Phylogeny and taxonomy of obscure genera of microfungi


Key words
Brycekendrickiomycetes
Chalastospora
Cyphellophora
Dictyosporium
Edenia
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taxonomy
Thedgonia
Trochophora
Verrucisporota
Vonarxia
Xenostigmina

Abstract The recently generated molecular phylogeny for the kingdom Fungi, on which a new classification scheme is based, still suffers from an under-representation of numerous apparently asexual genera of microfungi. In an attempt to populate the Fungal Tree of Life, fresh samples of 10 obscure genera of hyphomycetes were collected. These fungi were subsequently established in culture, and subjected to DNA sequence analysis of the ITS and LSU rRNA genes to resolve species and generic questions related to these obscure genera. Brycekendrickiomycetes (Herpotrichiellaceae) is introduced as a new genus similar to, but distinct from Haplographium and Launiyomycetes. Chalastospora is shown to be a genus in the Pleosporales, with two new species, C. ellipsioidea and C. oblata, to which Alternaria malorum is added as an additional taxon under its oldest epithet, C. gossypii. Cyphellophora eugeniiae is newly described in Cyphellophora (Herpotrichiellaceae), and distinguished from other taxa in the genus. Dictyosporium is placed in the Pleosporales, with one new species, D. streliziae. The genus Edenia, which was recently introduced for a sterile endophytic fungus isolated in Mexico, is shown to be a hyphomycete (Pleosporales) forming a pyronellae-like synanamorph in culture. Thedgonia is shown not to represent an anamorph of Mycosphaerella, but to belong to the Helotiales. Trochophora, however, clustered basal to the Pseudocercospora complex in the Mycosphaerellaceae, as did Verrucisporota. Vonarxia, a rather forgotten genus of hyphomycetes, is shown to belong to the Herpotrichiellaceae and Xenostigmina is confirmed as synanamorph of Mycopappus, and is shown to be allied to Seifertia in the Pleosporales. Dichotomous keys are provided for species in the various genera treated. Furthermore, several families are shown to be polyphyletic within some orders, especially in the Capnodiales, Chaetothyriales and Pleosporales.

INTRODUCTION

The recent ‘Deep Hypha’ issue of Mycologia (vol. 98, 2006) included 21 phylogenetic studies employing multi-gene phylogenies to resolve major groups of Fungi. These papers provided the foundation for the study of James et al. (2006), in which six genes (SSU, LSU, 5.8S rRNA, rpB1, rpB2 and tef1) for approximately 200 fungal taxa were used to present the first kingdom-level phylogeny, and a new classification for the Fungi (Hibbett et al. 2007). These studies also illustrated clearly that it was merely the ‘tip of the iceberg’, and that numerous genera must now be accommodated in this phylogenetic framework. A major problem encountered during the Assembling the Fungal Tree of Life (AFTOL, www.aftol.org) project, was that many genera are insufficiently known, and have never been cultured, or subjected to DNA analyses. This is especially true for the majority of apparently asexual microfungi, namely the coelomycetes (Sutton 1980, Nag Raj 1993) and hyphomycetes (Ellis 1971, 1976, Carmichael et al. 1980). The only means to deal with this problem is, therefore, to encourage mycologists to recollect these genera and species, to establish cultures for them and to ultimately generate DNA sequence data (Shenoy et al. 2007), a process which can be described as ‘leaving out the fungal tree of life’.

Ten genera of hyphomycetes not previously known from culture, or for which the phylogenetic classification is uncertain, are treated in the present study. These fungi were collected from diverse hosts from various continents, isolated in axenic culture, and subjected to DNA sequence analysis. They are shown to belong to the Chaetothyriales (Brycekendrickiomycetes, Cyphellophora, Vonarxia), Pleosporales (Chalastospora, Dictyosporium, Edenia, Xenostigmina), Helotiales (Thedgonia), and the Capnodiales, Mycosphaerellaceae (Trochophora, Verrucisporota).

The present paper represents a further contribution in a series aiming to clarify the morphology and DNA phylogeny of obscure genera of microfungi. Other than resolving their phylogenetic relationships, several novelties are described, and keys are provided to the accepted species in these genera.

MATERIAL AND METHODS

Isolates
Symptomatic leaves and leaf litter were collected on various continents, and sent to the Centraalbureau voor Schimmelcultures (CBS) for isolation of microfungi. Leaves with visible fruiting structures (CBS) for isolation of microfungi. Leaves with visible fruiting structures were immediately subjected to direct isolation of hyphomycetes, or alternatively were first incubated in moist chambers to...
<table>
<thead>
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<th>Species</th>
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Table 1 Collection details and GenBank accession numbers for fungal species included in this study.


2 ITS: Internal transcribed spacers 1 and 2 together with 5.8S nrDNA; LSU: 28S nrDNA.
stimulate sporulation. Single-conidial isolates were established on malt extract agar (MEA), 20 g/L Biolab malt extract, 15 g/L Biolab agar) using the technique outlined in Crous (1998). Cultures were later plated on fresh MEA, 2 % water agar (WA) supplemented with sterile pine needles, 2 % potato-dextrose agar (PDA), synthetic nutrient agar (SNA) and/or oatmeal agar (OA) (Crous et al. 2009), and subsequently incubated at 25 °C under near-ultraviolet light to promote sporulation. Reference strains are maintained in the culture collection of the CBS, Utrecht, the Netherlands (Table 1). Descriptions, nomenclature, and illustrations were deposited in MycoBank (www.mycobank.org, Crous et al. 2004b).

DNA isolation, amplification and analyses
Genomic DNA was isolated from fungal mycelium grown on MEA, using the UltraClean™ Microbial DNA Isolation Kit (Mo Bio Laboratories, Inc., Solana Beach, CA, USA) according to the manufacturer’s protocols. The Primers V9G (de Hoog & Gerrits van den Ende 1998) and LR5 (Vilgalys & Hester 1990) were used to amplify part of the nuclear rDNA operon spanning the 3′ end of the 18S rRNA gene (SSU), the first internal transcribed spacer (ITS1), the 5.8S rRNA gene, the second ITS region (ITS2) and the first 900 bases at the 5′ end of the 28S rRNA gene (LSU). The primers ITS4 (White et al. 1990) and LROR (Rehner & Samuels 1994) were used as internal sequence primers to ensure good quality sequences over the entire length of the amplicon. The PCR conditions, sequence alignment and subsequent phylogenetic analysis followed the methods of Crous et al. (2006b). Alignment gaps were treated as new character states. Sequence data were deposited in GenBank (Table 1) and alignments in TreeBASE (www.treebase.org). The ITS sequences were compared with those sequences available in NCBI’s GenBank nucleotide database using a megablast search and the results are discussed where applicable under the taxonomic notes. Because the genus *Chalastospora* is relatively novel, species in this genus were supported by a separate phylogenetic tree.

Morphology
Fungal descriptions were based on cultures sporulating in vitro (media indicated). Wherever possible, 30 measurements (× 1 000 magnification) were made of structures mounted in lactic acid, with the extremes of spore measurements given in parentheses. Colony colours (surface and reverse) were assessed after 2–4 wk on different media at 25 °C in the dark, using the colour charts of Rayner (1970).

