New records of plant parasitic Asterinaceae (Dothideomycetes, Ascomycota) with intercalary appressoria from Central America and Panama

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ABSTRACT
New records of species of Asterinaceae with intercalary appressoria infecting plants in Central America and Panama are described and illustrated in detail. New records are Asterolibertia licaniicola on the new host Licania arborea (Chrysobalanaceae), Asterolibertia nodulosa on the new hosts Oxandra venezuelana and Xylopia sp. (Annonaceae), and Cirsosia splendida on the new hosts Chrysobalanus icaco and Hirtella triandra (Chrysobalanaceae). The teleomorph C. splendida is linked for the first time to the asexual morph Homalopeltis chrysobalani based on morphological observation. For the presented fungi an identification key is provided and infection strategies are discussed. Nomenclatural novelties are introduced, Leprieuria radiata becomes a synonym of H. chrysobalani and Asterina nodulifera is recombined into Asterolibertia nodulifera.

Key words: Asterolibertia, Chrysobalanus icaco, Cirsosia, Homalopeltis, obligate biotrophs.

INTRODUCTION
Species of Asterinaceae (Dothideomycetes, Ascomycota) are parasitic microfungi of vascular plants in the tropics and subtropics. An overview of the family is provided by Hofmann et al. (2010). Asterinaceae infect mostly wild plants but also have been reported from cultivated crops such as Asterina manihotis Syd. on Manihot esculenta Crantz (Hofmann & Piepenbring, 2008). Due to their obligate biotrophic lifestyle these fungi depend on a living host, but they do not cause visible diseases. However, they can have negative effects on the photosynthesis of the plant and/or weaken host defense. Asterina congesta Cooke was shown to influence photosynthetic activity on sandal tree (Santalum album L.) in India since the extensively growing black colonies prevent the entry of light and reduce the chlorophyll content in leaves (Hosagoudar et al., 1997). It was shown that A. congesta infection in sandal tree leads to increased production of cyclic compounds such as proline, indicating high stress levels in the host (Hosagoudar et al., 1997). The accumulation of proline in plants is known as a common physiological response to environmental abiotic and biotic stresses (Verbruggen & Hermans, 2008).

According to Hansford (1946), the family includes specialized ecto-parasites with surface mycelia that feed via haustoria on individual epidermal cells of a particular host. In the modified family concept characteristics such as spherical asci and their vertical development in the shield-shaped ascomata (thyrothecia) are prioritized upon infection strategy (Müller & Arx, 1962). Accordingly, species of Asterinaceae sensu Müller & Arx (1962) show various modes of host infection, like haustoria in single epidermal cells, hyphal penetration of stomata, intra- and subcuticular hyphae or stromata, intracellular or intercellular hyphae, or hyposstomata in epidermal and subepidermal cells. Depending on the species, infection types can occur separately or combined. Due to the lack of detailed molecular studies, it is unknown whether infection strategies might represent informative characteristics for the separation of species and genera in this family.

Species of Asterina Lév. (Aina.), Asterolibertia G. Arnaud (A.), Cirsosia G. Arnaud, Lembosia Lév., or Trichasterina G. Arnaud typically form lateral or intercalary mycelial appressoria for the infection of host tissue. Surface mycelia of species of Asterolibertia and Cirsosia have intercalary appressoria at regular intervals. These appressoria are often inflated and, therefore, can be distinguished easily from cells of the surface mycelium. However, some species develop intercalary appressoria that are identical to other mycelial cells and can only be distinguished by an indistinct penetration porus. In these cases it is useful to study thin transversal sections of fresh leaves with fungal infection. The haustoria can be easily recognized especially when stained with cotton blue, and are normally localized directly below the appressoria.
Species of *Asterolibertia* form circular ascomata, whereas *Cirsosia* species are characterized by elongated, L-, Y- or X-shaped ascomata.

