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ORIGINAL ARTICLE

First catalogue of the rust fungi of French Guiana, northern South America

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Abstract An annotated list of the rust fungi (Uredinales or Pucciniales) of French Guiana is presented. It enumerates 68 species of which 57 are new reports for the department and 3, *Aecidium plukenetiae*, *Puccinia kourouensis* and *P. parianicola*, are new to science. *Dicheirinia guianensis* and *Hapalophragmium angylocalycis* are excluded from the French Guianan mycobiota. New host plants are reported for *Batistopsora crucis-filii*, *B. pistila*, *Cerotelium ficicola*, *C. sabiceae*, *Crossopsora piperis*, *Desmella aneimiae*, *Endophyllum guttatum*, *Kweilingia divina*, *Puccinia lateritia*, *Uredo anthurii* and *Uromyces anguriae*. Previously undescribed characters are presented for *Achrotelium lucumae*, *Chaconia ingae*, *Cerotelium sabiceae*, *Prospodium amapaense*, *Sphenospora smilacina* and *Uromyces wulffiae-stenoglossae*. *Chaconia ingae* showed haustorial complexes comprising both intracellular hyphae and D-haustoria. In *Cerotelium sabiceae*, the haustorial mother cells retained the nuclei while D-haustoria were enucleate. The occurrence of these haustorial types in tropical rust fungi is discussed. Internal basidium formation is described for the first time in *Sphenospora*: teliospores of *S. smilacina* produced external or internal basidia. The species richness and composition of the French Guianan rust mycobiota are discussed in a neotropical context.

Keywords Checklist · D-haustorium · Guianas · Neotropics · Species richness · Teliospore germination

Taxonomical novelties *Aecidium plukenetiae* R. Berndt
Puccinia kourouensis R. Berndt
Puccinia parianicola R. Berndt

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Introduction

French Guiana forms the easternmost part of the Guianan region in northern South America. With the exception of some low mountain ranges and a few inselbergs reaching an altitude of little more than 800 m, the landscape is flat or undulating lowland clad in different types of evergreen broadleaf rainforest (de Granville 2002; ter Steege et al. 2000). French Guiana remains relatively unaffected by deforestation and boasts a forest cover of about 90 % (Demenois and Brunaux 2005). In the northern coastal lowlands, naturally open vegetation can be found comprising swamps and marshlands as well as minor tracts of savannah (de Granville 2002). The number of vascular plants is moderate compared to other parts of Amazonia (e.g., Silman 2007) and counts some 5,400 species (Funk et al. 2007).

Very little is known about the presence and diversity of rust fungi (Uredinales/Pucciniales) in French Guiana. The checklist of fungi of French Guiana (Courtecuisse et al. 1996) does not include a single rust species, and a query of the Fungal Databases provided by USDA-ARS (Farr and Rossman 2012) produced only four hits of which two were erroneous. Obviously, French Guiana is still a blank spot on the uredinological map of South America.

An exploratory trip was therefore made to French Guiana during the dry season in July/August 2009 to collect rust fungi. Most specimens were gathered in the northern coastal lowlands where the main habitats are rather easily accessible. Collecting in the center remained restricted to the surroundings of the hamlet of Saül; the south was not visited. Ca. 180 rust specimens were collected representing at least 66 species. Six of them have been described as new (Beenken et al. 2012; Berndt and Beenken in prep.). The present paper adds 3 new species and enumerates 57 new records for French Guiana resulting in a total of 68 species.

In a number of known species, new observations are reported regarding morphology, life cycle, or host plants.

Materials and methods

Rust fungi were dried with their host plants between blotting paper and corrugated cardboard in a conventional plant press. Spores and hand sections obtained from dried material were mounted in lactophenol and gently heated to facilitate soaking of the fungal structures and host tissue. In some cases, preparations were made in Hoyer's Fluid (Cunningham 1972) mixed with a small droplet of cotton blue dissolved in lactic acid or, occasionally, in 3 % KOH using Congo Red as stain. The preparations were examined with an Olympus BX51 compound microscope equipped with a ColorView IIIu camera. The Cell B software package (Software Imaging System) was used to capture micrographs and to make measurements. Spore measurements represent at least 30, but usually 40–50, spores and comprise the range of measurements and the arithmetic mean. The encountered spore states are indicated by Roman numerals, aecia by I, uredinia by II, telia by III, and spermogonia by 0. Terminology follows the 'ontogenic system' (Hiratsuka 1973).

The examined specimens and their collection data are cited under the respective species which are listed in alphabetic order. All specimens were collected by the author and Ludwig Beenken.

French Guiana comprises 19 administrative units called 'cantons'. The names of the cantons are used as the most general geographic units to designate the collection sites. RN = route nationale (national road). Names of herbaria are cited by their acronyms according to Index Herbariorum (Holmgren et al. 1990).

