

Ravenelia cenostigmatis, a new rust fungus from Brazil*

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Ravenelia cenostigmatis is described as a new species of plant rust (Uredinales) on *Cenostigma gardnerianum* (Caesalpinaceae) from Brazilian Cerrado. Teliospore heads of *R. cenostigmatis* exhibit an unusually complex structure with four different kinds of cells: teliospore cells, sterile apical cells (intercalary between pedicel hyphae and teliospores), sterile hygroscopic cysts, and morphologically distinct border cells. The last are flattened, elaborately ornamented and probably sterile cells that are wedged between the teliospores and the cysts. *Ravenelia cenostigmatis* probably belongs to a natural assemblage of ravenelias that occur on caesalpinaceous hosts and exhibit similar morphological traits.

Key Words—Caesalpinaceae; *Kernkampella*; systematics; teliospore morphology.

The genus *Ravenelia* comprises about 190 species that are distributed in the subtropics and tropics around the world and infect almost exclusively members of Leguminosae. The telial morphology of *Ravenelia* species is unique: Complex teliospore heads are subtended by hygroscopic sterile cysts and consist of several teliospores and sterile apical cells (between teliospores and stalk hyphae). Similar teliospore heads occur only in the genus *Spumula* that cannot be sharply delimited from *Ravenelia* (Berndt, 1996) and in *Kernkampella*.

A rust specimen recently collected on *Cenostigma gardnerianum* Tul. (Caesalpinaceae) in the Cerrado dry forest of NE Brazil was assigned to *Ravenelia* because of its typical teliospore heads and the leguminous host. The specimen was different from the only other *Ravenelia* on *Cenostigma*, *R. spiralis* Hennen & Cummins, and other members of the genus. It is therefore described as new.

Ravenelia cenostigmatis R. Berndt & F. Freire, sp. nov.

Figs. 1–6

(etymology: named after the host genus, *Cenostigma*)

Uredinia non observata. Urediniosporae solitariae, in teliis sparsae, ochraceae ad clare brunneae, late ellipsoideae, obovoideae vel subgloboseae, 24–31 × 20–24 μm (longitudine media 27 μm, latitudine media 22.2 μm), membrana indistincte bilaminata, ca. 2–2.5 μm crassa, ad apicem leniter incrassata vel crassa usque ad 5–7(–9) μm, lamina exterior tenuissima, subhyalina, spiraliter denseque striata (spatium inter strias ca. 2 μm), strii delicate incisus, poris germinationis (2–)3(–4), prope hilum sitis. Telia abaxialia, dense sparsa, ca. 0.2–0.3