RESULTS

Phylogenetic analysis
Amplification products of approximately 1 700 bases were obtained for the isolates listed in Table 1. The LSU region of the sequences was used to obtain additional sequences from GenBank, which were added to the alignment. Due to the inclusion of the shorter LSU sequences of *Dictyosporium alatum* (GenBank accession DQ018101), *Dictyosporium elegans* (GenBank accession DQ018100) and *Dictyosporium toruloides* (GenBank accession DQ018104) in the alignment, it was not possible to subject the full length of the determined LSU sequences (Table 1) to analyses. The manually adjusted LSU alignment contained 115 sequences (including the two outgroup sequences) and, of the 568 characters used in the phylogenetic analyses, 267 were parsimony informative, 30 were variable and parsimony uninformative, and 271 were constant. Neighbour-joining analyses using three substitution models on the sequence data yielded trees supporting the same tree topology to one another but differed from the most parsimonious tree shown in Fig. 1 with regard to the placement of the clade containing *Ochoconis* and *Fusicladium* (in the distance analyses, this clade moves to a more basal position). Forty equally most parsimonious trees (TL = 1 039 steps; CI = 0.477; RI = 0.833; RC = 0.397), the first of which is shown in Fig. 1, were obtained from the parsimony analysis of the LSU alignment. The manually adjusted ITS alignment contained 28 sequences (including the outgroup sequence) and, of the 521 characters used in the phylogenetic analyses, 97 were parsimony informative, 91 were variable and parsimony uninformative, and 333 were constant. Neighbour-joining analyses using three substitution models on the sequence data yielded trees supporting the same tree topology to one another but differed from the most parsimonious tree shown in Fig. 2 with regard to the placement of *Chalastospora ellipsidea* (in the distance analyses, this taxon moves to a more basal position in *Chalastospora*). Six equally most parsimonious trees (TL = 253 steps; CI = 0.913; RI = 0.938; RC = 0.856), the first of which is shown in Fig. 2, were obtained from the parsimony analysis of the ITS alignment. The results of the phylogenetic analyses are highlighted below under the taxonomic notes, or in the Discussion, where applicable.

Taxonomy

**Bryceekendrickomyces** Crous & M.J. Wingf., *gen. nov.* — MycoBank MB509515

Mycelium ex hyphis ramosis, septatis, laevibus, pallide brunneis, 1–2 µm latis compositum. Conidiophora solitaria, erecta, cylindrica, recta vel leviter flexuosa, cellula basali bulbosa, sine rhizoideis, stipite modice brunneo vel atro-brunneo, laevi, transverse euseptato, ad apicem cum (1)–2–4(–6) cellulis conidiogenis. Cellulae conidiogenae subcylindricae, allontoides vel doliformes, rectae vel leviter curvatae, pallide brunnea, polyploida, polysymplastica, sympodialiter proliferantes. Conidia hyalina, mucilagine aggregata (sed non catenata), ellipsoidae, apice subobtusae, basic subtruncata.

*Type species.* *Bryceekendrickomyces acaciae* Crous & M.J. Wingf.

*Etymology.* Named for Bryce Kendrick, husband of Laurie Kendrick, for which *Launiomyces* was named and that resembles the current genus.

*Mycelium* consisting of branched, septate, smooth, pale brown, 1–2 µm wide hyphae. *Conidiophores* solitary, erect, cylindrical, straight to somewhat flexuous, basal cell bulbous, without rhizoids; stalk medium to dark brown, smooth, transversely euseptate; upper cell giving rise to (1)–2–4(–6) conidiogenous cells. *Conidiogenous cells* subcylindrical to allantoid or doliform, straight to gently curved, pale brown, polyploidal, proliferating sympodially. *Conidia* hyaline, aggregating in slimy mass (never in chains), ellipsoid, apex subobtuse, base subtruncated.

**Bryceekendrickomyces acaciae** Crous & M.J. Wingf., *sp. nov.* — MycoBank MB509517; Fig. 3

Macroaeae modice brunnea vel atro-brunnea, margine elevato, rubro-purpureo, oblongae vel ellipticae, ad 7 mm diam, in consortione *Phaeotrichoconis* crotalariae. In vitro (MEA): Mycelium ex hyphis ramosis, septatis, laevibus, pallide brunneis, 1–2 µm latis compositum. Conidiophora ex hyphis oriunda, solitaria, erecta, cylindrica, recta vel leviter flexuosa, cellula basali bulbosa, sine rhizoideis, 4–6 µm lata, ad basim 10–15 µm lata, stipite modice brunneo vel atro-brunneo, laevi, transverse 2–5 euseptato, (15)–30–50(–60) µm longo, (3)–4(–5) µm lato, ad apicem cum (1)–2–4(–6) cellulis conidiogenis. Cellulae conidiogenae subcylindricae, allontoides vel doliformes, rectae vel leviter curvatae, pallide brunnea, 5–8 × 2.5–2.5 µm, polysymplastica, sympodialiter proliferantes. Conidia hyalina, mucilagine aggregata (sed non catenata), ellipsoidae, apice subobtusae, basic subtruncata, latitudine maxima in parte centrali vel in parte supra centralum, saepe leviter asymmetria, (3.5–)4(–4.5) × (2–2.5) µm.

*Etymology.* Named after the host genus on which the fungus occurs, *Acacia.*
Leaf spots medium to dark brown, margin raised, red-purple, oblong to elliptoid, up to 7 mm diam, associated with ‘Phaeo-trichoceros’ crotalariae. Description based on culture on MEA: Mycelium consisting of branched, septate, smooth, pale brown, 1–2 μm wide hyphae. Conidiophores arising from mycelium, solitary, erect, cylindrical, straight to somewhat flexuous; basal cell bulbous, without rhizoids, 4–6 μm wide in upper part, but becoming 10–15 μm wide at basal part; stalk medium to dark brown, smooth, transversely 2–5-euseptate, (15–)30–50(–60) μm tall, (3–)4(–5) μm wide in the middle part; upper cell giving rise to (1–)2–4(–6) conidiogenous cells. Conidiogenous cells subcylindrical to allantoid or doliform, straight to gently curved, pale brown, 5–8 × 2–2.5 μm; polyblastic, proliferating sympodially. Conidia hyaline, aggregating in slimy mass (never in chains), ellipsoid, apex subobtuse, base subtruncate, widest in the middle or upper third of the conidium, frequently somewhat asymmetrical, (3.5–)4(–4.5) × (2–2.5) μm.

Characteristics in culture — Colonies on MEA erumpent, spreading, with moderate aerial mycelium; surface folded, margin lobate, smooth; surface olivaceous-grey, outer margin iron-grey; reverse iron-grey; colonies reaching up to 20 mm after 1 mo. Colonies fertile on SNA, OA and MEA. After 1 mo. Colonies fertile on SNA, OA and MEA.