Results

Achrotelium lucumae Cummins ex Cummins (Fig. 1a, b)

Cayenne canton, Mt. Bourda, trail leading to "Calvaire" from SW, on *Pouteria macrophylla* (Lam.) Eyma (Sapotaceae) in secondary forest, 14 Jul 2009 (FG09/27. II, III). Kourou canton, golf course near Kourou Space Center, track through golf course next to the golfers' home, on *P.* cf. *macrophylla* in secondary forest, 1 Aug 2009 (FG09/64. II, III).

Hitherto known from Brazil and Cuba on *Pouteria* and the USA (Florida) on *Lucuma*, this species is reported for the first time from French Guiana. The urediniospores differed from *Uredo lucumae* Arthur & J.R. Johnst. as described in Arthur (1924a, b). They were asymmetric, in front view rhomboid to square-shaped, in side view approx. kidney-shaped, 42.1–49.5×35.4–41.4 µm (44.9×38.6 µm), with 3–4(5) but most often 3 germ pores, of which 2 were usually equatorial and opposite and a third one subapical. The indistinctly two-layered spore wall was echinulate with rather coarse spines ca. 2.5 µm long and spaced at 6–9 µm on the strongly convex 'dorsal' spore side; spines were slightly shorter and ca. 3–6 µm apart on the 'ventral' side. The teliospores showed the characteristic retraction of the protoplast to the distal half of the spores before germination as described and illustrated by Cummins (1940).

Aecidium cf. *amazonense* Henn.

Roura canton, route de Kaw (D6) through Montagne de Tresor, along "Sentier botanique", alt. 210 m, on *Guatteria punctata* (Aubl.) R. A. Howard (Annonaceae), 27 Jul 2009 (FG09/130. 0, I). Roura canton, route de Kaw (D6), side road to Fougasier, alt. ca. 100 m, on *G. punctata*, 28 Jul 2009 (FG09/131. 0, I). Roura canton, route de Kaw (D6), side road to Fougasier, alt. ca. 100 m, on *G.* cf. *ouregou* Dunal, 28 Jul 2009 (FG09/132. 0, I). Montsinéry-Tonnégrande canton, road D6, Zoological Garden, alt. ca. 10 m, on *G. punctata*, 28 Jul 2009 (FG09/133. 0, I). Maripasoula canton, Saül, several collections along foot trails around hamlet, on *G. punctata*, 3–4 Aug 2009 (FG09/134–140. 0, I).

A number of *Aecidium* species have been described from Annonaceae. They are difficult to distinguish using published descriptions and Hennen et al. (2005) suggested that several of them may be synonymous. The present collections on *Guatteria* were provisionally attributed to *A. amazonense*. This rust has been known so far from Peru and Brazil on *G. schomburgkiana* Mart. and *G.* sp. and would be new for French Guiana on two new host species.

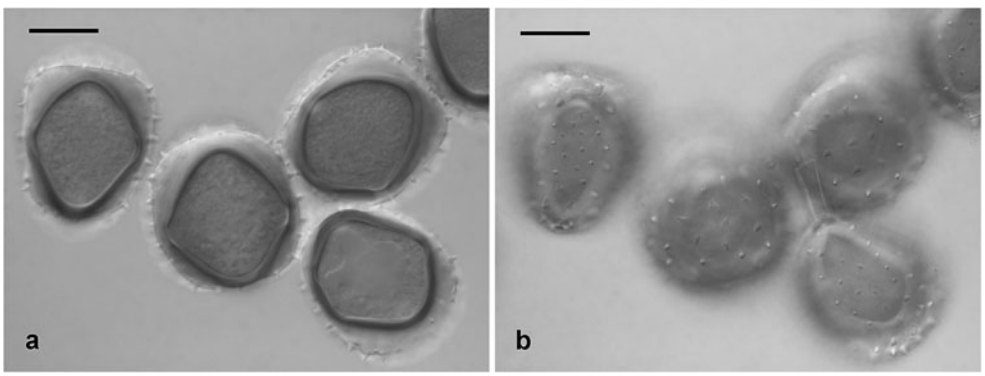

Fig. 1 *Achrotelium lucumae* (FG09/27), urediniospores. **a** Optical section. **b** Focus on spore surface. Two spores show the dorsal, two the ventral side. *Bars* 20 µm

Aecidium cf. *guatteriae* Dietel

Mana canton, track to Angoulême ca. 500 m after turn-off from RN 1 at km 206, on *Guatteria schomburgkiana* (Annonaceae), 23 Jul 2009 (FG09/127. 0, I).

Aecidium guatteriae is known from Brazil and Peru (Hennen et al. 2005). It would be new for French Guiana. Hennen et al. (2005) consider *A. guatteriae* Dietel a synonym of *A. rionegrense* Henn. It has been reported from Brazil on *G. schomburgkiana* and *G.* sp. and from Guyana on Annonaceae indet. (Hernández et al. 2005).

