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ARTICLE

Additions to the genera *Asterolibertia* and *Cirsosia* (*Asterinaceae, Asterinales*), with particular reference to species from the Brazilian Cerrado

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Abstract: Four new *Asterolibertia* species and a new variety of *Cirsosia splendida*, all found on native Cerrado plants, belonging to three host families are described, illustrated and named as: *A. bahiensis* sp. nov. on *Erythroxylum* sp. (*Erythroxylaceae*); *A. barrinhensis* sp. nov. on *Diospyros burchellii* (*Ebenaceae*); *A. campograndensis* sp. nov. on *Hirtella glandulosa* (*Chrysobalanaceae*); *A. parinaricola* sp. nov. on *Parinari obtusifolia* (*Chrysobalanaceae*); and *Cirsosia splendida* var. *laevigata* var. nov., showing both sexual and asexual morphs, on *H. glandulosa* and *H. gracilipes* (*Chrysobalanaceae*). Finally, *A. licaniae* is reported on a new host, *H. gracilipes*. Keys to all the known species of *Asterolibertia* and *Cirsosia* are included.

Key words:
biotrophic ascomycetes
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INTRODUCTION

Molecular data are generally unavailable for members of *Asterinaceae* and the taxonomy of most genera in this family to date relies chiefly on morphological data. That is the case of *Asterolibertia* and *Cirsosia*. Overcoming this limitation will depend on recollecting the taxa described in the past and where appropriate epitypifying these after extracting and sequencing genomic DNA. There have been a few cases where this was performed successfully from old herbarium specimens (Telle & Thines 2008, O'Gorman *et al*. 2010, Hawksworth 2013, Guatimosim *et al*. 2015, Thomas *et al*. 2015).

The genera of *Asterinaceae* are presently segregated using well-defined morphological characters, such as the presence or absence of appressoria on the external mycelium, setae on ascomata and/or on the external mycelium, appressorium type (intercalary or lateral), and ascospore septation (Bezerra 2004, Hosagoudar 2012). Within the family, only three genera have intercalary appressoria: *Asterolibertia*, *Cirsosia,* and *Bheemamyces* (Arnaud 1918, Bezerra 2004, Hosagoudar 2010, 2012). However, in *Bheemamyces* the appressoria are both lateral and intercalary (Hosagoudar *et al*. 2010).

For almost a century, *Asterolibertia* was considered a well-supported genus, due to the presence of intercalary appressoria as originally established by Arnaud (1918), and this has been always regarded as a strong morphological character. However, Hongsanan *et al*. (2014), without any molecular basis and morphological justification, recombined species of *Asterolibertia* into *Asterina*, a genus with species showing only lateral appressoria. Such recombinations must be regarded as questionable, particularly in the absence of molecular data.

Currently, *Asterolibertia* includes 35 species (Tables 1–2) found only in the tropics and mainly on the host families *Chrysobalanaceae*, *Malpighiaceae,* and *Rubiaceae* (Hosagoudar 2010, Farr & Rossman 2015). The genus *Cirsosia* accommodates 15 species and one variety, all from the tropics (Tables 3–4), found mainly on *Arecaceae*, *Chrysobalanaceae*, *Dipterocarpaceae*, and *Malpighiaceae* (Hosagoudar 2010, Farr & Rossman 2015).

Asterolibertia couepiae, the type species of the genus, was collected in the Brazilian Cerrado by Ule in 1892, while *C. manaosensis*, the type species of *Cirsosia,* also from Brazil, was collected also by Ule in the Amazonian forest (Arnaud 1918). *Asterolibertia* species are characterized by having circular thyriothecial ascomata opening by a central star-shape fissure, adhering to the host by superficial hyphae with intercalary appressoria, and showing 2-celled ascospores. *Cirsosia* species differ from *Asterolibertia* in the lirelliform or V–Y-shaped ascomata, opening by a longitudinal fissure. However, as in *Asterolibertia*, *Cirsosia* species have superficial hyphae with intercalary appressoria and 2-celled ascospores (Bezerra 2004, Hosagoudar 2010, 2012). The specimens studied here were collected from different areas of the Brazilian Cerrado (including a fragment of Cerrado vegetation inserted in an area of the Brazilian Atlantic Forest in the State of Bahia) and yielded what is here recognised as novel taxa and host-associations for *Asterolibertia* and *Cirsosia.*

This paper describes four new *Asterolibertia* species, a new variety of *C. splendida*, and illustrates *A. licaniae* in association with a new host.

Table 1. Morphometric characteristics of *Asterolibertia* species (µm), including five new ones described in this study.

Asterolibertia Species	Ascomata	Hyphae	Appressoria	Asci	Ascospores	Source and country
anisopterae (Syd. & P. Syd.) Hansf.	< 800 × 300–450	6–7	15–20 × 10–15	50–70 × 45–55	28–38 × 17–22	Hansford (1949), Philippines
bahiensis Firmino, Inácio & Dianese	175–235	4–5	14–17.5 × 9–10	35–52.5 × 30–42.5	32.5–37.5 × 10–14	Present study, Brazil
bakeri (Syd. & P. Syd.) Hansf.	< 350	3–5	10–15 × 5–8	50–70 × 30–40	26–36 × 12–14	Hansford (1949), Philippines
barrinhensis Firmino & Dianese	105–167.5	4–5	9–15 × 7.5–10	30–42.5 diam	20–27.5 × 9–12.5	Present study, Brazil
bredemeyerae (Rehm) Arx	170–280	4–5.5	–	55–70 × 18–27	18–25 × 8–10	Müller & Arx (1962), Brazil
burchelliae (Doidge) Doidge	90–120	3–4	5–5.5 wide	27–37.5 × 16–20	13–17.5 × 5–6.5	Doidge (1942), South Africa
campograndensis Firmino & Dianese	75–160	5–7	9–14 × 7.5–12	30–40 × 20–32.5	22.5–30 × 9.5–10.5	Present study, Brazil
couepiae (Henn.) G. Arnaud	150–200	6–8	–	30–35 × 26–32	16–24 × 8–13	Arnaud (1918), Brazil
crustacea (Ellis & Everh.) Hansf.	< 400	4.5–5.5	4.5–5.5 wide	100 × 20–25	25–28 × 8–14	Hansford (1955), Dominican Republic
cryptocaryae (Cooke) Hansf.	< 300	4–5	–	100 × 35	25–32 × 11–13	Hansford (1954b), Australia
gibbosa (Gaillard) Hansf	< 90	5–6	10–14 × 7–8	27–32 × 18–24	17–21 × 8–9	Hansford (1949), Brazil
hiiranensis (W. Yamam.) W. Yamam.	35–62	3–4.5	7–11 × 5.5–7	23–30 × 16–23	14–16 × 6.5–7	Yamamoto (1957), Taiwan
hydnocarpi Hosag. & T.K. Abraham	< 264	11–13.5	14–16 × 11–13.5	< 67 diam	49–51.5 × 26–32.5	Hosagoudar & Abraham (1997), India
inaequalis (Mont.) Toro	180–280	6–9	9–14 wide	100 diam	32–40 × 18–25	Toro (1933), French Guiana
licaniae (Cooke) Hansf.	< 450 × 300	6–9	7–13 × 9–13	–	30–33 × 18–20	Hansford (1949), Brazil
licaniicola Hansf.	170	4–5	9–11 × 6–7	–	24–28 × 12–15	Hansford (1949), Brazil
malpighii Bat. & H. Maia	120–185	4–8	13.5–21 × 4–8	37–43 × 27–32	29–35 × 15–16.5	Batista & Maia (1960a), Brazil
mangiferae Hansf. & Thirum.	250–300	7	12–15 × 10–11	< 70 diam	35–42 × 16–19	Hansford & Thirumalachar (1948), India
megathyria (Doidge) Doidge	140–200	5–6	7.5–10 wide	27–40 × 15–20	16–20 × 8–9	Doidge (1942), South Africa
myocoproides (Sacc. & Berl.) Arx	500	8.5–9	16–20 wide	50–60 × 20–22	26–28 × 10–12	Müller & Arx (1962), Brazil
nodulifera (Syd. & P. Syd.) T.A. Hofmann	320–420	4.5–7	9–13 × 8–12	33–36 × 13–15	33–36 × 13–16	Hofmann & Piepenbring (2014), Philippines
nodulosa (Speg.) Hansf.	< 250	5–6	10–15 × 10–12	100 × 50	30–40 × 14–18	Hansford (1949), Costa Rica
nothopegiae Hosag. & T.K. Abraham	< 265	5–7	10–12 × 9.5–11	32–35 × 24–27	19–21 × 9–10	Hosagoudar & Abraham (1997), India
parinaricola Firmino, Inácio *et al*.	150–207.5	4.5–5.5	10–15 × 7–9	37.5–47.5 × 29–32.5	34–40 × 10–14	Present study, Brazil
parinarii (Syd.) Hansf.	130–160	3–4.5	6.5–7.5 × 5–6	30–38 × 25–35	18–22.5 × 5–6	Hansford (1947), Democratic Republic of the Congo
peruviana Hansf.	200	4–6	4–6 wide	–	17 × 8	Hansford (1955), Peru
pogonophorae Bat. & H. Maia.	125–175	4–6	10–12 × 6–8	43–55 × 33–35	33–35 × 10–12	Batista *et al.* (1961), Brazil
randiae (Doidge) Arx	75–100	2–4	20 × 5–8	–	15–18 × 5–6.5	Müller & Arx (1962), Southern Africa
santiriae (Syd. & P. Syd.) Hansf.	400 × 250–300	5–7	15–20 × 8–10	50–75 × 45–60	32–36 × 17–22	Hansford (1954a), Philippines
schroeteri (Rehm) Arx	220–300	6–8	10–13 wide	60–70 × 42–46	38–42 × 11–13	Müller & Arx (1962), Brazil
spatholobi Hansf.	250	5–6	6–8 × 6–8	45 × 35	18–20 × 7.5–8.5	Hansford (1954a), Java
sporoboli E. Castell. & Graniti	60–110	6	6–16 × 7–10	–	16–22 × 7–9	Castellani & Graniti (1950), Ethiopia
thaxteri Hansf.	250	3–5	6–7 × 4–7	–	50–55 × 21–24	Hansford (1957), Grenada
ulei Hansf.	200	6–7	8–12 × 9–11	–	24–30 × 12–17	Hansford (1949), Brazil
vateriae Hosag.	300–400 × 150–250	11–13	10–15 × 2–14	< 35 diam	36–39 × 21–23	Hosagoudar *et al*. (2006), India

MATERIAL AND METHODS

Leaves bearing black colonies were collected and dried in a plant press before being processed and deposited in the Fungarium known as the UB Mycological Collection, a part of Herbarium UB (Universidade de Brasília). Colonies were initially examined using a Zeiss Discovery v.8 stereomicroscope. Entire colonies were removed from the leaves by applying small drops of nail polish. After these had solidified and fungal structures became embedded preventing the collapse of the colonies, these were peeled from the leaf surfaces. These colonies and small samples taken directly from the leaves were mounted on slides containing lacto-glycerol for light microscopic observations. Imaging and measurements were done using a Leica DM 2500 light microscope adapted with a DFC 490 Leica digital camera, operated by a Leica Qwin Plus digital image-processing software. For scanning electron microscopy (SEM), air-dried material was fixed to disks using carbon double-sided tape, and then treated with gold using a 25-mA current, at 1.10–2 mbar for 2 min and 30 s. Photographs were obtained using a JEOL Model JSM-700 1 F SEM.