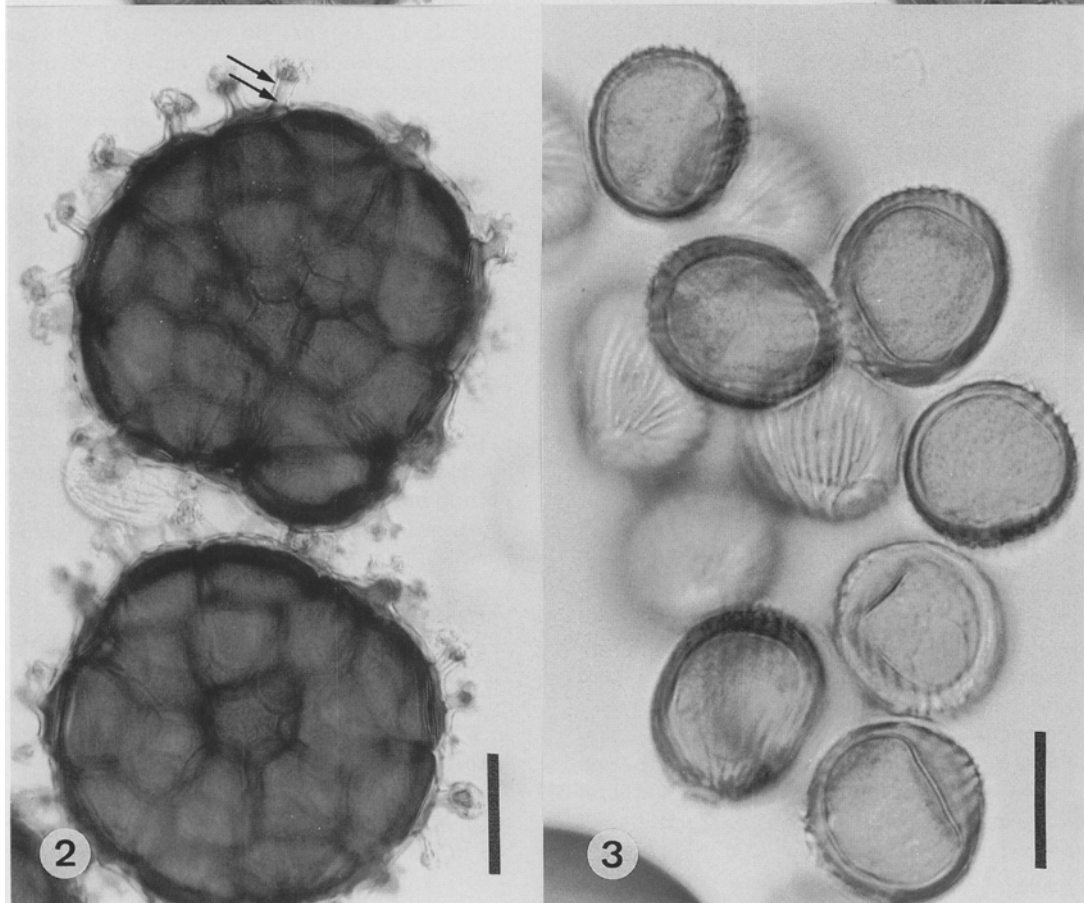
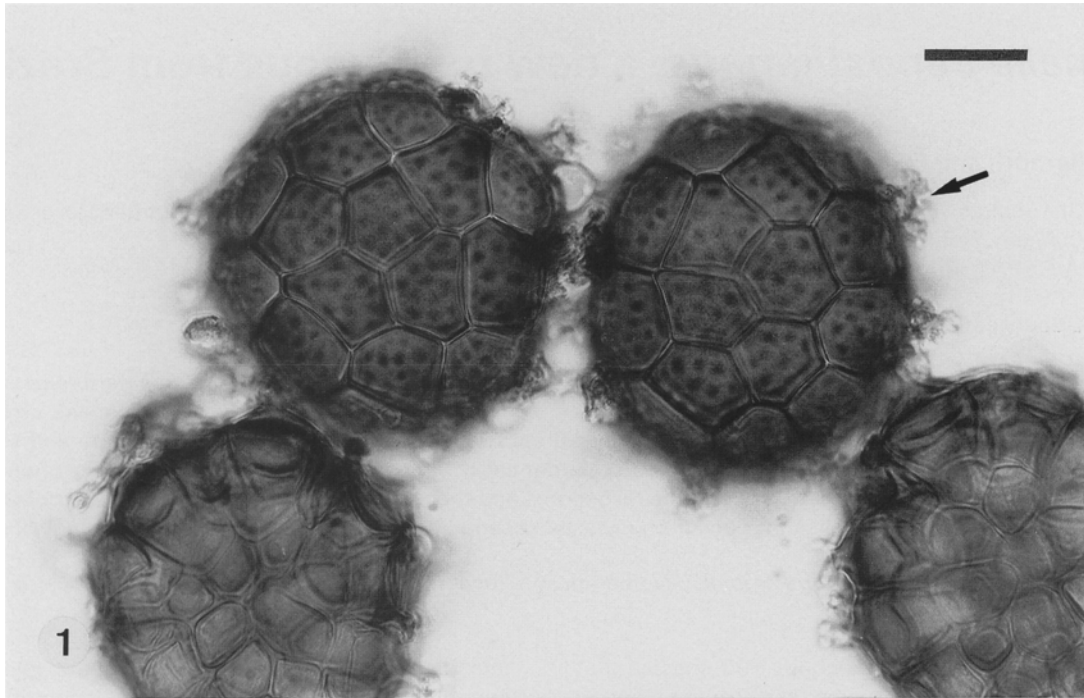
mm diametro, atrobrunnea, complanate globuliformes, paraphysibus periphericis copiosis, incurvatis, ca. 55–130 × 8–12 μm, pariete aurantiaco, dorsaliter et ad apicem valde incrassato. Capitulae teliosporarum castaneae, globosae, subgloboseae vel late ellipsoideae, 60–100 μm diametro, ex 3–6 cellulis in omni directione compositae, teliosporae unicellulatae, sporae centrales 18–27 × 15–20 μm (longitudine media 21.3 μm, latitudine media 18 μm), membrana bilaminata, exterior tenui, subhyalina, verrucis inconspicuis, latis et applanatis dense sitis, interior crassa, castanea. Capitulae duobus seriebus cellulis sterilibus (?), applanatis, teliosporis basaliter et lateraliter adpressis, conspicue appendiculatis appendicibus validis, 10–15 μm longis, botryoideis. Pedicellae sporarum copia structurae fibrillosae vel membranosa circumdatae. Cystidia uniseriata, adpressa. Pedicellae fragiles, ex hyphis paucis compositae. Mycelio parasitico intercellulari, haustoriis delicate pedicellatis, filiformibus, ramosis.

