Key words
Brycekendrickomyces
Chalastospora
Cyphellophora
Dictyosporium
Edenia
phylogeny
taxonomy
Thedgonia
Trochophora
Vernucospo­ra
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 nrRNA genes to resolve species and generic questions related to these obscure genera. Brycekendrickomyces (Herpotrichieli­aceae) is introduced as a new genus similar to, but distinct from Haplographi­um and Laurniomyces. Chalastospora is shown to be a genus in the Pleosporales, with two new species, C. ellipsoidea and C. oblata, to which Alternaria malorum is added as an additional taxon under its oldest epithet. C. gossypii. Cyphellophora eugeni­ae 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. strelitziae. The genus Edenia, which was recently introduced for a sterile endophytic fungus isolated in Mexico, is shown to be a hyphomycete (Pleospor­ales) forming a pyronella-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 Vernucospo­ra. 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 ‘leafing 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 (Brycekendrickomyces, Cyphellophora, Vonarxia), Pleosporales (Chalastospora, Dictyosporium, Edenia, Xenostigmina), Helotiales (Thedgonia), and the Capnodiales, Mycosphaerellaceae (Trochophora, Vernucospo­ra). 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 were immediately subjected to direct isolation of hyphomycetes, or alternatively were first incubated in moist chambers to

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7 Departamento de Fitopatologia, Universidade Federal de Viçosa, 36.570 Viçosa, MG, Brazil.
8 Crop Protection Cluster, College of Agriculture, University of the Philippines, Los Baños College, Laguna 4031, Philippines.
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2 ITS: Internal transcribed spacers 1 and 2 together with 5.8S rDNA; LSU: 28S rDNA.
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 (IT52) and the first 900 bases at the 5' end of the 28S rRNA gene (LSU). The primers ITS4 (White et al. 1990) and LR0R (Rehnner & 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 new, 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 (> 1000 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 Ochroconis and Fusicladium (in the distance analyses, this clade moves to a more basal position). Forty equally most parsimonious trees (TL = 1 039 steps; Cl = 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, 30 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 ellipsoidae (in the distance analyses, this taxon moves to a more basal position in Chalastospora). Six equally most parsimonious trees (TL = 253 steps; Cl = 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

Brycekendrickomyces 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, rectae 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. Conidia hyalina, mucilagine aggregata (sed non catenata), ellipsoidae, apice subobtusae, basi subtruncatae. Type species. Brycekendrickomyces acaciae Crous & M.J. Wingf.

Etymology. Named for Bryce Kendrick, husband of Laurie Kendrick, for which Lautromyces 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 bulbose, without rhizoids; stalk medium to dark brown, smooth, transversely euseptate; upper cell giving rise to (1–)2–4(–6) conidiogenous cells. Conidigenous cells subcylindrical to allantoid or doliform, straight to gently curved, pale brown, polyblastic, proliferating sympodially. Conidia hyaline, aggregating in slimy mass (never in chains), ellipsoid, apex subobtuse, base subtruncate.

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

Maculae modice brunneae vel atro-brunneae, margine elevato, rubro-purpureae, oblongae vel ellipsoidea, ad 7 mm diam, in consortione ‘Phaeotrichonis’ crotalarium. In vitro (MEYA): Mycelium ex hyphis ramosis, septatis, laevibus, pallide brunneis, 1–2 µm latis compositum. Conidiophora ex hyphis orinaria, solitaria, erecta, cylindrica, recta vel leviter flexuosa, cellula basali bulbosa, sine rhizoideis, 4–6 µm lata, ad basim 10–15 µm lata, stipite modice bruno vel atro-bruno, 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. Conidia conidiogenousae subcylindraceae, allantoides vel doliformes, rectae vel leviter curvatae, pallide brunneo, polyblasticae, sympodialiter proliferantes. Conidia hyalina, mucilagine aggregata (sed non catenata), ellipsoidae, apice subobtusae, basi subtruncatae. Taxonomy. Named after the host genus on which the fungus occurs, Acacia.
Fig. 1 The first of 1 000 equally most parsimonious trees obtained from a heuristic search with 100 random taxon additions of the LSU sequence alignment. The scale bar shows 10 changes, and bootstrap support values from 1 000 replicates are shown at the nodes. Novel sequences generated for this study are shown in bold. Branches present in the strict consensus tree are thickened. Orders and families are coded as indicated in the legends. The tree was rooted to a sequence of *Saccharomyces cerevisiae* (GenBank accession Z73326).

