

Rinodina brasiliensis, a new corticolous isidiate species, and closely related taxa

Mireia GIRALT, Klaus KALB and Helmut MAYRHOFER

Abstract: *Rinodina brasiliensis*, a corticolous isidiate species with large *Pachysporaria*-type ascospores is described from south-eastern Brazil. The new species is closely related to *R. dolichospora* and to *R. guianensis*. *Rinodina confinis* is a synonym of *R. dolichospora*. Notes on the taxonomy, morphology, anatomy, chemistry and distribution of these three taxa are given. Descriptions and iconography are provided. A key to species is also included.

Key words: lichenized fungi, Lecanoromycetes, new species, new records, *Physciaceae*, *Rinodina dolichospora*

Introduction

This paper introduces a new corticolous species from Brazil, *Rinodina brasiliensis*, mainly characterized by its isidiate thallus (Fig. 1A) lacking secondary lichen substances and its large *Pachysporaria*-type ascospores, with walls not ornamented, but including globular inclusions surrounding the lumina. The last feature clearly relates the new species to *R. dolichospora* and *R. guianensis*. These taxa are also discussed and included in the key to the species presented in this contribution.

The key character of the three species mentioned above is the unique shape of their ascospores. Between the lumina and the outer spore-wall, there are abundant, minute, scattered, seldom contiguous, inclusions, which can clearly be seen in young but already brown-pigmented ascospores (Figs. 2C, 3A). As the ascospores mature, the drops (inclusions) increase in size and

number, approaching and closely surrounding the lumina (Figs. 2D, 3B–C, 4D). Finally, in overmature ascospores, the lumina are almost completely covered (overcast), and therefore hidden, by large drops. The origin and nature of these drops or inclusions are at present uncertain (Fig. 2E).

These globular structures are different from the sporoblastidia present in the *Polyblastidium*-type ascospores of *Heterodermia*, described and illustrated in Kurokawa (1962, under *Anaptychia*) and Poelt (1965). In contrast, the sporoblastidia arise or bud from the lumina and remain united to them for a long time, are larger, of variable shape, often elongate, and, according to Kurokawa (*op. cit.*), they are true cells. For comparison, see the photographs of the sporoblastidia of *Heterodermia flabellata* (Fée) D. D. Awasthi in Schumm. & Schäfer-Verwimp (2006: 36; Abb. 2).

Other characters that these treated species have in common are: 1) rather large, smooth ascospores without a torus belonging to the *Pachysporaria*-type; 2) crustose to subsquamulose, thin, smooth and ochraceous to brownish thallus; 3) tall hymenium (up to 150 µm high); 4) orange-brown epihymenium composed of richly branched and interwoven paraphyses; 5) *Lecanora*-type asci; and 6) small photobiont cells. Furthermore, all of them are known from tropical to

M. Giralt: Departament de Bioquímica i Biotecnologia (Àrea de Botànica), Facultat d'Enologia de Tarragona, Universitat Rovira i Virgili, Marcel·lí Domingo s/n, 43007, Tarragona, Spain. Email: mireia.giralt@urv.cat
K. Kalb: Lichenologisches Institut Neumarkt, Im Tal 12, D-92318 Neumarkt, Germany.
H. Mayrhofer: Institut für Pflanzenwissenschaften, Karl-Franzens-Universität Graz, Holteigasse 6, A-8010 Graz, Austria.

subtropical areas and reach temperate regions in Australia and south-western Europe.

The terricolous *Rinodina intermedia* Bagl., a species with a world-wide distribution, presents most of the characters cited above. However, apart from its ecology, it is distinguished, by its mature submuriform ascospores with 4–12 locules (Mayrhofer *et al.* 2001). Sampaio (1924) has indicated its close relationship with *R. confinis*.

Another species related to this group is *R. inspersoparietata* Giralt & van den Boom, recently discovered in the Cape Verde Islands. It is saxicolous and is treated in detail in a paper including all *Rinodina* species hitherto known from these islands (Giralt & van den Boom 2008). Apart from its different habitat, it is easily separated from *R. brasiliensis* and *R. guianensis* by a lack of isidia; from *R. dolichospora* by having smaller

ascospores, of 17–23 × 7.5–12 µm, which develop after an ontogeny of type B; and from *R. intermedia* by possessing *Pachysporaria*-type ascospores. Because of their close relationship with *R. dolichospora*, *R. intermedia* and *R. inspersoparietata* are also included in the key, but in parentheses.

