Novel fungal genera and species associated with the sooty blotch and flyspeck complex on apple in China and the USA

H.L. Yang¹, G.Y. Sun¹, J.C. Batzer², P.W. Crous³, J.Z. Groenewald³, M.L. Gleason²

Key words

anamorph
SBFS
taxonomy

INTRODUCTION

Fungi in the sooty blotch and flyspeck (SBFS) complex occur in humid temperate regions and blemish the appearance of pomaceous fruits, resulting in economic losses for growers. The SBFS fungi colonise the epicuticular wax layer of pomaceous fruit but do not invade the cuticle. Fungi causing fuliginous and punctate mycelial types on apple are particularly difficult to identify based on morphological criteria because many species in the SBFS complex share the same mycelial phenotypes. We compared the morphology and nuclear ribosomal DNA phylogeny (ITS, LSU) of 11 fungal strains isolated from SBFS blemishes on apple obtained from two provinces in China and five states in the USA. Parsimony analysis, supported by cultural characteristics and morphology in vitro, provided support to delimit the isolates into three novel genera, representing five new species. Phaeothecoidiella, with two species, P. missouriensis and P. illinoisensis, is introduced as a new genus with pigmented endoconidia in the Dothideomycetes. Houjia (Capnodiales) is introduced for H. pomigena and H. yanglingensis. Although morphologically similar to Stanjehughesia (Chaetosphaeriaceae), Houjia is distinct in having solitary conidiogenous cells. Spordesmajuora (Capnodiales), based on S. pennsylvaniensis, is distinguished from Spordesmium (Sordariomycetes) in having long, multisepate conidiophores that frequently have a subconical, darkly pigmented apical cell, and very long, multi-euseptate conidia.

MATERIALS AND METHODS

Isolates

During the fall of 2007 apples infected with SBFS were collected from orchards in Jingning County, Gansu Province, and Lingboa, Henan Province, China. Thalli were transferred from colonies on the apple surface to potato-dextrose agar (PDA; Crous et al. 2009c) slants and cultured at 25 °C in darkness (Sun et al. 2003). Two isolates from China were selected for this study, along with nine isolates sampled in 2000 and 2005 from five orchards in Missouri, Illinois, Kentucky, Tennessee and Pennsylvania, USA (Batzer et al. 2005, Diaz Arias et al. In press). All isolates were purified and stored in glycerol at -80 °C at Iowa State University. Segments of apple peels exhibiting colonies with sooty blotch morphology were preserved by pressing the thallus and supporting peel between paper towels until dry. Specimens on apple peels were deposited at the Iowa State University Herbarium, Ames, Iowa.

Single-conidial isolates were established on malt extract agar (MEA; 20 g/L Biolab malt extract, 15 g/L Biolab agar) using the technique of Crous (1998). Cultures were plated onto fresh MEA, 2 % PDA and oatmeal agar (OA; Crous et al. 2009c), and subsequently incubated at 25 °C under near-ultraviolet light to promote sporulation. Reference strains are maintained in the culture collection of the Centraalbureau voor Schimmelcultures (CBS-KNAW Fungal Biodiversity Centre, P.O. Box 85167, 3508 AD Utrecht, the Netherlands).
Table 1  Collection details and GenBank accession numbers of isolates for which novel sequences were generated in this study.