In this study two species of *Asterolibertia* and one species *Cirsosia* and the asexual stage *Homalopeltis* are reported for Central America and Panama for the first time and are described and illustrated in detail. The teleomorph *C. splendida* is linked for the first time to the asexual morph *H. chrysobalani* based on morphological observation. Additionally, an identification key of genera of Asterinaceae with intercalary appressoria from western Panama is provided and nomenclatural novelties are introduced.

**MATERIALS AND METHODS**

Infected leaves with colonies of *Asterolibertia* and *Cirsosia* were collected randomly in different habitats in western Panama between 2003 and 2007. Host plants were identified with the Flora of Panama (Woodson & Schery, 1943-1980). Air-dried material was observed with a Nikon SMZ645 stereomicroscope and a Nikon Eclipse 80i microscope with drawing tube. Microscopic slides, drawings and materials used for scanning microscopy (SEM) were prepared according to Hofmann et al. (2010). Type material was loaned from the US National Fungus Collections, Beltsville, Maryland (BPI) and the Plant Protection Research Institute, Pretoria (PREM). Known host plants and the distribution of the presented species were taken from the Fungal Databases (Farr & Rossman, 2010; Systematic Mycology and Microbiology Laboratory, ARS, USDA, retrieved February 23, 2014, from http://nt.ars-grin.gov/fungal databases/) and examined herbarium specimens. Dried herbarium specimens were deposited in the Forschungsinstitut Senckenberg, Frankfurt (FR), in the Botanische Staatssammlung München (M), Germany, and in the Herbario Nacional de la Universidad de Panamá, Panama (PMA).

**RESULTS**

**Key to species of Asterinaceae with intercalary appressoria in western Panama**

1  Sporomata elongated, on Chrysobalanaceae .......................... .......................... 
   ...................................................... .......................... *Cirsosia splendida*

1* Sporomata circular, on Chrysobalanaceae or Annonaceae .......................... 
   ...................................................... .......................... .......................... 2

2  Asexual, pycnothyria with pores, conidia cylindrical ..
   ...................................................... .......................... *Homalopeltis chrysobalani*

2*  Teleomorphic, thyriothecia with star-shaped fissures, ascospores ellipsoidal .......................... 3

3  Internal hypostroma missing, haustoria present ...........
   ...................................................... .......................... *Asterolibertia licanicola*

3*  Internal hypostroma present, spread in epidermal layer
   ...................................................... .......................... *Asterolibertia nodulosa*

**New records for Central America and Panama**

With this study the number of known species of Asterinaceae from Panama increases from 26 to 29. The genera *Asterolibertia* and *Cirsosia/Homalopeltis* are reported for the first time for Panama.


Type on *Licania* sp. (Chrysobalanaceae). Brazil, Santa Catarina, São Francisco, June 1885, E. Ule, Rabenhorst-Winter 3746 (type, PREM 4086!, labeled as *Asterina inaequalis*).

Colonies epiphyllous, irregularly circular, mostly single, sometimes confluent, 0.1–22 mm diam. (n=10), black, conspicuous, and dense. Surface hyphae straight, rigid, not undulating, branching mostly opposite, rarely