Materials and Methods

All descriptions are based on our personal examinations. The specimens were examined by standard techniques using stereoscopic and compound microscopes. Current mycological terminology generally follows Kirk *et al.* (2001). Only free ascospores lying outside the asci have been measured. The terminology used for the asci follows Rambold *et al.* (1994) and for the ascospore-types and ascospore-ontogenies Giralt (2001).

The standard methods of thin-layer chromatography (TLC) (e.g. Culberson & Ammann 1979; Culberson *et al.* 1981; Culberson & Johnson 1982) were employed for the search of chemical constituents.

Key to the *Rinodina dolichospora* group

- 1 Thallus never isidiate 2
- Thallus isidiate 4
- 2(1) Terricolous; young ascospores with four lumina, similar to the *Conradia*-type; mature ascospores submuriform, with 6–12 lumina, (20–)25–30 × 12–15(–18) µm **(R. intermedia)**
- Saxicolous or corticolous; young and mature ascospores with two lumina, *Pachysporaria*-type **3**
- 3 (2) Saxicolous; ascospores 17–23 × 7.5–12 µm, ontogeny type B **(R. inspersoparietata)**
- **R. dolichospora**
- Corticolous; ascospores (20–)25–35(–40) × 11–18 µm, ontogeny type A **R. dolichospora**
- 4 (1) Isidia (50–)70–90(–100) µm wide; ascospores (24–)26–33(–40) × (10–)13–16 (–18) µm, ontogeny type A **R. brasiliensis**
- Isidia (20–)30–40(–50) µm wide; ascospores (14–)16–19(–22) × (6.5–)8–10(–12) µm, ontogeny type B. **R. guianensis**

The Species

***Rinodina brasiliensis* Giralt, Kalb & H. Mayrhofer sp. nov.**

Rinodina dolichospora similis sed thallus isidiatus. Isidia numerosa, subcontigua ad densa, simplices vel ramosa, ad 0.4 mm alta, circa 0.1 mm crassa, thallo concolora.

Type: Brazil, Rio de Janeiro, Serra da Mantiqueira; Itatiaia, between Registro do Picú and Agulhas Negras, on *Cupressus* by the roadside, 1500 m, 22°20' S, 44°45' W, 12 July 1979, K. Kalb (hb. Kalb 37183—holotypus; GZU—isotypus).

(Figs 1A, 2A–E & 5A)

Thallus corticolous, crustose to subsquamulose, with numerous isidia, free or mostly united at the base into a subsquamulose structure (Fig. 1A), covering wide areas, thin, smooth, ochraceous to brownish. *Isidia* (100–)200–400 µm long × (50–)70–90(–100) µm wide, simple to branched, concolorous with thallus.

