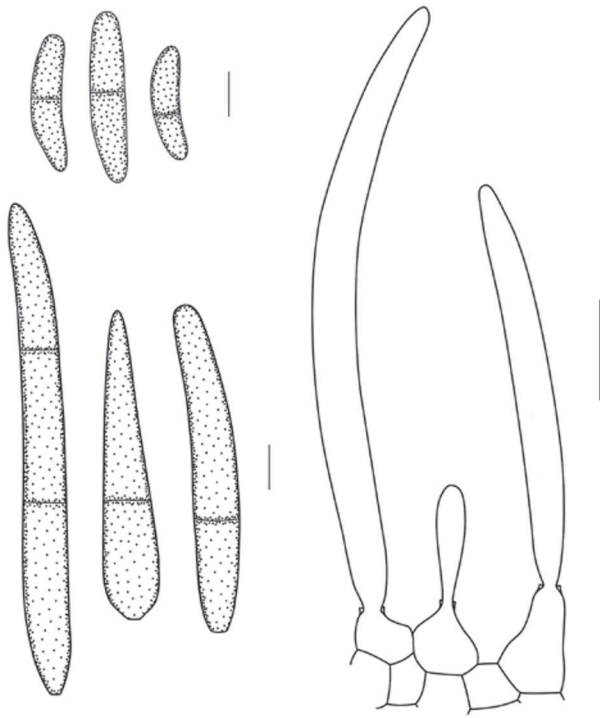


Fig. 12. *Stenocarpella maydis* (top) and *S. macrospora* (bottom) (redrawn from Sutton 1980). Scale bars = 10 µm.

within the *Diaporthales* (Crous *et al.* 2006, Lamprecht *et al.* 2011), supporting the decision of Sutton (1980).

***Trichoseptoria*** Cavara, Atti Ist. Bot. Univ. Lab. Crittog. Pavia 2: 40. 1892.

*Type species:* *T. alpei* Cavara, Atti Ist. Bot. Univ. Lab. Crittog. Pavia 2: 40. 1892.

*Notes:* Not much is known about this septoria-like genus, except that it is distinguished from *Septoria* by having setae on its pycnidia with 1–2-septate, hyaline conidia. This genus is in further need of revision once fresh material has been recollected (*Citrus vulgaris*, Belgiojoso, Alps).

***Zymoseptoria*** Quaedvlieg & Crous, Persoonia 26: 64. 2011.

*Conidiomata* pycnidial, semi-immersed to erumpent, dark brown to black, subglobose, with central ostiole; wall of 3–4 layers of brown *textura angularis*. *Conidiophores* hyaline and smooth, 1–2-septate, or reduced to conidiogenous cells, lining the inner cavity. *Conidiogenous cells* are tightly aggregated and ampulliform to doliiform or subcylindrical, phialidic with periclinal thickening, or with 2–3 inconspicuous, percurrent proliferations at the apex. *Conidia* (Type I) solitary, hyaline, smooth, guttulate, narrowly cylindrical to subulate, tapering towards acutely rounded apex, with bluntly rounded to truncate base, transversely euseptate; hila not thickened nor darkened. On OA and PDA media plates the aerial hyphae disarticulate into phragmospores (Type II conidia) that again give rise to Type I conidia via microcyclic conidiation; yeast-like growth and microcyclic conidiation (Type III conidia) common on agar media (Quaedvlieg *et al.* 2011).

*Type species:* *Z. tritici* (Desm.) Quaedvlieg & Crous, Persoonia 26: 67. 2011.

*Notes:* *Zymoseptoria* was split off from *Septoria s. str.* and redescribed by Quaedvlieg *et al.* (2011) based on LSU sequence data when said authors delimited *Septoria s. str.* by sequencing the ITS and LSU sequences out of *S. cytisi* herbarium material. Phylogenetic analysis showed that *Zymoseptoria* species cluster within a distinct clade inside the *Mycosphaerellaceae* that is closely related to *Ramularia*, but located distant from *Septoria s. str.*

**Acervular forms**

***Asteromidium*** Speg., Ann. Soc. cient. argent. 26(1): 66. 1888. Figs 13, 14.

*Mycelium* immersed, branched, septate, hyaline. *Conidiomata* acervular, subcuticular, separate or confluent, pulvinate to doliiform, at the base, composed of hyaline to pale brown, thin-walled *textura angularis* which extends laterally, finally with separate cells dispersed in a mucilaginous matrix to form the overlying wall; cuticle discoloured and occasionally pseudoparenchymatous, walls adjacent to the upper epidermal wall also discoloured; dehiscence irregular. *Conidiogenous cells* holoblastic, discrete, indeterminate, ± cylindrical, hyaline, smooth, with 1–2 sympodial proliferations, scars unthickened, flat, formed from the basal and lateral walls. *Conidia* cylindrical to fusoid, gently tapered at each end, apex obtuse, base truncate, thin-walled, guttulate to granular, hyaline, 3-septate (Sutton 1980).

*Type species:* *A. imperspicuum* Speg., Ann. Soc. cient. argent. 26(1): 66. 1888.

*Specimen examined:* Paraguay, on leaves of *Sapindaceae*, 1883, isotype K(M) 180228, ex B. Balansa Pl. du Paraguay No. 4085.

*Notes:* This genus has to be recollected (*Sapindaceae*, Paraguay) to allow for a molecular comparison to other existing genera in this

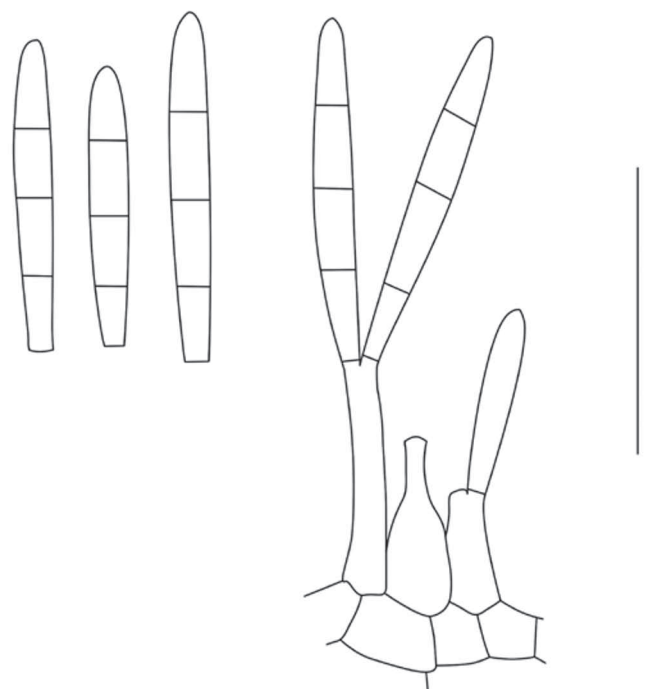


Fig. 13. Conidia and conidiogenous cells of *Asteromidium imperspicuum* (redrawn from Sutton 1980). Scale bar = 10 µm.

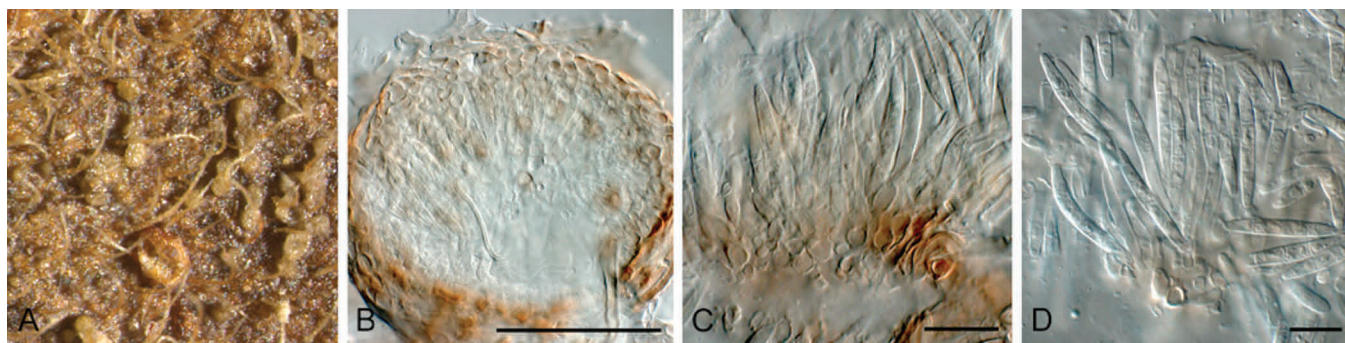


Fig. 14. *Asteromidium imperspicuum* [K(M) 180228]. A. Conidiomata on host surface. B. Section through conidioma. C, D. Conidiogenous cells and conidia. Scale bars: B = 75  $\mu$ m, all others = 10  $\mu$ m.

complex. The morphology of the specimen examined correlates well with the description provided by Sutton (1980).

**Ciferriella** Petr., Ann. Mycol. 28(5/6): 409. 1930.

Type species: *C. domingensis* Petr. & Cif., Ann. Mycol. 28(5/6): 409. 1930.

= *Pseudocercospora* Speg., Anales Mus. Nac. Hist. Nat. B. Aires, Ser. 3, 20: 437. 1910.

**Pseudocercospora domingensis** (Petr. & Cif.) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804401. Figs 15, 16.

Basionym: *Ciferriella domingensis* Petr. & Cif., Ann. Mycol. 28(5/6): 409. 1930.

*Leaf spots* amphigenous, subcircular, medium brown with dark purple margin, 1.5–6 mm diam. Sporulation hypophyllous, fasciculate to sporodochial, brown, arising from a brown stroma, up to 50  $\mu$ m diam. *Conidiophores* medium brown, smooth, subcylindrical, 0–2-septate, straight to once geniculate, 15–20  $\times$  3–5  $\mu$ m. *Conidiogenous cells* terminal, brown, smooth to finely verruculose, ampulliform to subcylindrical, proliferating sympodially or percurrently, tapering to a truncate apex, 2  $\mu$ m diam, 10–15  $\times$  3–4  $\mu$ m. *Conidia* brown, smooth, straight to slightly curved, obclavate, apex subobtuse, base obconically truncate, 0–3-septate, 35–60  $\times$  3–4  $\mu$ m.

*Specimen examined*: Dominican Republic, on *Vitex umbrosa* (Lamiaceae), 26 May 1929, coll. R. Ciferri, det. F. Petrak, **holotype** ex N.Y. Bot. Gard. No 01048475.

*Notes*: The dimensions of the conidia and conidiophores correlate with the observations of Sutton (1980). However, the conidiomata are sporodochial to fasciculate, and not acervular. *Ciferriella domingensis* is a typical *Pseudocercospora sensu* Crous *et al.* (2013). Based on the species presently known from *Vitex* (Crous & Braun 2003), it appears to represent a distinct taxon, for which a new combination in *Pseudocercospora* is proposed.

**Colletogloeum** Petr., Sydowia 7: 368. 1953.

*Mycelium* immersed, branched, septate, hyaline to pale brown. *Conidiomata* acervular, epidermal to subepidermal, separate, occasionally confluent, composed of hyaline to pale brown, thin-walled *textura angularis*. *Conidiophores* hyaline to pale brown, sparsely branched, septate, smooth, cylindrical or slightly irregular, formed from

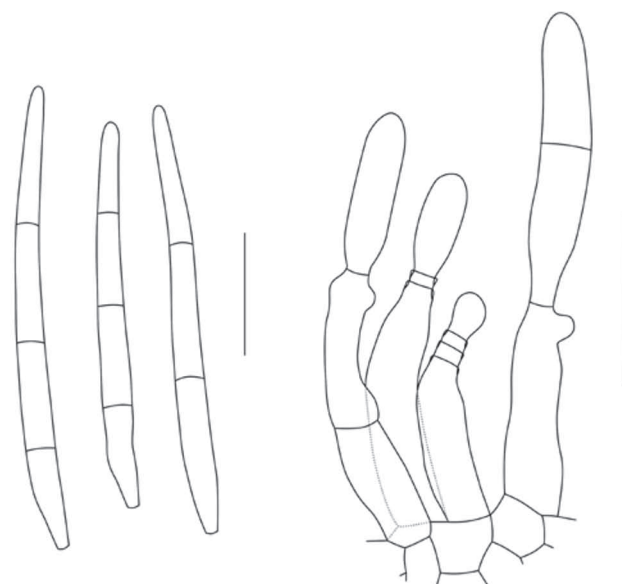


Fig. 15. Conidia and conidiogenous cells of *Pseudocercospora domingensis* (NY No 01048475). Scale bars = 10  $\mu$ m.

the upper cells of the acervulus. *Conidiogenous cells* integrated or discrete, indeterminate, cylindrical or doliiform, with several percurrent proliferations at apex. *Conidia* hyaline to pale brown, 0–multiseptate, straight, curved or irregular, truncate at the base, obtuse at the apex, usually thin-walled, smooth, guttulate or not.

Type species: *C. dalbergiae* (S. Ahmad) Petr., Sydowia 7: 369. 1953. [= *C. sissoo* (Syd.) B. Sutton, Mycol. Pap. 97: 14. 1964.]

*Notes*: The exact taxonomic position of *Colletogloeum* was unclear for a long time as it included many species that appear to represent asexual morphs of *Teratosphaeria*. Crous *et al.* (2009a–c) used ITS sequence data from a specimen representative of *C. sissoo* (IMI 119162) to demonstrate that the type of *Colletogloeum* clustered near the *Pseudocercospora* complex within the *Mycosphaerellaceae*.

**Cylindrosporium** Grev., Scott. crypt. fl. (Edinburgh) 1: pl. 27. 1822.

= *Cylindrodochium* Bonord., Handb. Allgem. mykol. (Stuttgart): 132. 1851.

*Mycelium* immersed, branched, septate, hyaline. *Conidiomata* acervular, white, slimy, subcuticular, separate or confluent, formed of pale brown to hyaline, thin-walled *textura angularis*; dehiscence irregular. *Conidiophores* hyaline, parallel, branched



Fig. 16. *Pseudocercospora domingensis* (NY No 01048475). A. Leaf spot. B, C. Conidiogenous cells. D. Conidia. Scale bars = 10 µm.

only at the base, 1–2-septate, smooth, formed from the upper pseudoparenchyma. *Conidiogenous cells* enteroblastic, phialidic, integrated, cylindrical, hyaline, smooth. *Conidia* straight or slightly curved, aseptate, cylindrical, thin-walled, smooth, hyaline, eguttulate (Sutton 1980).

*Type species:* *C. concentricum* Unger, Exanth. Pflanzen (Wien) 2: 9. 1833.

*Notes:* Sutton (1980), Von Arx (1983), Deighton (1987) and Braun (1990) could not agree on the taxonomic status of this genus, which is associated with light leaf spot of oil seed rape (sexual morph *Pyrenopeziza brassicae*). This genus is in need of revision, awaiting the recollection of fresh material of *C. concentricum* (on *Pulmonaria officinalis*, Germany).

***Phloeospora*** Wallr., Fl. Crypt. Germ. (Norimbergae) 2: 176. 1833.

*Mycelium* immersed, septate, hyaline. *Conidiomata* acervular, subepidermal, circular, discrete or confluent, composed of hyaline to pale brown, thin-walled *textura angularis*; dehiscence irregular. *Conidiophores* reduced to conidiogenous cells or with one or two supporting cells, branched at base or not. *Conidiogenous cells* holoblastic, annellidic, occasionally also sympodial, discrete, indeterminate hyaline, smooth, cylindrical, with several apical inconspicuous annellations, formed from the upper cells of the acervuli. *Conidia* hyaline, septate, smooth, guttulate or not, cylindrical, curved, attenuated towards the apices, apex obtuse to subobtuse, base truncate, with minute marginal frill.

*Type species:* *P. ulmi* (Fr.) Wallr., Fl. Crypt. Germ. (Norimbergae) 2: 177. 1833.

*Notes:* Sexual morphs of *Phloeospora* have been linked to genera that resemble the concepts of *Mycosphaerella*, *Didymella* and *Sphaerulina*. Verkley & Priest (2000) already noted that this genus is heterogeneous and in need of revision. The phylogenetic analysis performed in this study confirmed that *Phloeospora* (based on *P. ulmi*) clusters close to, but separate from *Septoria* s. str. (Fig. 1).

***Phloeosporella*** Höhn., Ann. Mycol. 22: 201. 1924. Fig. 17.

*Mycelium* immersed, branched, septate, hyaline. *Conidiomata* acervular, subepidermal, ± circular, discrete, composed of hyaline

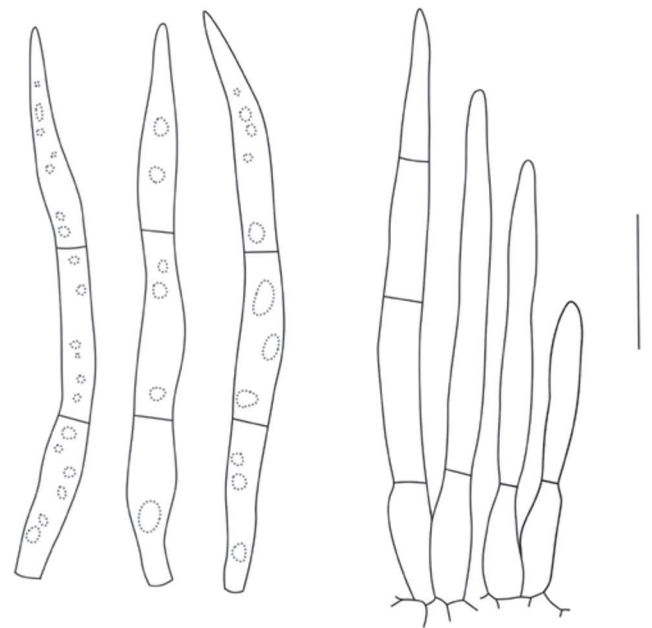


Fig. 17. Conidia and conidiogenous cells of *Phloeosporella ceanothi* (redrawn from Sutton 1980). Scale bar = 10 µm.

to pale brown, thin-walled *textura angularis*. *Conidiogenous cells* holoblastic, sympodial, discrete, indeterminate, hyaline, smooth, lageniform to cylindrical, with 1–2 broad, flat unthickened apical scars, formed from the upper pseudoparenchyma. *Conidia* hyaline, 2-euseptate, thin-walled, smooth, guttulate, straight, curved or irregular, tapered gradually to an obtuse apex and abruptly to a truncate base (Sutton 1980).

*Type species:* *P. ceanothi* (Ellis & Everh.) Höhn., Ann. Mycol. 22(1–2): 201. 1924.

*Notes:* Not much is known of the sexual state of this genus, but *P. padi* has been linked to *Blumeriella jaapii* (Sutton 1980). A phylogenetic analysis performed on available isolates (unpubl. data) indicated that *Phloeosporella* is polyphyletic. However, as the type is not known from culture (on *Ceanothus*, California, USA), this matter could not be resolved.

***Septogloeum*** Sacc., Michelia 2(6): 11. 1880.

*Mycelium* immersed, branched, septate, hyaline. *Conidiomata* acervular, epidermal to subepidermal, separate or confluent, formed

of pale brown thin-walled pseudoparenchyma. *Conidiophores* short, stout, 1–2-septate, hyaline, smooth, branched at the base, formed from the upper pseudoparenchyma. *Conidiogenous cells* phialidic, discrete or integrated, determinate, cylindrical, doliform to obpyriform, hyaline, smooth, with minute collarette and prominent periclinal thickening. *Conidia* hyaline, 1–3-euseptate, thin-walled, smooth, eguttulate, base truncate, apex obtuse, straight or curved, constricted, obovoid (Sutton 1980).

*Type species:* *S. carthusianum* (Sacc.) Sacc., *Michelia* 2(6): 11. 1880.

*Notes:* Although more than 120 species of *Septogloeum* have been described, the genus was reduced to just two species by Sutton & Pollack (1974). Sexual morphs have been linked to *Pleuroceras* in the *Diaporthales* (Monod 1983). The genus is in need of revision pending fresh collections.

### ***Xenocylindrosporium*** Crous & Verkley, *Fungal Planet* 44. 2009.

*Conidiomata* immersed, black, opening by irregular rupture, acervuloid, up to 300 µm diam; wall consisting of 3–4 layers of pale brown *textura angularis*. *Conidiophores* hyaline, smooth, subcylindrical, branched, septate, or reduced to ampulliform conidiogenous cells. *Conidiogenous cells* hyaline, smooth, ampulliform to subcylindrical, terminal or lateral on septate conidiophores, monophialidic with minute periclinal thickening. *Conidia* solitary, hyaline, smooth, curved, widest in middle, tapering to acutely rounded apex and truncate base, 0–1-septate.

*Type species:* *X. kirstenboschense* Crous & Verkley, *Fungal Planet* 44. 2009.

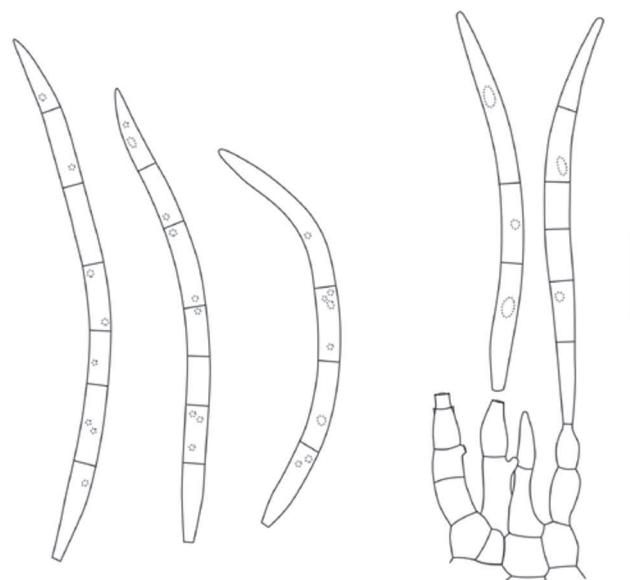
### **Stromatic forms**

#### ***Dothistroma*** Hulbary, *Bull. Ill. Nat. Hist. Surv.* 21: 235. 1941.

*Mycelium* immersed, branched, septate, pale brown to hyaline. *Conidiomata* sometimes acervular, initially subepidermal later erumpent, composed of pale brown, thin-walled *textura angularis*, sometimes eustromatic, multilocular and of darker brown, thick-walled tissue. *Stromata* are strongly erumpent and finally pulvinate. *Conidiogenous cells* holoblastic, discrete, determinate, ampulliform, hyaline, smooth, non-proliferating, formed from the upper cells of stroma or from inner cells of the locular walls. *Conidia* hyaline, straight or curved, filiform, 1–5-euseptate, continuous, thin-walled and smooth (Barnes *et al.* 2004).

*Type species:* *D. pini* Hulbary, *Bull. Ill. Nat. Hist. Surv.* 21: 235. 1941.

*Notes:* *Dothistroma* sexual morphs are mycosphaerella-like (Evans 1984), and the two species of *Dothistroma* that have been subjected to DNA sequencing (*D. septosporum* and *D. pini*) cluster together in the “*Dothistroma* clade” as described by Crous *et al.* (2009a, c). Because of a lack of recognisable morphological characteristics, it is virtually impossible to discriminate between *D. septosporum* and *D. pini* without molecular tools (Barnes *et al.* 2004). Multiple morphological varieties of both *D. septosporum* and *D. pini* have



**Fig. 18.** Conidia and conidiogenous cells of *Phlyctaeniella humuli* (IMI 202260) (redrawn from Sutton 1980). Scale bar = 10 µm.

been described based on differences in conidia length alone (e.g. *D. septosporum* var. *keniense*). However, controversy exists as to whether spore size represents an adequate characteristic to distinguish among these *Dothistroma* varieties, as since the introduction of molecular tools only *D. septosporum* and *D. pini* have been confirmed as distinct species.

#### ***Phlyctaeniella*** Petr., *Ann. Mycol.* 20: 323. 1922. Fig. 18.

*Mycelium* immersed, branched, septate, hyaline. *Conidiomata* eustromatic, separate, immersed, pale brown, globose, unilocular, scarcely erumpent; side wall and base of several cell layers of hyaline, thin-walled *textura angularis*, above of larger pale brown tissue. *Ostiole* indistinct, and dehiscence by rupture of the upper wall. *Conidiophores* hyaline, smooth, septate, irregularly branched, especially at the base, formed from the inner cells of the stroma wall. *Conidiogenous cells* phialidic, integrated or discrete, determinate, hyaline, markedly tapered at the apices, smooth, with apical or lateral apertures, collarette minute, with periclinal thickening; only rarely becoming percurrent. *Conidia* hyaline, smooth, thin-walled, irregularly guttulate, filiform, straight, curved or irregular, multiseptate (Sutton 1980).

*Type species:* *P. polonica* Petr., *Ann. Mycol.* 20: 323. 1922.

*Note:* Fresh material needs to be collected of this taxon (on *Aruncus silvestris*, Austria), before its taxonomy can be resolved.

#### ***Septocyta*** Petr., *Ann. Mycol.* 25: 330. 1927. Figs 19, 20.

*Mycelium* immersed, branched, septate, hyaline to pale brown. *Conidiomata* eustromatic, immersed, separate, erumpent, dark brown to black, finally opening widely, unilocular, multilocular or convoluted, thick-walled; wall of pale brown, thin-walled *textura angularis* except in the dehiscent region which is darker brown and more thick-walled. *Ostiole* absent, dehiscence by breakdown of the upper wall. *Conidiogenous cells* are holoblastic, sympodial with 1–3

Specimen examined: **Germany**, Brandenburg, on *Rubus fruticosus* (Rosaceae), 7 June 1923, coll. P. Sydow, det. H. Sydow, Sydow Mycoth. Germ. PDD 51271.

Notes: *Septocyta ramealis*, the type of *Septocyta*, has a long list of synonyms. The specimen examined here (PDD 51271), differs somewhat from the description provided by Sutton (1980), and appears to represent a species of *Septoria* s. str., as the mode of conidiogenesis is not that different. Presently there is a single ITS sequence labelled as *S. ruborum* available on GenBank (JN133277.1), placing it in the middle of *Septoria* s. str. As no type material of *S. ramealis* could be located, this matter remains unresolved.

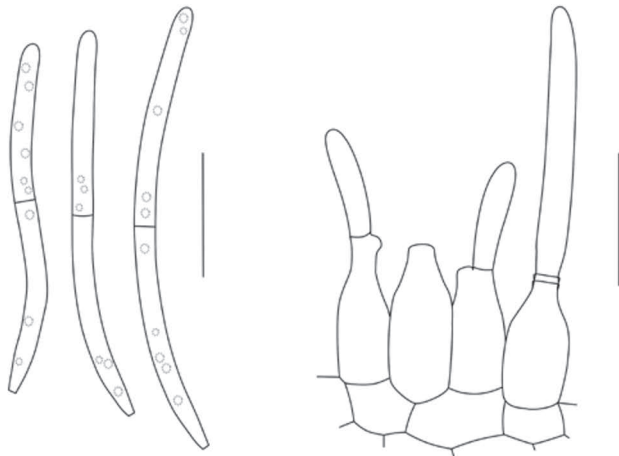


Fig. 19. Conidia and conidiogenous cells of *Septocyta ramealis* (PDD 51271). Scale bars = 10 µm.

apical, scarcely protruding, unthickened denticles, indeterminate, discrete, ampulliform to lageniform, hyaline, smooth, formed from the inner cells of the locular walls. *Conidia* hyaline, 1–3 euseptate, smooth, straight or slightly curved, acicular, apex obtuse, base truncate, often with minute guttules associated with septa (Sutton 1980).

Type species: *S. ramealis* (Roberge ex Desm.) Petr., Ann. Mycol. 25: 330. 1927.

***Septocyta ramealis*** (Roberge ex Desm.) Petr., Ann. Mycol. 25: 330. 1927.

*Conidiomata* eustromatic to pycnidial, black, up to 160 µm diam, aggregated in clusters, erumpent through ruptures in epidermis, convoluted; wall of 3–8 layers of brown *textura angularis*. *Conidiophores* lining the inner cavity, reduced to conidiogenous cells, or one or two supporting cells. *Conidiogenous cells* hyaline, smooth, ampulliform, proliferating sympodially and percurrently near apex, also with lateral denticle-like protrusions, 6–12 × 2.5–4 µm. *Conidia* hyaline, smooth, guttulate, (9–)20–30(–35) × 1.5(–2) µm, 1(–3)-septate, irregularly curved, subcylindrical, apex obtuse, base tapering slightly to truncate hilum, 0.5 µm diam.

***Septopatella*** Petr., Ann. Mycol. 23: 128. 1925.

*Mycelium* immersed, branched, septate, hyaline to subhyaline. *Conidiomata* superficial, often subtended by a superficial, pale brown, septate, branched mycelium, pulvinate, separate to occasionally aggregated, dark brown to black, finally opening widely, cupulate; basal wall of small-celled, brown, thin-walled *textura angularis*, becoming *textura porrecta* as it merges into the periclinal walls; a hypostroma attaches the conidioma to the substrate; *Ostiole* absent. *Conidiophores* hyaline, septate, branched at the base, thin-walled, cylindrical, formed from the gelatinized basal wall of the conidioma. *Conidiogenous cells* holoblastic, sympodial, integrated, indeterminate, cylindrical, hyaline, smooth, produced as 2–3 branches from the apex of the conidiophores. *Conidia* hyaline, 3–4-euseptate, thin-walled, smooth, minutely guttulate, straight or curved, occasionally irregularly filiform (Dyko & Sutton 1979, Sutton 1980).

Type species: *S. septata* (Jaap) Petr., Ann. Mycol. 23: 129. 1925.

Note: Not much is known about this genus, and as no cultures of *S. septata* are presently available (on *Pinus montana*, Czech Republic) this matter cannot be resolved.

***Stictosepta*** Petr., Sydowia 17: 230. 1964. [1963]. Fig. 21.

*Mycelium* immersed, branched, septate, hyaline. *Conidiomata* eustromatic, immersed, globose to collabent, papillate, unilocular, often convoluted, hyaline; walls thick, of hyaline, thin-walled

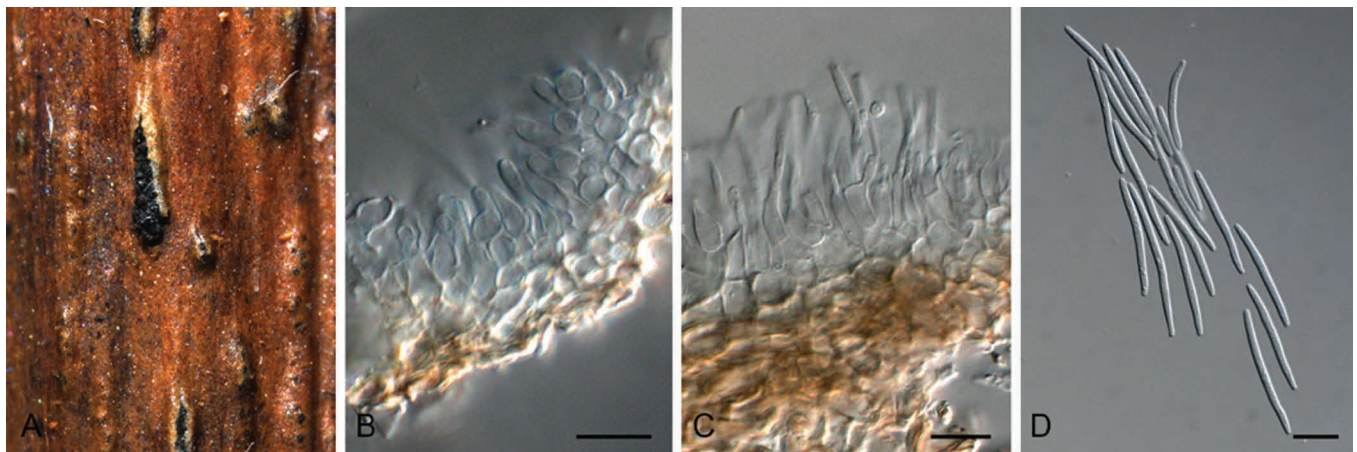


Fig. 20. *Septocyta ramealis* (PDD 51271). A. Conidiomata on host tissue. B, C. Conidiogenous cells. D. Conidia. Scale bar = 10 µm.



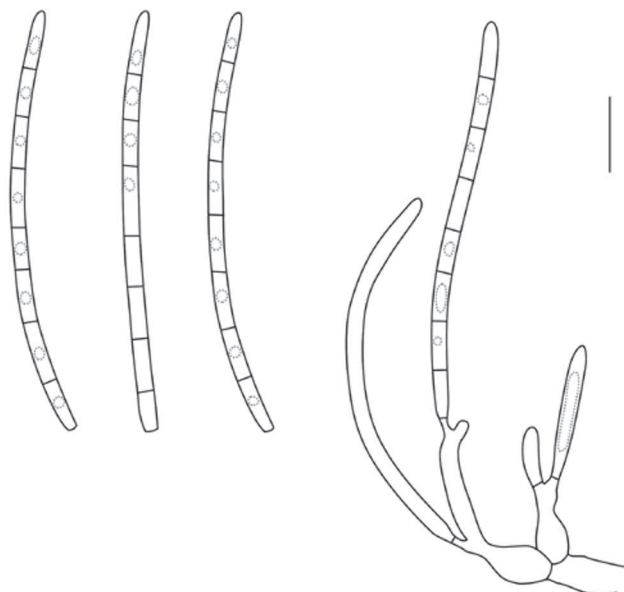


Fig. 21. Conidia and conidiogenous cells of *Stictosepta cupularis* (redrawn from Sutton 1980). Scale bar = 10  $\mu$ m.

*textura intricata*. Ostiole central and circular, single, furfuraceous. Conidiophores hyaline, septate, branched, anastomosing, formed from the inner cells of the locular wall. Conidiogenous cells sympodial or synchronous, integrated, indeterminate, hyaline, thin-walled, with usually two small, unthickened, apical, slightly protuberant conidiogenous loci. Conidia hyaline, thin-walled, smooth, multiseptate, slightly constricted at the septa, each cell medianly guttulate, straight or curved, base truncate, apex obtuse (Sutton 1980).

*Type species*: *S. cupularis* Petr., Sydowia 17: 230. 1964. [1963].

*Note*: Not much is known about this genus, but as no isolate of *S. cupularis* is presently available (on stems of *Fraxinus*, Czech Republic), it will not be treated here.

### Sexual morphs linked to *Septoria*

Several sexual genera have been linked to *Septoria* and allied genera in literature, but very few have been confirmed in culture. Most sexual states cluster in the *Mycosphaerella* complex.

***Mycosphaerella*** Johanson, Öfvers. K. Svensk. Vetensk.-Akad. Förhandl. 41(no. 9): 163. 1884.

= *Ramularia* Unger, Exanth. Pflanzen (Wien): 119. 1833.

*Mycelium* immersed to superficial, septate, hyaline, branched. *Caespituli* usually whitish to greyish on host tissue. Conidiophores fasciculate to synnematal, rarely solitary, or forming small sporodochia, emerging through stomata, from inner hyphae or stromata; conidiophores straight, subcylindrical to geniculate-sinuous, aseptate or septate, hyaline, occasionally branched, smooth, rarely rough. Conidiogenous cells integrated, terminal, polyblastic, elongating sympodially, apex more or less straight to geniculate-sinuous or strongly curved, cicatrized, conidial scars hardly to conspicuously thickened, but always darkened, refractive. Conidia solitary to catenate, sometimes in branched chains, 0–4(–multi)-septate, hyaline, ellipsoid-ovoid to cylindrical-fusoid, rarely filiform, occasionally constricted at the septa, smooth

to verruculose-echinulate; hila distinct, slightly to conspicuously thickened, darkened, refractive; conidial secession schizolytic. *Ascomata* immersed to superficial, uniloculate, globose to subglobose with papillate, central, periphysate ostiole, dark brown to black, scattered or gregarious. *Peridium* of 3–6 layers of thin- to thick-walled *textura angularis*, dark brown to black. *Hamathecium* dissolves at maturity, and no stromatic tissue remains between the asci. *Asci* bitunicate, fissitunicate, 8-spored, cylindrical to cylindrical-clavate, ovoid to ampulliform or saccate, sessile to subsessile, apex rounded with distinct or indistinct ocular chamber. *Ascospores* bi- to tri- or multiseriate, ellipsoid-fusoid to obclavate or subcylindrical, hyaline, medianly 1-septate, often constricted at the septum, smooth-walled, granular to guttulate, mostly lacking any sheath.

*Type species*: *Ramularia pusilla* Unger, Exanth. Pflanzen (Wien): 169. 1833.

*Notes*: Species of *Ramularia* (including the *Mycosphaerella* sexual morph) have evolved over a broad developmental and physiological adaptation range that includes endophytes, saprophytes and symbionts. However, for a major part *Ramularia* consists of a wide range of narrow host range, foliicolous plant pathogens which are the cause of significant economical losses in both temperate and tropical crops worldwide (Crous *et al.* 2001). Verkley *et al.* (2004) showed that *Mycosphaerella* s. str. (linked to *M. punctiformis*) was in fact restricted to species with *Ramularia* anamorphs, leaving many “*Mycosphaerella*” species to be disposed to other genera. In employing the one fungus = one name concept (Hawksworth *et al.* 2011, Wingfield *et al.* 2012), the choice is to use *Ramularia* over *Mycosphaerella*, as the former is monophyletic and recently monographed (Braun 1995, 1998), while *Mycosphaerella* is poly- and paraphyletic, and consists of more than 40 genera, many as yet untreated (Crous *et al.* 2009c)

***Sphaerulina*** Sacc., Michelia 1(no. 4): 399. 1878.

*Ascomata* pseudothecial, immersed, subepidermal, erumpent at the top, single to clustered, globose, papillate. Ostiole central, with hyaline periphyses; wall of *textura angularis*, composed of 2–4 layers of brown cells. *Hamathecium* dissolving at maturity. *Asci* bitunicate, fissitunicate, clustered, cylindrical to obclavate, rounded at apex, with or without a shallow apical chamber, short-stipitate or sessile, with 8 biseriate to triseriate ascospores. *Ascospores* subcylindrical to fusiform, rounded at ends, slightly tapered, straight or slightly curved, 1–3-septate, with a primary septum nearly median, hyaline, smooth, without sheath or appendages.

*Type species*: *Sphaerulina myriadea* (DC.) Sacc., Michelia 1(no. 4): 399. 1878.

*Notes*: The genus *Sphaerulina* was chiefly separated from *Mycosphaerella* on the basis of ascospore septation (Crous *et al.* 2011). *Sphaerulina myriadea*, which occurs on hosts in the *Fagaceae*, appears to be a species complex. Results in this paper show that *Sphaerulina myriadea* clusters together with many septoria-like species in a clade that is distinct, but very closely related to *Septoria* s. str. The septoria-like species in this *Sphaerulina* clade were subsequently redescribed in *Sphaerulina*. Species including ones with 1-septate ascospores and septoria-like asexual morphs are treated below and by Verkley *et al.* (2013).

## Treatment of phylogenetic clades

Based on the phylogenetic data generated in this study, we were able to delineate several clades in the *Septoria* complex. Recognised clades, as well as novel species and genera, are described and discussed below. Taxa with descriptions that are freely available online in MycoBank or open access journals, are not repeated here.

### Clade 1: *Septoria*

*Description:* See above.

*Type species:* *S. cytisi* Desm., Ann. Sci. Nat. Bot. 8: 24. 1847.

***Septoria* cf. *agrimoniicola*** Bondartsev, Mater. mikol. obsléd. Ross. 2: 6. 1921.

*Leaf spots* on the upper leaf surface, distinct, scattered, brown with purplish margin, circular to angular, sometimes vein-limited, discrete lesions 2–4 mm diam, reaching 10 mm wide when confluent, finally the center becoming pale colored to nearly whitish; on the lower leaf surface similar but discoloured (Shin & Sameva 2004). On sterile *Carex* leaves on WA. *Conidiomata* pycnidial, separate but frequently aggregated and linked by brown stromatic tissue in a stroma; globose, black, exuding a creamy conidial mass via a central ostiole; conidiomata up to 350 µm diam; wall of 6–12 layers of dark brown, thick-walled *textura angularis*. *Conidiophores* reduced to conidiogenous cells or 1–2 supporting cells, hyaline, subcylindrical, lining the inner layer of conidioma. *Conidiogenous cells* hyaline, smooth, subcylindrical to ampulliform, 10–17 × 3–4 µm; proliferating sympodially but also percurrently near apex. *Conidia* hyaline, smooth, guttulate, filiform, apex subobtuse, base long obconically truncate, 1–4-septate, (20–)25–35(–40) × 1.5–2(–2.5) µm; microcyclic conidiation observed.

*Culture characteristics:* Colonies on PDA flat, undulate with sparse, white aerial mycelium, surface olivaceous-black, reverse olivaceous-black, after 14 d, 3.5 cm diam; on MEA with sparse white aerial mycelium, surface olivaceous-black, reverse olivaceous-black, after 14 d, 5 cm diam; on OA with sparse white aerial mycelium, surface olivaceous, reverse olivaceous, after 14 d, 3 cm diam.

*Specimen examined:* **South Korea**, Guri, on leaves of *Agrimonia pilosa* (Rosaceae), 11 Jul. 2009, H.D. Shin (CBS H-21279, culture CBS 128602 = KACC 44644 = SMKC 24292).

*Notes:* This fungus was first reported from Korea by Shin & Sameva (2002) as *S. agrimoniicola*, and fits well with the original description of this European taxon. However, fresh European collections and cultures are required for comparison, as *S. agrimoniicola* may well be restricted to Europe.

***Septoria* cf. *stachydicola*** Hollós, Mathem. Természettud. Közlem. Magg. Tudom. Akad. 35(1): 60. 1926.

*Leaf spots* on the upper leaf surface distinct, scattered, brown with purplish margin, circular to angular, sometimes vein-limited, discrete lesions 2–4 mm diam, reaching 10 mm wide when

confluent, finally the center becoming paler or nearly whitish; on the lower leaf surface similar but discoloured (Shin & Sameva 2004). On OA. *Conidiomata* solitary to aggregated, black, globose, becoming somewhat papillate, up to 250 µm diam, opening by means of central ostiole, up to 40 µm diam; wall of 6–8 layers of thick-walled, brown *textura angularis*; exuding a creamy conidial mass. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* lining the inner wall layer, hyaline, discrete, ampulliform to lageniform, 4–10 × 3–5 µm, proliferating sympodially or percurrently with inconspicuous proliferations. *Conidia* filiform, curved or flexuous, rarely straight, (60–)65–75(–90) × 1.5–2(–3) µm, hyaline, guttulate, 4–7(–11)-septate, apex subobtuse, slightly tapering from basal septum to truncate base, 1.5–2 µm.

*Culture characteristics:* Colonies on PDA erumpent, with feathery margin, with sparse white aerial mycelium, surface greenish-black, reverse olivaceous-black, after 14 d, 2.5 cm diam; on MEA with sparse white aerial mycelium, surface cinnamon to olivaceous-black in the younger patches, reverse cinnamon to olivaceous-black in patches, after 14 d, 4 cm diam; on OA with sparse white aerial mycelium, surface greenish-black, reverse fuscous-black, after 14 d, 3 cm diam.

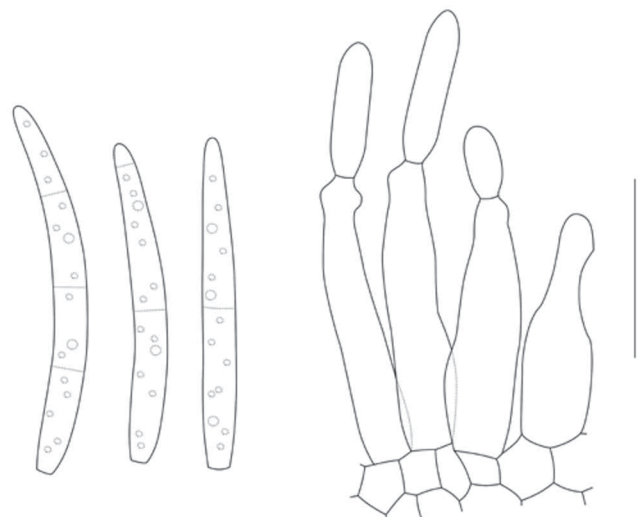
*Specimen examined:* **South Korea**, Incheon, leaf of *Stachys riederi* var. *japonica* (Lamiaceae), 14 Aug. 2008, H.D. Shin (CBS H-21278, culture CBS 128668 = KACC 44796 = SMKC 24663).

*Note:* The Korean collection was originally identified as *Septoria stachydicola*, which fits the original description provided for this taxon (Shin & Sameva 2004). However, authentic European material is required for a comparison to confirm this identification, as we suspect *S. stachydicola* may be restricted to Europe.

***Septoria cretae*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804402. Figs 22, 23.

*Etymology:* Named after Crete, the island from where it was collected.

On sterile *Carex* leaves on WA. *Conidiomata* up to 250 µm diam, brown, immersed, subepidermal, pycnidial, subglobose with central



**Fig. 22.** Conidia and conidiogenous cells of *Septoria cretae* (CBS 135095). Scale bar = 10 µm.

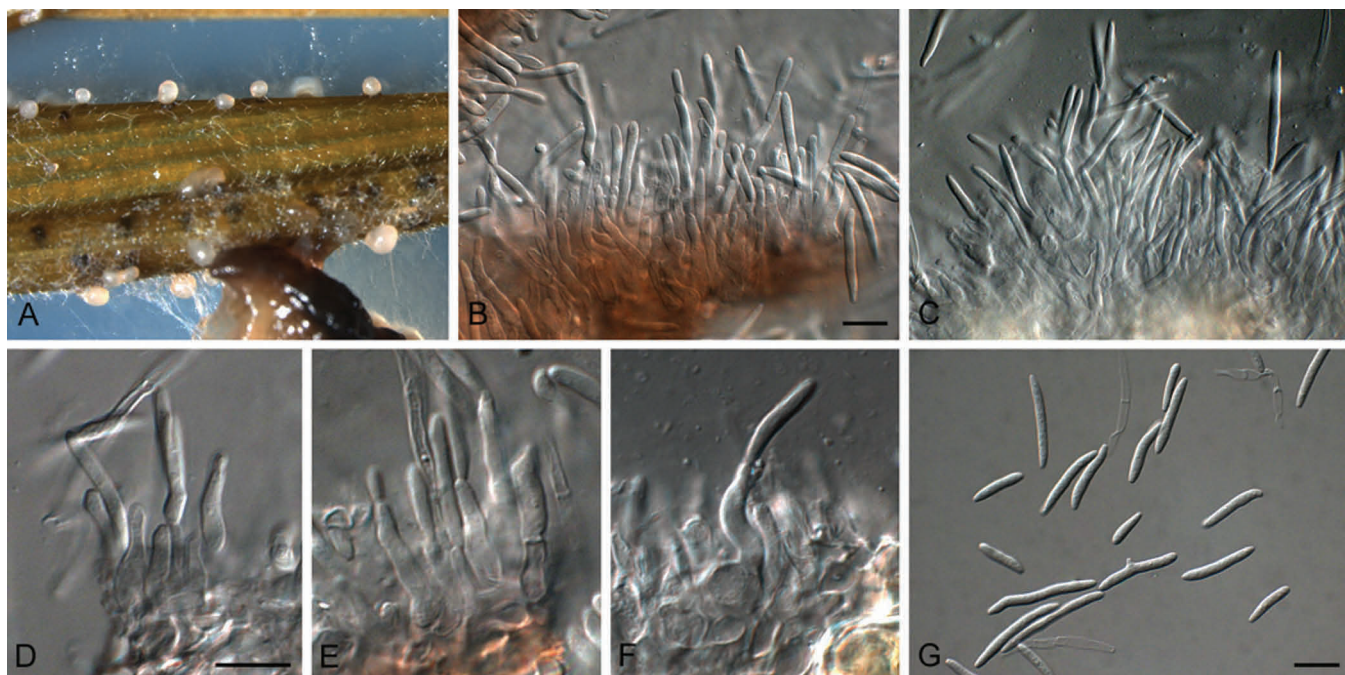


Fig. 23. *Septoria cretae* (CBS 135095). A. Colony sporulating in culture. B–F. Conidiophores and conidiogenous cells giving rise to conidia. G. Conidia. Scale bars = 10 µm.

ostiole, exuding creamy conidial mass; wall of 2–3 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells, or with a supporting cell that gives rise to several conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to subcylindrical, straight to curved, proliferating sympodially near apex, 10–20 × 2–3.5 µm. *Conidia* hyaline, smooth, thin-walled, subcylindrical to narrowly obclavate, granular, with subobtuse apex and obconically truncate to truncate base, 1–3-septate, (8–)15–22(–27) × 2(–3) µm.