Notes — Castañeda & Kendrick (1990) established the genus Lauriomyces, characterised by dark brown conidiophores,
and a series of branches, giving rise to chains of hyaline conidia via sympodial conidiogenesis. Brycekendrickomyces is morphologically similar to Lauriomyces, which in turn resembles Haplographium. The genus Haplographium is based on H. delicatum. Its confused history is discussed in detail by Zucconi & Pagano (1993). Haplographium delicatum was originally described by Berkeley & Broome as having conidia in chains. Furthermore, it is not phylogenetically related to species of Lauriomyces or Haplographium presently known from culture (Fig. 1). Brycekendrickomyces is somewhat similar to Argopericonia (Sutton & Pascoe 1987), although the latter fungus produces hyaline, apical conidiogenous heads, and it has ellipsoidal, single to short catenate conidia, each with a prominent, globose guttule.

Type species. Chalastospora cetera (E.G. Simmons) E.G. Simmons.

Conidiophores solitary, brown, smooth, arising from surface hyphae or as short, lateral branches from ropes of aerial hyphae; short, subcylindrical to flask-shaped, 0–2-transversely euseptate, seldom once geniculate or branched. Conidiogenous cells integrated, terminal or conidiophores reduced to conidiogenous loci visible as minute pores, without or with somewhat darkened and slightly thickened rim. Conidia in acropetal, branched chains, narrowly ellipsoid to narrowly ovoid, pale to medium brown, rarely 1–3 transversely euseptate, generally lacking longitudinal or oblique septa; conidial apex functioning as secondary conidiophore, proliferating laterally.

Chalastospora gossypii (Jacz.) U. Braun & Crous, comb. nov.


Fig. 2  The first of 6 equally most parsimonious trees obtained from a heuristic search with 100 random taxon additions of the ITS sequence alignment. The scale bar shows 10 changes, and bootstrap support values (blue are from the parsimony analysis and red from the distance analysis using the HKY85 substitution model) from 1 000 replicates are shown at the nodes. Branches present in the strict consensus tree are thickened. The tree was rooted to a sequence of Phaeosphaeriopsis musae (GenBank accession DQ885894).
Notes — The genus *Chalastospora* appears to represent an anamorph lineage in the *Pleosporales* (Fig. 1). *Chalastospora cetera* and *C. gossypii* are clearly congeneric (Fig. 2). Based on the ITS data, there are some point mutations among strains of *C. gossypii*, suggesting that other genes need to be sequenced to fully elucidate the variation within this species (Fig. 2). On SNA, ramoconidia of CBS 114810 were 10–17 × 3–5 µm, and conidia narrowly ellipsoid-ovoid, cylindrical to fusiform, 6–10 × 2–2.5 µm, thus much smaller than that reported by Braun et al. (2003) on PDA. Jaczewski introduced the name *Cladosporium gossypii* in 1929, and provided a brief Russian description, including shape and size of conidia. This description, published before 1935, is, however, valid. In his paper of 1931, he re-introduced *C. gossypii* together with a Latin description and a micrograph of conidia. Type material of *C. gossypii* was re-examined and it is identical to *C. malorum*. However, *C. gossypii* is an older name than *C. malorum*, which was published in 1931, and has priority.

*Chalastospora ellipsoidea* Crous & U. Braun, sp. nov. — MycoBank MB509519; Fig. 5

Chalastosporae gossypii similis, sed conidia ellipsoides, longioribus et leviter latioribus, (8–)10–15(–17) × 3(–3.5) µm.

*Etymology.* Named after its ellipsoid conidia.
On SNA: Conidiophores arising singly from aerial and creeping hyphae; subcylindrical, erect, medium brown, smooth, up to $25 \times 3$ $\mu$m, frequently reduced to conidiogenous cells, $5–13 \times 3$ $\mu$m; seldom once geniculate, mostly straight, with a slight swelling in the apical conidiogenous region; conidiogenous loci 1–3 per conidiogenous cell, medium brown, slightly thickened, darkened, up to $10 \times 3$ $\mu$m; conidiogenous loci medium brown, slightly thickened, darkened, 1–1.5 $\mu$m wide. Ramoconidia (0–)1–3-septate, ellipsoid-ovoid, subcylindrical or fusiform, smooth, medium brown, (12–)15–18(–30) $\times$ 3(–4) $\mu$m; apex at times with short beak, giving rise to lateral branch. Conidia ellipsoid to fusoid, medium brown, smooth, in long acropetal chains, simple, or branched with short apical or basal, lateral branches, (8–)10–15(–17) $\times$ 3(–3.5) $\mu$m, 0–1(–2)-septate; hila thickened and darkened, 0.5–1 $\mu$m wide.

Characteristics in culture — Colonies on OA spreading, with moderate, flattened aerial mycelium, smoke-grey. On MEA cinnamon with patches of hazel on surface and reverse. On PDA olivaceous-grey, with moderate aerial mycelium; iron-grey in reverse.

Specimen examined. AUSTRALIA, on Triticum, H.L. Harvey & S. Perth, holotype CBS H-20199, culture ex-type E.G.S. 22.060 = CBS 121331.

Notes — The most characteristic features of this species are its short lateral branches, and ellipsoid conidia. It is clearly distinct from *C. cetera* and *C. gossypii* based on ITS sequence data (Fig. 2).

**Chalastospora obclavata** Crous & U. Braun, sp. nov. — MycoBank MB509520; Fig. 6

Differt ab omnibus specibus *Chalastosporae* conidiis intercalaribus obclavatis.

Etymology. Named after its obclavate conidia.

Sporulating poorly on SNA. Conidiophores 17–30 $\times$ 3–4 $\mu$m, arising singly from aerial and creeping hyphae; subcylindrical, somewhat clavate near apex of conidiogenous region, erect, straight to once geniculate, medium brown, smooth, frequently reduced to conidiogenous cells, $5–10 \times 3–4$ $\mu$m; conidiogenous loci medium brown, slightly thickened, darkened, 1–1.5 $\mu$m wide. Ramoconidia medium brown, smooth, developing short lateral beaks at apex that give rise to lateral chains (verticillate-like appearance), obclavate, widest at base, 0–3-septate, (28–)30–35 $\times$ (3.5–)4–5(–6) $\mu$m. Conidia obclavate, widest at base, (23–)26–30(–35) $\times$ (3.5–)4 $\mu$m, 0–3-septate; hila thickened, darkened, 1–1.5 $\mu$m wide.

Characteristics in culture — Colonies on OA spreading, with moderate, white aerial mycelium, grey-olivaceous to smoke grey; reverse grey-olivaceous. On MEA cream with dense aerial mycelial mat.

Specimen examined. USA, Kansas, Manhattan, ex air, Jan. 1958, C.T. Rogerson, holotype CBS H-20200, culture ex-type E.G.S. 12.128 = CBS 124120.
Notes — The most characteristic features of this species are its conidial branching pattern and conidial shape. This strain was discussed by Simmons under *Alternaria cetera* (Simmons 1996), and under *Chalastospora* in Simmons (2007). It is clearly distinct from *C. cetera* (ex-type CBS 121340, Fig. 7), *C. ellipsoidea* and *C. gossypii* based on ITS sequence data (Table 1, Fig. 2).