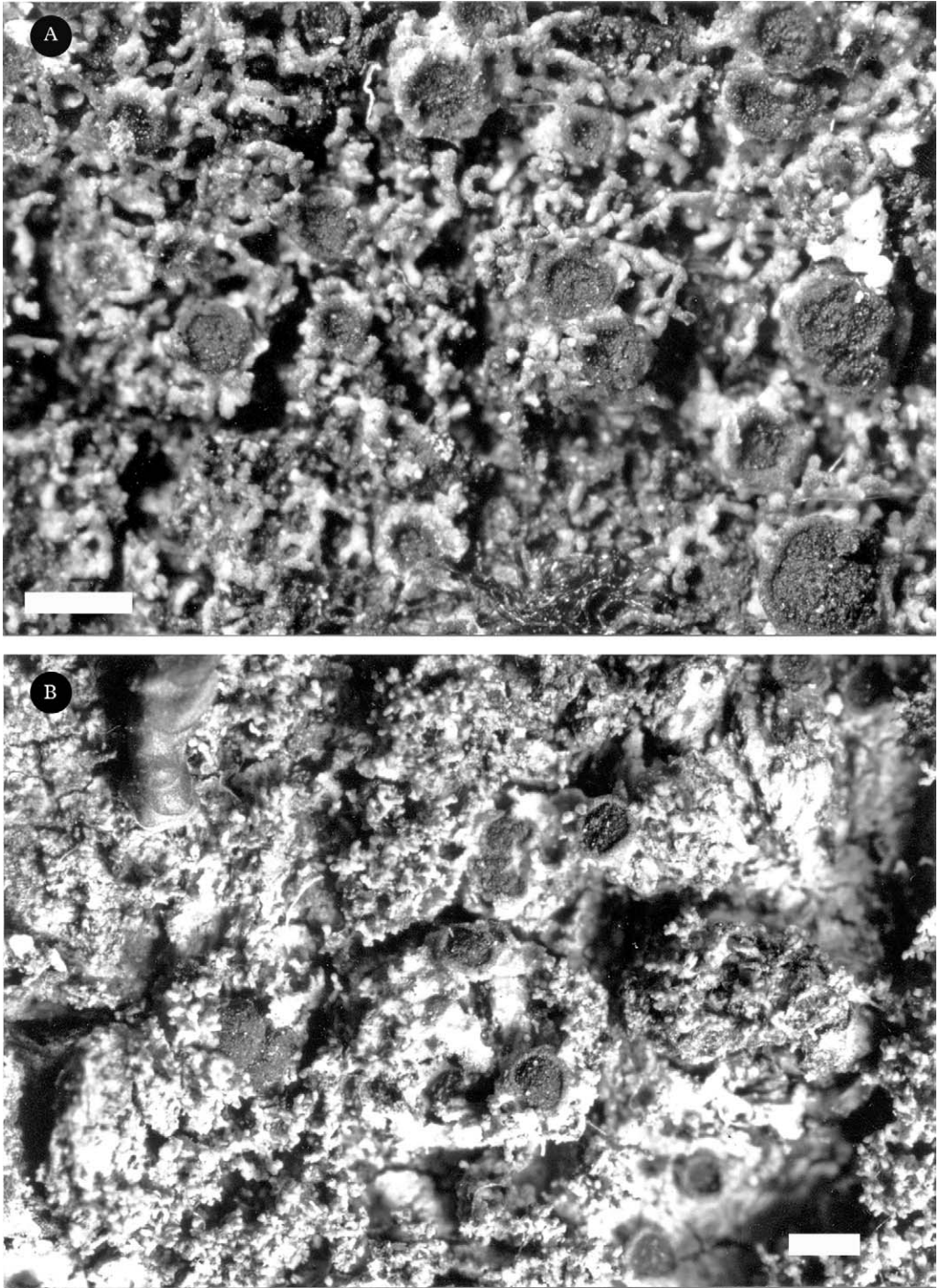


FIG. 1. *Rinodina* species, habit. A, *R. brasiliensis* (holotype); B, *R. guianensis*. [*Kalb* s. n. (hb. *Kalb* 37186)]. Scales: A = 0.475 mm; B = 0.5 mm.

