Cercosporoid hyphomycetes on hosts of the Annonaceae: Cercospora annonaceae and Isariopsis annonarum revisited

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Abstract — Type material of Cercospora annonaceae and several collections assigned to this species by C. Chupp have been re-examined. The status of this species as a member of the genus Stereum is confirmed, but most collections in Chupp's herbarium referred to as C. annonaceae proved to be misidentified, and pertain to Isariopsis annonarum, herein reallocated to Pseudocercospora, and the new species Phaeoceras annona-chimerae. A key to 25 cercosporoid hyphomycete species on hosts belonging to the Annonaceae is provided, and the taxonomy of the species concerned is briefly discussed. The following new combinations are proposed: Pseudocercospora annonarum, P. stigmatae and P. oblecta. Furthermore, a revised, detailed description of Pseudocercospora annona-squamosae is provided.

Key words — anamorphs, cercospora-like, Annona

Introduction

Cercospora annonaceae (Hennings 1909) was introduced for a cercosporoid hyphomycete on an unknown member of the Annonaceae collected in Brazil. The original data are rather scanty, simply describing hypophyllous caespituli, fasciculate 'hyphae' (i.e. conidiophores), up to 150 × 3.5 μm, septate, and cylindrical-fusiform conidia, 15–35 × 2.5–3.5 μm, 3–7-septate, brown. In his monograph of Cercosporae Fresen., Chupp (1954) considered this species a coremiaid hyphomycete, which has to be excluded from the latter genus. His observations were based on a revision of type material, deposited at the herbarium of the Botanical Garden and Museum in Berlin, Germany (B), and several secondary samples in his own herbarium, now maintained at the Plant Pathology Herbarium of the Cornell University, Ithaca, New York, USA (CUP). Unfortunately the type material at B has been lost. Braun (in Braun
& Mel'nik (1996) detected and examined syntype material of this species deposited at the Russian herbarium LEP. Hennings (1908) cited the following details for the type collection: 'Agua Branca in folis Annonaceae. Mai 1903, no. 738' ['Agua Branca, São Paulo, Annonaceae, A. Puttemans, No. 738, May 10-16], 1903' is the altered version given in Chupp (1954), who examined this material. The label of the syntype material at LEP deviates and reads as follows: 'Pará, Annonaceae, V 1903, Puttemans.' The whole context of the protologue and the labels concerned suggest the locality Agua Branca (or Agua Branca do Paulinhos?) in the state of Pará, in which also a city with the name São Paulo exists. Braun (Braun & Mel'nik 1996) reallocated C. annonae to Stenella Syd., since the only discernable cercosporoid hyphomycete found in the syntype material at LEP was a member of the latter genus. However, in the latter material only solitary conidiophores arising from superficial hyphae were found, i.e. fasciculate conidiophores were lacking, which was in conflict with the original description (Hennings 1908) as well as Chupp's (1954) comments on this species, and raised the question whether a single polymorphic or two different cercosporoid taxa had been involved. Therefore, herbarium specimens referred to as C. annonae by C. Chupp have been re-examined in order to clarify his taxonomic decision and concept.

Materials and methods

The collections examined were described, mounted in distilled water, using oil immersion (bright field and phase contrast), but without any staining, by means of standard light microscopy (Olympus BX 50, Hamburg, Germany). 30 measurements (×1000 magnification) of conidia and other structures were made, with the extremes given in parentheses. The collections examined are deposited at the herbaria CUP and W (abbreviations according to Holmgen et al. 1990).

Taxonomy

The examination of four specimens from CUP referred to as C. annonae by C. Chupp revealed them to represent several distinct taxa. A single collection from Brazil on Annona reticulata proved to be a member of Stenella conspecific with C. annonae, a specimen from Venezuela on A. squamosa belongs to Isariopsis annonarum (=Passalora annonarum), and another one from Mexico on A. cherimola has to be described as new species of Phacellum Bonord.


Material examined: BRAZIL Pará, Annona reticulata, leaf spots, 0.5-1-2-septate, ovate, 10-20 μm wide, hila slightly thickened, 


Phacellum sessilis, sp. nov., conidium base 0-1-2-septate, ovate, 10-20 μm wide, hila slightly thickened, 1-2 μm wide. 6-14 μm long.

Material examined: MEXICO, Jalapa, Annona cherimolya (Annonaceae), 0.5-1-2-septate, ovate, 10-20 μm wide, hila slightly thickened, 1-2 μm wide. 6-14 μm long.
Material examined: BRAZIL. Pará, on living leaves of a host belonging to the Annonaceae (probable Annona sp.), May 1903, Putternang (LEP), lectotype of C. annonaceae, designated here. BRAZIL. Fungos de Minas Gerais, Viçosa-Escola, on living leaves of Annona reticulata, 23 Mar. 1930, A.S. Muller (CUP-MG 157).