**KEY TO SPECIES OF CHALASTOSPORA**

1. Intercalary conidia usually longer than 20 µm  
2. Intercalary conidia shorter than 20 µm  
3. Intercalary conidia narrowly ellipsoid to narrowly ovoid, widest in middle or lower third, (10–)19–24(–30) × 3(–4) µm, 0–3-septate  
4. Intercalary conidia narrowly ellipsoid-ovoid to cylindrical or fusiform, 6–10 × 2–2.5 µm, mostly aseptate .  
5. Intercalary conidia ellipsoid, not cylindrical nor fusiform, (8–)10–15(–17) × 3(–3.5) µm, 0(–2)-septate *C. ellipsoidea*  

1 Colonies cultivated on SNA.

**Cyphellophora** G.A. de Vries, Mycopathol. Mycol. Appl. 16: 47. 1962

Type species. *Cyphellophora laciniata* G.A. de Vries.

*Cyphellophora eugeniae* Crous & Alfenas, sp. nov. — MycoBank MB509521; Fig. 8

*Cyphellophora taiwanensis* similis, sed conidiis valde longioribus, (40–)60–75(–90) × 2–2.5(–3) µm.

**Etymology.** Named after the host on which it occurs, *Eugenia*.

On PDA. *Mycelium* consisting of branched, greenish brown, septate, smooth, 3–5 µm wide hyphae, constricted at septa. *Conidiogenous cells* phialidic, intercalary, inconspicuous to subdenticulate, 1 µm wide, with minute collarettes, with several loci aggregated at hyphal swellings. *Conidia* subcylindrical, tapering towards obtuse ends, curved, smooth, hyaline to olivaceous,
Fig. 6  Chalastospora obclavata (CBS 124120). a, b. Superficial mycelium on SNA showing conidiophores with branched conidial chains; c–e. conidia in chains. — Scale bar = 10 µm.

Fig. 7  Chalastospora cetera (CBS 121340). a–g. Superficial mycelium on SNA showing conidiophores with conidial chains. — Scale bars = 10 µm.
finely guttulate, 4–6(–10)-septate, prominently constricted at septa, widest in the middle of conidium, (40–)60–75(–90) × 2–2.5(–3) µm; conidia also anastomose and undergo microcyclic conidiation in culture.

Characteristics in culture — Colonies on PDA erumpent, with sparse aerial mycelium and even margins; surface olivaceous-grey, with patches of iron-grey; reverse iron-grey. On MEA erumpent, with folded surface and smooth, lobate margin, and sparse aerial mycelium; surface pale olivaceous-grey to olivaceous-grey; reverse iron-grey. On OA spreading, flat, with even, smooth margins and sparse aerial mycelium, olivaceous-grey. Colonies reaching 15 mm diam after 1 mo at 25 °C, fertile, sporulating in slimy sporodochial masses.

Notes — The indistinct conidiogenous loci of *C. eugeniae* are reminiscent of those of *C. taiwanensis* (Matsushima 1985). The two species can be distinguished by the much longer conidia in *C. eugeniae*. Based on the key provided by Decock et al. (2003), *C. eugeniae* appears to represent a new species. Further collections of this complex are required to confirm the synonymy of the genera *Cyphellophora* with *Pseudomicrodochium* and *Kumbhayama* (Decock et al. 2003, Crous et al. 2007b), which were originally distinguished based on the absence of conidial pigmentation. The ITS sequence of *C. eugeniae* has 89 % similarity to that of *Cyphellophora hylomeconis* (GenBank accession EU035415).


Fig. 8 *Cyphellophora eugeniae* (CBS 124105). a, b. Colonies sporulating on OA; c–e. conidia attached to conidiogenous cells (arrows denote loci); f–j. conidia. — Scale bars = 10 µm.
**KEY TO SPECIES OF CYPHELLOPHORA**
(adapted from Decock et al. 2003)

1. Phialides intercalary, reduced to a sessile locus with collarette ........................................... 2
1. Phialides prominent, cylindrical, flask-shaped, sessile or with an elongated base ........................................... 6
2. Conidia 1–3-septate ........................................... 3
2. Conidia usually more than 3-septate ........................................... 4
3. Conidia up to 2.5 µm wide (11–20 × 2–2.5 µm), 1(–2)-septate ........................................... C. fusarioides
3. Conidia up to 5 µm wide (11–25 × 2–5 µm), 1–3-septate ........................................... C. laciniata
4. Conidia up to 2 µm wide, 3–6-septate, sigmoid (16–35 × 1.5–2 µm) ........................................... C. taiwanensis
4. Conidia wider than 2 µm ........................................... 5
5. Conidia subcylindrical, 4–6(–10)-septate, (40–)60–75(–90) × 2–2.5(–3) µm ........................................... C. eugeniae
5. Conidia sigmoid, 1–5-septate, (15–)25–35(–55) × (2.5–)3(–4) µm ........................................... C. hylomeconis
6. Phialides short to long and cylindrical; conidia 1–1.2 µm wide, 2–3-septate ........................................... C. suttonii
6. Phialides prominent, flask-shaped, sessile or with an elongated base ........................................... 7
7. Conidia mainly straight, on average smaller than 20 µm, 1–5-septate ........................................... C. pluriseptata
7. Conidia straight to more commonly falcate, curved, or sigmoid, on average longer than 20 µm ........................................... 8
8. Conidia (1–)3-septate, wider than 3 µm, 25–40 × 3.5–5.5 µm; phialides commonly with an elongated base ........................................... C. indica
8. Conidia 2–8-septate, narrower than 3 µm; phialides without elongated base ........................................... 9
9. Conidia vermiform, mostly curved, mostly 4–8-septate, 30–55 × 1.2–1.5 µm ........................................... C. vermispora
9. Conidia straight, falcate or slightly sigmoid, (2–)3–6-septate, (18–)19.5–28(–29) × 1.5–2 µm ........................................... C. guyanensis

**Dictyosporium** Corda, in Weitenweber, Beitr. Gesammten Natur-Heilwiss., Prag 1: 87. 1836

*Type species.* *Dictyosporium elegans* Corda.

*Conidiomata* sporodochial, black, scattered. *Mycelium* predominantly immersed, consisting of branched, septate, smooth, thin-walled hyphae. *Conidiophores* micronematous, mononematous, pale brown, smooth to finely verruculose, thin-walled, septate, cylindrical. *Conidiogenous cells* monoblastic, integrated, pale to medium brown, smooth to finely verruculose, cylindrical, determinate; at times remaining attached to released conidium. *Conidia* cheiroid, medium to dark brown, smooth, euseptate, one cell-layer thick, cells arranged in 1–2 planes, fan-shaped; cell rows originating from a central basal cell; rows usually attached along their length; outer rows usually shorter than inner rows, at times paler in colour than central rows, and with or without hyaline, thin-walled, 1–2-celled appendages that are allantoid, clavate to globose, or fusoid to cylindrical.

*Dictyosporium strelitziae* Crous & A.R. Wood, sp. nov. — MycoBank MB509522; Fig. 9

*Dictyosporium bulbosii* valde simile, sed conidiis leviter longioribus, (30–)40–46(–55), et phylogenetice manifeste divergens.