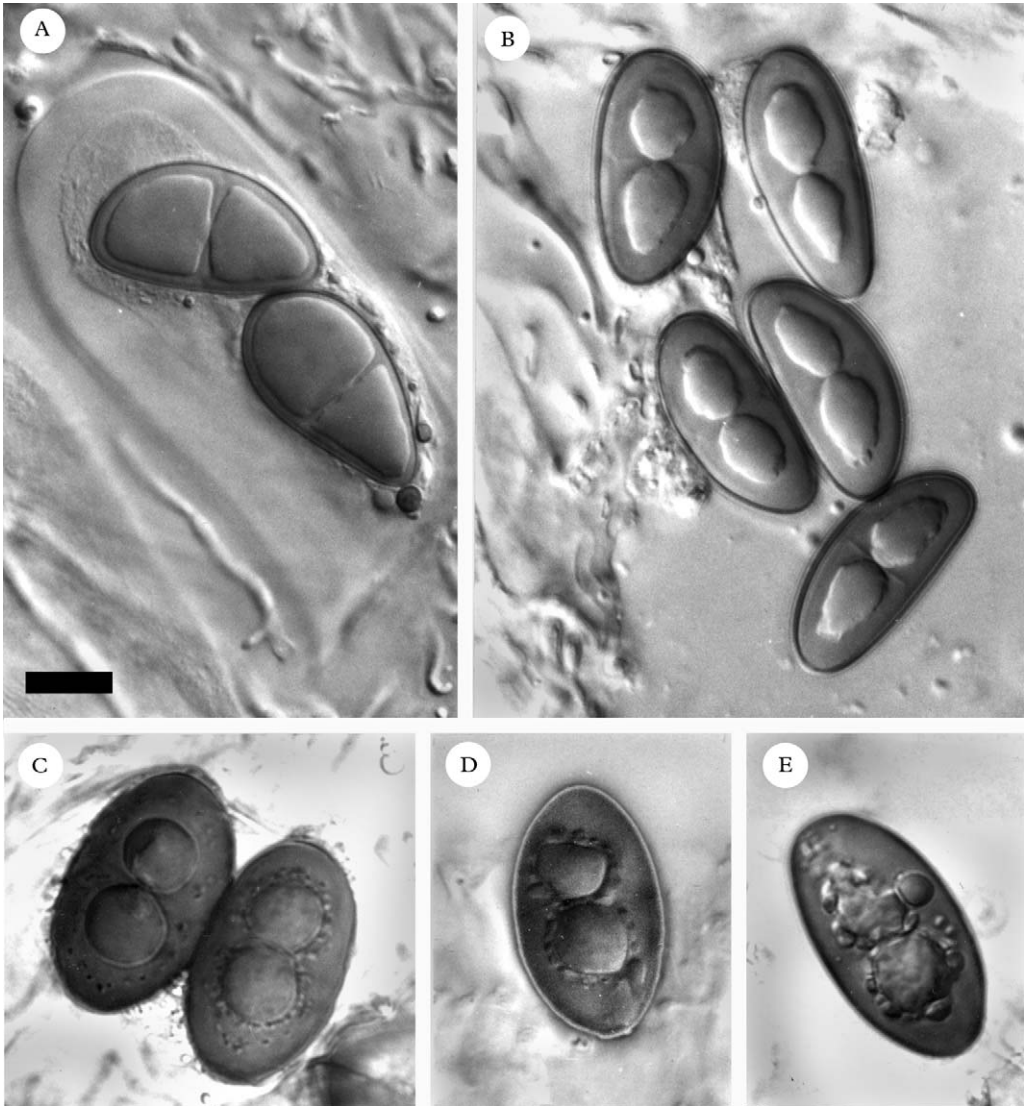


FIG. 2. *Rinodina brasiliensis*, ascospores showing the peculiar globular inclusions within the spore wall (holotype). A, type A ontogeny; B–C, *Pachysporaria*-type ascospores; C, minute, scattered inclusions; D, larger inclusions surrounding the lumina; E, coalescent inclusions partially hiding the lumina. Scale = 10 μ m.

Apothecia lecanorine, sessile, broadly attached, becoming more or less constricted at the base, usually scattered, (0.3–)0.5–0.8(–1) mm diam. Thalline margin concolorous with thallus, thin, entire, becoming isidiate, finally partially excluded. Disc dark brown, plane to subconvex. Proper margin entire, thick, prominent, clearly visible as a ring within the thalline margin, persistent.

Excipulum thallinum up to 100 μ m wide. Cortex nearly indistinct, not expanded below. *Excipulum propium* 10–20 μ m laterally, expanded to (40–)60–100 μ m above. *Hymenium* 120–150(–180) μ m high. *Epihymenium* orange-brown. *Hypothecium* pale yellowish-brown, to 50 μ m deep. *Paraphyses* 1–1.5 μ m wide, richly branched and interwoven at epihymenium level. Apices up to

3(–4) μm wide. *Asci* *Lecanora*-type, 110–130 \times 15–28 μm . *Ascospores* *Pachysporaria*-type, (24–)26–33(–40) \times (10–)13–16(–18) μm , smooth, walls not ornamented, including globular inclusions surrounding the lumina, without torus, ontogeny type A (Fig. 2A–E, 5A).

Pycnidia and *conidia* not seen.

Chemistry. No substances detected by TLC.