*Culture characteristics*: Colonies on PDA erumpent, with feathery margin, lacking aerial mycelium, surface fuscous-black, reverse olivaceous-black, after 14 d, 3.5 cm diam; on MEA surface fuscous-black, reverse olivaceous-black, after 14 d, 4 cm diam; on OA surface fuscous-black, reverse fuscous-black, after 14 d, 3.5 cm diam.

*Specimen examined*: Greece, Crete, on leaves of *Nerium oleander* (Apocynaceae), 7 Jul. 2012, U. Damm, (holotype CBS H-21277, culture ex-type CBS 135095).

*Notes*: Several species of *Septoria* are known on *Nerium oleander*, namely *S. juliae* [conidia 1–6(–7)-septate, 26–54 × 2.5–5.5 µm], *S.*

*neriicola* (conidia 1-septate, 30–40 × 0.7–1 µm), *S. oleandriicola* [conidia 1–3-septate, 12.5–22.5–37.5(–40) × 2.5–3(–4.5) µm], *S. oleandrina* (conidia 0–1-septate, 9–19 × 1–1.5 µm), and *S. roll-hansenii* (conidia 0–4-septate, 25–39 × 3–4 µm) (Bedlan 2011), which differ from *S. cretae* based on conidial dimensions and septation.

***Septoria glycinicola*** Quaedvlieg, H.D. Shin, Verkley & Crous, *sp. nov.* MycoBank MB804403. Fig. 24.

*Etymology*: Named after the host genus on which it was collected, *Glycine*.

On OA. *Conidiomata* forming in concentric circles, pycnidial, separate, black, globose, up to 150 µm diam, opening by a central ostiole, up to 30 µm diam, exuding a creamy conidial mass; wall consisting of 3–6 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* lining the inner cavity, hyaline, smooth, ampulliform, 10–16 × 2.5–3.5 µm, proliferating sympodially near apex, holoblastic.

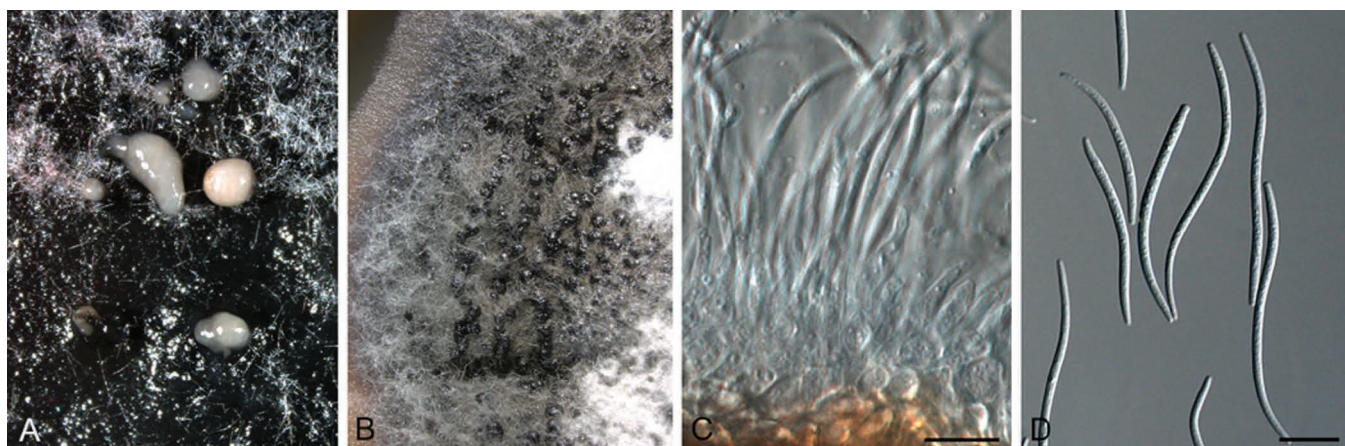


Fig. 24. *Septoria glycinicola* (CBS 128618). A, B. Colonies sporulating on PDA. C. Conidiogenous cells. D. Conidia. Scale bars = 10 µm.

*Conidia* hyaline, smooth, guttulate to granular, subcylindrical to narrowly obclavate, irregularly to gently curved, apex subobtuse, base long obconically truncate, 3–6-septate, (33–)45–55(–65) × (1.5–)2 µm.

**Culture characteristics:** Colonies on PDA flat, circular, with sparse black aerial mycelium with black tufts, surface patches of olivaceous-black to fawn in the younger parts, reverse with patches of olivaceous-black in the older parts to mouse-grey and pale purplish grey in the younger mycelium, after 14 d, 6.5 cm diam, pinkish exudate; on OA lobate, with sparse white aerial mycelium, surface patches of vinaceous to olivaceous-black, reverse fuscous-black to vinaceous-buff; after 14 d, 8.5 cm diam, pinkish exudate; on MEA with radial lobes, very short white aerial mycelium, surface fuscous-black, reverse olivaceous-black; after 14 d, 4.5 cm diam.

**Specimen examined:** South Korea, Namyangju, on leaves of *Glycine max* (*Fabaceae*), 22 Sep. 2008, H.D. Shin (**holotype** CBS H-21270, culture ex-type CBS 128618 = KACC 43091 = SMKC 22879).

**Notes:** *Septoria glycines* is the common *Septoria* species associated with brown spot of soybeans. *Septoria glycinicola* is distinct from *S. glycines* (conidia 1–4 septate, 21–45 × 1.5–2 µm) in that it has larger conidia.

***Septoria oenanthicola*** Quaedvlieg, H.D. Shin, Verkley & Crous, **sp. nov.** MycoBank MB804405. Fig. 25.

**Etymology:** Named after the host genus from which it was collected, *Oenanthe*.

On sterile *Carex* leaves on WA. *Conidiomata* pycnidial, separate but aggregated, black, globose, up to 200 µm diam, opening by central ostiole, up to 20 µm diam, exuding a creamy conidial mass; wall consisting of dark brown, thickened, 6–10 layers of *textura angularis*. *Conidiophores* reduced to conidiogenous cells or to one

supporting cell. *Conidiogenous cells* hyaline, smooth, 3–5 × 3–7 µm, ampulliform, proliferating sympodially near apex, holoblastic. *Conidia* hyaline, smooth, guttulate, subcylindrical to narrowly obclavate, apex subobtuse, base long obconically truncate, 1–6-septate, (17–)25–45(–55) × (2–)2.5(–3) µm.

**Culture characteristics:** Colonies on PDA flat, undulate with sparse, white aerial mycelium, surface olivaceous-grey, reverse olivaceous, after 14 d, 2.5 cm diam; on MEA with sparse, white aerial mycelium, surface olivaceous-grey, reverse olivaceous-black, after 14 d, 5 cm diam; on OA with sparse white aerial mycelium, surface olivaceous-grey, reverse olivaceous, after 14 d, 3 cm diam.

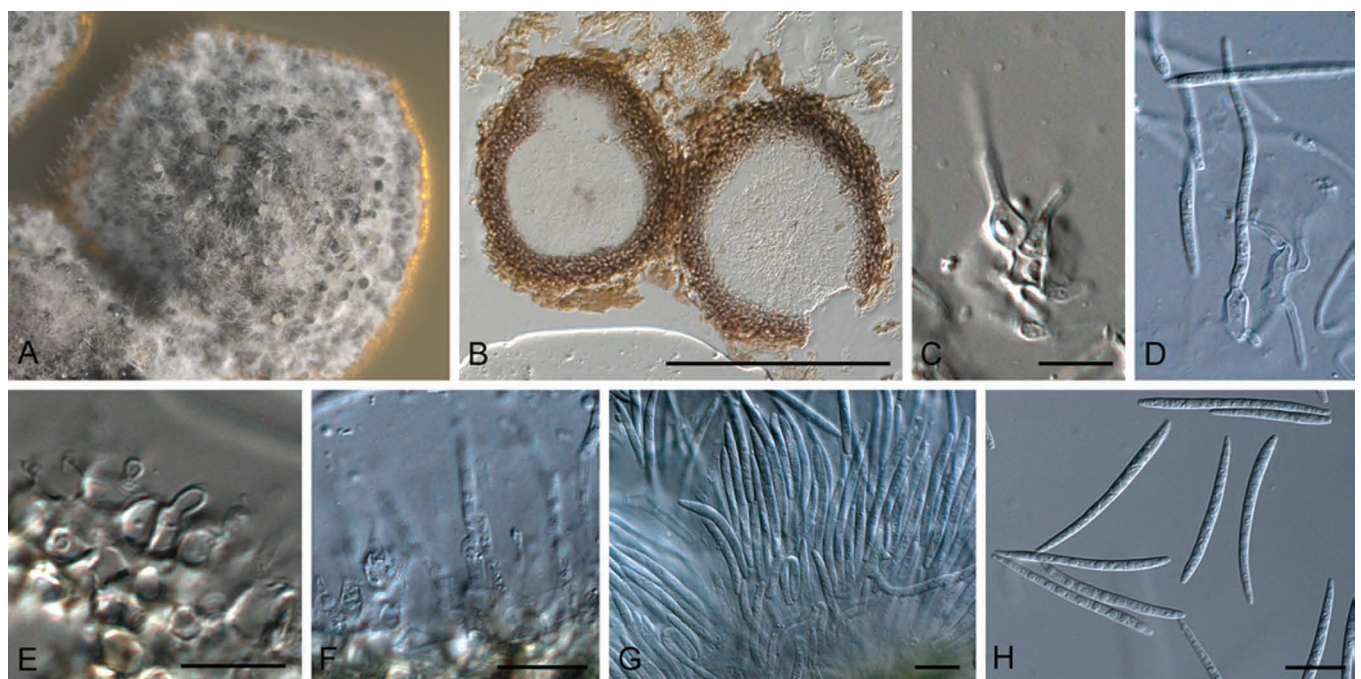
**Specimen examined:** South Korea, Yangpyeong, on leaves of *Oenanthe javanica* (*Apiaceae*), 25 May 2006, H.D. Shin (**holotype** CBS H-21281, culture ex-type CBS 128649 = KACC 42394 = SMKC 21807).

**Notes:** This fungus was originally recorded from Korea by Shin (1998) as *Septoria oenanthis*. However, conidia of Korean specimens (30–60 × 1.5–2.5 µm; Shin & Sameva 2004) are much larger than that of the American type collection (20–35 × 1.5–2 µm; Saccardo 1895), and therefore better treated as a separate taxon.

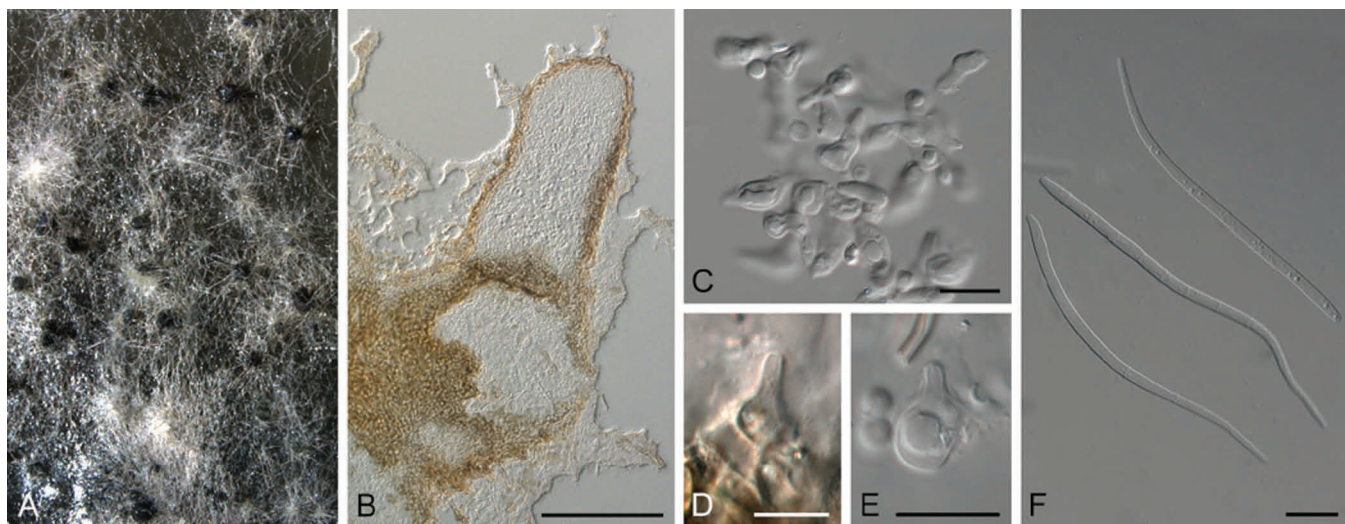
***Septoria pseudonapelli*** Quaedvlieg, H.D. Shin, Verkley & Crous, **sp. nov.** MycoBank MB804404. Fig. 26.

**Etymology:** Named after its morphological similarity to *Septoria napelli*.

*Leaf spots* on the upper leaf surface, scattered to confluent, distinct, angular to irregular, usually vein-limited, small to large, up to 30 mm when confluent, at first appearing small angular brown discoloration, later turning blackish brown with or without distinct border line, finally central area becoming blackish and surrounded by pale greenish margin; on the lower leaf surface similar but discoloured (Shin



**Fig. 25.** *Septoria oenanthicola* (CBS 128649). A. Colony sporulating on MEA. B. Section through conidiomata. C–G. Conidiogenous cells. H. Conidia. Scale bars: B = 200 µm, all others = 10 µm.



**Fig. 26.** *Septoria pseudonapelli* (CBS 128664). A. Colony sporulating on PDA. B. Section through conidioma. C–E. Conidiogenous cells. F. Conidia. Scale bars: B = 125  $\mu$ m, all others = 10  $\mu$ m.

& Sameva 2004). On sterile *Carex* leaves on WA. *Conidiomata* pycnidial, separate, black, globose, papillate with short neck (at times 1–2 necks develop), up to 250  $\mu$ m wide, 500  $\mu$ m high with central ostiole; wall of 5–7 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* ampulliform, lining the inner cavity, hyaline, smooth, with sympodial or apical percurrent proliferation, 10–13  $\times$  5–7  $\mu$ m. *Conidia* filiform, curved to flexuous, (50–)75–90(–100)  $\times$  (2.5–)3(–3.5)  $\mu$ m, hyaline, guttulate, 4–10-septate, apex subobtuse, base obconically truncate, 2  $\mu$ m diam.

*Culture characteristics:* Colonies on PDA flat, undulate with sparse, white aerial mycelium, surface olivaceous-black, reverse olivaceous-black, after 14 d, 2 cm diam; on MEA with sparse white aerial mycelium, surface olivaceous-black, reverse olivaceous-black, after 14 d, 4 cm diam; on OA with sparse white aerial mycelium, surface olivaceous, reverse olivaceous, after 14 d, 2 cm diam.

*Specimen examined:* South Korea, Chuncheon, on leaves of *Aconitum pseudolaeve* var. *erectum* (*Ranunculaceae*), 4 Sep. 2008, H.D. Shin (holotype CBS H-21280, culture ex-type CBS 128664 = KACC 43952 = SMKC 23638).

*Notes:* This taxon was originally reported as *Septoria napelli* from Korea by Shin & Sameva (2004), and broadly corresponds with the original description provided for this taxon (Petra 1957). However, we have examined European material authentic for the name (see Verkley *et al.* 2013, this issue), from which the Korean fungus is genetically different. Based on these observations we describe the Korean collection as new.

## Clade 2: *Sphaerulina*

*Sphaerulina* Sacc., *Michelia* 1(no. 4): 399. 1878.

*Description:* See above.

*Type species:* *Sphaerulina myriadea* (DC.) Sacc., *Michelia* 1(no. 4): 399. 1878.

*Specimens examined:* Germany, Driesen, Lasch [Rabenhorst, *Fungi Eur.* no. 149] (L). Japan, Aomori, Tsugaru, Kidukuri, Bense-marsh (40°51'53" N, 140°17'42"E), on leaves of *Q. dentata*, 21 Apr. 2007, K. Tanaka 2243 (HHUF 29940; single ascospore culture CBS 124646 = JCM 15565). UK, on leaves of *Quercus robur*

(*Fagaceae*), J.E. Vize [*Microfungi Brit. Ex. No.* 195] (ex IMI 57186, K(M) 167735). USA, California: Sequoia National Park, alt. 2590 m, on leaves of *Castanopsis sempervirens*, 18 Jun. 1931, H.E. Parks (BPI 623686); Lake Co., Hoberg's Resort, on leaves of *Q. kelloggii*, 15 May 1943, V. Miller (BPI 623707); Maryland, Marlboro, on leaves of *Q. alba*, 26 Apr. 1929, C.L. Shear (BPI 623705); Texas, Houston, on leaves of *Q. alba*, 8 Apr. 1869, H.W. Ravenel (BPI 623704).

*Notes:* Sivanesan (1984) linked *Sphaerulina* to *Septoria*, *Cercospora* and *Cercosporella* asexual morphs, though these were never confirmed based on DNA data. The latter two genera have since been shown to be distinct (Crous *et al.* 2013, Groenewald *et al.* 2013; this volume), which leaves septoria-like asexual morphs such as *Sphaerulina rubi* Demaree & Wilcox (linked to *Cylindrosporium rubi* Ellis & Morgan), and *S. rehmi* (linked to *Septoria rosae*), which confirms the results obtained here (Fig. 1).

*Sphaerulina abeliceae* (Hiray.) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804406.

*Basionym:* *Septoria abeliceae* Hiray., *Mem. Col. Agr. Kyoto. Imp. Univ.* 13(3): 33. 1931.

*Specimen examined:* South Korea, Jeonju, on leaves of *Zelkova serrata* (*Ulmaceae*), 29 Oct. 2006, H.D. Shin, CBS 128591 = KACC 42626.

*Sphaerulina amelanchier* Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804407. Figs 27, 28.

*Etymology:* Named after the host genus from which it was collected, *Amelanchier*.

On sterile *Carex* leaves on WA. *Conidiomata* pycnidial, brown, separate, immersed, globose, up to 150  $\mu$ m diam, exuding a creamy conidial mass via central ostiole; wall of 3–6 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* hyaline, smooth, subcylindrical, irregularly curved, branched to once geniculate-sinuuous, 5–20  $\times$  3–4  $\mu$ m; proliferating sympodially. *Conidia* hyaline, smooth, guttulate, filiform, narrowly obclavate, apex subacutely rounded, base long obconically truncate, 1–8-septate, (25–)40–55(–60)  $\times$  (1.5–)2(–2.5)  $\mu$ m; microcyclic conidiation common. *Ascomata* globose, brown,

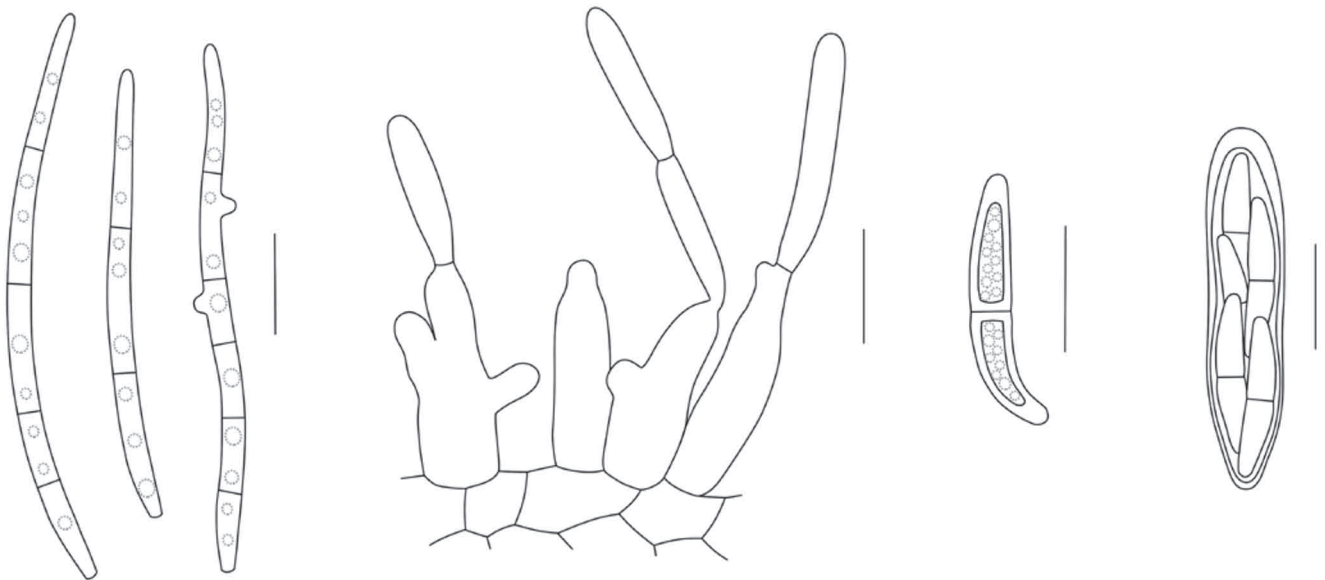


Fig. 27. Conidia, conidiogenous cells, ascospore and ascus of *Sphaerulina amelanchier* (CBS 135110). Scale bars = 10 µm.

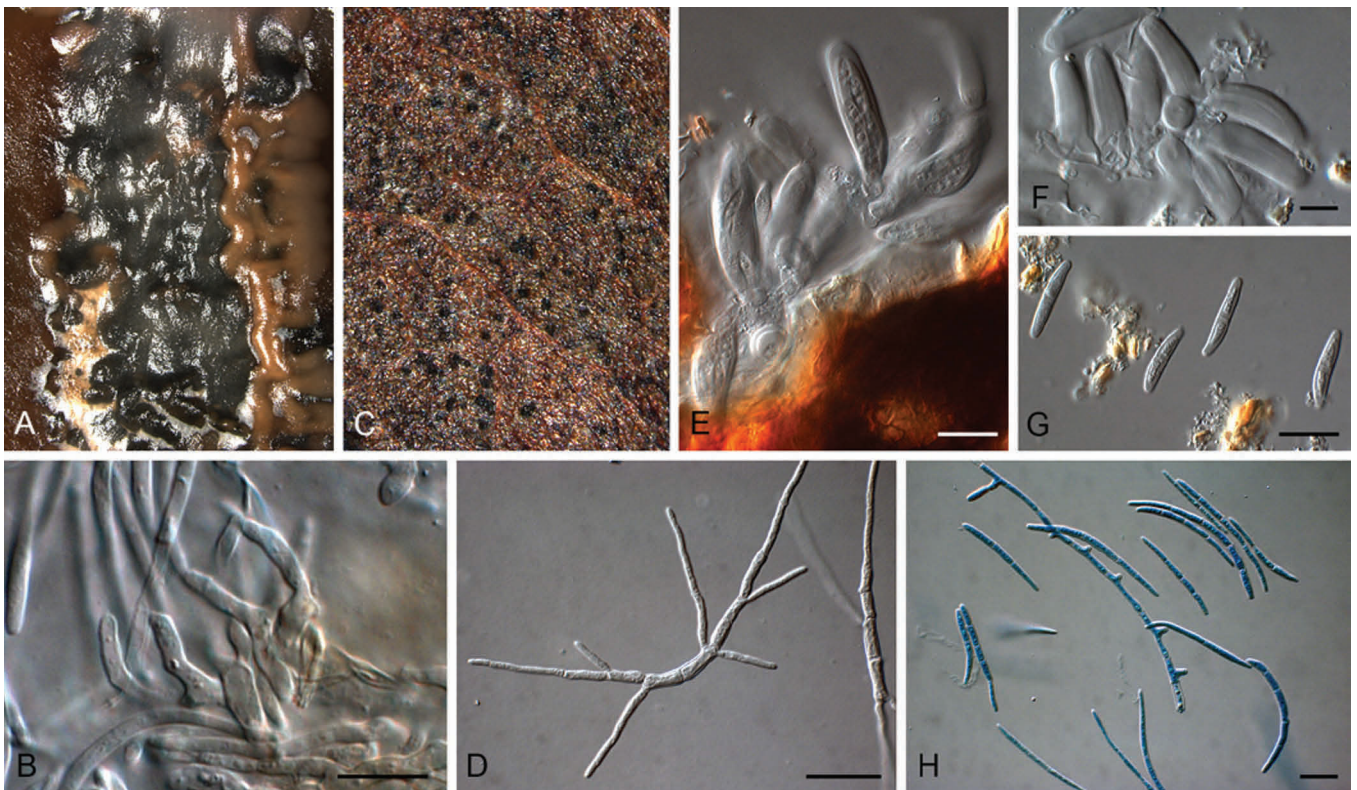


Fig. 28. *Sphaerulina amelanchier* (CBS 135110). A. Colony on PDA. B. Conidiogenous cells. C. Ascomata on host tissue. D. Germinating ascospore. E, F. Asci. G. Ascospores. H. Conidia. Scale bars = 10 µm.

separate, immersed to erumpent, up to 150 µm diam. *Asci* broadly ellipsoid to obclavate, 22–35 × 7–9 µm; apical chamber visible, 1–1.5 µm diam. *Ascospores* fusoid-ellipsoid, hyaline, smooth, granular, not to slightly constricted at median septum, widest just above septum, prominently curved, (13–)17–20(–25) × (2.5–)3(–3.5) µm. *Ascospores* germinating from both ends, with germ tubes parallel to the long axis, developing lateral branches and becoming constricted at septum, 3–4 µm diam.

*Culture characteristics*: Colonies on PDA radially striate with lobate edge, sparse white aerial mycelium, surface fuscous-black to buff for the younger tissue, reverse cinnamon to olivaceous-black, after

14 d, 3 cm diam; on MEA surface patches of hazel to fawn to fuscous-black, reverse sepia to olivaceous-black, after 14 d, 4.5 cm diam; on OA surface pale-vinaceous to fuscous-black, reverse cinnamon to fuscous-black, after 14 d, 3 cm diam.

*Specimen examined*: Netherlands, Houten, on leaf litter of *Amelanchier* sp. (*Rosaceae*), 28 Mar. 2012, S. Videira (**holotype** CBS H-21282, culture ex-type CBS 135110 = MP8 = S544).

*Note*: Presently there are no known species of septoria-like fungi known from *Amelanchier*. Phylogenetically, it is similar to *Sphaerulina rhabdoclinis* (conidia 8–30 × 1.5–2 µm), which infects needles of *Pseudotsuga menziesii*. Phylogenetically similar

isolates occur on *Betula*, *Castanea* and *Quercus*. More isolates and molecular data are required to resolve this complex.

***Sphaerulina azaleae*** (Voglino) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804408.

*Basionym:* *Septoria azaleae* Voglino, Syll. Fung. (Abellini) 14(2): 976. 1899.

= *Phloeospora azaleae* (Voglino) Priest, Fungi of Australia: 224. 2006.

*Specimens examined:* **Belgium**, on leaves of *Rhododendron* sp. (*Ericaceae*), J. van Holder, CBS 352.49. **South Korea**, Hongcheon, on leaves of *Rhododendron* sp., 18 Oct. 2009, H.D. Shin, KACC 44865 = CBS 128605.

***Sphaerulina berberidis*** (Niessl) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804409.

*Basionym:* *Septoria berberidis* Niessl, in Rabenhorst, Bot. Ztg. 24: 411. 1866.

= *Sphaerella berberidis* Auersw., in Gonnermann & Rabenhorst, Mycol. eur. Abbild. Sämmtl. Pilze Eur. 5-6: 3. 1869 (nom. nov. for *Sphaeria berberis* Nitschke ex Fuckel).

= *Mycosphaerella berberidis* (Auersw.) Lindau, in Engler & Prantl, Nat. Pflanzenfam., Teil. I (Leipzig) 1(1): 424. 1897.

*Description in vitro* (CBS 116724): Colonies on OA 16–20 mm diam after 14 d, with an even, colourless margin; colonies spreading to restricted, somewhat elevated in the centre, the surface covered by a dense mat of pure white, woolly aerial mycelium; reverse in the centre dark brick to brown vinaceous, surrounded by cinnamon tinges; small amounts of a yellow to greenish pigment diffusies into the surrounding medium. Colonies on MEA 8–10 mm diam after 14 d, with an even to slightly ruffled vinaceous buff margin; colonies restricted, pustulate, the surface ochraceous or darker, with diffuse to locally more dense finely felted grey aerial mycelium; reverse brown vinaceous to vinaceous buff. Culture remained sterile.

*Specimen examined:* **Switzerland**, Kt. Graubünden, Rodels-Realta, on *Berberis vulgaris* (*Berberidaceae*), 2 Jun. 1951, E. Müller, specimen CBS-H4984, culture CBS 324.52.

***Sphaerulina betulae*** (Pass.) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804410.

*Basionym:* *Septoria betulae* Pass., Primo Elenc. Funghi Parm.: no. 52. 1867.

*Specimens examined:* **Netherlands**, Olst, leaves of *Betula pubescens* (*Betulaceae*), Sep. 2004, S. Green, CBS 116724. **South Korea**, Hongcheon, leaves of *B. platyphylla* var. *japonica*, 27 May 2008, H.D. Shin, CBS 128600 = KACC 43769.

***Sphaerulina cercidis*** (Fr.) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804411.

*Basionym:* *Septoria cercidis* Fr., in Léveillé, Ann. Sci. Nat., Bot., Sér. 3 9: 251. 1848.

= *Septoria provincialis* Crous, Stud. Mycol. 55: 127. 2006.

*Specimens examined:* **Argentina**, La Plata, on *Cercis siliquastrum* (*Caesalpinaceae*), 12 Feb. 2008, H.D. Shin, KACC 43596 = CBS 129151; on *C. siliquastrum*, 1 Sep. 2007, H.D. Shin, KACC 44497 = CBS 128634. **France**, Provence, Cheval Blanc camping site, on leaves of *Eucalyptus* sp., 29 Jul. 2005, P.W. Crous, **holotype** of *S. provincialis*, CBS H-19701, culture ex-type CBS 118910. **Netherlands**, on *C. siliquastrum*, Sep. 1950, G. van den Ende, CBS 501.50.

***Sphaerulina menispermi*** (Thüm.) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804412.

*Basionym:* *Septoria menispermi* Thüm., Pilzflora Siber.: no. 818. 1880.

*Specimens examined:* **South Korea**, Chuncheon, on leaves of *Menispermum dauricum* (*Menispermaceae*), 16 Jun. 2008, H.D. Shin, KACC 43848 = CBS 128761; Pyeongchang, on leaves of *M. dauricum*, 23 Sep. 2008, H.D. Shin, KACC 43968 = CBS 128666.

***Sphaerulina musiva*** (Peck) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804413.

*Basionym:* *Septoria musiva* Peck, Ann. Rep. N.Y. St. Mus. Nat. Hist. 35: 138. 1883 [1881]

= *Mycosphaerella populorum* G.E. Thomps., Phytopathology 31: 246. 1941.

= *Davidiella populorum* (G.E. Thomps.) Aptroot, CBS Diversity Ser. (Utrecht) 5: 164. 2006.

= *Cylindrosporium oculatum* Ellis & Everh., J. Mycol. 5(3): 155. 1889.

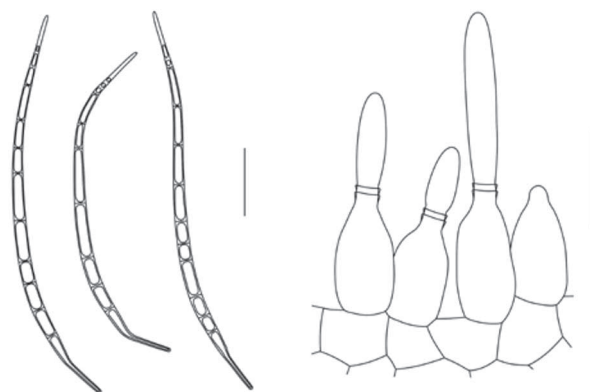
*Specimen examined:* **Canada**, Quebec, leaf spot of *Populus deltoids* (*Salicaceae*), J. LeBoldus, CBS 130570.

***Sphaerulina oxyacanthae*** (Kunze & J.C. Schmidt) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804414. Figs 29, 30.

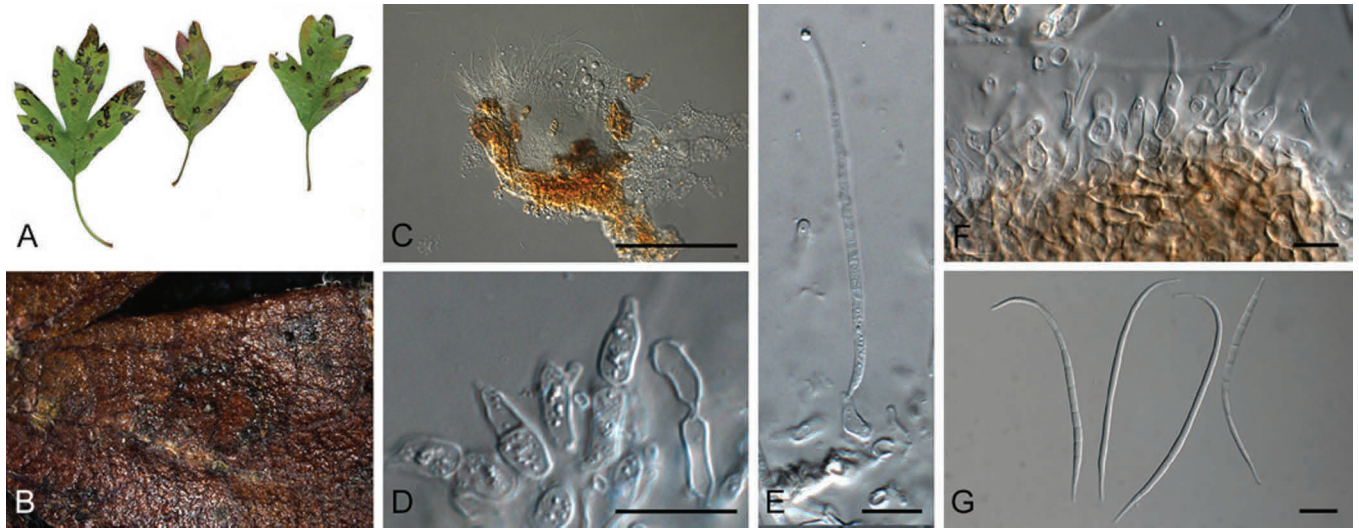
*Basionym:* *Septoria oxyacanthae* Kunze & J.C. Schmidt, Myk. Hefte (Leipzig) 2: 108. 1823.

= *Phloeospora oxyacanthae* (Kunze & J.C. Schmidt) Wallr., Fl. Crypt. Germ. (Norimbergae) 2: 117. 1833.

*Leaf spots* amphigenous, medium to dark brown, subcircular to angular, 1–6 mm diam, with dark brown border. *Conidiomata* epiphyllous, up to 150 µm diam, brown, immersed, subepidermal, opening by irregular rupture of upper layer, with 3–4 apical flaps, exuding a long crystalline flame-like cirrhus of conidia; wall 3–8 layers of brown *textura angularis*. On sterile *Carex* leaves on WA. *Conidiophores* reduced to conidiogenous cells, or with one supporting cell that can become fertile, forming a lateral conidiogenous locus just below the septum, 10–20 × 2.5–4 µm. *Conidiogenous cells* hyaline, smooth, aggregated, lining the inner cavity, terminal and lateral, ampulliform, 5–10 × 2.5–3.5 µm; proliferating several times percurrently near apex. *Conidia* hyaline, smooth, guttulate, 6–12-septate, falcate, widest in lower third of conidium, flexuous, apical cell tapering to subacute apex, forming a curved apical appendage-like elongation, 10–17 µm long, median cells are 5–10 µm long, basal cell forming an eccentric appendage that tapers to a subacutely rounded base, scar approximately 2–4



**Fig. 29.** Conidia and conidiogenous cells of *Sphaerulina oxyacanthae* (CBS 135098). Scale bars = 10 µm.



**Fig. 30.** *Sphaerulina oxyacanthae* (CBS 135098). A. Leaves with leaf spots. B. Close-up of conidiomata. C. Section through conidioma. D–F. Conidiogenous cells. G. Conidia (note appendages). Scale bars: C = 150 µm, all others = 10 µm.

µm below basal septum; basal cell (incl. appendage) 11–20 µm long, conidia (60–)75–90(–100) × 2(–2.5) µm.

**Culture characteristics:** Colonies on PDA umbonate with undulate edge and sparse, white aerial mycelium, surface isabelline, reverse greyish sepia, after 14 d, 3 cm diam; similar on MEA and PDA.

**Specimen examined:** Netherlands, Wageningen, 51°57'50.43"N 5°41'0.41"E, on leaves of *Crataegus* sp. (*Rosaceae*), Sep. 2012, W. Quaedvlieg (CBS H-21291, culture CBS 135098 = S654).

**Notes:** Several septoria-like species have been described from leaves of *Crataegus* (Farr & Rossman 2013). The present collection matches the description of *Septoria oxyacanthae* (leaf spots on *Crataegus oxyacantha* in Germany, conidia 8–12-septate; conidial dimensions not given). Unfortunately we have been unable to locate type material of this species.

***Sphaerulina patriniae* (Miura) Quaedvlieg, Verkley & Crous, comb. nov.** MycoBank MB804415.

**Basionym:** *Septoria patriniae* Miura, Flora of Manchuria and East Mongolia, III Cryptogams, Fungi (Industr. Contr. S. Manch. Rly 27) 3: 465. 1928.

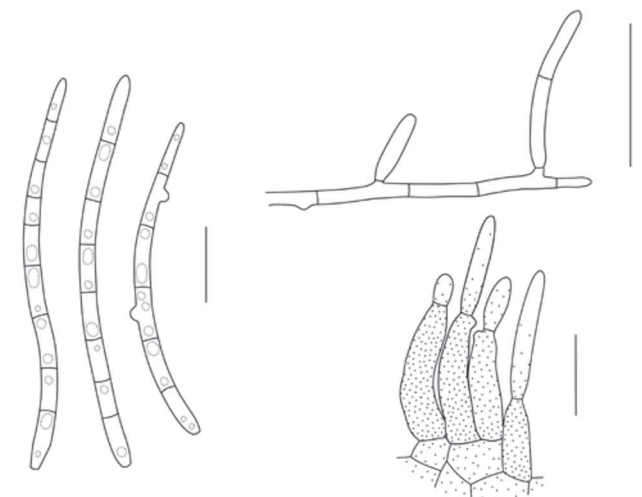
**Specimen examined:** South Korea, Pocheon, on leaves of *Patrinia scabiosaefolia* (*Valerianaceae*), 20 Aug. 2006, H.D. Shin, KACC 42518 = CBS 128653.

***Sphaerulina populicola* (Peck) Quaedvlieg, Verkley & Crous, comb. nov.** MycoBank MB804416.

**Basionym:** *Septoria populicola* Peck, Ann. Rep. N.Y. St. Mus. 40: 59. 1887.

- = *Septoria populicola* House, Bull. N.Y. St. Mus.: 59. 1920. (nom. illegit.)
- = *Mycosphaerella populicola* C.H. Thoms., Phytopathology 31: 251. 1941.

**Specimen examined:** USA, Washington, Puyallup, on *Populus trichocarpa* (*Salicaceae*), 2 May 1997, G. Newcombe, CBS 100042.



**Fig. 31.** Conidia, conidiogenous loci on a hypha, and conidiogenous cells of *Sphaerulina pseudovirgaureae* (CBS 135109). Scale bars = 10 µm.

***Sphaerulina pseudovirgaureae* Quaedvlieg, Verkley & Crous, sp. nov.** MycoBank MB804417. Figs 31, 32.

**Etymology:** Named after its similarity to *Septoria virgaureae*.

Conidiomata pycnidial, separate, erumpent, globose, up to 120 µm diam, dark brown, exuding a creamy conidial cirrhous through central ostiole, somewhat papillate; wall of 2–3 layers of brown textura angularis. Conidiophores reduced to conidiogenous cells or with one supporting cell, subcylindrical, 0–1-septate, branched below or not, pale brown at base, 10–20 × 3–5 µm. Conidiogenous cells integrated, hyaline, but pale brown at base, smooth, proliferating sympodially near apex, 7–17 × 2–3 µm. Conidia solitary, hyaline, smooth, guttulate, subcylindrical to narrowly obclavate, scolecosporous, irregularly curved, apex subobtuse, base truncate or narrowly obconically truncate, 3–10-septate, (30–)40–60(–80) × 2.5(–3) µm.

**Culture characteristics:** Colonies spreading, erumpent with sparse aerial mycelium and smooth, lobate margin and folded surface; reaching 13 mm diam after 2 wk. On MEA surface saffron with



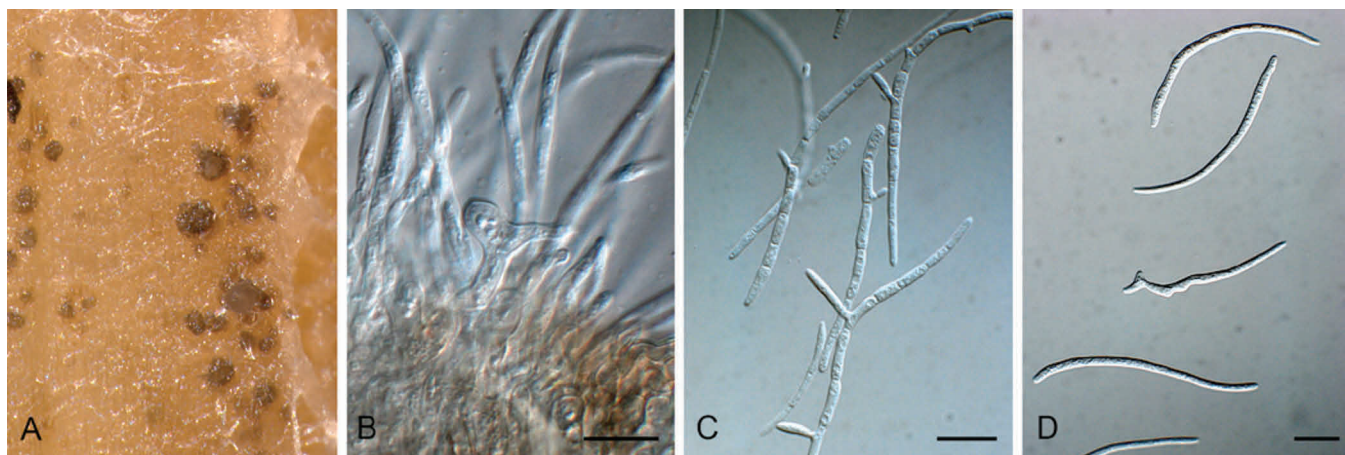


Fig. 32. *Sphaerulina pseudovirgaureae* (CBS 135109). A. Conidiomata forming in culture. B. Conidiogenous cells. C. Microcyclic conidiation. D. Conidia. Scale bars = 10 µm.

patches of dirty white, reverse saffron to orange; on PDA surface and reverse saffron; on OA surface saffron.

*Specimen examined*: Netherlands, Nijmegen, de Duffelt, on leaves of *Solidago gigantea* (Asteraceae), Aug. 2012, S. Videira (holotype CBS H-21327, culture ex-type CBS 135109 = S669).

*Notes*: Several septoria-like species have been recorded on *Solidago* (Farr & Rossman 2013). Of these taxa *Sphaerulina pseudovirgaureae* is most similar to *Septoria virguareae* (conidia 80–100 × 1.5 µm) except that its conidia are shorter and wider.

***Sphaerulina quercicola*** (Desm.) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804419. Figs 33, 34.

*Basionym*: *Septoria incondita* var. *quercicola* Desm., Ann. Sci. nat., Sér. 3, Bot. 20: 95. 1853.

≡ *Septoria quercicola* (Desm.) Sacc., *Michelia* 1: 174. 1879.

≡ *Phleospora quercicola* (Desm.) Sacc., in P. A. Saccardo & D. Saccardo, 1906. Syll. Fung. 18: 490. 1906.

= *Septoria quercina* Fautr., in Fautrey & Lambotte, *Revue Mycol.* 17: 170. 1895 (nom. illeg., art. 53; non Desmazières, 1847). Nom. nov. pro *Septoria quercicola* f. *macrospora* Roum., *Revue Mycol.* 13: 80. 1891.

*Description in vivo*. *Symptoms* definite, small hologenous leaf spots, scattered or in clusters, in the centre orange brown, pale yellowish brown to white, usually delimited by a blackened, somewhat elevated zone, the surrounding leaf tissues becoming red or yellow. *Conidiomata* pycnidial or acervuloid, one to a few in each leafspot, scattered, semi-immersed, predominantly hypophyllous, pale to dark brown, lenticular to globose, 100–200 µm diam; *ostiolum* often not well-developed, initially circular, central, soon opening widely, lacking distinctly differentiated cells; *conidiomatal wall* composed of *textura angularis* without distinctly differentiated layers and sometimes only well-developed in the lower part of the conidioma, mostly 10–15 µm thick, the outer cells with brown, somewhat thickened walls and 4.5–8 µm diam, the inner cells hyaline, thin-walled, 3–8 µm diam. *Conidiogenous cells* hyaline, discrete or integrated in simple, short, (1–)3–5-septate conidiophores which may be branched at the base, doliiform, cylindrical, or ampuliform, hyaline, holoblastic, proliferating percurrently with one to several, more or less distinct annellations, or sympodially, sometimes both types of proliferation occurring in a single conidiogenous cell, 4.5–16(–22.5) × 3–4.5 µm. *Conidia* cylindrical, curved or flexuous, broadly rounded at the apex which is provided with a cap of mucilaginous material, attenuated

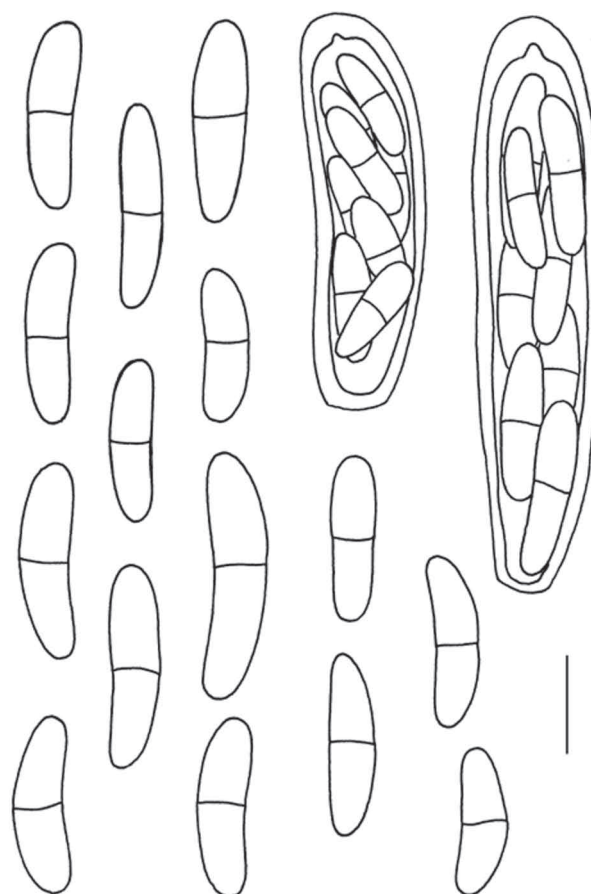


Fig. 33. Ascospores and asci of *Sphaerulina quercicola* (CBS 113266). Scale bar = 10 µm.

gradually to a broadly or more narrowly truncate base which often is also provided with an amorphous mass of mucilaginous material, hyaline, (0–)1–3-septate, constricted around the septa, sometimes at one or more septa also some amorphous mucilaginous material may be present, contents with numerous small oil droplets, (32.5–)38–50(–65) × 3–4 µm. *Ascospores* tri- to

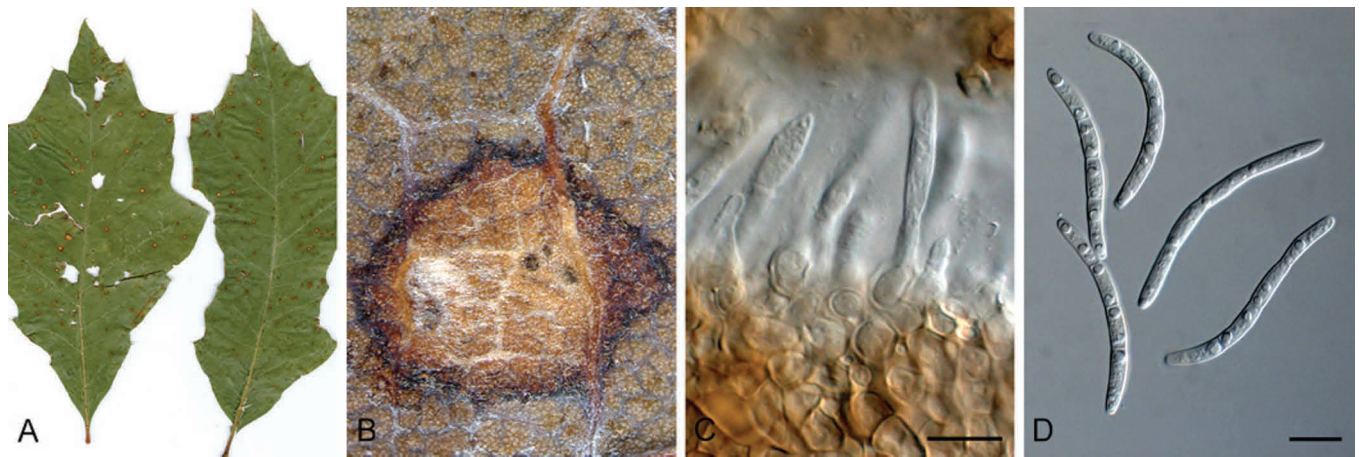


Fig. 34. *Sphaerulina quercicola* (CBS 663.94). A. Leaves with leaf spots. B. Close-up of lesion. C. Conidiogenous cells. D. Conidia. Scale bars = 10 µm.