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

*Leaf spots* absent, colonies occurring on dead leaf tissue. Description based on colonies sporulating on WA with pine nee-

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**Fig. 9** *Dictyosporium strelitziae* (CBS 123359). a. Colony sporulating on PDA; b, c. conidia attached to conidiogenous cells; d–h. conidia with hyaline, apical appendages. — Scale bars = 10 µm.
D. tetrasporum
D. yunnanensis
D. bulbosum

22
17
20

D. toruloides
19
25
9
13
15
18

Conidia with darker colour at apex of inner rows; apical cells of outer rows each bearing a hyaline, cylindrical appendage.

Conidia concolorous

Conidia 24–40 × 14–20 µm; appendages clavate

Conidia 36–45 × 16–21 µm; appendages tapering

Conidia mostly comprising 5 rows of cells

Conidia mostly comprising 6–8 rows, 46–88 × 26–46 µm; appendages hyaline, curved

Conidia longer than 32 µm, appendages globose to obovoid

Conidia shorter than above, 26–32 × 15–24 µm; appendages cylindrical to clavate

Conidia up to 46 µm long, and 30 µm wide, 27–46 × 11–30 µm; appendages globose to obovoid

Conidia longer than 46 µm, but not wider than 25 µm, (30–)40–46(–55) × (20–)21–23(–25) µm; appendages globose

Conidia complanate, one cell layer thick

Conidia not complanate, more than one cell layer thick

Conidia regularly consisting of 3 rows of cells

Conidia consisting of at least 4 rows of cells

Conidia 15–22.5 × 10–16.5 µm

Conidia 26–32 × 16–18 µm

Conidia curved, with 5–7 rows of cells, each curving in the same direction, 34–56 × 20–38 µm

Conidia not curved

Conidia less than 25 µm long

Conidia more than 25 µm long

Conidia 18–24 × 13–19 µm

Conidia 15–17 × 11–12 µm

Conidia with paler outer rows

Conidia concolorous

Conidia 25–45 × 22–38 µm, with (5–)6–(7) rows

Conidia 26–40 × 13–25 µm, mostly with 5 rows

Conidia with 4 rows, 23.5–40 × 16–21.5 µm

Conidia with more than 4 rows

Conidia 40–80 × 24–36 µm, mostly with 5 rows, slightly constricted at septa

Conidia mostly with more than 5 rows, strongly constricted at septa

Conidia 26–34 × 23–34 µm, mostly with 7–9 rows of cells; conidiomata sporodochial

Conidia 38–56 × 25–32 µm, mostly 6–8 rows of cells; conidiomata not sporodochial

Conidia 26–40 × 13–25 µm, mostly with 5 rows

Conidia with 4 rows, 23.5–40 × 16–21.5 µm

Conidia with more than 4 rows

Conidia 40–80 × 24–36 µm, mostly with 5 rows, slightly constricted at septa

Conidia mostly with more than 5 rows, strongly constricted at septa

Conidia 26–34 × 23–34 µm, mostly with 7–9 rows of cells; conidiomata sporodochial

Conidia 38–56 × 25–32 µm, mostly 6–8 rows of cells; conidiomata not sporodochial

Conidia campaniform, with a darker base; with 12–16 rows of cells, 22–40 × 20–30 µm

Conidia more or less cylindrical, concolorous, comprising 3–7 rows of cells

Conidia regularly with 3 rows of cells; usually 13.5 µm or less wide

Conidia mostly with 4–7 rows of cells; more than 13.5 µm wide

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KEY TO SPECIES OF DICTYOSPORIUM
(adapted from Cai et al. 2003b)

1. Conidia with appendages .......................... 2
2. Conidia lacking appendages ......................... 13
3. Appendages apical .................................. 3
4. Appendages not apical ................................ 4
5. Apical appendages aseptate .......................... 6
6. Apical appendages frequently 1-septate, cylindrical, 24–51 × 6–10.5 µm; conidia 27.5–47.5 × 20–25 µm, complanate, with 4–5 rows of cells ...................... D. canisporum
7. Appendages subapical, cylindrical to clavate; conidia 52.5–72.5 × 18.5–26.5 µm, not complanate, with 5 rows of cells .......................................................... D. tetraploides
8. Appendages not subapical, but central or basal .............................. 5
9. Appendages central, hyaline, thin-walled, clavate to obovoid; conidia 36–45 × 16–21 µm, not complanate, mostly 7 rows of cells ........................................ D. musae
10. Appendages basal, fusoid to cylindrical; conidia 22–28 × 12.5–18 µm, complanate, with 3 rows of cells .......... D. mangleietae
11. Conidia with 3 rows of cells, (27–)31–43 × 10–12 µm ........................................... D. freycinetiae
12. Conidia with more than 3 rows of cells .............. 7
13. Conidia mostly with 4 rows of cells .................. 8
14. Conidia with 5 or more rows of cells .................. 10

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Notes — The genus Dictyosporium is well defined, and separated from similar genera by having smooth-walled, euseptate conidia produced from determinate conidiogenous cells (Sutton et al. 1996, Tsui et al. 2006). Based on the key provided by Cai et al. (2003b), D. strelitziae is morphologically most similar to D. bulbosum (conidia 27–46 × 30–35 µm), but its conidia are somewhat longer, and there is a 10 bp difference between the ITS sequences of D. strelitziae and D. bulbosum (DQ101806).

Phylogenetically, D. strelitziae is closest to D. elegans (conidia 44–80 × 24–36 µm; appendages absent) (5 bp difference in the ITS sequence, DQ018087), but it has smaller conidia than the latter species. Furthermore, it also appears distinct from all species not occurring in the key of Cai et al. (2003b) (Arambarri et al. 2001, Cai et al. 2003a, Zhao & Zhang 2003, Kodsiueb et al. 2006, Cai & Hyde 2007, McKenzie 2008).

Type species. Edenia gomezpompae M.C. González, Anaya, Glenn, Saucedo & Hanlin.

**Conidiophores** fasciculate, subcylindrical, medium brown, finely roughened, 3–15-septate, straight to variously curved or geniculate-sinusous, irregular in width, constricted at some septa, with percurrent rejuvenation in upper part, situated on a submerged, brown stroma. **Conidiogenous cells** terminal, integrated, becoming paler brown towards apex, tapering to a subtruncate tip, with several lateral loci that are somewhat thickened and protruding (pimple-like), giving rise to conidia.

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**Fig. 10** *Edenia gomezpompae* (CBS 124106). a. Hyphal tufts visible when cultivated on MEA; b. leaf spot with conidiophores; c. fasciculate conidiophores; d. conidiophores arising from conidioma; e–g. conidiophores and conidiogenous cells; h. conidia; i. conidiomata forming on OA; j. conidioma with ostiolar setae; k, l. conidiogenous cells; m. conidia. — Scale bars = 10 µm.
via sympodial proliferation near apex. Conidia 11–16 × 3.5–6 μm, subhyaline, smooth, thin-walled, finely guttulate, fusoid-ellipsoidal with obtuse apex and tapering from its widest point in the middle towards a subtruncate base, 1–1.5 μm wide.