Abbreviations used: Families: AMO = Amorphothecaceae, CHA = Chaetothyriaceae, HEL = Helotiales, HER = Herpotrichiellaceae, HYA = Hyaloscyphaceae, IC = Incertae sedis; LEP = Leptosphaeriaceae, LOP = Lophiostomataceae, MEL = Melanommataceae, MYC = Mycosphaerellaceae, PSE = Pseudosclerotiniaceae, PLE = Pleosporaceae, PSE = Pseudonectriaceae, RHY = Rhytismataceae, SCH = Schizothyriaceae, TER = Teratosporaceae. Orders: 1 = Capsidiellales, 2 = Chaetothyriales, 3 = Incertae sedis, 4 = Rhytismales, 5 = Helotiales, 6 = Hypocreales, 7 = Pezizales, 8 = Pleosporales.

Leaf spots medium to dark brown, margin raised, red-purple, oblong to ellipsoid, 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 doliiform, 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.


Notes — Castañeda & Kendrick (1990) established the genus *Lauriomycetes*, 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. delicaturn. 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 differs from Haplographium and Lauriomyces by the absence of an intricate conidiophore branching system, and in having conidia produced in slimy heads rather than 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.

Fig. 1 (cont.)

Lauriomyces bellus CBS 517.93
Lauriomyces heliocephalus CBS 112054
Haplographium catenatum CBS 482.67
Haplographium catenatum CBS 196.73
Haplographium catenatum CBS 739.68
Cathrosporium intricatum AY616235
Hydrocina chaetocladiad AY789412
Rhyzoscyphus ericae AM867699
Protoventuria alpina EU035444
Thedgonia ligustrina CPC 10019
Thedgonia ligustrina CPC 101861
Thedgonia ligustrina CPC 14754
Thedgonia ligustrina CPC 10630
Trichoconis echinophila EU107315

Treatomosphaeria pertusa DQ678072
Aposphaeria populi EU754130
Herpotrichia juniper DQ678030
Wettsteinina macrotheica AY849969
Seifertia azaleae EU030276
Mycopassis aceris CPC 14379
Xenostigmina zilleri CBS 115685
Xenostigmina zilleri CBS 115686
Xenostigmina zilleri CPC 14376

Dictyosporium toruloides DQ018104
Dictyosporium streltzieae CPC 15359
Dictyosporium elegans DQ018100
Dictyosporium alatum DQ018101

Edenia gomezpompae CPC 15689
Chalastospora gossypii CBS 112844
Chalastospora gossypii DQ008142
Chalastospora gossypii CBS 114810
Chalastospora gossypii CBS 114005
Chalastospora gossypii CBS 900.87
Chalastospora gossypii var. polymorpha AY251080
Chalastospora gossypii AY251081
Chalastospora gossypii AY251079
Chalastospora gossypii CPC 3685
Chalastospora gossypii CPC 3680
Chalastospora obclavata CBS 124120
Chalastospora gossypii CPC 3690
Chalastospora gossypii CPC 15567
Chalastospora gossypii CBS 114809
Chalastospora cetera CBS 121340
Chalastospora ellipsoidea CBS 121331
**Chalastospora** E.G. Simmons, Alternaria. An identification manual: 668. 2007

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.

— MycoBank MB509518; Fig. 4


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

*Chalastosporae gossypii* similis, sed conidia ellipsoides, longioribus et leviter latioribus, (6–)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 $1 \, \mu m$ 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).