Fig. 35. *Sphaerulina rhabdoclinis* (CBS 102195). A. Conidiomata forming in culture. B. Sporulation on PDA. C. Conidia. Scale bar = 10 µm.

multiseriate, overlapping, hyaline, guttulate, thin-walled, curved, rarely straight, fusoid-ellipsoidal with obtuse ends, widest at septum or just above, medianly 1-septate, not constricted at the septum, tapering towards both ends, (13–)15–18(–20) × (3.5–)4–4.5(–5) µm (av. 17 × 4.5 µm).

**Culture characteristics:** Colonies on OA reaching 5–7 mm diam in 21 d, with an even to undulating, colourless margin; colonies restricted, irregularly pustulate, immersed mycelium appearing dark greyish to olivaceous black, rosy buff near the margin, covered mostly with a dense mat of woolly, pure white or greyish aerial mycelium; reverse in the centre brown vinaceous or more greyish black, surrounded by brick to rosy buff. Pycnidia developing on the agar surface in the centre, releasing droplets of rosy-buff conidial slime. **Colonies** on MEA reaching 4–6(–8) mm diam in 21 d, with an even, to irregularly undulating margin which is mostly hidden under the aerial mycelium; colonies restricted, irregularly pustulate, the surface mostly blackish or very dark grey, covered by dense to diffuse, finely felted, white aerial mycelium; reverse mostly olivaceous black, near the margin cinnamon to buff. Numerous single and aggregated pycnidia developing on the colony surface in the centre, releasing milky white to rosy buff conidial slime. **Conidia** as *in planta* (CBS 663.94) though on average considerably longer, 51.5–74.5 × 3–4(–4.5) µm (OA), the apex, base and area around septa normally both provided with mucilaginous material as described above, (0–)1–3(–5)-septate.

**Specimens examined:** **Austria**, endophyte culture ex twig of *Quercus petraea* (Fagaceae), Aug. 1991, E. Halmschlagler 212 (H. A. van der Aa 10986), CBS 456.91. **France**, loc. unknown, on leaves of *Quercus* sp. (“divers Chênes”), distributed in

Desmazières, Pl. crypt. Fr., Fasc. 43, no. 2193 (PC, type of *Septoria incondita* var. *quercicola* Desm.). **Netherlands**, Utrecht, Baarn, on living leaves of *Q. robur*, 11 Aug. 1994, G. Verkley 225 (CBS H-21188), living culture CBS 663.94; prov. Utrecht, Soest, De Stompert, on living leaves of *Q. rubra*, 15 Aug. 1995, G. Verkley 310 (CBS H-21189), CBS 791.95; Same loc., dead fallen leaves of *Q. robur*, Apr. 2003, G. Verkley s.n., single ascospore-isolate CBS 113266 (‘Crous 3’); Same loc., G. Verkley & I. van Kempen, endophyte isolates ex green leaves of *Q. robur* CBS 115016, 115136, 115137; Prov. Gelderland, Amerongen, Park Kasteel Amerongen, leaf spot of *Q. rubra*, 11 Jul. 2000, G. Verkley 973 (CBS H-21231), living culture CBS 109009; Prov. Utrecht, Amelisweerd, on dead leaves of *Q. robur*, 25 Apr. 2005, G. Verkley 3108A, culture CBS 117803, CPC 12097.

***Sphaerulina rhabdoclinis*** (Butin) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804420. Fig. 35.

**Basionym:** *Dothiostroma rhabdoclinis* Butin, For. Path. 30: 196. 2000.

**Specimen examined:** **Germany**, Wolfenbüttel, on needles of *Pseudotsuga menziesii* (Pinaceae), 24 May 1998, H. Butin, culture ex-type CBS 102195.

**Note:** *Sphaerulina rhabdoclinis* is phylogenetically closely related to *S. amelanchier*, which appears to be a species complex occurring on unrelated hosts (see Verkley et al. 2013).

***Sphaerulina viciae*** Quaedvlieg, H.D. Shin, Verkley & Crous, **sp. nov.** MycoBank MB804418. Figs 36, 37.

**Etymology:** Named after the host genus from which it was collected, *Vicia*.

On *Anthriscus* stem. Conidiomata pycnidial, solitary, erumpent, brown, globose, up to 150  $\mu\text{m}$  diam, with central ostiole; wall of 3–6 layers of *textura angularis*. Conidiophores reduced to conidiogenous cells. Conidiogenous cells lining the inner cavity, hyaline, smooth, subcylindrical, tapering and proliferating sympodially at apex, 5–10  $\times$  3–4  $\mu\text{m}$ . Conidia hyaline, smooth, guttulate, subcylindrical, irregularly curved, apex obtuse, base truncate, (3–)6-multiseptate, not or slightly constricted at septa (especially constricted on SNA, OA and MEA), (45–)55–75(–110)  $\times$  (2.5–)3(–3.5)  $\mu\text{m}$ .

**Culture characteristics:** Colonies erumpent, spreading with folded surface and sparse aerial mycelium, and smooth, lobate margin; reaching 12 mm diam after 2 wk. On MEA and PDA surface and reverse olivaceous-grey. On OA surface pale olivaceous-grey.

**Specimen examined:** South Korea, on leaves of *Vicia amurensis* (Fabaceae), 12 Aug. 2004, H.D. Shin (holotype CBS H-21283, culture ex-type CPC 11414, 11416, 11415 = CBS 131898).

**Notes:** Several septoria-like species are known from *Vicia* (Farr & Rossman 2013). Of these, *Sphaerulina viciae* is most similar to *Septoria viceae* (conidia 30–60  $\times$  2.5  $\mu\text{m}$ ), but distinct in having longer and wider conidia.

### Clade 3: *Caryophylloseptoria*

**Description:** See Verkley *et al.* (2013)

**Type species:** *Caryophylloseptoria lychnidis* (Desm.) Verkley, Quaedvlieg & Crous.

***Caryophylloseptoria pseudolychnidis*** Quaedvlieg, H.D. Shin, Verkley & Crous, **sp. nov.** MycoBank MB804481. Fig. 38.

**Etymology:** Named after its morphological similarity to *Septoria lychnidis*.

**Leaf spots** on the upper leaf surface, scattered to confluent, distinct, circular, angular to irregular, usually very large, reaching up to 20 mm diam, often surrounded with yellow halo, lacking concentric rings, initially dark brown with pale green border, becoming brown to dark brown, finally turning greyish brown to pallid in the centre; on the lower leaf surface greyish brown to brown with yellowish margin (Shin & Sameva 2004). On sterile *Carex* leaves on WA. **Conidiomata** pycnidial, globose, up to 250  $\mu\text{m}$  diam, black with central ostiole, but frequently splitting open at maturity, appearing acervular; wall of 6–8 layers of dark brown *textura angularis*. **Conidiophores** subcylindrical, lining the inner cavity, hyaline, smooth, reduced to conidiogenous cells, or with 1–2 supporting cells, frequently branched at base, 10–25  $\times$  3–5  $\mu\text{m}$ . **Conidiogenous cells** subcylindrical to ampulliform, 7–15  $\times$  3–5  $\mu\text{m}$ ; proliferating sympodially or percurrently near apex. **Conidia**

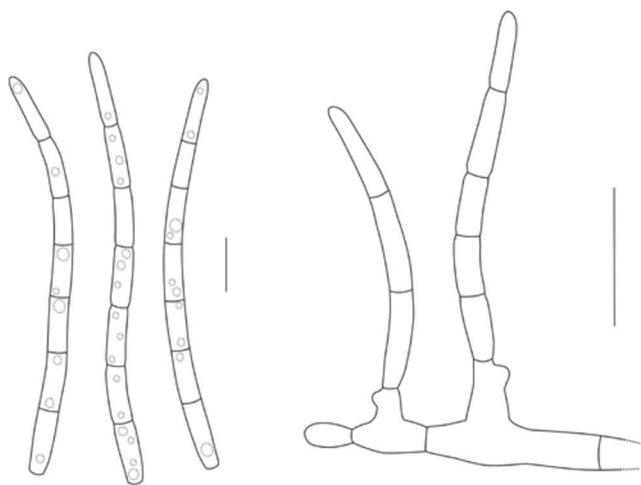


Fig. 36. Conidia and conidiogenous cells of *Sphaerulina viciae* (CBS 131898). Scale bars = 10  $\mu\text{m}$ .

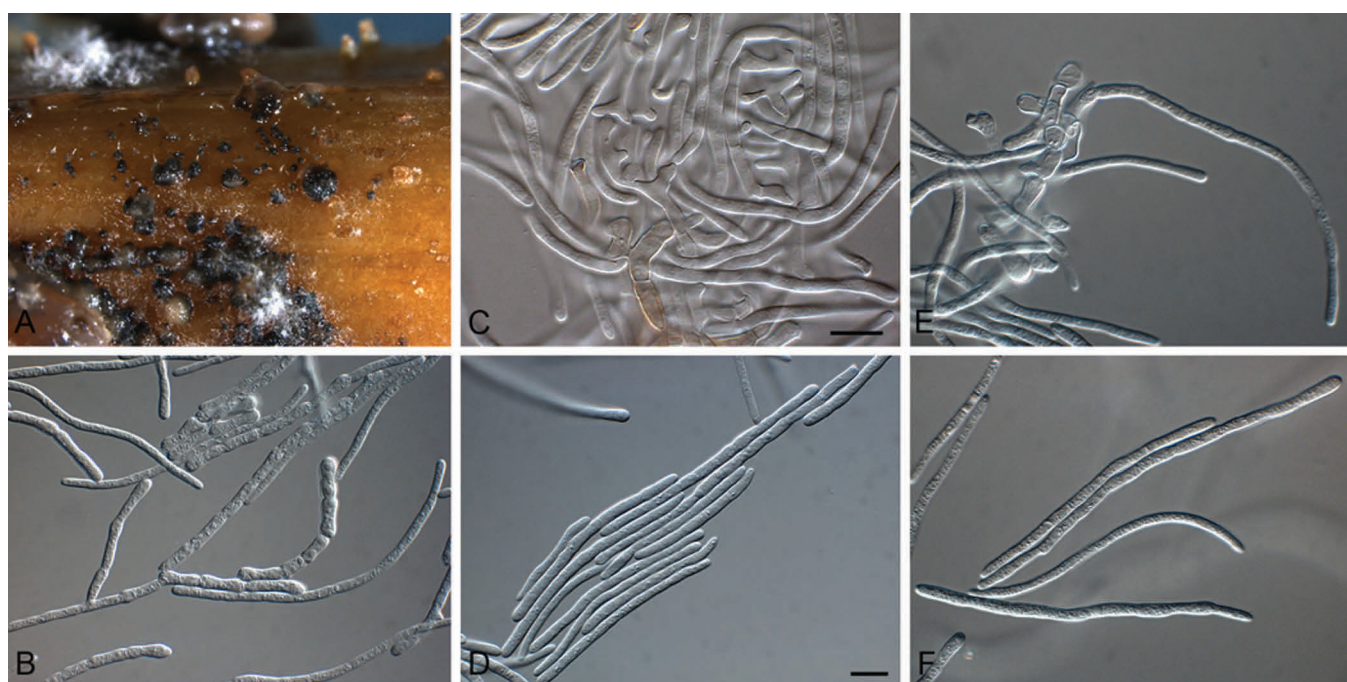
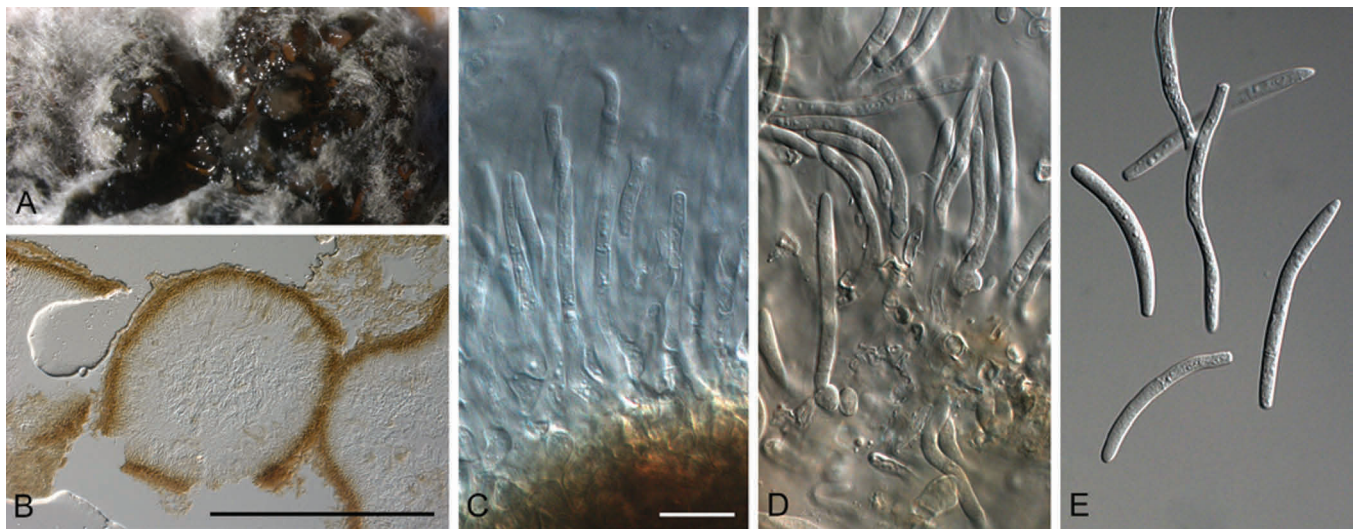


Fig. 37. *Sphaerulina viciae* (CBS 131898). A. Conidiomata forming in culture. B, C, E. Conidiogenous cells. D, F. Conidia. Scale bars = 10  $\mu\text{m}$ .



**Fig. 38.** *Caryophylloseptoria pseudolychnidis* (CBS 128630). A. Colony sporulating on MEA. B. Vertical section through conidiomata. C, D. Conidiogenous cells. E. Conidia. Scale bar: B = 250 µm, others = 10 µm.

hyaline, smooth, guttulate, cylindrical, apex obtuse to subobtuse, base truncate, 3–3.5 µm; 1–3(–5)-septate, (25–)32–45(–50) × (2–)2.5–3(–3.5) µm.

**Culture characteristics:** Colonies on PDA flat, undulate, very sparse, mixed grey and white aerial mycelium, surface isabelline to fuscous-black, reverse olivaceous-black to isabelline for the younger tissue, after 14 d, 3 cm diam; on MEA umbonate, striate, undulate, surface fuscous-black to honey for the younger tissue after 14 d 3.5 cm diam; on OA surface dark-mouse-grey, reverse iron-grey to mouse-grey.

**Specimen examined:** South Korea, Yangpyeong, Jungmi mountain, on leaves of *Lychnis cognata* (Caryophyllaceae), 27 May 2007, H.D. Shin (**holotype** CBS H-21292, culture ex-type CBS 128630 = KACC 43866 = SMKC 23519).

**Notes:** Shin (1995) recorded this species for the first time in Korea, while Shin & Sameva (1999) provided a full morphological description of this European taxon, its conidia tend to be smaller than those of *S. lychnidis* (50–70 × 2.5–3 µm), of which we have also examined European material (see Verkley *et al.* 2013, this issue).

**Clade 4: pseudocercosporella-like**

**Note:** See Frank *et al.* (2010).

**Clade 5: Cercospora**

**Note:** See Groenewald *et al.* (2013).

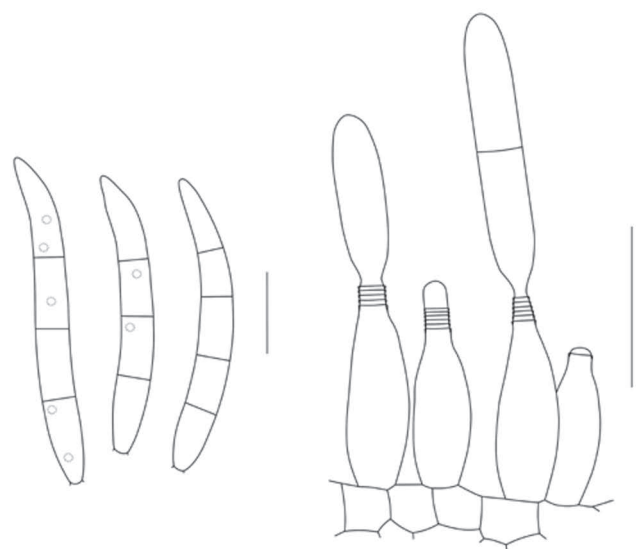
**Clade 6: Phloeospora**

**Description:** See above.

**Type species:** *P. ulmi* (Fr.) Wallr., Fl. Crypt. Germ. (Norimbergae) 2: 177. 1833.

**Phloeospora ulmi** (Fr.) Wallr., Fl. Crypt. Germ. (Norimbergae) 2: 177. 1833. Figs 39, 40.

= *Septoria ulmi* Fr. [as 'Septaria'], Novit. Fl. Svec. 5(cont.): 78. 1819.



**Fig. 39.** Conidia and conidiogenous cells of *Phloeospora ulmi* (CBS 613.81). Scale bars = 10 µm.

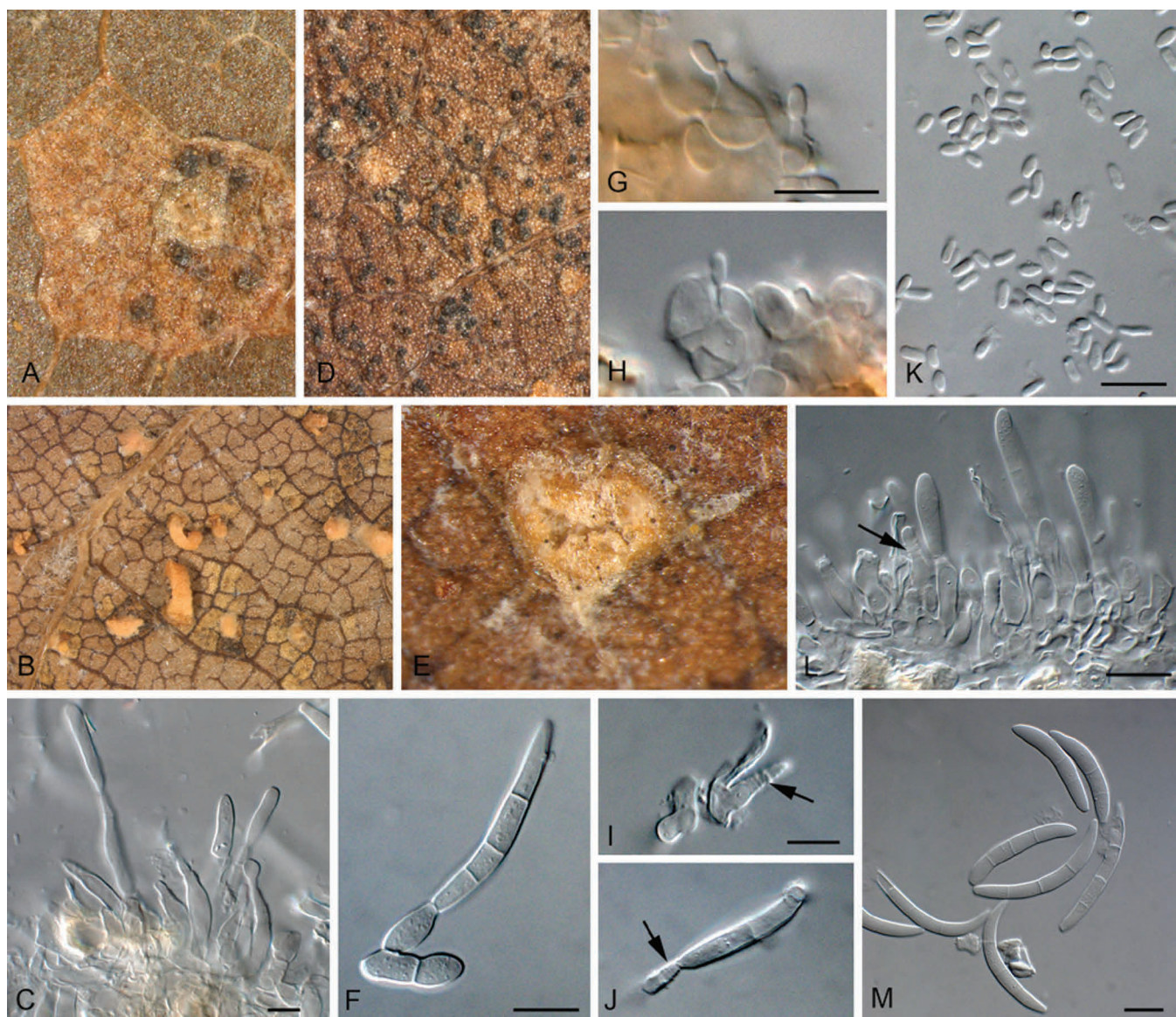
= *Septogloeum ulmi* (Fr. & Kunze) Died., Krypt. Fl. Brandenburg (Leipzig) 9: 836. 1915.

= *Cylindrosporium ulmi* (Fr.) Vassiljevsky, Fungi Imperfecti Parasitici 2: 580. 1950.

= *Mycosphaerella ulmi* Kleb., Z. PflKrankh. 12: 257. 1902.

= *Sphaerella ulmi* (Kleb.) Sacc. & D. Sacc., Syll. Fung. (Abellini) 17: 642. 1905.

**Leaf spots** angular, vein limited, separate, becoming somewhat confluent, initially small yellow-green spots that finally turn brown. **Conidiomata** acervular, hypophyllous, separate, subepidermal, composed of thin-walled, medium brown *textura angularis*, up to 200 µm diam, opening by irregular rupture, and exuding a prominent cirrhus of orange to yellow-orange conidia. **Conidiophores** reduced to conidiogenous cells, or with 1–2 supporting cells, branched below or not, subcylindrical, 10–30 × 4–5 µm. **Conidiogenous cells** hyaline, smooth, subcylindrical, straight to once geniculate, with numerous prominent percurrent proliferations at apex, 10–15 × 4–5 µm. **Conidia** solitary, hyaline, smooth, straight to curved, guttulate or not, fusiform, tapering towards an obtuse or subobtuse apex, and truncate base, 2–3 µm diam, with minute marginal frill,



**Fig. 40.** *Phloeospora ulmi* (CBS 613.81). A, B, D, E. Conidiomata bursting through host tissue. G, H. Microconidiogenous cells. K. Spermatia. C, F, I, J, L. Macroconidiogenous cells (arrows denote percurrent proliferation). M. Conidia. Scale bars = 10  $\mu$ m.

3–5-septate, (20–)30–50(–60)  $\times$  (3.5–)4–5(–6)  $\mu$ m. Leaf spots also contain black spermatogonia and ascomata.

*Specimens examined:* **Austria**, Innsbruck, near Hungerburg, on leaves of *Ulmus* sp. (*Ulmaceae*), 21 Sep. 1981, H.A. van der Aa, CBS H-14740, H-14861, culture CBS 613.81; Innsbruck, road to Hungerburg, on leaves of *Ulmus glabra*, 20 Oct. 1996, W. Gams, CBS 344.97. **Netherlands**, Baarn, garden of CBS, Oosterstraat 1, on leaves of *Ulmus* sp., 26 Aug. 1998, H.A. van der Aa, CBS H-14739, culture CBS 101564. **Unknown**, on leaves of *Ulmus pedunculata*, 15 Jul. 1901, A. van Luijk, CBS H-920.

*Note:* Distinct from *Septoria* s. str. by having acervuli, and conidiogenous cells with prominent percurrent proliferation.

### Clade 7: septoria-like

***Septoria gladioli*** Pass., in Rabenhorst, *Fungi europ. exsicc.*: no. 1956. 1875. Passerini, *Atti Soc. crittog. ital.* 2: 41. 1879.

*Descripton in vitro* (18  $^{\circ}$ C, NUV). **CBS 121.20:** Colonies on OA 15–18 mm diam after 21 d, with an even to slightly ruffled, colourless margin; colonies plane, immersed mycelium olivaceous black, fading over amber towards the margin, aerial mycelium absent;

reverse concolorous. No sporulation observed. *Colonies* on MEA 10–15 mm diam after 21 d, with an even, pale luteous to amber margin; colonies restricted, irregularly pustulate to cerebriform, immersed mycelium ochreous to salmon, covered by diffuse, finely felted, white aerial mycelium; reverse in the centre rust, fading towards the margin over apricot to pale luteous. No sporulation observed. **CBS 353.29:** Colonies on OA 16–20 mm diam after 21 d, with an even to slightly ruffled, colourless margin; colonies plane, immersed mycelium rosy buff mixed with some olivaceous grey, aerial mycelium absent; reverse mainly pale purplish grey to pale mouse grey. No sporulation observed. *Colonies* on MEA 14–22(–26) mm diam after 21 d, with an even to lobed, buff margin; colonies restricted, elevated towards the centre, radially striate, immersed mycelium greenish olivaceous fading to ochreous or buff salmon, the central part mostly covered by diffuse, finely felted, white aerial mycelium; reverse in the centre dark brick to isabelline or hazel, fading towards the margin over pale cinnamon to buff. No sporulation observed.

*Specimen examined:* **Netherlands**, Mar. 1929, J.C. Went, CBS 353.29. Unknown location and host, 1920, W.J. Kaiser, CBS 121.20.

Notes: Priest (2006) provided a complete description of *S. gladioli* on host material, based on observations of an isotype in MEL, and several specimens on *Gladiolus* cultivars collected in Australia. The two strains available from the CBS are old and sterile, and show some differences that also seem to be reflected in the DNA data obtained. *Septoria gladioli* is the only species of septorioid fungi described from the genus *Gladiolus*. An unusual feature of the species is that it overwinters as “sclerotia”, that cause leaf infections in the next season (Priest 2006). The conidiogenous cells are holoblastic and very distinctly proliferate percurrently to form subsequent conidia, but no sympodial proliferation has been reported. Based on the multilocus phylogeny, the aforementioned isolates should be placed in their own genus, with the genus *Phloeospora* as its closest relative. Recollecting material will be required to determine the generic disposition, the delimitation of the taxa (as there seem to be at least two) and to which of these taxa the name *Septoria gladioli* should be applied.

**Clade 8: passalora-like**

***Passalora dioscoreae*** (Ellis & G. Martin) U. Braun & Crous, in Crous & Braun, CBS Biodiversity Ser. (Utrecht) 1: 162. 2003.

Specimen examined: **South Korea**, on leaves of *Dioscorea tokoro* (*Dioscoreaceae*), 24 Oct. 2003, H.D. Shin (CPC 10855); *ibid.*, on leaves of *Dioscorea tenuipes*, 1 Jan. 2004, H.D. Shin (CPC 11513).

Notes: *Passalora dioscoreae* is not congeneric with the type species of the genus, *P. bacilligera*. The taxonomy of *Passalora* and its relatives will be treated in a future publication (Videira *et al.*, in prep.).

**Clade 9: Neoseptoria**

***Neoseptoria*** Quaedvlieg, Verkley & Crous, **gen. nov.** MycoBank MB804421.

*Etymology*: Resembling the genus *Septoria*.

*Foliicolous*. *Conidiomata* black, immersed, subepidermal, pycnidial, subglobose with central ostiole, exuding creamy conidial

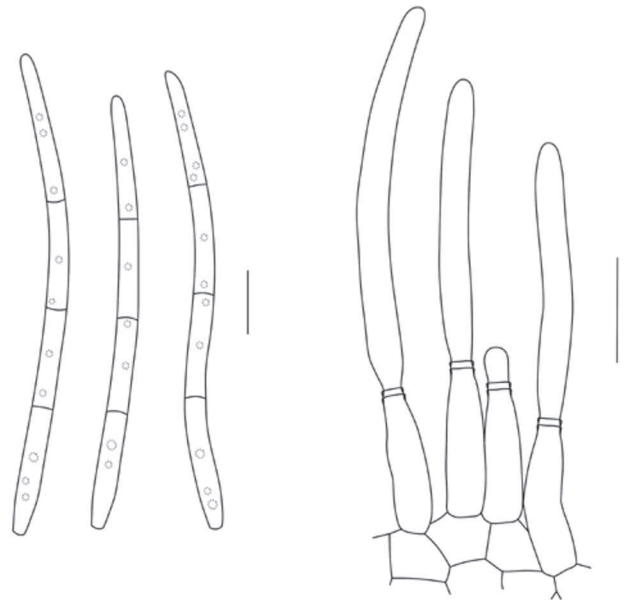
mass; wall of 2–3 layers of brown *textura angularis*. *Conidiophores* 0–2-septate, subcylindrical, hyaline to pale brown at base, smooth, straight to geniculate-sinuous. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, subcylindrical to ampulliform, straight to geniculate-sinuous; proliferating several times percurrently near apex, rarely sympodially. *Conidia* scolecosporous, hyaline, smooth, flexuous, rarely straight, granular, thin-walled, narrowly obclavate, apex subobtuse, base long obconically truncate, tapering to a truncate hilum, 3–multiseptate.

*Type species*: *Neoseptoria caricis* Quaedvlieg, Verkley & Crous.

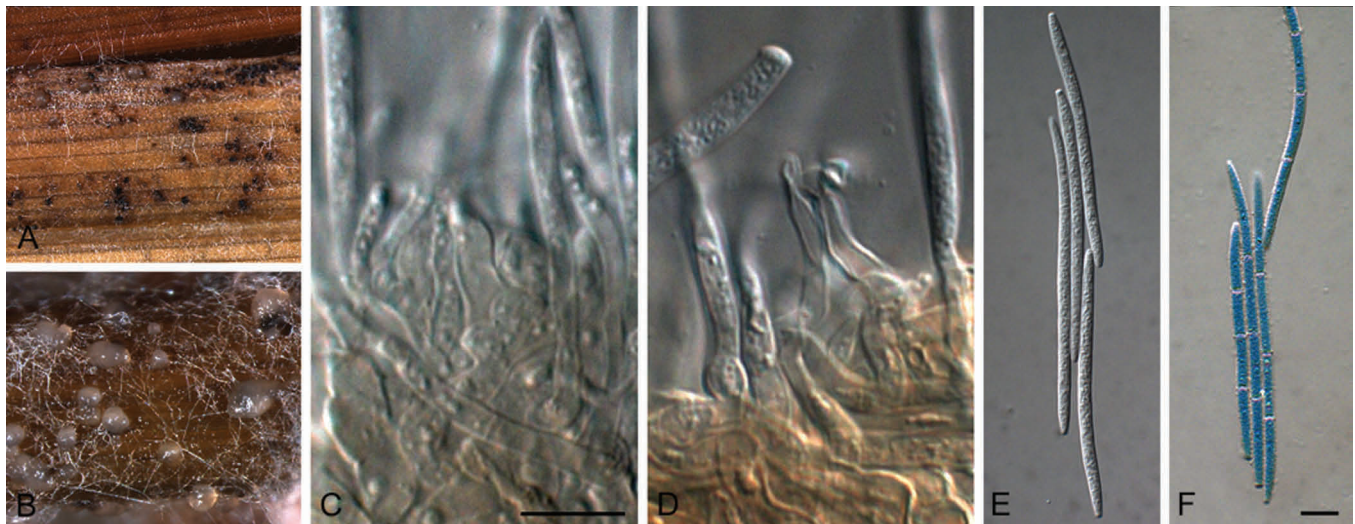
*Note*: The genus *Neoseptoria* is morphologically similar to *Septoria*, but distinct in having mono- to polyphialidic conidiogenous cells that proliferate percurrently at the apex.

***Neoseptoria caricis*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804422. Figs 41, 42.

*Etymology*: Named after the host genus on which it occurs, *Carex*.



**Fig. 41.** Conidia and conidiogenous cells of *Neoseptoria caricis* (CBS 135097). Scale bars = 10 µm.



**Fig. 42.** *Neoseptoria caricis* (CBS 135097). A, B. Conidiomata developing in culture. C, D. Conidiogenous cells. E, F. Conidia. Scale bars = 10 µm.

On sterile *Carex* leaves on WA. *Conidiomata* up to 150 µm diam, black, immersed, subepidermal, pycnidial, subglobose with central ostiole, exuding creamy conidial mass; wall of 2–3 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells, or 0–2-septate, subcylindrical, hyaline to pale brown at base, smooth, straight to geniculate-sinuous, 10–30 × 2.5–3.5 µm. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, subcylindrical to ampulliform, straight to geniculate-sinuous, 8–15 × 2.5–3 µm; proliferating several times percurrently near apex, rarely sympodially. *Conidia* scolecosporous, hyaline, smooth, flexuous, rarely straight, granular, thin-walled, narrowly obclavate, apex subobtuse, base long obconically truncate, tapering to a truncate hilum, 1.5–2 µm diam, 3(–5)-septate, (40–)55–68(–80) × (2.5–)3(–3.5) µm.

**Culture characteristics:** Colonies on PDA erumpent, undulate, lacking aerial mycelium, reverse iron-grey, after 14 d, 3 cm diam; on MEA reverse greyish sepia, after 14 d, 3 cm diam, with fine, pale pink to orange aerial mycelium; on OA similar to MEA, but with pinkish tufts of aerial mycelium.

**Specimen examined:** Netherlands, Wageningen, on leaves of *Carex acutiformis* (Cyperaceae), Aug. 2012, W. Quaedvlieg (holotype CBS H-21293, culture ex-type CBS 135097 = S653).

**Notes:** Several septoria-like species have been described from *Carex* (Farr & Rossman 2013). Of these, *N. caricis* is most similar to *S. caricicola* (conidia 25–55 × 4 µm; (6–)7(–8)-septate), but distinct in having longer and narrower conidia with less septa.

#### Clade 10: *Pseudocercospora*

**Note:** See Crous *et al.* (2013)

#### Clade 11: *Zymoseptoria*

**Note:** See Quaedvlieg *et al.* (2011).

#### Clade 12: *Ramularia*

**Note:** See Crous *et al.* (2009a, c).

#### Clade 13: *Dothistroma*

**Note:** See Barnes *et al.* (2004).

#### Clade 14: *Stromatoseptoria*

***Stromatoseptoria* Quaedvlieg, Verkley & Crous, gen. nov.**  
Mycobank MB804423.

**Etymology:** Stroma = referring to central stoma in pycnidium that gives rise to conidiophores; *Septoria* = septoria-like morphology.

**Foliicolous**, plant pathogenic. *Conidiomata* pycnidial, hypophyllous, subglobose to lenticular, very pale brown to dark brown, immersed to erumpent, exuding conidia in white cirrus; *ostiolium* central, circular, surrounding cells concolorous; *conidiomatal wall* composed of a homogenous tissue of hyaline to very pale brown, angular to irregular cells. *Conidiophores* subcylindrical, branched, hyaline, septate. *Conidiogenous cells* hyaline, discrete or integrated, cylindrical or narrowly ampulliform, holoblastic, often also proliferating percurrently. *Conidia* cylindrical, slightly to distinctly curved, broadly rounded apex, attenuated towards a truncate base, transversely euseptate, mostly constricted at septa.

**Type species:** *Stromatoseptoria castaneicola* (Desm.) Quaedvlieg, Verkley & Crous.

**Notes:** *Stromatoseptoria* is distinguished from *Septoria* based on the central cushion or stroma that gives rise to its conidiophores (*sensu Coniella* and *Pilidiella*; van Niekerk *et al.* 2004), and conidia that tend to be olivaceous-brown in mass, and also turn olivaceous and verruculose with age.

***Stromatoseptoria castaneicola* (Desm.) Quaedvlieg, Verkley & Crous, comb. nov.** MycoBank MB804424. Fig. 43. **Basionym:** *Septoria castaneicola* Desm., Ann. Sci. Nat., Sér. 3, Bot. 8: 26. 1847.

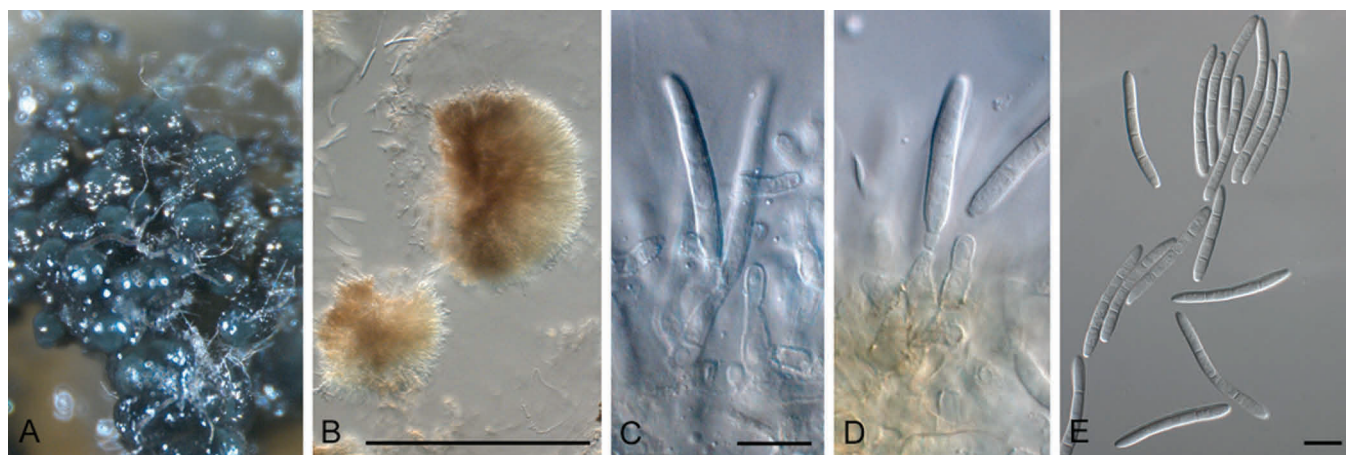
≡ (?) *Phleospora castanica* (Desm.) D. Sacc., Mycoth. Ital., Cent. 1-2, no. 173.

= *Septoria gilletiana* Sacc., Melchioria 1: 359. 1878.

? = *Septoria castaneae* Lév., Ann. Sci. Nat., Sér. 3, Bot. 5: 278. 1846.

≡ *Cylindrosporium castaneae* Krenner, Bot. Közl. 41(3-4): 126. 1944.

**Description in vivo.** *Leaf spots* numerous, small, angular, and often merging to irregular patterns, visible on both sides of the leaf, initially pale yellowish brown, later reddish brown with a narrow, darker border; *Conidiomata* pycnidial, hypophyllous, several in each



**Fig. 43.** *Stromatoseptoria castaneicola* (CBS 102320). A. Colony sporulating on MEA. B. Stroma giving rise to conidiogenous cells. C, D. Conidiogenous cells. E. Conidia. Scale bars: B = 200 µm, all others = 10 µm.

leaf spot, subglobose to lenticular, very pale brown to dark brown, usually fully immersed, 80–150(–200) µm diam, releasing conidia in white cirrhi; *ostiolum* not well-differentiated, central, circular, 18–50 µm wide, surrounding cells concolorous; *conidiomatal wall* about 10–17 µm thick, composed of a homogenous tissue of hyaline to very pale brown, angular to irregular cells 4–10 µm diam; *Conidiophores* subcylindrical, branched at base, hyaline, smooth, 1–2-septate; base frequently brown, verruculose. *Conidiogenous cells* hyaline, discrete or integrated in conidiophores cylindrical or narrowly ampulliform, holoblastic, often also proliferating percurrently with up to 3 closely positioned annellations, 7–17(–20) × 3–4(–5) µm. *Conidia* cylindrical, slightly to distinctly curved, irregularly bent or flexuous, with a relatively broadly rounded apex, attenuated towards a truncate base, basal and apical cell often both wider than intermediate cells, (0–)2–3(–4)-septate, mostly constricted around the septa in the living state, hyaline, contents with several oil-droplets and granular material in each cell in the living state, with granular contents in the rehydrated state, 30–46 × 3–4 µm ("T"; rehydrated, "NT" 2–3 µm wide). Conidia are olivaceous-brown in mass, and older conidia also turn olivaceous and verruculose, and at times anastomose in culture.

**Culture characteristics:** Colonies (CBS 102322) on OA reaching 4–8 mm diam in 25 d (9–12 mm in 33 d), with an even, glabrous, buff margin; colonies restricted, up to 1 mm high, immersed mycelium homogeneously buff, where conidiomatal complexes develop dark brick to black, in part covered by pure white, dense, appressed and woolly aerial mycelium, later a salmon haze occurs in the immersed mycelium; reverse buff, locally cinnamon to sepia. Colonies on CMA reaching (4–)7–11 mm diam in 25 d (8–12 mm in 33 d), as on OA, but with a halo of reddish to salmon, diffusing pigment, which becomes more intense after 33 d, and immersed mycelium in the centre darker, and aerial mycelium more strongly developed, later becoming locally salmon or citrine; reverse brick and dark brick, surrounded by a reddish to salmon zone. Colonies on MEA reaching 6.5–9 mm diam in 25 d (9–11.5 mm in 33 d), with an even, buff to cinnamon margin, entirely hidden under the aerial mycelium, with a very faint halo of diffusing pigment; colonies restricted, up to 4 mm high, hemispherical to irregularly pustulate, entirely covered by a dense mat of felted aerial mycelium, which, especially in the centre, attains a rosy buff or primrose to citrine haze; reverse cinnamon to hazel, around a brick to dark brick centre. Colonies on CHA reaching 7–9 mm diam in 25 d (9–11 mm in 33 d), as on MEA, but no diffusing pigment observed around the colonies. *Conidiomata* on OA developing after 10–15 d, black, globose, single or merged to complexes up to 250 µm diam, releasing milky white conidial slime. *Conidiogenous cells* as in *planta*. *Conidia* as in *planta*, mostly 3-septate, 30–45 × 3.5–4.5 µm (CBS 102320, OA, "T"; "NT" 3 µm wide).

**Specimens examined:** **Austria**, Tirol, Klausen, on leaves of *Castanea vesca* (Fagaceae), Aug., distributed in F. von Höhnel, Krypt. exsicc. no. 415, (PC0084576, PC0084583). **France**, Lébisey, Aug. and Sep. 1843, M. Roberge, 'Coll. Desmazières 1863, no. 8', on leaves of *Castanea sativa* (PC0084574, type of *Septoria castanicola* Desm.); same substr., Meudon, 1 Aug. 1849 (PC0084571, PC0084589, PC0084590, PC0084591) and Jul. 1852 (PC0084572); same substr., loc. and date unknown, 'Coll. Desmazières 1863, no. 8' (PC0084570); Seine-et-Marne, Fontainebleau, Sep 1881, distributed in Roumeguère, Fungi Gallici exsicc. no. 2029 (PC0084575). **Netherlands**, prov. Utrecht, Baarn, Lage Vuursche, on living leaves of *Castanea sativa*, 29 Aug. 1999, G. Verkley 912 (CBS H-21200), cultures CBS 102320–102322; same substr., prov. Limburg, St. Jansberg, 9 Sep. 1999, G. Verkley 932 (CBS H-21214), culture CBS 102377; same substr., prov. Limburg, Molenhoek, Heumense Schans (46-12-55), 23 Aug. 2004, G. Verkley & M. Starink 3040, culture CBS 116464.

**Notes:** According to the original diagnosis that Desmazières published in 1847 based on material on *Castanea* collected in autumn, the conidia are elongated, thin and curved, and about 40 µm in length. No further details like conidial septa were given. The material PC0084574 is the only collection received from PC that antedates the publication and assumedly is the type. It consists of several leaves with numerous pycnidia in leaf spots, some of which belong to *Septoria castaneicola* with the characteristic conidia, but most are a spermatial state of most likely the *Mycosphaerella punctiformis* complex (= *Ramularia*, Verkley et al. 2004).

Teterevnikova-Babayana (1987) treated *S. castaneicola* Desm. as a synonym of *S. castaneae* Lév., and both originally were described from the same host, *Castanea sativa* (syn. *C. vesca*). Teterevnikova-Babayana (1987) described the conidia as 3-septate, 25–40 × 2.5–4.5 µm, which is in fairly good agreement with present observations. The type of *S. castaneae* Lév. could not be studied and the name remains doubtful. Even though Léveillé described symptoms that match those of *S. castaneicola* fairly well, he described the conidia as aseptate, and failed to give information about their size.

### Clade 15: *Lecanosticta*

**Note:** See Quaedvlieg et al. (2012).

### Clade 16: *Phaeophleospora*

**Note:** See Crous et al. (2009b, c).

### Clade 17: *Cytostagonospora*

*Cytostagonospora* Bubák, Ann. Mycol. 14: 150. 1916.

**Description:** See above.

**Type species:** *Cytostagonospora photiniicola* Bubák [as "*photinicola*"], Ann. Mycol. 14: 150. 1916.

*Cytostagonospora martiniana* (Sacc.) B. Sutton & H.J. Swart, Trans. Br. mycol. Soc. 87: 99. 1986. Figs 44, 45.

**Basionym:** *Septoria martiniana* Sacc., Syll. Fung. (Abellini) 10: 351. 1892.

= *Septoria phyllodiorum* Cooke & Masee, Grevillea 19(90): 47. 1890, non *S. phyllodiorum* Sacc., Hedwigia 29: 156. 1890.