**FIGURE 1**- *Asterolibertia licanicola* on *Licania arborea* (T.A. Hofmann 578). A. Adaxial side of infected leaf. Scale bar = 4 cm; B. Part of the colony with large immature and smaller mature thyriothecia and surface mycelium. Scale bar = 1 mm; C. Haustorium in epidermal host cell. Scale bar = 15 µm; D. Open thyriothecium with liberated, mature ascospores. Scale bar = 50 µm; E. Surface mycelium with intercalary appressoria and ascma initials. Scale bar = 25 µm; F. Mature, slightly verrucose ascospores, some of them germinating. Lower cells of ascospores collapse during germination and endohyphae are formed. Scale bar = 20 µm.
unilateral or alternate, brown, cells cylindrical, (9)15–28(34)×(3.5)4–4.5(5) µm (n=30), wall up to 1 µm thick, smooth. Appressoria numerous, intercalary, cylindrical with a slightly swollen central part, (9)10–13(14)×(6)7–8 µm (n=30), penetration pore central, up to 2.5 µm diam. Haustoria arbuscular, globose, ellipsoidal to ovate or reniform, (10)11–14(15)×(5)6–8(9) µm (n=10), hyaline, filling up to 1/4 of host cell. Hypostroma absent. Thryothece single or confluent, circular, dimidiate, strongly fringed at margins, (200)217–302(350)×(310)340–430(470) µm diam. (n=30), dark brown to black, opening with central star-shaped fissures, young and closed ascomata conspicuously larger with entire margins. Scutellum radiate, composed of dichotomously branched filaments, cells isodiametric to cylindrical, straight, (4)6–12(17)×(3)4–5(6) µm (n=30), dark brown to black. Ascii globose to ovate, without ocular chambers, bitunicate, ascus wall 1+, 37–40 µm diam. (n=4), 8-spored, rapidly disintegrating, developing on ascogenous hyphae with proliferating croziers, interascal tissue absent. Ascospores 2-celled, ellipsoidal, straight, septate, slightly constricted at septum, ends rounded, lower cell tapered, (25)26–29(30) µm long (n=16), upper cell 12–15 µm wide, lower cell 11–13(14) µm wide, brown, wall up to 1 µm thick, verrucose, germinating first at the distal part of the upper cell with a stalked and entire appressorium, (9)10–12(15)×(8)10–12(14) µm. Scutellum radiate, composed of dichotomously branched filaments, cells isodiametric to cylindrical, straight, (4)6–12(17)×(3)4–5(6) µm (n=30), dark brown to black. Ascii globose to ovate, without ocular chambers, bitunicate, ascus wall 1+, 37–40 µm diam. (n=4), 8-spored, rapidly disintegrating, developing on asco-genous hyphae with proliferating croziers, interascal tissue absent. Ascospores 2-celled, ellipsoidal, straight, septate, slightly constricted at septum, ends rounded, lower cell tapered, (25)26–29(30) µm long (n=16), upper cell 12–15 µm wide, lower cell 11–13(14) µm wide, brown, wall up to 1 µm thick, verrucose, germinating first at the distal part of the upper cell with a stalked and entire appressorium, lower cell collapsing during germination, with endohyphae. Anamorph absent.

Known host plants: Chrysobalanaceae: *Licania arborea* Seem. (new host plant) and *Licania* sp. (Hansford, 1949).

Known distribution: Neotropics: Central America (new record) – Panama (new record) and South America – Brazil (Hansford, 1949). *A. licaniicola* occurs in western Panama in lowland gallery forests at approx. 140 m a.s.l.

Specimens examined: BRAZIL. Santa Catarina: type, see above. PANAMA. Chiriqui Province: Los Algarrobos, border of Majagua river, ca. 140 m a.s.l., epiphyllous on *Licania arborea* (det. T.A. Hofmann) associated with *Camarotella* sp. (Phyllachorales, det. T. Trampe), 6 October 2007, T.A. Hofmann 578 (M-0141092, PMA); same locality, Panama in lowland gallery forests at approx. 140 m a.s.l. 1949.


Notes: The type collection of *Asterolina inaequalis* on *Licania* sp. contains various foliicolous thyrithecioid ascomycetes and the most dominant is *Asterolina inaequalis* (Mont.) Toro. In contrast to *A. licaniicola*, *A. inaequalis* forms conspicuous and dense colonies with a dark, rigid surface mycelium with barrel-shaped, intercalary appressoria, measuring 9–14 µm (Arnaud, 1925; Müller & Arx, 1962). *Asterolibertia inaequalis* has 2-celled, dark brown, compressed ascospores with broadly rounded ends, with sizes of 32–40×18–25 µm. The ascospores are smooth, with a septum in the upper third of the ascospore and germinate at the upper cell with a stalked, entire appressorium (Arnaud, 1925; Müller & Arx, 1962). In contrast to *A. inaequalis*, the ascospores of *A. licaniicola* are smaller and finely verrucose (not observed by Hansford, 1949). During germination of the ascospore, a stalked, globose appressorium develops at the upper cell and an endohypha grows through the collapsed lower cell to initiate the development of surface mycelium (Figure 1F).