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**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 (verticil-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
2. Intercalary conidia shorter than 20 µm ............... 3
3. Intercalary conidia narrowly ellipsoid to narrowly ovoid, widest in middle or lower third, (10–)19–24 (–30) × 3 (–4) µm, 0–3-septate ............... *C. cetera*
4. Intercalary conidia obclavate, widest at base, (23–)26–30 (–35) × (3.5–)4 µm, 0–3-septate ............... *C. obclavata*
5. Intercalary conidia narrowly ellipsoid-ovoid to cylindrical or fusiform, 6–10 × 2–2.5 µm, mostly aseptate. . *C. gossypii*
6. Intercalary conidia ellipsoid, not cylindrical nor fusiform, (8–)10–15 (–17) × 3 (–3.5) µm, 0(–2)-septate *C. ellipsoidea*

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

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

*Hyphae* fertile, pale brown, 1.5–3 µm wide, at times constricted at septa. *Conidiogenous cells* phialidic, intercalary, at times on short lateral branches, with a prominent to indistinct collarette. *Conidia* sickle-shaped, brown, smooth-walled, 1–3-septate, adhering in bundles.

**Cyphellophora eugeniae** Crous & Alfenas, sp. nov. — Myco-Bank 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; 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).
KEY TO SPECIES OF CYPHELLOPHORA
(adapted from Decock et al. 2003)

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


Type species. Dictyosporium elegans Corda.

Conidiomata sporodochial, black, scattered. Mycelium predominantly immersed, consisting of branched, septate, smooth, thin-walled hyphae. Conidiophores 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 bulbosum valde simile, sed conidiis leviter longioribus, (30–)40–46(–55), et phylogeneticamente manifeste diversum.

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-

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.
Conidia with 3 rows of cells, (27–)31–43 µm; appendages hyaline, curved.

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

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

Conidia 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 obvoid.

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 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.

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 × 11–30 µm), but its conidia are somewhat longer, and there is a 10 bp difference between the ITS sequences of D. strelitziae and D. bulbosum (DQ018086). 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) (Araribarri et al. 2001, Cai et al. 2003a, Zhao & Zhang 2003, Kodsub et al. 2006, Cai & Hyde 2007, McKenzie 2008).

Key to Species of Dictyosporium
(adapted from Cai et al. 2003b)

1. Conidia with appendages.
2. Conidia lacking appendages.
3. Appendages apical.
4. Appendages not apical.
5. Apical appendages aseptate.
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.
7. Appendages subapical, cylindrical to clavate; conidia 52.5–72.5 × 18.5–26.5 µm, not complanate, with 5 rows of cells.
8. Appendages not subapical, but central or basal.
9. Appendages central, hyaline, thin-walled, clavate to obvoid; conidia 36–45 × 16–21 µm, not complanate, mostly 7 rows of cells.
10. Appendages basal, fusoid to cylindrical; conidia 22–28 × 12.5–18 µm, complanate, with 3 rows of cells.
12. Conidia with more than 3 rows of cells.
13. Conidia mostly with 4 rows of cells.
14. Conidia with 5 or more rows of cells.
15. Conidia with darker colour at apex of inner rows; apical cells of outer rows each bearing a hyaline, cylindrical appendage.
18. Conidia 36–45 × 16–21 µm; appendages tapering.
20. Conidia up to 46 µm long, and 30 µm wide, 27–46 × 11–30 µm; appendages globose to obvoid.
22. Conidia complanate, one cell layer thick.
23. Conidia not complanate, more than one cell layer thick.
24. Conidia regularly consisting of 3 rows of cells.
25. Conidia consisting of at least 4 rows of cells.
28. Conidia curved, with 5–7 rows of cells, each curving in the same direction, 34–56 × 20–38 µm.
29. Conidia not curved.
30. Conidia less than 25 µm long.
31. Conidia more than 25 µm long.
32. Conidia 18–24 × 13–19 µm.
34. Conidia with paler outer rows.
35. Conidia concolorous.
36. Conidia 25–45 × 22–38 µm, with (5–)6(–7) rows.
38. Conidia 23.5–40 × 16–21.5 µm.
39. Conidia with more than 4 rows.
40. Conidia 40–80 × 24–36 µm, mostly with 5 rows, slightly constricted at septa.
41. Conidia mostly with more than 5 rows, strongly constricted at septa.
42. Conidia 26–34 × 23–34 µm, mostly with 7–9 rows of cells; conidiomata sporodochial.
43. Conidia 38–56 × 25–32 µm, mostly 6–8 rows of cells; conidiomata not sporodochial.
44. Conidia campaniform, with a darker base; with 12–16 rows of cells, 22–40 × 20–30 µm.
45. Conidia more or less cylindrical, concolorous, comprising 3–7 rows of cells.
46. Conidia regularly with 3 rows of cells; usually 13.5 µm or less wide.
47. Conidia mostly with 4–7 rows of cells; more than 13.5 µm wide.