| Species                | Strain no. | Substrate | Country       | Collector | GenBank Accession Numbers |
|------------------------|------------|-----------|---------------|-----------|---------------------------|
| Houjia pomigena        | CBS 125224; CPC 16109; CMG UIF2b | Malus sp. (fuliginous morphology on apple) | Illinois, USA | M. Gleason | AY598928, AY598929        |
| Houjia yanglingensis   | CBS 125225; CPC 16114; CMG YHJB13 | Malus sp. (fuliginous morphology on apple) | Jingning, China | G.Y. Sun | GQ433628, GQ433631        |
|                        | CBS 125226; CPC 16113; CMG LB20 | Malus sp. (fuliginous morphology on apple) | Lingbao, China | G.Y. Sun | GQ433629, GQ433630        |
|                        | CBS 125227; CPC 16111; CMG TN1_2.2F1e | Malus sp. (fuliginous morphology on apple) | Tennessee, USA | S. Bost | FJ438378, FJ147166        |
| Phaeotheca fissurella   | CBS 520.89; ATCC 44385; CBS 158.81; DAOM 178454; IMI 254604; UAMH 4245 | Pinus contorta | Canada       | J. Petty | AJ244255, GU117900        |
| Phaeothecoidea minutaspora | CBS 124995; CPC 13710 | Phaeothecoidiella illinoisensis | Illinois, USA | M. Gleason | GU117927, GU117928        |
|                        | CBS 118947; CMG AHE7a | Malus sp. (punctate morphology on apple) | Missouri, USA | M. Gleason | GU117929, GU117930        |
| Phaeothecoidiella missouriensis | CBS 118959; CMG AHE7c | Malus sp. (punctate morphology on apple) | Missouri, USA | M. Gleason | GU117926, GU117931        |
| Sporidesma pennsylvaniensis | CBS 118962; CPC 13710 | Phaeothecoidiella illinoisensis | Missouri, USA | M. Gleason | GU117926, GU117932        |

* ITS: Internal transcribed spacers 1 and 2 together with 5.8S nrDNA; LSU: 28S nrDNA.

**Morphology**

Signs of SBFS on preserved apple peels are described, including mycelial growth patterns and fruiting body size and density. Morphological descriptions are based on cultures sporulating on synthetic nutrient-poor agar (SNA; Crous et al. 2009c) in vivo. Wherever possible, 30 measurements (>1 000 magnification) were made of all taxonomically informative structures mounted in lactic acid, with the extremes of spore measurements given in parentheses. Colony colours (surface and reverse) were assessed after 1 mo on MEA, PDA and OA 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 these 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 'AHE7c' (AY598917), Stomio­pettis sp. (AY598919) and Stomio­pettis versicolor (FJ147163) in the alignment, it was not possible to subject the full length of the determined LSU sequences (Table 1) to the analysis. The manually adjusted LSU alignment contained 85 sequences (including the outgroup sequence) and, of the 568 characters used in the phylogenetic analysis, 271 were parsimony-informative, 62 were variable and parsimony-uninformative, and 235 were constant. Fourteen equally most parsimonious trees (TL = 1 737 steps; CI = 0.349; RI = 0.749; RC = 0.261), the first of which is shown in Fig. 1, were obtained from parsimony analysis of the LSU alignment. The results of the phylogenetic analysis are highlighted below under the taxonomic notes or in the Discussion, where applicable. Although the ITS sequences were not used in phylogenetic analyses, they were lodged in GenBank (Table 1) and the alignment in TreeBASE (www.treebase.org).

**Taxonomy**

The present study resulted in discovery of several novel genera and species that are associated with SBFS on apples. These taxa are treated below:

**Phaeothecoidiella** Batzer & Crous, gen. nov. — MycoBank MB514394

Mycelia ex hyphis brunneis, laevibus vel sublittulibus exasperatis, ramosis, atro-brunneis, cum vaginae crassa mucilaginis, endoconidios phragmosporioidibus, in hyphis evolutis, pallide vel molide brunneis, asепtatis, tenuilatibus,
Fig. 1 The first of 14 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 > 64 % from 1,000 replicates are shown at the nodes. Novel species from Malus treated in this study are indicated in bold. Branches present in the strict consensus tree are thickened. Classes are shown to the left of the tree and families, where known, to the right. The tree was rooted to a sequence of Agaricus bisporus (GenBank accession DQ071710).
subcylindraceis vel late ellipsoideis, sed deinde (post liberationem) subglobosis, atro-brunneis, verruculosis, interdum cum septo tenui inconspicuo.

