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Rhytismataceae (*Ascomycota*) in Cuba

Abstract

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Knowledge of *Rhytismataceae* (*Ascomycota*) in Cuba is inadequate; many specimens have been collected and identified by foreign specialists and many types are mostly preserved in reference collections of other countries. Following extensive field and herbarium studies, nine species of *Rhytismataceae* are reported, discussed and illustrated from Cuba, of which three: *Coccomyces leptosporus*, *C. tesselatus* and *Lophodermium mangiferae* are new for this country. Six other species: *Coccomyces clusiae*, *C. limitatus*, *Lophodermium australe*, *L. platyplacum*, *Marthamyces quadrifidus* and *Terriera minor*, which had been reported previously, are now confirmed. New host records for some species are also presented. Fruit bodies and spores, as well as ecology of the species included, are described. An identification key to the accepted species in Cuba is provided and host organisms are cited.

Additional key words: *Coccomyces*, *Lophodermium*, *Marthamyces*, *Terriera*, Caribbean

Introduction

The diversity of the *Rhytismataceae* (*Ascomycota*) in the Caribbean is poorly known. Two reports published by 19th century authors (Montagne 1842; Berkeley & Curtis 1868) listed eight species from Cuba purportedly belonging to this family: *Hysterium foliicola* Fr. (= *Lophodermium foliicola* (Fr.) P. F. Cannon & Minter), *H. platyplacum* Berk. & M. A. Curtis (= *L. platyplacum* (Berk. & M. A. Curtis) Sacc.), *Phacidium clusiae* Lév. (= *Coccomyces clusiae* (Lév.) Sacc.), *P. limitatum* Berk. & M. A. Curtis (= *C. limitatus* (Berk. & M. A. Curtis) Sacc.), *Rhytisma concentricum* Berk. & M. A. Curtis, *R. gyrosum* Mont., *Stictis macularis* Berk. & M. A. Curtis (= *Naemacyclus macularis* (Berk. & M. A. Curtis) Sacc.), and *S. quadrifida* Lév. (= *Marthamyces quadrifidus* (Lév.) Minter). Other species were cited by these authors as being part of the *Rhytismataceae*, but their taxonomic status has changed: *R. atramentarium* Berk. & M. A. Curtis (= *Cyclostomella atramentaria* (Berk. & M. A. Curtis) Inácio & P. F. Cannon, *Parmulariaceae*), *R. leptospilum* Berk. & M. A. Curtis (= *Hysterostomella leptospila* (Berk. & M. A. Curtis) Höhn., *Parmulariaceae*), *R. maculans* Schwein. (= *Phyllachora maculans* (Schwein.) Sacc., *Phyllachoraceae*), *R. micraspis* (= *Cavaraella micraspis* (Berk. & M. A. Curtis) Speg., incertae sedis in *Rhytismatales*), and *R. rufulum* (= *Schizothyrium rufulum* (Berk. & M. A. Curtis) Arx, *Schizothyriaceae*). All were collected and identified by foreign specialists with types preserved in European fungal reference collections. Most lacked information about exact locations of collection, host organisms and substrates.

Since then, there have been very few works published containing information about the *Rhytismataceae* in Cuba. Leontouyč (1972) stated that *Lophodermium pinastri* (Schrad.) Chev. occurred in all pine woods of

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Cuba without causing significant damage. Alonso & Pérez (1987) and Alonso & Maintoni (1990) disagreed, and considered the common species associated with pines in Cuba to be *L. australe* Dearn., which they reported as causing a "brown spot" ("mancha parda") disease of pine needles. The location of the specimens on which those reports were based is not known. A brief summary of records of this family from Cuba was provided by Minter & al. (2001). *Coccomyces clusiae*, *Lophodermium platyplacum* and *Terriera minor* were reported from Cuba by Cabarroi & Minter (2005a–c) and *Marthamyces quadrifidus* by Cabarroi & al. (2012).

The aim of the present work is to review all of these reports and to add new information about the *Rhytismataceae* in Cuba.

Material and methods

Most of the records reported here are based on collections made by the senior author since March 2004. Only two unidentified specimens were found in the fungal reference collection at the National Botanic Garden, HAJB (M).

Hand-cut sections of fresh and dried material were mounted for examination under the microscope in common water, 3 % and 5 % KOH, Melzer's reagent and lactophenol. The methods and taxonomic concepts of Sherwood (1980), Cannon & Minter (1986), Johnston (1986, 2001), Minter (2003) and Kirk & al. (2008) were followed during the identification of the material collected.

Most of the cited material studied is preserved in HAJB (M). Additional collections studied, included the types, were borrowed from IMI and K (M). Herbarium codes are according to Index herbariorum (Holmgren & al. 1990).

An asterisk (*) against a species name indicates a new record for Cuba, and against a host organism name, a new host record.

Results

Key to accepted species of *Rhytismataceae* in Cuba

1. Occurring on *Pinaceae* (*Pinus caribaea* Morelet) . . . . . 5. ***Lophodermium australe***
– Occurring on leaves of "dicot" angiosperms 2
2. Ascocarps oblong-elliptical to elliptical, often sublinear 3
– Ascocarps orbicular or angular in outline 5
3. Ascocarps concolorous with host tissue, pale brown or slightly green . . 7. ***Lophodermium platyplacum***
– Ascocarps dark grey to black 4
4. Ascocarps significantly raising substrate surface, shiny, 0.4–1 mm long, ends rounded and black . . . . . 9. ***Terriera minor***
– Ascocarps not significantly raising substrate surface, not shiny, 0.5–0.8 mm long, with grey region at each end . . . . . 6. ***Lophodermium mangiferae***
5. Ascocarps opening by 3–6 prominent, irregular, pruinose and white teeth; hymenium pruinose, pale grey when fresh, drying grey, white or yellowish . . . . . 8. ***Marthamyces quadrifidus***
– Ascocarps without irregular, pruinose and white teeth 6
6. Ascocarps orbicular to slightly angular in outline . 7
– Ascocarps angular in outline, not orbicular 8
7. Ascocarps 0.7–1.6 mm in diam., opening when wet by 4–8 teeth; hymenium dark brown . . . . . 1. ***Coccomyces clusiae***
– Ascocarps 0.3–0.8 mm in diam., opening by 3–5 teeth; hymenium greyish to yellow when fresh, drying yellow . . . . . 2. ***Coccomyces leptosporus***
8. Upper wall of ascocarp with preformed dehiscence mechanism of light-coloured cells; hymenium honey-yellow when fresh, drying yellow; paraphyses not swollen at apex . . . . . 3. ***Coccomyces limitatus***
– Upper wall of ascocarp without preformed dehiscence mechanism; hymenium yellow when fresh, drying orange-reddish; paraphyses swollen to 3–4 µm thick at apex . . . . . 4. ***Coccomyces tesselatus***