Aecidium plukenetiae R. Berndt, sp. nov. (Fig. 2a–c)

Etymology: After the host genus, *Plukenetia*.

Mycobank no. MB 800281

Spermogonia et aecia in maculis luteolis ad olivaceis leniter incrassatis 5–20 mm diam. foliorum dense sparsa. Spermogonia adaxialia picea-nitida bullata subepidermalia, hymenio plusminusve plano hyphis sterilibus peripheriicis carenti. Aecia typi *Aecidii*, abaxialia ca. 0.15–0.2 mm diam., peridio albo campanulato vel breviter conico laceranti; aeciosporae irregulariter vel subangulariter subglobosae usque ad late ellipsoideae, 18.5–23.3×16.0–20.0 μm (21.0×17.8 μm), pariete 1–1.5 μm crasso passim crebre minuteque verruculoso; cellulis peridii regulariter dispositis, intus grosse verrucosis, extus laevibus.

In foliis *Plukenetiae polyadeniae* Müll.-Arg. (Euphorbiaceae).

Spermogonia and aecia on yellowish to olivaceous, slightly hypertrophied leaf spots of 5–20 mm diameter. Spermogonia adaxial, blackish-glossy, bullate, subepidermal, with±flat hymenium lacking bounding structures. Aecia of *Aecidium*-type, abaxial, ca. 0.15–0.2 mm diam., with white, cup-shaped or conical peridium that lacerates into a few lobes; aeciospores subglobose to broadly ellipsoid, generally subpolyhedral or slightly deformed, 18.5–23.3×16.0–20.0 μm (21.0×17.8 μm), wall hyaline, 1–1.5 μm thick, more or less evenly and densely verruculose; peridial cells very regularly arranged in rows, coarsely verrucose on inner side by irregular individual warts interspersed with scattered and much smaller warts, smooth on outside.

On leaves of *Plukenetia polyadenia* Müll.-Arg. (Euphorbiaceae).

Holotype (PC). Roura canton, Coralie forest road departing from RN 1 shortly SE of Cacao crossing, 4°30′43,5″N 52°22′15,1″W, on *P. polyadenia* in secondary growth/forest edge, 8 Aug 2009 (FG09/58. 0, I). Isotype ZT Myc.

Similar species examined: *Aecidium cornu-cervi* Henn. Brazil: Rio Juruá, Marary, on *Dalechampia*, leg. E. Ule no. 3080, Sep 1900 (B 700014689. 0, I. Syntype!). *Aecidium dalechampiicola* Henn. Brazil: Rio de Janeiro, park of the museum, on *Dalechampia*, leg. E. Ule no. 1098, May 1900 (B 700014737. 0, I. Type!).