Type species. *Phaeothecoidiella missouriensis* Batzer & Crous, sp. nov.

Etymology. Named after the genus *Phaeothecoidiella*, which it resembles.

Hyphomycetous. Mycelium consisting of brown, smooth to finely roughened, branched, regularly septate hyphae, becoming wider, dark brown, with irregular warts, encased in a thick mucilaginous sheath. *Endoconidia* developing like phragmospores inside hyphae, pale to medium brown, aseptate, globose to ellipsoid, smooth to roughened, 5–8–4–5 µm; older conidia becoming more globose to broadly ellipsoid, thin-walled, pale brown to brown, 6–10 µm diam.

Culture characteristics — Colonies after 1 mo at 25 °C in the dark on MEA erumpent, slimy, with sparse aerial mycelium and even, lobate margin; surface iron-grey, reaching 18 mm diam. Similar on PDA and OA, reaching up to 10 mm diam.

Appearance on apple — Punctate mycelia type; dark brown to black colonies; reaching 2.5 mm diam with even, feathered margins; shiny black sclerotium-like bodies scattered on the surface at a density of 15 per mm² and ranging from 28 µm to 60 µm diam.

Specimen examined. USA, Illinois, on fruit surface of apple, Sept. 2000, M. Gleason, CBS H-20323 holotype, cultures ex-type CPC 16115 = UIE3a = CBS 125223.

*Phaeothecoidiella illinoisensis* Batzer & Crous, sp. nov.

— MycoBank MB514396; Fig. 2

Mycelio ex hyphis brunneis, laevibus vel subtiliter exasperatis, ramosis, 2–4 µm latis, cum vagina crassa mucilagina, ad 2 µm lata; endoconidiis medium-brunneis, aseptatis, 3–7 × 3–5 µm, tenuitunicatis, subcylindraceis; conidiis veteribus ad 12 µm longis et 8 µm latis.

*Phaeothecoidiella missouriensis* Batzer & Crous, sp. nov.

— MycoBank MB514396; Fig. 3

Mycelio ex hyphis brunneis, laevibus vel subtiliter exasperatis, ramosis, 2–4 µm latis, cum vagina crassa mucilagina, ad 2 µm lata; endoconidiis medium-brunneis, aseptatis, 3–7 × 3–5 µm, tenuitunicatis, subcylindraceis; conidiis veteribus ad 12 µm longis et 8 µm latis.

Etymology. Named after its type locality, Missouri, USA.

On SNA. Mycelium consisting of brown, smooth to finely roughened, branched, regularly septate, 2–4 µm diam hyphae, becoming wider, dark brown with irregular warts, up to 1 µm high, or encased in a thick, mucilaginous sheath, up to 2 µm thick. *Endoconidia* developing like phragmospores inside hyphae, medium brown, aseptate, 3–7 × 3–5 µm, thin-walled, subcylindrical, but becoming more globose, dark brown and roughened upon release, up to 12 µm long and 8 µm wide, at times with a thin, inconspicuous septum.

Cultural characteristics — Colonies after 1 mo at 25 °C in the dark on MEA erumpent, spreading, with sparse aerial mycelium and uneven, crenate margin; surface uneven, folded, iron-grey,
reaching up to 20 mm diam. Similar on PDA, reaching up to 15 mm diam, as well as on OA, reaching up to 10 mm diam. Appearance on apple — Punctate mycelial type (Batzer et al. 2005); dark brown to black colonies; diameter reaching 2 mm with irregular feathered margins; shiny black sclerotium-like bodies scattered on the surface at a density of 10 per mm² and ranging in diameter from 17 µm to 47 µm.

Specimens examined. USA, Missouri, on fruit surface of apple, Sept. 2000, M. Gleason, CBS H-20322 holotype, cultures ex-type CPC 16116 = AHE7c = CBS 125222; AHE7a = CBS 118959.