Leaf spots amphigenous, subcircular to angular-irregular, 1–25 mm diam., sometimes confluent, pale to dull dark brown, later grayish to dingy grayish white, margin indefinite or with a narrow darker border or marginal line. Colonies amphigenous, mainly hypophyllous, inconspicuous, effuse to punctiform, brown to grayish brown. Mycelium internal and external; superficial hyphae emerging through stomata, 1.5–3 μm wide, branched, septate, subhyaline, pale to medium olivaceous, olivaceous-brown or yellowish brown, thin-walled, verruculose. Stromata lacking or small, not very conspicuous, 10–40 μm diam., immersed, brown. Conidiophores solitary, arising from superficial hyphae or in small to moderately large fascicles, loose to usually rather dense, occasionally even coriaceous, arising from immersed stromatic hyphal aggregations, erect, unbranched, subcylindrical, straight to somewhat flexuous-sinuous, upper fertile part usually geniculate-sinuous, sometimes strongly so, 20–150 × (2.5–3)–4(–4.5) μm, pluriseptate, pale to dark brown, yellowish brown or olivaceous-brown, smooth, wall thin to slightly thickened (<1 μm). Conidiogenous cells integrated, terminal and intercalary, 5–20 μm long, occasionally longer, with several conspicuous conidiogenous loci, slightly thickened and darkened, 1.5–1.5 μm diam. Conidia solitary, subcylindrical-filiform, acicular to narrowly obclavate, 20–100 × 2.5–4.5 μm, 2–8-septate, pale olivaceous, yellowish brown to brown, verruculose, wall thin (ca. 0.5 μm wide), apex obtuse to subacute, base truncate to usually obconically truncate, 1.5–(2) μm wide, hila slightly thickened and darkened.

Comments: The collection on Annona reticulata agrees well with the original description of C. annonaceae as well as the lectotype of this species in that solitary as well as fasciculate conidiophores are formed. Fasciculate conidiophores were described by Hennings (1908) and observed by Chupp (1954), whereas solitary conidiophores arising from superficial hyphae were found by Braun & Melnik (1996) in the lectotype sample.

Phacellium annonaceae-cherimoliae U. Braun, sp. nov. Fig. 2

MycoBank MB 511858.

Phacellium sessilis similis, sed conidiis longioribus et angustioribus, 8–25 × 2–4(–5) μm, 0–1(–2)-septatis, levibus.

Material examined: MEXICO: Jalapa, Vera Cruz, on living leaves of Annona cherimolilia (Annonaceae), 19 Jul. 1932, O.A. Plunkett 143 (CUP 60731), holotype. Isotype: CUP 39057.

Leaf spots amphigenous, subcircular to angular-irregular, 1–5 mm diam., occasionally confluent, pale to dark brown, later grayish brown to dingy gray,
on the lower leaf surface usually much brown to blackish. Mycelium inter-aggregations at the base of synnema synnematous, erect, straight, often subcylindrical or somewhat attenuate, medium brown, composed of a firm (condiophores) and a rather compactly or only slightly splaying out, pale to mid olivaceous, olivaceous-smooth, thin-walled. Conidiogenous and pleurogenous, 5–20 × 2–5 μm, olivaceous-brown, with a single to two loci, 1–1.5 μm diam., slightly thick simple or occasionally branched cells, 2–4(–5) μm, 0–1(-2)-septate, hyaline or almost so, ends obtuse to somewhat thickened and darkened.

Comments: Due to synnematous as well as pleurogenous, cinctured, hyaline or subhyaline conidial form on Annona cherimolia fits the concept as circumscribed by Braun (1998). Species of Phacellium on a host below close to P. sessile U. Braun, but differs in septate, smooth conidia. P. sessile, on possesses very similar synnematous cells, but the conidia are 10–16(-20) μm (Braun 1998). The South American similar species, also characterized often somewhat narrowed towards and abundant pleurogenous conidia, reddish to pink and the conidia as in P. inhonestum Bond. var. alboc (≡ P. alboc), the synnematous conidiomata, clearly distinctly pigmented synnemata resembling phaeomandrella-like pleurogenous, hyaline or subhyaline. The taxonomy of this genus within the anamorphs is still unclear. Culture analyses of various Phacellium species pigmented synnemata, are not Phacellium tentatively.
on the lower leaf surface usually much paler, margin conspicuous, narrow, dark brown to blackish. Mycelium internal, forming immersed stromatic hyphal aggregations at the base of synnemata, 20–50 μm diam., brown. Conidiomata synnematos, erect, straight, occasionally slightly curved to sinuous, subcylindrical or somewhat attenuated towards the apex, 150–400 × 10–40 μm, medium brown, composed of a firm stipe of densely appressed parallel threads (conidiophores) and a rather compact, often poorly developed capitulum, barely or only slightly splaying out. Individual conidiophores 1–4 μm wide, pale to mid olivaceous, olivaceous-brown or brown, plurisepate throughout, smooth, thin-walled. Conidiogenous cells integrated, terminal, intercalary and pleurogenus, 5–20 × 2–5 μm, subhyaline to very pale olivaceous or olivaceous-brown, with a single to usually several conspicuous conidiogenous loci, 1–1.5 μm diam., slightly thickened and darkened. Conidia catenate, in simple or occasionally branched chains, ellipsoid-ovoid, cylindrical, 8–25 × 2–4(–5) μm, 0–1(–2)-septate, hyaline or subhyaline, thin-walled, smooth or almost so, ends obtuse to somewhat attenuated, hila 1–1.5 μm diam., slightly thickened and darkened.