Observations. *Rinodina brasiliensis* is characterized by the thin, smooth, and ochraceous thallus, composed of scattered to contiguous, entire to sublobate squamules which dissolve into large, simple to branched isidia, and the large smooth, *Pachysporaria*-type ascospores, not constricted at septum, without a torus and including globular inclusions in the spore wall. The large isidia together with the large ascospores separate this new taxon from all the other species treated here. All specimens hitherto known are fertile. *Rinodina brasiliensis* is very closely related to *R. dolichospora* from which it differs only in the presence of isidia. According to the original description of Malme (1902), *R. dolichospora* may be “*crebe brevissimeque isidiosus*”. As noted in Mayrhofer *et al.* (1999), the squamules of *R. dolichospora* are “at times present ascending margins somewhat microphylline or lobulate” but they are never clearly isidiate as in *R. brasiliensis*.

A morphologically similar species possessing larger isidia united at the base into a subsquamulose structure and large *Pachysporaria*-type ascospores, is the oceanic-temperate *R. isidioides*, which is distinguished by the presence of atranorin (Giralt *et al.* 1995; Giralt 2001).

Ecology and distribution. The new species was found on the trunks of well-lit trees at the edge of a tropical rainforest, called mata atlântica, in parts disturbed by human activity. It is known only from the Serra da Mantiqueira (SE Brazil).

Additional specimen examined. **Brazil:** São Paulo: Serra da Mantiqueira; above Campos do Jordão, c. 45 km N von Taubaté, on a free standing *Podocarpus* sp.,

1850 m, 22°45' S, 45°35' W, 1978, K. Kalb & G. Plöbst (hb. Kalb 37184).

Rinodina dolichospora Malme

Bihang K. Svenska Vet.-Akad. Handl. 28 (III/1): 30 (1902); type: Brazil, Matto Grosso, Santo Antonio, Morro Grande, ad truncum dejectum in siulvula humidam, 1893, G. O. Malme 2159 (S—lectotype! Mayrhofer *et al.* 1999: 183).

New synonym: *Rinodina confinis* Sampaio, *Bolet. Soc. Broter. Ser. 2*, 2: 177 (1924); type: Portugal, Minho, Póvoa do Lanhoso, S. Gens, August 1919, G. Sampaio (UPS—syntype).

Exs.: SAMPAIO: *Lich. exs. Portugal* 198 (M, as *R. confinis*).

(Fig. 3A–C)

Thallus corticolous, crustose to subsquamulose, ochraceous to olivaceous, composed of entire to sublobate squamules, sometimes with ascending margins.

Apothecia lecanorine, 0.4–0.6(–1) mm diam. **Hymenium** up to 170 μm tall. **Epithymenium** orange-brown. **Hypothecium** pale yellowish-brown. **Ascospores** *Pachysporaria*-type, (20–)25–35(–40) \times 11–18 μm , smooth, walls not ornamented but including globular inclusions surrounding the lumina without torus, ontogeny of type A (Fig. 3A–C). Sometimes the European material possesses a few ascospores showing tendencies towards four lumina.

Conidia 4.5–6 \times 1.5 μm .

Additional information including detailed descriptions is given in Sampaio (1924), Magnusson (1947), Giralt & Mayrhofer (1995) and Giralt (2001), under *R. confinis*, and Mayrhofer *et al.* (1999) and Sheard & Mayrhofer (2002), under *R. dolichospora*.

Chemistry. No substances could be detected by TLC.

Observations. The lack of vegetative propagules together with the large *Pachysporaria*-type ascospores distinguish this species from all the other species treated here.

Distribution. *Rinodina dolichospora* is hitherto known from several localities in the