Descriptions of the species

1. *Coccomyces clusiae* (Lév.) Sacc., Syll. Fung. 8: 747. 1889 ≡ *Phacidium clusiae* Lév. in Ann. Sci. Nat., Bot., ser. 4, 20: 291. 1863. – Lectotype (designated by Sherwood 1980: 36): Colombia, "Villeta, Linding, 1400 msm.", 1861 (PC #2821 n.v.). – Fig. 1A, B.
= *Phacidium musae* Lév. in Ann. Sci. Nat., Bot., ser. 3, 5: 303. 1846, nom. rej. (Art. 56.1) ≡ *Coccomyces musae* (Lév.) Sacc., Syll. Fung. 8: 752. 1889, nom. rej. – Holotype: [country unknown] "Herbier de la Amerique equatorial donné par M. Bonpland" (PC n.v.).
= *Phacidium pluridens* Berk. & M. A. Curtis in J. Linn. Soc., Bot. 10: 371. 1869 ≡ *Coccomyces pluridens* (Berk. & M. A. Curtis) Sacc., Syll. Fung. 8: 747. 1889. – Syntypes: Cuba, "on dead leaves of *Clusia parasitica*" [from protologue], Oct 1868, *C. Wright 533* (FH-Curtis n.v., K M164440!).

Description — Ascocarps on abaxial and adaxial surfaces of fallen leaves, sometimes with more on one surface than other, not significantly raising substrate surface, making surrounding host tissue paler, usually without zone lines (although delicate grey line was seen on some material). *Ascocarp viewed from above* orbicular to slightly angular in outline, 0.7–1.5 mm in diam., wall dark brown to dark grey, with preformed dehiscence mechanism of light-coloured cells, opening when wet by 4–8 teeth (usually 5); *perimeter line* dark grey to black; *lips* absent. *Ascocarp in vertical section* intra-epidermal; *upper wall* lo-

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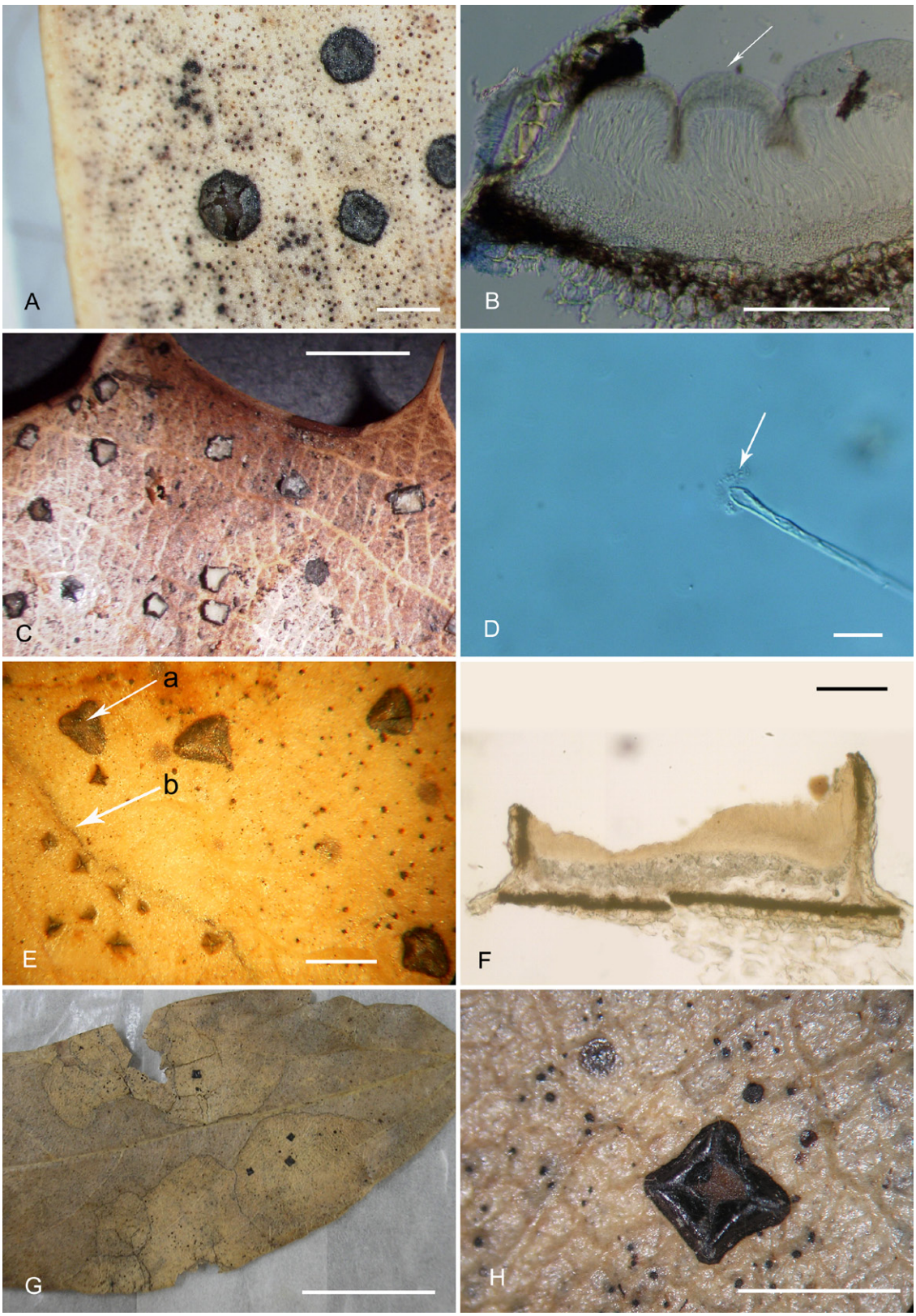


Fig. 1. A, B: *Coccomyces clusiae* – A: dry ascocarps on leaf of *Clusia rosea* (scale bar = 1 mm); B: ascocarp in vertical section (scale bar = 100 µm), arrow indicates convolute hymenium; C, D: *Coccomyces leptosporus*, C: dry ascocarps on leaf of *Ouratea agrophylla* (scale bar = 1 mm), D: paraphysis with swollen tip, arrow indicates mucous coat (scale bar = 10 µm); E, F: *Coccomyces limitatus*, E: ascocarps on leaf of *Clusia rosea* (scale bar = 1 mm), arrows indicate: (a) preformed dehiscence mechanism, (b) black zone line, F: ascocarp in vertical section (scale bar = 100 µm); G, H: *Coccomyces tesselatus*, G: dry ascocarps on leaf of *Clusia rosea* with less circular lesions surrounded by black zone line (scale bar = 10 mm), H: drying ascocarp with orange-reddish hymenium (scale bar = 1 mm).