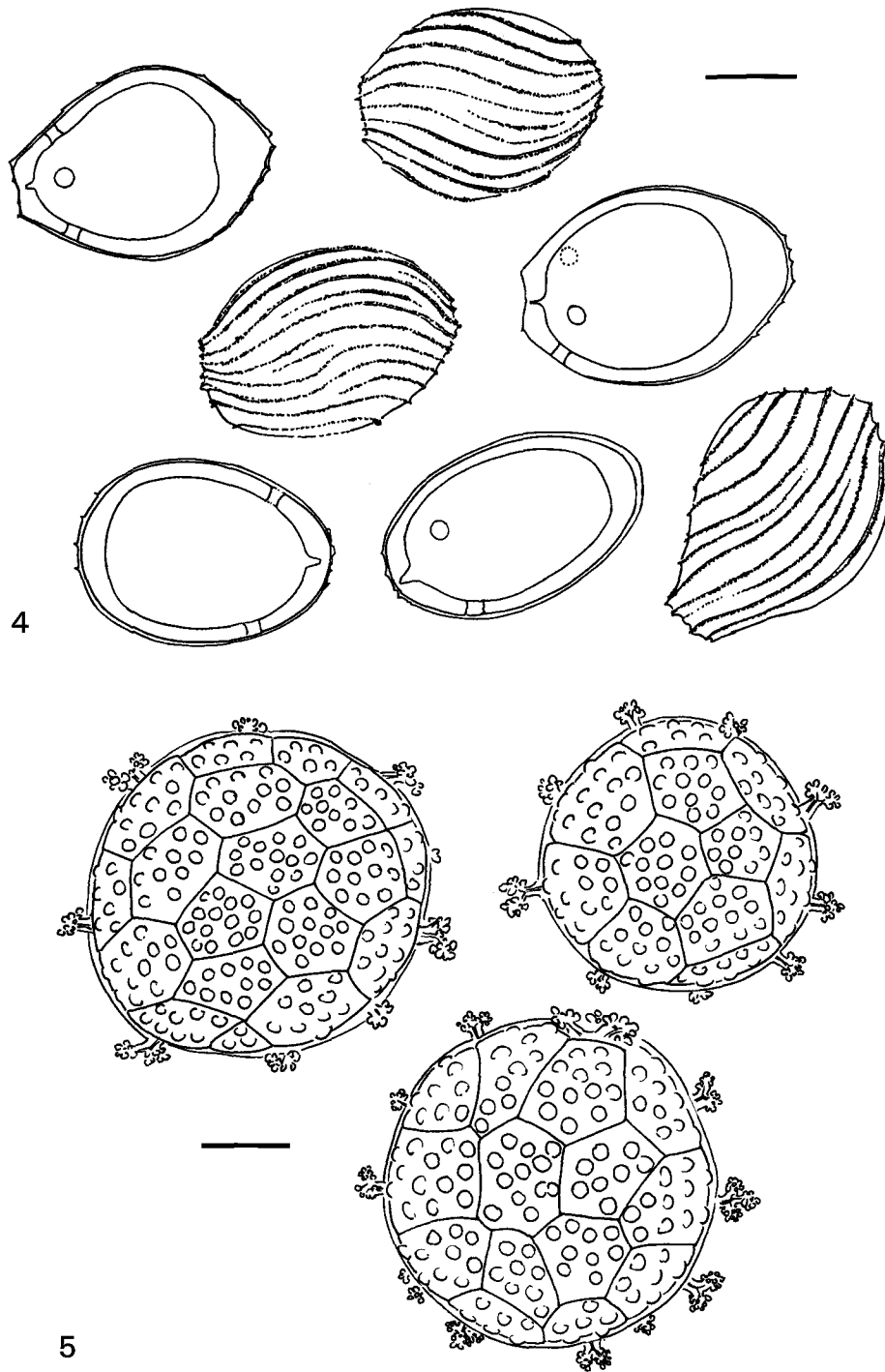
In foliis *Cenostigmatis gardneriani* Tul. (Caesalpinaceae).