On sterile *Carex* leaves on WA. **Leaf spots** amphigenous, circular, grey to brown with raised dark brown border, 1–3 mm diam. **Conidiomata** immersed, subepidermal, epiphyllous, solitary to aggregated with stromatic tissue, with central ostiolar opening exuding a creamy to white conidial mass, rupturing at maturity (pycnidial to acervular), brown, globose, up to 400 µm diam; wall of 3–6 layers of brown *textura angularis*. **Conidiophores** hyaline, smooth, subcylindrical, 0–5-septate, branched or not, 10–15(–50) × 3–4 µm, giving rise to terminal and lateral conidiogenous cells. **Conidiogenous cells** hyaline, smooth, subcylindrical or ampulliform, 4–8 × 3–4 µm, polyphialidic, with apical and lateral loci, with visible periclinal thickening, at times also proliferating percurrently (both modes can also be present on the same conidiogenous cell). **Conidia** hyaline, smooth, granular, irregularly curved, subcylindrical



to narrowly obclavate, apex subobtuse, base long, obconically truncate, (1–)3-septate, (18–)32–45(–50) × (1.5–)2(–3) μm; base not thickened, 0.5–1 μm diam.

**Culture characteristics:** Colonies on PDA convex, erumpent with feathery margin, lacking aerial mycelium, surface fuscous-black, reverse olivaceous-black, after 14 d, 4 cm diam, with a beautiful purple exudate at the outer edges; on MEA, after 14 d, 3.5 cm diam, lacking any exudate; on OA surface fuscous-black, reverse olivaceous-grey, after 14 d, 4 cm diam, purplish-red coloured exudate.

**Specimen examined:** Australia, Warneet close to Melbourne, S38°13'37.8" E145°18'25.4", on leaves of *Acacia pycnantha* (Mimosaceae), 21 Oct. 2009, P.W. Crous (specimen CBS H-21297, culture CBS 135102 = CPC 17727).

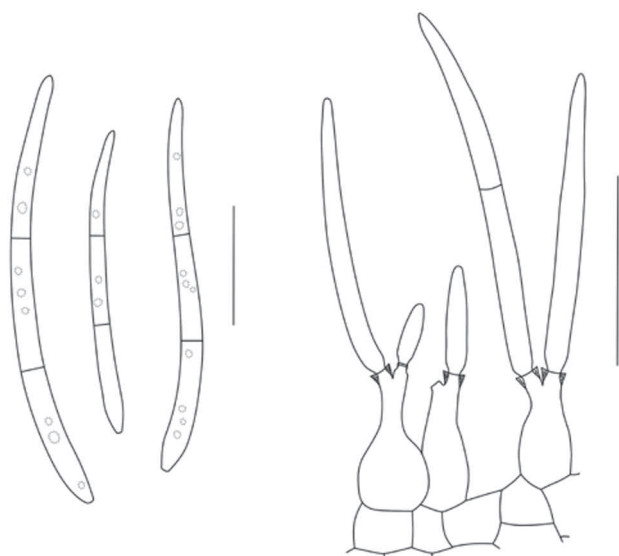


Fig. 44. Conidia and conidiogenous cells of *Cytostagonospora martiniana* (CBS 135102). Scale bars = 10 μm.

**Notes:** The present collection matches the description of *Cytostagonospora martiniana* provided by Sutton & Swart (1986). As discussed by the authors, this genus is distinct from *Septoria* s. str. based on its conidiomata aggregated in stromatic tissue, and unique mode of conidiogenesis. In culture conidiogenous cells exhibited a mixture of sympodial proliferation, or were polyphialidic with periclinal thickening, but also proliferated percurrently. Species of *Septoria* occurring on *Acacia* were treated by Sutton & Pascoe (1987).

#### Clade 18: *Zasmidium*

**Note:** See Crous *et al.* (2007a, b, 2009c).

#### Clade 19: *Polyphialoseptoria*

***Polyphialoseptoria*** Quaedvlieg, R.W. Barreto, Verkley & Crous, **gen. nov.** MycoBank MB804425.

**Etymology:** Polyphialo = polyphialides; *Septoria* = septoria-like.

**Foliicolous**, plant pathogenic. **Conidiomata** brown, erumpent, pycnidial (acervular in culture), globose, brown; wall of 3–6 layers of pale brown *textura angularis*. **Conidiophores** reduced to conidiogenous cells. **Conidiogenous cells** hyaline, smooth, subcylindrical to ampulliform; proliferating sympodially at apex, forming polyphialides with minute periclinal thickening, or as solitary loci on superficial mycelium in culture. **Conidia** hyaline, smooth, granular to guttulate, scolecosporous, irregularly curved, apex subobtuse, base long obconically truncate, transversely multi-euseptate, in older cultures disarticulating at septa; microcyclic conidiation also common in older cultures.

**Type species:** *Polyphialoseptoria terminaliae* Quaedvlieg, R.W. Barreto, Verkley & Crous.

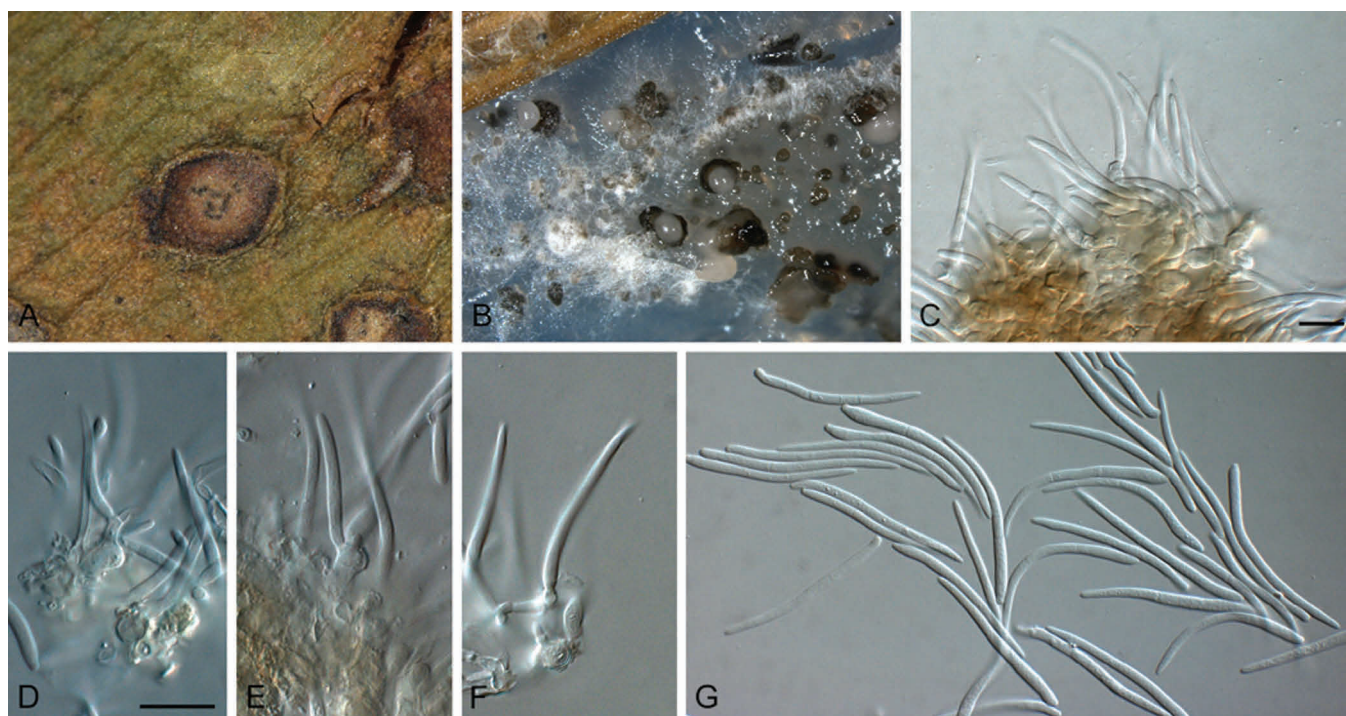


Fig. 45. *Cytostagonospora martiniana* (CBS 135102). A. Leaf spot. B. Conidiomata forming in culture. C–F. Conidiogenous cells. G. Conidia. Scale bars = 10 μm.

***Polyphialoseptoria tabebuiae-serratifoliae*** Quaedvlieg, Alfenas & Crous, **sp. nov.** MycoBank MB804427. Figs 46, 47.

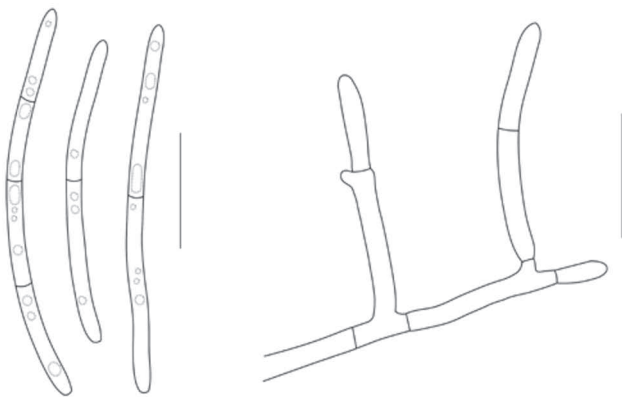
*Etymology:* Named after its host, *Tabebuia serratifolia*.

*Leaf spots* variable in number on mature leaves; initially as small spots or purple-brown areas, with the inner part becoming grey-white with age, surrounded by a purple-brown halo. *Conidiomata* developing on sterile barley leaves on WA, pale cream in colour, erumpent, globose, up to 180 µm diam; wall of 2–3 layers of pale brown *textura angularis*. *Conidiophores* hyaline, smooth, cylindrical, septate, branched, 10–35 × 1.5 µm. *Conidiogenous cells* terminal and lateral, cylindrical, hyaline, smooth, proliferating sympodially, 10–15 × 1.5 µm. *Conidia* solitary, hyaline, smooth, granular, irregularly curved, subcylindrical, apex subobtuse, base truncate, (0–)1–3(–4)-septate, (15–)25–35(–55) × 1.5(–2) µm.

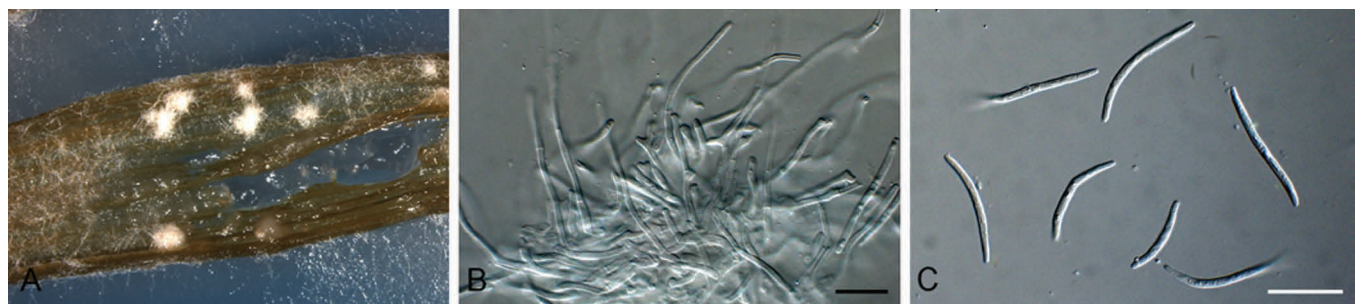
*Culture characteristics:* Colonies flat, spreading, with sparse aerial mycelium and smooth, even margins, reaching 40 mm diam after 2 wk. On OA surface dirty pink; on PDA surface and reverse dirty white. On MEA surface folded, dirty white, reverse cinnamon.

*Specimen examined:* **Brazil**, Minas Gerais, Viçosa, on leaves of *Tabebuia serratifolia* (*Bignoniaceae*), 1999, A.C. Alfenas (**holotype** CBS H-21299, culture ex-type CBS 112650).

*Notes:* Inácio & Dianese (1998) described *Septoria tabebuiae-impetiginosae* on *T. impetiginosa* (conidia 25–67 × 2–4 µm, 2–6-septate), and also compared this species to *S. tabebuiae* (18–40 × 1.7–2.5 µm, aseptate conidia) on *T. berteroi*, and *S. cucutana* (34–40 × 0.8–1 µm) on *T. pentaphylla* and *T. spectabilis*. Furthermore, they also referred to an undescribed species Ferreira (1989) mentioned on *T. serratifolia* in Viçosa, Minas Gerais, which is named as *S. tabebuiae-serratifoliae* in the present study.



**Fig. 46.** Conidia and conidiogenous loci on hypha of *Polyphialoseptoria tabebuiae-serratifoliae* (CBS 112650). Scale bars = 10 µm.



**Fig. 47.** *Polyphialoseptoria tabebuiae-serratifoliae* (CBS 112650). A. Conidiomata forming in culture. B. Conidiogenous cells. C. Conidia. Scale bars = 10 µm.

*Polyphialoseptoria tabebuiae-serratifoliae* is distinct from species of *Septoria* known from *Tabebuia* based on its conidial morphology.

***Polyphialoseptoria terminaliae*** Quaedvlieg, R.W. Barreto, Verkley & Crous, **sp. nov.** MycoBank MB804426. Fig. 48.

*Etymology:* Named after the host genus from which it was collected, *Terminalia*.

*Leaf spots* irregular to subcircular, amphigenous, mostly aggregated along leaf veins, pale brown, 3–8 mm diam, surrounded by a prominent, wide, red-purple border. On sterile *Carex* leaves on WA. *Conidiomata* brown, erumpent, pycnidial (acervular in culture), up to 600 µm diam, globose, brown, exuding a crystalline cirrus of conidia; wall of 3–6 layers of pale brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* hyaline, smooth, subcylindrical to ampulliform, 5–10 × 3–4 µm; proliferating sympodially at apex, forming polyphialides with minute periclinal thickening, or as solitary loci on superficial mycelium in culture. *Conidia* hyaline, smooth, granular to guttulate, scolecosporous, irregularly curved, apex subobtuse, base long obconically truncate (1–1.5 µm diam), multiseptate (–16), in older cultures disarticulating at septa; microcyclic conidiation also common in older cultures, (40–)75–120(–140) × 2–3(–3.5) µm.

*Culture characteristics:* Colonies on PDA erumpent with feathery margin, lacking aerial mycelium, surface fuscous-black, reverse olivaceous-black to buff in the younger tissue, after 14 d, 1 cm diam; on MEA surface and reverse isabelline to greyish-sepia; on OA surface pale-vinaceous, reverse rosy-buff to buff.

*Specimen examined:* **Brazil**, Minas Gerais, Viçosa, on leaves of *Terminalia catapa* (*Combretaceae*), 18 May 2010, R.W. Barreto (**holotype** CBS H-21298, culture ex-type CBS 135106 = CPC 19611); *ibed.*, (CBS 135475 = CPC 19487)

*Notes:* As far as we could establish there are presently no species of *Septoria* described from *Terminalia*, and as this taxon is distinct from all taxa in GenBank, we herewith describe it as a novel species. A *Septoria* sp. has been reported on leaves of *Terminalia* sp. in Florida and Venezuela (Farr & Rossman 2013). *Polyphialoseptoria* is distinct from *Septoria* based on the presence of polyphialides. *Neoseptoria* also has phialides as observed in *Polyphialoseptoria*, but these tend to chiefly be monopialides.

### Clade 20: *Ruptoseptoria*

***Ruptoseptoria*** Quaedvlieg, Verkley & Crous, **gen. nov.** MycoBank MB804428.

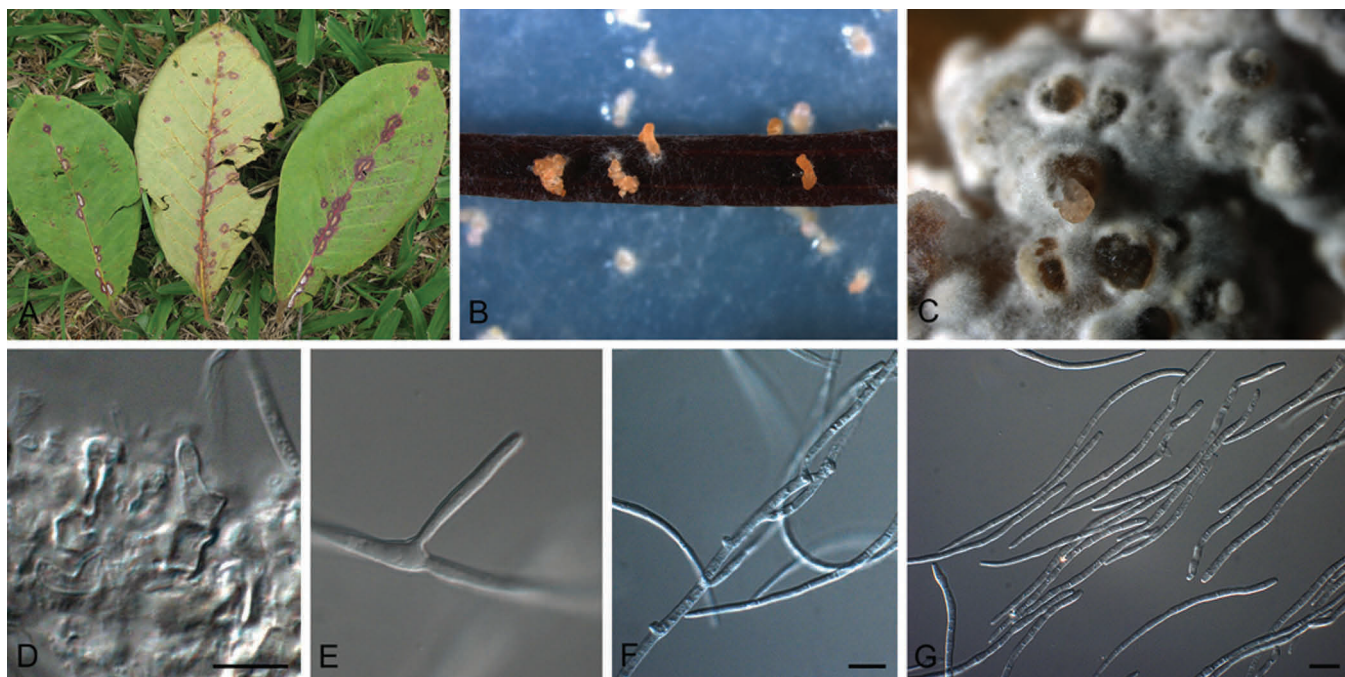


Fig. 48. *Polyphialoseptoria terminaliae* (CBS 135106). A. Leaves with leaf spots. B, C. Conidiomata sporulating in culture. D–F. Conidiogenous cells and loci. G. Conidia. Scale bars = 10  $\mu$ m.

**Etymology:** Rupto = irregular rupture of conidiomata; *Septoria* = septoria-like.

**Foliicolous**, plant pathogenic. **Conidiomata** black, appressed, elongated, pycnidial, but opening via irregular rupture, convoluted; exuding a creamy white conidial mass; outer wall dark brown, crusty, consisting of 6–8 layers of dark brown *textura angularis*; giving rise to 2–3 inner layers of pale brown to hyaline *textura angularis*. **Conidiophores** lining the inner cavity, hyaline, smooth or pale brown, verruculose at base, branched below, septate, subcylindrical. **Conidiogenous cells** integrated, terminal, subcylindrical, smooth; proliferating sympodially at apex, or apex phialidic with minute periclinal thickening. **Conidia** solitary, hyaline, smooth, guttulate, subcylindrical to narrowly obclavate, gently to irregularly curved, apex subobtuse, base truncate to narrowly obovoid, transversely septate.

**Type species:** *Ruptoseptoria unedonis* (Roberge ex Desm.) Quaedvlieg, Verkley & Crous.

***Ruptoseptoria unedonis*** (Roberge ex Desm.) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804429. Figs 49, 50.

**Basionym:** *Septoria unedonis* Roberge ex Desm., Ann. Sci. Nat., Bot., Sér. 3(8): 20. 1847.

- = *Sphaerella arbuticola* Peck, Bull. Torrey Bot. Club 10(7): 75. 1883.
- ≡ *Mycosphaerella arbuticola* (Peck) Jaap, Ann. Mycol. 14(1/2): 13. 1916.
- ≡ *Mycosphaerella arbuticola* (Peck) House, Contr. Univ. Mich. Herb. 9(8): 587. 1972.

**Leaf spots** numerous, small, amphigenous, irregular to subcircular, whitish in the middle, with very broad, purple borders. **Conidiomata** black, appressed, elongated, pycnidial, but opening via irregular rupture, convoluted, up to 450  $\mu$ m diam, exuding a creamy white conidial mass; outer wall dark brown, crusty, consisting of 6–8 layers of dark brown *textura angularis*; giving rise to 2–3 inner

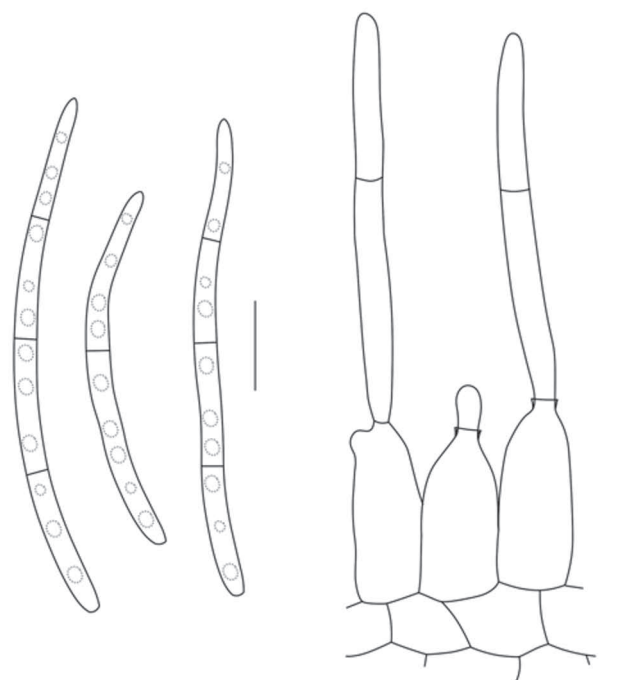
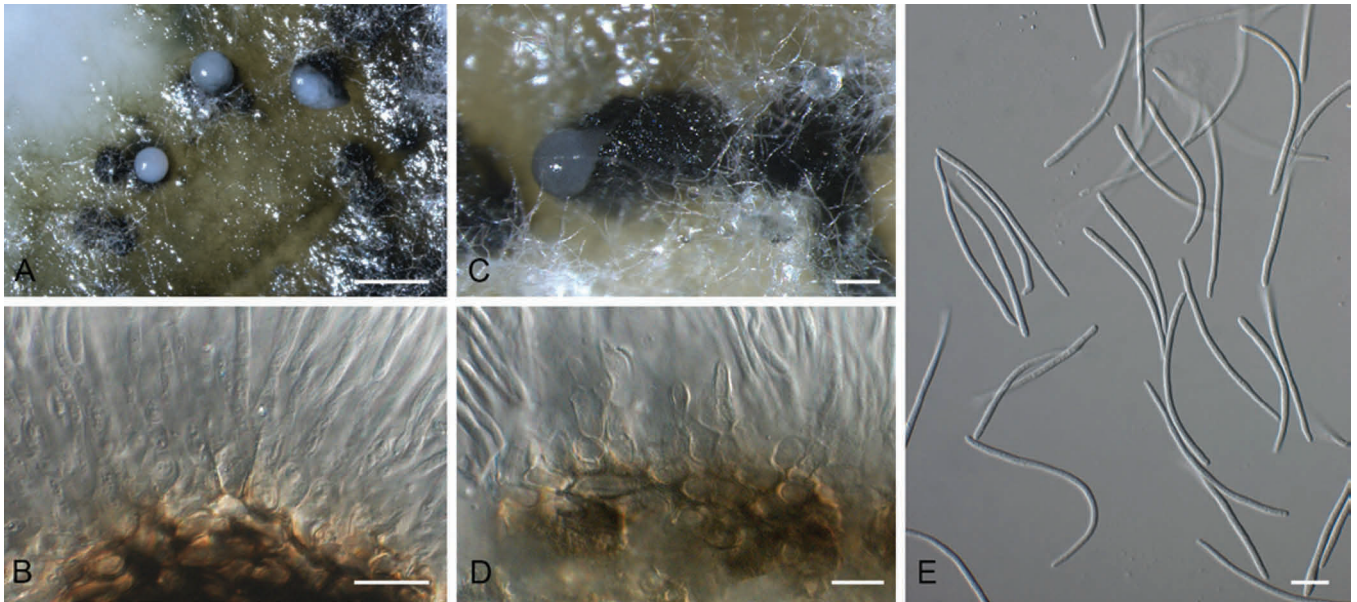


Fig. 49. Conidia and conidiogenous cells of *Ruptoseptoria unedonis* (CBS 355.86). Scale bars = 10  $\mu$ m.

layers of pale brown to hyaline *textura angularis*. **Conidiophores** lining the inner cavity, hyaline, smooth or pale brown, verruculose at base, branched below, 1–2-septate, subcylindrical, 10–15  $\times$  2–4  $\mu$ m. **Conidiogenous cells** integrated, terminal, subcylindrical, smooth, 6–12  $\times$  2.5–3.5  $\mu$ m; proliferating sympodially at apex, or apex phialidic with minute periclinal thickening. **Conidia** solitary, hyaline, smooth, guttulate, subcylindrical to narrowly obclavate, gently to irregularly curved, apex subobtuse, base truncate to narrowly obovoid, 1–3(–6)-septate, (25–)30–47(–56)  $\times$  2(–3)  $\mu$ m.



**Fig. 50.** *Ruptoseptoria unedonis* (CBS 355.86). A, C. Conidiomata forming in culture. B, D. Conidiogenous cells. E. Conidia. Scale bars: A = 450 µm, C = 110 µm, all others = 10 µm.

**Culture characteristics:** Colonies on OA spreading with moderate aerial mycelium and smooth, even margins; surface olivaceous-grey in outer region, centre dirty white to pale pink, reverse iron grey; on MEA surface dark-mouse-grey to mouse-grey, reverse greenish-black; on PDA surface mouse-grey to dark-mouse-grey, reverse greenish-black.

**Specimen examined:** France, Seignosse le Penon, Lamdes, Forest communale de Seignosse, on leaves of *Arbutus unedo* (*Ericaceae*), Aug. 1986, H.A. van der Aa (CBS H-14645, culture CBS 355.86).

**Notes:** *Mycosphaerella arbuticola* (CBS 355.86) is a species pathogenic to *Arbutus menziesii* in California (Aptroot 2006), clusters with “*Septoria*” *unedonis* (CBS 755.70, CBS H-18192), which is associated with leaf spots on *Arbutus unedo* in Croatia, and elsewhere in Europe. Based on these results, the sexual-asexual link between these two names is confirmed. Morphologically, however, *Ruptoseptoria* is similar to *Septoria*, and can only be distinguished based on its conidiomata that are convoluted, opening by irregular rupture, and conidiogenous cells that are frequently phialidic.

**Clade 21: *Dissoconium* (*Dissoconiaceae*)**

*Note:* See Li *et al.* (2012).

**Clade 22: *Readeriella* (*Teratosphaeriaceae*)**

*Note:* See Crous *et al.* (2007a, 2009a–c).

**Clade 23: *Teratosphaeria***

*Note:* See Crous *et al.* (2007, 2009c).

**Clade 24: septoria-like**

**Specimen examined:** Brazil, Nova Friburgo, on leaves of *Tibouchina herbacea* (*Melastomataceae*), 15 Dec. 2007, D.F. Parreira (CBS 134910 = CPC 19500).

*Note:* The taxonomy of this species could not be resolved, as isolate CPC 19500 proved to be sterile.

**Clade 25: *Cylindroseptoria***

***Cylindroseptoria*** Quaedvlieg, Verkley & Crous, **gen. nov.** MycoBank MB804430.

*Etymology:* Cylindro = cylindrical conidia; *Septoria* = septoria-like.

*Conidiomata* pycnidial with central ostiole, or cupulate, separate, brown, short-stipitate, tapering towards base; rim with elongated brown, thick-walled cells with obtuse ends; rim covered with mucoid layer that flows over from conidiomatal cavity, filled with conidial mass; wall of 3–4 layers of medium brown *textura angularis*, becoming hyaline towards inner region. *Conidiogenous cells* hyaline, smooth, ampulliform, lining inner cavity, with prominent periclinal thickening at apex. *Conidia* solitary, hyaline, smooth, granular or not, cylindrical with obtuse apex, tapering at base to truncate scar, aseptate.

*Type species:* *Cylindroseptoria ceratoniae* Quaedvlieg, Verkley & Crous.

***Cylindroseptoria ceratoniae*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804431. Figs 51, 52.

*Etymology:* Named after the host genus on which it occurs, *Ceratonia*.

*Conidiomata* separate, brown, cupulate, short-stipitate, rim up to 300 µm diam, 100–180 µm tall, tapering towards base, 20–50 µm diam (on *Anthriscus sylvestris* stems, not on OA or PDA, where they appear more flattened with agar surface); rim with elongated brown, thick-walled cells with obtuse ends, 5–12 × 4–5 µm; rim covered with mucoid layer that flows over from conidiomatal cavity, filled with conidial mass; wall of 3–4 layers of medium brown *textura angularis*, becoming hyaline towards inner region. *Conidiogenous cells* hyaline, smooth, ampulliform, lining inner cavity, 7–12 × 4–6 µm; apex 2 µm diam, with prominent periclinal thickening. *Conidia* solitary, hyaline, smooth, granular or not, cylindrical with obtuse

apex, tapering at base to truncate scar 1  $\mu\text{m}$  diam, aseptate, (10–12–14(–16)  $\times$  3(–3.5)  $\mu\text{m}$ .

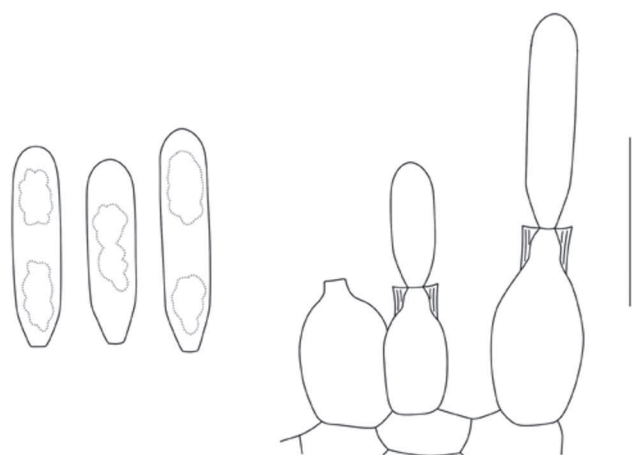
**Culture characteristics:** Colonies spreading, reaching 28 mm diam after 2 wk, with sparse aerial mycelium and even, lobate margins. On MEA surface iron-grey, reverse olivaceous-grey. On OA surface olivaceous-grey. On PDA surface and reverse iron-grey.

**Specimen examined:** Spain, Mallorca, Can Pastilla, on leaves of *Ceratonia siliqua* (Caesalpinaceae), 24 May 1969, H.A. van der Aa (holotype CBS H-21300, culture ex-type CBS 477.69).

**Notes:** *Cylindroseptoria ceratoniae* is quite distinct in that it has cup-shaped acervuli, ampulliform conidiogenous cells with periclinal thickening, and hyaline, aseptate, cylindrical conidia. *Cylindroseptoria* needs to be compared with *Satchmopsis* (infundibular conidiomata), *Cornucopiella* (tubular conidiomata) and *Thaptozona* (cylindrical / lageniform / campanulate conidiomata), but the combination of cupulate conidiomata and cylindrical, and aseptate conidia is distinct.

***Cylindroseptoria pistaciae*** Quaedvlieg, Verkley & Crous, sp. nov. MycoBank MB804432. Figs 53, 54.

**Etymology:** Named after the host genus on which it occurs, *Pistacia*.



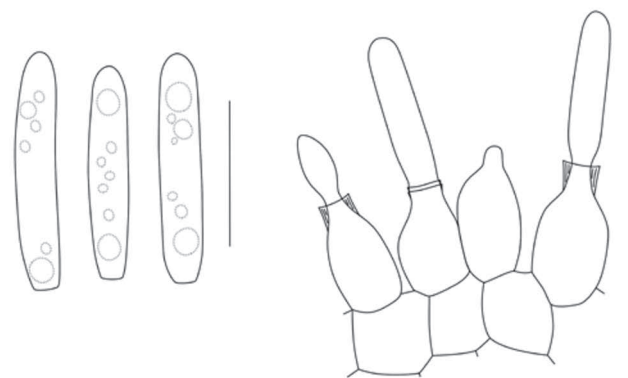
**Fig. 51.** Conidia and conidiogenous cells of *Cylindroseptoria ceratoniae* (CBS 477.69). Scale bar = 10  $\mu\text{m}$ .

*Conidiomata* pycnidial, erumpent, globose, black, separate, with black crusty outer layer of cells, up to 200  $\mu\text{m}$  diam, with central ostiole; wall of 3–6 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic (mostly monophialidic, but a few observed to also be polyphialidic), lining the inner cavity, hyaline, smooth, ampulliform, 5–8  $\times$  3–4  $\mu\text{m}$ , proliferating percurrently (inconspicuous) or with periclinal thickening at apex (also occurring as solitary loci on superficial hyphae surrounding pycnidia). *Conidia* hyaline, smooth, cylindrical, mostly straight, rarely slightly curved, apex subobtuse, base truncate, guttulate, aseptate, (9–)11–13(–18)  $\times$  2.5–3(–3.5)  $\mu\text{m}$ .

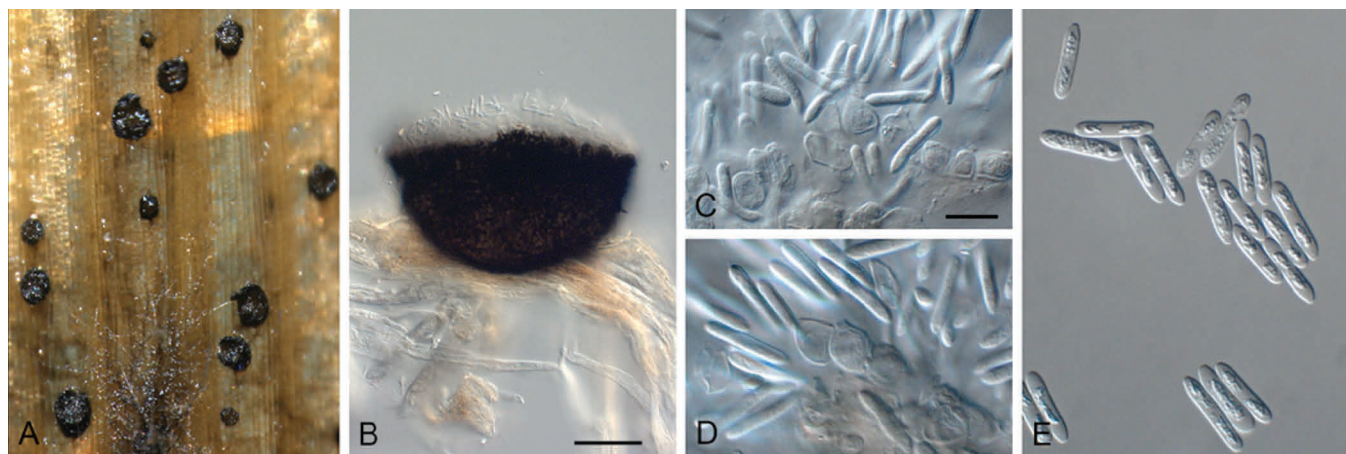
**Culture characteristics:** Colonies on PDA flat, circular, lacking aerial mycelium, surface fuscous-black, reverse olivaceous-black, after 14 d, 3.5 cm diam; on MEA surface fuscous-black, reverse olivaceous-black, after 14 d, 4.5 cm diam; on OA similar to PDA.

**Specimen examined:** Spain, Mallorca, El Arenal, on leaves of *Pistacia lentiscus* (Anacardiaceae), 25 May 1969, H.A. van der Aa (holotype CBS H-21301, culture CBS 471.69).

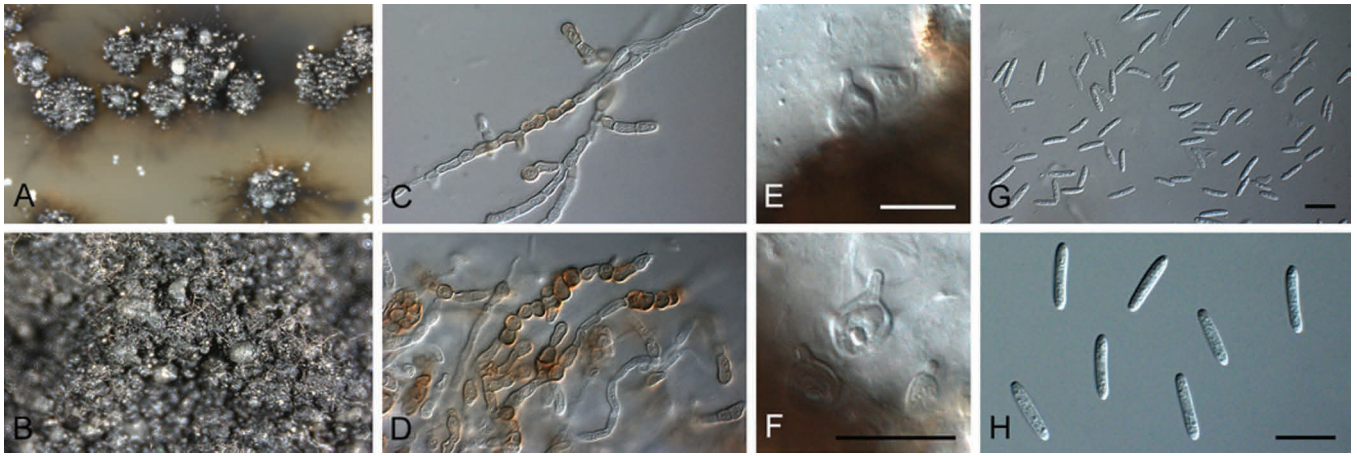
**Notes:** *Cylindroseptoria pistaciae* is tentatively placed in *Cylindroseptoria*, as it has pycnidial rather than cupulate conidiomata. However, synapomorphies with *Cylindroseptoria* include phialides with periclinal thickening, and cylindrical, aseptate conidia. Further collections are required to determine if conidiomatal anatomy is more important than conidiogenesis and conidial morphology. For the present, however, the generic circumscription



**Fig. 53.** Conidia and conidiogenous cells of *Cylindroseptoria pistaciae* (CBS 471.69). Scale bars = 10  $\mu\text{m}$ .



**Fig. 52.** *Cylindroseptoria ceratoniae* (CBS 477.69). A, B. Conidiomata forming in culture. C, D. Conidiogenous cells giving rise to conidia. E. Conidia. Scale bars: B = 45  $\mu\text{m}$ , all others = 10  $\mu\text{m}$ .



**Fig. 54.** *Cylindroseptoria pistaciae* (CBS 471.69). A, B. Conidiomata sporulating in culture. C, D. Intercalary chains of chlamydospore-like cells. E, F. Conidiogenous cells. G, H. Conidia. Scale bars = 10 µm.

of *Cylindroseptoria* has been widened to include taxa with pycnidial conidiomata. *Cylindroseptoria pistaciae* could be confused with *Septoria pistaciae*, though conidia of the latter are 20–30 × 1.6 µm, and are 1(–3)-septate (Chitzanidis & Michaelides 2002).

**Clade 26: Pseudoseptoria**

***Pseudoseptoria*** Speg., Ann. Mus. Nac. B. Aires, Ser. 3 13: 388. 1910.

= *Aphanofalx* B. Sutton, Trans. Brit. Mycol. Soc. 86: 21. 1986.

*Caulicolous* and *foliicolous*, plant pathogenic or saprobic. Conidiomata stromatic, pycnidoid, unilocular, glabrous, black, ostiolate; wall of *textura angularis*, in some cases cells in the upper wall larger and darker than cells in the lower wall. *Conidiophores* reduced to conidiogenous cells lining the cavity of the conidioma. *Conidiogenous cells* discrete or integrated, cylindrical or lageniform, colourless, smooth-walled, invested in mucus, with a prominent cylindrical papilla with several percurrent proliferations at the apex; collarette prominent and extending past conidia, or reduced

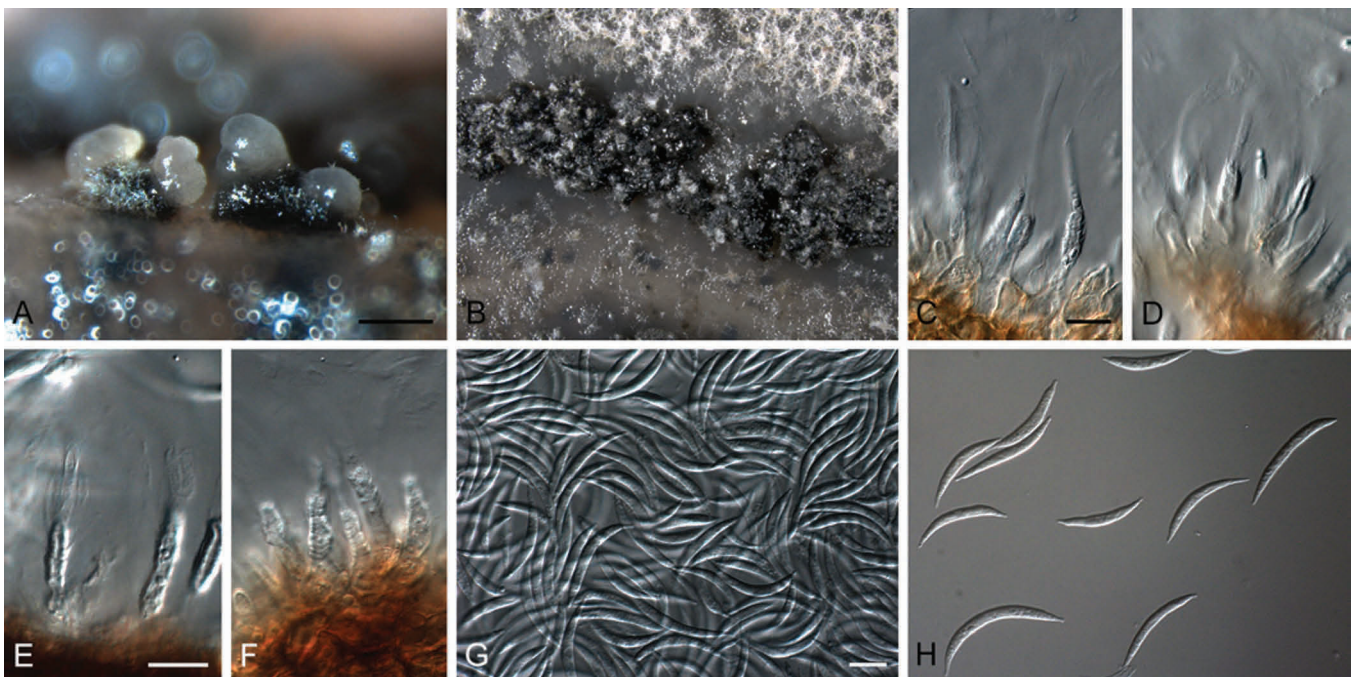
and inconspicuous. *Conidia* fusiform, lunate or irregular, curved, unicellular, colourless, smooth-walled with or without an excentric basal appendage, continuous with conidium body, plectronoid to podiform, or with a blunt or spatulate distal end.

*Type species:* *P. donacicola* Speg., Ann. Mus. Nac. B. Aires, Ser. 3 13: 388. 1910. [= *P. donacis* (Pass.) B. Sutton].

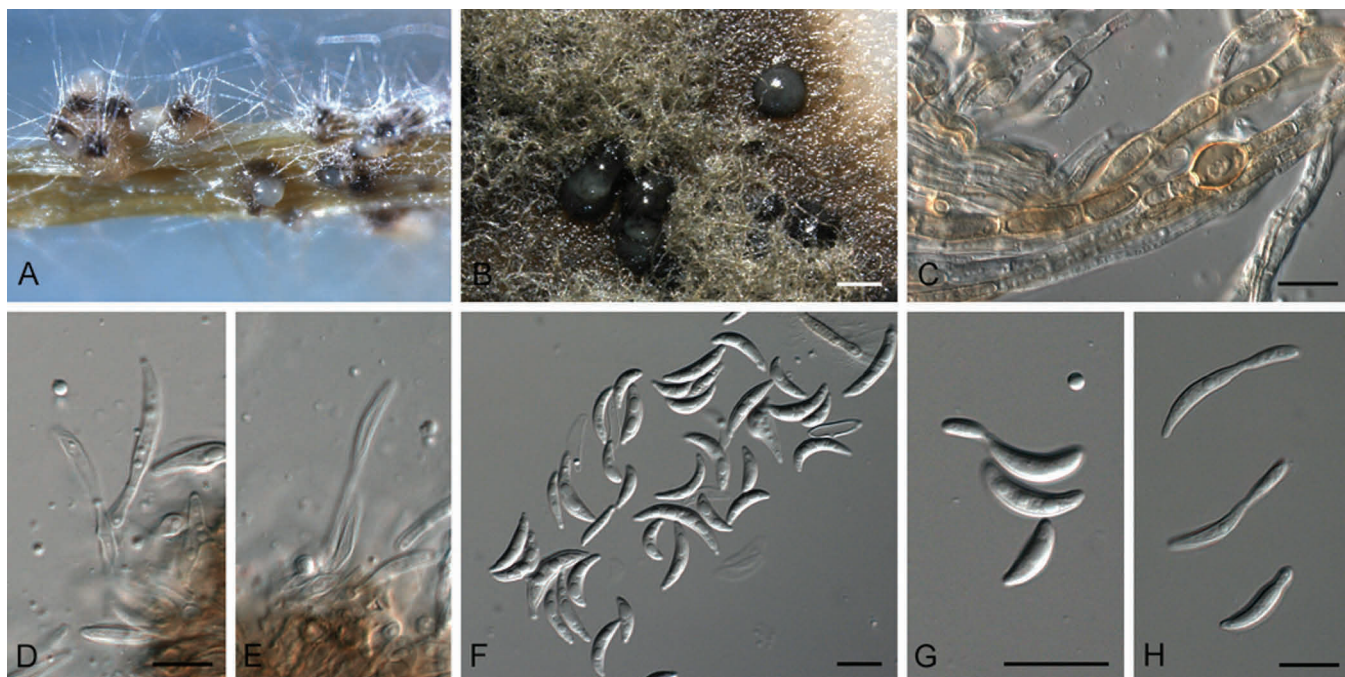
***Pseudoseptoria collariana*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804433. Fig. 55.

*Etymology:* Named after its prominently flared collarettes, forming a sleeve.

On sterile *Carex* leaves on WA. *Conidiomata* immersed to erumpent, globose, dark brown, up to 400 µm diam, unilocular, opening via central ostiole; wall of 6–10 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells, or branched at the base with one supporting cell that is dark brown, encased



**Fig. 55.** *Pseudoseptoria collariana* (CBS 135104). A, B. Colonies sporulating in culture. C–F. Conidiogenous cells with prominent collarettes. G, H. Conidia. Scale bars: A = 400 µm, all others = 10 µm.



**Fig. 56.** *Pseudoseptoria obscura* (CBS 135103). A, B. Colony sporulating in culture. C. Chlamydospore-like cells developing. D, E. Conidiogenous cells. F–H. Conidia. Scale bars: B = 250 µm, all others = 10 µm.

in a mucilaginous matrix. *Conidiogenous cells* subcylindrical to ampulliform, hyaline, smooth to pale brown, finely verruculose,  $18\text{--}35 \times 3.5\text{--}8$  µm; apical region with numerous conspicuous percurrent proliferations, with long, prominent collarettes that completely enclose and extend above young, developing conidia, but disintegrating into a mucoid mass with age. *Conidia* fusiform, lunate, curved, aseptate, hyaline, smooth, tapering to an subobtuse to spatulate apex, base truncate (1 µm diam), with a single, unbranched, eccentric basal appendage, 2–4 µm long; conidia (from apex to hilum)  $(24\text{--})26\text{--}28\text{--}(30) \times (2.5\text{--})3$  µm.