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Fig. 2. A: *Lophodermium australe*, ascocarp on needle of *Pinus* (scale bar = 1 mm), arrow indicates black zone line; B: *Lophodermium mangiferae*, curved ascocarp on leaf of *Mangifera indica* (scale bar = 1 mm); C, D: *Lophodermium platyplacum*, C: ascocarps on leaf of *Clusia rosea* (scale bar = 3 mm), arrow indicates diffuse reddish zone, D: ascocarp in vertical section (scale bar = 100 µm); E, F: *Marthamyces quadrifidus*, E: open ascocarps on leaf of *Clusia rosea* (scale bar = 1 mm), F: paraphysis branched near apex (scale bar = 25 µm); G, H: *Terriera minor*, G: ascocarps on leaf of *Clusia rosea* (scale bar = 1 mm), H: ascocarp in vertical section (scale bar = 100 µm).

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cated beneath cuticle and, in places, beneath epidermis of leaf, black, uniformly 15–30 µm thick, extending at sides to join lower wall, composed of brown rather thick-walled cells 2–3 µm in diam., forming textura angularis; *lower wall* located beneath subhymenium or, in places, beneath displaced leaf epidermal cells, black, curved, 10–20 µm thick, sometimes thinner, composed of brown rather thick-walled cells 2–3 µm in diam., forming textura angularis. *Hymenium* dark brown, convolute (Fig. 1B). *Paraphyses* embedded in brown gel, hyaline, filiform, rarely septate, 74.5–95 × 2–4 µm, apex swollen to 5–6 µm thick, not recurved, embedded in thick mucous coat. *Asci* cylindrical, 80–120 × 7–8 µm, thin-walled, 8-spored. *Ascospores* colourless, filiform, non-septate, 55–60 × 1–1.5 µm, coated in mucous sheath.

Host organisms — **Clusia minor* L.; *C. rosea* Jacq. (*Clusiaceae*).

Remarks — This species is common in humid forest and middle elevations in Cuba. Sherwood (1980) reported *Coccomyces clusiae* on *Clusia* species and unidentified *Ericaceae*, but we found it only on fallen leaves of *Clusia minor* and *C. rosea*. On leaves of *C. rosea* it is often found in association with *Lophodermium platyplacum* and *Coccomyces limitatus.* Cuban collections typically had ascocarps with five teeth although Sherwood (1980) noted there could be up to ten. Ascocarps of this species are very conspicuous and easy to distinguish from other species of *Coccomyces* by having swollen paraphysis apices embedded in a brown gel. Neither Sherwood (1980) nor Cabarroi & Minter (2005b) reported zone lines for this species, but we found a faint grey zone line on some leaves of *Clusia minor*. Cannon & Minter (1986) noted that one possible function of zone lines may be to conserve water. *Clusia minor* has leaves of similar structure to those of *C. rosea*, but this material was found in a drier area, which could explain the occurrence of the zone lines.

Cuban specimens examined — Pinar del Río: La Palma: Área de Recursos Manejados "Mil Cumbres", Camino al Orquideario El Caimito, on fallen leaves of *Clusia rosea*, 14 Sep 2004, *M. Cabarroi* (HAJB M10666); ibid. *M. Cabarroi & al.* (HAJB M10688); around Río Ancón, on fallen leaves of *Clusia rosea*, 24 Mar 2005, *L. del Castillo* (HAJB M10707); around La Estación, near falls, on fallen leaves of *Clusia rosea*, 25 Mar 2005, *L. del Castillo* (HAJB M10711). — Los Portales: Campismo La Cueva, on fallen leaves of *Clusia rosea*, 3 Oct 2005, *D. Thoen* (HAJB M10765). — Viñales: "Maravillas de Viñales" track, to exit, on fallen leaves of *Clusia rosea*, 20 Jul 2009, *M. Cabarroi & al.* (HAJB M11142); ibid., on fallen leaves of *Clusia minor* (HAJB M11143). — Ciudad de la Habana: Boyeros: Jardín Botánico Nacional, around laboratories, on fallen leaves of *Clusia rosea*, 8 Nov 2005, *M. Cabarroi* (HAJB M10768). — Cienfuegos: Cienfuegos: Jardín Botánico de Cienfuegos, natural forest, on fallen leaves of *Clusia rosea*, 11 Jun 2005, *M. Cabarroi & al.* (HAJB M10728). — Villa Clara: Santa Clara: Reserva Manejada de Cubanacán "El Playazo", dry thickets, on fallen leaves of *Clusia rosea*, 10 Dec 2007, *M. Cabarroi* (HAJB M10982). — Guantánamo: Baracoa: near to Mina Amores, Baez river, subtropical moist montane forest, on fallen leaves of *Clusia rosea*, 8 Jul 2004, *M. Camino* (HAJB M10423); Baez river, near to Mina Amores camp, 9 Mar 2006, on fallen leaves of *Clusia rosea*, *M. Camino* (HAJB M10770). — Holguín: Mayarí: Sierra de Nipe, Alto La Torre, on fallen leaves of *Clusia rosea*, 2 Jul 2004, *M. Camino* (HAJB M10422).

Other specimens examined — Venezuela: Puerto La Cruz, on *Clusia rosea*, 26 Dec 1927, *H. Sydow* [Fungi exotici exsiccati] (IMI 29769). — Distrito Federal: El Ávila, near Hotel Humboldt, in cloud forest, c. 2000 m, on dead leaves of *Clusia* sp., 4 Jul 1958, *R. W. G. Dennis 1281* as *Coccomyces pluridens* (K M164441).
Dominican Republic: San Jose de las Matas, on leaf of *Clusia rosea*, Apr 1930, *E. L. Ekman* [ex herb. F. Petrak] (K M164443).

2. **Coccomyces leptosporus* Speg. in Anales Soc. Ci. Argent. 19: 264. 1885. – Holotype: Brazil, Guarapí, on leaf of *Lauraceae*, *Balansa 3861* (LPS 28182 n.v.). – Fig. 1C, D.