Notes — Both species of Phaeothecoidiella have endocnia that resemble phragmospores inside hyphae, and are rarely arranged in clusters. Conidia of P. missouriensis are 3–7 × 3–5 µm, while those of P. illinoisensis are somewhat larger, 5–8 × 4–5 µm. It would be difficult, however, to separate these taxa without the aid of molecular data (Table 1).

Houjia G.Y. Sun & Crous, gen. nov. — MycoBank MB514397
Mycelium ex hyphis ramosis, septatis, brunneis, exasperates vel verrucatis, ad septa saepe constrictis; conidiophoros in cellulis conidiogenis reductis, intercalaribus, atro-brunneis, subcylindraceis vel cuneiformibus, crassitunicatis, latitudine maximo basali, apice truncato; formatione conidiorum holoblastica vel phialidica; conidiis late ellipsoidibus-subcylindraceis vel obclavatis, basi truncata, apice obtuse rotundata, transverse et oblique septatis, ad septa leniter constrictis, subtiliter verruculosis, medio-brunneis, tenuitunicatis, basi cuneiforme attenuata, hilo truncato.

Type species. Houjia yanglingensis G.Y. Sun & Crous, sp. nov. — MycoBank MB514398; Fig. 4
Mycelium ex hyphis ramosis, septatis, brunneis, exasperatis vel verrucatis, ad septa saepe constrictis; conidiophoros in cellulis conidiogenis reductis, intercalaribus, atro-brunneis, subcylindraceis vel cuneiformibus, crassitunicatis, latitudine maximo basali, apice truncato; formatione conidiorum holoblastica vel phialidica; conidiis late ellipsoidibus-subcylindraceis vel obclavatis, basi truncata, apice obtuse rotundata, transverse et oblique septatis, ad septa leniter constrictis, subtiliter verruculosis, medio-brunneis, tenuitunicatis, basi cuneiforme attenuata, hilo truncato.

Etymology. Named after the fruit that it blemishes.

Fig. 3 Phaeothecoidiella missouriensis (CPC 16116). a, b. Colonies on apple surface; c. colony on OA; d. colony on SNA; e–g. hyphae with phragmo- and endoconidia (note sheath); h, i. conidia. — Scale bars = 10 µm.
On SNA. Mycelium consisting of branched, septate, brown, roughened to warty, 2–3 µm wide hyphae, frequently constricted at septa. Conidiophores reduced to conidiogenous cells, intercalary, dark-brown, subcylindrical to cuneiform, thick-walled, widest at the base, 12–16 × 5–9 µm, apex truncate, 3 µm wide, at times appearing somewhat cup-shaped with what could be periclinal thickening, but conidiogenesis unclear, varying from holoblastic to phialidic. Conidia obclavate, base truncate, apex obtusely rounded, 4(–5)-septate, slightly constricted at septa, finely verruculose, medium brown, thin-walled, widest in middle of basal cell, from where it tapers to a cuneiform basal part with a truncate hilum that is dark brown, 3 µm wide and long, appearing more thick-walled than the rest of the conidium, (30–)38–40(–47) × (5–)6–7(–8) µm.

Cultural characteristics — Colonies after 1 mo at 25 °C in the dark on PDA leaden-black, erumpent, folded, lacking aerial mycelium, and with lobate margins, reaching 5 mm diam. On SNA similar, but more flattened, reaching 5 mm diam. On MEA similar, but more erumpent, reaching 10 mm diam. On OA similar, reaching 15 mm diam.

Appearance on apple — Fuliginous mycelial type; lacking sclerotium-like bodies; densely arranged ropey mycelia, arborrescent margins; circular shaped, brown colonies reaching 10 mm diam.

Specimen examined. USA, Illinois, on fruit surface of apple, Sept. 2000, M. Gleason, CBS H-20324 holotype, cultures ex-type CPC 16109 = UIIF2b = CBS 125224.