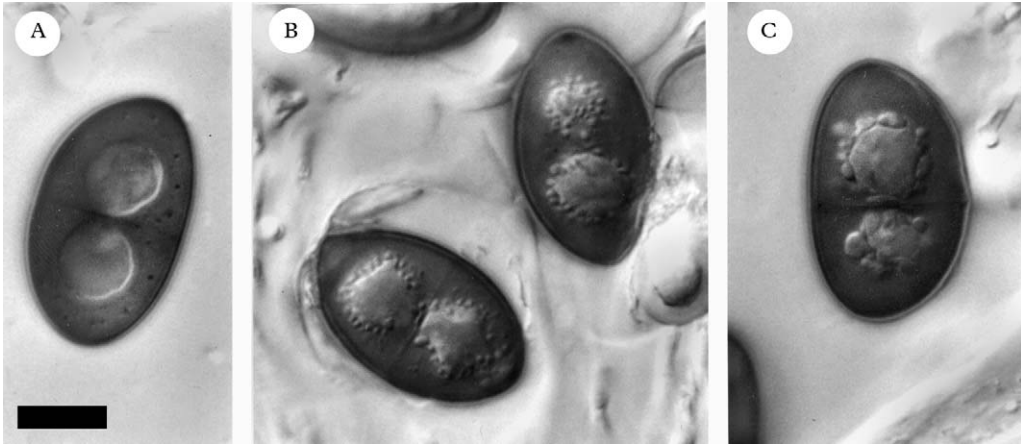


FIG. 3. *Rinodina dolichospora*, ascospores [Kalb s. n. (hb. Kalb 37185)]. A–C, *Pachysporaria*-type ascospores showing the evolution of the globular inclusions within the spore wall. Scale = 10 μ m.

Atlantic coast of the Iberian Peninsula and from Italy (Liguria), Europe (Giralt & Mayrhofer 1995, as *R. confinis*); from two localities of New South Wales, Australia (Mayrhofer *et al.* 1999); and from Georgia, Louisiana and North Carolina, North America (Sheard & Mayrhofer 2002).

Additional specimen examined. Brazil: São Paulo: Ponta do Baleeiro; c. 6 km S of São Sebastião, on young, free standing deciduous trees along the beach, 3 m, 23°50' S, 45°25' W, 1979, K. Kalb & J. Poelt (hb. Kalb 37185).—*Australia:* New South Wales: Buckenbowra River Estuary, 7.5 km W Batemans Bay, 1–2 m, 1988, K. Kalb & J. Elix (hb. Kalb 18745, 18746, 18905).

Rinodina guianensis Aptroot

Proc. Kon. Ned. Akad. Wetensch., Ser. C, 90(3): 240 (1987); type: French Guiana, Cayenne, Place des Palmistes in the centre of the town, on *Maximiliana* (Palmae), March 1985, A. Aptroot (U—holotype).

(Figs. 1B, 4A–D & 5B)

Thallus crustose, rarely subsquamulose, continuous, smooth, thin, ochraceous, almost entirely isidiate (Fig. 1B). *Isidia* (20–) 30–40(–50) wide \times 100–200–(400) μ m long, simple to richly branched, concolorous with thallus.

Apothecia sessile, broadly attached, scattered, 0.3–0.5(–0.6) mm diam. Thalline margin concolorous with thallus, thin, becoming isidiate and \pm excluded. Disc dark

brown, persistently plane. Proper margin visible as a ring inside the thalline margin. *Excipulum thallinum* up to 90 μ m wide. Cortex nearly indistinct. *Excipulum propium* 10–20 μ m laterally, expanded to 50–60 μ m above. *Hymenium* 90–110 μ m high. *Epihymenium* orange-brown. *Hypothecium* colourless to pale yellowish brown. *Asci* *Lecanora*-type. *Ascospores* *Pachysporaria*-type, (14–)16–19(–22) \times (6.5–)7–10(–12) μ m, smooth, walls not ornamented but including globular inclusions surrounding the lumina, without torus, ontogeny type B (Fig. 4A–D, 5B).

Pycnidia and *conidia* not seen.

Additional information including detailed descriptions may be found in Aptroot (1987) and Giralt & Mayrhofer (1995).

Chemistry. No substances could be detected by TLC. Nevertheless a yellowish orange pigment which reacts K+ purple-rose is sometimes present at the base of some apothecia. This reaction was missed by Aptroot (1987) in the diagnosis of the species. No chemical analyses have been carried out to identify this pigment, but as in *R. intermedia* it could be skyrin.