Description — *Ascocarps* scattered in bleached spots with delicate reddish to black line on abaxial and adaxial surface of coriaceous fallen leaves. *Ascocarp viewed from above* orbicular in outline, 0.3–0.6 mm in diam., wall pale brown to dark brown, almost black when dry, immersed in substrate, becoming erumpent, opening by 3–5 teeth; *lips* absent. *Hymenium* greyish to yellow when fresh, yellow when drying, remaining exposed when dry. *Ascocarp in vertical section* intra-epidermal; *upper wall* black, extending at sides to join lower wall; *lower wall* c. 10 µm thick, composed of black cells. *Paraphyses* hyaline, filiform, 100–105 µm long, apex swollen to 2.5–3 µm thick, not recurved, mucous coat forming obvious epithecium (Fig. 1D). *Asci* short-stalked, 95–105 × 4–6 µm, cylindrical, thin-walled, 8-spored. *Ascospores* hyaline, filiform, non-septate, 98–100 × 0.8–1 µm, not obviously sheathed.

Host organism — **Ouratea agrophylla* (Tiegh.) Urb. (*Ochnaceae*).

Remarks — Sherwood (1980) noted that *Coccomyces leptosporus* is common in tropical America on an apparently single, unknown host. In Cuba we found this species only once, on dead leaves of *Ouratea agrophylla* at middle elevations. *Ouratea agrophylla* grows as a thorny scrub in dry thickets from 20–300 m above sea level

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(Berazaín 2006). It is an endemic to Cuba and a new host record for this fungus species. Although *Ouratea* is widespread in tropical America, and the host noted by Sherwood (1980) could have been a species in this genus, the Sydow collection cited below is from a different host, *Inga spectabilis* (Vahl) Willd. (*Fabaceae*).

Coccomyces leptosporus, *C. limitatus* and *C. tesselatus* are all characterized by having ascospores less than 1 µm wide. They are all included in the *C. leptosporus* species complex. *Coccomyces leptosporus* sensu stricto can be separated from the others by its orbicular, brown ascocarps and by its paraphyses with a mucous coat forming an epithecium.

Cuban specimens examined — Villa Clara: Santa Clara: Reserva Manejada de Cubanacán "El Playazo", dry thickets, on fallen leaves of *Ouratea agrophylla*, 10 Dec 2007, *M. Cabarroi* (HABJ M10983).

Other specimens examined — Venezuela: Estado Vargas: Puerto La Cruz, near Caguita, on leaves of *Inga spectabilis*, 27 Dec 1927, *H. Sydow* [Fungi exotici exsiccati 863] (K M164427).

3. *Coccomyces limitatus* (Berk. & M. A. Curtis) Sacc., Syll. Fung. 8: 747. 1889 ≡ *Phacidium limitatum* Berk. & M. A. Curtis in J. Linn. Soc., Bot. 10: 371. 1869. – Holotype: Cuba, "on dead coriaceous leaves, probably of some *Clusia*" [from protologue], 1868, *C. Wright 422* (K!). – Fig. 1E, F.

Description — *Ascocarps* principally on abaxial surface of fallen leaves, scattered, not significantly raising substrate surface, in bleached spots surrounded with strong black zone line, shining. *Ascocarp viewed from above* angular in outline, 0.5–9 mm in diam., 3- or 4-sided, wall black, with preformed dehiscence mechanism of light-coloured lines, opening when wet by 3 or 4 teeth; *lips* absent. *Hymenium* honey-yellow when fresh, drying yellow. *Ascocarp in vertical section* intra-epidermal; *upper wall* black, uniformly 20–35 µm thick, extending at sides to join lower wall, composed of rather thick-walled black cells 4–5 µm in diam.; *lower wall* black, 10–15 µm thick, curved, separated from 25–30 µm-wide subhymenium by colourless hyphae intermixed with crystals. *Paraphyses* hyaline, cylindrical, 95–112 × 2–4 µm, apex not swollen, not forming epithecium. *Asci* short-stalked, cylindrical, tapering slightly to rounded apex, 90–110 × 4.8–5.5 µm, thin-walled, 8-spored. *Ascospores* hyaline, filiform, non-septate, 75–85 × 0.8–1 µm, coated in mucous sheath.

Host organisms — *Clusia rosea*; **C. tetrastigma* Vesque (*Clusiaceae*).

Remarks — This species is common at low and middle elevations in Cuba and is often associated with *Coccomyces clusiae* and *Lophodermium platyplacum* on leaves of *Clusia rosea*. It was collected for the first time on leaves of *C. tetrastigma*, an endemic and threatened plant of Cuba (Panfet 2008). *Coccomyces limitatus* is included in the *C. leptosporus* species complex and is similar to *C. tesselatus*, and both could be found on the same host. *Coccomyces limitatus* is distinguished from *C. tesselatus* by its narrow asci 4.8–5.5 µm, its paraphyses being broad along their entire length and by its honey-yellow hymenium. Sherwood (1980) reported a black zone line for this species, but it is not visible on some of the Cuban material collected from humid forests. Climatic differences may cause variation in this character.

Cuban specimens examined — Pinar del Río: Viñales: El Moncada town, on fallen leaves of *Clusia rosea*, 25 Feb 2001, *M. Rodríguez* (HABJ M8809). — La Palma: Área de Recursos Manejados "Mil Cumbres", near "El Segui" falls, on fallen leaves of *Clusia rosea*, 10 Dec 2004, *J. M. Pérez* (HABJ M10536); ibid. *M. Cabarroi & al.* (HABJ M10688); near Ancón river, on fallen leaves of *Clusia rosea*, 24 Mar 2005, *L. del Castillo* (HABJ M10708); near La Estación, near falls, on fallen leaves of *Clusia rosea*, 25 Mar 2005, *L. del Castillo* (HABJ M10711); Sierra Chiquita, los Catorce, on fallen leaves of *Clusia rosea*, 25 Mar 2004, *L. del Castillo* (HABJ M10712); Reserva San Marcos, on fallen leaves of *Clusia rosea*, 26 Mar 2005, *L. del Castillo* (HABJ M10715). — Holguín: Mayarí: Sierra de Nipe, Alto La Torre, on fallen leaves of *Clusia rosea*, 2 Jul 2004, *M. Camino* (HABJ M10422). — Villa Clara: Santa Clara: Reserva Florística Manejada "Monte Ramonal", on fallen leaves of *Clusia rosea*, 15 Jan 2005, *J. M. Pérez* (HABJ M10533). — Santiago de Cuba: Guamá: Pico Juaquín road to Pico Turquino, after Paso de los Monos, on fallen leaves of *Clusia tetrastigma*, 14 Mar 2006, *M. Camino* (HABJ M10806). — Guantánamo: Baracoa: near to Mina Amores, Baez river, subtropical moist montane forest, on fallen leaves of *Clusia rosea*, 8 Jul 2004, *M. Camino* (HABJ M10423).