**Edenia gomezpompae** M.C. González, Anaya, Glenn, Sauce-do & Hanli, Mycotaxon 101: 254. 2007 — Fig. 10

Leaf spots subcircular, 3–12 mm diam, grey-brown, with a dark brown, raised border, surrounded by a diffuse, black halo (absent in smaller spots). Conidiophores in fascicles of 5–30, subcylindrical, medium brown, finely roughened, 3–15-septate, straight to variously curved or geniculate-sinuous, 50–170 × 4–6 μm, irregular in width, constricted at some septa, with persistent rejuvenation in upper part; fascicles randomly distributed over lesion, amphigenous, visible as erect, dark brown to black tufts on lesions, situated on a submerged, brown stroma, up to 60 μm wide and 40 μm high, intermingled among leaf trichomes (fruited structures of a *Rumaluraria* sp. and acacoma of another fungus also present in some lesions). Conidiogenous cells 15–30 × 3–4 μm, terminal, integrated, becoming paler brown towards apex, tapering to a subtruncate tip, with several lateral loci that are somewhat thickened and protruding (pimple-like), up to 1 μm diam, giving rise to conidia via sympodial proliferation near apex, but some conidiogenous cells also show signs of percurrent proliferation, but this appears to be linked to rejuvenation, not conidiogenesis. **Conidia** (11–)13–15(–16) × (3.5–)4.5–5.5(–6) μm, subhyaline, smooth, thin-walled, finely guttulate, fusoid-ellipsoidal with obtuse apex and tapering from its widest point in the middle towards a subtruncate base, 1–1.5 μm wide.

Characteristics in culture — Colonies fluffy, with white hyphal strands that turn brown with age; surface woolly with abundant aerial mycelium; margins uneven. On MEA buff to rosy-buff (surface), brick to dark brown (reverse); on PDA fluffy, cream to buff (surface), dark brown to buff (reverse); on OA brick with patches of cream to buff. Colonies reaching 25 mm diam after 2 wk at 25 °C, becoming fertile on OA.


Notes — The genus *Edenia* was originally introduced for a sterile fungus (suspected to be a member of the *Pleospora*-ceae), isolated as an endophyte from leaves of *Callicarpa acuminate* in Mexico (González et al. 2007). The genus was characterised by producing numerous sterile, whitish mycelial strands and coils on PDA. The present collection from *Callicarpa alata* in the Philippines has the same colony characteristics, and based on its identical DNA sequence data (GenBank EF565744.1), we believe that this is the same fungus. What is interesting, however, is the fact that the latter collection was made from conidia of a dematiaceous hyphomycete sporulating from its widest point in the middle towards a subtruncate base, 1–1.5 μm wide. Morphologically, the hyphomycete state of *Edenia* resembles genera such as *Digipodium*, although species of this genus have rhizoids, and 1-septate, pale brown conidia that can also occur in short chains (Heuchert et al. 2005). It also shares some similarities with *Blastophorium* (Matsushima 1971), although the latter fungus is distinct in having solitary conidiophores with rhizoids, and a hyaline, upper conidiogenous region.


Type species. **Thedonia ligustrina** (Boerema) B. Sutton.

Conidiomata fasciculate, punctiform. Mycelium internal, hyphae subhyaline, septate, branched, forming substomatal stroma, hyaline to pale brown. Conidiophores fasciculate, arising from stroma, simple, rarely branched, subcylindrical, straight to geniculate-sinuous, continuous to septate, smooth, hyaline to pale yellowish green. Conidiogenous cells integrated, terminal, occasionally conidiophores reduced to conidiogenous cells, sympodial, conidiogenous loci more or less planate, unthickened, non-pigmented. **Conidia** in disarticulating chains, rarely in branched chains, subcylindrical to obclavate, with one to several transverse eusepta, hyaline or almost so, apex rounded to truncate, base truncate, hila flat, unthickened, hyaline.

**Thedonia ligustrina** (Boerema) B. Sutton, Trans. Brit. Mycol. Soc. 61: 428. 1973 — Fig. 11


Characteristics in culture — On MEA erumpent, slow growing, 5–8 mm after 2 wk, with moderate, white aerial mycelium and smooth, lobate margins; umber in reverse. On OA5–8 mm diam after 2 wk, submerged to flattened on surface, sparse aerial mycelium, and smooth, even margins; umber on surface.


Notes — Kaiser & Crous (1998) linked *Thedonia lupini* as anamorph to *Mycosphaerella lupini*, and thus suggested that *Thedonia* belongs in the *Mycosphaerellaceae*. Results of this study (Fig. 1), however, show that *Thedonia* s.str. belongs to the *Helotiales*, and is unrelated to the *Mycosphaerellaceae*. Furthermore, there is presently no separate anamorph genus in the *Mycosphaerellaceae* to accommodate *T. lupini*. Although *T. lupini* resembles species of *Pseudocercospora* (Braun 1995), it appears to represent a separate phylogenetic lineage.

**Trophophora** R.T. Moore, Mycologia 47: 90. 1955


Colonies hypophyllous, medium to dark brown, consisting of numerous synnemata. *Stroma* absent, but a superficial network of hyphae linking the various synnemata. Conidiophores synnematosus, mostly unbranched and straight, or with 1–2 short branches, straight or curved, cylindrical, individual conidiophores tightly aggregated, but separating near the apex, pale to medium brown, smooth. Conidiogenous cells polyblastic, integrated, terminal, determinate to sympodial, with visible
unthickened scar, clavate. Conidia solitary, terminal or lateral on conidiogenous cells, prominently curved to helicoid, pale to medium brown, smooth, transversely septate with a darkened, thickened band at the septa.

**Trochophora fasciculata** (Berk. & M.A. Curtis) Goos (as ‘fasciculatum’), Mycologia 78: 759. 1986 — Fig. 12


≡ **Helicosporium fasciculatum** (Berk. & M.A. Curtis) Sacc., Syll. fung. 4: 560. 1886.


Notes — Two species have been described in the genus, namely **T. fasciculata** and **T. simplex**; the latter recognised as a synonym of the former (Zhao et al. 2007). Within the Mycosphaerellaceae, pseudocercospora-like species cluster in two well-defined clades, namely the **P. vitis** clade (**Pseudocercospora** s.s.), and the **P. heimi** clade (**pseudocercospora-like**). Based on LSU DNA phylogeny (Fig. 1), **Trochophora** clusters basal to the pseudocercospora-like clade. Although it is tempting to use the name **Trochophora** for this clade, further collections of **Trochophora** are required to clarify the morphological variation among taxa with this unique conidial morphology. Using sequence data of the ITS gene, the closest taxa obtained from a BLAST search is the **Mycosphaerella heimii** species complex (96% similarity).

Zhao et al. (2007) consider **T. fasciculata** as a pathogen of Daphniphyllum, and report it from this host in several Asian countries, namely Sri Lanka, China (incl. Hong Kong and Taiwan) and India.


Type species. **Verrucisporota proteacearum** (D.E. Shaw & Alcorn) D.E. Shaw & Alcorn.