Observations. The isidiate thallus with thin, long and richly branched isidia, and the

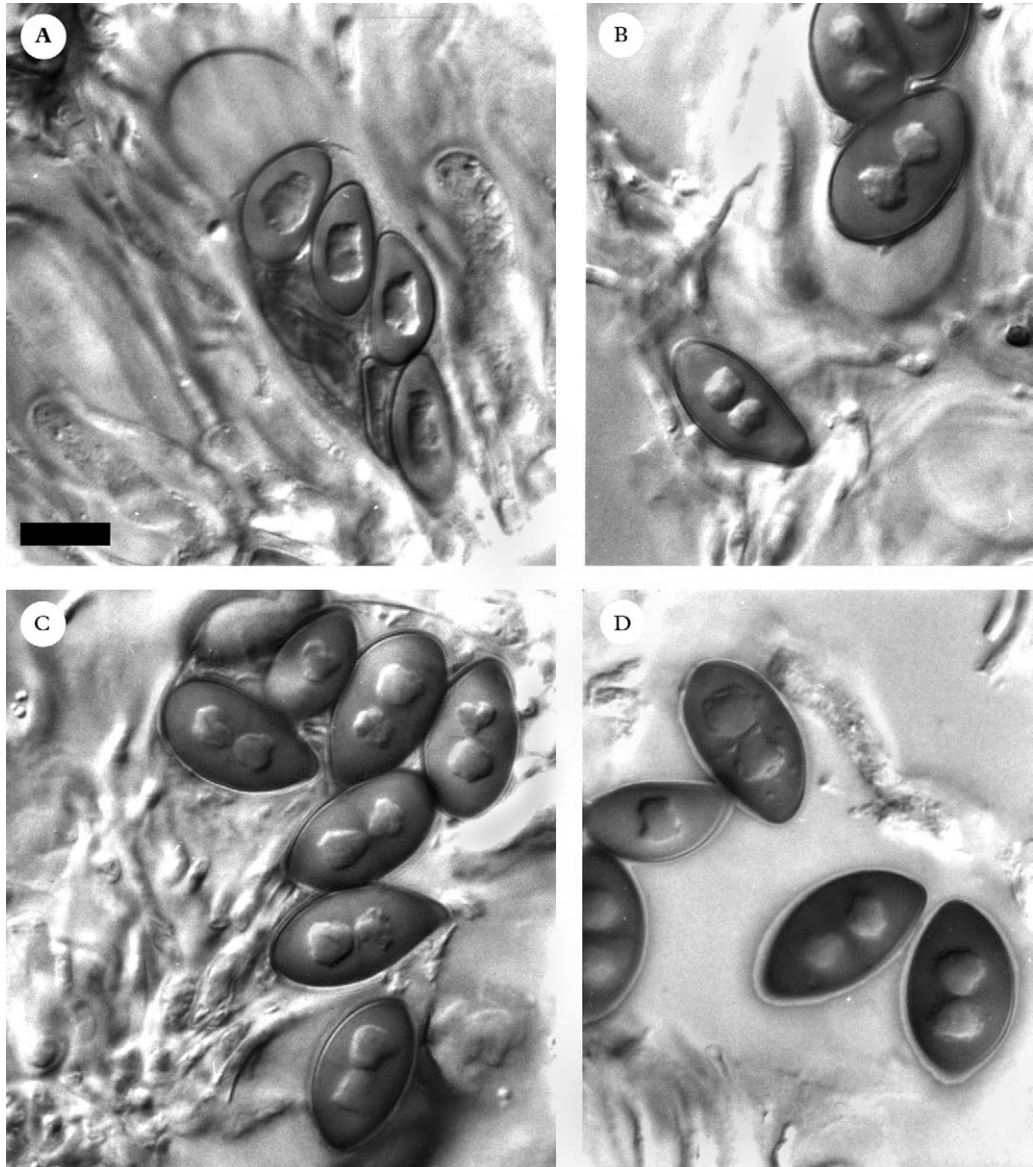


FIG. 4. *Rinodina guianensis*, ascospores [Kalb s. n. (hb. Kalb 27014)]. A & B, type B ontogeny; C & D mature *Pachysporaria*-type ascospores, some showing the globular inclusions. Scale = 10 μm .

Pachysporaria-type ascospores, including globular inclusions within the spore walls and developed after an ontogeny of type B, are diagnostic for this species.

Rinodina guianensis seems to be a rather variable species, especially concerning the size of the ascospores as well as that of the

isidia. Whereas some specimens have ascospores no larger than $19 \times 9 \mu\text{m}$, in some others they reach $18\text{--}22 \times 9\text{--}12 \mu\text{m}$. The same applies to the isidia, which range from rather short and branched to long and richly branched. However these characters are not correlated.