Other specimens examined — Venezuela: Amazonas: Puerto Jamuro, Orinoco, May 1877, on leaf of *Clusia rosea*, *A. Gaillard 26* (K M164426).

4. **Coccomyces tesselatus* Sherwood in Occas. Pap. Farlow Herb. Cryptog. Bot. 15: 90. 1980. – Holotype: Puerto Rico, Maricao Forest Reserve, along route 105 at km 23.8, 12 Jun 1970, *R. P. Korf & al. 4050* (CUP-PR n.v.). – Fig. 1G, H.

Description — *Ascocarps* generally on adaxial surface of fallen leaves, scattered, in ± circular lesions surrounded by black zone line. *Ascocarp viewed from above* black, shining, angular in outline, 4–6-sided (usually 4-sided), 0.5–0.9 mm in diam., wall without preformed dehiscence mechanism, immersed, becoming erumpent, opening by

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4–6 irregular teeth; *lips* absent. *Hymenium* yellow when fresh, drying orange-reddish, remaining exposed when dry, with soluble yellow pigment in water. *Ascocarp in vertical section* intra-epidermal; *excipulum* of 4 or 5 rows of septate hyphae; *lower wall* black, 5–8 µm thick, separated from 20–25 µm-thick subhymenium by colourless hyphae intermixed with crystals. *Paraphyses* filiform, apex swollen to 3–4 µm thick, not forming epithecium. *Asci* short-stalked, cylindrical, 112–120 × 5–6 µm, 8-spored. *Ascospores* non-septate, 90–100 × 0.6–0.8 µm, not obviously sheathed.

Host organisms — Clusia rosea; **Cinnamomum montanum* (Sw.) Bercht. & J. Presl (*Lauraceae*).

Remarks — Sherwood (1980) reported *Coccomyces tesselatus* as fairly common in tropical America, but these are the first records of this species from Cuba, where it has been found on dead leaves of *Clusia rosea* and *Cinnamomum montanum*. On leaves of *C. rosea* the ascocarps form in a yellow lesion with some delicate red spots and a black zone line. On leaves of *C. montanum* the ascocarps are surrounded by more or less circular lesions each surrounded by a black zone line. *Coccomyces tesselatus* is similar to *C. limitatus*, both included in the *C. leptosporus* species complex and both sometimes found on the same host. *Coccomyces tesselatus* is distinguished from *C. limitatus* by its orange hymenium when dry, its pigmented hymenium with a soluble yellow pigment in water, its paraphyses swollen at the apex, and its asci 5–6 µm wide, somewhat wider than those of *C. limitatus*.

Cuban specimens examined — Sancti Spíritus: Trinidad: Topes de Collantes, around the base of haystack mountain Mi Retiro, on fallen leaves of *Clusia rosea*, 9 Dec 2007, *M. Cabarroi* (HAJB M10970). — Sancti Spíritus: Reserva Ecológica Alturas de Banao, La Sabina, road to Naranjal, 200 m, on fallen leaves of *Cinnamomum montanum*, 23 Mar 2007, *D. W. Minter* (HAJB M10893); ibid. (HAJB M10895).

5. *Lophodermium australe* Dearn. in Mycologia 18: 242. 1926. – Lectotype (designated by Minter 1981: 32): U.S.A., "Florida, en acículas de *Pinus palustris"*, 27 Feb 1919, *G. G. Hedgecock 32146* (DAOM n.v.). – Fig. 2A.

Description — *Ascocarps* mostly on abaxial surface of needles, significantly raising substrate surface, resembling thin black line between two rows of stomata, sometimes making needle surface somewhat grey on either side of blackened area, with delicate grey zone line. *Ascocarp viewed from above* sometimes with faint grey region surrounding opening slit, elliptic-linear to sublinear, 0.4–1.2(–2) mm long, edge usually not visible; *perimeter line* absent; *lips* inconspicuous. *Ascocarp in vertical section* subepidermal; *upper wall* black, 40–60 µm in centre; *lower wall* absent; *subhymenium* lying directly on hypodermis, with 2 or 3 epidermal cells included within and scattered along subhymenium. *Paraphyses* filiform, septate, 120–140 × 1.5–2 µm, apex frequently somewhat curved and swollen, covered in thick gelatinous sheath. *Asci* short-stalked, cylindrical, 100–150 × 10–12 µm, 8-spored, apex rounded. *Ascospores* filiform, some tapered toward base, non-septate, 80–110 × 1–2 µm, covered with gelatinous sheath.

Host organisms — Pinus caribaea Morelet; *P. occidentalis* Sw. (*Pinaceae*).

Remarks — In Cuba this species is common on fallen needles of *Pinus caribaea*, but Alonso & Jančařik (1986) found it also on *P. occidentalis* (as *P. maestrensis* Bisse). In Cuba both of these species are categorized as VU (Vulnerable) (Berazaín & al. 2005). Although Leontouyč (1972) reported *Lophodermium pinastri* (Schrad.) Chev. as widespread on *Pinus* in Cuba, we found only *L. australe*. Alonso & Pérez (1987) and Alonso & Maintoni (1990) reported *L. australe* causing a "brown spot" ("mancha parda") disease of needles, but in this study we did not find this disease, all our collections being on fallen needles. Minter (1981) did not report zone lines for this species but they were faintly visible on some of the Cuban material.

Cuban specimens examined — Pinar del Río: La Palma: Área de Recursos Manejados "Mil Cumbres, road to orquideario El Caimito, on needles of *Pinus caribaea*, 14 Nov 2004, *M. Cabarroi & al.* (HAJB M10665). — Sancti Spíritus: Sancti Spíritus: Reserva Ecológica Alturas de Banao, road to Jarico, on needles of *Pinus caribaea*, 28 Feb 2005, *M. Camino & al.* (HAJB M10703). — Trinidad: Topes de Collantes, road to Salto del Caburní, on needles of *Pinus caribaea*, 19 Sep 2005, *M. Cabarroi & al.* (HAJB M10749).