Uredinia not observed. Urediniospores scattered within the telia, ochraceous to light brown, broadly ellipsoid, obovoid or subglobose, 24–31 × 20–24 μm (27 × 22.2 μm on average), spore wall ca. 2–2.5 μm thick, apically only slightly to more pronouncedly thickened, up to 5–7(–9) μm, two-layered with a very thin subhyaline outer layer that is ornamented with closely spaced (ca. 2 μm) and spirally arranged, delicate, very finely notched ridges, germ pores (2–)3(–4), in the proximal third of the urediniospore. Telia abaxial, densely scattered, ca. 0.2–0.3 mm in diameter, blackish brown, basket-like, surrounded by a dense border of stout, subacute to obtuse, incurved paraphyses, ca. 55–130 × 8–12 μm, walls golden yellow, much thickened dorsally and apically. Teliospore heads chestnut brown, round or broadly ellip-

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Figs. 1–5. Teliospore heads and urediniospores of *Ravenelia cenostigmatis* (holotype). Fig. 1. Teliospore heads showing the verrucose surface of the teliospores and peripheral botryose appendages (arrow). Scale bar = 25 μm . Fig. 2. Teliospore head from below with peripheral appendages. The wall of the appendages is two-layered (arrows). Scale bar = 25 μm . Fig. 3. Urediniospores with spirally striate ornament. Scale bar = 20 μm . Fig. 4. Line drawings of urediniospores with striate ornament. The urediniospores have mostly three germ pores located in the proximal third of the spore wall. Some spores are considerably thickened apically. Scale bar = 10 μm . Fig. 5. Line drawing of three teliospore heads showing the verrucose teliospores, peripheral appendages and the thin outer wall layer of the teliospores. Scale bar = 20 μm .