1 Appearing morphologically similar to D. taishanensis, also described from China; conidia with (3–)5–(7) cell layers, 27–43 × 15–30 µm (Zhao & Zhang 2003). Dictyosporium taishanensis (22 February 2003) is older than D. yunnanensis (March 2003), and would have priority if these fungi are shown to be synonymous.
26. Conidia 40–60 × 10–13.5 µm .......... *D. triramosum*

26. Conidia shorter than 43 µm ............... 27

27. Conidia 36–43 × 11–12 µm; sporodochia usually covered with gelatinous matrix .......... *D. australiense*

27. Conidia 20–30 × 10–12 µm; sporodochia not as above .......... *D. micronesicum*

28. Conidia 40–50 × 18–25 µm, with 4–6 rows of cells, muriform, with hyaline, subglobose conidiogenous cell remaining attached as basal appendage .......... *D. gauntii*

28. Conidial morphology not as above .......... 29

29. Conidia with rows of cells that are distinctly incurved or hook-like at the apex .......... 30

29. Conidia with more or less straight rows of cells at the apex .......... 32

30. Conidia 105–121 × 25–32 µm .......... *D. giganticum*

30. Conidia up to 80 µm long .......... 31

31. Conidia 50–80 × 20–30 µm .......... *D. heptasporum*

31. Conidia 33–42 × 16–20 µm .......... *D. subramanianii*

32. Colonies effuse, not sporodochial; conidia irregularly cylindrical or oblong, strongly constricted at septa; 30–50 × 12–30 µm .......... *D. oblongum*

32. Colonies sporodochial; conidia more or less cylindrical, slightly constricted at septa; 53–76 × 19–22 µm .......... *D. cocophilum*


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-sinuous, 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
via sympodial proliferation near apex. Conidial 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 percurrent rejuvenation in upper part; fascicles randomly distributed over lesion, amphigenous, visible as erect, dark brown to black tufts on lesions, situated on a submersed, brown stroma, up to 60 μm wide and 40 μm high, intermingled among leaf trichomes (fruiting structures of a *Ramularia* sp. and ascomata 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 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 brick (reverse); on PDA fluffy, cream to buff (surface), dark brick 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 acuminata* 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 *Cassia 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 on leaf spots of *C. alata* as other fungi were also present on these spots, its potential role as pathogen remains uncertain. On host tissue, however, some conidiophores were associated with a weakly developed layer of pale brown stromatic cells. On OA, cultures became fertile, and conidiophores were arranged around well-developed ostioles of submerged pycnidia (with a similar pale brown stromatic wall to that observed on the host). It is possible, therefore, that if the field material had been placed in moist chambers, the pycnidial state would have developed. The latter state resembles species that are pyronella-like in morphology.

Morphologically, the hyphomycete state of *Edenia* resembles genera such as *Digitopodium*, 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 *Blastosporum* (Matsushima 1971), although the latter fungus is distinct in having solitary conidiophores with rhizoids, and a hyaline, upper conidiogenous region.


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

Conidiomata fasciculate, punctiform. Mycelium internal, hyphae subhyaline, septate, branched, forming substomatal stromata, hyaline to pale brown. Conidiophores fasciculate, arising from stromata, 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 reverse eusepta, hyaline or almost so, apex rounded to truncate, base truncate, hila flat, unthickened, hyaline.

**Thedgonia 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 OA 5–8 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 ‘*Thedgonia* lupini’ as anamorph to *Mycosphaerella lupini*, and thus suggested that *Thedgonia* belongs in the *Mycosphaerellaceae*. Results of this study (Fig. 1), however, show that *Thedgonia* 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 *Pseudocercosporella* (Braun 1995), it appears to represent a separate phylogenetic lineage.

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


Colonies hypophyllous, medium to dark brown, consisting of numerous synnemata. *Stroma* absent, but a superficial network of hypheae linking the various synnemata. *Conidiophores* synnematus, mostly branched 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


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.str.), 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 heimi* 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.