RESULTS

A total of 35 species of *Asterolibertia* have previously been described on 19 different host families (Hosagoudar 2010, Farr & Rossman 2015). These have been described on the families: *Chrysobalanaceae* (9 species, including two new species described here), *Rubiaceae* (4); *Anacardiaceae*, *Annonaceae*, *Dipterocarpaceae*, *Fabaceae,* and *Malpighiaceae* (2 on each); and *Achariaceae*, *Arecaceae*, *Bignoniaceae*, *Bromeliaceae*, *Burseraceae*, *Ebenaceae* (described here), *Erythroxylaceae* (described here), *Euphorbiaceae*, *Lauraceae*, *Melastomataceae*, *Myrtaceae*, *Poaceae*, *Polygalaceae,* and *Styracaceae* (1 on each; Table 2). *Asterolibertia bredemeyerae* was reported from two different families (*Polygalaceae* and *Fabaceae*), as well as *A. schroeteri* (*Annonaceae* and *Chrysobalanaceae*) and *A. peruviana* (*Bignoniaceae* and *Chrysobalanaceae*). However, *A. peruviana* apparently belongs to *Microthyriaceae* due to the well-defined circular ostiole present on the ascomata (Hansford 1955, Wu *et al*. 2011). As *Asterolibertia* species are usually host specific, a reevaluation of the three species that occur in two different host families is recommended.

A total of 15 species and one variety of *Cirsosia* have been described on six different host families (Hosagoudar 2010, Hofmann & Piepenbring 2014, Farr & Rossman 2015): *Dipterocarpaceae* (5 species); *Arecaceae* (4); *Chrysobalanaceae* (3, including the new variety described here); *Malpighiaceae* (2); and *Burseraceae* and *Lauraceae* (1 on each; Table 4). There is no record of the same *Cirsosia* species being found on two different host families (Hosagoudar 2010, Farr & Rossman 2015).

TAXONOMY

The data in Tables 1–4 that include the characteristics of the new taxa herein proposed were used to formulate the keys provided for the identification of *Asterolibertia* and *Cirsosia* species, thus simplifying the text.

Asterolibertia bahiensis Firmino, Inácio & Dianese, **sp. nov.**
MycoBank MB813315
(Fig. 1)

Etymology: Refers to the state of Bahia where the fungus was collected.

Diagnosis: *Asterolibertia bahiensis* is quite close to *A. nodulifera* but differs in having smaller paraphysate ascomata and larger appressoria.

Type: **Brazil**: *Bahia*: Una, Bolandeira Farm, on an enclosure of Cerrado vegetation in the Brazilian Atlantic Forest, close to the entrance to Comandatuba Island, 15° 21' 12.7" S 39° 00' 7.7" W, on leaves of *Erythroxylum* sp. (*Erythroxylaceae*), 26 Aug. 1995, *M. Sanchez* (UB-Mycol Col. 9882 – holotype).

Description: *Colonies* amphigenous, circular to irregular, single to confluent, black, 1–12 mm diam. *Hyphae* straight to flexuous, branching irregularly, pale brown, septate, hyphal cells cylindrical, 4–5 µm diam, smooth. *Appressoria* numerous, entire, sessile, intercalary, elongated with a lateral protuberance, unicellular, 14–17.5 × 9–10 µm, brown, penetration peg central on the appressorial cell. *Ascomata* superficial, thyriothecia, scutiform, on top of mycelial mat, circular, single to confluent, fringed at margins, randomly distributed in the colony, 175–235 µm diam, opening by a central star-shaped fissure, dark brown; wall of *textura radiata*, cells cylindrical. *Pseudoparaphyses* cylindrical, septate, branched, hyaline, to 1 µm wide. *Asci* bitunicate in structure, fissitunicate, disposed as an upright palisade layer, globose to ovoid, 8-spored, hyaline, 35–52.5 × 30–42.5 µm. *Ascospores* cylindrical, ends rounded, straight or slightly arched, 1-septate, constricted at the septum at the supramedian septum, hyaline, becoming brown at maturity, verruculose, 32.5–37.5 × 10–14 µm. Asexual morph not seen.

Other specimens examined: On leaves of *Erythroxylum* sp. (*Erythroxylaceae*). **Brazil**: *Minas Gerais*: Buritis, Pedra Grande Farm, 8 May 1993, *J. C. Dianese 863* (UB-Mycol Col. 3934). *Bahia*: Una, on an enclosure of Cerrado vegetation in the Brazilian Atlantic Forest at Fazenda Bolandeira, near entrance to Comandatuba Island, *J.C. Dianese* (UB-Mycol Col. 9871).

Notes: The type material was collected in a rare small enclosure of Cerrado vegetation in the Brazilian Atlantic Forest. However another specimen (UB – Mycol Col. 3934) was found in a typical Cerrado natural landscape in Buritis, Minas Gerais. In addition, this is the first *Asterolibertia* species found on a member of *Erythroxylaceae* (Hosagoudar 2010, Farr & Rossman 2015).

Table 2. Summary of the main characteristics of *Asterolibertia* species indicating respective host family, host species, and morphology of colonies, appressoria, paraphyses, asci, and ascospores.

Species	Host	Families	Colonies	Appressoria	Pseudoparaphyses	Asci	Ascospores
anisopterae	*Anisoptera thurifera*	*Dipterocarpaceae*	epiphyllous	protuberance towards one side	absent	globose	constricted in the upper third, verruculose
bahiensis sp.nov.	*Erythroxylum* sp.	*Erythroxylaceae*	amphigenous	protuberance towards one side	branched	globose to ovoid	constricted in the upper third, verruculose
bakeri	*Calamus* sp.	*Arecaceae*	epiphyllous	barrel-shaped to subglobose	absent	ovoid	constricted in the upper third, verruculose
barrinhensis sp. nov.	*Diospyrus burchellii*	*Ebenaceae*	epiphyllous	protuberance towards one side	unbranched	globose to ovoid	constricted in the upper third, verruculose
bredemeyerae	*Bredemeyera lucida* *Sweetia nitens*	*Polygalaceae* *Fabaceae*	amphigenous	subglobose	unbranched	ovoid to clavate-cylindrical	constricted at the central septum, smooth
burchelliae	*Bertiera racemosa* *Burchellia bubalina* *Cremaspora triflora* *Tarenna pavettoides*	*Rubiaceae*	epiphyllous	barrel-shaped to cylindrical	absent	ellipsoid-ovoid	constricted in the upper third, smooth
campograndensis sp.nov.	*Hirtella glandulosa*	*Chrysobalanaceae*	epiphyllous	protuberance towards one side	unbranched	globose to ovoid	constricted in the upper third, smooth
couepiae	*Couepia grandiflora*	*Chrysobalanaceae*	epiphyllous	protuberance towards one side	absent	globose to subglobose	constricted in the upper third, smooth
crustacea	*Psidium guajava*	*Myrtaceae*	epiphyllous	cylindrical	absent	clavate to cylindrical	constricted in the upper third, smooth
cryptocaryae	*Cryptocarya grandis*	*Lauraceae*	amphigenous	–	absent	ellipsoid	constricted in the upper third, smooth
gibbosa	*Basanacantha spinosa*	*Rubiaceae*	amphigenous	barrel-shaped to cylindrical	absent	ovoid to globose	constricted in the upper third, smooth
hiiranensis	*Styrax hayataianus* *Styrax suberifolius*	*Styracaceae*	epiphyllous	–	absent	obovoid to subglobose	constricted at the central septum, smooth
hydnocarpi	*Hydnocarpus macrocarpa*	*Achariaceae*	epiphyllous	globose to ovoid	–	globose	constricted in the upper third, smooth
inaequalis	*Melastomataceae* member	*Melastomataceae*	epiphyllous	barrel-shaped to subglobose	absent	subglobose	constricted in the upper third, verruculose
licaniae	*Licania* sp.	*Chrysobalanaceae*	epiphyllous	barrel-shaped	absent	globose	constricted at the central septum, smooth
licaniicola	*Licania* sp.	*Chrysobalanaceae*	epiphyllous	barrel-shaped	absent	–	constricted at the central septum, smooth
malpighii	*Malpighiaceae* member	*Malpighiaceae*	epiphyllous	protuberance towards one side	absent	ellipsoid to subglobose	constricted at the central septum, verruculose
mangiferae	*Mangifera indica*	*Anacardiaceae*	epiphyllous	barrel-shaped	absent	globose	constricted in the upper third, smooth

Table 2. (Continued).

Species	Host	Families	Colonies	Appressoria	Pseudoparaphyses	Asci	Ascospores
megathyria	*Tricalysia capensi* *T. lanceolata* and *T. sonderiana*	*Rubiaceae*	amphigenous	barrel-shaped	–	ovoid to clavate-cylindrical	constricted in the upper third, smooth
myocoproides	*Guzmania plumieri*	*Bromeliaceae*	amphigenous	–	branched	ovoid to cyllindrical	constricted at the central septum, verruculose
nodulifera	*Angelesia splendens*	*Chrysobalanaceae*	amphigenous	protuberance towards one side	absent	globose to ovoid	constricted in the upper third, verruculose
nodulosa	*Guatteria dolichopoda*	*Annonaceae*	epiphyllous	barrel-shaped to subglobose	absent	ovoid to ellipsoid	constricted at the central septum, verruculose
nothopegiae	*Nothopegia aureofulva*	*Anacardiaceae*	epiphyllous	globose	–	ovoid	constricted at the central septum, smooth
parinaricola sp. nov.	*Parinari obtusifolia*	*Chrysobalanaceae*	epiphyllous	protuberance towards one side	branched	globose to ovoid	constricted in the upper third, verruculose
parinarii	*Parinari subcordata*	*Chrysobalanaceae*	epiphyllous	protuberance towards one side	unbranched	ellipsoid to subglobose	constricted in the upper third, smooth
peruviana	*Bignoniaceae* member *Licania macrophylla*	*Bignoniaceae* *Chrysobalanaceae*	epiphyllous	cylindrical	–	–	constricted in the upper third, smooth
pogonophorae	*Pogonophora schomburgkiana*	*Euphorbiaceae*	epiphyllous	protuberance towards one side	absent	oblong to subglobose	constricted in the upper third, smooth
randiae	*Randia dumetorum*, *Keetia gueinzii*and *Canthium capensis*	*Rubiaceae*	amphigenous	protuberance towards one side	–	ovoid to subclavate	constricted in the upper third, smooth
santiriae	*Santiria* sp.	*Burseraceae*	amphigenous	globose	absent	ovoid to ellipsoid	constricted in the upper third, smooth
schroeteri	*Annona* sp. *Chrysobalanus icaco*	*Annonaceae* *Chrysobalanaceae*	epiphyllous	protuberance towards one side	absent	ovoid to ellipsoid	constricted in the upper third, smooth
spatholobi	*Spatholobus ferrugineus*	*Fabaceae*	epiphyllous	barrel-shaped to cylindrical	absent	ovoid to globose	constricted in the upper third, smooth
sporoboli	*Sporobolus ruspolianus*	*Poaceae*	epiphyllous	globose to ellipsoid	–	–	constricted in the upper third, verruculose
thaxteri	unknown plant	-	hypophyllous	–	–	–	constricted in the upper third
ulei	*Malpighiaceae* member	*Malpighiaceae*	epiphyllous	subglobose	absent	ovoid to globose	constricted in the upper third, verruculose
vateriae	*Vateria indica*	*Dipterocarpaceae*	amphigenous	oblong to ovoid	–	ovoid to globose	constricted at the central septum, smooth