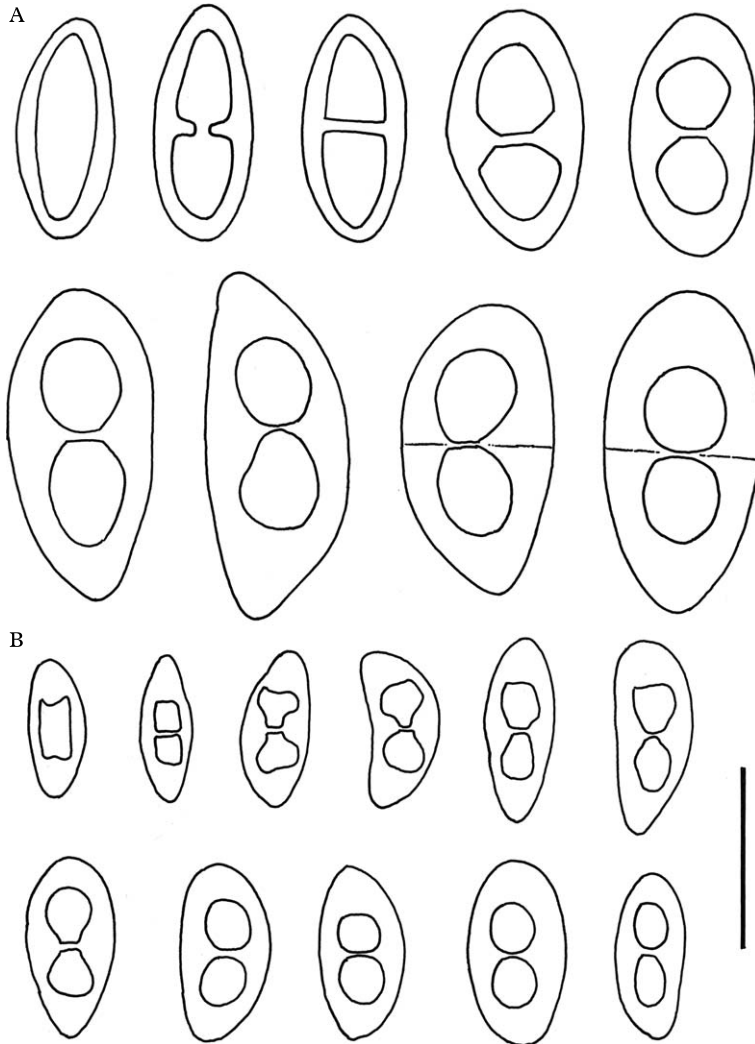


FIG. 5. Ascospore ontogeny and ascospore variability. A, *Rinodina brasiliensis* (holotype); B, *R. guianensis* [Kalb s.n. (hb. Kalb-27014)]. Scale = 10 μ m.

Compared with *R. brasiliensis* and *R. confinis*, this species rarely shows a subsquamulose thallus and has a lower hymenium. Furthermore, because of the smaller size of its ascospores, the globular inclusions within the spore wall are not so clearly visible.

A K+ purple-rose medullary reaction is also sometimes present in the related *R. intermedia*. In this case it is caused by the yellow to orange pigment skyrin (Mayrhofer *et al.* 2001). In the account of *R. intermedia* given by Mayrhofer *et al.* (*op. cit.*), the pres-

ence of globular inclusions within the spore walls of this species is not recorded.

Distribution. The distribution of *R. guianensis* seems to be restricted to the tropics. Hitherto it has been reported from French Guiana (Aptroot 1987), Brazil and Guatemala (Giralt *et al.* 1995).

Additional specimens examined not cited in Giralt *et al.* (1995). **Brazil:** Goiás: between Jataí and Rio Verde, c. 48 km W of Rio Verde, on deciduous trees at the edge of a cerrado, 780 m, 17°55' S, 51°10' W, 1980, K. Kalb

& M. Marcelli (hb. Kalb 37186).—**Venezuela:** Mérida: Distr. Sucre, Hacienda “Los Topes”, San Juanito, a few km ENE of Chiguara, 1500 m, 1989, K. Kalb & A. Morales (hb. Kalb 27014); Chiguara, Finca Antonio Basilio, 900 m, 1989, K. Kalb & A. Morales (hb. Kalb 37187).

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