In Panama, *A. licaniicola on Licania arborea* forms large conspicuous colonies and is not associated with *A. inaequalis*. However, different fungal hyperparasites and mites were found on the colonies. *A. licaniicola* is illustrated here for the first time.


Type on *Tabebuia* sp. (Bignoniaceae) [= Guatteria sp. (Annonaceae) fide Theissen 1913]. Brazil, São Paulo, Apiály, October 1881, no. 1585 (type, LPS n.v.).


Colonies epiphyllous, rarely hypophyllous, irregularly circular, single, 0.5–5 mm diam. (n=10), black, conspicuous and dense. Surface hyphae straight, rigid, not curved, branching opposite or rarely unilateral, brown to dark brown, at tips paler, septate, cells cylindrical, (10)19–31(33)×(3.5)4–5(5) µm (n=30), wall 0.5–1(1.5) µm thick. Appressoria numerous, intercalary, cylindrical cell with a swollen middle part, (9)10–12(15)×(8)10–12(14) µm (n=70), penetration pore central, up to 1 µm diam. Haustoria not observed, infection hyphae penetrate epidermal host cells. Hypostroma epidermal to subepidermal, composed of bundles of intracellular hyphae, hyaline to pale brown, completely filling epidermal host cells, infectious hyphae penetrating cuticle and form brown, thick-walled hyphae in the upper part of an epidermal cell from which a hyaline stroma is initiated, later brown, thick-walled hyphae develop in lower part of the epidermal cell to form infectious hyphae that penetrate subepidermal host cells. Thryothece crowded and confluent, circular, dimidiate, strongly fringed at margins, (200)259–317(350) µm diam. (n=64), dark brown to black, opening with central star-shaped fissures. Scutellum radiate, composed of dichotomously branched
filaments, cells isodiametric to cylindrical, straight, (4)5–12(17)×(2)3–5(6.5) µm (n=30), brown to dark brown or blackish. Asci globose to ovate, without ocular chambers, bitunicate, I–, (45)50–59(60.5) µm diam. (n=30), 8-spored, developing on ascogenous hyphae with proliferating croziers, rapidly disintegrating, interascal tissue present, filamentous, septate, anastomosing. Ascospores 2- (rarely 3-) celled, ellipsoidal, straight, ends rounded, slightly tapering to one end, first septum forms in the upper third of the ascospore, slightly constricted at first septum, second septum if present inconspicuous and thin-walled, second septum in the lower third of ascospore, not constricted, (27.5)28–32(33)×(14)15–17(17.5) µm (n=30), brown to dark brown, wall up to 1 µm thick, verrucose, germinating at distal or lateral part of lower cell (more rarely at upper cell) with a multicellular, conical, multilobate and dark brown appressorium from which surface mycelium is formed laterally, upper and lower cell of ascospore collapse during development of first appressorium. Anamorph not observed.

Known hosts: Annonaceae: Guatteria dolichopoda Donn. Sm. (Hansford, 1949), Guatteria sp. (Theissen, 1913), Oxandra venezuelana R.E. Fr. (new host plant genus and species) and Xylopia sp. (new host plant genus).

Known distribution: Neotropics: Central America – Costa Rica (Hansford, 1949), Panama (new record) and South America – Brazil (Spegazzini, 1889). A. nodulosa occurs in western Panama in lowland gallery forests at approx. 140 m a.s.l.