*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 separte, verrucose to verruculose.
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 (= Daviesia cormyosae 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 — MycoBank MB509523; Fig. 13

Differt a Verrucisporota protearum conidiis angustioribus et longioribus, (30–)50–65(–80) × (5–)6–7 µm, et conidiophoris brevioribus, (35–)80–120(–160) × (5–)6–7 µm.

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

Leaf spots angular, elongated, amphigenous, 1–2 mm wide, 3–10 mm long, medium to dark brown to black, discrete. Mycelium immersed and superficial, hyphae medium brown, septate, verrucose, 1.5–3 µm wide. Stromata up to 60 µm wide and 40 µm high, forming in substomatal cavities, becoming erumpent, cells brown, thick-walled, pseudoparenchymatous. Conidiophores macronematous, mononematous, caespitose, emerging through the stomata, simple, flexuous, often geniculate-sinuous, 4–7-septate, mainly smooth, dark brown, from a bulbous base tapering towards the apex, but often becoming more swollen, and also verrucose at the apex, (35–)80–120 (–160) × (5–)6–7 µm. Conidiogenous cells cylindrical, becoming geniculate, integrated, terminal, polyblastic, proliferating sympodially, 20–45 × 5–7 µm, with conspicuous, cicatrised, protuberant, conidiogenous loci, 3 µm diam. Conidia subcylindrical, narrowing slightly to an obtuse apex (frequently swollen), and with a truncate base with a distinctly thickened, darkened, somewhat refractive hilum, 3 µm wide, red-brown, straight or curved, with 3–7(–12) mainly unconstricted eusepta, thick-walled, verrucose, (30–)50–65(–80) × (5–)6–7 µm. Conidiophores frequently arising from brown, erumpent spermatogonia, up to 150 µm wide. Spermatia hyaline, smooth, bacilliform, 4–6 × 1–1.5 µm.

Characteristics in culture — Colonies on MEA erumpent, with sparse aerial mycelium; margins feathery, crenate; surface
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 × 10–15 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. grevillea_ (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. grevillea**
3. Conidia mostly up to 30 µm long, (0–)2–3–(7)–septate, 13–30(–70) × 2.75–4 µm; on _Capparis._ **V. kimberleyana**
4. Conidia longer, mostly up to 77 µm long, 1–11–septate, (10–)27–77(–108) × 3–4.5 µm; on _Struthanthus._ **V. struthanthicola**
5. Conidia up to 3–septate, obclavate, 1–3–septate, 32.5–55 × 7–10.5 µm; on _Celastrus._ **V. indica**
6. Conidia more than 3 septa ................................. 5
5. Conidia up to 32 µm long, (1–)3–4–(5)–septate, 20–32 × 6–10 µm; on _Bridelia._ **V. bridellae**
6. Conidia frequently longer than above ........................ 6
6. Conidia 0–6–septate, 18–56 × 4.5–7 µm; on _Daviesia._ **V. daviesiae**
7. Conidia 3–7–septate, 23–51 × 5.6–10.5 µm; on _Finschia._ **V. proteacearum**


_Type species._ Vonarxia anacardii Beilharz & J.L. Bezerra.

_Mycelium_ immersed and superficial, composed of branched, septate, pale to medium brown, smooth to finely roughened hyphae. _Conidiomata_ sporodochial; basal stroma 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 (1–1.5 µm diam), (5–)10–12(–16)–septate, septa rather thick, but becoming thinner towards apex, basal cell 10–13 µm wide, with slight taper towards bluntly rounded, ob- tuse apex, (120–)150–200(–220) µm; width at basal septum (5–)6–7(–7) µm; width at apical septum, 2–3(–5) µm; apical two cells frequently pale brown; individual cells 10–25 µm long. _Conidiogenous 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, basal cell subcylindrical to clavate to doliform, 0–1–septate, 10–15 µm long, with smooth, even margin; reverse brown-vinaceous; colonies reaching up to 20 mm diam after 1 mo.

*Specimens examined._ **BRAZIL,** São Paulo Horto Botânico, 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. Alfenas, isotype LPS 12280, culture ex-type CPC 15151 = CBS 123533, CPC 15152.