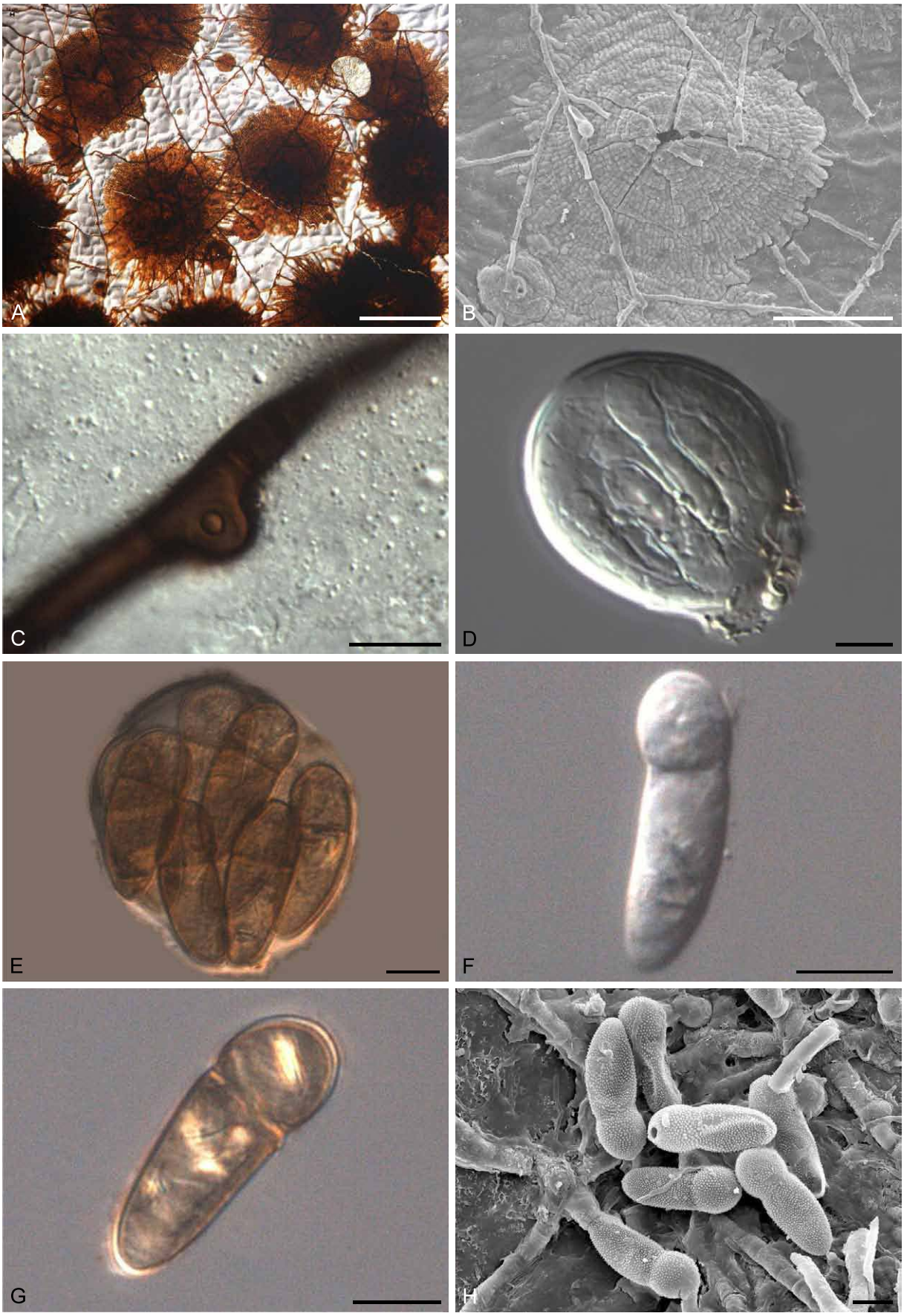

Fig. 1. A–H. *Asterolibertia bahiensis* (UB-Mycol. Col. 9882 – holotype): **A.** Colony showing thyriothecial ascomata on superficial mycelium. **B.** Central star-shape fissure in SEM. **C.** Intercalary appressoria with lateral protuberance. **D.** Immature ascus. **E.** Globose to ovoid mature ascus. **F.** Immature ascospores. **G.** Brown, verruculose, cylindrical ascospores. **H.** Verruculose ascospores in SEM. Bars: A = 100 µm; B = 50 µm, and all others = 10 µm.

Asterolibertia barrinhensis Firmino & Dianese, **sp. nov.**
MycoBank MB813316
(Fig. 2)

Etymology: Epithet refers to the type locality in Brazil, Barrinha.

Diagnosis: *Asterolibertia barrinhensis* is quite close to *A. campograndensis* but differs in having opposite hyphal branching, loose ascomatal fringes and verruculose ascospores.

Type: **Brazil**: *Minas Gerais*: Divinópolis, Barrinha Farm, right side of Highway from Divinopólis to Formiga, 20° 13' 54.9" S 45° 05' 33.7" W, on leaves of *Diospyros burchellii* (*Ebenaceae*), 16 Feb. 1994, *J. C. Dianese* (UB-Mycol Col. 5890 – holotype).

Description: *Colonies* epiphyllous, circular to irregular, single to confluent, black, 1–8 mm diam. *Hyphae* straight to flexuous, with opposite branches, ferruginous to brown, septate, hyphal cells cylindrical, 4–5 µm diam, smooth. *Appressoria* numerous, entire, intercalary, elongated with a lateral protuberance, unicellular, 9–15 × 7.5–10 µm, ferruginous to brown, penetration peg central on the appressorial cell. *Ascomata* superficial, thyriothecia, scutiform, on top of mycelial mat, circular, single to confluent, fringed at the margins, randomly distributed in the colony, 105–167.5 µm diam, opening by a central star-shaped fissure, brown; wall of *textura radiata*, cells isodiametric to cylindrical. *Pseudoparaphyses* cylindrical, septate, unbranched, hyaline, to 2.5 µm wide. *Asci* bitunicate in structure, fissitunicate, forming as an upright palisade layer, globose to ovoid, 8-spored, hyaline, 30–42.5 µm diam. *Ascospores* cylindrical, oblong-clavate, ends broadly rounded, straight, 1-septate, slightly constricted at supramedian septum, hyaline, becoming brown at maturity, verruculose, 20–27.5 × 9–12.5 µm. Asexual morph not seen.

Other specimens examined: On leaves of *Diospyros burchellii* (*Ebenaceae*). **Brazil**: *Minas Gerais*: Divinópolis, Barrinha, 16 Feb. 1994, *J. C. Dianese* (UB-Mycol Col. 5891, and 5901); *Goiás*: Mineiros, Parque Nacional das Emas, Água Ruim, 18° 8' 12.04" S 52° 58' 44.06" W, 7 Apr. 1997, *J. C. Dianese* (UB-Mycol Col. 13844).

Notes: This new *Asterolibertia* species is the first reported on a member of *Ebenaceae* (Hosagoudar 2010, Farr & Rossman 2015). It shows characteristics in common with several species (Tables 1–2), including the one described below, but clear differences persist as shown in the discussion that follows the description of *A. campograndensis*.

Asterolibertia campograndensis Firmino & Dianese, **sp. nov.**
MycoBank MB813317
(Fig. 3)

Etymology: Epithet refers to the city where the fungus was collected, Campo Grande.

Diagnosis: *Asterolibertia campograndensis* differs from *A. parinarii* in having larger hyphae, appressoria and ascospores, and globose to ovoid asci.

Type: **Brazil**: *Mato Grosso do Sul*: Campo Grande, left lane of BR-163 Highway, 200 m from the roundabout turn to São Paulo, behind Cerealista Juliana, 20° 35' 8.58" S 54° 34' 49.51" W, on leaves of *Hirtella glandulosa* (*Chrysobalanaceae*), 22 Aug. 1996, *M. Sanchez* (UB-Mycol Col. 12712a – holotype).

Description: *Colonies* epiphyllous, circular to irregular, single to confluent, black, 1–6 mm diam. *Hyphae* straight to flexuous, mostly showing opposite seldom irregular branches, ferruginous to brown, septate, hyphal cells cylindrical, 5–7 µm diam, smooth. *Appressoria* numerous, entire, intercalary, elongated with a lateral protuberance, unicellular, 9–14 × 7.5–12 µm, ferruginous to brown, penetration peg central on the appressorial cells. *Ascomata* superficial, thyriothecia, scutiform, on top of mycelial mat, circular, single to confluent, fringed at margins, massed in the centre of the colony, 75–160 µm diam, opening by a central star-shaped fissure, dark brown; wall of *textura radiata* to *irregulata*, cells cylindrical to irregular. *Pseudoparaphyses* cylindrical, septate, unbranched, hyaline, to 1 µm wide. *Asci* bitunicate in structure, fissitunicate, disposed as an upright palisade layer, globose to ovoid, 8-spored, hyaline, 30–40 × 20–32.5 µm. *Ascospores* oblong-clavate, rounded ends, straight, 1-septate, septum supramedian, constricted at septum, hyaline, becoming brown at maturity, smooth, 22.5–30 × 9.5–10.5 µm. Asexual morph not seen.