**Culture characteristics:** Colonies on PDA flat, round with feathery margins, lacking aerial mycelium, surface olivaceous-black to rosy-buff for younger tissue, reverse olivaceous-black, to rosy-buff for younger tissue, after 14 d 1.5 cm diam; on MEA surface olivaceous-black to buff for younger tissue, reverse olivaceous-black to brick for younger tissue, after 14 d, 2 cm diam; on OA similar to MEA.

**Specimen examined:** Iran, Golestan Province, on leaves of Bamboo (*Poaceae*), 12 May 2009, A. Mirzadi Gohari (**holotype** CBS H-21302, culture ex-type CBS 135104 = CPC 18119).

***Pseudoseptoria obscura* Quaedvlieg, Verkley & Crous, sp. nov.** MycoBank MB804434. Fig. 56.

**Etymology:** Named after the obscure basal appendage that occurs on some conidia.

On sterile *Carex* leaves on WA. *Conidiomata* immersed to erumpent, globose, dark brown, up to 250 µm diam (smaller than in 18119), unilocular, opening via central ostiole; wall of 3–6 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* subcylindrical to doliiform, hyaline, smooth to pale brown, finely verruculose,  $6\text{--}12 \times 2\text{--}5$  µm; apical region with numerous inconspicuous to conspicuous percurrent proliferations; collarettes absent to prominent. *Conidia* fusiform,

lunate, curved, aseptate, hyaline, smooth, tapering to an subobtuse apex; base truncate, rarely with a single, unbranched, eccentric basal appendage, 1–2 µm long; conidia (from apex to hilum)  $12\text{--}14\text{--}(15) \times (2\text{--})2.5\text{--}(3)$  µm.

**Culture characteristics:** Colonies on PDA flat, undulate with feathery margins, lacking aerial mycelium, surface concentric rings of fuscous-black to pale purplish grey to fuscous-black, reverse concentric rings of greyish-sepia to fawn to fuscous-black, after 14 d, 2 cm diam; on MEA similar to PDA; OA flat, undulate, lacking aerial mycelium, surface fuscous-black to purplish grey for the younger tissue, reverse greyish-sepia to vinaceous-buff for the younger tissue.

**Specimen examined:** Iran, Golestan Province, on leaves of Bamboo (*Poaceae*), 12 May 2009, A. Mirzadi Gohari (**holotype** CBS H-21303, culture ex-type CBS 135103 = CPC 18118).

**Notes:** Species of the genus *Aphanofalx* occur on members of *Poaceae*, presumably as saprobes. The genus is characterised by having taxa with pycnidial conidiomata, and percurrently proliferating conidiogenous cells, and hyaline, aseptate conidia with a basal, excentric appendage. In contrast, species of *Pseudoseptoria* are known to occur on members of *Poaceae* as plant pathogens. The genus is also characterised by having taxa with pycnidial conidiomata, and percurrently proliferating conidiogenous cells, and hyaline, aseptate conidia that lack basal appendages. During this study we also investigated three strains identified as *P. donasis* (CBS 291.69, 313.68 and 417.51), the type species of *Pseudoseptoria*. Much to our surprise they formed a monophyletic lineage (results not shown) with the two strains described here (which have basal appendages), suggesting that *Pseudoseptoria* represents an older name for *Aphanofalx*, and that the basal appendage is a species-specific character, as also found in other groups of coelomycetes (Crous *et al.* 2012b).

*Aphanofalx* is presently known from two species, *A. mali* (conidia  $26\text{--}33 \times 2\text{--}2.5$  µm), and *A. irregularis* (conidia  $12\text{--}28\text{--}(31) \times (2\text{--})2.5\text{--}$

3(–3.5) µm (Nag Raj 1993). *Pseudoseptoria collariana* [conidia (24–) 26–28(–30) × (2.5–)3 µm] and *P. obscura* [conidia (8–)12–14(–15) × (2–)2.5(–3) µm] are easily distinguished from these taxa based on their conidial dimensions. The three species of *Pseudoseptoria* treated by Sutton (1980), namely *P. donacis* (conidia 20–23 × 2–2.5 µm), *P. stromaticola* (conidia 16–18.5 × 2 µm) and *P. bromigena* (conidia 20–23 × 2–2.5 µm) can be distinguished from *P. collarata* and *P. obscura* by conidial dimensions, and lacking basal conidial appendages.

### Clade 27: *Parastagonospora*

***Parastagonospora*** Quaedvlieg, Verkley & Crous, **gen. nov.** MycoBank MB804435.

*Etymology*: Resembling the genus *Stagonospora*.

*Foliicolous*, plant pathogenic. Ascocarps immersed, globose, becoming depressed, medium brown to black; wall of 3–6 layers of thick-walled, brown *textura angularis*; ostiole slightly papillate. Asci clavate, cylindrical or curved, shortly stipitate, 8-spored; ascus wall thick, bitunicate. Ascospores fusoid, subhyaline to pale brown, transversely euseptate (–3), constricted at the septa, penultimate cell swollen. Pseudoparaphyses filiform, hyaline, septate. *Conidiomata* black, immersed, subepidermal, pycnidial, subglobose with central ostiole, exuding creamy conidial mass; wall of 2–3 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to subcylindrical, with percurrent proliferation near apex. *Conidia* hyaline, smooth, thin-walled, cylindrical, granular to multi-guttulate, with obtuse apex and truncate base, transversely euseptate.

*Type species*: *Parastagonospora nodorum* (Berk.) Quaedvlieg, Verkley & Crous.

*Notes*: The genus *Parastagonospora* is introduced to accommodate several serious cereal pathogens that were formerly accommodated in either *Septoria*/*Stagonospora*, or *Leptosphaeria*/*Phaeosphaeria*. As shown previously, *Septoria* is not available for these fungi (Quaedvlieg et al. 2011), and neither is *Leptosphaeria* (de Gruyter et al. 2013). Furthermore, in the present study we also clarify the phylogenetic positions of *Stagonospora* and *Phaeosphaeria*, which cluster apart from this group of cereal pathogens, which are best accommodated in their own genus, *Parastagonospora*.

*Parastagonospora* is distinguished from *Stagonospora* in that *Stagonospora* has conidiogenous cells that proliferate percurrently, or via phialides with periclinal thickening, and conidia that are subcylindrical to fusoid-ellipsoidal. Sexual morphs known for species of *Parastagonospora* are phaeosphaeria-like, whereas those observed for *Stagonospora* s. str. are didymella-like.

***Parastagonospora avenae*** (A.B. Frank) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804436.

*Basionym*: *Septoria avenae* A.B. Frank, Ber. Dt. Bot. Ges. 13: 64. 1895.

- ≡ *Stagonospora avenae* (A.B. Frank) Bissett [as 'avena'], Fungi Canadenses, Ottawa 239: 1. 1982
- = *Leptosphaeria avenaria* G.F. Weber, Phytopath. 12: 449. 1922.
- ≡ *Phaeosphaeria avenaria* (G.F. Weber) O.E. Erikss., Ark. Bot., Ser. 2 6: 408. 1967.
- = *Pleospora tritici* Garov., Arch. Triennale Lab. Bot. Crittog. 1: 123. 1874.

*Specimens examined*: **Germany**, Kiel-Kitzeberg, on *Lolium multiflorum*, 1968, U.G. Schlösser, CBS 290.69, CBS 289.69.

*Notes*: Although the oldest epithet for this taxon is *Pleospora tritici* (1874), “*avenae*” has been well established in literature, and accepted by the community. We thus recommend that this epithet be retained for this pathogen. *Parastagonospora avenae* leaf blotch of barley and rye (f.sp. *tritici*), appears distinct from the pathogen on oats (f.sp. *avenaria*) (Cunfer 2000), and further research is required to resolve this issue.

***Parastagonospora caricis*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804437. Figs 57, 58.

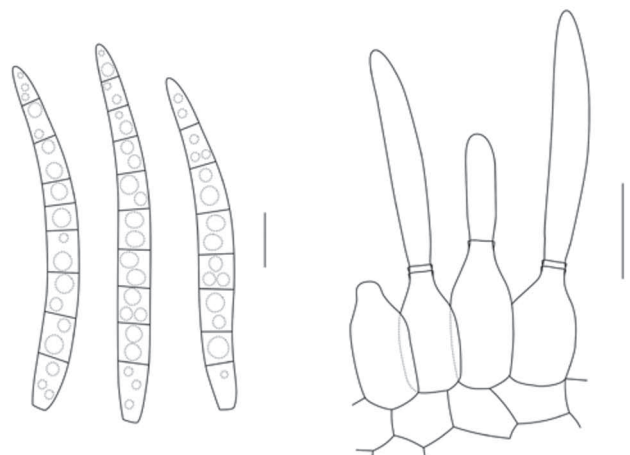
*Etymology*: Named after the host genus from which it was collected, *Carex*.

On sterile *Carex* leaves on WA. *Conidiomata* up to 250 µm diam, black, immersed, subepidermal, pycnidial, subglobose with central ostiole, exuding pale pink conidial cirrhous; wall of 2–3 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform, 8–15 × 4–6 µm, with percurrent proliferation at apex. *Conidia* hyaline, smooth, thin-walled, scolecosporous, subcylindrical, with subobtuse apex and truncate base, 7–15-septate, (50–)60–70(–75) × (5–)6 µm.

*Culture characteristics*: Colonies on PDA flat, undulate, with short, white aerial mycelium, surface olivaceous-black in the older parts, vinaceous-buff in the younger mycelium, reverse olivaceous-black in the older parts, brick in the younger mycelium, after 14 d, 4 cm diam; on MEA convex, fimbriate, surface fawn to hazel, reverse fusceous-black to cinnamon, after 14 d, 3 cm diam; on OA similar to MEA.

*Specimen examined*: **Netherlands**, Veenendaal, de Blauwe Hel, on leaves of *Carex acutiformis* (Cyperaceae), 25 Jul. 2012, W. Quaedvlieg (**holotype** CBS H-21304, culture ex-type CBS 135671 = S615).

*Note*: Conidia of *P. caricis* are larger than those of *P. avenae*, which are (1–)3(–7)-septate, 17–46 × 2.5–4.5 µm (Bissett 1982), and narrower than those of *Stagonospora gigaspora*, which are 58–84 × 10–14 µm (Ellis & Ellis 1997).



**Fig. 57.** Conidia and conidiogenous cells of *Parastagonospora caricis* (CBS H-21304). Scale bars = 10 µm.



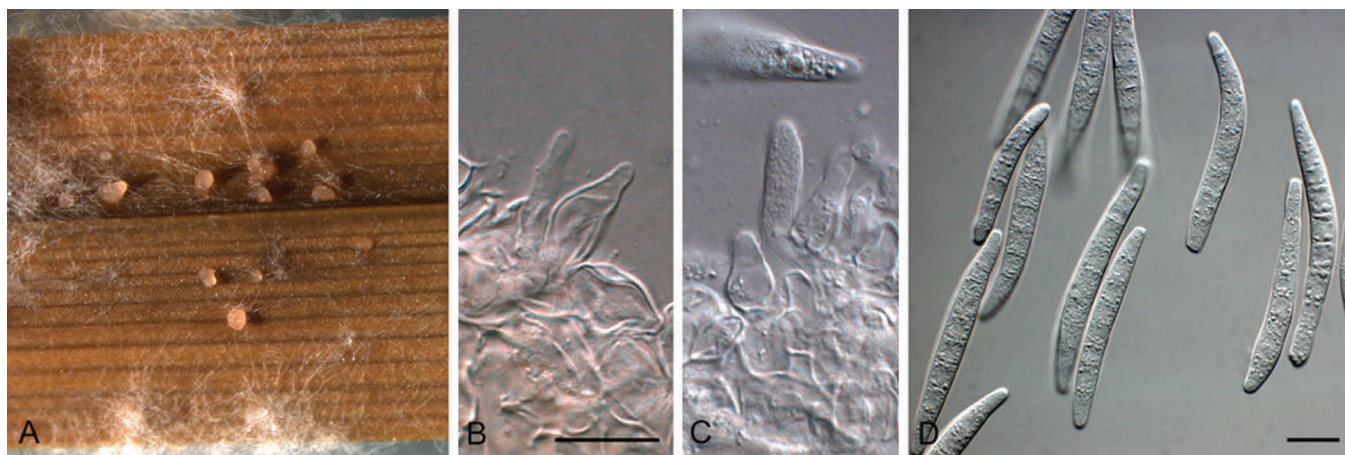


Fig. 58. *Parastagonospora caricis* (CBS H-21304). A. Colony sporulating in culture. B, C. Conidiogenous cells. D. Conidia. Scale bars = 10 µm.

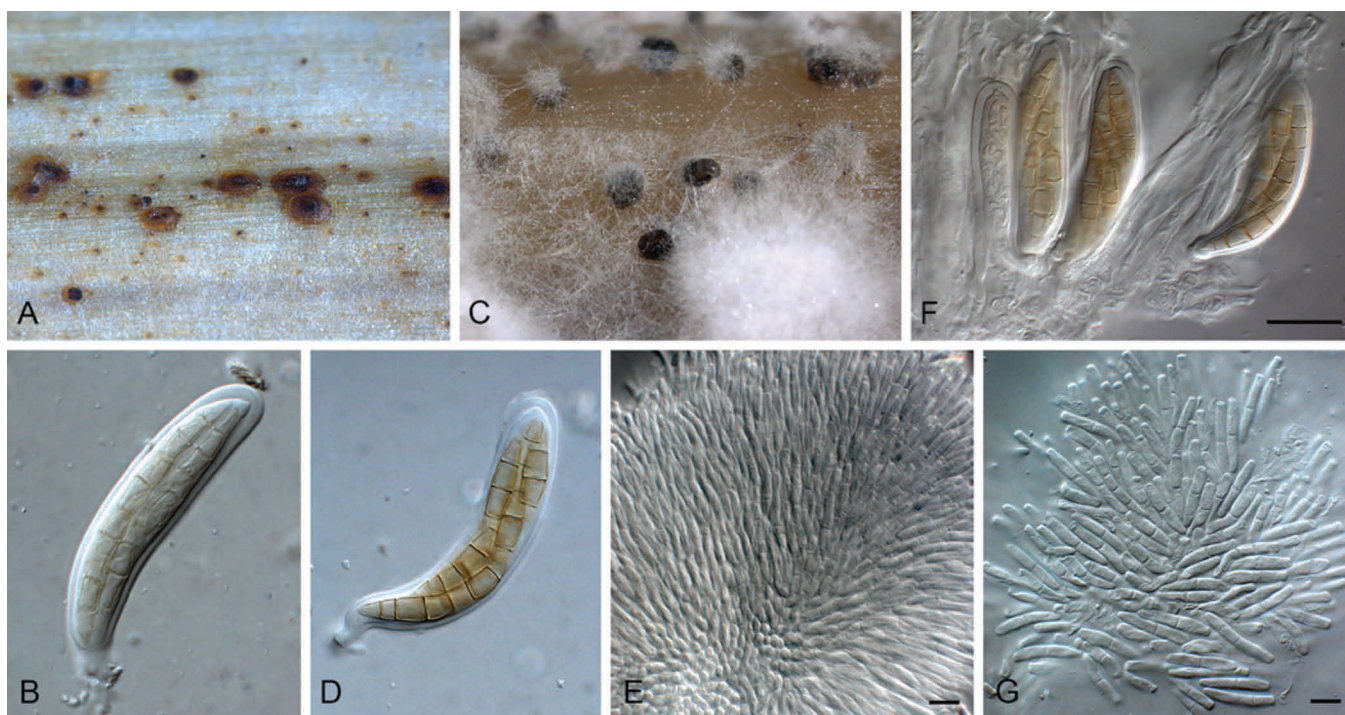


Fig. 59. *Parastagonospora nodorum* (CBS H-13909). A, C. Ascomata and conidiomata forming in culture. B, D, F. Asci with ascospores. E, G. Conidia. Scale bars = 10 µm.

***Parastagonospora nodorum*** (Berk.) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804438. Fig. 59.

*Basionym:* *Depazea nodorum* Berk., Gard. Chron., London: 601. 1845.

- ≡ *Septoria nodorum* (Berk.) Berk., Gard. Chron., London: 601. 1845.
- ≡ *Stagonospora nodorum* (Berk.) E. Castell. & Germano, Annali Fac. Sci. Agr. Univ. Torino 10: 71. 1977. [1975–76]
- = *Leptosphaeria nodorum* E. Müll., Phytopath. J. 19: 409. 1952.
- ≡ *Phaeosphaeria nodorum* (E. Müll.) Hedjar., Sydowia 22: 79. 1969. [1968]

*Specimen examined:* **Denmark**, on *Lolium perenne*, Feb. 2002, M.P.S. Câmara, CBS 110109.

*Notes:* *Parastagonospora nodorum* blotch is an important disease of cereals, having been reported from barley and wheat in most countries where these crops are cultivated (Cunfer 2000). Recent studies have also indicated that *P. nodorum* probably resembles a species complex, awaiting further morphological characterisation (McDonald *et al.* 2013).

***Parastagonospora poae*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804439. Figs 60, 61.

*Etymology:* Named after the host genus from which it was collected, *Poa*.

On sterile *Carex* leaves on WA. *Conidiomata* up to 250 µm diam, black, immersed, subepidermal, pycnidial, subglobose with central ostiole, exuding creamy conidial mass; wall of 2–3 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to subcylindrical, with percurrent proliferation near apex, 6–10 × 3–4(–5) µm. *Conidia* hyaline, smooth, thin-walled, cylindrical, granular, with obtuse apex and truncate base, medianly 1-septate, (20–)25–27(–32) × (2–)2.5(–2.5) µm; ends becoming swollen and guttulate with age.

*Culture characteristics:* Colonies on PDA flat, circular, with sparse, white aerial mycelium, surface dark-mouse-grey, reverse black,

after 14 d, 8.5 cm diam; on MEA surface hazel, reverse dark-brick to sepia; OA similar to MEA.

*Specimens examined:* Netherlands, Wageningen, on leaves of *Poa* sp. (*Poaceae*), 2 Aug. 2012, S. Videira J (holotype CBS H-21305, culture ex-type CBS 135089 = S606); Wageningen, on leaves of *Poa* sp., 2 Aug. 2012, S. Videira CBS 135091 = S613).

*Note:* Conidia of *P. poae* are narrower than those of *P. nodorum*, which are (0–)1–3-septate, 13–28 × 2.8–4.6 μm (Bissett 1982).

**Clade 28: *Neostagonospora***

***Neostagonospora*** Quaedvlieg, Verkley & Crous, **gen. nov.** MycoBank MB804440.

*Etymology:* Resembling the genus *Stagonospora*.

*Foliicolous.* Conidiomata immersed, pycnidial, globose, exuding a pale luteous to creamy conidial mass; wall of 2–3 layers of pale brown *textura angularis*. Conidiophores reduced to conidiogenous cells. Conidiogenous cells phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to doliiform, tapering at apex with prominent periclinal thickening. Conidia hyaline, smooth, granular, thin-walled, narrowly fusoid-ellipsoidal to subcylindrical, apex subobtusely rounded, base truncate, widest in middle, transversely euseptate, becoming constricted with age.

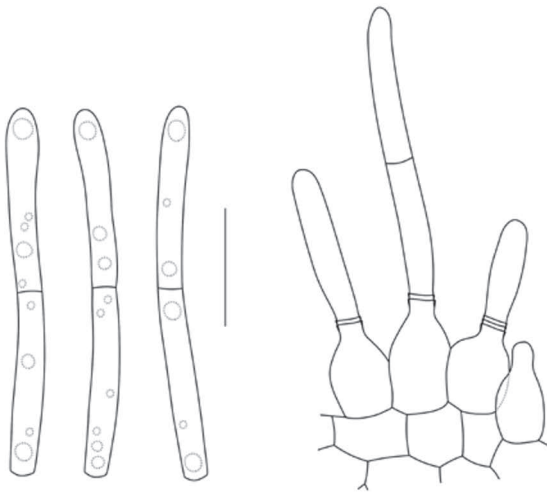
*Type species:* *Neostagonospora caricis* Quaedvlieg, Verkley & Crous.

*Note:* *Neostagonospora* is similar to *Stagonospora* by having pycnidial conidiomata with euseptate, hyaline, fusoid-ellipsoidal to subcylindrical conidia, but distinct in having conidiogenous cells that are phialidic, with prominent periclinal thickening.

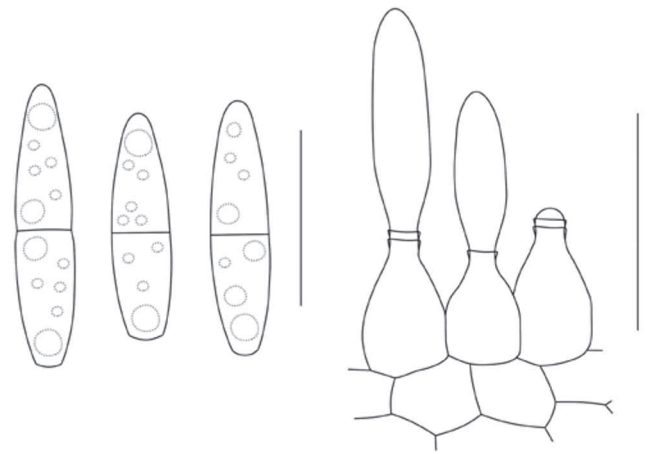
***Neostagonospora caricis*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804441. Figs 62, 63.

*Etymology:* Named after the host genus on which it occurs, *Carex*.

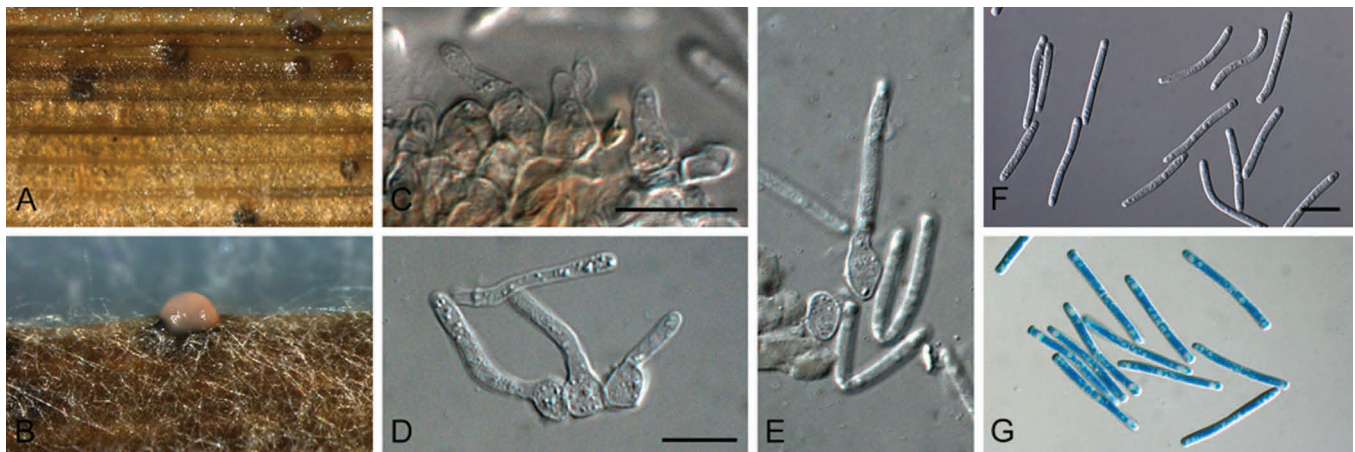
On sterile *Carex* leaves on WA. Conidiomata immersed, pycnidial, globose, up to 200 μm diam, exuding a pale luteous to creamy conidial mass; wall of 2–3 layers of pale brown *textura angularis*. Conidiophores reduced to conidiogenous cells. Conidiogenous cells phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to doliiform, 5–7 × 5–7 μm; tapering at apex with prominent periclinal thickening. Conidia hyaline, smooth, granular, thin-walled, narrowly fusoid-ellipsoidal, apex subobtusely rounded, base truncate, widest in middle, 1-septate, becoming constricted with age, (10–)13–16(–19) × (3–)3.5(–4) μm.



**Fig. 60.** Conidia and conidiogenous cells of *Parastagonospora poae* (CBS 135091). Scale bars = 10 μm.



**Fig. 62.** Conidia and conidiogenous cells of *Neostagonospora caricis* (CBS 135092). Scale bars = 10 μm.



**Fig. 61.** *Parastagonospora poae* (CBS 135091). A, B. Conidiomata forming in culture. C–E. Conidiogenous cells. F, G. Conidia. Scale bars = 10 μm.

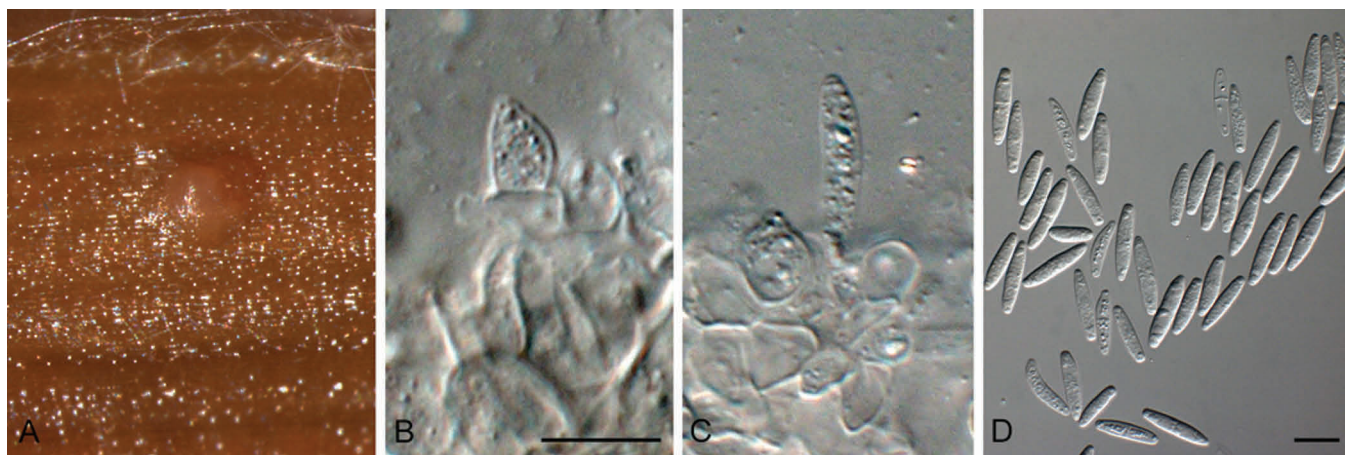


Fig. 63. *Neostagonospora caricis* (CBS 135092). A. Conidioma forming in culture. B, C. Conidiogenous cells. D. Conidia. Scale bars = 10 µm.

**Culture characteristics:** Colonies on PDA flat, undulate, with sparse, powdery white aerial mycelium, surface greyish-sepia to isabelline, reverse olivaceous-grey to pale olivaceous-grey, after 14 d, 8.5 cm diam; on MEA erumpent, circular, with fine white aerial mycelium, surface honey, reverse cinnamon, after 14 d, 6 cm diam; on OA similar to PDA but surface honey, reverse cinnamon.

**Specimen examined:** Netherlands, Veenendaal, de Blauwe Hel, on leaves of *Carex acutiformis* (Cyperaceae), Aug. 2012, W. Quaedvlieg (holotype CBS H-21306, culture ex-type CBS 135092 = S616).

**Note:** *Neostagonospora caricis* is similar to *Septoria caricis* (conidia 1-septate, 20–35 × 2.5–3 µm; Ellis & Ellis 1997), although its conidia are shorter.

***Neostagonospora elegiae*** Quaedvlieg, Verkley & Crous, sp. nov. MycoBank MB804442. Figs 64, 65.

**Etymology:** Named after the host genus from which it was collected, *Elegia*.

On *Anthriscus* stem. *Conidiomata* pycnidial, up to 150 µm diam, erumpent, globose, brown, opening by a central ostiole, exuding a crystalline conidial mass; wall consisting of 3–6 layers of pale brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, lining the inner cavity, hyaline, smooth, ampulliform, 4–7 × 4–6 µm; apex with prominent periclinal thickening. *Conidia* hyaline, smooth, guttulate to granular, scolecosporous, irregularly curved, subcylindrical, apex subobtuse, base truncate (slight taper from apical septum to apex and basal septum to hilum visible in some conidia), (0–)3-septate, (20–)50–65(–70) × (2.5–)3 µm.

**Culture characteristics:** Colonies spreading, erumpent with moderate aerial mycelium and smooth, even margins; reaching 35 mm diam after 2 wk. On OA pale luteous. On MEA dirty white on surface, luteous in reverse. On PDA dirty white on surface, pale luteous in reverse.

**Specimen examined:** South Africa, Western Cape Province, Harold Porter Botanical Garden, on leaves of *Elegia cuspidata* (Restionaceae), 30 Nov. 2001, S. Lee (holotype CBS H-21307, culture ex-type CBS 135101 = CPC 16977).

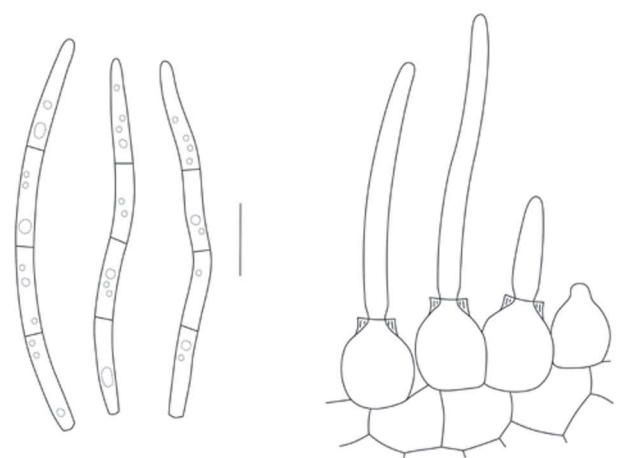


Fig. 64. Conidia and conidiogenous cells of *Neostagonospora elegiae* (CBS 135101). Scale bars = 10 µm.

**Notes:** No septoria-like fungi are presently known from *Elegia* (Lee *et al.* 2004). *Neostagonospora elegiae* is distinguished from *N. caricis* based on its conidial morphology.

### Clade 29: *Phaeosphaeriopsis*

***Phaeosphaeriopsis*** M.P.S. Câmara, M.E. Palm & A.W. Ramaley, Mycol. Res. 107: 519. 2003.

**Saprobic or plant pathogenic.** *Ascomata* solitary or aggregated, immersed, subepidermal to erumpent, pushing up flaps of the epidermis, globose to pyriform, often papillate, solitary or gregarious in a stroma of scleropectenchyma or dark brown *textura angularis*, often surrounded by septate, brown hyphae extending into the host tissues. *Asci* 8-spored, bitunicate, cylindrical to broadly fusoid, short stipitate, with visible apical chamber. *Ascospores* uni- to triseriate, cylindrical, broadly rounded at apex, tapering to narrowly rounded base, 4–5-septate, first septum submedian, often constricted, medium brown, echinulate, punctate or verrucose. Asexual morph coniothyrium-like or phaeostagonospora-like. *Conidiomata* pseudoparenchymatous, sometimes of scleropectenchyma. *Conidiogenous cells* lining locule, ampulliform, hyaline, proliferating percurrently, resulting in inconspicuous annellations. *Conidia* cylindrical, with bluntly rounded ends, 0–3-septate, yellowish brown, punctate (Câmara *et al.* 2003, Zhang *et al.* 2012).

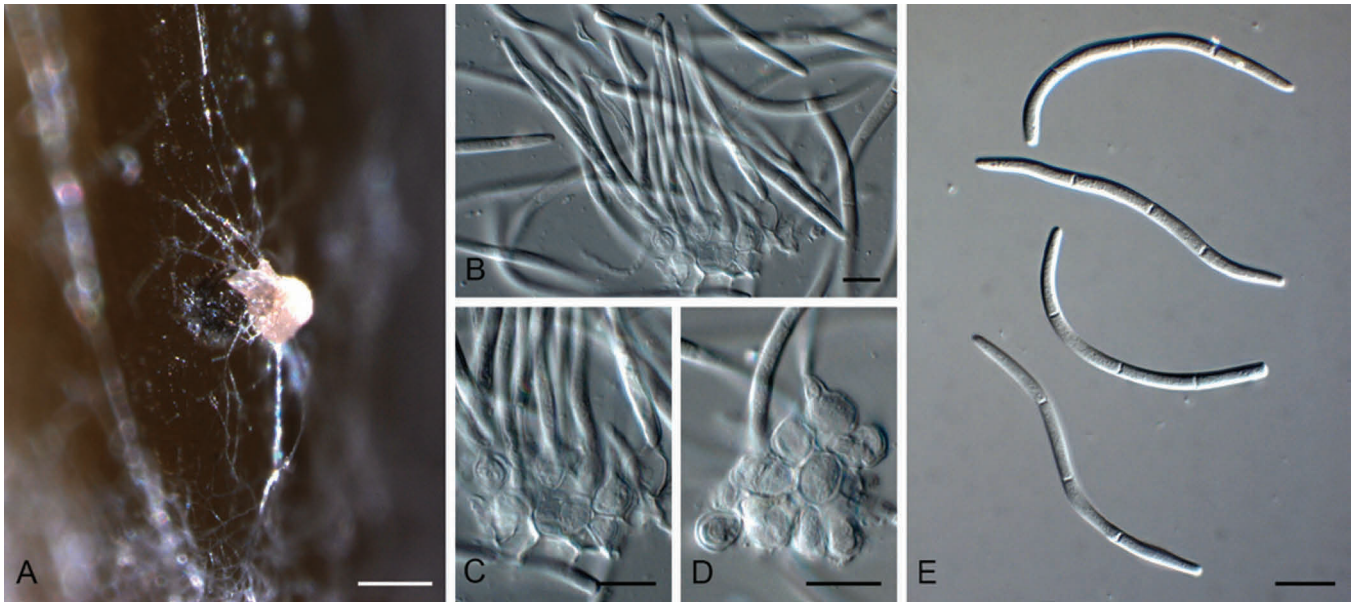


Fig. 65. *Neostagonospora elegiae* (CBS 135101). A. Conidioma forming in culture. B–D. Conidiogenous cells. E. Conidia. Scale bars: A = 150 µm, all others = 10 µm.

Type species: *Phaeosphaeriopsis glaucopunctata* (Grev.) M.P.S. Câmara, M.E. Palm & A.W. Ramaley, Mycol. Res., 107: 519. 2003.

***Phaeosphaeriopsis glaucopunctata*** (Grev.) M.P.S. Câmara, M.E. Palm & A.W. Ramaley, Mycol. Res. 107: 519. 2003. Figs 66, 67.

Basionym: *Cryptosphaeria glaucopunctata* Grev., Fl. Edin.: 362. 1824.

- ≡ *Paraphaeosphaeria glaucopunctata* (Grev.) Shoemaker & C. E. Babc., Can. J. Bot. 63: 1286. 1985.
- = *Sphaeria rusci* Wallr., Fl. Crypt. Germ. 2: 776. 1833.
- ≡ *Leptosphaeria rusci* (Wallr.) Sacc., Syll. Fung. 2: 74. 1883.
- ≡ *Paraphaeosphaeria rusci* (Wallr.) O. E. Erikss., Ark. Bot., Ser. 2 6: 406. 1967.

*Ascomata* scattered or aggregated, immersed, globose to subglobose, up to 250 µm diam; peridium up to 25 µm wide, of thick-walled *textura angularis*; *hamathecium* of dense, wide, cellular pseudoparaphyses, 3–5 µm diam. *Asci* 8-spored, bitunicate, cylindrical to broadly fusoid, with a short pedicel and small apical chamber, 50–110 × 10–16 µm. *Ascospores* uni- to triseriate, cylindrical, medium brown, 4(–5)-septate, without constriction or slightly constricted at the basal septum, the forth cell from the apex usually slightly inflated, the basal cell often longer, 14–28 × (3.5–)5–7.5 µm. *Conidiomata* pycnidial, immersed, scattered or aggregated, dark brown, subglobose, ostiolate, up to 200 µm diam. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* lining the inner cavity, ampulliform, hyaline, smooth, 5–10 × 3–6 µm; proliferating percurrently at apex. *Conidia* aseptate, smooth to finely verruculose, medium brown, subcylindrical, straight to reniform with obtuse ends, (5–)7–9(–10) × (2.5–)3(–5) µm.

*Culture characteristics*: On PDA colonies flat, spreading, with sparse aerial mycelium and smooth, lobate, even margins, surface primrose, reverse olivaceous-buff, On OA buff with patches of isabelline due to sporulating conidiomata. On MEA dirty white on surface, isabelline in reverse (centre), cinnamon in outer region.

*Specimen examined*: Switzerland, Kt. Basel-Stadt, Park Basel, on *Ruscus aculeatus* (*Ruscaceae*), 25 Sep. 1980, A. Leuchtman (CBS H-21308, culture CBS 653.86).

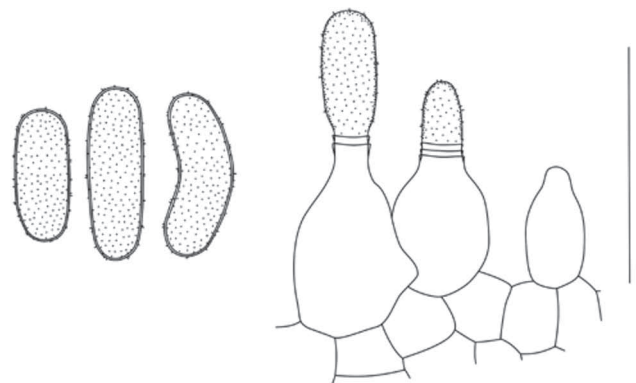


Fig. 66. Conidia and conidiogenous cells of *Phaeosphaeriopsis glaucopunctata* (CBS 653.86). Scale bar = 10 µm.

*Notes*: The genus *Phaeosphaeriopsis* is characterised by having uni- or multiloculate stromata and 4–5-septate ascospores. It presently contains species with coniothyrium-like, and phaeostagonospora-like asexual morphs (e.g. *P. musae*; Arzanlou & Crous 2006). The type species, *Phaeosphaeriopsis glaucopunctata*, is associated with leaf spot and necrosis on *Ruscus aculeatus* (Câmara et al. 2003, Golzar & Wang 2012). The fact that an isolate identified as *Chaetosphaeronema hispidulum* (lectotype of *Chaetosphaeronema*) clusters in this clade is puzzling. The genus *Chaetosphaeronema* is characterised by setose, dark brown pycnidia with thick-walled outer cell layers, producing hyaline, 1-septate conidia (Sutton 1980). Isolate CBS 216.75 proved to be sterile, however, so this matter could unfortunately not be resolved.

### Clade 30: *Sclerostagonospora*

*Description*: See above.

*Type species*: *S. heraclei* (Sacc.) Höhn., Hedwigia 59: 252. 1917.

***Sclerostagonospora phragmiticola*** Quaedvlieg, Verkley & Crous, sp. nov. MycoBank MB804443. Fig. 68.

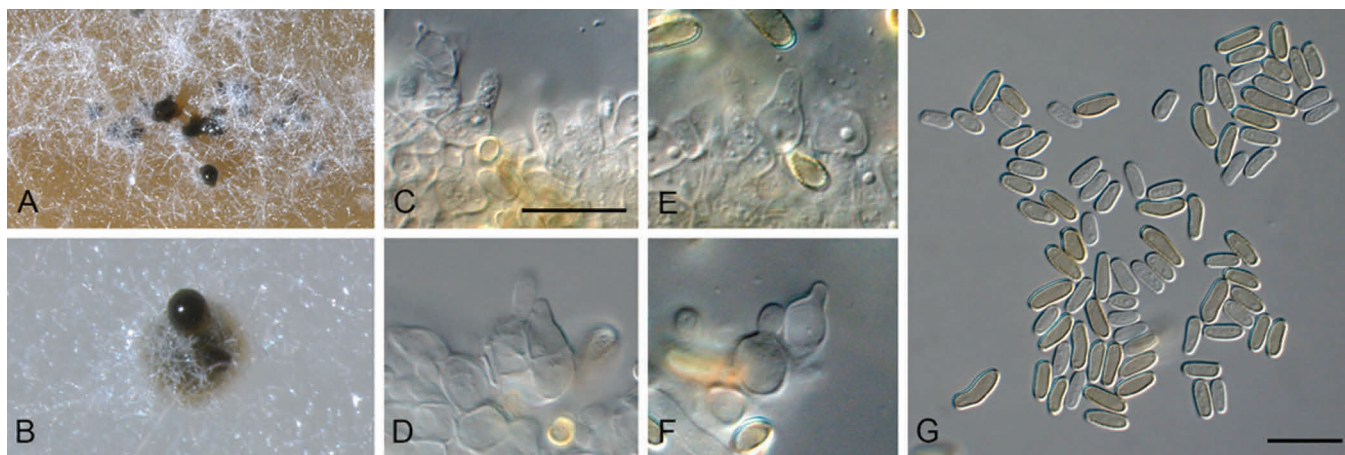


Fig. 67. *Phaeosphaeriopsis glaucopunctata* (CBS 653.86). A. Colony on MEA. B. Colony on OA. C–F. Conidiogenous cells giving rise to conidia. G. Conidia. Scale bars = 10 µm

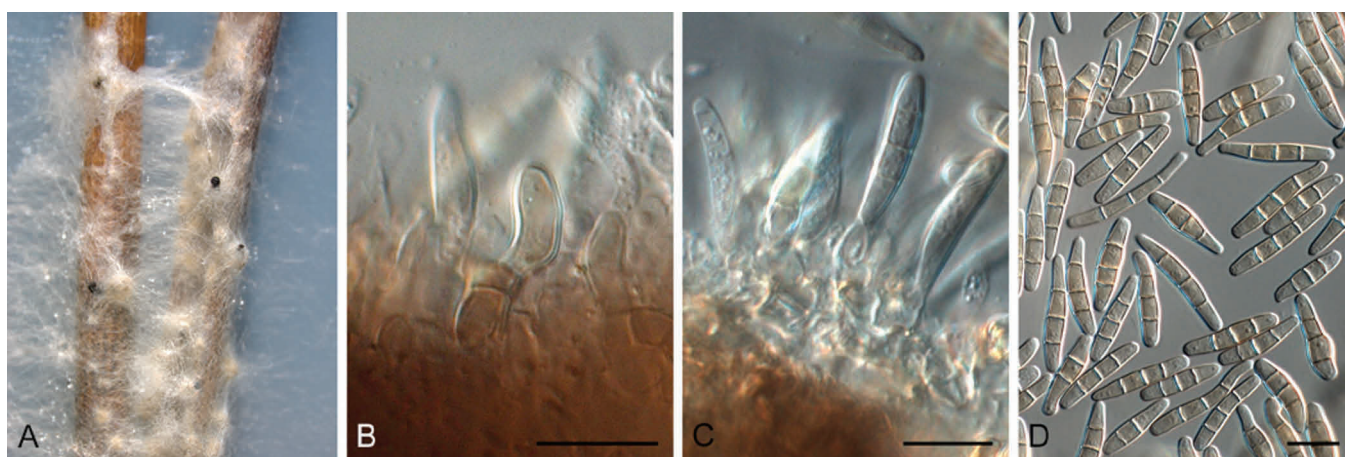


Fig. 68. *Sclerostagonospora phragmiticola* (CBS 338.86). A. Colony sporulating in culture. B, C. Conidiogenous cells. D. Conidia. Scale bars = 10 µm.

**Etymology:** Named after the host genus from which it was collected, *Phragmites*.

On sterile *Carex* leaves on WA. *Conidiomata* pycnidial, brown, globose, immersed to erumpent, up to 400 µm diam with central ostiole; wall of 6–8 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* lining the inner cavity of conidioma, hyaline to pale olivaceous, smooth, subcylindrical to doliiform, 6–15 × 3–4 µm, proliferating several times percurrently at apex. *Conidia* brown, smooth, subcylindrical, apex obtuse, base truncate, straight to gently curved, (1–)3(–5)-euseptate, older conidia swelling, becoming widest in second or third cell from base, (15–)20–25(–27) × (3–)3.5(–4) µm.

**Specimen examined:** France, Landes, Seignosse, Étang d'Hardy, on leaves of *Phragmites australis* (Poaceae), 11 June 1986, H.A. van der Aa (**holotype** CBS H-21309, culture ex-type CBS 338.86).

**Notes:** *Sclerostagonospora caricicola* fits the concept of *Sclerostagonospora* by having pycnidial conidiomata that give rise to hyaline conidiogenous cells that proliferate percurrently, and subcylindrical, pigmented conidia. Until fresh material of the type species, *S. heraclei* has been recollected and subjected to DNA analysis, the application of this generic name will remain tentative. Several other species cluster in this clade, suggesting that the sexual morph is phaeosphaeria-like.

### Clade 31: *Phaeosphaeria*

***Phaeosphaeria*** I. Miyake, Bot. Mag., Tokyo 23: 93. 1909.

= *Phaeoseptoria* Speg., Revta Mus. La Plata 15: 39. 1908.

**Follicolous.** *Ascomata* immersed, subepidermal, ellipsoidal to globose, glabrous; ostiole central, devoid of periphyses; wall of 2–3 layers of brown *textura angularis*. *Pseudoparaphyses* transversely septate, guttulate, encased in mucous. *Asci* stipitate, clavate to cylindrical, stalked, biseriolate. *Ascospores* brown, narrowly fusiform, straight or slightly curved, transversely septate, smooth to verruculose, enclosed in a mucoïd sheath or not. *Conidiomata* pycnidial, immersed, becoming erumpent, brown, with central ostiole; wall of 2–3 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* hyaline, ampulliform to subcylindrical or doliiform; proliferating inconspicuously percurrently near apex. *Conidia* solitary, pale brown, smooth, guttulate, subcylindrical to narrowly obclavate, apex obtuse, base truncate, straight to curved, transversely euseptate, at times slightly constricted at septa; hilum not darkened nor thickened.

**Type species:** *P. oryzae* I. Miyake, Bot. Mag. Tokyo, 23(266): 93. 1909.

**Notes:** *Phaeosphaeria* (1909; based on *P. oryzae*) is congeneric with *Phaeoseptoria* (1908; based on *P. papayae*). We choose to

use the sexual name *Phaeosphaeria*, as it is well established, and less confused than *Phaeoseptoria*, which has become a confused concept applied to numerous septoria-like taxa with pigmented conidia (see Walker *et al.* 1992).

***Phaeosphaeria oryzae*** I. Miyake, Bot. Mag. Tokyo, 23(266): 93. 1909. Figs 69, 70.

- ≡ *Pleospora oryzae* (I. Miyake) Hara, J. Agric. Soc. Japan 31(361): 17. 1927.
- ≡ *Trematosphaerella oryzae* (I. Miyake) Padwick, A manual of rice diseases: 153. 1950.
- ≡ *Leptosphaerella oryzae* (I. Miyake) Hara, A monograph of rice diseases: 53. 1959.

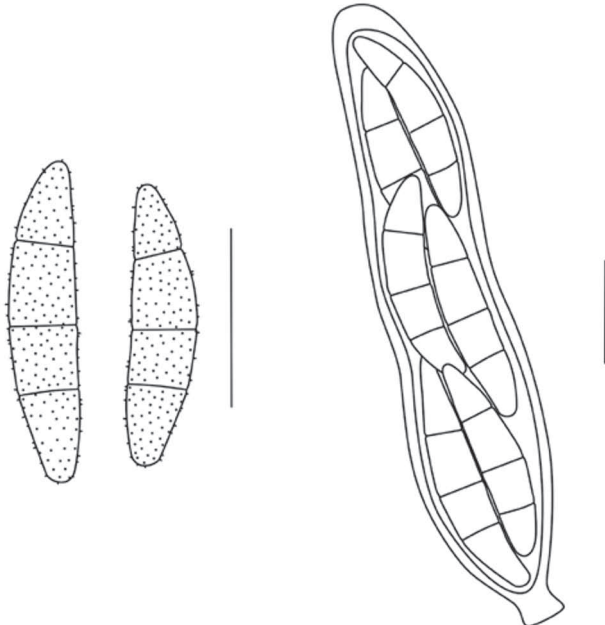


Fig. 69. Asci and ascospores of *Phaeosphaeria oryzae* (BPI 744438). Scale bars = 10 µm.