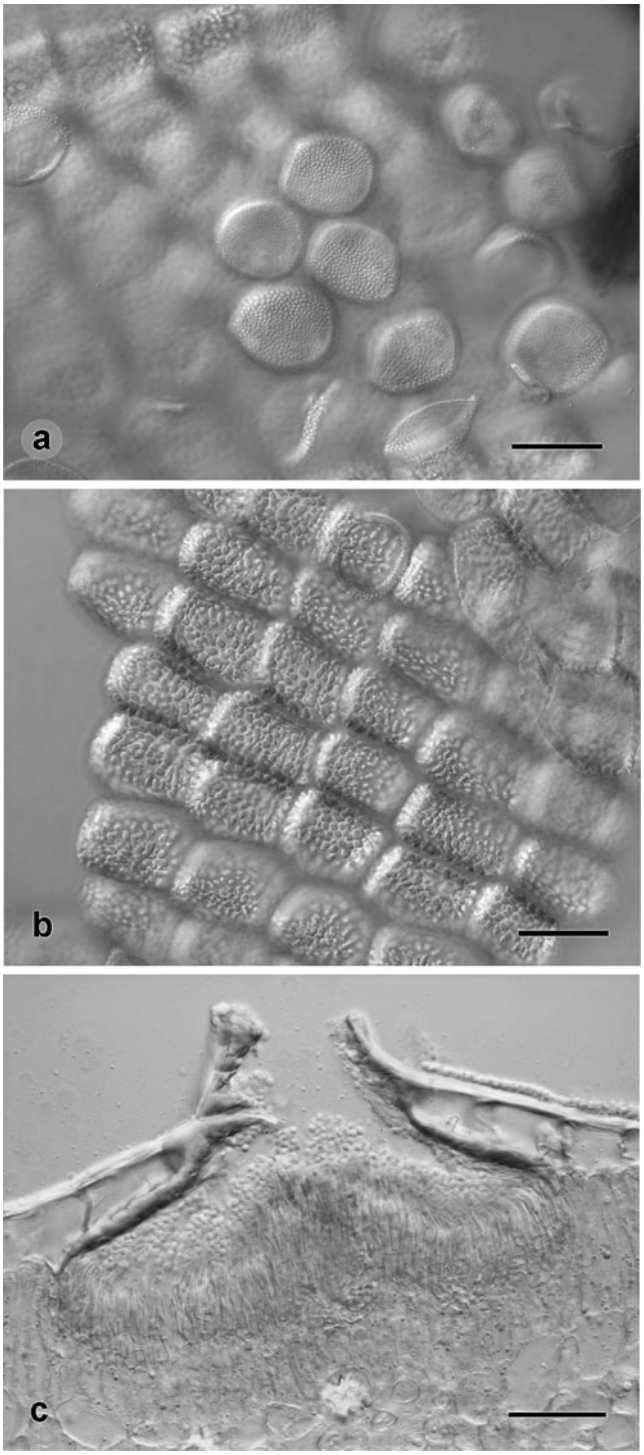

Fig. 2 *Aecidium plukenetiae*. **a** Finely verruculose aeciospores. **b** Peridium of aecidial cup is composed of regularly arranged cells that are densely warty on inner periclinal wall. *Bars* 20 μm. **c** Subepidermal spermogonium with flat hymenium lacking sterile bounding hyphae. *Bar* 50 μm

The only rust fungus reported on *Plukenetia* is *Aecidium cornu-cervi* Henn. (Hennen et al. 2005) which was originally described from *Dalechampia* (Euphorbiaceae) (Hennings 1904a). From the same genus, Hennings (1899, 1904a, b)

described *A. dalechampiae* Henn. and *A. dalechampiicola* Henn.

Aecidium plukenetiae differed from the type of *A. cornu-cervi* in the way it affected the host plant as well as spore and peridium characters. It did not transform shoots into witches' brooms or evoke galls as described by Hennings (1904a, b), but just led to decoloration and slight hypertrophy of leaves. In addition, aeciospores were more finely verruculose and the peridial cells showed a different surface ornamentation. *Aecidium plukenetiae* also differed from the type of *A. dalechampiicola* in larger aeciospores [19–23× 16–20 μm (21.0×17.8 μm) vs.16–19×13–17 μm (17.6× 14.9 μm)] and more coarsely verrucose inner walls of the peridial cells. The outer walls of the peridial cells were entirely smooth while they were most finely verruculose in *A. dalechampiicola*. The type specimen of *A. dalechampiae* was not studied because it was considered entirely useless by Sydow and Sydow (1924) due to destruction by *Tuberculina*. It differs from *A. plukenetiae* in larger spores according to the original description.

Spermogonia of *A. plukenetiae* (Fig. 2c) were subepidermal and had a more or less flat hymenium lacking bounding structures (group I, type 2 according to Hiratsuka and Hiratsuka 1980). This spermogonial type is known in Pucciniastraceae, Coleosporiaceae, Cronartiaceae, and Melampsoraceae though never in combination with *Aecidium*-like aecia (Hiratsuka and Hiratsuka 1980). Spermogonia have been unknown in *A. cornu-cervi* and *A. dalechampiicola* but were present on the type specimens. In both species, they also had a flat hymenium and appeared to lack bounding structures. The latter was difficult to assess on the old and brittle herbarium material.

Aecidium sp.

Mana canton, track to Angoulême after turn-off from RN 1 at km 206, on *Duguetia* cf. *yeshidan* Sandwith (Annonaceae), 23 Jul 2009 (FG09/129. 0, I).

The *Aecidium* found on *D.* cf. *yeshidan* differed from the ones tentatively determined as *A. amazonense* and *A. guatteriae* and could not be assigned to any other described *Aecidium* spp. on Annonaceae. It will be described by L. Beenken in a study on rust fungi of Annonaceae.

Batistopsora crucis-filii Dianese et al.

On *Annona paludosa* Aubl. (Annonaceae): Iracubo canton, side road of RN 1 W of Iracubo, under transmission line, alt. ca. 25 m, 19 Jul 2009 (FG09/114. II). Kourou canton, RN 1, Savanne de Pères, between turn-off to Guatemala and Kourou river bridge, alt. ca. 10 m, 9 Aug 2009 (FG09/126. II). Mana canton, side road of RN 1 at km 200, Piste de Montagne de Fer, alt. ca. 70 m, 23 Jul 2009 (FG09/119. II). Sinnamary canton, RN 1, savannah tract close to "Maison de la Nature Sinnamary, Les Pripris de Yiyi", 24 Jul 2009 (FG09/121. II).

This rust has been known from Brazil and Guyana on *Annona* spp. It is new for French Guiana, on a new host plant.

Batistopsora pistila Buriticá & Herrera

On *Annona sericea* (Annonaceae): Saint Laurent du Maroni canton, St. Jean, road to Plateau des Mines, alt. ca. 50 m, 22 Jul 2009 (FG09/118. II). Kourou canton, Dégrad Saramaka, near waterworks, forest at Kourou river, alt. ca. 10 m, 19 Jul 2009 (FG09/116. II). Iracubo canton, side road of RN 1 W of Iracubo, under transmission line, alt. ca. 25 m, 19 Jul 2009 (FG09/115. II).