Notes: Seven species of *Asterolibertia* have been reported previously in association with living leaves of chrysobalanaceous hosts. Four of these were recorded from Brazil: *A. couepiae* on *Couepia grandiflora, A. licaniae* and *A. licaniicola* on *Licania* sp., and *A. peruviana* on *Licania macrophylla*. Additionally, *A. nodulifera* was recorded on *Angelesia splendens* from the Philippines, *A. parinarii* on *Parinari subcordata* from the Democratic Republic of the Congo, and *A. schroeteri* on *Chrysobalanus icaco* from India (Arnaud 1918, Hansford 1947, 1949, 1955, Müller & von Arx 1962, Hosagoudar 2010, Hofmann & Piepenbring 2014, Farr & Rossman 2015).

Asterolibertia campograndensis differs from the species previously reported on *Chrysobalanaceae* (Table 1) (Arnaud 1918, Hansford 1947, 1949, 1955, Müller & von Arx 1962, Hosagoudar 2010, Hofmann & Piepenbring 2014, Farr & Rossman 2015). It is closest to *A. parinarii*, which has smaller appressoria and ascospores, narrower hyphae, and ellipsoid to subglobose asci. *Asterolibertia couepiae* is distinct from the new species in having black hyphae, larger thyriothecial ascomata, lacking pseudoparaphyses, 4–6-spored asci, and ovoid ascospores. *Asterolibertia nodulifera* has amphigenous colonies, no pseudoparaphyses, larger ascomata and larger, echinulate ascospores. *Asterolibertia licaniae* differs from *A. campograndensis* in the dark brown hyphae, barrel-shaped and larger appressoria, ascomatal dehiscence by an irregular fissure, a lack of fringes at the margins of the ascomata, the absence of pseudoparaphyses, and finally larger, ellipsoidal, dark brown ascospores with a central septum. *Asterolibertia*

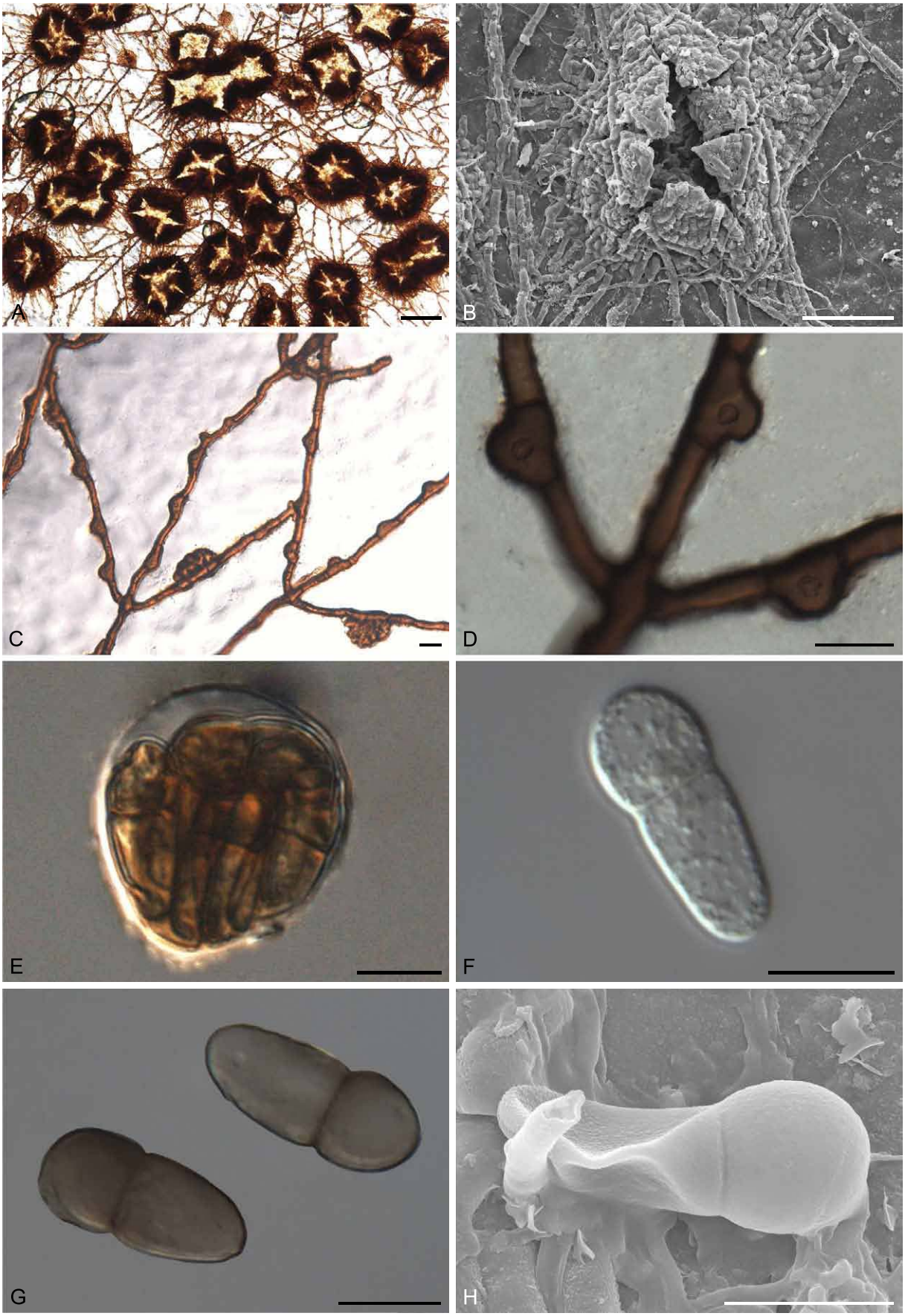

Fig. 2. A–H. *Asterolibertia barrinhensis* (UB-Mycol. Col. 5890 – holotype): **A.** Colony showing thyriothecial ascomata on superficial mycelium. **B.** Ascomata showing central star-shape fissure in SEM. **C.** Superficial mycelium showing intercalary appressoria. **D.** Intercalary appressoria with lateral protuberance. **E.** Globose to ovoid mature ascus. **F.** Immature ascospores. **G.** Brown smooth cylindrical to oblong-clavate ascospores. **H.** Smooth ascospores in SEM. Bars: A = 100 µm; B = 50 µm, and all others = 10 µm.

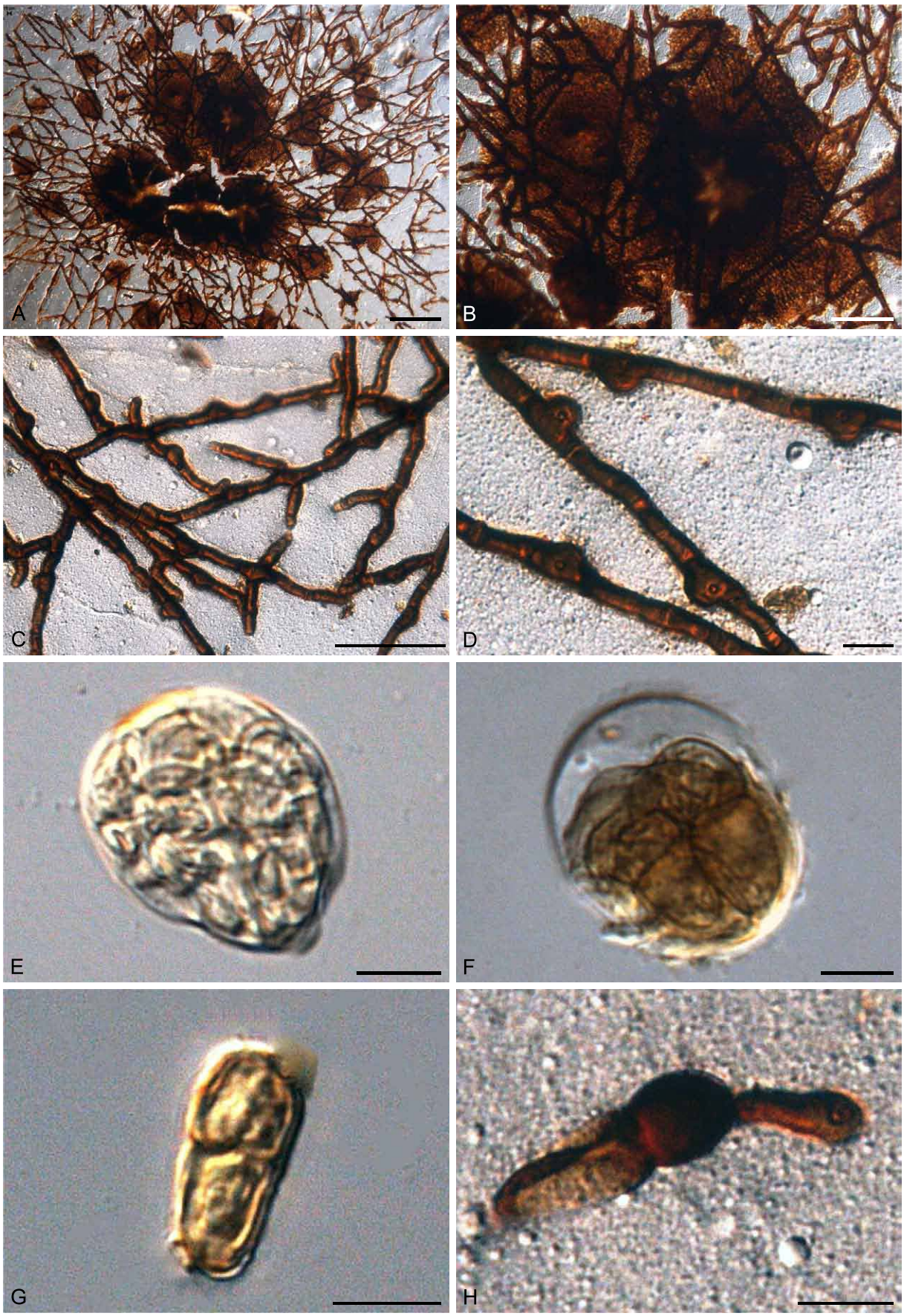

Fig. 3. A–H. *Asterolibertia campograndensis* (UB-Mycol. Col. 12712a – holotype): **A.** Colony showing thyriothecial ascomata on superficial mycelium. **B.** Ascomata showing central star-shape fissure in SEM. **C.** Superficial mycelium with intercalary appressoria. **D.** Intercalary appressoria with lateral protuberance **E.** Immature ascus. **F.** Globose to ovoid mature ascus. **G.** Light brown immature ascospores. **H.** Brown, smooth, oblong-clavate ascospores, constricted at septum on its upper third. Bars: A = 100 µm; B, C = 50 µm, and all others = 10 µm.

licaniicola differs from *A. campograndensis* in the wider hyphae, barrel-shaped appressoria, larger ascomata, absence of pseudoparaphyses, and dark brown ascospores with a central septum. *Asterolibertia peruviana* has narrower appressoria, larger ascomata that are not fringed at the margins, and smaller appressoria and ascospores. *Asterolibertia schroeteri* differs in the larger ascomata with an irregular fissure, the absence of pseudoparaphyses, and larger asci and ascospores (Tables 1–2) (Arnaud 1918, Hansford 1947, 1949, 1955, Müller & von Arx 1962, Hofmann & Piepenbring 2014).