Other specimens examined — India: sine loc., Jun 1979, on needles of *Pinus elliottii*, *S. Singh* [ex herb. Forest Research Institute Dehra Dun no. 80] (IMI 250593). — Himachal Pradesh: Kasuli, 1 Oct 1982, on needles of *Pinus roxburghii*, *M. P. Sharma 11907* (IMI 274763b).

6. **Lophodermium mangiferae* Koorders in Verh. Kon. Akad. Wetensch., Afd. Natuurk., Sect. 2, 13(4): 163. 1907. – Holotype: Java, "prov. Kediri, Penunggalan, on leaves of *Mangifera indica*", 23 Apr 1906 [S. H. Koorders no. 8, ser. 11] (BO n.v.). – Fig. 2B.

Description — *Ascocarps* principally on abaxial surface of fallen leaves of *Mangifera indica*, not significantly raising substrate surface, within pale grey or yellowish brown spots surrounded with thin black and rather poorly developed or frequently absent zone line. *Ascocarp*

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viewed from above dark grey to black, sometimes with grey region at each end, elliptical, frequently curved, sometimes 3-lobed, 0.5–0.8 mm long, opening by single longitudinal sometimes branched slit; *perimeter line* dark grey to black; *lips* absent. *Hymenium* dark brown to black. *Ascocarp in vertical section* subepidermal; *upper wall* convex, 15–25 µm; *lower wall* concave, 8–15 µm, continuous with upper wall. *Paraphyses* hyaline, filiform, septate, 110–115 µm, covered with thin gelatinous coating, apex swollen to form epithecium. *Asci* cylindrical, 100–110 × 5–6 µm, thin-walled, 8-spored, apex obtuse to acute. *Ascospores* hyaline, filiform, sometimes slightly curved, non-septate, 70–80 × 1–2 µm, surrounded by thin gelatinous sheath.

Host organism — *Mangifera indica* L. (*Anacardiaceae*).

Remarks — This is the first record of this species from Cuba. Although *Mangifera indica* is common throughout Cuba, we found only a few specimens of *Lophodermium mangiferae* in February and March. Ascocarps are frequently curved. The infected leaf initially has a grey spot, which then turns yellow to yellowish brown and is irregular in shape.

Cuban specimens examined — Ciudad de la Habana: Boyeros: Finca la Chata (Instituto de Ecología y Sistemática), on fallen leaves of *Mangifera indica*, 20 Feb 2005, *D. W. Minter* (HAJB M10691). — Sancti Spíritus: Sancti Spíritus: Reserva Ecológica Alturas de Banao, La Sabina, road to Naranjal, 200 m, on fallen leaves of *Mangifera indica*, 23 Mar 2007, *D. W. Minter* (HAJB M10894).

Other specimens examined — India: Uttar Pradesh: Allahabad, on leaves of *Bucklandia populnea*, 30 May 1983, *M. D. Mehrotra* (K M164460).
Malaysia: Malaya, Kepong, on leaves of *Elateriospermum tapos*, 31 Jun 1984, *P. M. Kirk 1784* (K M164461).

7. *Lophodermium platyplacum* (Berk. & M. A. Curtis) Sacc., Syll. Fung. 2: 792. 1883 ≡ *Hysterium platyplacum* Berk. & M. A. Curtis in J. Linn. Soc., Bot. 10: 372. 1869 ≡ *Clithris platyplacum* (Berk. & M. A. Curtis) Tehon in Illinois Biol. Monogr. 13(4): 115. 1935. – Syntypes: Cuba, "on dead leaves of *Clusia*" [from protologue], 1868, *C. Wright 423* (?K n.v.); ibid., *C. Wright 424* (K!). – Fig. 2C, D.

Description — *Ascocarps* on abaxial or adaxial surface or petiole of dead leaves, scattered or covering almost entire surface, tending to be aligned with each other, within yellow or slightly green bleached spots, causing diffuse reddish (or sometimes delicate black) zone line in surrounding substrate. *Ascocarp viewed from above* erumpent from substrate surface, concolorous with host tissue, pale brown or slightly green, oblong-elliptical to elliptical, often sublinear, frequently curved or bifurcate, sometimes 3-lobed, 1–3.2 mm long, opening by single longitudinal sometimes branched slit; *perimeter line* pale grey to dark grey; *lips* absent. *Hymenium* yellowish to reddish brown, remaining exposed when dry. *Ascocarp in vertical section* subepidermal; *upper wall* 30–50 µm, extending at each side to join lower wall, composed of brown cells 8–13 µm in diam., forming textura angularis; *lower wall* of similar structure, 15–30 µm. *Paraphyses* filiform, non-septate (occasionally septate), 115–120 × 1.5–2 µm, apex slightly swollen to 3–4 µm thick, coated in thick mucous coat. *Asci* claviform to cylindrical, 120–150 × 6–8 µm, thin-walled, 8-spored. *Ascospores* hyaline, filiform, tapering slightly to base, non-septate, 80–110 × 1–1.5 µm, surrounded by gelatinous sheath.

Host organisms — **Clusia minor*; *C. rosea*; **C. tetrastigma*; *Clusia* sp. (*Clusiaceae*).

Remarks — This species is very common and can be found throughout the year on fallen leaves of *Clusia rosea*, less commonly on other *Clusia* species. On *C. tetrastigma* the ascocarps are slightly green and cover almost all of the leaf surface. *Lophodermium platyplacum* is found in rather drier locations in Cuba and is often associated with *Coccomyces clusiae*, *C. limitatus* and *Marthamyces quadrifidus*. *Lophodermium platyplacum* is the only member of the *Rhytismataceae* known to occur on leaf petioles of *Clusia* species in Cuba. It is easily recognized because the ascocarps are often in groups, forming a continuous line to 1 cm long.