- ≡ *Leptosphaerulina oryzae* (I. Miyake) Karan, Mycopath. Mycol. Appl. 24: 88. 1964.
- = *Phaeoseptoria oryzae* I. Miyake, J. Coll. Agric. Imp. Univ. Tokyo 2(4): 260. 1910.

*Ascomata* immersed, subepidermal, ellipsoidal to globose, glabrous, up to 150 µm diam, ostiole central, up to 20 µm diam, devoid of periphyses; wall of 2–3 layers of brown *textura angularis*. *Pseudoparaphyses* 2–3 µm diam, transversely septate, guttulate, encased in mucous. *Asci* stipitate, cylindrical, 30–55 × 7–9 µm, stalked, biseriate. *Ascospores* brown, narrowly fusiform, straight or slightly curved, (15–)17–20(–23) × 4(–5) µm, 3-septate, uniformly verruculose, enclosed in a mucoid sheath; after discharge, ascospores become prominently swollen, up to 33 µm long and 8 µm wide.

*Specimens examined*: **Japan**, No. 196178, on 2, Prov. Susuya Shizuoka, Sep. 1907, ex Herb. Sydow, ex S., as *Leptosphaeria oryzae* Hori = *Phaeosphaeria oryzae* I. Miyake, slides prepared by O. Eriksson, **lectotype** (UPS). **Korea**, on leaf of *Oryza sativa* (*Poaceae*), intercepted at Port San Francisco, CA, 29 Dec. 1997, coll. L. Hausch, det. M.E. Palm, **epitype** designated here as BPI 744438, culture ex-epitype CBS 110110 (MBT175330).

*Notes*: Several detailed accounts of this species are available (Eriksson 1967, Shoemaker & Babcock 1989, Fukuhara 2002). The epitype chosen here closely matches the lectotype in morphology.

***Phaeosphaeria papayae*** (Speg.) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804444. Figs 71, 72.

*Basionym*: *Phaeoseptoria papayae* Speg., Revta Mus. La Plata: 39. 1908.

*Leaf spots* associated with infections of *Asperisporium caricae*, amphigenous, pale brown to grey-white, subcircular to angular, 1–5 mm diam, with red-purple margin; conidiomata developing

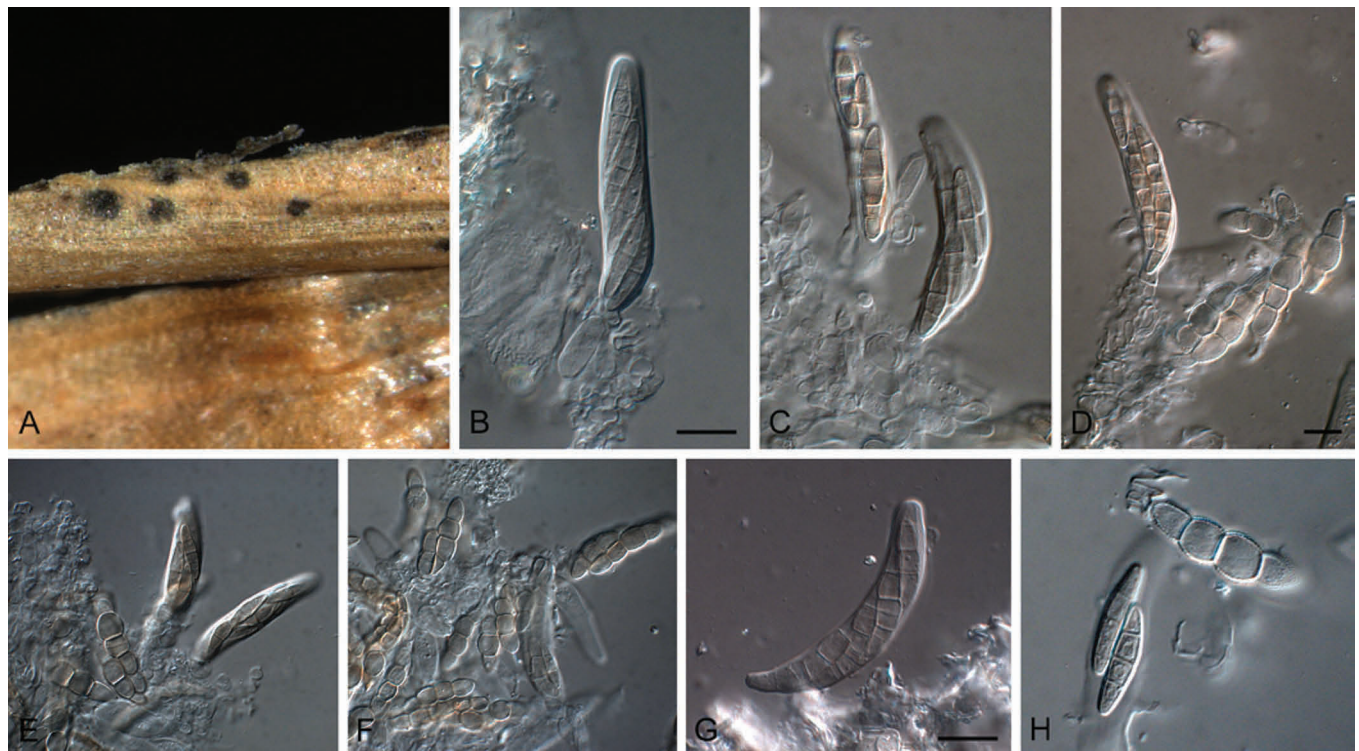


Fig. 70. *Phaeosphaeria oryzae* (BPI 744438). A. *Ascomata* on host tissue. B–G. *Asci*. H. *Ascospores*. Scale bars = 10 µm.

and sporulating on leaves when incubated in moist chambers, with white, fluffy mycelium erupting from lesions. *Conidiomata* amphigenous, pycnidial, brown, globose, up to 120  $\mu\text{m}$  diam, with central ostiole, exuding a brown conidial cirrus; wall of 3–4 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* lining the inner cavity, hyaline, smooth, ampulliform to subcylindrical or doliiform, 5–12  $\times$  4–6  $\mu\text{m}$ ; proliferating inconspicuously percurrently near

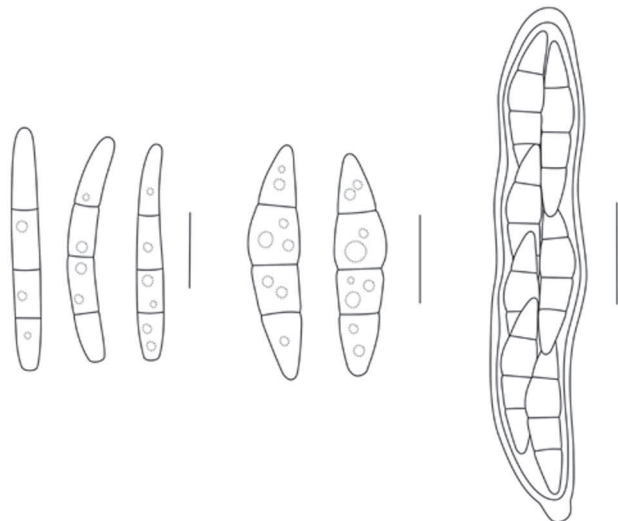


Fig. 71. Conidia, ascospores and ascus of *Phaeosphaeria papayae* (CBS H-21310). Scale bars = 10  $\mu\text{m}$ .

apex (conidiogenous cells disintegrating at maturity). *Conidia* solitary, pale brown, smooth, guttulate, subcylindrical to narrowly obclavate, apex obtuse, base truncate, (1–)3(–)4-septate, at times slightly constricted at septa, straight to slightly curved, (15–)26–32(–)35  $\times$  (2.5–)3  $\mu\text{m}$ ; hilum not darkened nor thickened, 2  $\mu\text{m}$  diam. *Ascospores* developed after 4 wk in culture on sterile nettle stems: aggregated in black clusters, globose, up to 150  $\mu\text{m}$  diam, with central ostiole; wall of 2–3 layers of brown *textura angularis*. *Asci* bitunicate, curved to straight, fasciculate, short stipitate with ocular chamber, 40–60  $\times$  8–11  $\mu\text{m}$ . *Pseudoparaphyses* hyaline, smooth, 2–3  $\mu\text{m}$ , septate, constricted at septa, not anastomosing, hypha-like with obtuse ends, distributed among asci. *Ascospores* tri to multiseriate, fusoid, curved to straight, brown, verruculose throughout, somewhat constricted at septa with age, second cell from apex swollen, (18–)24–26(–)29  $\times$  (3–)4(–)5  $\mu\text{m}$ .

**Culture characteristics:** Colonies with abundant aerial mycelium, covering dish within 2 wk at 24  $^{\circ}\text{C}$ , fast growing, olivaceous-grey on MEA (surface and reverse); margins smooth, even, sterile on MEA, PDA and OA, as well as on SNA with sterile barley leaves.

**Specimens examined:** **Brazil**, São Paulo, Botanical Garden, on leaves of *Carica papaya* (Caricaceae), Sep. 1908, IMI 246301, slide ex-holotype; Minas Gerais, Viçosa, UFV campus, on leaves of *Carica papaya*, Mar. 2013, A.C. Alfenas, **epitype** designated here as CBS H-21310, culture ex-epitype CBS 135416 (MBT175331).

**Notes:** It is interesting to note that Walker *et al.* (1992) also observed *Phaeoseptoria papayae* to co-occur with *Asperisporium*

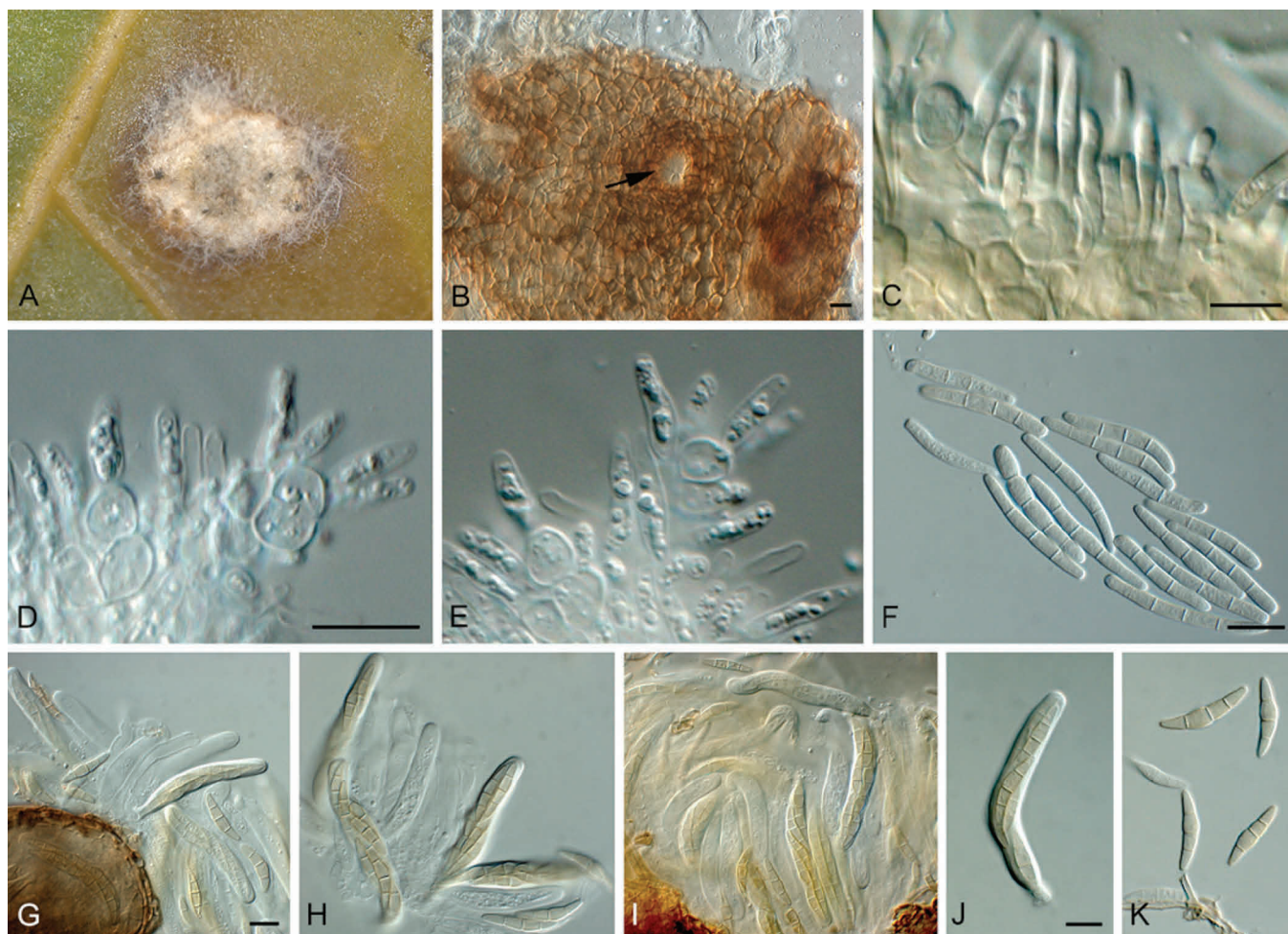


Fig. 72. *Phaeosphaeria papayae* (CBS H-21310). A. Leaf spot. B. Conidioma with ostiole (arrow). C–E. Conidiogenous cells. F. Conidia. G–K. Asci and ascospores. Scale bars = 10  $\mu\text{m}$ .

*caricae* on the holotype specimen (noted by Spegazzini as *Cercospora caricae*), suggesting that the co-occurrence of these two pathogens is quite common. The fresh collection obtained in this study enabled us to elucidate the conidiogenesis of the fungus (not observed by Walker *et al.* 1992), and also designate an epitype specimen. Phylogenetically it is closely related to *Phaeosphaeria oryzae*, which has *Phaeoseptoria oryzae* as asexual morph.

**Clade 32: *Neosetophoma***

***Neosetophoma*** Gruyter, Aveskamp & Verkley, *Mycologia* 102(5): 1075. 2010.

*Foliicolous*, plant pathogenic. *Conidiomata* pycnidial, solitary to confluent, on upper surface of agar, globose to irregular, with mycelial outgrowths, or confluent, with papillate ostioles, sometimes developing long necks, honey to olivaceous or olivaceous-black, with up to 10 layers of pseudoparenchymatal cells. *Conidiogenous cells* hyaline, monophyalidic. *Conidia* slightly yellowish, 0–1(–3)-septate, ellipsoidal to cylindrical, usually attenuate at one end, often guttulate.

*Type species: N. samarorum* Gruyter, Aveskamp & Verkley, *Mycologia* 102(5): 1075. 2010.

*Note:* The fact that several strains with a phaeosphaeria-like morphology cluster in this clade, suggests that sexual states do exist for species of *Neosetophoma*.

**Clade 33: *Paraphoma***

***Paraphoma*** Morgan-Jones & J.F. White, *Mycotaxon* 18: 58. 1983.

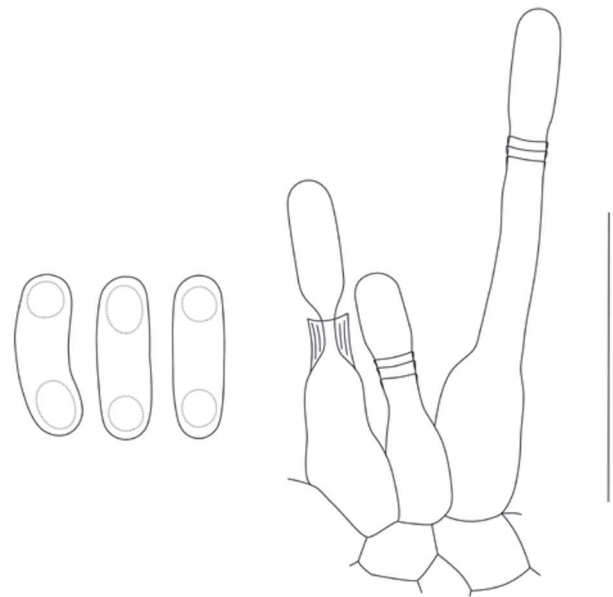
*Mycelium* consisting of branched, septate, subhyaline to pale brown, smooth hyphae. *Conidiomata* pycnidial, solitary to aggregated, superficial to immersed, dark brown, globose to subglobose, papillate, uniloculate, setose; ostiole circular, single; wall of 3–6 layers of brown *textura angularis*. *Setae* copious, straight to flexuous, smooth to verruculose, thick-walled, septate, pale brown to brown. *Conidiogenous cells* lageniform, monophalidic, formed from inner layer of conidiomatal wall, hyaline to subhyaline, discrete. *Conidia* ellipsoid, aseptate, hyaline, smooth, guttulate. *Chlamydospores* if present unicellular.

*Type species: P. radicina* (McAlpine) Morgan-Jones & J.F. White, *Mycotaxon* 18: 60. 1983.

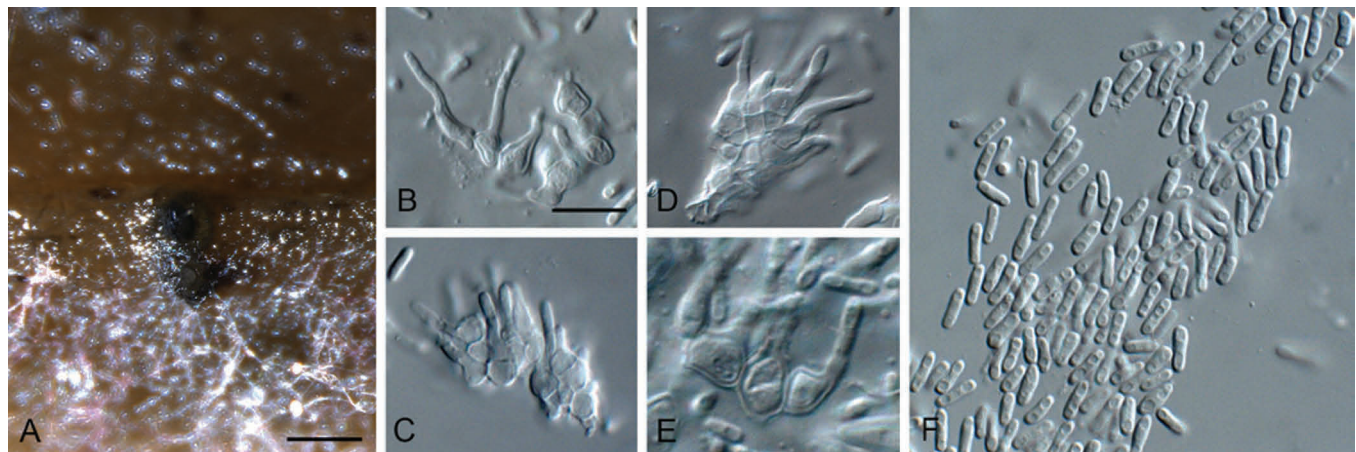
***Paraphoma dioscoreae*** Quaedvlieg, H.D. Shin, Verkley & Crous, **sp. nov.** MycoBank MB804445. Figs 73, 74.

*Etymology:* Named after the host genus from which it was collected, *Dioscorea*.

On *Anthriscus* stem. *Conidiomata* pycnidial, separate, immersed becoming erumpent, globose, with papillate neck and central ostiole exuding a crystalline conidial mass; conidiomata up to 350 µm diam, neck up to 150 µm diam, of darker brown cells than body, which is pale brown; wall of 3–6 layers of pale brown *textura angularis*. *Conidiophores* hyaline, smooth, subcylindrical, reduced to conidiogenous cells, 1–5-septate, irregularly branched, 5–20 × 3–5 µm. *Conidiogenous cells* phialidic, hyaline, smooth, ampulliform to subcylindrical (long, elongated neck on *Anthriscus* stem, but not on MEA), 5–15 × 2–3 µm; apex with prominent periclinal thickening, or with several percurrent proliferations (especially on conidiogenous cells with elongated necks). *Conidia* solitary, straight to slightly curved, hyaline, smooth, aseptate, cylindrical with obtuse ends and a guttule at each end, (5–)6(–7) × 2(–2.5) µm.



**Fig. 73.** Conidia and conidiogenous cells of *Paraphoma dioscoreae* (CBS 135100). Scale bar = 10 µm.



**Fig. 74.** *Paraphoma dioscoreae* (CBS 135100). A. Conidioma forming in culture. B–E. Conidiogenous cells. F. Conidia. Scale bars: B = 350 µm, all others = 10 µm.



**Culture characteristics:** Colonies flat, spreading with sparse aerial mycelium and even, smooth margins; after 2 wk reaching 30 mm diam on MEA, 40 mm on PDA and 50 mm on OA. On PDA dark brick, reverse fuscous-black. On OA dark brick with patches of sienna and ochreous. On MEA surface dirty white (due to aerial mycelium), also somewhat sectored, reverse umber.

**Specimen examined:** South Korea, on leaves of *Dioscorea tokoro* (Dioscoreaceae), 24 Oct. 2003, H.D. Shin (holotype CBS H-21311, culture ex-type CPC 11357 = CBS 135100).

**Note:** *Paraphoma dioscoreae* is phylogenetically distinct from the three other species presently known in the genus (de Gruyter *et al.* 2010).

### Clade 34: *Xenoseptoria*

***Xenoseptoria*** Quaedvlieg, H.D. Shin, Verkley & Crous, **gen. nov.** MycoBank MB804446.

**Etymology:** Similar to the genus *Septoria* s. str., but distinct.

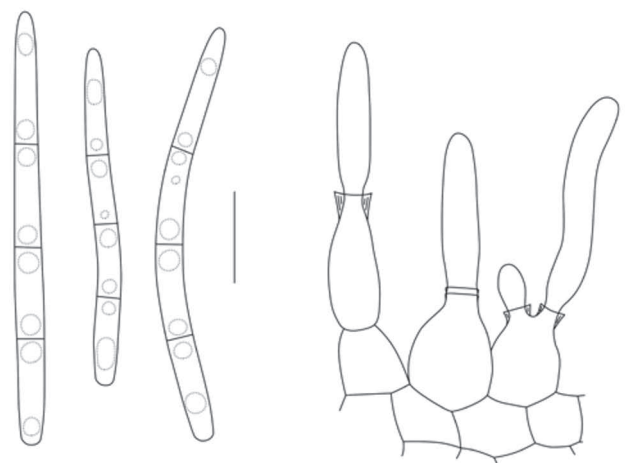
**Foliicolous**, plant pathogenic. *Conidiomata* separate, pycnidial, immersed becoming erumpent, globose, brown, developing 1–3 papillate necks, exuding a pink to orange conidial mass; wall of 4–8 layers of brown *textura angularis*. *Conidiophores* hyaline, smooth, reduced to conidiogenous cells or septate, branched below. *Conidiogenous cells* lining the inner cavity, hyaline, smooth, ampulliform to doliiform or subcylindrical, mono- to polyphialidic, with prominent periclinal thickening, but also with percurrent proliferation. *Conidia* hyaline, smooth, guttulate, scolecosporous, straight to irregularly curved, cylindrical to obclavate, transversely euseptate, tapering to subobtuse apex, base obtuse.

**Type species:** *Xenoseptoria neosaccardoi* Quaedvlieg, Verkley & Crous.

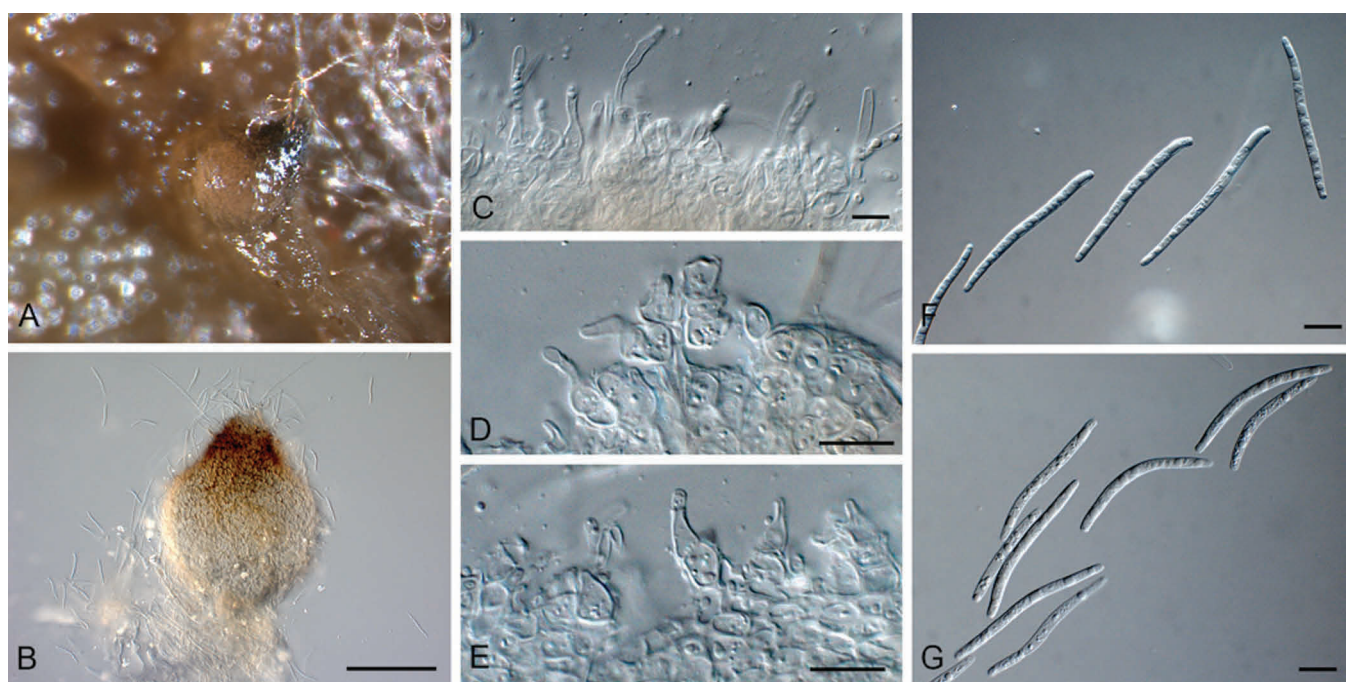
***Xenoseptoria neosaccardoi*** Quaedvlieg, H.D. Shin, Verkley & Crous, **sp. nov.** MycoBank MB804447. Figs 75, 76.

**Etymology:** Resembling *Septoria saccardoi*, but morphologically distinct.

**Leaf spots** on the upper leaf surface, scattered, distinct, circular, 2–4 mm diam, initially appearing as reddish brown discolouration, later turning brown to reddish brown without a distinct border line, finally central area becoming greyish brown to dull grey and surrounded by reddish to dark brown margin, reddish pigments may diffuse outward to form a halo; on the lower leaf surface initially showing reddish discolouration, later becoming brown with distinct border line, center greyish brown to grey with indistinct border (Shin & Sameva 2004). On sterile *Carex* leaves on WA. *Conidiomata* separate, pycnidial, immersed becoming erumpent, globose, up to 350 µm diam, brown, becoming ostiolate, developing 1–3 papillate necks, exuding a pink to orange conidial mass; wall of 4–8 layers of brown *textura angularis*. *Conidiophores* hyaline,



**Fig. 75.** Conidia and conidiogenous cells of *Xenoseptoria neosaccardoi* (CBS 128665). Scale bars = 10 µm.



**Fig. 76.** *Xenoseptoria neosaccardoi* (CBS 128665). A, B. Pycnidia forming in culture. C–E. Conidiogenous cells. F, G. Conidia. Scale bars: B = 170 µm, all others = 10 µm.

smooth, reduced to conidiogenous cells or 1–2-septate, branched below, 10–20 × 4–6 µm. *Conidiogenous cells* lining the inner cavity, hyaline, smooth, ampulliform to doliiform or subcylindrical, mono- to polyphialidic, with prominent periclinal thickening, but also with percurrent proliferation, 5–15 × 3–5 µm. *Conidia* hyaline, smooth, guttulate, scolecosporous, straight to irregularly curved, cylindrical to obclavate, (1–)3-septate, (23–)33–45(–48) × (2.5–)3(–4) µm, tapering to subobtuse apex, base obtuse, 2–2.5 µm diam.

**Culture characteristics:** Colonies flat, spreading, with sparse aerial mycelium and lobate, feathery margins, reaching 30 mm after 2 wk. On PDA surface iron-grey, reverse olivaceous-grey; on OA surface olivaceous-grey; on MEA surface folded, bay, reverse umber.

**Specimen examined:** South Korea, Pyeongchang, on leaves of *Lysimachia vulgaris* var. *davurica* (*Primulaceae*), 30 May 2007, H.D. Shin (**holotype** CBS H-21312, culture ex-type CBS 128665 = KACC 43962 = SMKC 23666).

**Notes:** An isolate of *Septoria saccardoi* (CBS 128756) clusters in *Septoria* s. str., thus well apart from this taxon, which was collected in Korea. The Korean collection closely matches that of the original description of *Septoria saccardoi* (on *Lysimachia vulgaris* in Italy), having 3-septate, curved, cylindrical conidia, 38–40 × 3.5 µm, 3-septate (Saccardo & Saccardo 1906). *Xenoseptoria* is however distinct from *Septoria* s. str. in forming pycnidia with multiple papillate necks, and having conidiogenous cells that are mono- or polyphialidic.

**Clade 35: *Vrystaatia***

***Vrystaatia*** Quaedvlieg, W.J. Swart, Verkley & Crous, **gen. nov.** MycoBank MB804448.

**Etymology:** Named after the Free State Province in South Africa, “Vrystaat” in Afrikaans, where this fungus was collected.

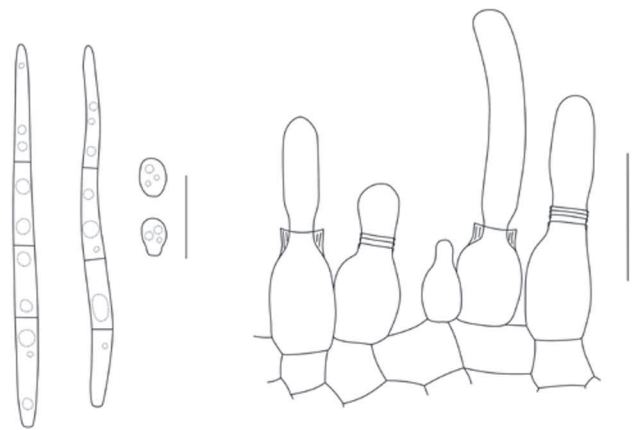
**Foliicolous.** *Conidiomata* black, globose, pycnidial with central, dark brown ostiolar area, substomatal on host, erumpent in culture;

wall of 6–8 layers of pale brown *textura angularis*; exuding cirrhus of orange conidia. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* lining the inner cavity of conidioma, globose to ampulliform, rarely allantoid, hyaline, smooth; with prominent periclinal thickening, or proliferating several times percurrently near apex, giving rise to macro- and microconidia. *Macroconidia* solitary, hyaline, smooth, guttulate, subcylindrical to narrowly obclavate or acicular, apex obtuse to subobtuse, base truncate to long obconically truncate, conidia widest at or just above basal septum, transversely euseptate. *Microconidia* hyaline, smooth, aseptate, pear-shaped to globose or ellipsoid, apex obtuse, base truncate.

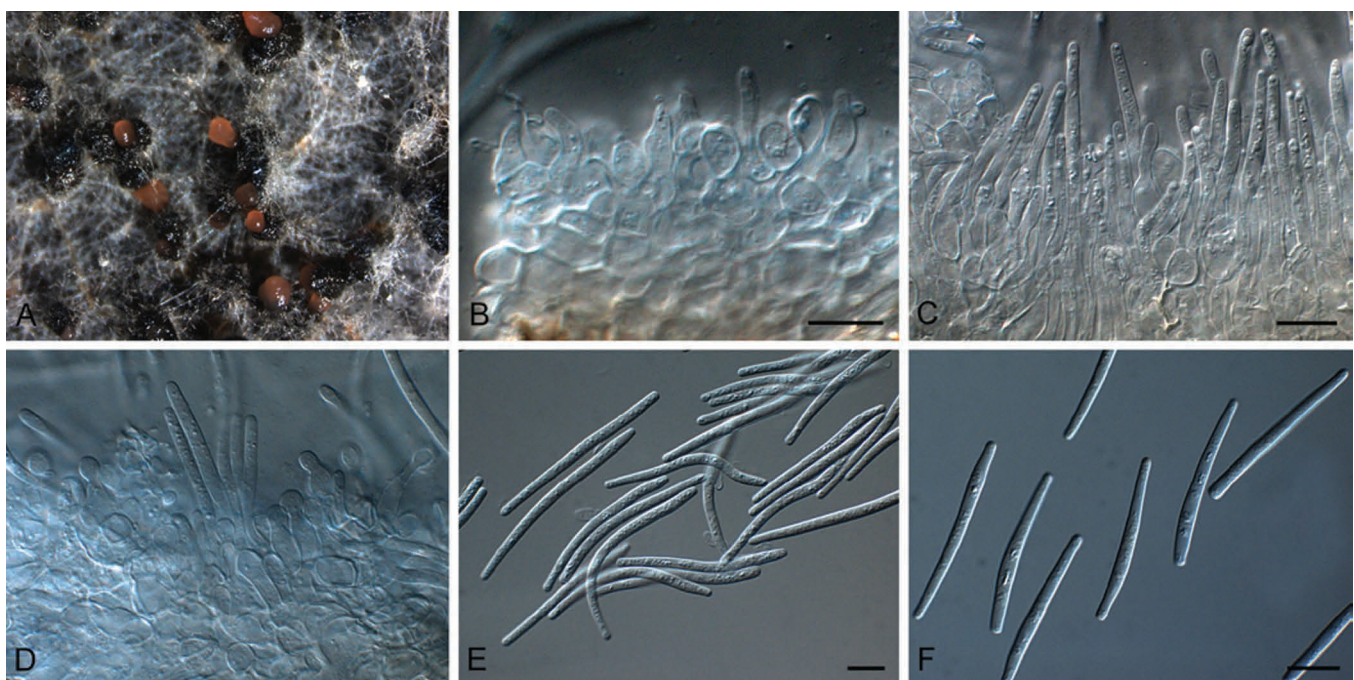
**Type species:** *Vrystaatia aloicola* Quaedvlieg, Verkley, W.J. Swart & Crous.

***Vrystaatia aloicola*** Quaedvlieg, Verkley, W.J. Swart & Crous, **sp. nov.** MycoBank MB804449. Figs 77, 78.

**Etymology:** Named after the host genus from which it was collected, *Aloe*.



**Fig. 77.** Macro- and microconidia and conidiogenous cells of *Vrystaatia aloicola* (CBS 135107). Scale bars = 10 µm.



**Fig. 78.** *Vrystaatia aloicola* (CBS 135107). A. Conidiomata sporulating on PDA, with characteristic orange conidial cirrhi. B–D. Conidiogenous cells. E, F. Conidia. Scale bars = 10 µm.

On sterile *Carex* leaves on WA. *Conidiomata* black, globose, pycnidial with central, dark brown ostiolar area, substomatal on host, erumpent in culture; wall of 6–8 layers of pale brown *textura angularis*; exuding cirrhus of orange conidia. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* lining the inner cavity of conidioma, globose to ampulliform, rarely allantoid, hyaline, smooth, 5–12 × 4–6 µm; with prominent periclinal thickening, or proliferating several times percurrently near apex, 2–2.5 µm diam, giving rise to macro- and microconidia. *Macroconidia* solitary, hyaline, smooth, guttulate, subcylindrical to narrowly obclavate or acicular, apex obtuse to subobtuse, base truncate to long obconically truncate, conidia widest at or just above basal septum, (1–)3-septate, (30–)40–52(–65) × (2.5–)3(–3.5) µm. *Microconidia* hyaline, smooth, aseptate, pear-shaped to globose or ellipsoid, apex obtuse, base truncate, 4–6 × 3–3.5 µm.

**Culture characteristics:** On MEA colonies spreading fast, with moderate aerial mycelium and smooth, even margin, reaching 30 mm diam after 2 wk; surface with concentric zones of umber and apricot; reverse umber, produces brown exudates; on PDA round lobate margins, lacking aerial mycelium, reaching 20 mm diam after 2 wk, surface fuscous-black to greyish-sepia for younger mycelium, reverse fuscous-black to greyish-sepia for younger mycelium; on OA round, lobate, lacking aerial mycelium, reaching 30 mm diam after 2 wk, surface vinaceous-grey, reverse greyish sepia.

**Specimen examined:** South Africa, Orange Free State, Bloemfontein, Free State National Botanical Garden, on dead leaf tips of *Aloe maculata* (Aloaceae), 7 May 2012, P.W. Crous & W.J. Swart (**holotype** CBS H-21313, culture ex-type CBS 135107 = CPC 20617).

**Notes:** *Vrystaatia* is distinct from *Septoria* s. str. in that it has phialidic conidiogenous cells that proliferate percurrently or with prominent periclinal thickening, and form macro- as well as microconidia in culture, which is not typical of *Septoria*. *Rhabdospora aloetica* was described from stems of *Aloe* sp. in Portugal, with aseptate conidia, 12–16 × 1.5 µm (Saccardo & Saccardo 1906); it is likely this is an asexual morph of *Diaporthe*. As far as we could establish, no septoria-like fungi have thus far been described from *Aloe*.

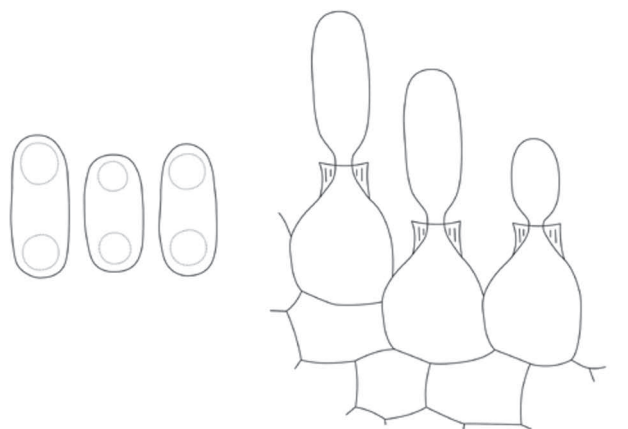
## Clade 36: *Setophoma*

***Setophoma*** Gruyter, Aveskamp & Verkley, *Mycologia* 102: 1077. 2010.

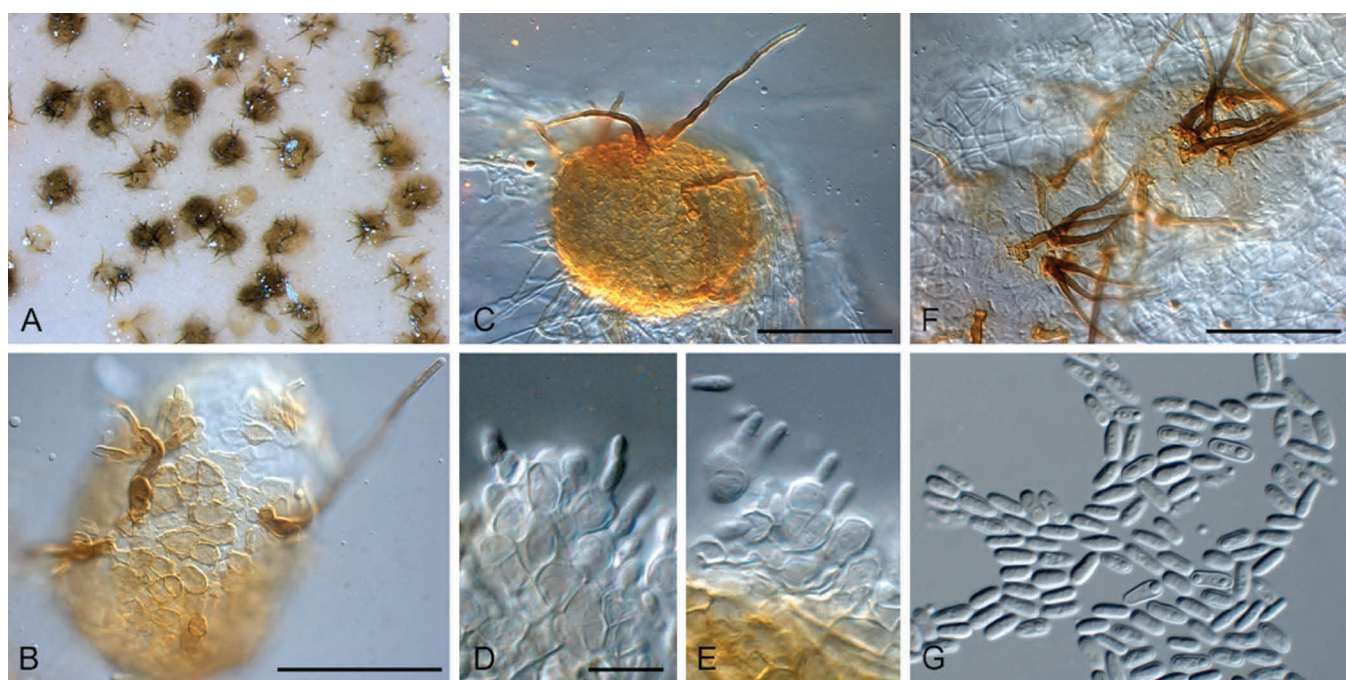
*Conidiomata* pycnidial, solitary to confluent, superficial or submerged in agar, globose to subglobose, setose, with papillate ostioles, honey to olivaceous to olivaceous-black, with 2–7(–11) layers of pseudoparenchymatal cells. *Conidiogenous cells* hyaline, monophyalidic. *Conidia* aseptate, ellipsoidal to subcylindrical to subfusoid, guttulate.

**Type species:** *S. terrestris* (H.N. Hansen) Gruyter, Aveskamp & Verkley, *Mycologia* 102: 1077. 2010.

***Setophoma chromolaenae*** Quaedvlieg, Verkley, R.W. Barreto & Crous, **sp. nov.** MycoBank MB804450. Figs 79, 80.



**Fig. 79.** Conidia and conidiogenous cells of *Setophoma chromolaenae* (CBS 135105). Scale bar = 10 µm.



**Fig. 80.** *Setophoma chromolaenae* (CBS 135105). A. Conidiomata forming on OA. B, C, F. Conidiomata with setae. D, E. Conidiogenous cells. G. Conidia. Scale bars: B = 22 µm, C, F = 45 µm, all others = 10 µm.

**Etymology:** Named after the host genus from which it was collected, *Chromolaena*.

*Conidiomata* pycnidial, brown, globose, separate, erumpent, up to 90 µm diam; outer surface covered in brown setae, up to 80 µm long, brown, thick-walled, 3–5 µm diam, 1–4-septate, with slight apical taper to obtuse apex; conidial wall of 3–6 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* lining the inner cavity, ampulliform, hyaline, smooth, 4–6 × 3–6 µm, with prominent periclinal thickening at apex. *Conidia* hyaline, smooth, subcylindrical, somewhat narrowly ellipsoid when old, with two prominent guttules at ends, (4.5–)5–6 (–7) × (2–)2.5(–3) µm.

**Culture characteristics:** On MEA spreading, with sparse aerial mycelium, folded surface, margin smooth, lobate; surface umber with patches of apricot and dirty white, reverse ochreous. On PDA surface iron-grey, reverse olivaceous-grey. On OA surface iron-grey, surrounded by orange to apricot diffuse pigment layer in agar; reaching 55 mm diam after 2 wk.

**Specimen examined:** Brazil, Rio de Janeiro, Fazenda Santa Rosa, Ponte das Laranjeiras, on leaves of *Chromolaena odorata* (Asteraceae), 6 Apr. 2010, R.W. Barreto (holotype CBS H-21314, culture ex-type CBS 135105 = CPC 18553).

**Note:** *Setophoma chromolaenae* is phylogenetically distinct from *S. sacchari* and *S. terrestris*, the two other species presently known from the genus (de Gruyter et al. 2010).

### Clade 37: *Coniothyrium* (Coniothyriaceae)

***Coniothyrium*** Corda, Icon. Fung. (Prague) 4: 38. 1840.

*Mycelium* immersed, consisting of septate, hyaline to brown, branched hyphae. *Conidiomata* pycnidial, separate, globose, pale to dark brown, immersed, unilocular, thin-walled; wall of brown, thick-walled *textura angularis*. *Ostiole* circular, central, papillate or not. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* lining the inner cavity, phialidic, annellidic, indeterminate, discrete, doliiform to cylindrical, hyaline to pale brown, smooth, several annellations at apex. *Conidia* subcylindrical, spherical, ellipsoid or broadly clavate, brown, thick-walled, 0(–1)-euseptate, smooth to verruculose, apex obtuse, base truncate, at times with minute marginal frill (Sutton 1980).

**Type species:** *C. palmarum* Corda, Icon. Fung. (Prague) 4: 38. 1840.

***Coniothyrium sidae*** Quaedvlieg, Verkley, R.W. Barreto & Crous, sp. nov. MycoBank MB804451. Figs 81, 82.

**Etymology:** Named after the host genus from which it was collected, *Sida*.

*Conidiomata* pycnidial, globose, immersed becoming erumpent, up to 200 µm diam; wall consisting of 3–4 layers of subhyaline to pale brown *textura angularis*. *Ostiole* central, papillate, dark brown, up to 30 µm diam, surrounded by a whorl of brown setae, smooth, thick-walled, 4–8-septate, straight to curved, tapering to subobtuse apices, up to 130 µm long, 5–8 µm diam at base. *Conidiogenous cells* hyaline, smooth, lining the inner cavity, ampulliform to

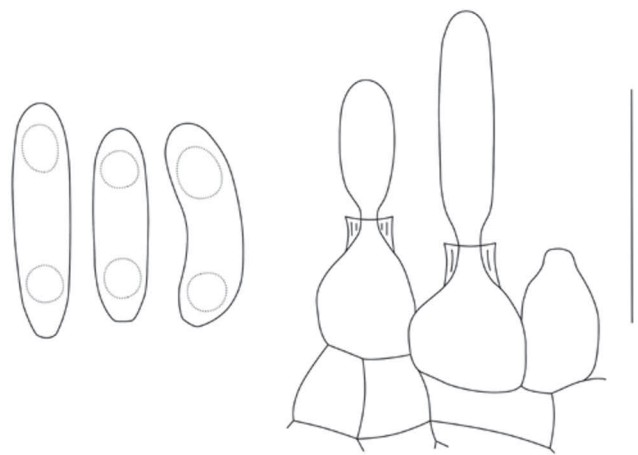


Fig. 81. Conidia and conidiogenous cells of *Coniothyrium sidae* (CBS 135108). Scale bar = 10 µm.

globose, 4–7 × 4–6 µm; apex with prominent periclinal thickening. *Conidia* solitary, hyaline, smooth, aseptate, granular (in Shear's medium, prominently guttulate in lactic acid), fusoid-ellipsoidal, straight to slightly curved, apex obtuse, base truncate to bluntly rounded, (9–)10–12(–13) × (2.5–)3 µm. *Ascumata* developing after several weeks on MEA, separate, pseudothecial, erumpent, uniloculate, papillate, brown, up to 300 µm diam; wall of 4–8 layers of brown *textura angularis*. *Asci* fasciculate, 8-spored, short papillate, hyaline, smooth, subcylindrical, bitunicate, with well-developed apical chamber, 2 µm diam, 55–65 × 8–11 µm. *Ascospores* bi- to triseriate, brown, smooth, guttulate, straight to slightly curved, (3–)5-septate, apical cell obtusely rounded, basal cell somewhat elongated and subobtuse; in ascospores that are 4-septate, the second cell from the apex is markedly swollen, in 5-septate ascospores the third cell from the apex is markedly swollen, (18–)20–24(–26) × (4–)5(–5.5) µm. *Pseudoparaphyses* hyaline, smooth, intermingled among asci, anastomosing, cellular, constricted at septa, up to 80 µm long, 2–4 µm diam.