This rust has been known so far only from Central America (Honduras, Panama) (Farr and Rossman 2011). It is new for French Guiana, on a new host plant.

Cerotelium ficicola Buriticá & J.F. Hennen

Kourou canton, near Degrad Saramaka at Kourou river, moist road shoulder at Kourou river inlet on *Ficus* cf. *guianensis* Desv. (Moraceae), 18 Jul 2009 (FG09/100. II).

This rust is apparently widely distributed in the neotropics on *Ficus* spp. (e.g., Laundon and Rainbow 1971; Farr and Rossman 2011). It has not been previously reported from the Guianas and the present report is the first from French Guiana, probably on a new host species.

Buriticá (1999) and Hennen et al. (2005) described the germ pores of the urediniospores as conspicuous, while in the present specimen, the pores were hardly visible—an observation also made by Laundon and Rainbow (1971). Urediniospores measured 24.1–33.6×18.7–23.2 μm (27.6× 21.3 μm). Uredinial paraphyses tallied well with the ones depicted in Laundon and Rainbow (1971) but quite often revealed a warty apex. The author does not know of other examples of this unusual character in rust fungi.

Cerotelium sabiceae Buriticá & J.F. Hennen in Buriticá = *Uredo sabiceicola* Arthur

On *Sabicea cinerea* Aubl. (Rubiaceae): Matoury canton, Matoury, Massif de Mirande, secondary forest at the accession road to Sentier de Mirande, 15 Jul 2009 (FG09/50. II). Matoury canton, Massif de Mirande, at Sentier de Mirande, 15 Jul 2009 (FG09/6. II). Sinnamary canton, Barrage de Petit Saut, close to the ultimate boat inlet, roadside shrub, 17 Jul 2009 (FG09/25. II). Kourou canton, near Degrad Saramaka at Kourou river, abandoned plantations and secondary forest, 18 Jul 2009 (FG09/54. II). Roura canton, Montagne de Kaw, secondary forest bordering rough road to Cascades de Fougassier, 28 Jul 2009 (FG09/71. II).

On *Sabicea* sp.: Aprouague-Kaw canton, at Auberge Aprouague above the Aprouague river SW of Regina, 8 Aug 2009 (FG09/3. II). Kourou canton, Montagne des Singes, at parking lot and trailhead of walking trail, 17 Jul 2009 (FG09/57. II, III).

This is the first report of *C. sabiceae* from French Guiana where the rust appears to be widespread and common in the northern part of the department. It has been reported so far from Brazil, Trinidad, and Puerto Rico (Buriticá 1999) on a

number of *Sabicea* spp. *Sabicea cinerea* seems to be a new host species. The uredinia were surrounded by paraphyses that varied from club-shaped to narrowly cylindrical and from geniculate to more or less straight. The straight ones had uniformly thin walls, the bent ones were dorsally moderately thickened to 3 μm. Buriticá (1999) noted that urediniospores of *C. sabiceae* were sessile. All specimens investigated here showed pedicellate urediniospores. They measured 22.4–33.4×15.9–21.4 μm, tallying quite well with the measurements obtained by Arthur (1915) for *U. sabiceicola* Arthur (25–29×16–23 μm). D-haustoria were delicately stalked and had slenderly cylindrical haustorial bodies. The haustorial bodies were enucleate as the nuclei remained in the haustorial mother cells.

Chaconia clusiae R. Berndt & Beenken (inedited)

Sinnamary canton, road to Barrage de Petit Saut some 100 m after turn-off from RN 1, on *Clusia* cf. *palmicida* Rich. (Clusiaceae), 17 Jul 2009 (FG09/111. III). Isotype Z + ZT (ZT Myc 3558).

This rust fungus was recognized recently (Berndt and Beenken, in preparation) and is only known from northern French Guiana.

Chaconia heliconiae R. Berndt & Beenken (inedited)

Kourou canton, hiking trail on golf course adjacent to Kourou Space Center, on *Heliconia* cf. *psittacorum* L. f. (Heliconiaceae), 16 Jul 2009 (FG09/106. II, III). On *H.* sp., 16 Jul 2009 (FG09/97. II). Sinnamary canton, Piste de St. Elie, degraded savannah and swampy area shortly after turn-off from RN 1, on *H. psittacorum*, 24 Jul 2009 (FG09/68. II). Roura district, Montagne de Kaw, "Sentier botanique", on *H. bihai* L. f., 25 Jul 2009 (FG09/69. II). Matoury canton, Massif de Mirande, "Sentier de Mirande", on *H.* sp., 15 Jul 2009 (FG09/96. [II], III).