Cuban specimens examined — Pinar del Río: Viñales: Viñales, on fallen leaves of *Clusia rosea*, 16 Jun 1969, *H. Kreisel* (HAJB M1145); Moncada town, on fallen leaves of *Clusia rosea* 25 Feb 2001, *M. Rodríguez* (HAJB M8809); Área de Recursos Manejados "Mil Cumbres", Sendero Ecoturístico La Altura, on fallen leaves of *Clusia rosea*, 29 Mar 2004, *M. Camino & al.* (HAJB M10230, HAJB M10231); around to "El Segui" falls, on fallen leaves of *Clusia rosea*, 10 Dec 2004, *J. M. Pérez* (HAJB M10536); road to orquideario El Caimito, on fallen leaves of *Clusia rosea*, 14 Nov 2004, *M. Cabarroi & al.* (HAJB M10666, HAJB M10689); pine forest near to Reduán, way in Sagua, on fallen leaves of *Clusia rosea*, 24 Mar 2005, *L. del Castillo* (HAJB M10706); around to Ancón river, on fallen leaves of *Clusia rosea*, 24 Mar 2005, *L. del Castillo* (HAJB M10708, HAJB M10709). — Güane: Sabanalamar, Arenas Blancas, on fallen leaves of *Clusia rosea*, 15 Nov 2004, *M. Cabarroi & al.* (HAJB M10676). — Ciudad de la Habana: Boyeros: Jardín Botánico Nacional, pine forest surrounding Ranchón, on fallen leaves of *Clusia rosea*, 28 Apr 2005, *M. Cabarroi* (HAJB M10718); on fallen leaves of *Clusia rosea*, 7 Jan 2006, *M. Cabarroi* (HAJB M10769). — Holguín: Mayarí: Sierra de Nipe, Alto La Torre, on fallen leaves of

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Clusia rosea, 2 Jul 2004, *M. Camino* (HAJB M10422). — Villa Clara: Santa Clara: Reserva Florística Manejada "Monte Ramonal", on fallen leaves of *Clusia rosea*, 15 Jan 2005, *J. M. Pérez* (HAJB M10533). — Sancti Spíritus: Sancti Spíritus: Reserva Ecológica Alturas de Banao, road to Jarico, on fallen leaves of *Clusia rosea*, 28 Feb 2005, *M. Camino & al.* (HAJB M10701, HAJB M10702). — Trinidad: Topes de Collantes, road to Salto del Caburní, on fallen leaves of *Clusia rosea*, 19 Sep 2005, *M. Cabarroi & al.* (HAJB M10754); Mi Retiro mogote around, on fallen leaves of *Clusia rosea*, 9 Dec 2007, *M. Cabarroi* (HAJB M10973, K M 157614). — Cienfuegos: Cienfuegos: Jardín Botánico de Cienfuegos Soledad, natural forest, on fallen leaves of *Clusia rosea*, 11 Jun 2005, *M. Cabarroi & al.* (HAJB M10728, HAJB M10729). — Guantánamo: Baracoa: Báez river, near to campamento de Mina Amores, on fallen leaves of *Clusia rosea*, 9 Mar 2006, *M. Camino* (HAJB M10770). — Santiago de Cuba: Santiago de Cuba: climb to Gran Piedra, 1200 m, on fallen leaves of *Clusia* sp., 11 Mar 2006, *M. Camino* (HAJB M10781). — Guamá: Pico Juaquín, on fallen leaves of *Clusia* sp., 14 Mar 2006, *M. Camino* (HAJB M10802); road from Pico Juaquín to Pico Regino (km 9), on fallen leaves of *Clusia tetrastigma*, 14 Mar 2006, *M. Camino* (HAJB M10804); road from Pico Juaquín to Pico Turquino, after Paso de los Monos, on fallen leaves of *Clusia tetrastigma*, 14 Mar 2006, *M. Camino* (HAJB M10806).

Other specimens examined — Venezuela: Distrito Federal: El Ávila, near Hotel Humboldt, in cloud forest; c. 2000 m, on leaves of *Clusia* sp., 4 Jul 1958, *R. W. G. Dennis 28A* (K M164457). — Estado Miranda: Los Guayabitos Forest, c. 1300 m, on leaf, 8 Jun 1958, *R. W. G. Dennis 1340* (K M164458).

8. ***Marthamyces quadrifidus*** (Lév.) Minter in Mycotaxon 87: 52. 2003 ≡ *Stictis quadrifida* Lév. in Ann. Sci. Nat., Bot., ser. 3, 5: 255. 1846 ≡ *Propolis quadrifida* (Lév.) Mont. in Gay, Flora Chilena 7: 425. 1852. – Holotype: Cuba, "Habana", *Gay* (PC n.v.). – Fig. 2E, F.
= *Stictis chilensis* Speg. in Revista Fac. Agron. Univ. Nac. La Plata, ser. 2, 6: 129. 1910. – Lectotype (designated by Sherwood 1977: 327): Chile, "Concepción, en *Boldoa* sp.", *Anonymous 28232* (LPS n.v.).
= *Stictis serenoae* E. K. Cash in Mycologia 35: 599. 1943. – Holotype: U.S.A., Florida, "en *Serenoa* sp.", *Shear 1396* (BPI n.v.).

Description — *Ascocarps* on abaxial and adaxial surface of dead coriaceous leaves, not associated with bleaching of surrounding substrate, without zone lines. *Ascocarp viewed from above* initially resembling small pustules, erumpent from substrate surface, colourless, orbicular to angular, 0.4–1 mm in diam., opening by 3–6 prominent, irregular, pruinose and white teeth; *perimeter line* and *lips* absent. *Hymenium* somewhat depressed below level of substrate, pruinose, pale grey when fresh, drying grey, white or yellowish. *Ascocarp in vertical section* subepidermal; *lower wall* adnate to ruptured epidermis, colourless, comprising poorly developed layer of hyphae intermixed with crystals. *Paraphyses* hyaline, filiform, septate, 80–110 × 1–1.5 µm, near apex swollen and branched. *Asci* cylindrical to clavate, 75–100 × 7–9.5 µm, thin-walled, 8-spored, apex rounded to apiculate. *Ascospores* hyaline, filiform, tapering proximally, sometimes 1–3-septate, 60–80 × 1.8–2 µm, surrounded by gelatinous sheath.

Host organisms — *Clusia rosea*; **Mangifera indica*.

Remarks — This species is common throughout Cuba on fallen leaves of *Clusia rosea* and is often associated with *Coccomyces clusiae* and *Lophodermium platyplacum*. *Marthamyces quadrifidus* is distinguished from these other species by its ascocarps opening by prominent, irregular, pruinose and white teeth.