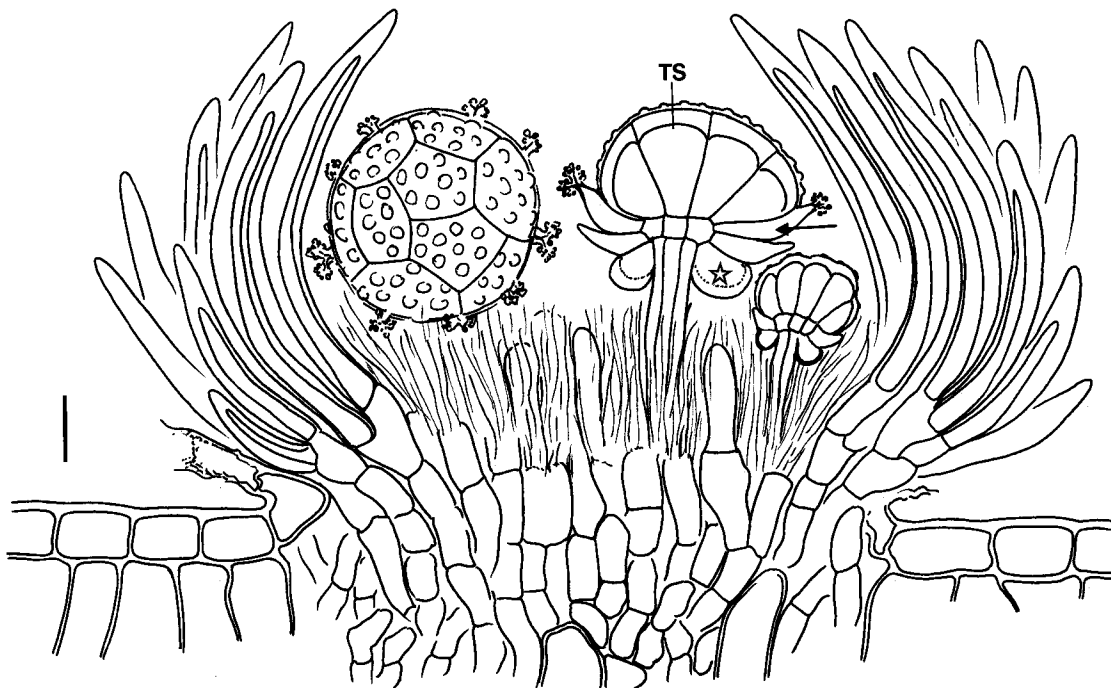


Fig. 6. Longitudinal section through telium of *Ravenelia cenostigmatis*. The telium is bound by incurved thick-walled paraphyses. The pedicels of the teliospore heads are densely surrounded by filamentous or membranous structures. Two spore heads are drawn in the optical section. The central one, which is almost mature, shows the arrangement of the cells in the spore heads and how the appendaged cells (arrow) are wedged between the cysts (star) and the fertile teliospores (TS). Scale bar = 20 μm .

soid, 60–100 μm in diameter, with 3–6 spores across, all spores one-celled, central spores 18–27 \times 15–20 μm (21.3 \times 18 μm on average), spore wall two-layered, with a thin, outer subhyaline layer and a thicker, chestnut brown inner layer, ornamented densely with inconspicuous broad, flat warts formed by the outer wall layer. Spore heads mostly with two displaced rows of brown, flattened sterile (?) cells, which are pressed onto the fertile teliospores basally and laterally, conspicuously ornamented by one, more rarely two stout 10–15 μm long outgrowths of the entire cell wall which branch finely and profusely apically. Around the pedicels and between the teliospores numerous fibrillate or membranous structures are present. Cysts uniseriate, appressed (swelling and resolving after warming of spores in lactophenol). Pedicel of a few hyphae, frail. Parasitic mycelium intercellular, forming stalked, filiform and branched haustoria.

On leaves of *Cenostigma gardnerianum* Tul. (Caesalpiaceae).

Holotype: Brazil, Piauí State, São Raimundo Nonato County, Luiziana Farm, at the road Pi 140 between São Raimundo Nonato City and Canto do Buriti City, ca. 30 km from São Raimundo Nonato City. 28 Aug. 1999, leg. F. Freire. Holotype deposited in M, isotypes in B, IBI, PUR, UB and authors' herbaria.

Further specimens examined: *Kernkampella coimbatorica* (Ramakr. & Sundaram) Laundon, India, Maharashtra state, Pune, at the Sinhagar fortress, on *Phyllanthus* sp. (Euphorbiaceae), 19 Nov. 1995, leg. R. Berndt (HerB C-5). *Ravenelia spiralis* Hennen &

Cummins, Brazil, Goiás, 33 km S of Araguaina, highway 153, on *Cenostigma* sp. (Caesalpiaceae), 3 Dec. 1977, leg. J. F. Hennen & M. M. Hennen (Type).

The only rust fungus described from *Cenostigma* appears to be *Ravenelia spiralis* (Hennen and Cummins, 1990). This rust is similar to the present fungus in urediniospore morphology and the telial paraphyses. *Ravenelia spiralis* differs from *R. cenostigmatis* by smooth teliospores and slightly smaller urediniospores with mostly two germ pores and less densely situated, higher ridges.

Ravenelia cenostigmatis shows some features that are unusual for most other members of the genus: (a) the presence of two rows of sterile, appendaged cells within the teliospore heads (Figs. 1, 2, 6) and (b) the presence of a basket-like border of incurved more or less acute paraphyses around the telia and probably uredinia (Fig. 6). Appendaged teliospores occur in a few *Ravenelia* species: the marginal teliospores can differ from the central ones by long aculei or appendages (e.g., *R. fimbriata* Spegazzini, *R. ornata* Sydow, and *R. pennatae* Durrieu). These marginal teliospores represent fertile teliospores, however, and the appendages or aculei seem to be formed only by the outer wall layer, although this cannot be deduced with certainty from most descriptions. According to the micrographs presented by Baxter (1966), the appendaged cells in the spore heads of *R. corbula* Baxter may represent sterile cells similar to those in *R. cenostigmatis*. It is interesting to note that the former species also has long, incurved paraphyses and spirally ornamented urediniospores and grows on a *Caesalpinia*