Houjia yanglingensis G.Y. Sun & Crous sp. nov. — MycoBank MB514399; Fig. 5

Mycelium ex hyphis ramosis, septatis, medi-brunneis, subtilliter exasperates, 2–3 µm latis; cellulis conidiogenis solitaryis, intercalaris, erectis, subcylindraceis, brunneis, laevibus, 0–1-septatis, 10–15 × 5–6 µm; conidiis brunneis, laevibus, rectis vel leniter curvatis, (18–)25–28 × (5–)6–7(–8) µm, muriforme septatis, 3–6(–10) transverse et 1–4 oblique septatis.

Etymology. Named after its type locality, the city in China where it was first isolated.

On SNA. Mycelium consisting of branched, septate, medium brown, finely roughened, 2–3 µm wide hyphae. Conidiophores solitary, intercalary, erect, subcylindrical, brown, smooth, 0–1-septate, 10–15 × 5–6 µm. Conidiogenous cells brown, smooth, subcylindrical, tapering towards a subtruncate apex, 1.5–2 µm wide, 6–11 × 3–4 µm. Conidia brown, smooth, straight to slightly curved, (18–)25–28 × (5–)6–7(–8) µm, muriformly septate, with 3–6(–10) transverse (eusepta or distosepta), and 1–4 oblique septa, slightly constricted at septa, broadly ellipsoid to subcylindrical or obclavate, widest in the middle; apex obtuse, tapering towards a cuneiform basal part with subtruncate base, 1.5–2 µm wide, 1–2 µm long.

Culture characteristics — Colonies after 1 mo at 25 °C in the dark on MEA erumpent, spreading, with sparse aerial mycelium and folded surface, with even, lobate margins; colonies iron-grey, reaching up to 30 mm diam. On PDA similar, with moderate aerial mycelium, reaching 30 mm diam. On OA similar, outer region more olivaceous-grey in colour, reaching 35 mm diam.

Appearance on apple — Fuliginous mycelial type; lacking sclerotium-like bodies; irregularly shaped brown colonies with even margins reaching 5 mm diam.

Specimens examined. CHINA, Jingning County, Gansu Province, on fruit surface of apple, Oct. 2007, G.Y. Sun, CBS H-20325 holotype, cultures ex-type CPC 16114 = JN13 = CBS 125225; Lingbao County, Henan Province, on fruit surface of apple, Oct. 2007, G.Y. Sun, cultures CPC 16113 = LB20 = CBS 125226. — USA, cultures CPC 16114 = TN1_2.2F1d = CBS 125227; Davidson County, Tennessee, on fruit surface of apple, Sept. 2005, S.C. Bost, cultures CPC 16110 = KY3_13F1d = CBS 125228; Paducha, Kentucky, on fruit surface of apple, Sept. 2005, J. Hartman.

Notes — Houjia pomigena can be distinguished from H. yanglingensis by having conidia that are 30–47 × 5–8 µm, 4(–5)-septate, while those of H. yanglingensis are shorter (18–30 × 5–8 µm), with 3–6(–10) transverse and 1–4 oblique septa.

Fig. 4 Houjia pomigena (CPC 16109). a. Colony on apple surface; b. colony on SNA; c. colony on OA; d–f. conidiogenous cells giving rise to conidia; g, h. conidia. — Scale bar = 10 µm.
**Sporidesmajora** Batzer & Crous, gen. nov. — MycoBank MB514400

Mycelium ex hyphis ramosis, septatis, brunneis, subtiliter verruculosus, cum chlamydosporis brunneis in fasciulis terminalibus; conidiophoris erectis, subcylindraceis, saepe subclavatis, medio-vel atro-brunneis, subtiliter verruculosis, 1–pluriseptatis, ex cellulis hypharum oriundis, pro ramosulis lateralisibus, vel inflatis et bulbosis; cellulis conidiogenis terminalibus, medio-brunneis, subcylindraceis vel subconicis, holoblasticis; conidiis obclavatis vel longe obclavatis, rectis vel curvatis, medio-brunneis, laevibus vel subtiliter verruculosus, guttulatis, transverse pluriseptatis.