Asterolibertia campograndensis is morphologically rather similar to *A. barrinhensis*. However, these species differ in important morphological details such as ascospore ornamentation, the shape of the ascomatal fringes (loosely set in *A. barrinhensis*), and hyphal branching patterns (opposite in *A. barrinhesis*, and irregular in *A. campograndensis*).

Asterolibertia campograndensis is the fifth species of *Asterolibertia* reported on hosts belonging to *Chrysobalanaceae* in Brazil, and the first on *Hirtella*.

Asterolibertia parinaricola Firmino, Inácio & Dianese, **sp. nov.**
MycoBank MB813319
(Fig. 4)

Etymology: Refers to the host genus, *Parinari*.

Diagnosis: *Asterolibertia parinaricola* differs from *A. licaniicola* in having conspicuous lateral protuberance of the appressoria, presence of pseudoparaphyses, and much larger, verruculose ascospores constricted at a supramedian septum.

Type: **Brazil**: *Distrito Federal*: Brasília, PAD-DF, on leaves of *Parinari obtusifolia* (*Chrysobalanaceae*), 10 Nov. 1992, *C. Furlanetto* (UB-Mycol Col. 2567 – holotype).

Description: *Colonies* epiphyllous, circular or irregular, single or confluent, black, 3–10 mm diam. *Hyphae* straight, with opposite branches, brown, septate, hyphal cells cylindrical, 4.5–5.5 µm diam, smooth. *Appressoria* numerous, entire, intercalary, elliptical or with a lateral protuberance, unicellular, 10–15 × 7–9 µm, brown, penetration peg central on the appressorial cells. *Ascomata* superficial, thyriothecia, scutiform, on top of a mycelial mat, circular, single to confluent, fringed at the margins, randomly distributed in the colony, 150–207 µm diam, opening by a central star-shaped fissure, dark brown; wall *textura radiata*, with isodiametrical cells. *Pseudoparaphyses* cylindrical, septate, branched, hyaline, 1–1.5 µm wide. *Asci* bitunicate in structure, fissitunicate, disposed as an upright palisade layer, globose to ovoid, 8-spored, hyaline, 37.5–47.5 × 29–32.5 µm. *Ascospores* oblong to oblong-clavate, ends rounded, straight to slightly arched, 1-septate, constricted at the supramedian septum, hyaline, becoming pale brown to brown at maturity, verruculose, 34–40 × 10–14 µm. Asexual morph not seen.

Other specimens examined: On leaves of *Parinari obtusifolia* (*Chrysobalanaceae*). **Brazil**: *Maranhão*: Nogueiras, 60 km North of Balsas, 6° 57' 52.47" S 46° 10' 13.19" W, 11 Apr. 1995, *M. A. de Freitas* (UB-Mycol Col. 8020). *Distrito Federal*: Brasília, PAD-DF, 04 Nov. 1993, *C. Furlanetto* (UB-Mycol Col. 2568 and 2569).

Notes: Seven species of *Asterolibertia* have been reported previously in association with living leaves of chrysobalanaceous hosts. *Asterolibertia couepiae* on *Couepia grandiflora* from Brazil, *A. nodulifera* on *Angelesia splendens* from the Philippines, *A. licaniae* and *A. licaniicola* on *Licania* sp. from Brazil, *A. parinarii* on *Parinari subcordata* from the Democratic Republic of the Congo, *A. peruviana* on *Licania macrophylla* from Brazil, and *A. schroeteri* on *Chrysobalanus icaco* from India (Arnaud 1918, Hansford 1947, 1949, 1955, Müller & von Arx 1962, Hosagoudar 2010, Hofmann & Piepenbring 2014, Farr & Rossman 2015).

Asterolibertia parinaricola differs from the species previously reported on *Chrysobalanaceae* (Table 1) (Arnaud 1918, Hansford 1947, 1949, 1955, Müller & von Arx 1962, Hosagoudar 2010, Hofmann & Piepenbring 2014, Farr & Rossman 2015), and is most similar to *A. licaniicola*. However, the latter has barrel-shaped appressoria, no pseudoparaphyses, and much smaller, smooth ascospores constricted at the central septum. *Asterolibertia couepiae* differs from the new species in the wider hyphae, lack of pseudoparaphyses, smaller asci and ascospores, and smooth ascospores. *Asterolibertia nodulifera* differs in the amphigenous colonies, smaller thyrothecia, lack of pseudoparaphyses, and echinulate ascospores. Additionally, *A. licaniae* differs from the new species in the larger thyriothecia and wider hyphae, barrel-shaped appressoria, the lack of pseudoparaphyses, and smaller, ellipsoidal, smooth ascospores that are constricted at the central septum. *Asterolibertia parinarii* has narrower hyphae, unbranched pseudoparaphyses, smaller appressoria, asci and ascospores, and also smooth ascospores. *Asterolibertia parinaricola* and *A. parinarii* are described on the same host genus, but on different *Parinari* species. Besides, there is no record of the host species of *A. parinarii* in Brazil, further supporting that they are really distinct species (Sothers *et al*. 2015). *Asterolibertia peruviana* has narrower appressoria without a lateral protuberance to one side of the hypha, and smaller, smooth ascospores. Finally, *A. schroeteri* differs from *A. parinaricola* in the larger thyriothecia, asci and hyphae, the lack of pseudoparaphyses, and smooth ascospores (Tables 1–2) (Arnaud 1918, Hansford 1947, 1949, 1955, Müller & von Arx 1962, Hofmann & Piepenbring 2014). *Asterolibertia campograndensis*, newly described above, differs in the unbranched pseudoparaphyses and smaller, smooth ascospores.

Asterolibertia parinaricola is distinct from all seven species known on *Chrysobalanaceae*, and represents the sixth species of *Asterolibertia* reported on this host family in Brazil. This is the second species of *Asterolibertia* described on *Parinari*, and the first species found on *P. obtusifolia*.

Asterolibertia licaniae (Cooke) Hansf., *Proc. Linn. Soc. Lond*. **160**: 140 (1949).
MycoBank MB284420
(Fig. 5)
Basionym: Asterina licaniae Cooke, *Grevillea* **12**: 85 (1884).

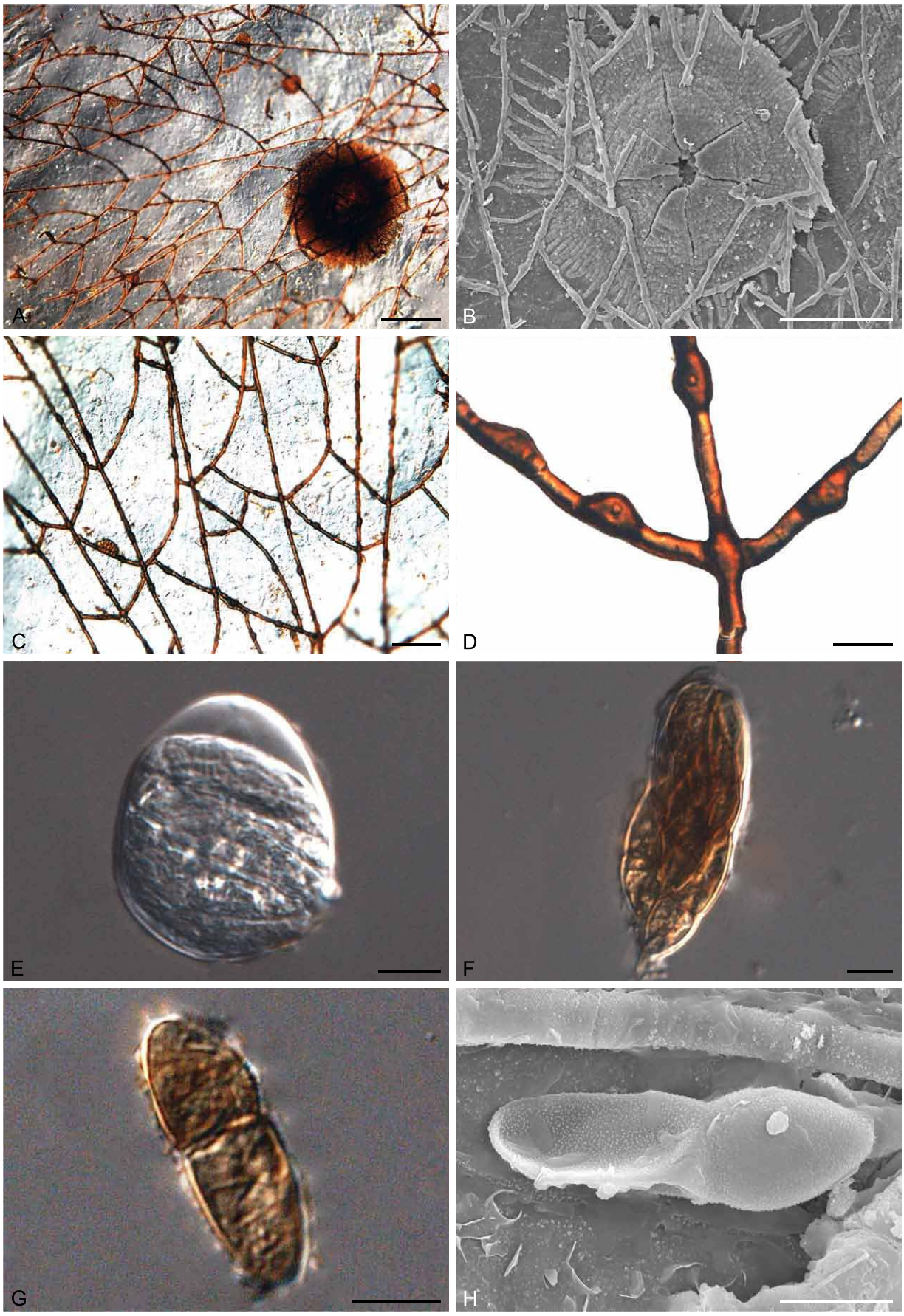

Fig. 4. A–H. *Asterolibertia parinaricola* (UB-Mycol. Col. 2567 – holotype): **A.** Colony showing thyriothecial ascomata on superficial mycelium. **B.** Ascomata showing central star-shape fissure in SEM. **C.** Superficial mycelium with intercalary appressoria. **D.** Intercalary elliptic appressoria showing a lateral protuberance. **E.** Globose to ovoid immature ascus. **F.** Mature ascus. **G.** Pale brown to brown, ascospores, constricted at septum on its upper third. **H.** Verrucolose ascospores on SEM. Bars: A, B = 100 µm; C = 50 µm, and all others = 10 µm.