**Mycelium** consisting of pale brown, septate, verrucose hyphae. **Stroma** forming in substomatal cavities, cells brown-walled, pseudoparenchymatous. **Conidiophores** macronematous, mononematous, simple, flexuous, often geniculate, septate, mainly smooth, pale to dark brown, tapering towards the apex, but often becoming more swollen, and also verrucose to verrucose at the apex. **Conidiogenous cells** cylindrical, becoming geniculate, integrated, terminal, becoming intercalary, polyblastic, proliferating sympodially, cicatrised; conidiogenous loci planate, conspicuous, protuberant, thickened and darkened. **Conidia** cylindrical, narrowing slightly to an obtuse apex and with a truncate base with a distinctly thickened hilum, medium brown, straight or curved, transversely septate, verrucose to verruculose.

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Fig. 11 Thedgonia ligustrina (CBS 124332). a, b. Leaf spots on Ligustrum; c. fasciculate conidiophores; d, e. conidiophores; f, g. conidia. — Scale bars = 10 µm.
Verrucisporota daviesiae (Cooke & Massee) Beilharz & Pascoe, Mycotaxon 82: 360. 2002


Characteristics in culture — On MEA erumpent, spreading with folded surface, and sparse aerial mycelium and even, lobate margin; surface iron-grey to olivaceous-grey; reverse iron-grey; colonies reaching 7 mm diam after 2 wk. On PDA erumpent, spreading, with moderate aerial mycelium and uneven margins; surface white in middle, olivaceous-grey in outer region, iron-grey underneath; colonies reaching 8 mm diam after 2 wk. On OA erumpent, spreading, with moderate aerial mycelium and uneven margin; surface white in middle, olivaceous-grey in outer region; colonies reaching 8 mm diam after 2 wk.

Specimen examined. Australia, Victoria, on living leaves of Daviesia mimosoides (≡ D. corymbosa var. mimosoides), V. & R. Beilharz, VPRI 31767 = CBS 116002.

Notes — The type species of the genus Stenella, S. araguata, clusters in the Teratosphaeriaceae (Crous et al. 2007a), and thus the majority of the stenella-like anamorphs in the Mycosphaerellaceae, will need to be placed in another genus. One option would be Zasmidium (Arzanlou et al. 2007), which clusters in the Mycosphaerellaceae, along with Verrucisporota (Fig. 1). This clade, however, is neither morphologically nor phylogenetically well resolved, and taxa need to be added to improve the phylogeny before a reasonable assessment can be made. The ITS sequence of this species is distinct from the other two species of this genus treated in this paper (Table 1).

Verrucisporota daviesiae (Cooke & Massee) Beilharz & Pascoe, Mycotaxon 82: 360. 2002


Characteristics in culture — On MEA erumpent, spreading with folded surface, and sparse aerial mycelium and even, lobate margin; surface iron-grey to olivaceous-grey; reverse iron-grey; colonies reaching 7 mm diam after 2 wk. On PDA erumpent, spreading, with moderate aerial mycelium and uneven margins; surface white in middle, olivaceous-grey in outer region, iron-grey underneath; colonies reaching 8 mm diam after 2 wk. On OA erumpent, spreading, with moderate aerial mycelium and uneven margin; surface white in middle, olivaceous-grey in outer region; colonies reaching 8 mm diam after 2 wk.

Specimen examined. Australia, Victoria, on living leaves of Daviesia mimosoides (≡ D. corymbosa var. mimosoides), V. & R. Beilharz, VPRI 31767 = CBS 116002.

Notes — The type species of the genus Stenella, S. araguata, clusters in the Teratosphaeriaceae (Crous et al. 2007a), and thus the majority of the stenella-like anamorphs in the Mycosphaerellaceae, will need to be placed in another genus. One option would be Zasmidium (Arzanlou et al. 2007), which clusters in the Mycosphaerellaceae, along with Verrucisporota (Fig. 1). This clade, however, is neither morphologically nor phylogenetically well resolved, and taxa need to be added to improve the phylogeny before a reasonable assessment can be made. The ITS sequence of this species is distinct from the other two species of this genus treated in this paper (Table 1).

Fig. 12 Trochophora fasciculata (CPC 10280). a. Leaf spots on Daphniphyllum; b. colony on MEA; c. fasciculate conidiophores; d. conidiophores and conidiogenous cells; e–g. conidia. — Scale bars = 10 µm.
folded, with zones of salmon or smoke-grey mycelium; outer region and reverse olivaceous-grey; colonies reaching 10 mm diam after 1 mo.


Notes — Conidia of V. grevilleae are narrower and longer, and conidiophores shorter than those of V. protearum (conidia 23–51 × 5.6–10.5 µm, conidiophores up to 290 µm long, 4.5–8.5 µm wide; Shaw & Alcorn 1967). South African specimens from the genus Protea have conidia that are (20–)31–36(–49) × (7–)8.5–9.5(–12) µm (Crous et al. 2004a). These findings suggest that the fungus treated as V. protearum on Proteaceae (Shaw & Alcorn 1967, 1993, Beilharz & Pascoe 2002, Crous et al. 2004a), probably represents a complex of several taxa.

Fig. 13 Verrucisporota grevilleae (CBS 124107). a. Leaf spots on Grevillea; b. conidiophores; c, d. conidiophores and conidiogenous cells; e–h. conidia; i. colony on PDA; j. colony on SNA. — Scale bars = 10 µm.


Characteristics in culture — On MEA erumpent with sparse aerial mycelium; surface cream to pale olivaceous-grey, folded, with smooth, even margin; reverse brown-vinaceous; reaching 8 mm diam after 2 wk. On PDA erumpent with sparse aerial mycelium and smooth to feathery margin; surface cream to pale olivaceous-grey; reverse olivaceous-grey, reaching 8 mm diam after 2 wk. On OA erumpent, with moderate aerial mycelium and uneven margin, pale white in middle, pale olivaceous-grey in outer region; reaching 10 mm diam after 2 wk.

Specimen examined. AUSTRALIA, Grevillea sp., V. Beilharz, VPRI31812 = CBS 116003.

Notes — Because V. proteacearum was originally described from Finschia (conidia 23–51 × 5.6–10.5 µm; Shaw & Alcorn 1967), there is a strong possibility that the strain listed here from Grevillea (conidia 30–45 × 10–12 µm on OA) may represent a different taxon to the one occurring on Finschia. Although apparently identical based on the LSU phylogeny (see Fig. 1), the ITS sequence of this isolate is different to that of V. grevilleae (95 % similarity and 4 % gaps).

KEY TO SPECIES OF VERRUCISPOROTA

1. Conidia wider than 4.5 µm ........................................... 2
2. Conidia narrower than 4.5 µm ........................................ 3
3. Conidia up to 56 µm long ............................................. 4
4. Conidia longer than 56 µm, 3–(7–)12-septate, (30–)50–65(–80) × (5–)6–7 µm; on Grevillea. V. grevilleae
5. Conidia mostly up to 30 µm long, (0–)2–3–(7–)septate, 13–30(–70) × 2.75–4 µm; on Capparis. V. kimberleyana
6. Conidia longer, mostly up to 77 µm long, 1–11–septate, (10–)27–77(–108) × 3–4.5 µm; on Struthanthus. V. struthanthicola
7. Conidia up to 3-septate, obclavate, 1–3–septate, 32.5–55 × 7–10.5 µm; on Celastrus. V. indica
8. Conidia more than 3 septa ............................................. 5
9. Conidia up to 32 µm long; (1–)3–(4–)5-septate, 20–32 × 6–10 µm; on Bridelia. V. brideliae
10. Conidia frequently longer than above ................................ 6
11. Conidia 0–6–septate, 18–56 × 4.5–7 µm; on Daviesia (Beilharz & Pascoe 2002). V. daviesiae
12. Conidia 3–7–septate, 23–51 × 5.6–10.5 µm; on Finschia. V. proteacearum


Type species. Vonarxia anacardi Bat. & J.L. Bezerra.