**Culture characteristics:** Colonies erumpent, spreading, moderate aerial mycelium even, lobate margins. On MEA surface olivaceous-grey, reverse umber. On OA surface olivaceous-grey with diffuse umber pigment in agar. On PDA surface and reverse olivaceous-grey.

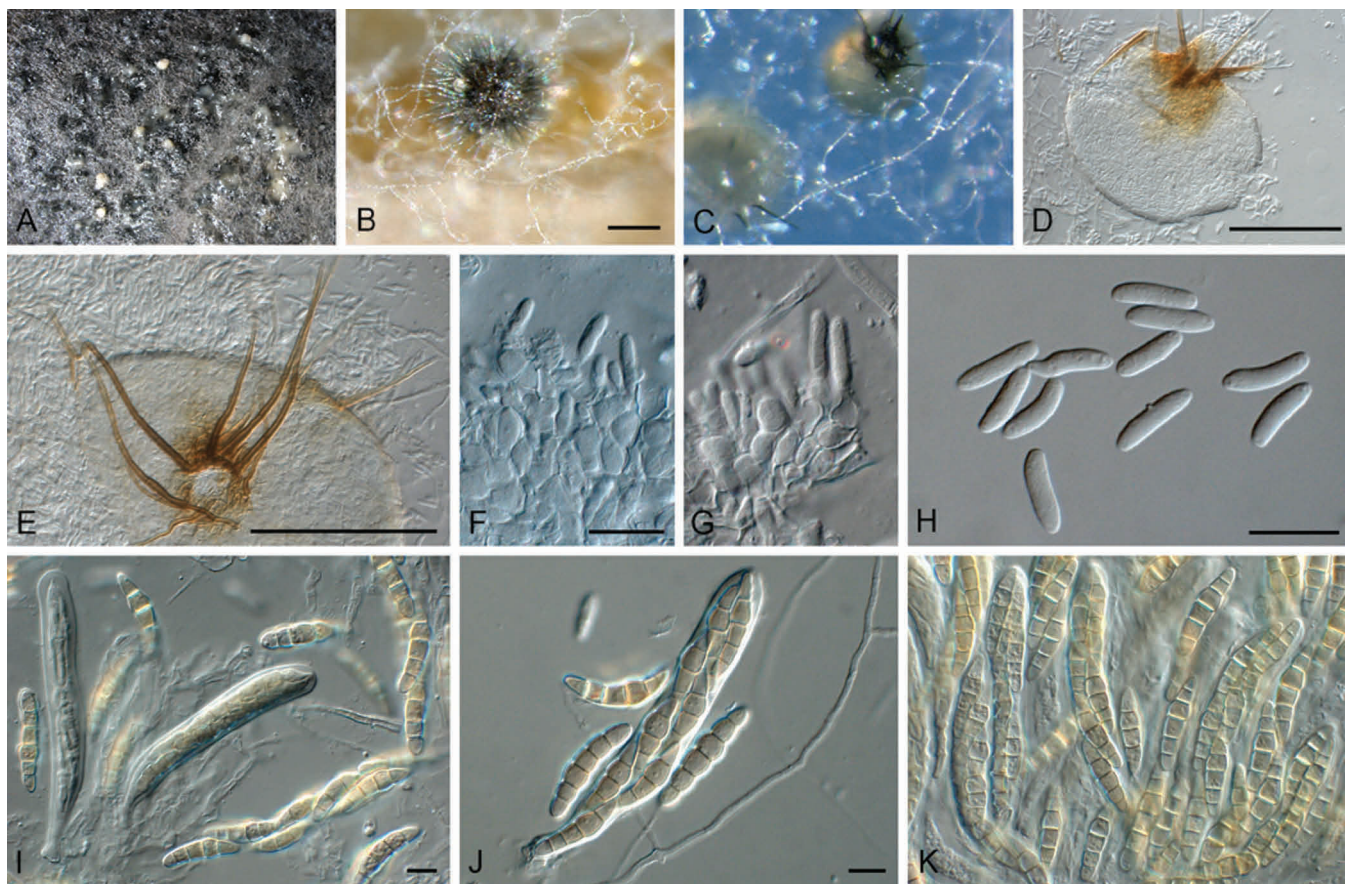
**Specimen examined:** Brazil, Rio de Janeiro, Nova Friburgo, Riograndina, along roadside on *Sida* sp. (Malvaceae), 24 Feb. 2008, R.W. Barreto (holotype CBS H-21315, culture ex-type CPC 19602 = RWB 866 = CBS 135108).

**Note:** De Gruyter et al. (2013) placed several phoma-like species with a similar morphology in the genus *Coniothyrium*, to which *C. sidae* is allied. Of interest is the paraphaeosphaeria-like sexual morph that developed in culture, which is newly linked here to *Coniothyrium*. The genus *Paraphaeosphaeria* is linked to *Paraconiothyrium* (Verkley et al. 2004).

### Clade 38: *Xenobotryosphaeria*

***Xenobotryosphaeria*** Quaedvlieg, Verkley & Crous, gen. nov. MycoBank MB804452.

**Etymology:** Resembling the genus *Botryosphaeria*, but distinct.



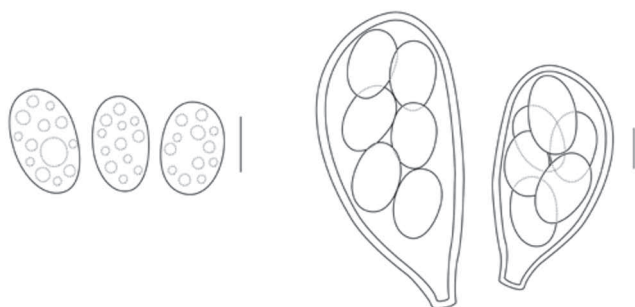
**Fig. 82.** *Coniothyrium sidae* (CBS 135108). A–E. Conidiomata forming in culture, showing setae. F, G. Conidiogenous cells. H. Conidia. I–K. Asci and ascospores. Scale bars: B, D, E = 100  $\mu\text{m}$ , all others = 10  $\mu\text{m}$ .

*Ascomata* brown, globose, smooth, ostiolate, superficial on stems; wall of 3–4 layers of brown *textura angularis*. *Asci* clavate, hyaline, smooth, short stipitate, fasciculate, bitunicate, thin-walled, apical chamber not visible, 6–8-spored. *Ascospores* multiseriate, hyaline, smooth and thin-walled, granular, broadly ellipsoid, ends obtuse, aseptate. *Pseudoparaphyses* not seen.

*Type species:* *Xenobotryosphaeria calamagrostidis* Quaedvlieg, Verkley & Crous.

***Xenobotryosphaeria calamagrostidis*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804453. Figs 83, 84.

*Etymology:* Named after the host genus from which it was collected, *Calamagrostis*.



**Fig. 83.** Ascospores and asci of *Xenobotryosphaeria calamagrostidis* (CBS 303.71). Scale bars = 10  $\mu\text{m}$ .

On *Anthriscus* stem. *Ascomata* brown, globose, smooth, superficial on stems, ostiolate, up to 180  $\mu\text{m}$  diam; wall of 3–4 layers of brown *textura angularis*. *Asci* clavate, hyaline, smooth, short stipitate, fasciculate, bitunicate, thin-walled, apical chamber not visible, 6–8-spored, 60–80  $\times$  30–40  $\mu\text{m}$ . *Ascospores* multiseriate, hyaline, smooth and thin-walled, granular, broadly ellipsoid, ends obtuse, aseptate, (17–)18–20(–24)  $\times$  (11–)12–13(–14)  $\mu\text{m}$ . *Pseudoparaphyses* not seen.

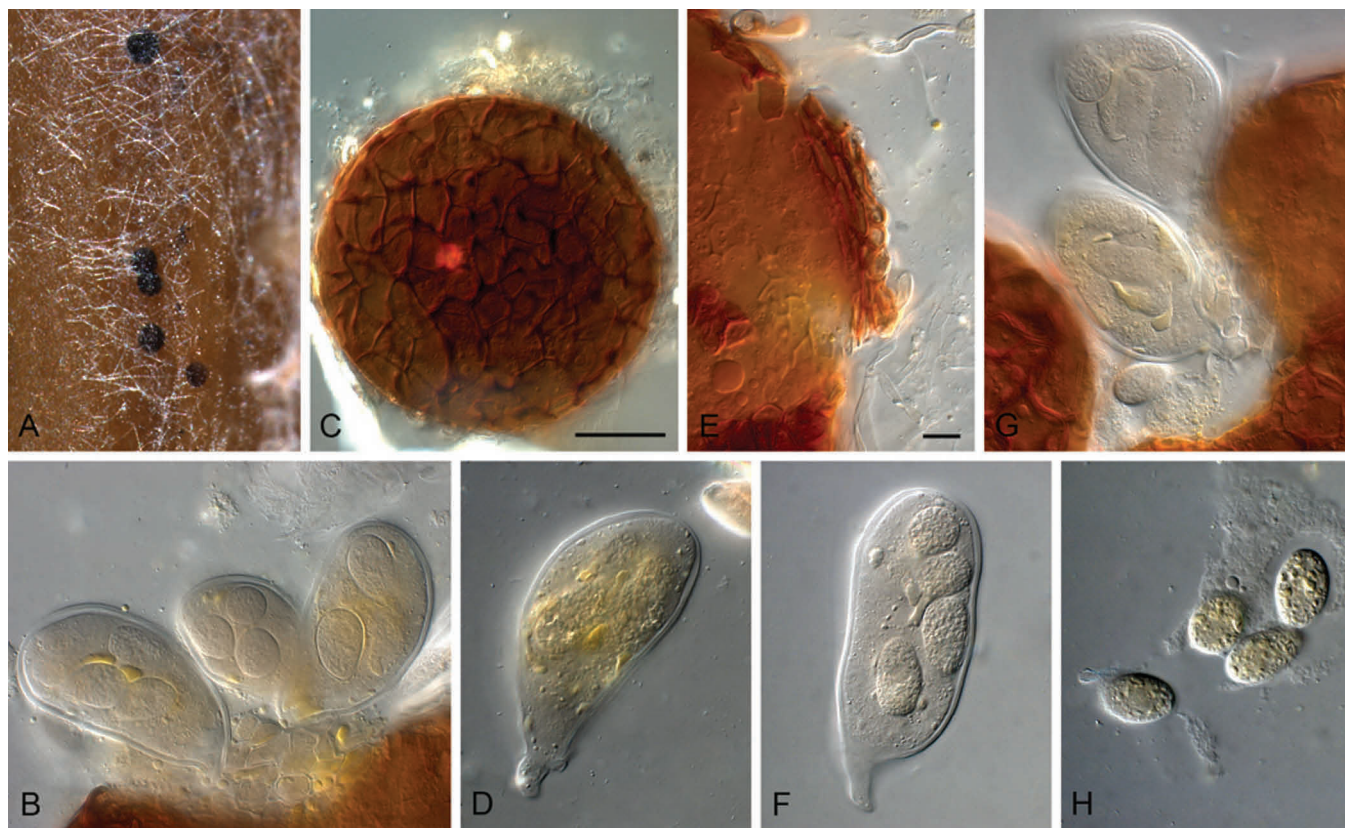
*Culture characteristics:* Colonies flat, spreading, with sparse to no aerial mycelium. On PDA surface and reverse dirty white; on MEA concolorous with agar; on OA pale pink on surface.

*Specimen examined:* Italy, Bergamo Vigolo, on *Calamagrostis* sp. (*Poaceae*), 20 Jun. 1967, G.A. Hedjaroude (**holotype** CBS H-21316, culture ex-type CBS 303.71).

*Notes:* Hedjaroude (1968) studied the specimen (ETH 7131; as *Phaeosphaeria silvatica*), but obviously the incorrect fungus was cultivated, as *X. calamagrostidis* is quite distinct from *P. silvatica*, which has cylindrical-fusoid, brown, 6–8-septate ascospores, 18–18  $\times$  4–5  $\mu\text{m}$ . *Xenobotryosphaeria* is reminiscent of genera in the *Botryosphaeriales*, but is phylogenetically distinct (Crous *et al.* 2006, Phillips *et al.* 2008, Liu *et al.* 2012). It also resembles species of *Muyocopron* (*Muyocoproneae*), but the latter genus differs in that it has circular, flattened ascomata, as well as prominent pseudoparaphyses, which are absent in *Xenobotryosphaeria*.

### Clade 39: *Phoma*

*Note:* See Aveskamp *et al.* (2010), de Gruyter *et al.* (2009, 2013).



**Fig. 84.** *Xenobotryosphaeria calamagrostidis* (CBS 303.71). A, C. Ascomata forming in culture. E, G. broken wall with asci. B, D, F. Asci. H. Ascospores. Scale bars: C = 45  $\mu$ m, all others = 10  $\mu$ m.

**Clade 40: *Acicuseptoria***

***Acicuseptoria*** Quaedvlieg, Verkley & Crous, **gen. nov.**  
 MycoBank MB804454.

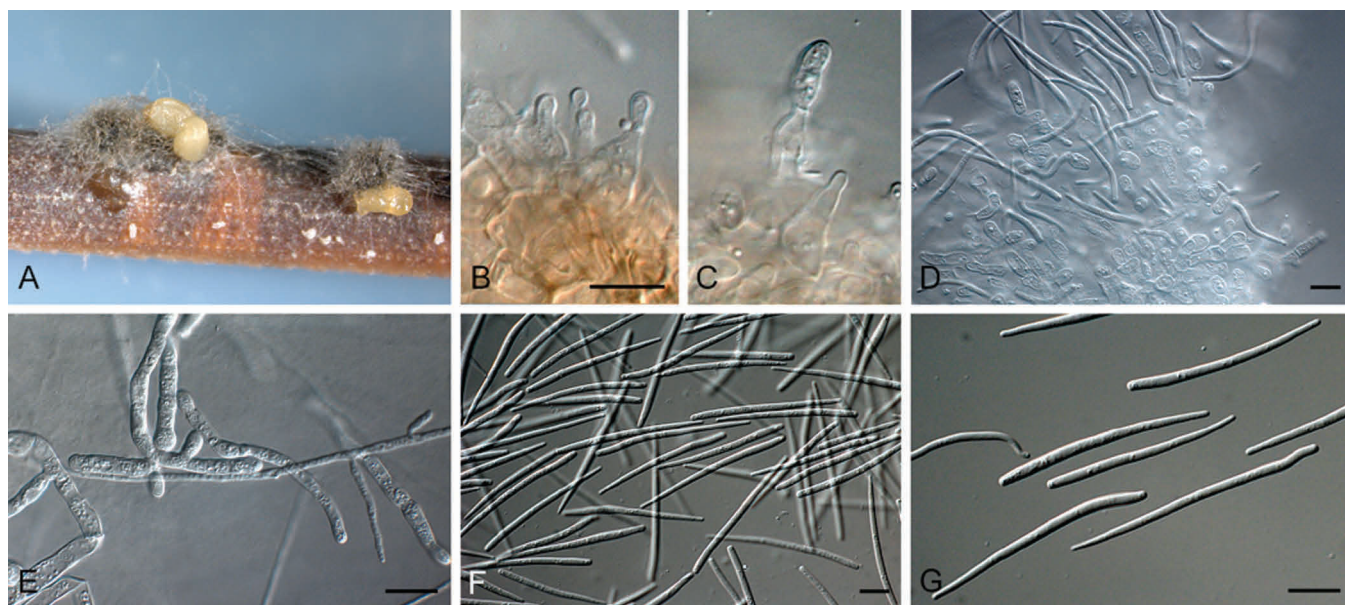
*Etymology:* *Acicu-* from acicular (conidia), and *Septoria* = septoria-like.

*Conidiomata* pycnidial, erumpent, brown, globose, with central ostiole, exuding a cream conidial mass; wall consisting of 3–6 layers of thin, brown *textura angularis*. *Conidiophores* reduced

to conidiogenous cells. *Conidiogenous cells* hyaline, smooth, ampulliform; proliferating inconspicuously and percurrently at apex, or simply appearing holoblastic. *Conidia* solitary, hyaline, granular, acicular, straight to gently curved, tapering towards apex that is acutely rounded, base truncate, transversely euseptate.

*Type species:* *Acicuseptoria rumicis* Quaedvlieg, Verkley & Crous.

***Acicuseptoria rumicis*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804455. Fig. 85.



**Fig. 85.** *Acicuseptoria rumicis* (CBS 522.78). A. Conidiomata sporulating in culture. B–E. Conidiogenous cells. F, G. Conidia. Scale bars = 10  $\mu$ m.

**Etymology:** Named after the host genus from which it was collected, *Rumex*.

On sterile *Carex* leaves on WA. *Conidiomata* pycnidial, erumpent, brown, globose, up to 300  $\mu\text{m}$  diam, with central ostiole, exuding a cream conidial mass; wall consisting of 3–6 layers of thin, brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* hyaline, smooth, ampulliform, 7–15  $\times$  5–7  $\mu\text{m}$ ; proliferating inconspicuously and percurrently at apex, or simply appearing holoblastic. *Conidia* solitary, hyaline, granular, acicular, straight to gently curved, tapering towards apex that is acutely rounded, base truncate, 1.5–2  $\mu\text{m}$  diam, up to 8-septate, (32–)40–60(–70)  $\times$  2(–2.5)  $\mu\text{m}$ .

**Culture characteristics:** Colonies lobate, flat with little appressed, white aerial mycelium. On MEA surface olivaceous-grey, reverse umber. On OA surface olivaceous-grey. On PDA surface and reverse olivaceous-grey.

**Specimen examined:** France, Haute Savoie, Mt. Beaudin, 2000 m alt., stem of *Rumex alpinus* (*Polygonaceae*), Oct. 1978, H.A. van der Aa (**holotype** CBS H-18163, culture ex-type CBS 522.78).

**Notes:** *Acicuseptoria rumicis* was originally deposited as *Septoria rumicum*, but is distinct from the latter in having acicular, narrower conidia. *Acicuseptoria* is distinct from *Septoria* s. str. in having acicular conidia.

#### Clade 41: *Stagonospora*

***Stagonospora*** (Sacc.) Sacc., Syll. Fung. (Abellini) 3: 445. 1884.

**Description:** See above.

**Type species:** *S. paludosa* (Sacc. & Speg.) Sacc., Syll. Fung. (Abellini) 3: 453. 1884.

***Stagonospora duoseptata*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804459. Figs 86, 87.

**Etymology:** Named after the fact that conidia are 2-septate.

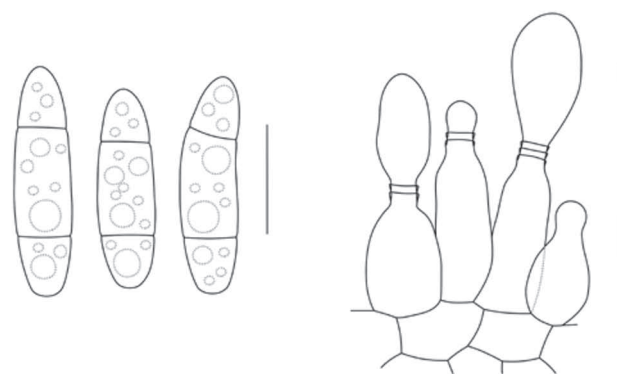


Fig. 86. Conidia and conidiogenous cells of *Stagonospora duoseptata* (CBS 135093). Scale bars = 10  $\mu\text{m}$ .

On sterile *Carex* leaves on WA. *Conidiomata* dark brown, immersed, subepidermal, pycnidial, globose, up to 400  $\mu\text{m}$  diam, exuding a short, hyaline cirrhous of conidia; wall of 3–4 layers of medium brown *textura angularis*. *Conidiophores* hyaline, smooth, lining inner cavity, 0–1-septate, subcylindrical, 10–20  $\times$  4–5  $\mu\text{m}$ . *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, subcylindrical to ampulliform or doliiform, 6–8  $\times$  3–4  $\mu\text{m}$ ; phialidic with several apical percurrent proliferations. *Conidia* hyaline, smooth, thin-walled, granular, fusoid-ellipsoidal, 2-septate, with septa 4–6  $\mu\text{m}$  inwards from both obtuse conidial ends; conidia widest in middle, (18–)20–23(–25)  $\times$  (5–)6(–7)  $\mu\text{m}$ .

**Culture characteristics:** Colonies on PDA flattened, circular with lobate edges, and fine grey aerial mycelium, surface mouse-grey, reverse olivaceous-black, after 14 d, 4 cm diam; on MEA after 14 d, 4.5 cm diam; on OA similar to MEA.

**Specimen examined:** Netherlands, Nijmegen, de Duffelt, on leaves of a *Carex acutiformis* (*Cyperaceae*), 29 Jul. 2012, W. Quaedvlieg (**holotype** CBS H-21321, culture ex-type CBS 135093 = S618).

**Notes:** *Stagonospora duoseptata* is distinct from other species occurring on *Carex* in that it has fusoid-ellipsoidal, 2-septate conidia, (18–)20–23(–25)  $\times$  (5–)6(–7)  $\mu\text{m}$ , with septa positioned 4–6  $\mu\text{m}$  inwards from its obtuse conidial ends. *Stagonospora bisepitata* (occurring on *Carex lanuginosa*, Wisconsin, USA) has conidia that are larger, (35–)40–50(–55)  $\times$  (2–)10–11(–13)  $\mu\text{m}$  (Greene 1961).

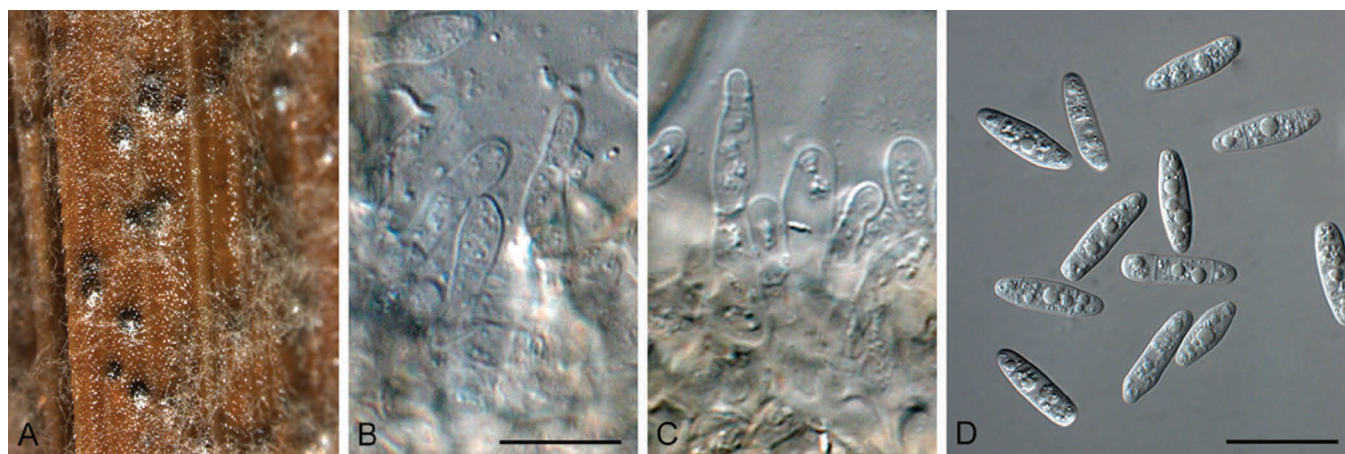


Fig. 87. *Stagonospora duoseptata* (CBS 135093). A. Conidiomata forming in culture. B, C. Conidiogenous cells. D. Conidia. Scale bars = 10  $\mu\text{m}$ .

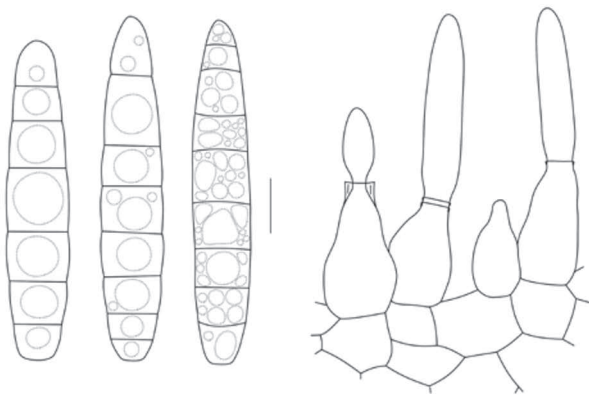
***Stagonospora paludosa*** (Sacc. & Speg.) Sacc., Syll. Fung. (Abellini) 3: 453. 1884. Figs 88, 89.

*Basionym:* *Hendersonia paludosa* Sacc. & Speg., *Michelia* 1(no. 3): 353. 1878.

On sterile *Carex* leaves on WA. *Conidiomata* black, immersed, subepidermal, pycnidial, globose, up to 400 µm diam, exuding a short, hyaline cirrhus of conidia; wall of 3–4 layers of medium brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to doliform, 5–10 × 5–10 µm; tapering at apex with prominent periclinal thickening or 1–2 inconspicuous percurrent proliferations visible at apex. *Conidia* hyaline, smooth, thin-walled, granular, or each cell with a large central guttule, subcylindrical to fusoid, apex subobtusely to obtusely rounded, base truncate (4–7 µm diam), (6–)7–8-septate (becoming constricted at septa with age), (45–)55–63(–65) × (9–)10–11 µm.

*Culture characteristics:* Colonies on PDA flat, circular, with grey aerial mycelium, reverse olivaceous-black to buff at the margins, after 14 d, 8.5 cm diam; on MEA umbonate, round, with appressed, grey aerial mycelium, with white patches; OA similar to PDA, but reverse buff with iron-grey patches at the outer region.

*Specimens examined:* **Italy**, on *Carex riparia* (*Cyperaceae*), Feb. 1878, holotype (presumably lost). **Netherlands**, Utrecht, Veenendal, de Blauwe Hel, *Carex acutiformis* (*Cyperaceae*), 23 Jul. 2012, W. Quaedvlieg (**neotype** designated here CBS H-21317, culture ex-type S601 = CBS 135088) (MBT175339).



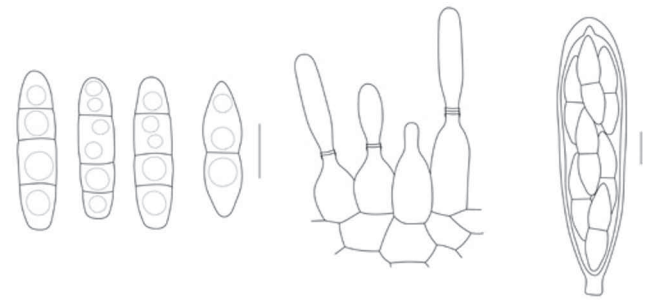
**Fig. 88.** Conidia and conidiogenous cells of *Stagonospora paludosa* (CBS 135088). Scale bars = 10 µm.

*Notes:* For more than a century, *Stagonospora* was confused with *Septoria*. The introduction of molecular techniques around the turn of the century made it possible to definitively establish that *Stagonospora* was not linked to *Septoria*, and that it in fact clusters with other important plant pathogenic genera like *Phoma* and *Leptosphaeria* in the *Pleosporales* (Cunfer & Ueng 1999, Solomon *et al.* 2006). The type of *Stagonospora* (*S. paludosa*) was recollected from a *Carex* during this study and phylogenetic analyses showed that this species clustered separately from most other known “*Stagonospora*” spp. (mostly isolated from *Poaceae*), but together with several other *Stagonospora* species that were also collected from *Carex*. This led to the conclusion that *Stagonospora* s. str. was limited to *Carex*, and that other commercially important stagonospora-like species on *Poaceae* (e.g. *S. avenae* and *S. nodorum*) in fact belonged to different genera.

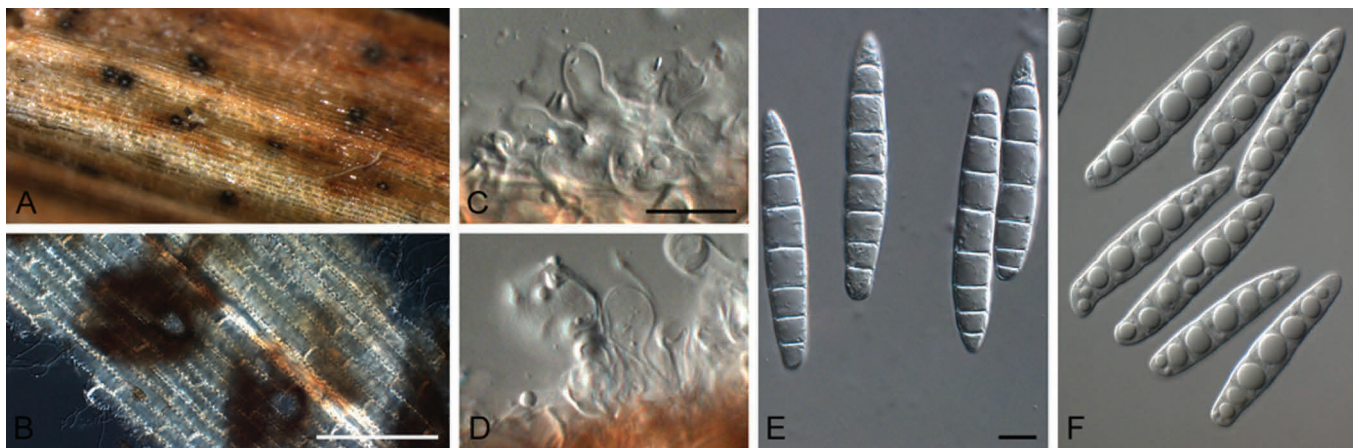
***Stagonospora perfecta*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804458. Figs 90, 91.

*Etymology:* Named after the fact that both sexual and asexual morphs of the fungus developed in culture.

On sterile *Carex* leaves on SNA. *Ascromata* developing on SNA, solitary, globose, brown, erumpent, up to 300 µm diam, with central ostiole; wall of 3–4 layers of brown *textura angularis*. *Pseudoparaphyses* intermingled among asci, hyaline, smooth, guttulate, multi-septate, constricted at septa, branched, hyphal-like, 4–6 µm diam, filling entire cavity. *Asci* stipitate, hyaline, smooth, clavate to fusoid-ellipsoidal, bitunicate, with prominent apiculus, 1.5–2.5 µm diam, 8-spored, 45–100 × 12–18 µm. *Ascospores* hyaline, smooth, 3- to multi-seriate in ascus,

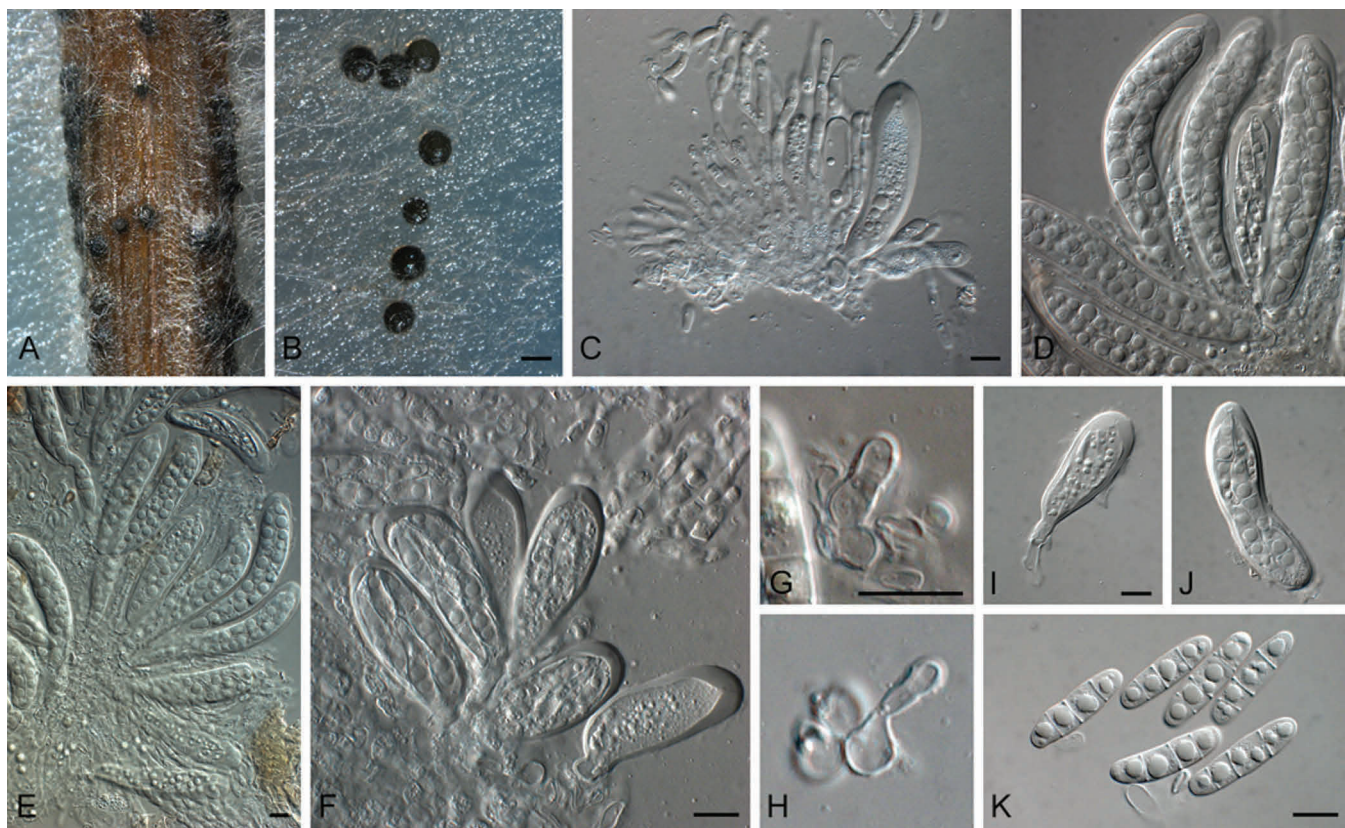


**Fig. 90.** Conidia, conidiogenous cells and ascus with ascospores of *Stagonospora perfecta* (CBS 135099). Scale bars = 10 µm.



**Fig. 89.** *Stagonospora paludosa* (CBS 135088). A, B. Conidiomata forming in culture. C, D. Conidiogenous cells. E, F. Conidia. Scale bars: B = 400 µm, all others = 10 µm.





**Fig. 91.** *Stagonospora perfecta* (CBS 135099). A. Conidiomata forming in culture. B. Ascomata forming in culture. C–F, I, J. Asci and pseudoparaphyses. G, H. Conidiogenous cells. K. Conidia. Scale bars: B = 300 µm, all others = 10 µm.

fusoid-ellipsoidal with median septum, prominently constricted at septum, tapering towards subobtuse apices, with 1–2 large guttules per cell, thin-walled, widest just above septum in upper cell,  $(20\text{--}23\text{--}25\text{--}27) \times (5\text{--}6\text{--}7\text{--}8)$  µm. *Conidiomata* up to 300 µm diam, brown, immersed, subepidermal, pycnidial, subglobose with central ostiole, exuding crystalline to creamy conidial mass; wall of 2–3 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to doliiform or subcylindrical, with several percurrent proliferations near apex,  $5\text{--}12 \times 4\text{--}6$  µm. *Conidia* hyaline, smooth, thin-walled, subcylindrical to narrowly fusoid-ellipsoidal, with obtuse apex and bluntly rounded base, 2–3-septate, slightly constricted at septa, with 1–2 large guttules per cell,  $(19\text{--}25\text{--}29\text{--}32) \times (6\text{--}7\text{--}8)$  µm.

**Culture characteristics:** Colonies on PDA flattened, convex, circular, with white aerial mycelium, surface fuscous-black, reverse iron-grey to black, after 14 d, 8.5 cm diam; on MEA surface fuscous-black, reverse olivaceous-black; on OA surface isabelline, reverse fuscous-black.

**Specimen examined:** Netherlands, Limburg, Weert, Moerselpeel, on leaves of *Carex acutiformis* (Cyperaceae), Sep. 2012, W. Quaedvlieg (holotype CBS H-21320, culture ex-type CBS 135099 = S656).

**Notes:** *Stagonospora perfecta* is the first species with a confirmed sexual state in the genus *Stagonospora*. Of interest is the fact that it is didymella-like, rather than phaeosphaeria-like in morphology, which also explains its clustering in the *Didymellaceae*. Morphologically *S. perfecta* resembles *S. vitensis* ( $18\text{--}32 \times 4\text{--}6$  µm, 2–3(–4)-septate; Ellis & Ellis 1997), but conidia are wider. *Stagonospora perfecta* is closely related to *S. pseudovitensis*, though in the latter conidia are

slightly longer, more fusoid-ellipsoidal in shape, and lack a sexual morph in culture.

***Stagonospora pseudocaricis*** Quaedvlieg, Verkley, Gardiennet & Crous, **sp. nov.** MycoBank MB804456. Figs 92, 93.

**Etymology:** Named after the species that it resembles, *Stagonospora caricis*.

On sterile *Carex* leaves on WA. *Conidiomata* black, immersed, subepidermal, pycnidial, globose, up to 400 µm diam, exuding a short, hyaline cirrus of conidia; wall of 3–4 layers of medium brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to doliiform,  $5\text{--}9 \times 5\text{--}8$  µm; tapering at apex with prominent periclinal thickening or 1–2 inconspicuous percurrent proliferations visible at apex. *Conidia* hyaline, smooth, thin-walled, granular, or each cell with a large central guttule, subcylindrical to fusoid, apex subobtusely to obtusely rounded, base truncate,  $(5\text{--}6\text{--}7)$ -septate,  $(35\text{--}42\text{--}48\text{--}50) \times (6\text{--}7\text{--}8)$  µm.

**Culture characteristics:** Colonies on PDA flat, circular, with appressed, grey aerial mycelium, surface sepia, reverse olivaceous-black to buff, after 14 d, 8.5 cm diam; on MEA umbonate, round, with appressed, grey aerial mycelium with white patches, surface greyish sepia, reverse fuscous-black to olivaceous-black; OA similar to PDA.

**Specimens examined:** France, Foncegrive, Rive de la Venelle, on *Carex acutiformis* (Cyperaceae), Oct. 2012, A. Gardiennet (holotype CBS H-21318, culture ex-type CBS 135132 = S610); *ibed.*, S609 = CBS 135414).

Note: Conidia of *S. pseudocaricis* closely resemble those of *S. caricis* (25–45 × 4–8 μm, 5–7-septate; Ellis & Ellis 1997), but are longer.

***Stagonospora pseudovitensis*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804457. Figs 94, 95.

*Etymology:* Named after the species that it resembles, *Stagonospora vitensis*.

On sterile *Carex* leaves on WA. *Conidiomata* black, immersed, subepidermal, pycnidial, globose with central ostiole, up to 180 μm diam; wall of 3–4 layers of pale brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to doliform, 5–7 × 4–5 μm; tapering at apex with inconspicuous periclinal thickening or percurrent proliferation. *Conidia* hyaline, smooth, thin-walled, granular, subcylindrical with obtuse apex and truncate to bluntly rounded base, 3–4 μm diam, 3-septate, with large central guttule in each cell, (25–)28–33(–36) × (6–)7(–8) μm.

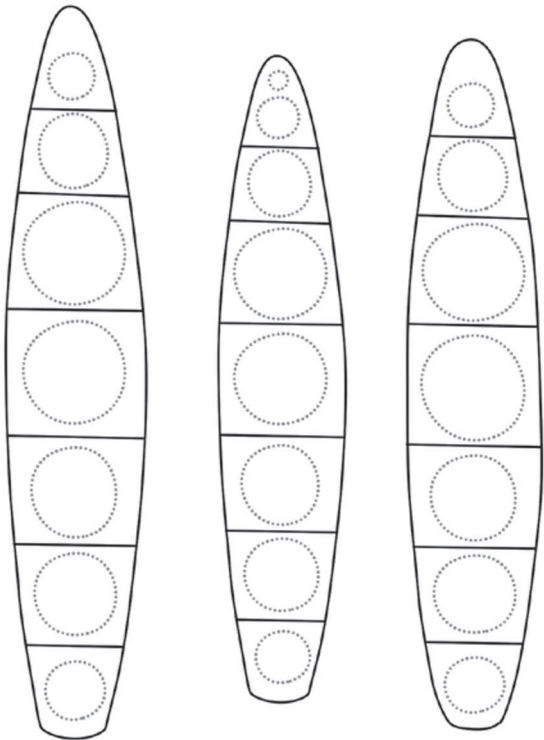


Fig. 92. Conidia of *Stagonospora pseudocaricis* (CBS 135132). Scale bar = 10 μm.

*Culture characteristics:* Colonies on PDA flat, circular, aerial mycelium consisting of some grey tufts, surface pale mouse-grey, reverse olivaceous-black, after 14 d, 8.5 cm diam; on MEA similar to PDA, but with appressed, white aerial mycelium, and with some grey tufts; OA similar to MEA, but reverse olivaceous-grey.

*Specimens examined:* Netherlands, Veenendaal, de Blauwe Hel, on leaves of *Carex acutiformis* (Cyperaceae), 23 Jul. 2012, W. Quaedvlieg (holotype CBS H-21319, culture ex-type CBS 135094 = S620); *ibed.*, S602.

Note: Conidia of *S. pseudovitensis* differ from that of *S. vitensis* (18–32 × 4–6 μm, 2–3(–4)-septate; Ellis & Ellis 1997), by having consistently 3-septate, wider conidia.

***Stagonospora uniseptata*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804460. Figs 96, 97.

*Etymology:* Named after the fact that conidia are 1-septate.

On sterile *Carex* leaves on WA. *Conidiomata* up to 150 μm diam, black, immersed, subepidermal, pycnidial, globose with central ostiole, exuding yellow conidial masses; wall of 3–4 layers of red-brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* phialidic, hyaline, smooth, aggregated, lining the inner cavity, ampulliform to subcylindrical, 5–8 × 3–4 μm, with percurrent proliferation at apex. *Conidia* hyaline, smooth, thin-walled, fusoid-ellipsoidal, with obtuse apex and truncate to bluntly rounded base (2 μm diam), medianly 1-septate, prominently constricted at septum, straight to irregularly curved, widest in middle of either apical or basal cell, granular, including yellow-green reflective guttules, (13–)16–20(–22) × (5–)5.5(–6) μm.

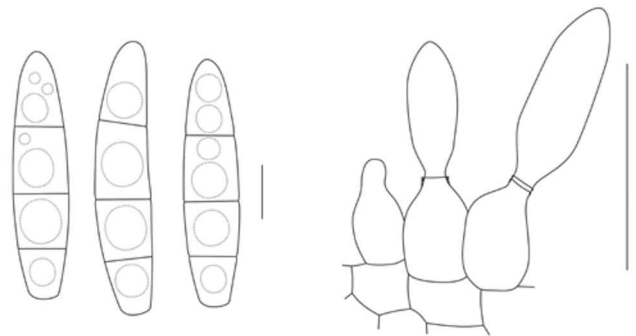


Fig. 94. Conidia and conidiogenous cells of *Stagonospora pseudovitensis* (CBS 135094). Scale bars = 10 μm.



Fig. 93. *Stagonospora pseudocaricis* (CBS 135132). A. Conidiomata forming in culture. B, C. Conidia. Scale bars = 10 μm.

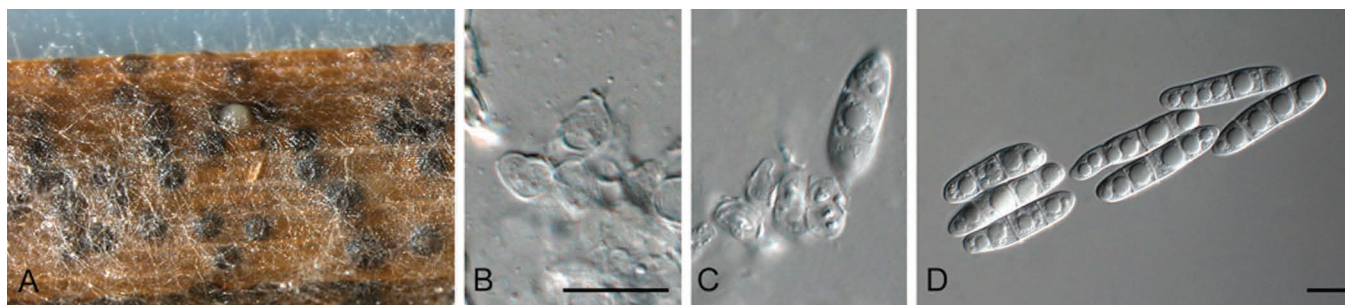


Fig. 95. *Stagonospora pseudovitensis* (CBS 135094). A. Conidiomata forming in culture. B, C. Conidiogenous cells. D. Conidia. Scale bars = 10  $\mu$ m.

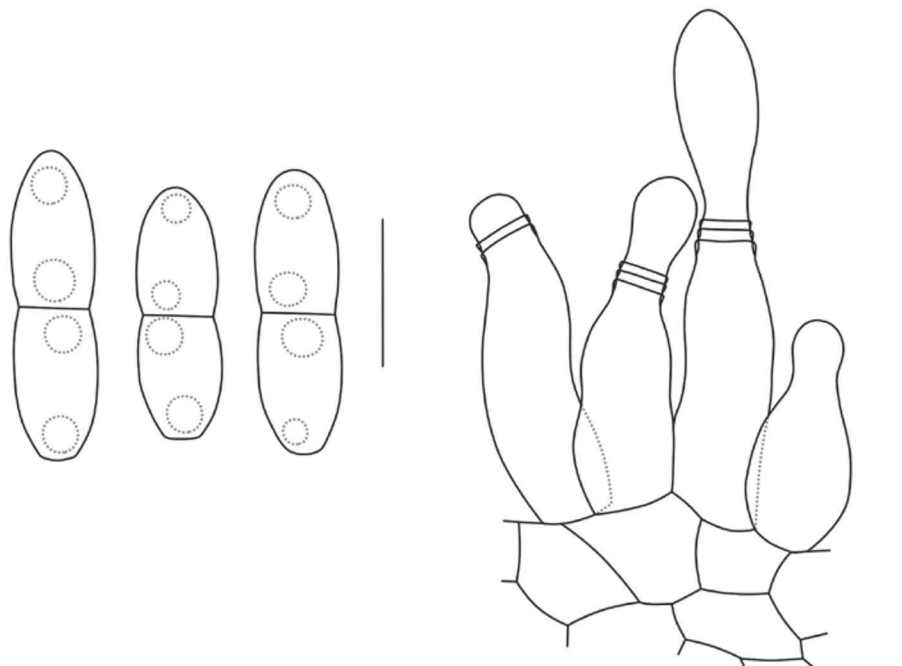


Fig. 96. Conidia and conidiogenous cells of *Stagonospora uniseptata* (CBS 135090). Scale bars = 10  $\mu$ m.