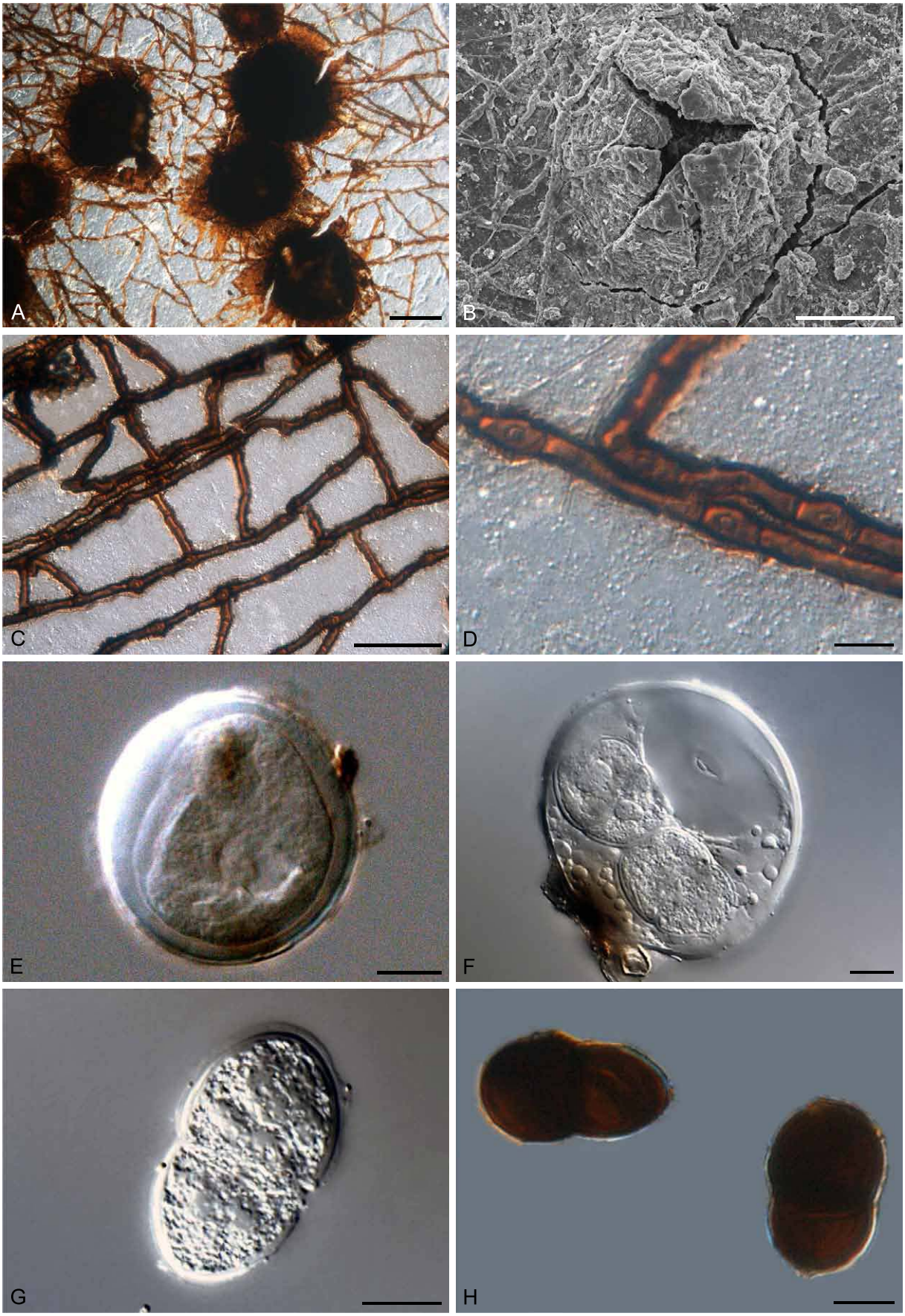

Fig. 5. A–H. *Asterolibertia licaniae* (UB-Mycol. Col. 9715): **A.** Colony showing thyriothecial ascomata on superficial mycelium. **B.** Ascomata showing central to irregular fissure in SEM. **C.** Superficial mycelium with intercalary appressoria. **D.** Intercalary, elliptical appressoria. **E–F.** Globose immature asci. **G.** Immature ascospores. **H.** Brown to ferruginous smooth ascospores constricted at middle septum. Bars: A, B = 100 µm; C = 50 µm, and all others = 10 µm.

Specimen examined: **Brazil**: *Rondônia*: RO-494 Highway, 82 km from Pimenta Bueno towards Parecis, 11° 45' 16.43" S 61° 18' 54.45" W, on leaves of *Hirtella gracilipes* (*Chrysobalanaceae*), 13 Jul. 1995, *M. Sanchez* (UB-Mycol Col. 9715).

Description: *Colonies* epiphyllous, circular to irregular, single to confluent, dark brown to black, 3–5 mm diam. *Hyphae* straight or flexuous, branching irregularly, pale brown to brown, septate, hyphal cells cylindrical, 5–8 µm diam, smooth. *Appressoria* numerous, entire, intercalary, elliptical, unicellular, 9–15 × 7.5–10 µm, pale brown, penetration peg central on the appressorial cell. *Ascomata*, superficial, thyriothecial, scutiform, radiate, arising on top of a mycelial mat, circular, single to confluent, fringed at the margins, randomly distributed in the colony, 180–410 µm diam, opening by a central star-shaped fissure, dark brown; wall *textura radiata*, cells cylindrical. *Pseudoparaphyses* cylindrical, septate, branched, hyaline, 1–1.5 µm wide. *Asci* bitunicate in structure, fissitunicate, disposed as an upright palisade layer, globose, 8-spored, hyaline, 57.5–65 µm diam. *Ascospores* oblong, ends rounded, straight, 1-septate, constricted at the median septum, hyaline, becoming brown to ferruginous at maturity, smooth, 30–35 × 19–22.5 µm. Asexual morph not seen.

Notes: The specimen described above was collected in the state of Rondônia on living leaves of *Hirtella gracilipes,* a new host for *A. licaniae.* This species was originally described by Hansford (1949) based on material from Brazil collected on leaves of *Licania* sp.

Key to the known *Asterolibertia* species

See Tables 1–2 for further information on the characters of the species keyed out here.

1	Colonies amphigenous or epiphyllous	2
	Colonies hypophyllous	**A. thaxteri**
2 (1)	Ascospores smooth	3
	Ascospores verruculose	24
3 (2)	Ascospores medianly constricted	4
	Ascospores constricted supramedianly	9
4 (3)	Ascomata with fringed margin	5
	Ascomata with uniform margin	**A. licaniae**
5 (4)	Ascomata opening by a stellar fissure	6
	Ascomata opening by an irregular fissure	**A. vateriae**
6 (5)	Colonies epiphyllous	7
	Colonies amphigenous	**A. bredemeyerae**
7 (6)	Ascospores more than 16 µm in length	8
	Ascospores14−16 × 6.5−7 µm	**A. hiiranensis**
8 (7)	Ascospores 19−21 × 9−10 µm	**A. nothopegiae**
	Ascospores 24−28 × 12−15 µm	**A. licaniicola**
9 (3)	Colonies amphigenous	10
	Colonies epiphyllous	14
10 (9)	Ascomata with a fringed margin	11
	Ascomata with a uniform margin	12
11 (10)	Ascospores 15−18 × 5−6.5 µm	**A. randiae**
	Ascospores 32−36 × 17−22 µm	**A. santiriae**
12 (10)	Ascomata over 90 µm diam	13
	Ascomata to 90 µm diam	**A. gibbosa**
13 (12)	Ascospores 16−20 × 8−9 µm	**A. megathyria**
	Ascospores 25−32 × 11−13 µm	**A. cryptocaryae**
14 (9)	Ascomata opening by stellar or irregular fissure	15
	Ascomata opening by ostiole [may belong in *Mycrothyriaceae*]	**A. peruviana**

15 (14) Pseudoparaphyses present 16
Pseudoparaphyses absent 17

16 (15) Ascospores 22.5−30 × 9.5−10.5 µm ..... **A. campograndensis**
Ascospores 18−22.5 × 5−6 µm ..... **A. parinarii**

17 (15) Ascomata with a fringed margin 18
Ascomata with a uniform margin ..... **A. hydnocarpi**

18 (17) No leaf discoloration under the colonies 19
Conspicuous leaf discoloration under the colonies ..... **A. crustacea**

19 (18) Ascomata opening by a stellar fissure 20
Ascomata opening by an irregular fissure ..... **A. schroeteri**

20 (19) Appressoria showing a lateral protuberance 21
Appressoria barrel-shaped to cylindrical 22

21 (20) Ascospores 16−24 × 8−13 µm ..... **A. couepiae**
Ascospores 33−35 × 10−12 µm ..... **A. pogonophorae**

22 (20) Ascospores less than 30 µm in length 23
Ascospores 35−42 × 16−19 µm ..... **A. mangiferae**

23 (22) Ascospores 13−17.5 × 5−6.5 µm ..... **A. burchelliae**
Ascospores 18−20 × 7.5−8.5 µm ..... **A. spatholobi**

24 (2) Ascomata with a fringed margin 25
Ascomata with a uniform margin ..... **A. sporoboli**

25 (24) Ascospores medianly constricted 26
Ascospores constricted supramedianly 28

26 (25) Pseudoparaphyses absent 27
Pseudoparaphyses present ..... **A. myocoproides**

27 (26) Appressoria with a lateral protuberance ..... **A. malpighii**
Appressoria barrel-shape to subglobose without a lateral protuberance ..... **A. nodulosa**

28 (25) Colonies epiphyllous 29
Colonies amphigenous 34

29 (28) Pseudoparaphyses present 30
Pseudoparaphyses absent 31

30 (29) Pseudoparaphyses branched ..... **A. parinaricola**
Pseudoparaphyses unbranched ..... **A. barrinhensis**

31 (29) Appressoria showing a lateral protuberance ..... **A. anisopterae**
Appressoria barrel-shaped to subglobose without a lateral protuberance 32

32 (31) Hyphae 3−5 µm wide ..... **A. bakeri**
Hyphae more than 5 µm wide 33

33 (32) Ascospores 24−30 × 12−17 µm ..... **A. ulei**
Ascospores 32−40 × 18−25 µm ..... **A. inaequalis**

34 (28) Pseudoparaphyses present ..... **A. bahiensis**
Pseudoparaphyses absent ..... **A. nodulifera**

Table 3. Morphometric characteristics of *Cirsosia* species (µm), including a new one described in this study.