Comments: Due to synnematos conidiomata with integrated, terminal as well as pleurogenus, cicatrized, hyaline or only pale conidiogenous cells, and hyaline or subhyaline conidia formed in chains, the new cercosporoid species on Annona cherimolia fits the concept of the hypnomyceae genus Phacellum as circumscribed by Braun (1998). Phacellum annosae-cherimolae, the first species of Phacellum on a host belonging to the Annonoaceae, is morphologically close to P. sessile U. Braun, but differs in having longer and narrower, 0–1(–2)-septate, smooth conidia. P. sessile, on Sanguisorba canadensis in North America, possesses very similar synnemata with numerous pleurogenus conidiogenous cells, but the conidia are 10–16(–18) × 4–6(–8) μm, aseptate and verruculose (Braun 1998). The South American P. paspali (Syd.) U. Braun is a further similar species, also characterized by having slender, pigmented synnemata, often somewhat narrowed towards the apex, with little differentiated capitula and abundant pleurogenus conidiogenous cells, but the synnemata are pale reddish to pink and the conidia are aseptate. The type species of Phacellum, P. inhonestum Bonord. [= P. alborosellum (Desm.) U. Braun], is, except for the synnematos conidiomata, close to Ramularia Unger. Other species with distinctly pigmented synnemata and conidiophores are more cercosporoid, resembling phaeoramularia-like Passalora Fr. species, but differ in having pleurogenus, hyaline or subhyaline conidiogenous cells and colourless conidia. The taxonomy of this genus within the complex of cercosporoid Mycosphaerella anamorphs is still unclear. Cultures of the type species and molecular sequence analyses of various Phacellum species, including those with colorless and pigmented synnemata, are not yet available. Thus, we prefer to maintain Phacellum tentatively.
**Pseudocercospora annonarum** (Petr. & Cif.) U. Braun & Crous, comb. nov.  
**FIG. 3**

MYCOBANK MB 511859.


Leaf spots amphigenous, subcircular to angular-irregular, 1–10 mm diam., occasionally confluent, pale to dark brown, later grayish brown to dingy gray, on the lower leaf surface usually much paler, margin conspicuous, dark brown to blackish, narrow. Conidiomata hypophyllous, synnematous, scattered, rather inconspicuous to punctiform, brown to dark brown. Mycelium internal. Stromata immersed, 20–60 µm diam., brown. Synnemata 80–250 × 20–50 µm, brown, composed of a mostly firm subcylindrical stipe of numerous, densely appressed parallel conidiophores and a more or less loose apical capitulum, often somewhat wider at the very base, occasionally with conidiophores in dense fascicles, i.e. not distinctly synnematous, individual conidiophores 40–250 × 2–5 µm, terminal cells (conidiogenous cells) up to 7 µm wide, olivaceous to medium brown, pluriseptate throughout, thin-walled, smooth. Conidiogenous cells integrated, terminal, rarely intercalary or pleurogenous, 10–25(–35) µm long; conidiogenous loci inconspicuous to subconspicuous by being subdenticulate or by having an unthickened, but slightly darkened-refractive ultimate rim (paracecispore-like), visible in front view as minute circle, 1–2 µm diam. Conidia solitary, obclavate-cylindrical, occasionally subclavate, short conidia sometimes ellipsoid-ovoid, straight to curved, (15–)25–70(–80) × (3.5–)4–8(–9) µm, (0–)1–7(–10)-septate, occasionally constricted at the septa, pale to medium olivaceous or olivaceous-brown, thin-walled (ca. 0.5 µm), smooth, apex obtuse, base obconically truncate to somewhat convex, (1.5–)2–2.5(–3) µm wide, unthickened, not darkened, at most slightly refractive.