Cuban specimens examined — "Habana", *C. Wright 488* [ex herb. Berkeley] (K M). — Pinar del Río: La Palma: Área de Recursos Manejados "Mil Cumbres", Sendero Ecoturístico La Altura, on fallen leaves of *Clusia rosea*, 29 Mar 2004, *M. Camino & al.* (HAJB M10230, HAJB M10231); Las Bateas, on fallen leaves of *Clusia rosea*, 10 Dec 2004, *L. del Castillo* (HAJB M10537); Sierra Chiquita, los Catorce, on fallen leaves of *Clusia rosea*, 25 Mar 2004, *L. del Castillo* (HAJB M10712). — Ciudad de la Habana: Boyeros: Jardín Botánico Nacional, around laboratories, 10 May 2008, on fallen leaves of *Clusia rosea*, *M. Cabarroi* (HAJB M11025). — Holguín: Mayarí: Sierra de Nipe, Alto La Torre, on fallen leaves of *Clusia rosea*, 2 Jul 2004, *M. Camino* (HAJB M10422). — Villa Clara: Santa Clara: Reserva Florística Manejada "Monte Ramonal", on fallen leaves of *Clusia rosea*, 15 Jan 2005, *J. M. Pérez* (HAJB M10533). — Sancti Spíritus: Sancti Spíritus: Reserva Ecológica Alturas de Banao, road to Jarico, on fallen leaves of *Clusia rosea*, 28 Feb 2005, *M. Camino & al.* (HAJB M10701, HAJB M10702); La Sabina, road to Naranjal, 200 m, on fallen leaves of *Mangifera indica*, 23 Mar 2007, *D. W. Minter* (HAJB M10894). — Cienfuegos: Cienfuegos: Jardín Botánico de Cienfuegos Soledad, natural forest, on fallen leaves of *Clusia rosea*, 11 Jun 2005, *M. Cabarroi & al.* (HAJB M10728).

Other specimens examined — Malaysia: Sabah: Burung Trail, Bukit, Mt Kinabalu, 5000 ft, on fallen leaf of *Fagraea* sp., 13 Dec 1985, *B. M. Spooner 36b* (K M164465).
Venezuela: Estado Miranda: Los Guayabitos, in forest, 1300 m, on leaves of *Clusia* sp., 8 May 1958, *R. W. G. Dennis 1340A* as *Stictis foliicola* (K M164467).

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9. *Terriera minor* (Tehon) P. R. Johnst. in Mycologia 95: 848. 2003 ≡ *Clithris minor* Tehon in Bot. Gaz. 65: 554. 1918 ≡ *Lophodermium minus* (Tehon) P. R. Johnst. in Sydowia 41: 174. 1989. – Neotype (designated by Johnston 1989: 174): Venezuela, "Edo. Aragua, Parq. Nac. Henry Pettier, c. 14 km en Maracay, en *Clusia* sp.", 12 Jul 1917, *Dumont & Haines 2051* (NY n.v.). – Fig. 2G, H.

Description — Ascocarps usually on one surface of leaf only, in discrete groups, within yellow spots usually without zone lines, although occasionally thin black zone line present. *Ascocarp viewed from above* significantly raising substrate surface, dark grey to black when dry, uniformly black when wet except sometimes for grey region at each end, shiny, oblong to oblong-elliptic, sometimes slightly curved or fusing, 0.4–1 mm long, opening by single longitudinal sometimes branched slit, ends rounded; *perimeter line* sometimes observed, black; *lips* absent. *Hymenium* dark grey to black. *Ascocarp in vertical section* while unopened with hymenium surrounded by layer of vertically oriented rows of cylindrical cells, when opened embedded beneath leaf cuticle and some epidermal cells; *upper wall* of dark brown angular cells covering whole ascocarp and extending at each side to join lower wall. *Paraphyses* colourless, filiform, septate, 120–135 × 1.5–2 µm, toward apex sometimes branching 2 or 3 times. *Asci* cylindrical, 110–130 × 6–7 µm, thin-walled, 8-spored, base tapering sharply, apex rounded. *Ascospores* hyaline, tapering slightly to both ends, non- or 1-septate, 70–100 × 1–2 µm, thin-walled, surrounded by thin mucous coat.

Host organism — Clusia rosea.

Remarks — This species is common on fallen leaves of *Clusia rosea*, sometimes associated with *Lophodermium platyplacum.* It is characterized by black ascocarps significantly raising the substrate surface, apparently always in discrete groups occupying a small part of the leaf.

Cuban specimens examined — Pinar del Río: La Palma: Área de Recursos Manejados "Mil Cumbres", orquideario El Caimito, on fallen leaves of *Clusia rosea*, 14 Nov 2004, *M. Cabarroi & al.* (HAJB M10689). — Ciudad de la Habana: Boyeros: National Botanical Garden, around laboratories, on fallen leaves of *Clusia rosea*, 11 Jun 2009, *M. Cabarroi* (HAJB M11084).

Discussion

Our survey confirmed earlier reports of *Coccomyces clusiae*, *C. limitatus*, *Lophodermium australe*, *L. platyplacum*, *Marthamyces quadrifidus* and *Terriera minor*, while *C. leptosporus*, *C. tesselatus* and *L. mangiferae* are new records for Cuba. We found no material matching *L. foliicola* or *Naemacyclus macularis.* The type collections of *Rhytisma concentricum* and *R. gyrosum* deposited in K (M) are damaged and impossible to place into a modern taxonomic concept. *Rhytisma concentricum* was described from wood (Berkeley 1868) and is unlikely to be *Rhytisma* in the modern sense of this genus. The morphologically distinctive *R. micraspis* is the type species of the monotypic genus *Cavaraella*, a genus reported only from Cuba. This species was not found during the survey. Judging from the Spegazzini (1921) illustration of the host, it is probably a pathogen of *Rubiaceae*.

Most species were found on leaves of *Clusia* species. The leathery leaves of *Clusia* lie on the soil for several months before decomposing, providing an ideal substrate for *Rhytismataceae* (Johnston 1989). *Lophodermium platypacum* ascocarps were present on *Clusia* leaves at most times of the year, the other species being found less frequently. *Rhytismataceae* were most abundant on *C. rosea*, with fewer collections found on *C. minor* and *C. tetrastigma*. *Clusia tetrastigma* is a threatened species endemic to Cuba, while *C. minor* and *C. rosea* have a preliminary categorization as LC (Least Concern) (Panfet 2008).

Lophodermium australe was found on fallen needles of *Pinus caribaea* and *P. occidentalis*. Both species of *Pinus* are categorized as VU (Vulnerable) (Berazaín & al. 2005). *Lophodermium australe* is common in pine forests through Cuba, and for this reason we do not consider this species threatened in this country.

Mena & al. (2012), in the Red List of fungi of Cuba, stated that *Coccomyces limitatus*, *Lophodermium australe*, *L. platyplacum* and *Marthamyces quadrifidus* are species evaluated as LC. Our survey supports this; none of the fungi we report were found to be specific to threatened plant species.

The Cuban flora has a high level of endemism. There are many plants with coriaceous leaves, which lie on the soil for several months, and it is likely that additional species of *Rhytismataceae* will be found during future surveys.

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