Type species. *Sporidesmajora pennsylvaniensis* Batzer & Crous, sp. nov.

Etymology. Named after its resemblance to *Sporidesmium*, but with much larger conidia.

Hyphomycetous. *Mycelium* consisting of branched, septate, brown, finely verrucose hyphae, frequently constricted at septa, and at times giving rise to terminal clusters of brown chlamydospores. *Conidiophores* erect, subcylindrical, frequently somewhat clavate, medium to dark brown, finely verrucose, at times with percurrent rejuvenation, 1–multi-septate; base arising as lateral branch directly from hyphal cell, or swollen and bulbous. *Conidiogenous cells* terminal, medium brown, subcylindrical to subconical; apex neither darkened nor thickened, truncate, holoblastic. *Conidia* obclavate to long obclavate, straight to curved, medium brown, smooth to finely verrucose, guttulose, transversely multi-euseptate; apex obtuse, base obconical, frequently darker pigmented than the rest of the conidium.

Notes — Even though the *Sporidesmium* complex was divided into numerous genera by Wu & Zhuang (2005), *Sporidesmium* remains heterogeneous. Although the type species, *S. atrum* is not known from culture, morphologically similar species such as *S. knawiae*, *S. macrusum* and *S. parvum* cluster among the *Sordariomycetes*, distant from the *Capnodiales*. *Sporidesmajora* is quite distinct from *Sporidesmium* in having long, multisepitate conidiophores that frequently have a subconical, darker pigmented apical cell, appearing to give rise to a single holoblastic conidium. Conidia are obclavate, frequently very long, multi-euseptate, and somewhat curved, having a somewhat darker, obconical basal cell.

**Sporidesmajora pennsylvaniensis** Batzer & Crous, sp. nov. — MycoBank MB514401; Fig. 6

Mycelium ex hyphis ramosis, septatis, brunneis, subtiliter verruculosus, 3–5 μm latis; conidiophoris erectis, subcylindraceis, saepe subclavatis, rectis vel unigeniculatis, medio-vel atro-brunneis, subtiliter verruculosus, 1–20-septatis, 35–170 × 4–6 μm; cellulis conidiogenis terminalibus, medio-brunneis (inter-dum atro bruneis quam conidiophora), subcylindraceis vel subconicis, apice distincte attenuato, truncato, 10–15 × 4–6 μm; conidiis obclavatis vel longe obclavatis, rectis vel curvatis, medio-brunneis, laevibus vel subtiliter verruculosus, guttulatis, 45–350 × 5–7 μm, transverse 6–pluriseptatis.

Etymology. Named after its type locality, Pennsylvania, USA.

On OA (sterile on SNA and PDA). *Mycelium* consisting of branched, septate, brown, finely verrucose, 3–5 μm wide hyphae, frequently constricted at septa, and at times giving rise to terminal clusters of brown chlamydospores up to 10 μm diam, in chains or in clumps. *Conidiophores* erect, subcylindrical, frequently somewhat clavate, straight to once geniculate, medium to dark brown, finely verrucose, at times with percurrent rejuvenation, 1–20-septate, 35–170 × 4–6 μm; base arising as lateral branch directly from hyphal cell, or becoming swollen and bulbous. *Conidiogenous cells* terminal, medium brown (at times darker brown than conidiophores), subcylindrical to subconical, with prominent taper towards truncate apex, 10–15 × 4–6 μm; apex not darkened nor thickened, 2–2.5 μm diam; each conidiogenous cell appearing to give rise to a single conidium. *Conidia* obclavate to long obclavate, straight to curved, medium brown, smooth to finely verrucose, guttulose, transversely multi-euseptate, at times constricted at septa, apex obtuse, tapering from the obconical basal cell to the subtruncate hilum, up to 2 μm wide; widest at basal cell, which is frequently more darkly pigmented than the rest of the conidium.