**Comments**: During the course of a revision and reassessment of the genus *Phacellium* (= *Isariopsis* Fresen.), Braun (1990) reallocated cercosporid species with pigmented, sceloid conidia, including *Isariopsis annonarum*, to *Phaeoisariopsis* Ferraris. Later it turned out that the formation of synnematous conidiomata is of little taxonomic relevance at generic level in cercosporid anamorphs. Furthermore, the genus *Phaeoisariopsis* proved to be heterogeneous, encompassing passalora-like species with conspicuous, thickened and darkened conidiogenous loci as well as pseudocercospore-like taxa with inconspicuous loci (Deighton 1990, Crous & Braun 2003).

**Figs 2-3. 2. Phacellium annonae-chromalinus.**  
B. Conidiophores in a dense fascicle. C. Conidiophore. D. Conidium except for fig. B of *P. annonarum* which is based on a holotype.

Hence, most species of *Phaeoisariopsis* and *Pseudocercosporella* are here transferred to *Pseudocercospora*, respectively. Due to the almost complete absence of useful synapomorphies (ultimate rim unthickened, but some...
Hence, most species of *Phaeoisariopsis* were reallocated to *Passalora* and *Pseudocercospora*, respectively. Due to subconspicuous conidiogenous loci (ultimate rim unthickened, but somewhat darkened-refractive, scars visible in
front view as minute circles), Crous & Braun (2003) assigned *I. annonarum* to *Passalora*. Based on a molecular and morphological reassessment of *Phaeoisariopsis griseola* (Sacc.) Ferraris, the type species, Crous et al. (2006) reduced the genus *Phaeoisariopsis* to synonymy with *Pseudocercospora*. *P. griseola* is characterized by having conidiogenous loci ranging from being quite inconspicuous to subconspicuous by being unthickened, but slightly darkened-refractive, at least with regard to the ultimate rim. Since *P. griseola* clustered within a subclade formed by other *Pseudocercospora* species, it became clear that taxa with minutely thickened and slightly darkened conidiogenous loci have to be placed in *Pseudocercospora*. The recent examination of the rich collection of *I. annonarum* from Venezuela showed that this species has a similar morphological range of the conidiogenous loci as in *P. griseola*. Thus, *I. annonarum* is better placed in *Pseudocercospora*.

**Key to cercosporoid hypomyctec species on hosts of the Annonaceae**

Numerous cercosporoid hypomyctec species, including the taxa treated herein, have been described on host species belonging to the *Annonaceae*. The following key and brief discussions on some of the species listed have been prepared to render the differences between the taxa concerned palpable.