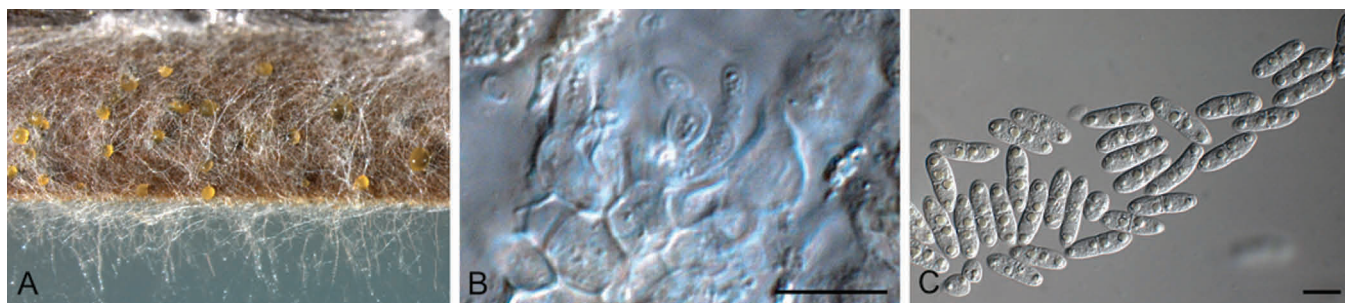


Fig. 97. *Stagonospora uniseptata* (CBS 135090). A. Conidiomata sporulating in culture. B. Conidiogenous cells. C. Conidia. Scale bars = 10  $\mu$ m.

**Culture characteristics:** Colonies on PDA appressed, circular, with short, greyish-white aerial mycelium, surface fusous-black, reverse olivaceous-black to hazel, after 14 d, 8.5 cm diam; on MEA surface hazel, reverse cinnamon; on OA with patches of white aerial mycelium, surface isabelline, reverse olivaceous to fuscous-black.

**Specimens examined:** Netherlands, Nijmegen, de Duffelt, on leaves of a *Carex acutiformis* (Cyperaceae), 29 Jul. 2012, W. Quaadvlieg, (holotype CBS H-21322, culture ex-type CBS 135090 = S611); *ibed.*, S607, S608 = CPC 22151 and CPC 22150.

**Notes:** Of the *Stagonospora* and *Septoria* species occurring on *Carex*, *Stagonospora uniseptata* is most similar to *Septoria caricis* (conidia 20–35  $\times$  2.5–3  $\mu$ m, 1-septate; Ellis & Ellis 1997), but distinct in that conidia are shorter and wider.

## Clade 42: *Corynespora*

***Corynespora*** Güssow, Z. PflKrankh. PflPath. PflSchutz 16: 10. 1906.

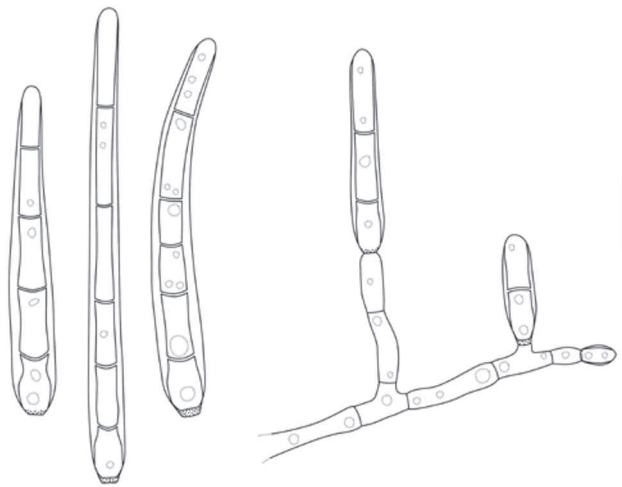
**Mycelium** immersed or superficial. **Stroma** present in some species. **Setae** and **hyphopodia** absent. **Conidiophores** macronematous, mononematous, straight or flexuous, unbranched, brown or olivaceous brown, smooth. **Conidiogenous cells** monotretic, integrated, terminal, percurrent, cylindrical or doliiform. **Conidia** solitary or catenate, dry, acrogenous, simple, obclavate, rarely cylindrical, subhyaline, pale to dark brown or olivaceous brown or straw-coloured, euseptate or distoseptate, smooth, rarely verruculose (Ellis 1971).

*Type species: C. mazei* Güssow, Consp. Regni Veget. (Leipzig) 16: 13. 1906. [= *C. cassicola* (Berk. & M.A. Curtis) C.T. Wei, Mycol. Pap. 34: 5. 1950.]

***Corynespora leucadendri*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804461. Figs 98, 99.

*Etymology:* Named after the host genus from which it was collected, *Leucadendron*.

On MEA and PDA after 2 wk. *Mycelium* consisting of creeping, branched, septate, hyaline, smooth, 3–4(–5) µm diam hyphae that become brown close to conidiophores; stroma lacking. *Conidiophores* subcylindrical, erect, medium brown, 100–300 µm tall, 4–6(–7) µm diam, thick-walled, transversely multiseptate, with several swollen nodes of conidiophore rejuvenation (up to 12 µm diam). *Conidiogenous cells* terminal, cylindrical, medium brown, smooth, ends swollen or not, central locus somewhat darkened or inconspicuous, 15–40 × 5–6(–7) µm. *Conidia* medium brown, obclavate to subcylindrical, straight to slightly curved, thick-walled, (3–)4–6(–10)-distoseptate, basal locus thickened, darkened, protruding, 2–3 µm diam, (35–)70–110(–170) × (6–)7–8(–11) µm.



**Fig. 98.** Conidia and conidiogenous loci of *Corynespora leucadendri* (CBS 135133). Scale bar = 10 µm.

*Culture characteristics:* Colonies erumpent, spreading with moderate aerial mycelium and smooth, even margin; reaching 25 mm diam after 2 wk. On MEA surface dirty white, reverse cinnamon. On PDA surface dirty white, reverse buff to rosy buff with diffuse rosy buff pigment. On OA surface dirty white with diffuse rosy buff pigment in agar.

*Specimen examined:* **South Africa**, Western Cape Province, Helderberg Nature Reserve, from the leaves of *Leucadendron* sp. (*Proteaceae*), 14 Aug. 2000, S. Lee (**holotype** CBS H-21323, culture ex-type CBS 135133 = CPC 19345).

*Notes:* This species was not treated by Marinowitz *et al.* (2008), and presently no species of *Corynespora* are known from *Leucadendron*. Furthermore, based on conidial morphology, none of the species treated by Ellis (1971, 1976) resemble *C. leucadendri*, nor is it similar to any *Corynespora* sequence presently deposited in GenBank. For these reasons we thus introduce *C. leucadendri* as a new taxon.

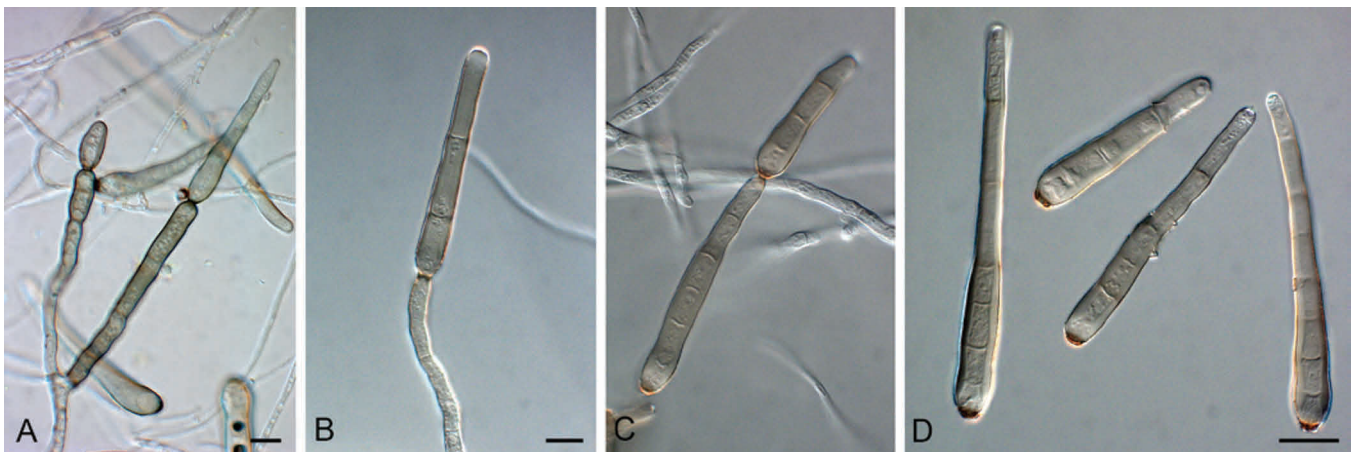
**Clade 43: *Setoseptoria***

***Setoseptoria*** Quaedvlieg, Verkley & Crous, **gen. nov.** MycoBank MB804462.

*Etymology:* Named after its conidiomata which are septoria-like, but setose.

*Conidiomata* pycnidial, brown, immersed, globose with central ostiole, somewhat papillate, apical erumpent part at times with brown, verruculose to warty setae; wall of 6–8 layers of brown *textura angularis*; inner layer of 6–10 layers of hyaline *textura angularis*. *Conidiophores* lining the inner cavity, reduced to conidiogenous cells, or with one supporting cell. *Conidiogenous cells* hyaline, smooth, subcylindrical to doliiform; apical region with several inconspicuous percurrent proliferations, or with periclinal thickening; collarete inconspicuous, or prominent, flared. *Conidia* hyaline, smooth, becoming somewhat olivaceous and verruculose in older cultures, subcylindrical, tapering in apical part to obtuse or subobtuse apex, base truncate, transversely euseptate, straight to somewhat curved, mostly with one large central guttule per cell, older conidia becoming constricted at septa, disarticulating into phragmospores.

*Type species: Setoseptoria phragmites* Quaedvlieg, Verkley & Crous.



**Fig. 99.** *Corynespora leucadendri* (CBS 135133). A–C. Conidiogenous cells giving rise to conidia. D. Conidia. Scale bars = 10 µm.

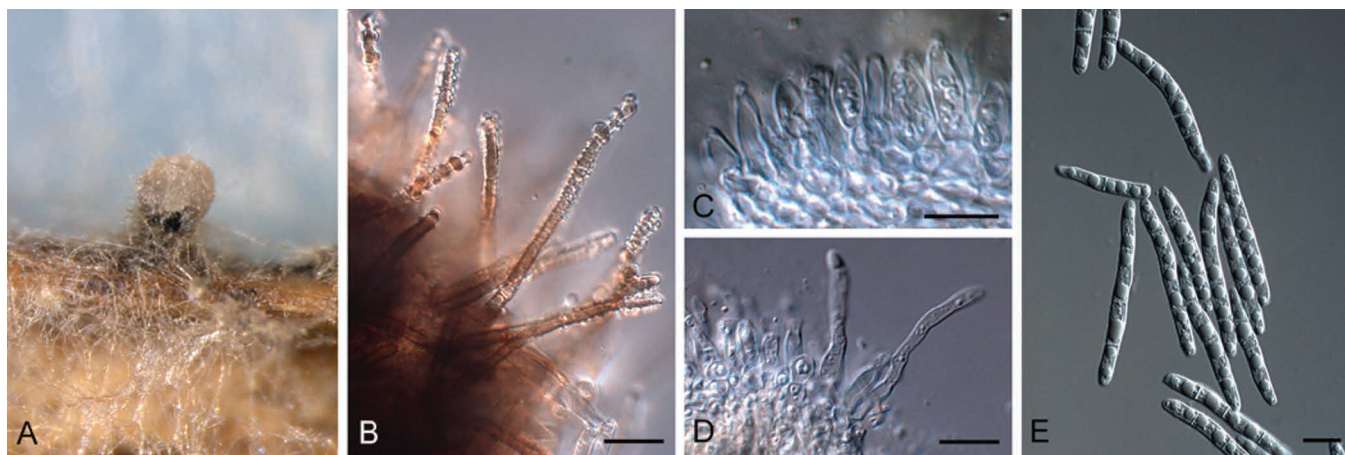


Fig. 100. *Setoseptoria phragmitis* (CBS 114802). Conidioma sporulating in culture. B. Setae. C, D. Conidiogenous cells. E. Conidia. Scale bars = 10 µm.

***Setoseptoria phragmitis*** Quaedvlieg, Verkley & Crous, **sp. nov.** MycoBank MB804463. Fig. 100.

*Etymology*: Named after the host genus from which it was collected, *Phragmites*.

On sterile *Carex* leaves on WA. *Conidiomata* pycnidial, brown, immersed, globose with central ostiole, up to 30 µm diam, somewhat papillate, up to 200 µm diam, apical erumpent part at times with brown, verruculose to warty setae; wall of 6–8 layers of brown *textura angularis*; inner layer of 6–10 layers of hyaline *textura angularis*. *Conidiophores* lining the inner cavity, reduced to conidiogenous cells, or with one supporting cell. *Conidiogenous cells* hyaline, smooth, subcylindrical to doliiform, 7–12 × 3–4 µm; apical region with several inconspicuous percurrent proliferations, or with periclinal thickening; collarette inconspicuous, or prominent, flared. *Conidia* hyaline, smooth, becoming somewhat olivaceous and verruculose in older cultures, subcylindrical, (1–)3-septate, (19–)25–35(–38) × (3.5–)4 µm, tapering in apical part to obtuse or subobtuse apex, base truncate, 1.5–2.5 µm diam, straight to somewhat curved, mostly with one large central guttule per cell, older conidia becoming constricted at septa, disarticulating into phragmospores.

*Culture characteristics*: Colonies on PDA umbonate, round, fluffy grey white aerial mycelium on the younger parts with longer grey blackish tufts on the older parts, surface olivaceous-black to buff at the younger mycelium, reverse olivaceous-black at the older parts to buff at the younger mycelium, after 14 days 6 cm diam; on MEA similar to PDA but after 14 d, 7 cm diam; on OA similar to PDA.

*Specimens examined*: **Hong Kong**, Mai Po Mangrove, from the leaves of *Phragmites australis* (Poaceae), 12 Mar. 1998, K.D. Hyde (**holotype** CBS H-21324, culture ex-type CBS 114802 = HKUCC 2689); *ibid.*, 3 Feb. 2000, K.D. Hyde (CBS 114966 = HKUCC 6029).

*Notes*: *Setoseptoria* needs to be compared to *Dearnessia* and *Trichoseptoria* (see above). The genus *Trichoseptoria* is poorly known, and details about its conidiogenesis is lacking, and thus it cannot be compared until it has been recollected. *Setoseptoria* is distinct from *Dearnessia* in that it has conidiogenous cells with prominent percurrent proliferation, and conidia that tend to become olivaceous and verruculose in older cultures, and disarticulate into phragmospores. Several *Septoria* species have been described from *Phragmites*, including *S. phragmitis* (conidia 20–30 × 1.5–2

µm), *S. arundinacea* (conidia 6–7-septate, 60–70 × 5–6 µm), *S. curva* (conidia 14–20 × 3.5–4.5 µm), and *S. graminum* (conidia multiseptate, 55–75 × 1–1.3 µm), all of which appear to differ from *Setoseptoria phragmitis* based on its conidial morphology.

#### Clade 44: *Septorioides*

***Septorioides*** Quaedvlieg, Verkley & Crous, **gen. nov.** MycoBank MB804464.

*Etymology*: Resembling the genus *Septoria*.

*Foliicolous*. *Conidiomata* black, unilocular, globose, flattened, opening by means of irregular rupture; wall consisting of 6–10 layers of dark brown *textura irregularis* to *angularis*, exuding a crystal conidial mass. *Paraphyses* intermingled among conidiophores, hyaline, cylindrical, branched at base, septate with obtuse ends. *Microconidia* hyaline, smooth, cylindrical, mostly straight, apex obtuse, base truncate. *Conidiophores* reduced to conidiogenous cells or with a supporting cell. *Conidiogenous cells* lining the inner cavity in basal layer, hyaline, smooth, subcylindrical to ampulliform, giving rise to macro- and microconidia. *Spermatia* formed in conidiomata, cylindrical, hyaline, smooth, straight to curved. *Macroconidia* hyaline, smooth, guttulate, subcylindrical, straight to irregularly curved, tapering in apical cell to subobtuse apex, base truncate, transversely euseptate.

*Type species*: *Septorioides pini-thunbergii* (S. Kaneko) Quaedvlieg, Verkley & Crous.

***Septorioides pini-thunbergii*** (S. Kaneko) Quaedvlieg, Verkley & Crous, **comb. nov.** MycoBank MB804465. Fig. 101.

*Basionym*: *Septoria pini-thunbergii* S. Kaneko, Trans. Mycol. Soc. Japan 30(4): 463. 1989.

Associated with needle blight, or isolated as endophyte. On PDA. *Conidiomata* black, unilocular, globose, flattened, up to 400 µm diam, opening by means of irregular rupture; wall consisting of 6–10 layers of dark brown *textura irregularis* to *angularis*, exuding a crystal conidial mass. *Paraphyses* intermingled among conidiophores, hyaline, cylindrical, branched at base, septate with obtuse ends, 2–2.5 µm diam, up to 80 µm long. *Microconidia* hyaline, smooth,

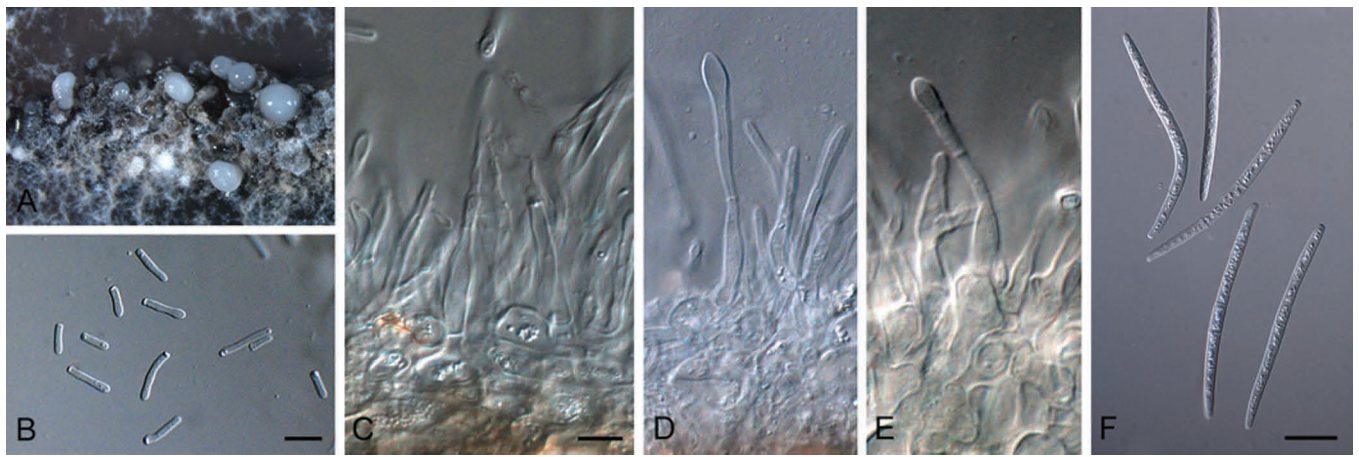


Fig. 101. *Septoriooides pini-thunbergii* (CBS 473.91). A. Colony sporulating on PDA. B. Spermatia. C–E. Conidiogenous cells. F. Conidia. Scale bars = 10 µm.

cylindrical, mostly straight, apex obtuse, base truncate, 5–15 × 2–2.5 µm. *Conidiophores* reduced to conidiogenous cells or with a supporting cell. *Conidiogenous cells* lining the inner cavity in basal layer, hyaline, smooth, subcylindrical to ampulliform, 10–15 × 4–6 µm, giving rise to macro- and microconidia. *Spermatia* formed in conidiomata, cylindrical, hyaline, smooth, straight to curved, 3–7 × 2 µm. *Macroconidia* hyaline, smooth, guttulate, subcylindrical, straight to irregularly curved, tapering in apical cell to subobtuse apex, base truncate, (60–)70–80(–110) × 3.5(–4) µm, (1–)3–6(–10)-septate.

*Specimen examined*: Japan, Akita Prefecture, Tenno-cho, on needles of *Pinus thunbergii* (Pinaceae), Aug. 1984, S. Kaneko & Y. Zinno, culture ex-type of *Septorio pini-thunbergii* (CBS 473.91).

*Note*: *Septoriooides* is distinguished from *Septoria* by having conidiomata that open by means of an irregular split (acervular), and having paraphyses intermingled among its conidiophores. *Septoriooides pini-thunbergii* was originally described from blighted needles of *Pinus thunbergii* in Japan (Kaneko *et al.* 1989). It was also recently isolated as endophyte from needles of *P. densiflora* in Korea (Yoo & Eom 2012).

**Clade 45: *Phlyctema***

*Phlyctema* Desm., Ann. Sci. Nat., Sér. 3, 8: 16. 1847.  
= *Allantozythia* Höhn., Mykol. Unters. 3: 322. 1923.

*Mycelium* immersed, branched, septate, hyaline. *Conidiomata* eustromatic, immersed, erumpent, sporodochial, separate, yellowish brown, pulvinate, circular, unilocular but convoluted, thick-walled; wall of *textura angularis*, darker brown and thicker-walled at base than at the sides. *Ostiole* absent, dehiscence by irregular rupture. *Conidiophores* hyaline, septate, branched irregularly, cylindrical to filiform, formed from the wall lining the conidiomata. *Conidiogenous cells* enteroblastic, phialidic, integrated or discrete, determinate, hyaline, with minute collarette and periclinal thickening. *Conidia* hyaline, aseptate, fusiform, eguttulate, straight to slightly curved or irregular (Sutton 1980).

*Type species*: *P. vagabunda* Desm., Ann. Sci. Nat., Bot., Sér. 3, 8: 16. 1847.

*Notes*: *Phlyctema* is characterised by having eustromatic, convoluted, pulvinate to sporodochial conidiomata, branched,

hyaline conidiophores, and phialidic conidiogenous cells that give rise to hyaline, aseptate, fusiform, straight to curved conidia. The genus has more than 80 names, and is in need of revision. The type species is linked to a sexual morph known as *Neofabraea alba* (Verkley 1999).

***Phlyctema vincetoxici* Quaedvlieg, Verkley & Crous, sp. nov.** MycoBank MB804466. Figs 102, 103.

*Etymology*: Named after the host genus from which it was collected, *Vincetoxicum*.

*Conidiomata* immersed, separate, eustromatic, unilocular, convoluted, opening by irregular rupture, becoming acervular to sporodochial, up to 450 µm diam; wall of 3–6 layers of brown *textura angularis*; outer surface covered in brown, warty hyphae. *Conidiophores* hyaline, smooth, subcylindrical, lining the inner layer, branched, 1–4-septate, 15–50 × 4–5 µm. *Conidiogenous cells* phialidic, hyaline, smooth, subcylindrical to cymbiform or doliiform, with apical periclinal thickening and minute, non-flaring collarette, 7–18 × 3.5–5 µm. *Conidia* hyaline, smooth, guttulate, aseptate, fusiform, curved, tapering to subobtuse apex and truncate base, (27–)33–37(–40) × 3(–3.5) µm.

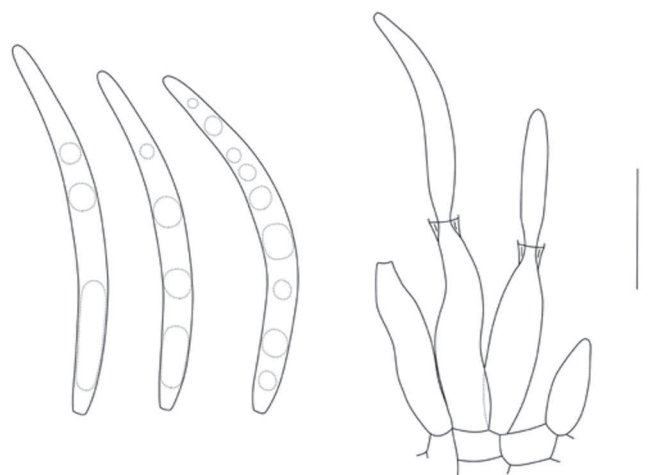


Fig. 102. Conidia and conidiogenous cells of *Phlyctema vincetoxici* (CBS 123727). Scale bar = 10 µm.

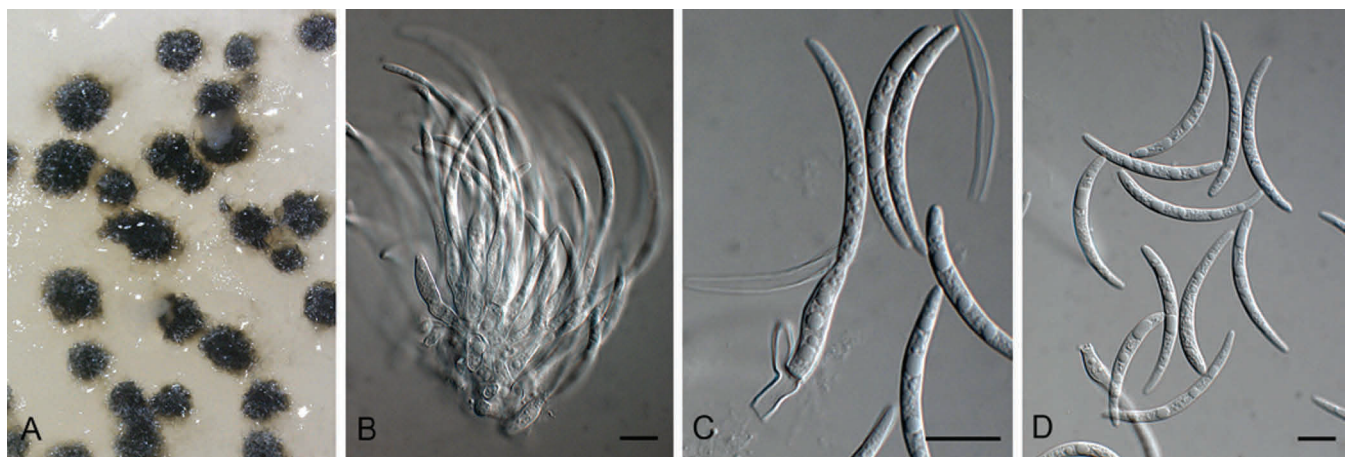


Fig. 103. *Phlyctema vincetoxici* (CBS 123727). A. Colonies forming on OA. B, C. Conidiogenous cells. D. Conidia. Scale bars = 10  $\mu$ m.

**Culture characteristics:** Colonies on PDA flat, circular, with sparse, white aerial mycelium, surface dark-brick, reverse greyish sepia, after 14 d, 7 cm diam; on MEA undulate, lacking aerial mycelium, after 14 d, 6 cm diam; on OA flat, circular, lacking aerial mycelium, after 14 d, 8.5 cm diam.

**Specimen examined:** Czech Republic, Moravia, Podyji National Park, Masovice, Klinka area, on leaves of *Vincetoxicum officinale* (Asclepiadaceae), 17 Sep. 2008, G. Verkley (holotype CBS H-21325, culture ex-type CBS 123727 = V6015.2).

**Notes:** No species of *Phlyctema* has thus far been described on *Vincetoxicum*. *Septoria vincetoxici* (conidia 30–50  $\times$  1–1.5  $\mu$ m; Saccardo 1884) has somewhat longer, narrower conidia. *Phlyctema vincetoxici* was found sporulating in leaf spots showing numerous hypophyllous teleospore sori of the rust fungus *Cronartium flaccidum* (identified by H.A. van der Aa).

#### Clade 46: *Kirstenboschia*

***Kirstenboschia*** Quaedvlieg, Verkley & Crous, gen. nov. MycoBank MB804467.

**Etymology:** Kirstenbosch National Botanical Garden is one of the most acclaimed botanical gardens of the world, set against the foot of Cape Town's Table Mountain. With more than 7000 plant species, it has also proven to be a source of numerous undescribed fungal species. Kirstenbosch was established in 1913, and to celebrate its centenary (2013), the fungal genus *Kirstenboschia* is named after this beautiful garden.

**Foliicolous.** *Conidiomata* erumpent, sporodochial, separate, with slightly raised outer margin of 3–10 layers of *textura intricata*. *Conidiophores* lining the inner cavity, hyaline, smooth, septate, subcylindrical, branched below and above. *Conidiogenous cells* terminal and lateral, hyaline, smooth, ampulliform to subcylindrical, proliferating sympodially, apical loci truncate, at times appearing subdenticulate. *Conidia* solitary, hyaline, scolecosporous, smooth, granular, thin-walled, acicular to narrowly obclavate with subobtuse apex and truncate to long obconically truncate base, 3-septate, irregularly curved.

**Type species:** *K. diospyri* Quaedvlieg, Verkley & Crous.

***Kirstenboschia diospyri*** Quaedvlieg, Verkley & Crous, sp. nov. MycoBank MB804468. Figs 104, 105.

**Etymology:** Named after the host genus from which it was collected, *Diospyros*.

**Conidiomata** erumpent, sporodochial, up to 300  $\mu$ m diam, separate, appearing creamy to pale yellow when sporulating on SNA with barley leaves, with slightly raised outer margin of 3–10 layers of *textura intricata*. *Conidiophores* lining the inner cavity, hyaline, smooth, 0–4-septate, subcylindrical, branched below and above, 5–15  $\times$  2–4  $\mu$ m. *Conidiogenous cells* 5–10  $\times$  2–3  $\mu$ m, terminal and lateral, hyaline, smooth, ampulliform to subcylindrical, proliferating sympodially, apical loci truncate, at times appearing subdenticulate, 1  $\mu$ m diam. *Conidia* solitary, hyaline, scolecosporous, smooth, granular, thin-walled, acicular to narrowly obclavate with subobtuse apex and truncate to long obconically truncate base, 3-septate, irregularly curved, (40–)60–70(–75)  $\times$  (1.5–)2  $\mu$ m.

**Culture characteristics:** Colonies on PDA erumpent, with moderate aerial mycelium, and smooth, lobate margin; surface and reverse dirty white. On OA dirty white with diffuse brown pigment in agar. On MEA surface folded, irregular, strongly erumpent, dirty white, reverse sienna.

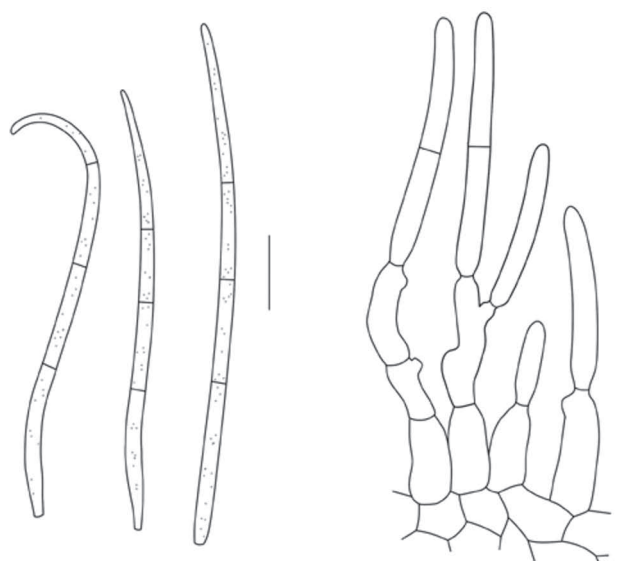


Fig. 104. Conidia and conidiogenous cells of *Kirstenboschia diospyri* (CBS 134911). Scale bars = 10  $\mu$ m.

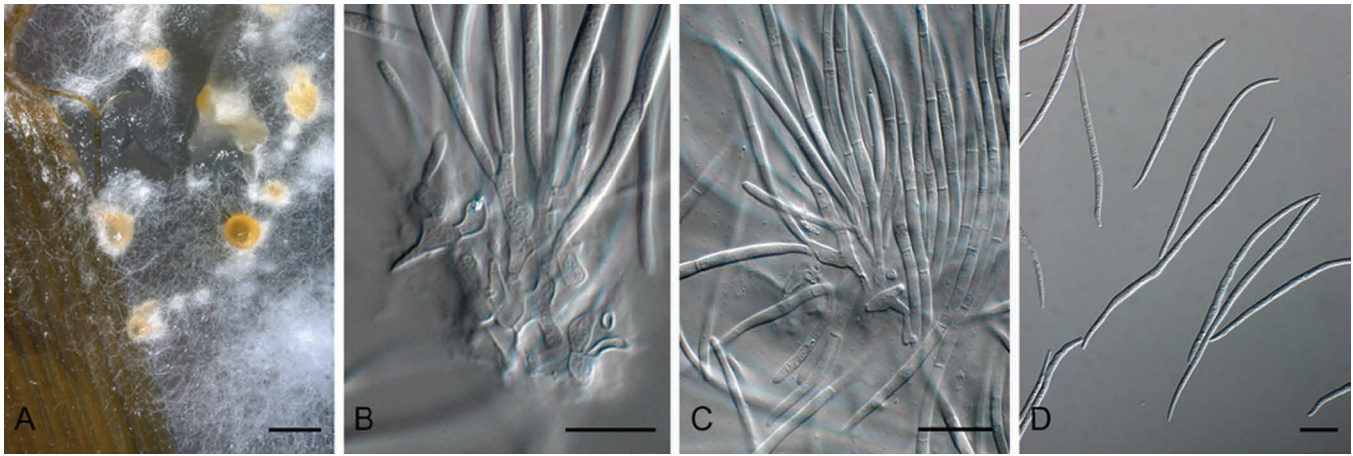


Fig. 105. *Kirstenboschia diospyri* (CBS 134911). A. Conidiomata forming in culture. B, C. Conidiogenous cells. D. Conidia. Scale bars: A = 300  $\mu\text{m}$ , all others = 10  $\mu\text{m}$ .

Specimen examined: **South Africa**, Western Cape Province, Kirstenbosch Botanical Garden, on leaves of *Diospyros whyteana* (*Ebenaceae*), 9 Aug. 2011, P.W. Crous (holotype CBS H-21326, culture ex-type CBS 134911 = CPC 19869).

Note: *Kirstenboschia* is distinguished from *Septoria* s. str. and allied genera based on its distinctive, sporodochial conidiomata, and conidiogenous cells that proliferate sympodially, but at times are subdentate.

**Clade 47: Phlogicylindrium**

**Phlogicylindrium** Crous, Summerb. & Summerell, Fungal Diversity 23: 340. 2006.

*Foliicolous*. Conidiomata synnematal to sporodochial, pale brown. Macroconidiophores arising from a brown stroma of 3–6 layers of *textura angularis*, giving rise to subcylindrical, hyaline (dark brown at the base), smooth, frequently branched conidiophores, 0–2(–6)-septate. Macroconidiogenous cells hyaline, smooth, subcylindrical, proliferating sympodially and percurrently near apex. Macroconidia hyaline, smooth, subcylindrical, transversely septate, apex obtusely rounded, base truncate, slightly curved. Microconidia formed in acervular conidiomata together with macroconidia. Microconidiophores intermingled among macroconidiophores, hyaline, smooth, subcylindrical, branched, 1–4-septate. Microconidiogenous cells terminal and lateral, hyaline, smooth, ampulliform, phialidic, solitary or in penicillate clusters. Microconidia hyaline, smooth, hamate, curved, apex subobtusely, base truncate, widest in upper third, aseptate (Summerell et al. 2006).

Type species: *P. eucalypti* Crous, Summerb. & Summerell, Fungal Diversity 23: 340. 2006.

**Phlogicylindrium eucalyptorum** Crous, Fungal Planet 20. 2007. Figs 106, 107.

On OA. Conidiomata synnematal to sporodochial, pale brown up to 300  $\mu\text{m}$  diam. Macroconidiophores arising from a brown stroma of 3–6 layers of *textura angularis*, giving rise to subcylindrical, hyaline (dark brown at the base), smooth, frequently branched conidiophores, 0–2(–6)-septate, 15–25(–45)  $\times$  3–4  $\mu\text{m}$ . Macroconidiogenous cells hyaline, smooth,

subcylindrical, 10–15  $\times$  2–4  $\mu\text{m}$ , proliferating sympodially and percurrently near apex. Macroconidia hyaline, smooth, subcylindrical, 1(–3)-septate, apex obtusely rounded, base truncate, slightly curved, (27–)40–50(–55)  $\times$  2–2.5(–3)  $\mu\text{m}$ . Microconidia formed in acervular conidiomata together with macroconidia. Microconidiophores intermingled among macroconidiophores, hyaline, smooth, subcylindrical, branched, 1–4-septate, 20–40  $\times$  2–2.5  $\mu\text{m}$ . Microconidiogenous cells terminal and lateral, hyaline, smooth, ampulliform, phialidic, 5–16  $\times$  2–2.5  $\mu\text{m}$ , solitary or in penicillate clusters of up to 3. Microconidia hyaline, smooth, hamate, curved, apex subobtusely, base truncate, widest in upper third, aseptate, (16–)17–20(–24) 1.5(–2)  $\mu\text{m}$ .

Specimens examined: **Australia**, Victoria, Otway Ranges, (near Gellibrand), latitude: -38.568412, longitude: 143.539586, elevation: 175 m, on leaves of *Eucalyptus globulus* (*Myrtaceae*), Sep. 2005, I. Smith, holotype CBS H-19771, cultures ex-type CPC 12429 = CBS 120221; New South Wales, on leaves of *E. nitens*, 22 Nov. 1996, P.W. Crous (CBS 111689 = CPC 1547 = STE-U 1547).

Notes: The present strain represents the second collection of this fungus. Isolates from this collection formed a microconidial state not observed in the type (Crous et al. 2007c), and novel for species of *Phlogicylindrium*.

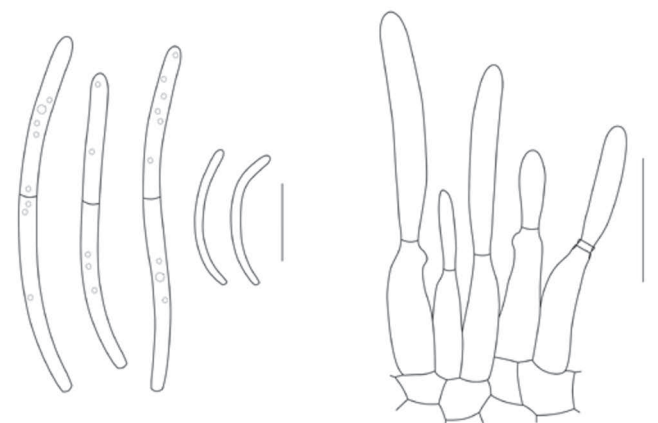
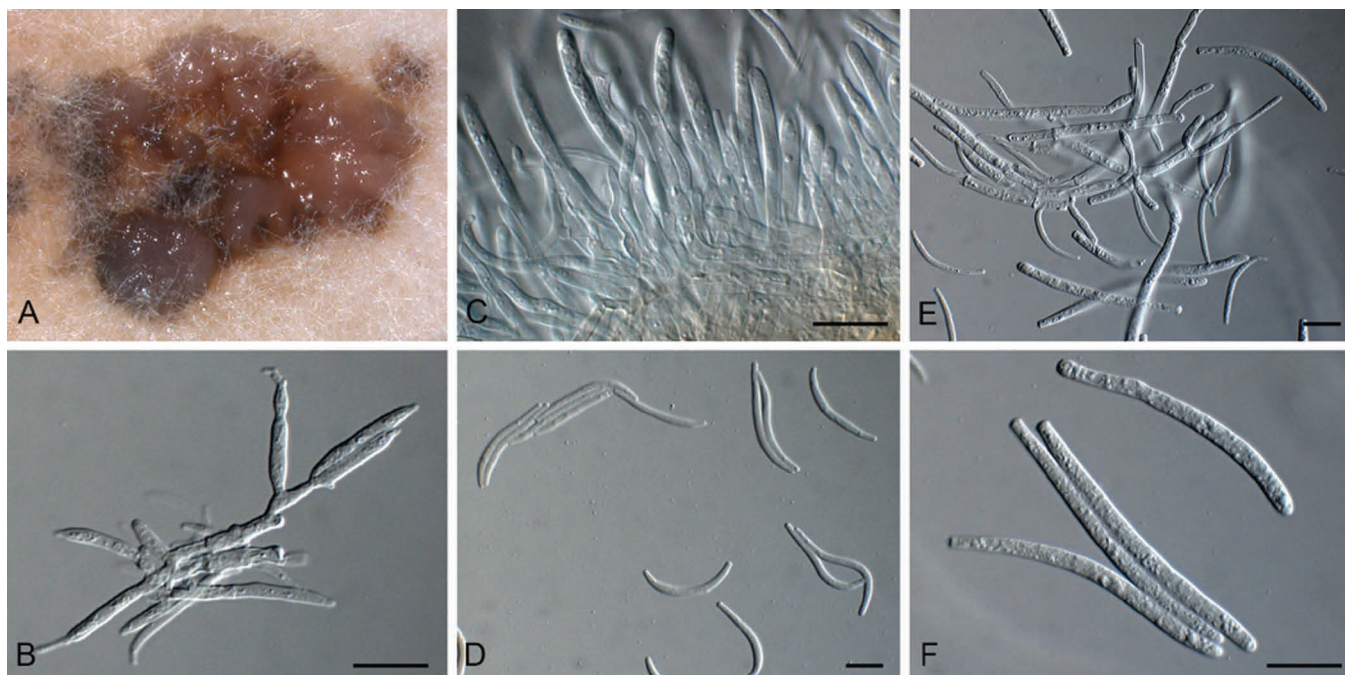


Fig. 106. Macro- and microconidia and conidiogenous cells of *Phlogicylindrium eucalyptorum* (CBS 111689). Scale bars = 10  $\mu\text{m}$ .





**Fig. 107.** *Phlogicylindrium eucalyptorum* (CBS 111689). A. Colony on OA. B, E. Microcyclic conidiation with macro- and microconidia. C. Macroconidiogenous cells. D. Microconidia. F. Macroconidia. Scale bars = 10  $\mu$ m.

## DISCUSSION

The main question considered in the present study was: what is *Septoria*? To address this we included 370 isolates representing 170 species, sampled from six continents. Furthermore, we also generated several phylogenetic datasets based on partial sequences of the ITS, LSU, Btub, RPB2 and EF-1 $\alpha$  loci. In the final analysis, it was clear that *Septoria* is a well-defined genus and phylogenetic clade, with pycnidial, ostiolate conidiomata, conidiophores reduced to conidiogenous cells that proliferate sympodially, and hyaline, filiform conidia with transverse eusepta, fitting the original concept of Sutton (1980). However, when host material has been incubated for a while, several pycnidial species tend to form acervuli (also not clearly defined when studied in culture on normal agar media), and conidiogenous cells could have a combination of sympodial and percurrent proliferation (as observed in *Pseudocercospora*; Crous *et al.* 2013).

The present study, including that of Verkley *et al.* (2013) defined an additional 15 genera that were formerly treated as “septoria” in the widest sense. Although it has recently been shown that *Phoma* is a generic complex representing many morphologic and phylogenetic genera (Aveskamp *et al.* 2010, de Gruyter *et al.* 2010, 2013), this was not expected to also be the case for *Septoria*. Furthermore, many of the septoria-like genera discussed earlier in this paper are presently still not known from sequence, and thus their phylogeny remains to be resolved, meaning that they could add further entities to the list of acknowledged septoria-like genera.

Although *Septoria s. str.* is a genus in the *Mycosphaerellaceae* (*Capnodiales*), several of the septoria-like genera clustered outside this family. Species of *Septoria* are morphologically conserved, and in the past many taxa were identified based on host, which has been shown to be unreliable (see Verkley *et al.* 2013), as several taxa have wide host ranges. Another complication revealed in the present study is that many septoria-like genera cluster in different phylogenetic clades, but have still retained the *Septoria* morphological characters, which means that as in *Phoma*, future

identifications in this complex will also have to rely on DNA sequence data to support morphological conclusions.

The genus *Stagonospora* has always been separated from *Septoria* on the basis that *Septoria* has conidiogenous cells with sympodial proliferation, whereas in *Stagonospora* they proliferate percurrently. As shown in the present study, however, conidiogenesis is far too broad a feature to define all genera that express these modes of proliferation in their conidiogenous cells. *Stagonospora*, which is based on *S. paludosa*, was epitypified in this study, and shown to cluster apart from *Septoria s. str.* Another major surprise lies in the fact that *Septoria nodorum* blotch, caused by “*Stagonospora*” *nodorum*, clusters in a distinct genus, unrelated to *Stagonospora s. str.*, and also separate from *Phaeosphaeria s. str.* A repercussion from these findings is the fact that the common cereal pathogens, which are neither *Stagonospora*, *Septoria*, *Phaeosphaeria* or *Leptosphaeria* (see de Gruyter *et al.* 2013), now have to be accommodated in a new genus, *Parastagonospora*. Furthermore, it appears that *Stagonospora s. str.* occurs on *Poaceae*, but has thus far only been confirmed from *Carex*, though further sampling will undoubtedly extend the host range of this genus. *Parastagonospora* is thus a novel, distinct stagonospora-like genus, which has sexual morphs that are phaeosphaeria-like in morphology, thus quite unlike those of *Stagonospora s. str.*, which are more didymella-like in morphology.

The genus *Phaeosphaeria* is based on *P. oryzae* (asexual morph *Phaeoseptoria oryzae*), for which we could designate an epitype in this study. Furthermore, we also recollected the type species of *Phaeoseptoria*, *P. papayae*, for which we also designated an epitype. As expected, *Phaeoseptoria* clusters with *Phaeosphaeria*, for which we choose the name of the sexual morph, *Phaeosphaeria*, on the basis that it is clearly resolved, and well established in literature. In contrast, *Phaeoseptoria* has in recent years become a muddled concept harbouring unrelated coelomycetes with pigmented conidia.

Obtaining a culture of *Cytostagonospora martiniana* clarified the phylogenetic position of the genus as distinct from *Septoria*, resolving the difference of opinion between von Arx (1983), who regarded it as synonym of *Septoria*, versus Sutton (1980), who

retained it as separate genus. Of interest is the unique mode of conidiogenesis, ranging from holoblastic sympodial to polyphialides with periclinal thickening to percurrent proliferation. It should be noted, however, that although this is a distinct genus, *C. marianina* is not the type of *Cytostagonospora*, and *C. photiniicola* (occurring on *Photinia serrulata*, Austria) will have to be recollected to confirm that these two fungi are congeneric.

The genus *Phloeospora* (based on *P. ulmi*) has for long been assumed to be a synonym of *Septoria* based on morphology. It is thus good to finally see it resolved as separate phylogenetic lineage, which is also supported morphologically based on its acervular conidiomata and conidiogenous cells with prominent percurrent proliferation. In spite of resolving 21 genera, several lineages remain unresolved, and are simply treated as “septoria-like” awaiting the recollection of additional material.

It is surprising that so many of the cereal pathogens actually have a confused taxonomy. Eyespot disease of wheat, formerly treated as *Tapesia* (*Ramulispora* asexual states), was shown to represent a distinct genus *Oculimacula* (*Helgardia* asexual states) (Crous *et al.* 2003), while Quaedvlieg *et al.* (2011) determined that *Septoria tritici* blotch, caused by “*Septoria*” *tritici*, is in fact better accommodated in a new genus, *Zymoseptoria*, which appears to be restricted to members of *Poaceae*. The present study also resolved the phylogenetic position of *Septoria nodorum* blotch, which proved to not represent a member of *Septoria*, *Stagonospora*, or *Phaeosphaeria*, but to represent a distinct genus, described here as *Parastagonospora*. Clearly more attention should be directed towards resolving the taxonomy of the pathogens of agricultural crops of major economic importance in future, as these findings also have implications for genomic studies, where organisms from different genera, and even families get compared to one another, and new evolutionary hypotheses are proposed on the assumption that these taxa are congeneric. To clarify the taxonomy of well-known plant pathogens, however, many species will have to be recollected, and epitypified, so that authentic cultures and DNA barcodes will become available to fix the genetic application of these names.

## General conclusions

The genus *Septoria* is defined by having pycnidial to acervular conidiomata, and hyaline conidiophores that give rise to conidiogenous cells that proliferate sympodially and percurrently, forming hyaline, filiform conidia with transverse eusepta. Many species have wide host ranges, and host occurrence should not be used as primary character for identification (see Verkley *et al.* 2013, this issue). Although species of *Septoria* and several of the novel genera introduced here have mycosphaerella-like sexual states, the name *Mycosphaerella* is restricted to the genus *Ramularia*, and is unavailable for species of *Septoria* and related genera.

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