This rust seems to be widespread in northern French Guiana (Berndt and Beenken, in preparation). Its uredinial state is similar to *Uredo heliconiae* Arthur (= *Puccinia heliconiae* Arthur) with which it might be confused in the absence of telia.

Chaconia ingae (Syd.) Cummins

Maripasoula canton, Saül, secondary forest along foot path between hamlet and airstrip, on *Inga* sp. (Mimosaceae), 6 Aug 2009 (FG09/39. 0, I?, II, III).

This is the first report of this species from French Guiana. It is widespread in the neotropics (Hernández and Hennen 2003) and was described from Guyana (Sydow 1925). In the investigated specimen, the entire parasitic mycelium was intracellular. It comprised intracellular hyphae that penetrated from host cell to host cell and bore haustorial mother cells laterally. These came into contact with the host cell wall by beak-like processes from which delicate D-haustoria were formed into adjacent host cells.

Chaconia maprouneae (Viégas) Ono & J.F. Hennen in J.F. Hennen & Figueiredo

On *Maprounea guianensis* Aubl. (Euphorbiaceae): Kourou canton, Degrad Saramaka at Kourou river, abandoned plantations and secondary forest, 18 Jul 2009 (FG09/45. II). Mana canton, Awala-Yalimapo, a few km E of Awala on cultivated land along road to Mana, 21 Jul 2009 (FG09/26. II). Matoury canton, savannah at road RN 2 shortly W of the Roura intersection, 26 Jul 2009 (FG09/29. II).

This is the first report of this species from French Guiana. It has been known on the same host species, *M. guianensis*, from Trinidad and on *M. brasiliensis* and *M.* sp. from Brazil (Ono and Hennen 1983).

Coleosporium vernoniae Berk. & Curtis

On *Elephantopus mollis* Kunth (Asteraceae): Kourou canton, hiking trail on golf course next to Kourou Space Center, 16 Jul 2009 (FG09/52. II). Cayenne canton, Mt. Bourda, trail leading to the "Calvaire" from SW, forest clearing, 14 Jul 2009 (FG09/55. II).

A widespread rust in warm regions mainly of the Americas, but apparently not reported hitherto from French Guiana.

Crossopsora byrsonimatis (Henn.) R.S. Peterson

Kourou canton, Savanne de Pères adjacent to RN 1, between turn-off to Guatemala and Kourou River bridge, on *Byrsonima crassifolia* (L.) Kunth (Malpighiaceae), 9 Aug 2009 (FG09/5. II, III).

This is the first report of *C. byrsonimatis* from French Guiana, on the type host, *B. crassifolia*.

Crossopsora mateleae W.T. Dale

Cayenne canton, Mt. Bourda, trail leading to the "Calvaire" from SW, on *Matelea denticulata* (Vahl) Fontanella & E.A. Schwarz (Apocynaceae, Asclepiadoideae) in secondary forest, 14 Jul 2009 (FG09/99. II).

Uredinia were scarce on the specimen and old. The rust was assigned to *C. mateleae* mainly on grounds of the host identity (compare discussion of *C. stevensii*). This is the first report of this species from French Guiana.

Crossopsora piperis R. Berndt, Freire & Bastos

Kourou canton, Montagne des Singes, hiking trail through rain forest, on *Piper* cf. *hirtellum* C. DC. (Piperaceae), 17 Jul 2009 (FG09/110. II). Approuague-Kaw canton, road through Montagne de Tresor near "degrade", on *P. dilatatum* Rich., 25 Jul 2007 (FG09/21. II). Roura/Approuague-Kaw canton, Montagne de Tresor, about 200 m on "Sentier Botanique", on *P.* cf. *dilatatum*, 27 Jul 2007 (FG09/22. II). On *Piper* sp.: Roura canton, forest road departing from RN 2 ca. 19 km SE of the Cacao crossing, secondary forest, 8 Aug 2009 (FG09/1. II. FG09/40. II). Maripasoula canton, Saül, secondary forest, 4 Aug 2009 (FG09/109. II).

This rust was first described by Sydow (1939) from Ecuador as *Cerotelium piperinum* Syd. based on uredinia. Buriticá (1999) recombined it to *Malupa piperinum* (Syd.) Buriticá & J.F. Hennen and annotated that a specimen from

Rio de Janeiro bore telia belonging to *Crossopsora* but inappropriate to be described. Useful telia were discovered on *P. hostmannianum* in Para, Brazil, and described as *Crossopsora piperis* (Berndt et al. 2002). The rust seems to be widespread in the neotropics. It is known from Brazil, Costa Rica, and Ecuador and is reported here for the first time from French Guiana on the new hosts *P. dilatatum* and *P.* cf. *hirtellum*.

Crossopsora stevensii Syd.

Approuague-Kaw canton, road through Montagne de Tresor near "degrade", on cf. *Mandevilla* sp. (Apocynaceae, Apocynoideae), 25 Jul 2009 (FG09/30. II).