1. Conidiophores in distinct synnemata .................................................. 2
2* Conidiophores mononematous, solitary or fasciculate .......................... 3
2. Synnema composed of a firm stipe and a ± loose capitulum; conidiogenous cells usually integrated, terminal; conidiogenous loci inconspicuous or only ultimate rim slightly darkened-refractive (visible in front view as minute circle); conidia solitary, pigmented. (15–)25–70(–80) × (3.5–)4–8(–9) μm; on *Annona squamosa* .................................................. *Pseudocercospora annonarum*
2* Conidiophores mononematous, solitary or fasciculate .......................... 3
2. Synnema composed of a firm stipe and a compact, little differentiated capitulum; conidiogenous cells frequently pleurogenous; conidiogenous loci minute, but conspicuous, thickened and darkened; conidia catenate, hyaline or subhyaline, 0–25 × 2–4(–5) μm, 0–1(–2)-septate; on *A. cherimola* .................................................. *Phaeoisariopsis annonae-cherimolae*
3. Conidiogenous loci conspicuous, thickened and darkened .................. 4
3* Conidiogenous loci inconspicuous, at most subconspicuous by being denticle-like, but neither thickened nor darkened ................................. 11
4. Superficial mycelium present; hyphae distinctly verruculose .................. 5
4* Superficial mycelium smooth or lacking .............................................. 6
5. Conidiophores solitary, arising from superficial hyphae, as well as fasciculate; on *Annona* spp., Brazil .................................................. *Stenella annonaeaceae*
5* Conidiophores consistently solitary, arising from superficial hyphae; on *Polyalthia suberosa*, India .................................................. *Stenella polyalthiae*
| Conidiophores fasciculate, pigmented; conidia solitary, acicular when mature, pluriseptate, hyaline | on Annoma spp. | Cercosporea api s. lat. | 6 |
| Conidiophores fasciculate or solitary, pigmented; conidia not acicular, solitary and pigmented or catenate and ± hyaline (Passalora) | | | 7 |
| Conidia catenate | | | 8 |
| Conidia solitary | | | 9 |
| Conidiophores 120–200(-250) μm long; conidia 30–70 × 3–4 μm, 2–7-septate, subhyaline to pale brown; on Isola caudiflora, Kenya | | Passalora isoloneae | 8 |
| Conidiophores 30–150 μm long; conidia 20–40(-65) × 2–4.5 μm, 0–3(-5)-septate, hyaline or subhyaline; on Annoma dioica and Xylopia grandiflora, Brazil | | Passalora xyloptae | 9(7) |
| Conidiophores solitary and fasciculate, ca. 60–210 × 5.5–9 μm; conidia ca. 35–130 × 7–9 μm, 1–4-septate; on Millispa sp., India | | Passalora annonacearum | 9 |
| Conidiophores much shorter and narrower, up to 80 × 6 μm | | | 10 |
| Conidiophores solitary, arising from superficial hyphae; conidia 14.5–50 μm long, up to 4-septate; on Millispa tormenta, India | | Passalora miiliaseae | 10 |
| Conidiophores fasciculate, emerging through stomata; conidia 25–80 μm long, 3–8-septate; on Annoma spp., Brazil | | Passalora annonigena | 10 |
| Superficial mycelium present; conidiophores solitary as well as fasciculate, sometimes even in sporodochial conidiomata | | | 11(3) |
| Superficial mycelium lacking; conidiophores consistently in loose to dense, almost sporodochial fascicles | | | 11 |
| Conidia very broad, 20–80 × 4–12 μm, with 1–9 transverse and occasionally 1(–2) oblique or longitudinal septa; on Asimina triloba, North America | | Pseudocercospora asiminae | 12 |
| Conidia much narrower, up to 7 μm wide, only transversely septate | | | 12 |
| Conidiophores consistently solitary, arising from superficial hyphae, distinct fascicles lacking, 12–70 × 3.5–5 μm; conidia narrowly obclavate-cylindrical, 40–156 × 2.5–3.5 μm, 3–13-septate; on Polyalthia suberosa, India | | Pseudocercospora polyalthiae | 13 |
| Conidiophores solitary as well as fasciculate | | | 14 |
| Conidia very long and wide, 50–150 × 5–7 μm, densely pluriseptate (6–18), hila 2.5–3.5 μm wide; conidiophores usually fasciculate, occasionally solitary, arising from superficial hyphae; on Annoma spp. and Rollahia sp., Asia, West Indies, Central to South America | | Pseudocercospora annonae | 14 |
| Conidia narrower, 1.5–6(–7) μm wide, up to 10-septate, hila narrower, 1–2.5 μm | | | 15 |
| Conidia 25–140 × 3(–6) μm, very pale, mostly subhyaline; on Asimina spp., North America | | Pseudocercospora asiminae-pyrginae | 15 |
| Conidia narrower, 1.5–4 μm, subhyaline to pale brown; on Annoma and Rollinia spp. | | | 16 |
Passalora annonacearum[annonacearum]
Kavaka 14: 33, 1988 [1986].
On Miliusa sp. Asia, India.

Passalora annenigena U. Braun & F. Crous
On Annona sp., South America, Brazil.

Passalora isolaniae (Siboe, P.M. Kirk)
in Crous & Braun, Mycosphaerellaceae
in Cercosporidaceae and Passalora. CBS
= Phaeococcomyces isolaniae Siboe, P.M. Kirk
Illustration: Siboe et al. (2000: 300).

Passalora miliusae U. Braun & Crous
in Crous & Braun, Mycosphaerellaceae
in Cercosporidaceae and Passalora. CBS
= Mycolerysia indica P. Kumar & Kamal
Kamal & P. Kumar, 1981.
Illustration: Kumar & Kamal (1982).
On Miliusa tomentosa, Asia, India.

Passalora xylophiæae (Viégas & Chupp)
in Crous & Braun, Mycosphaerellaceae
in Cercosporidaceae and Passalora. CBS
= Cercospora xylophiæae Viégas & Chupp, P.M. Kirk
Literature: Chupp (1954: 46).
On Annona dioica and Xylophia graei.

Phacelium annonae-thermophilae, ssp.

Pseudocercospora aethiopicae Deighton
Illustration: Deighton (1976: 14, Fig.
On Xylophia aethiopica, Africa, Sierra

Cercospora apiī Fresen. s. lat. (sensu Crous & Braun 2003).
Comment: C. apiī s. lat. (incl. C. canescens Ellis & G. Martin) has been recorded on Annona ‘odorata’ (Crous & Braun 2003).
ILLUSTRATION: Rai & Kamal (1988: 34, Fig. 2).
On Miliusa sp., Asia, India.

Passalora anonigena U. Braun & E.O. Freire,
ILLUSTRATION: Braun & Freire (2003: 298, Fig. 2).
On Annona sp., South America, Brazil.