Culture characteristics — Colonies after 1 mo at 25 °C in the dark spreading on MEA, with sparse aerial mycelium; surface folded, margin even, lobate, surface leaden-grey, reverse leaden-black, reaching up to 25 mm diam. On PDA similar, but margins more feathery, reaching 25 mm diam. On OA similar, reaching 20 mm diam.

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**Fig. 5** Houjia yanglingensis (CPC 16114). a. Colony on SNA; b. colony on MEA; c–f. conidiogenous cells giving rise to conidia; g–j. conidia. — Scale bar = 10 μm.
Appearance on apple — Fuliginous mycelia type; lacking sclerotium-like bodies; irregularly shaped pale brown colonies with uneven margins reaching 5 mm diam.

Specimen examined. USA, Adams County, Pennsylvania, on fruit surface of apple, Sept. 2005, J.W. Travis, CBS H-20326 holotype, cultures ex-type CPC 16112 = PA1_9F1a = CBS 125229.

DISCUSSION

All five of these newly identified fungi have been proven to cause SBFS signs on apple, based on a modified Koch’s postulates (Batzer et al. 2005). These findings are among the first evidence that the same SBFS species occur in both Asia and North America. The fact that several isolates of Houjia yanglingensis were isolated from two provinces in China and two states in the USA suggest it is a widely distributed member of the SBFS complex. There is only one previous report of a SBFS fungus, Zygophiala cryptogama, occurring in both continents (Zhai et al. 2008). Intercontinental distribution of SBFS species in Europe and North America was also documented (Wrona 2004, Ivanović et al. In press). Difficulty in isolating SBFS species from apple has impeded our understanding of the distribution of these slow-growing fungi. For example, recent use of specific primer pairs ITS1/Myc1R (Dutweiler et al. 2008) to amplify SBFS fungi directly from the thalli on apple peels has revealed that Phaeothecoidiella species are widely distributed throughout Iowa (Sisson 2009), despite the fact that we obtained only four pure cultures of this genus from a 30-orchard survey of the eastern USA (Batzer et al. 2005, Díaz Arias et al. In press).

The genus Phaeothecoidiella resembles Hyphospora, Phaeotheca and Phaeothecoidea, which also have endoconidia, and are placed in the Dothideomycetes. Morphologically they are distinct from Phaeothecoidiella in that the latter tends to
have more phragmospores, and hyphae that are covered in a mucoid sheath, as found in typical sooty moulds, but lacking in the former genera. Phylogenetically these genera also cluster apart.

The recent treatment of the *Sporidesmium* complex by Wu & Zhuang (2005) reiterated the numerous, as yet undefined genera present within the *Sporidesmium* complex. A complete revision of this polyphyletic complex has largely been hampered by the unavailability of cultures (Shenoy et al. 2006). Two genera in this complex are newly introduced in the present study, namely *Houjia* and *Sporidesmajora*. An important ecological feature of these genera lies in their growth habit, namely growing as epi- phytes (*Capnodiales*) on apple surfaces. Using the key provided by Wu & Zhuang (2005), *Houjia*, which is morphologically similar to *Stanjehughesia* (*Chaetosphaeriaceae*), can be distinguished based on its solitary conidiogenous cells. *Sporidesmajora*, on the other hand, is distinguished from *Sporidesmium* (*Sordariomyces*) based on its multisepate conidiophores with darkly pigmented, subconical apical conidiogenous cells, and long, multi-euseptate conidia.

Altogether we described three new genera and five new species in the SBFS complex. Although this finding is quite significant, the *Dothideomyces*, and the *Capnodiales* in particular, still host numerous undescribed families and genera (Schoch et al. 2006, Crous et al. 2007, 2009b), suggesting that these novel species represent yet another unique epiphytic niche, similar to that reported by Ruibal et al. (2008) from rock surfaces. By employing morphological and DNA comparisons, we were able to resolve the status of several previously collected genera and species which would otherwise have escaped recognition.

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