Specimens examined. COSTA RICA. Alajuela Province: San Pedro de San Ramon, 2 May 1925, H. Sydow 683 (BPI 690122, labeled as Asterina nodulosa). BRAZIL. Pernambuco: Recife, Dois Irmãos, on Xylopia sp., 16 March 1960, O. Soares 18841 (BPI 671071, labeled as Asterolibertia malpighii). PANAMA. Chiriqui Province: Los Algarrobos, border of Majagua river, ca. 140 m, epiphyllous on Oxandra venezuelana (det. T.A. Hofmann), associated with various hyperparasites, 3 October 2005, T.A. Hofmann et al. 356 (FR, PMA); same locality, host species and associated organisms, 22 March 2006, T.A. Hofmann et al. ppMP 482 (M-0141024, PMA); same locality, host species and associated organisms, 11 June 2006, T.A. Hofmann 465 (FR, PMA); same locality, host species and associated organisms, 21 June 2006, T.A. Hofmann et al. ppMP 599 (M-0141025, PMA); same locality, host species and associated organisms, 10 January 2007, T.A. Hofmann el al. ppMP 1203 (M-0141026, PMA); same locality, host species and associated organisms, 8 September 2007, T.A. Hofmann 528 (PMA).

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New records of plant parasitic Asterinaceae (Dothideomycetes, Ascomycota) with intercalary...from Costa Rica studied by Hansford 13 years earlier and without examining the type specimen from Brazil. Wardina is considered a synonym of Asterolibertia by Müller & Arx (1962).


Type on _Hirtella americana_ (Chrysobalanaceae), Brazil, Pernambuco, Recife, R.M. Rocha Batista s.n. (holotype, URM 2990 n.v.).

Anamorph: *Homalopeltis chrysobalani* (Henn.) Bat. & Valle, IMUR 337:6 (1961), new anamorph - teleomorph connection. Figures 6, 7C-D.

Type on _Chrysobalanus icaco_ L. (Chrysobalanaceae). Brazil, Pará, Belém, Botanical Garden Goeldi, 20 January 1908, C.F. Baker 244 (syntypes, B n.v., HBG n.v., MG 20408 n.v., BPI 391611!, S F40793 n.v., labeled as *Leptothyrella chrysobalani*).
Leptothyrella chrysobalani
Henn., Hedwigia 48:114 (1908).

= Leprieurina radiata Toro, Journ. Dept. Agric.
Porto Rico 5:16 (1926). Type on Chrysobalanus icaco L.
(Chrysobalanaceae). Puerto Rico. Loíza, 16 November
1925, R.A. Toro 428 (type, BPI 391581!), syn. nov.

Colonies amphigenous, irregularly circular, single,
later becoming confluent, 0.5–4 mm (n=10), conspicuous
and dense on C. icaco, often covering large parts of leaves, very
inconspicuous and discrete on H. triandra, black. Surface
hyphae straight to undulating, branches mostly opposite,
sometimes unilateral or alternate, brown to dark brown, at
tips paler, septate, cells cylindrical, (5)11–22(32)×(2.5)3–
5(5.5) µm (n=30), wall 0.5 µm thick, smooth. Appressoria
numerous, intercalary, cylindrical cell with a slightly swollen
middle part on one side of hyphae, (8.5)10–13(15)×(4)5–
6(7.5) µm (n=60), penetration pore central, up to 1 µm
diam. Haustoria ellipsoidal, sausage-shaped, reniform or
U-shaped, arbuscular, (11)12–16(17)×5–6 µm (n=10),
hyaline, filling up to 1/5 of host cell. Thyriothecia single
or confluent, elongated, L–, Y– or X–shaped, dimidiate,
fringed at margins, (150)227–544(600)×(110)135–
368(500) µm (n=27), brown to dark brown, opening with
central longitudinal slits. Scutellum radiate, composed of
dichotomously branched filaments, cells isodiametric
to cylindrical, straight in center, undulating at margins of
ascoma, (3)4–7(10)×2–5(6) µm (n=60), brown to dark
brown. Ascii globose to broadly clavate, or ovate, with
ocular chambers, bitunicate, ascus walls 1+, 22–27(28) µm
diam. (n=9), 8-spored, developing on ascogenous hyphae
with proliferating croziers, interascal tissue not observed.
Ascospores 2-celled, ellipsoidal, elongated, straight or
slightly bent, ends broadly rounded, lower cell sometimes
acuminate and tapered to one end, septum in upper third of
spore, constricted at septum, 18–21(22) µm long (n=11),
upper cell 7–9(10) µm wide, lower cell (6)7–8 µm wide,
pale brown to brown, cell wall up to 1 µm thick, slightly
 verrucose, germinating ascospores not observed.