Crossopsora stevensii is reported for the first time from French Guiana. The four *Crossopsora* spp. described on Apocynaceae and Asclepiadaceae are difficult to determine due to their morphological similarity and confusion resulting from uncertain host determinations and changes concerning the host families' taxonomy.

Asclepiadaceae was formerly regarded as a family of its own but is currently considered as a subfamily, Asclepiadoideae, of Apocynaceae (Endress and Bruyns 2000).

Sydow (1925) described *C. stevensii* on *Echites tomentosa* Rafin. (Apocynac., Echiteae) and an unknown host, likely *Mandevilla* sp. (Apocynac., Mesechiteae) according to Dale (1955). Davidson (1932) reported *C. stevensii* on *E. tomentosa* and *Fischeria* sp.? (Asclepiadoideae, Asclepiadeae). *Fischeria* could be a misidentification of *Macroscepis* (Asclepiadoideae, Asclepiadeae) according to Cummins (1943).

Dale (1955) distinguished *C. mateleae* on *Matelea* and *Gonolobus* spp. (both Asclepiadoideae, Asclepiadeae) from *C. stevensii* mainly on grounds of the different host family as morphological differences were not great. A specimen from Guatemala on *Mandevilla subsagittata* (Ruiz & Pav.) Woods. assigned to *C. stevensii* by Cummins (1943) was cited in Buriticá (1999) under *C. mateleae*. De Albuquerque (1971) quoted *C. mateleae* on *Schubertia* (Asclepiadoideae, Asclepiadeae). Hennen et al. (2005) assigned the specimen on *Schubertia* to *C. asclepidiaceae* Buriticá & J.F. Hennen (should read '*asclepiadaceae*') which otherwise grows on members of *Cyathostelma* and *Peckoltia* (Asclepiadoideae, Asclepiadeae) (Buriticá 1999). Jørstad (1956) described the possibly microcyclic *C. angusta* Jørst. on *Echites*, distinguished from *C. mateleae* in slightly smaller teliospores. Buriticá (1999) proposed the name *Malupa joerstadae* Buriticá (should read '*joerstadii*') for a uredinial state on *Echites* sp. which he claimed to belong to *C. angusta*.

Dasyspora ferrugineae Beenken

This species was recently described from French Guiana on *Xylopia frutescens* Aubl. var. *ferruginea* R.E. Fr. and is only known from there (Beenken et al. 2012).

Dasyspora frutescentis Beenken

This species was recently described based on specimens from French Guiana on *X. frutescens* var. *frutescens*. It is also known from Guyana, Venezuela, and Brazil on *X. frutescens* var. *ferruginea* and *X. discreta* (L. f.) Sprague & Hutch (Beenken et al. 2012).

Dasyspora gregaria (Kunze) Henn.

Beenken et al. (2012) reported this species from French Guiana, on *X. cayennensis* Maas, for the first time. It it also occurs in Suriname and Brazil (Beenken et al. 2012).

Dasyspora guianensis Beenken

This species is only known from French Guiana on *X. benthamii* R.E. Fr. (Beenken et al. 2012).

Dasyspora nitidae Beenken

This species is only known from French Guiana on *X. nitida* Dun. (Beenken et al. 2012).

Desmella aneimiae Syd. & P. Syd. (Fig. 3a–d)

Morph A: Maripasoula canton, Saül: Quad track near entrance to "Sentier de Mt. Fumée", on *Thelypteris hispidula* (Decne.) C.F. Reed (Thelypteridaceae), 4 Aug 2009 (FG09/77. II). "Sentier de Mt. Fumée", on *T. abrupta* (Desv.) Proctor, 4 Aug 2009 (FG09/76. II). Saül, at the giant 'fromagier' tree (*Ceiba pentandra* (L.) Gaertn.) close to the hamlet, on *T. poiteana* (Bory) Proctor, 2 Aug 2009 (FG09/37. II). Venezuela, Aragua State, Henry Pittier Natl. Park, road from Maracay to Ocumare de la Costa, on *Thelypteris* sp., leg. R. Berndt, 21 Nov 1993 (HeRB 3783. II).

Morph B: Sinnamary canton: Piste de St. Elie, shortly after end of tarred section of road, on *Cyathea surinamensis* Domin (Cyatheaceae), 24 Jul 2009 (FG09/24. II). Barrage de Petit Saut, close to ultimate boat inlet, on *Nephrolepis* cf. *biserrata* (Sw.) Schott (Nephrolepidaceae [Lomariopsidaceae s.l.]), 17 Jul 2009 (FG09/46. II). Maripasoula canton, Saül, "Sentier de Mt. Fumée", on *Triplophyllum* cf. *dicksonioides* (Fée) Holltum (Tectariaceae [Dryopteridaceae s.l.]), 5 Aug 2009 (FG09/44. II). Kourou canton, Montagne des Singes, walking trail through rain forest (large loop), on *Lomariopsis japurensis* (C. Martius) J. Sm. (Lomariopsidaceae), 18 Jul 2009 (FG09/15. II). Costa Rica, Guanacaste Prov., Laguna de Arenal, road from Palma to reservoir lake, on *Nephrolepis* cf. *rivularis* (Vahl.) Mett., leg. R. Berndt, 2 Apr 1992 (HeRB 3205. II).