Mycelium immersed and superficial, composed of branched, septate, pale to medium brown, smooth to finely roughened hyphae. Conidiodoma sporodochial; basil cell composed of globose-ellipsoidal, brown, slightly roughened cells. Setae irregularly scattered throughout colony, simple, subulate with a bulbous base, straight to slightly curved, dark brown, smooth to slightly roughened, thick-walled, 5–16–euseptate, septa rather thick, but becoming thinner towards apex. Conidigenous cells arise from upper cells of the stroma, tightly aggregated, doliform to ellipsoid, pale brown to subhyaline or hyaline, smooth, 8–10 × 3–5 µm, giving rise to a cluster of conidia by means of sympodial proliferation, with successive conidia forming at a higher level. Conidia hyaline, smooth-walled, tetradrate, basil cell subcylindrical to clavate to doliform, 0–1-septate, subcylindrical to cylindrical, apex subobtuse. The apical part of the basal cell, 3–10–septate, subcylindrical to cylindrical, apex subobtuse.

Vonarxia vagans (Speg.) Aa, Persoonia 13: 128. 1986 — Fig. 14


Notes — The holotype specimen (LPS 12280) was described from leaves of Spiraea cantoniensis, Sept. 1905, leg. Usteri no 15 bis, holotype LPS 12280; Rio Grande do Sul, Guaiba, living leaves of Stenocalyx uniflorus, 1 Apr. 2008, leg. A.C. Alfatiss, isol. P.W. Crous, epitype designated here CBS H-20206, culture ex-type CPC 15151 = CBS 123533, CPC 15152.

Notes — The holotype specimen (LPS 12280) was described and illustrated in detail by Nag Raj (1977). The species was originally described from leaves of Spiraea cantoniensis collected in the São Paulo Botanical Garden, where it occurred on leaves of several tree species, suggesting that it is not host specific. The present collection was obtained by inoculating Eugenia leaves with leaf spots of Phaeophysospora eugeniae in moist chambers, which resulted in a few conidiophores of Vonarxia vagans developing.

Nag Raj (1977) erected Kazulia for a genus of hyphomycetes with dark brown, septate setae, and tetradrate conidia, which he regarded as morphologically distinct, and a probable anamorph of the Chaetothyriaceae. The fact that he did not compare Kazulia with Vonarxia is not surprising, because
Batista et al. (1960) who initially described *Vonarxia*, showed setae on the outside of the pycnidia, and thus this fungus was regarded as a coelomycete. Later comments from Nag Raj (1977) (as *Kazulia*) suggest, however, that these bodies are perithecia of a probable teleomorph. In a subsequent study Van der Aa & Van Oorschot (1985) and Van der Aa & Von Arx (1986) showed that *Kazulia* is a synonym of *Vonarxia*. Wu & Sutton (1995) were not convinced of the distinction between *Vonarxia* and another hyphomycete genus, *Fumagopsis*, due to insufficient material, and chose to use the name *Fumagopsis for F. complexa*, which they described from *Eugenia* leaves collected in India. Based on the present collection of *V. vagans*, it

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**Fig. 14** *Vonarxia vagans* (CBS 123533). a, b. Colony on PDA; c. colony with setae; d, e. setae with rounded apices and swollen bases, lacking rhizoids; f–i. conidiogenous cells giving rise to conidia; j–o. conidia. — Scale bars = 10 µm.
is apparent, that these are two distinct genera. In Fumagopsis the setae are aseptate, arranged around the sporodochium, and taxa have rhizoid-like structures. In contrast, the setae of Vonarxia are septate, irregularly distributed and do not surround the sporodochium, and have a simple, bulbous base.

**KEY TO SPECIES OF **VONARXIA**

1. Setae 87–155 µm long; apical conidial arms 12–35 µm long . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . V. anacardii
2. Setae and conidial arms longer; setae 120–220 µm long; apical conidial arms 20–55(–90) µm long . . . . V. vagans

**Xenostigmina** Crous, Mycol. Mem. 21: 154. 1998

**Type species.** *Xenostigmina zilleri* (A. Funk) Crous.

Associated with leaf spots. *Mycelium* internal, consisting of hyaline to pale brown, septate, branched, smooth hyphae. *Conidiomata* sporodochial, brown to black. *Conidiophores* densely aggregated, arising from the upper cells of a pale brown stroma, finely verruculose, hyaline to pale brown, multisepaete, subcylindrical, straight to variously curved, branched. *Conidiogenous cells* terminal and intercalary, hyaline to pale brown, extending into a beak; base truncate at dehiscence, inner part extending later to form a short, subseptate basal appendage; septation muriform; basal marginal frill present.

**Xenostigmina zilleri** (A. Funk) Crous, Mycol. Mem. 21: 155. 1998 — Fig 15


Characteristics in culture — Colonies spreading on PDA with moderate to abundant aerial mycelium, and feathery margins; olivaceous-grey with patches of iron-grey and pale olivaceous-grey; iron-grey in reverse. On OA spreading, with abundant aerial mycelium, olivaceous-grey with patches of pale olivaceous-grey. On MEA erumpent, spreading, with abundant aerial mycelium, pale olivaceous-grey with patches of olivaceous-grey and iron-grey; reverse iron-grey.


_Notes._ — Although *Stigmina* s. str. has been shown to reside in *Pseudocercospora* s. str. (Crous et al. 2006a, Braun & Crous 2006, 2007), this is not the case for *Xenostigmina* (Crous 1998), which appears to be related to *Seifertia* (Seifert et al. 2007) in the *Dothideomycetes*. Isolates of the *Xenostigmina* state are shown here (Fig. 1) to be identical to those of the *Mycopappus* state, which proves that these two genera are indeed synanamorphs. No ascospore isolates were obtained, however, to confirm their relationship to *Mycosphaerella mycopappi*, though this species is clearly not a member of the *Mycosphaerellaceae*. *Xenostigmina wolfii* (Crous & Corlett 1998), which is the anamorph of *Mycosphaerella stigmata-platani*, and a *Pseudocercospora* synanamorph, is not congeneric with *X. zilleri*, and would be better accommodated in *Pseudocercospora* (Crous et al. 2006a) than in *Xenostigmina*.  

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**Fig. 15** *Xenostigmina zilleri* (CBS 124108). a–c. Conidial propagules of *Mycopappus aceris*; d. setae on the surface of conidial propagules; e. colony of *Xenostigmina zilleri*; f, g. fasciculate conidiophores; h. conidia. — Scale bars = 10 µm.
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