Passalora isolonae (Sibue, P.M. Kirk & P.F. Cannon) U. Braun & Crous,
ILLUSTRATION: Sibue et al. (2000: 300, Fig. 6).
On Isolona cauliflora, Africa, Kenya.

On Miliusa tomentosa, Asia, India.

LITERATURE: Chupp (1954: 46).
On Annona dioica and Xylopia grandiflora, South America, Brazil.

Phacellium annonae-cherimolae, see above.

Illustration: Deighton (1976: 14, Fig. 3).
On Xylopia aethiopica, Africa, Sierra Leone.
ILLUSTRATION: Kamal et al. (1987: 455, Fig. 2).

On Miltia velutina, Asia, India.

ILLUSTRATION: Braun et al. (2002: 113, Fig. 5).

On Annona cherimolia. A. muricata, A. reticulata, A. squamosa, Annona sp., Asia, West Indies, Central to South America (Brazil, Cuba, Guatemala, India, Panama, Philippines, Venezuela).

Pseudocercospora annosae-squamosae U. Braun & R.F. Castañeda, in Castañeda & Braun, Cryptog. Bot. 1: 50, 1989, Fig. 4
ILLUSTRATION: Vasudeva (1963: 68, Fig. 33), Castañeda & Braun (1989: 48, Fig. 19), Hsieh & Goh (1990: 22, Fig. 10).


On Annona atemoya, A. cherimolia x squamosa, A. muricata, A. purpurea, A. pygmaea, A. reticulata, A. squamosa, Annona sp., Rolfinia mucosa, Asia, West Indies, central to South America (Brazil, Cuba, India, Japan, Panama, Taiwan, Venezuela).

Fig. 4. Pseudocercospora annosae-squamosae. P. annosae-squamosae is solitary conidiophores. C. Hypheae climbing a conidiophore based on type material. Scale bar = 10 µm. U. Braun.

COMMENTS: With regard to the solitary conidiophores, P. annosae-squamosae is dense, sometimes almost sporodochi...
Cercosporoids on Annonaceae... 219


**COMMENTS:** With regard to the formation of solitary and fasciculate conidiophores, *P. annona-squamosae* is rather polymorphous. Relatively large, dense, sometimes almost sporodochial fascicles of conidiophores with well-
developed stromata, are usually epiphyllously formed, whereas on the lower leaf side the conidiophores are usually solitary arising from superficial hyphae, and only arranged in smaller fascicles with lacking or small stromata. The development of superficial hyphae with solitary conidiophores on the one hand and well-developed fascicles on the other hand is rather variable. Superficial mycelium may be sparsely developed in some collections, as for instance in the type material of C. caracasensis, and well-developed conidiophore fascicles may be lacking in other specimens, as in the holotype of this species. Therefore, the following redescription of this species is based on a wider range of collections on various host species is necessary in order to demonstrate its variability: LEAF SPOTS amphigenous, subcircular to angular-irregular, 1–30 mm diam., occasionally confluent, reddish brown, medium to dark or blackish brown, later often grayish brown to dingy gray, finally sometimes grayish white, often vein-limited, margin indefinite or with a darker marginal line. CAESPITULI amphigenous, on the upper side conspicuous, punctiform, scattered, dark brown to blackish, but soon turning grayish by abundant conidial formation, on the lower leaf surface subfusiform and less conspicuous, dingy grayish olivaceous to olivaceous-brown. MYCELIUM internal and external; superficial hyphae variable, ranging from almost lacking to well-developed, usually hypophysyllous, emerging through stoma, occasionally climbing leaf hairs, branched, septate, 1–3.5 μm wide, thin-walled, pale olivaceous to olivaceous-brown, smooth. STROMATA almost lacking to well-developed, above all on the upper side, 10–80 μm diam., substomatal to intraepidermal, olivaceous-brown. CONIDIOPHORES, in small, loose to large and dense, almost sporodochial fascicles, arising from internal hyphae or stroma, emerging through stoma or erumpent, and solitary, arising from superficial hyphae, lateral, rarely terminal (on the upper side usually in well-developed, sometimes almost sporodochial fascicles, on the lower side in small, loose and solitary, arising from superficial hyphae), erect, straight, subcylindrical, conical to distinctly geniculate-sinuous, usually unbranched, 5–30(–45) × 2–4(–5) μm, 0–1(–2)-septate, subhyaline to pale olivaceous or olivaceous-brown, medium olivaceous-brown in mass, thin-walled, smooth. CONIDIUMS, cylindrical, integrated, terminal or conidiophores reduced to conidiogenous cells, 5–20 μm long: conidiogenous loci inconspicuous to subconspicuous by being truncate or subdenticulate, but always unthickened and not darkened. CONIDIA solitary, narrowly obclavate-cylindrical, (15–)20–75(–85) × (1.5–)2–4(–5) μm, (1–)2–6(–8)-septate, occasionally slightly constricted at the septa, subhyaline to pale olivaceous, thin-walled, smooth, apex obtuse, above all in cylindrical conidia, subacute, above all in obclavate conidia, base short obconically truncate, 1–2 μm wide, hila unthickened, neither darkened nor refractive.