Anamorph present, called Homalopeltis
chrysobalani. Pycnothyria numerous, single or confluent,
circular, dimidiate, fringed at margins, (70)102–188(260)
µm diam. (n=60), brown to dark brown, with central
ostiole, (6)7–9(10) µm diam. (n=40). Conidiogenous
cells monoblastic, formed by single cells of inner part of
scutellum layer. Conidia numerous per pycnothyrium, first
1-celled, later becoming 2-celled, ellipsoidal, elongated,
upper end rounded or acuminate, lower end with truncate hilum, septum developing in the center or in the upper third of a mature conidium, not constricted, (19)21–24(25)×4–7(8) μm (n=60), first hyaline, pale to dark brown when fully mature, smooth, hilum of hyaline conidia sometimes with mucous droplet, development of septum and pigmentation after spore discharge, germinating at distal part of upper cell with a stalked simple appressorium, lower cell collapsing during germination, after successful penetration of host by first appressorium upper cell forming endohyphae through collapsed lower cell to initiate growth of appressoriate surface mycelium.

Known hosts: teleomorph: Chrysobalanaceae – Chrysobalanus icaco L. (new host plant species), Hirtella americana L. (Batista & Maia, 1960) and H. triandra Sw. (new host plant species); anamorph: Chrysobalanaceae – C. icaco L. (Batista & Valle, 1961; Toro, 1926 as Leprieurina radiata), H. americana L. and H. triandra Sw. (new host plant genus and species).

Known distribution: Neotropics: Caribbean – Puerto Rico (Toro, 1926, as Leprieurina radiata), Central America (new record) – Panama (new record) and South America – Brazil (Batista & Maia, 1960; Batista & Valle, 1961). Cirsosia splendida occurs in the anamorphic and teleomorph state in western Panama on the pacific coast, from 0 to about 5 m a.s.l., and in semi-deciduous lowland forests at approx. 150 m a.s.l.


Notes: According to Batista & Maia (1960), Cirsosia splendida grows intermixed with smaller, circular pycnothyria which form unicellular, bacilliform and hyaline conidia. A connection of the small conidia with the appressoriate surface mycelium of the teleomorph was not demonstrated by the authors. The small, bacilliform spores are probably formed by another fungus growing together with C. splendida. Unfortunately the type material of C. splendida could not be obtained from Brazil, although it was repeatedly requested.

The pycnothyria-forming fungus Homalopeltis chrysobalani was collected repeatedly on living leaves of Chrysobalanus icaco (Chrysobalanaceae) (Figure 6A) at the pacific coast of western Panama. H. chrysobalani forms brown surface mycelia with intercalary appressoria and was described as asexual plant parasitic fungus without sexual morph (Batista & Valle, 1961; Hennings, 1908). In older and very dense colonies of H. chrysobalani we observed elongated, L- or Y-shaped thyriothecia containing asci with 2-celled, brown ascospores. The thyriothecia-forming fungus corresponds to Cirsosia splendida. Both sexual and asexual morphs are characterized by the same type of appressoriate surface mycelium with saucer-shaped haustoria. Colonies of C. splendida together with H. chrysobalani could be observed additionally on a different host plant species, Hirtella triandra (Chrysobalanaceae), at a different location in a gallery forest in western Panama. However, on H. triandra the parasite develops much smaller and inconspicuous colonies (Figure 5A), with a less dominant asexual morph.