Cirsosia Species	Ascomata	Hyphae	Appressoria	Asci	Ascospores	Source and country
arecacearum Hosag. & M. Pillai	200–500 × 230–257	3–5	9–9.5 × 8–9.5	43–59 × 24–28	27–31 × 12–14	Hosagoudar & Pillai (1994), India
dipterocarpi (Henn.) Bat. & H. Maia	315–388 × 242–267	5–7	8–10 × 13.5–15	64–70 × 54–60	30–43 × 18–19	Batista & Maia (1960b), Philippines
flabellariae (Syd.) Bat. & H. Maia	240–300 × 141–178	3–5.5	8–16 × 6.5–8	27–29.5 × 19–24	24–27 × 14–16	Batista & Maia (1960b), Sierra Leone
globulifera (Pat.) Arx	240–350 × 150–200	3–6.5	9–12.5 × 7–9.5	60–74.5 × 31–46.5	43–46.5 × 15–18.5	Müller & Arx (1962), Vietnam
hopeae Hosag., Jac. Thomas & D.K. Agarwal	300–470 × 250–300	9–12	9–15 wide	35–44 diam	22–25 × 11–13	Hosagoudar *et al.* (2011), India
hughesii Bat. & H. Maia	1090–1750 × 300–365	2.5–5.6	8–10.5 × 6.5–10.5	51–62 × 40.5–43	32.5–38 × 13.5–16.5	Batista & Maia (1960b), Ghana
irregularis (Syd.) Arx	500–1100 × 190–280	6–8	–	60–80 × 50–65	32–38 × 15–18	Müller & Arx (1962), Philippines
litseae Hosag. & G.R. Archana	156–392 × 78–196	3–5	11–22 × 3–7	32–40 × 35–40	17–26 × 11–15	Hosagoudar (2012), India
manaosensis (Henn.) G. Arnaud	200–450 × 130–160	4–7	9–13 wide	30–40 diam	25–30 × 12–15	Arnaud (1918), Brazil
moquileae Bat. & H. Maia	150–375	3.5–5	10–12.5 × 6–7.5	25–45 × 22.5–40	20–25 × 14–20	Batista & Maia (1960b), Brazil
moulmeinensis Thaung	< 600 × 340	3.5–5.5	7.5–18.5 × 5.5–12	44.5–57.5 × 37–48	26–33.5 × 15–20.5	Thaung (1976), Myanmar
santiriae Bat. & H. Maia	542–752 × 303–364	5.5–6.5	8–10.5 × 3–5.5	75–85 × 56.5–57.5	32.5–35 × 19–21.5	Batista & Maia (1960b), Philippines
splendida Bat. & H. Maia	330–510 × 160–250	2.5–5	8.5–15 × 4–7.5	20–31 × 17.5–28	17.5–21.5 × 6–7.5	Batista & Maia (1960b), Brazil
splendida var. *laevigata* Firmino & Dianese n. var.	110–290 × 60–90	2.5–5	10–15 × 4.5–7.5	25–37.5 × 17.5–27.5	17.5–27.5 × 6–9.5	Present study, Brazil
transversalis (Syd.) Deighton	300–900 × 180–280	4–5	11–14 × 7–8	60–80 × 50–70	40–46 × 16–20	Hughes (1952), Philippines
vateriae Hosag.	245–345 × 90–245	7–9	14–18 × 9–11	35–50 diam	28–32 × 15–18	Hosagoudar (2012), India

Cirsosia splendida var. **laevigata** Firmino & Dianese, **var. nov.**
MycoBank MB813320
(Figs 6–7)

Etymology: Refers to the smooth ascospores.

Diagnosis: *Cirsosia splendida* var. *laevigata* differs from *C. splendida* var. *splendida* in having smaller ascomata, pseudoparaphyses, and the smooth ascospores.

Type: **Brazil**: *Mato Grosso do Sul*: Campo Grande, BR-163 Highway left lane, 200 m from the roundabout turn to São Paulo, behind Cerealista Juliana, 20° 35' 8.58" S 54° 34' 49.51" W, on leaves of *Hirtella glandulosa* (*Chrysobalanaceae*), 22 Aug. 1996, *M. Sanchez* (UB-Mycol Col. 12712b – holotype).

Description: *Sexual morph: Colonies* hypophyllous, circular or irregular, single or confluent, black, 1–9 mm diam. *Hyphae* straight or flexuous, with opposite branches, rarely unilateral or irregular, brown, septate, hyphal cells cylindrical, 2.5–5 µm wide, smooth. *Appressoria* numerous, entire, intercalary, elongated with a lateral protuberance, unicellular, 10–15 × 4.5–7.5 µm, brown, penetration peg central or at the distal part of the appressorial cell. *Ascomata* superficial, hysterothecia, lirelliform, V–Y-shaped, on top of a mycelia mat, single to confluent, fringed at margins, randomly distributed in the colony, 110–290 × 60–90 µm, opening by longitudinal fissures, brown; wall of *textura radiata*, cells isodiametric to cylindrical. *Pseudoparaphyses* cylindrical, septate, branched, hyaline, to 1 µm wide. *Asci* bitunicate in structure, fissitunicate, disposed as an upright palisade layer, globose to subclavate, 8-spored, hyaline, 25–37.5 × 17.5–27.5 µm. *Ascospores* cylindrical to oblong-clavate, ends rounded, straight, 1-septate, slightly constricted at the supramedian septum, hyaline, becoming brown to ferruginous at maturity, smooth, 17.5–27.5 × 6–9.5 µm. *Asexual morph: Colonies* amphigenous, circular or irregular, single or confluent, black, 1–8 mm diam. *Hyphae* straight or flexuous, branching irregularly, septate, hyphal cells cylindrical, 2.5–3 µm wide, smooth. *Appressoria* numerous, entire, intercalary, elongated with a lateral protuberance, unicellular, 10–15 × 5–7.5 µm, brown, penetration peg central on the appressorial cell. *Conidiomata* superficial, pycnothyrial, scutiform, on top of a mycelium mat, circular, single to confluent, fringed at margins, randomly distributed in the colony, 80–120 µm diam, centrally ostiolate, light to dark brown; wall *textura radiata*, cells isodiametric to cylindrical. *Hymenium* lining the inner side of upper wall of the conidioma. *Conidiogenous cells* monoblastic, single, hyaline. *Conidia* initially 1–celled becoming 2–celled at maturity, ellipsoidal, upper cell with rounded end and lower cell with a truncate base, ends rounded when mature, straight, medianly or supramedianly 1-septate, not constricted at the septum, hyaline, becoming brown to ferruginous at maturity, smooth, 20–25 × 4.5–5 µm.

Other specimen examined: **Brazil**: *Rondônia*: RO494 Highway, 82 km from Pimenta Bueno towards Parecis, on leaves of *Hirtella gracilipes* (*Chrysobalanaceae*), 13 Jul. 1995, *M. Sanchez* (UB-Mycol Col. 23245).

Table 4. Summary of the main characteristics of *Cirsosia* species indicating respective host family and species, and morphology of colonies, appressoria, paraphyses, asci, and ascospores.

Species	Host	Families	Colonies	Appressoria	Pseudoparaphyses	Asci	Ascospore
arecacearum	*Calamus thwaitesii*	*Arecaceae*	epiphyllous	globose	–	ovoid	constricted at the central septum, smooth
dipterocarpi	*Dipterocarpus grandiflorus*	*Dipterocarpaceae*	epiphyllous	protuberance towards one side	branched	globose to subglobose	constricted at the central septum, verruculose
flabellariae	*Flabellaria pedunculata*	*Malpighiaceae*	epiphyllous	barrel-shaped	unbranched	subglobose to ovoid	constricted at the central septum, verruculose
globulifera	*Calamus* sp.	*Arecaceae*	epiphyllous	globose	–	globoso to ovoid	constricted at the central septum, smooth
hopeae	*Hopea ponga*	*Dipterocarpaceae*	epiphyllous	globose to barrel-shaped	–	globose	constricted at the central septum, verruculose
hughesii	*Ancistrophyllum* sp.	*Arecaceae*	epiphyllous	globose	unbranched	subglobose to ovoid	constricted in the upper third, smooth
irregularis	*Vatica obtusifolia*	*Dipterocarpaceae*	hypophyllous	–	absent	globose to ovoid	constricted at the central septum, verruculose
litseae	*Litsea travancorica*	*Lauraceae*	hypophyllous	barrel-shaped	–	globose to ovoid	constricted at the central septum, smooth
manaosensis	*Malpighiaceae member*	*Malpighiaceae*	epiphyllous	globose to barrel-shaped	present	ovoid	constricted at the central septum, verruculose
moquileae	*Licania tomentosa*	*Chrysobalanaceae*	amphigenous	protuberance towards one side	branched	subglobose	constricted in the upper third, smooth
moulmeinensis	*Dipterocarpus* sp.	*Dipterocarpaceae*	epiphyllous	protuberance towards one side	absent	globose to ovoid	constricted in the upper third, smooth
santiriae	*Santiria nitida*	*Burseraceae*	amphigenous	globose to barrel-shaped	branched	subglobose to ellipsoid	constricted at the central septum, smooth
splendida	*Hirtella americana*	*Chrysobalanaceae*	hypophyllous	globose	unbranched	subglobose	constricted in the upper third, verruculose
splendida var. laevigata	*Hirtella glandulosa*	*Chrysobalanaceae*	hypophyllous	protuberance towards one side	branched	globose to subclavate	constricted in the upper third, smooth
transversalis	*Arecaceae* member	*Arecaceae*	epiphyllous	protuberance towards one side	branched	subglobose to ellipsoid	constricted at the central septum, verruculose
vateriae	*Vateria indica*	*Dipterocarpaceae*	amphigenous	globose	–	globose	constricted at the central septum, smooth