Illustration: Braun (2003: 93, Fig. 4).

On Asmina crassifolia, South America.


Literature: Chupp (1954: 45), Braun (1970: 176), Braun & Crous (1995: 222, Fig. 211).

On Asmina parviflora, 'A. obtusa' and 'A. obtusa'

COMMENTS: Based on a re-examination of Cercospora asiminae, P. asiminae is considered to be asiminae, P. asiminae, P. asiminae, and P. asiminae. These species are conspecific and, due to the occurrence of longitudinal septa, followed Arx & Albert & de Vries, 1955, in this species in Miuraea Hara. The fungi are undoubtedly heterogeneous (Braun & Crous, 1995: 222), analyses of M. degenerans (Syd. & P. J. Crous), available. This species is characterized by the presence of dictyosporous conidia. Miuraea sp. has anamorph and a dictyospore conidium. The fungus on Asmina species is known in this genus. The conidiophores are formed singly in fascicles, pigmented, with uniseriate conidiogenous loci. The conidia are ovoid to 1(–2) oblong to subglobose, 4(–5) μm, 0–1(–2)-septate, occasionally slightly constricted at the septa, subhyaline to pale olivaceous, thin-walled, smooth, apex obtuse, above all in cylindrical conidia, subacute, above all in obclavate conidia, base short obconically truncate, 1–2 μm wide, hila unthickened, neither darkened nor refractive.

Pseudocercospora asiminae-pygaeae, Ramularia and allied genera (phytotyaphes). Illustration: Braun (1999: 222, Fig. 211).

On Asmina angustifolia, A. incana and A. flavus.
Phyllously formed, whereas on the lower side solitary arising from superficial hyphae, with lacking or small stromata. The rhizoids solitary conidiophores on the one hand are rather variable. Superficial stromata are thin in some collections, as for instance in *Pseudocercospora anamnifoli* a well-developed conidiophore fascicles in the holotype of this species. Therefore, species based on a wider range of collections in order to demonstrate its variability: slender to angular-irregular, 3-30 mm diam., medium to dark or blackish brown, glabrous, finally sometimes grayish white, often with a darker marginal line. *Caespitulis* conspicuous, punctiform, scattered, dark grayish by abundant conidial formation, more or less conspicuous, dingy grayish bluish internal and external; superficial stromata, occasionally climbing leaf hairs, thin-walled, pale olivaceous to olivaceous-brown, to well-developed, above all on the leaf surface, to intraepidermal, olivaceous-brown, large and dense, almost sporodochial or stromata, emerging through stomata from superficial hyphae, lateral, rarely to be found in well-developed, sometimes almost reduced in small, loose fascicles and solitary, straight, subcylindrical, conical to subcylindrical, conical to subcylindrical, 5-30(-45) x 2(-4) (-5) μm, olivaceous or olivaceous-brown, medium thickened, smooth. *Conidiogenous cells* reduced to conidiogenous cells, 5-20 μm to subcylindrical by being truncate and not darkened. CONIDIA solitary, 7-7.5(-8.5) x (1.5-2)-4(-5) μm, (1-2)-6(-8) x (1-2)-6(-8) μm, restricted at the septa, subhyaline to pale brown, obtuse, above all in cylindrical conidia, base short obconically truncate, 1-2 μm thickened nor refractive.


Illustration: Braun (2003: 93, Fig. 4).

On *Anona crassifolia*, South America, Brazil.

**Pseudocercospora asiminae** (Ellis & Morgan) U. Braun & Crous, comb. nov.

- MycoBank, MB 511860.
- Bas: *Phleospora* ["Phleospora"] *asiminae* Ellis & Morgan, in Martin. J. Mycol. 3: 88, 1887.

Illustration: Braun (1995: 222, Fig. 21a).

On *Asimina parviflora*, *A. obtusa* and *A. trifolia*, North America, USA.