Notes — The holotype specimen 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 incubating _Eugenia_ leaves with leaf spots of _Phaeophleospora eugeniae_ in moist chambers, which resulted in a few conidiophores of _Vonarxia_ _vegans_ 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

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


On PDA. _Mycelium_ immersed and superficial, composed of branched, septate, pale to medium brown, smooth to finely roughened, 3–5 µm wide hyphae. _Conidiomata_ sporodochial, flattened to erect and globose (especially on WA, not so on MEA or PDA, tending to be more flattened, and more hemispherical on OA), up to 300 µm diam; basal stroma up to 70 µm thick, composed of globose-ellipsoidal, brown, slightly roughened cells, 5–10 µm diam. Setae irregularly scattered throughout colony, simple, subulate with a bulbous base, straight to slightly curved, dark brown, smooth to slightly roughened, thick-walled (1–1.5 µm diam), (5–)10–12(–16)–septate, septa rather thick, but becoming thinner towards apex, basal cell 10–13 µm wide, with slight taper towards bluntly rounded, ob-tuse apex, (120–)150–200(–220) µm; width at basal septum (5–)6–7(–7) µm; width at apical septum, 2–3(–5) µm; apical two cells frequently pale brown; individual cells 10–25 µm long. _Conidiogenous 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, basal cell subcylindrical to clavate to doliform, 0–1–septate, 10–15 × (1.5–)2–3 µm (10–18 µm long on OA); upper three arms arise from the apical part of the basal cell, 3–5–septate (prominently constricted at septa on WA and MEA, up to 10–septate on these media), subcylindrical to cylindrical, apex subtolute, arms 20–55 µm long (20–90 µm on OA), 1.5–2 µm wide (2–3 µm wide on OA).

Characteristics in culture — Colonies on OA spreading, with sparse aerial mycelium, and uneven, striate surface, with crenate margin; surface black, with patches of mouse-grey, reaching up to 25 mm diam after 1 mo; on PDA spreading, with sparse aerial mycelium and crenate margins; surface pale mouse-grey, outer region grey-olivaceous; reverse grey-olivaceous, reaching up to 25 mm diam after 1 mo; on MEA spreading, erumpent with sparse aerial mycelium; surface prominently striate, margin crenate; centre black, outer region mouse-grey; reverse black; colonies reaching up to 20 mm diam after 1 mo.

*Specimens examined._ **BRAZIL,** Rio Grande do Sul, Guaiba, leaves of _Finschia_. The present collection was obtained by incubating _Eugenia_ leaves with leaf spots of _Phaeophleospora eugeniae_ in moist chambers, which resulted in a few conidiophores of _Vonarxia_ _vegans_ 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
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 120–220 µm long; apical conidial arms longer; setae and conidial arms longer; setae 120–220 µm long; extending into a beak; base truncate at dehiscence, inner part ruculose, mostly straight, ellipsoidal, apex subobtuse, frequently brown, with pale brown apical and basal regions, finely verruculose, doliiform to subcylindrical, tapering to flat tipped loci, proliferating sympodially and percurrent; loci not thickened or conspicuous. Conidiomata sporodochial, brown to black. 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.

**Xenostigmina** Crous, Mycol. Mem. 21: 155. 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, multi-septate, subcylindrical, straight to variously curved, branched. *Conidiogenous cells* terminal and intercalary, hyaline to pale brown, finely verruculose, doliform to subcylindrical, tapering to flat tipped loci, proliferating sympodially and percurrent; loci not thickened or conspicuous. *Conidia* solitary, pale to medium brown, with pale brown apical and basal regions, finely verruculose, mostly straight, ellipsoidal, apex subbotubate, frequently extending into a beak; base truncate at dehiscence, inner part extending later to form a short, subbotubate basal appendage; septation muriform; basal marginal frill present.

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


Associated with leaf spots. *Mycelium* internal, consisting of hyaline to pale brown, septate, branched, smooth hyphae. *Conidiomata* sporodochial, brown to black. *Conidiogenous cells* septate, subcylindrical, straight to variously curved, branched. *Conidiophores* densely aggregated, arising from the upper cells of a pale brown stroma, finely verruculose, doliiform to subcylindrical, tapering to flat tipped loci, proliferating sympodially and percurrent; loci not thickened or conspicuous. Conidiomata sporodochial, brown to black. 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 stigmina-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*.

**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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