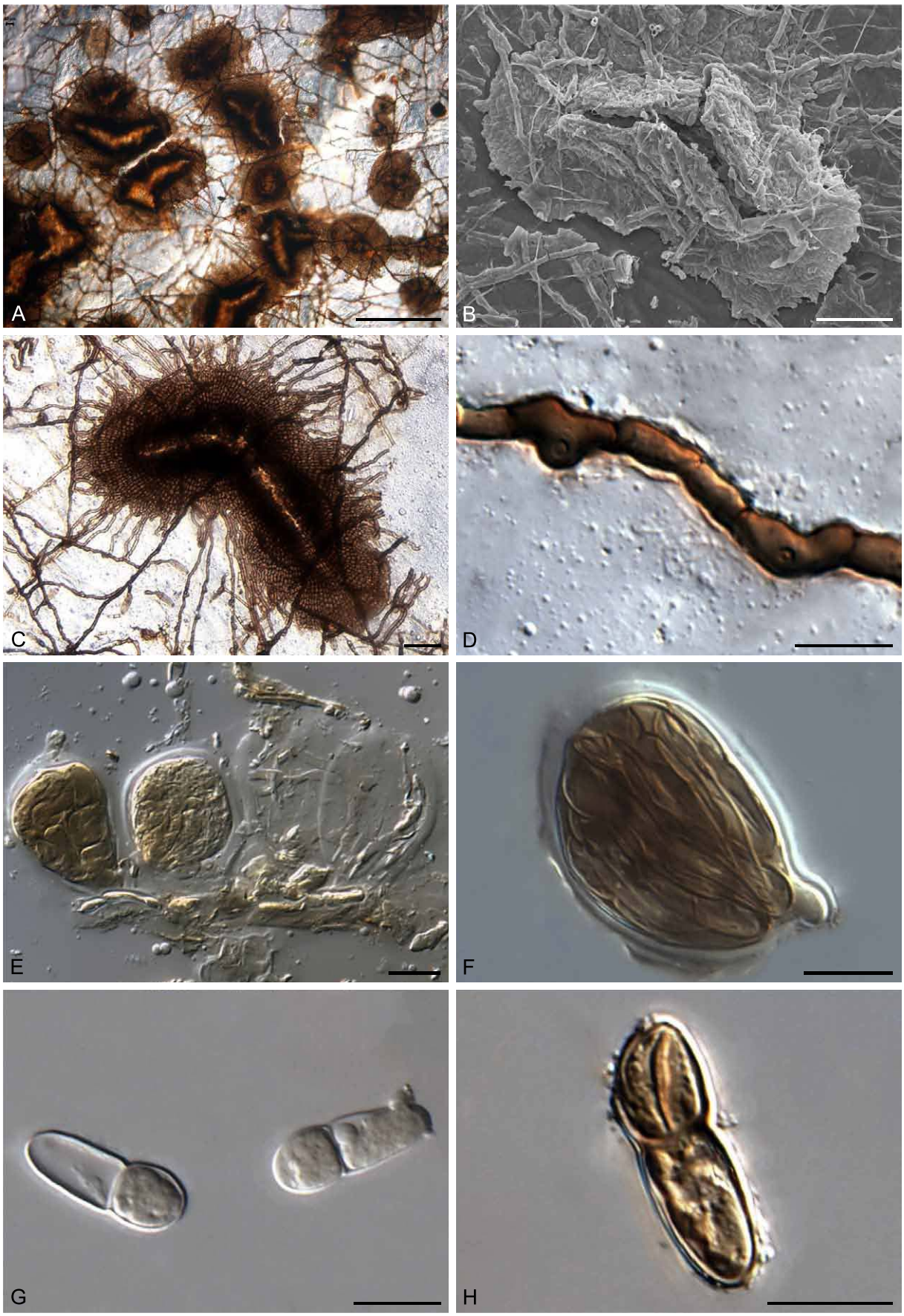

Fig. 6. A–H. *Cirsosia splendida* var. *laevigata*, sexual morph (UB-Mycol. Col. 12712b): **A.** Colony showing opened lirelliform ascomata on superficial mycelium. **B–C.** Ascomata opened by a longitudinal fissure seen in SEM and light microscopy, respectively. **D.** Intercalary elliptic appressoria showing a lateral protuberance. **E–F.** Globose to subclavate asci. **G.** Immature ascospores. **H.** Brown to ferruginous, smooth, cylindrical to subclavate ascospores, showing slight constriction at septum. Bars: A = 100 µm; B = 50 µm; C = 20 µm; G, H = 5 µm, and all others = 10 µm.

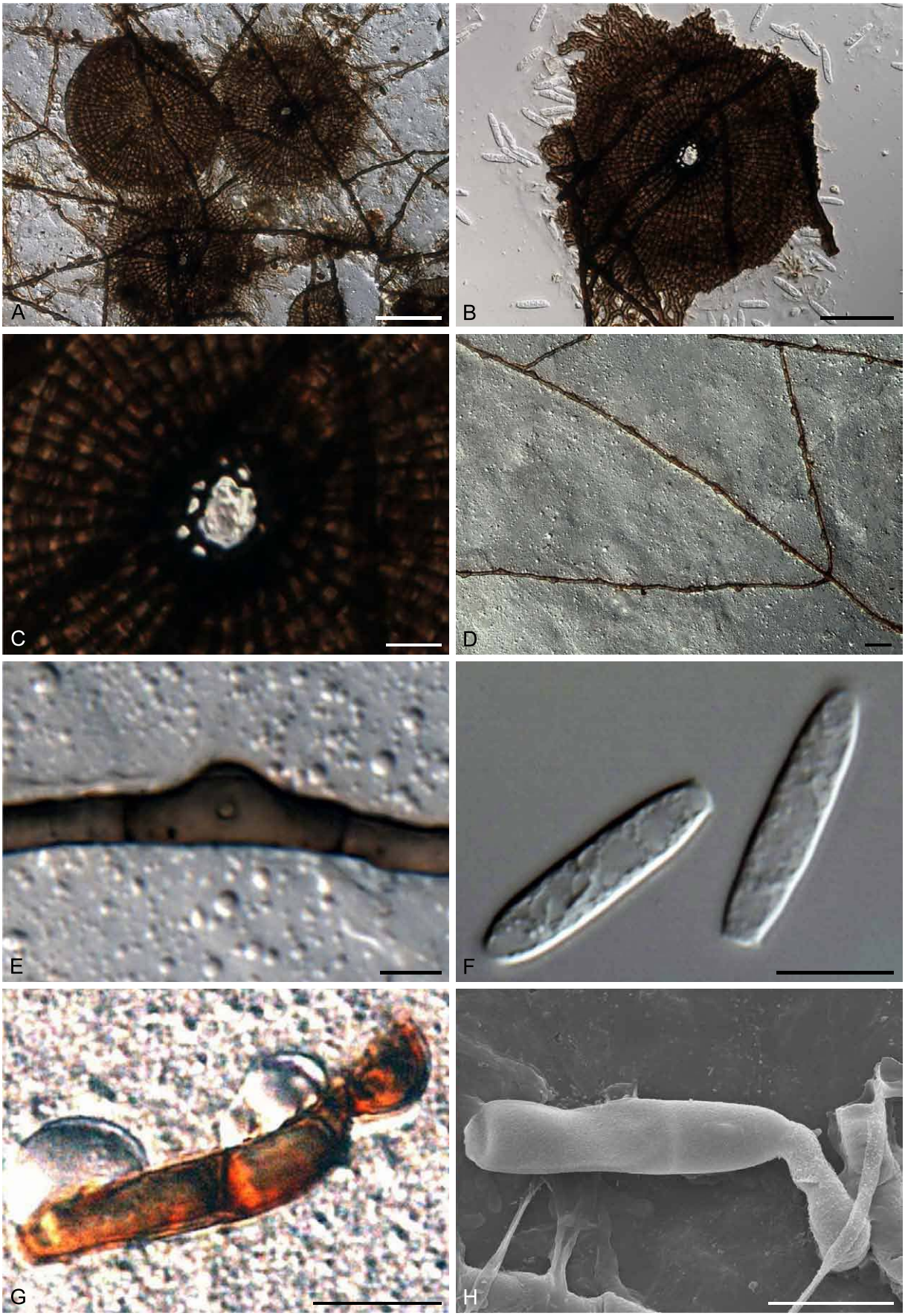

Fig. 7. A–H. *Cirsosia splendida* var. *laevigata*, asexual morph (UB-Mycol. Col. 12712b): **A.** Colony showing opened pycnothyrial condidiomata on superficial mycelium. **B–C.** Ostiolate pycnothyrium. **D.** Surface mycelium with intercalary appressoria. **E.** Intercalary appressorium showing lateral protuberance. **F.** Immature conidia. **G.** Brown to ferruginous, smooth, ellipsoidal germinating conidia. **H.** Smooth-walled conidium seen in SEM. Bars: A, B = 50 µm; D = 20 µm; E = 5 µm, and all others =10 µm.

Notes: Two species of *Cirsosia* have been reported previously in association with living leaves of chrysobalanaceous hosts: *C. moquileae* on *Licania tomentosa* from Brazil, and *C. splendida* on *Hirtella americana*, *Chrysobalanus icaco,* and *H. triandra* from Brazil, Panama, and Puerto Rico, respectively (Batista & Maia 1960b, Hosagoudar 2010, Hofmann & Piepenbring 2014, Farr & Rossman 2015).

Cirsosia splendida var. *laevigata*, the first *Asterinaceae* reported on *H. glandulosa* and *H. gracilipes,* is almost identical to *C. splendida*, except for the smaller ascomata, presence of pseudoparaphyses, and smooth ascospores (Batista & Maia 1960b, Hofmann & Piepenbring 2014). Such differences are here considered enough to recognize the specimen studied as a new variety of *C. splendida*. Furthermore, both occur on the same host genus in Brazil, but on different species.

Finally, *Cirsosia moquileae* differs from the new variety by dehiscence through a central star-shaped fissure (instead of the longitudinal fissure normally shown in *Cirsosia* species), and narrower ascospores (Batista & Maia 1960b). Indeed, such a form of dehiscence and the shape of the ascomata in *C. moquileae* indicate that that species could be better accommodated in *Asterolibertia* (Batista & Maia 1960b).

Key to the known *Cirsosia* species

See Tables 3–4 for further information on the characters of the species keyed out here.

1 Ascospores smooth 2
Ascospores verruculose 10

2 (1) Ascospores medianly constricted 3
Ascospores supramedianly constricted 7

3 (2) Colonies amphigenous 4
Colonies hypophyllous or epiphyllous 5

4 (3) Ascospores 28−32 × 15−18 µm ..... **C. vateriae**
Ascospores 32.5−35 × 19−21.5 µm ..... **C. santiriae**

5 (3) Colonies epiphyllous 6
Colonies hypophyllous ..... **C. litseae**

6 (5) Asci 4-spored ..... **C. arecacearum**
Asci 8-spored ..... **C. globulifera**

7 (2) Ascomata opening by a longitudinal fissure 8
Ascomata opening by a stellar fissure ..... **C. moquileae**

8 (7) Appressoria having a lateral protuberance 9
Appressoria globose ..... **C. hughesii**

9 (8) Ascospores 17.5–27.5 × 6–9.5 µm ..... **C. splendida** var. **laevigata**
Ascospores 26−33.5 × 15−20.5 µm ..... **C. moulmeinensis**

10 (1) Ascospores medianly constricted 11
Ascospores supramedianly constricted ..... **C. splendida** var. **splendida**

11 (10) Colonies epiphyllous 12
Colonies hypophyllous ..... **C. irregularis**

12 (11) Appressoria with a lateral protuberance 13
Appressoria barrel-shaped to globose 14

13 (12) Appressoria 8−10 × 13.5−15 µm ..... **C. dipterocarpi**
Appressoria 11−14 × 7−8 µm ..... **C. transversalis**

14 (12) Hosts in *Malpighiaceae* 15
Hosts in *Dipterocarpaceae* ..... **C. hopeae**

15 (14) Asci 27−29.5 × 19−24 µm ..... **C. flabellariae**
Asci 55−65 × 45−50 µm ..... **C. manaosensis**

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