**COMMENTS:** Based on re-examination of type material of *Phleospora asiminae* and *Cercospora asiminae*, Braun (1995) confirmed that the two taxa are conspecific and, due to the occurrence of some conidia with oblique or longitudinal septa, followed Arx & Constantinescu (in Arx 1983) in placing this species in *Miuraea* Hará. The latter genus is insufficiently known and undoubtedly heterogeneous (Braun 1995). Cultures and molecular sequence analyses of *M. degenerans* (Syd. & P. Syd.) Hará, the type species, are not yet available. This species is characterized by having pigmented, thick-walled, dictyosporous conidia. *Miuraea persicae* (Sacc.) Hará is a colorless *Myosphaerella* anamorph probably closely related to the genus *Pseudocercospora* Deighton. The fungus on *Asimina* species is, however, better placed in *Pseudocercospora*. The conidiophores are formed singly, arising from superficial hyphae, as well as fasciculate, pigmented, with unthickened, neither darkened nor refractive conidiogenous loci. The conidia are only slightly thickened, transversely septe, only occasionally with 1(-2) oblique or longitudinal septa (Braun 1995). The formation of oblique or longitudinal septa in conidia of *Pseudocercospora* is unusual, but may occur, even in *P. vitis* (Lév.) Speg. (Deighton 1976), the type species, i.e. this feature does not exclude this cercosporid *Asimina* species from the latter genus.


Illustration: Braun (1995: 222, Fig. 21b).

On *Asimina angustifolia*, *A. incana* and *A. pygmaea*, North America, USA.
**Pseudocercospora oblecta** (Syd.) Crous & U. Braun, *comb. nov.*
Mycobank MB 511861.
Illustration: Crous & Braun (1996: 286, Fig. 8).

On *Annona senegalensis*, South Africa.

**Comments:** On account of rather coarse conidiophores with percurrently proliferating conidiogenous cells, Crous & Braun (1996) assigned *C. oblecta* to the genus *Stigmnia* Sacc. in the broad sense of Ellis (1971, 1976). The conidiogenous loci in this species are pseudocercospora-like, i.e. unthickened and non-pigmented. Braun (1993) introduced the genus *Cercostigmnia* U. Braun for stigmnia-like *Mycoasperella* anamorphs with thin-walled, euseptate, scolecosporous conidia, which was later reduced to synonymy with *Pseudocercospora* based on a molecular and morphological reassessment (Crous & Braun 2003). *Scolecostigmnia* U. Braun (Braun et al. 1999) was proposed for similar anamorphs with coarse, thick- and often rough-walled conidiophores formed in sporodochial conidiomata and relatively broad conidia, with slightly thickened, relatively dark conidia. The status of this genus is unclear. Cultures of the type species and molecular sequence analyses are not yet available. But most species assigned to this genus are probably *Mycoasperella* anamorphs that should better be accommodated in *Pseudocercospora*. Crous et al. (2006) demonstrated that even *Stigmnia platani* (Focke) Sacc., the type species of *Stigmnia*, characterized by having phragmosporous, distoseptate conidia, represents a *Mycoasperella* anamorph clustering in the *Pseudocercospora* clade. Braun & Crous (2006) proposed to conserve *Pseudocercospora* against *Stigmnia* and *Phaeoisariopsis*. *Cercosporella oblecta* is morphologically similar to *Pseudocercospora annomforioli*.

**Pseudocercospora polyalthiae** J.M. Yen, A.K. Kar & B.K. Das,
Illustration: Yen et al. (1982: 44, Fig. 4 E–G).

On *Polyalthia suberosa*, Asia, India.

**Pseudocercospora xenoannonicola** Crous & Bench.,
Illustration: Crous et al. (2000: 87, Fig. 10).

On *Annona montana*, South America, Brazil.

**Stenella anmonaceae**, see above.

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Illustration: Chaudhary et al. (2002).

On *Polyalthia suberosa*, Asia, India.

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Cercospoid on Annonaceae ... 223

Illustration: Chaudhary et al. (2002-2005, Fig. 2).
On Polyalthia suberosa, Asia, India.

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The *Parmeliaceae* is the most significant Brazilian biome (Marcelly 1998). The Brazilian biome where 169 species were found was described as new species. During a survey of the *Parmeliaceae* in 2005, several new species were found, and they were described here. In addition, a new combination was made. The new species, *Bulbothrix megapotamica* and *B. subcoronata*, were described in 2007.

**Bulbothrix megapotamica** Canéz & Marcelli

*Mycobank* MB 511099

**Diagnosis:** Sier *Bulbothrix subcoronata*.

**Holotype:** Brazil, Rio Grande do Sul State, S 28°04'58.9"S, 50°56'48.9"W, 850 m alt., A.A. Spießmann 146, 23-II-2003 (SP).

**Thallus** whithish gray, subclinate, unbranched, 0.4–1.5 mm wide, adnate, 

**Novelties on South**

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**Abstract** — *Bulbothrix megapotamica,* conglomarata are described as new species. *Rimelia flaviscissa* is synonymized.

**Key words** — *Bulbothrix subcoronata, punctulata*