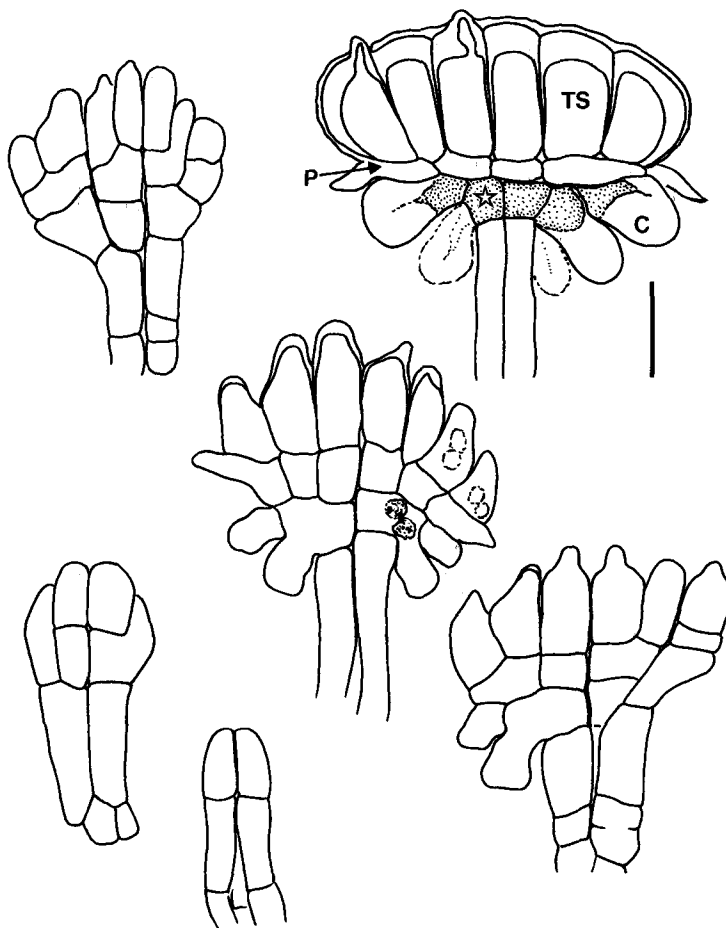


Fig. 7. *Kernkampella coiminatorica*. Longitudinal section through mature and developing teliospore heads showing teliospores (TS), patelliform layer (P), cysts (C) and sterile apical cells (star). Scale bar = 20 μ m.

host. Sterile cells with conspicuous appendages formed by the entire cell wall also occur in teliospore heads of members of *Kernkampella*. In this genus, these ornamented cells are border cells of the so-called "patelliform layer" of the teliospore heads (Fig. 7). The patelliform layer is a continuous layer of flattened cells that separates the proper teliospores from the sterile cysts and apical (intercalary) cells of the spore heads. *Kernkampella* is not accepted as a distinct genus by some uredinologists but regarded as a section of *Ravenelia* (Tyagi and Prasad, 1972). Despite the appendaged sterile cells within the teliospore heads, we do not think that *R. cenostigmatis* is related to *Kernkampella*. In our opinion, the euphorbiaceous hosts, the distinct papillate germ pores of the teliospores and the patelliform layer sufficiently distinguish and characterise *Kernkampella* as a natural and distinct group. *Ravenelia cenostigmatis* may just be another example for the diverse morphology of teliospore heads of *Ravenelia*.

Abundant peripheral paraphyses and spirally striate urediniospores (Figs. 3, 4) are other outstanding morphological traits of *R. cenostigmatis*. Besides *R. corbula* and *R. spiralis*, these characters are also present in *R. corbuloides* Hennen & Cummins and *R. pileolarioides* Sydow

(= *R. parahybana* Viégas). In his description of *R. parahybana*, Viégas (1945) supposed that the host belonged to the genus *Caesalpinia*. This opinion was also held by Hennen and Cummins (1990) when they compared *R. corbuloides* with *R. pileolarioides*. We suppose that *R. cenostigmatis*, *R. corbula*, *R. corbuloides*, *R. pileolarioides*, and *R. spiralis* may represent a natural group within the genus *Ravenelia* because of their similar morphological traits and the caesalpinaceae hosts.

The developing teliospore heads and the pedicels of the mature spores of *R. cenostigmatis* were densely surrounded by fibrous or membranous hyaline structures (Fig. 6) whose origin could not be determined with certainty by the light microscope. Similar structures were described as "hairy paraphyses" by Tyagi and Prasad (1972) from *R. acaciae-senegalae* Sanwal and *R. berkeleyi* Mundk. & Thirumal. and were observed in other *Ravenelia* spp. (R. Berndt, pers. observation). These structures may represent remnants of urediniospore and teliospore pedicels of discharged spores rather than paraphyses.

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