In 1926, Toro described Leprieurina radiata Toro on C. icaco from Puerto Rico. The type material of L. radiata from BPI was examined and is identical with H. chrysobalani, the asexual morph of C. splendida.
Both teleomorph and anamorph were illustrated before (Bastista & Maia, 1960; Batista & Valle, 1961; Toro, 1926), however, the surface composition of ascomata, pycnidia, conidia, and the ornamentation of the ascospores are illustrated here for the first time (Figures 5-7).

During the revision of species of Asterinaceae on Chrysobalanaceae, type specimens of *Asterina nodulifera* were investigated. The fungus presents a surface mycelium with intercalary appressoria, circular ascomata, and brown 2-celled ascospores and therefore corresponds to a species of *Asterolibertia*. A corresponding recombination is proposed. A complete description in english is given below.

*Asterolibertia nodulifera* (Syd. & P. Syd.) T.A. Hofmann, comb. nov.


Type on *Angelesia splendens* Korth. (Chrysobalanaceae). Philippines, Palawan Province, Taytay, May 1913, Merill 8901 (lectotype, designated here, BPI 690120!); same locality, date, host plant and collector (isolateotypes, BPI 690121!, S F12426 n.v.).

Mycobank MB809692

Colonies amphigenous, irregularly circular, single, sometimes confluent, conspicuous and dense, black. Surface hyphae straight, rarely undulating, branches mostly opposite, rarely unilateral or alternate, brown to dark brown, at tips paler, septate, cells cylindrical, (11)13–25(35)×(4.5)5–6(7) µm (n=30), wall 1 µm thick, smooth. Appressoria numerous, intercalary, short cylindrical cell swollen to one or both sides of hyphae, (9)10–12(13)×(8)9–11(12) µm (n=30), penetration pore central, 3 µm diam., often with ca. 1 µm broad rim. Haustoria not observed. Thryothecia single or confluent, circular, dimidiate, fringed at margins, (320)332–398(420) µm in diam. (n=17), dark brown, opening with central star-shaped fissures. Scutellum radiate, composed of dichotomously branched filaments, cells isodiametric to cylindrical, straight, slightly undulating at margins of ascoma, (4)6–15(23)×(3)4–6(7) µm (n=30), brown to dark brown. Asci, ascogenous hyphae and interascal tissue not observed. Ascospores 2-celled, ellipsoid, elongated, straight, ends broadly rounded, 33–35(36)×(13)14–15 µm (n=16), septum in upper third of spore, upper cell globose, lower cell ellipsoidal and tapered, constricted at septum, brown, upper cell darker than basal cell, cell wall up to 1 µm thick, echinulate, germinating first at the distal part of the upper cell with a stalked, 1-celled appressorium, lower cell collapsing during germination. Anamorph not observed.

**DISCUSSION**

The family Asterinaceae requires substantial revision on morphological and molecular level. Many species are described without any illustration or detailed discussion of morphologically related species. Type material is often in bad condition or difficult to access. Data on host specificity are lacking, since these obligate biotrophic parasites cannot be cultivated (Hofmann & Piepenbring, 2008, 2011). Field collection and detailed morphological analysis are necessary in order to understand the development and ecology of these apparently highly diverse tropical microfungi (Piepenbring et al., 2011). DNA sequences are not available for most of the representatives of the family, with exception of a few species of *Asterina* (Hofmann et al., 2010). Molecular analysis of Asterinaceae remains a challenging task due to the reduced hymenia and mostly melanized fungal structures, as well as the presence of other organisms on the same host plant. Dried voucher specimens are mostly not suitable for successful DNA extraction and fresh fungal material has to be accessed directly in the field. A representative sequence sampling of Asterinaceae is urgently needed to complete our understanding of the phylogenetic relationships in this poorly known lineage of Dothideomycetes.

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