Both morphs present: Costa Rica, Heredia Prov., OTS field station "Finca La Selva", on *Nephrolepis* sp., leg. R. Berndt, 6 Mar 1991 (HeRB 2408. II).

This paper notes *D. aneimiae* for the first time from French Guiana on seven different fern hosts belonging to five families and two orders of Polypodiopsida. All appear to represent new host species, and *Cyathea*, *Lomariopsis* and *Triplophyllum* represent new host genera. All specimens were uredinial. Each sporogenous cell of the superstomatal uredinia formed a number of shortly pedicellate urediniospores in the distal part. The presence of pedicel remnants

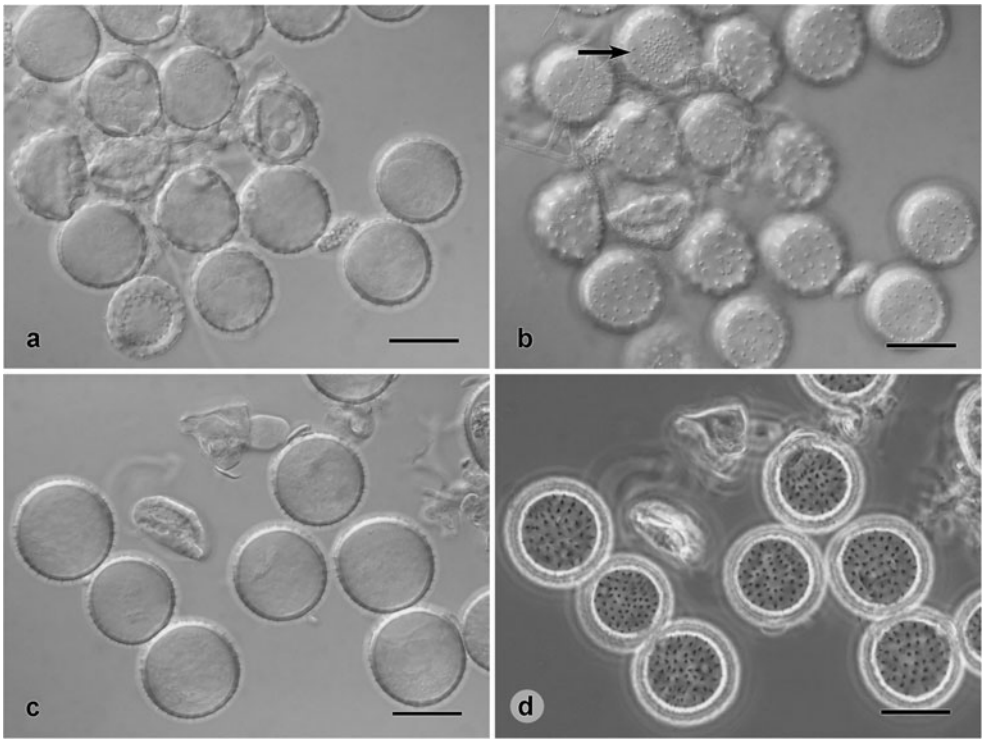

Fig. 3 *Desmella aneimiae*, urediniospores. **a**, **b** 'Morph A' (FG09/77) on *Thelypteris hispidula*, optical section and focus on spore surface. *Arrow* indicates a spore that shows echinulation around the hilum. **c**, **d** 'Morph B' (FG09/44) on *Triplophyllum* cf. *dicksonioides*, optical section and focus on spore surface. *Bars* 20 μm

sheathing the stalks of younger spores indicates that spores are formed repeatedly on the same loci.

Sydow and Sydow (1918) established the genus *Desmella*, based on *D. aneimiae* Syd. & P. Syd., to accommodate fern-dwelling rust fungi with superstomatal aparaphysate uredinia and telia. Five species have been proposed, but only *D. aneimiae* legitimately, based on teliospores. Arthur (1929) accepted *D. aneimiae* and *D. superficialis* (Speg.) Syd. & P. Syd. as distinct species, the latter with smaller urediniospores and thinner spore walls according to Sydow and Sydow (1918). *Desmella superficialis* is a combination of the anamorphic (uredinial) *Caeoma superficiale* Speg. Although Kern supplied a Latin description of the teliospores in Stevenson (1975), the name *D. superficialis* Syd. & P. Syd. ex Kern cannot be applied to the holomorph as it was attached to the uredinial state before. Hennen et al. (2005) considered *D. aneimiae* the only species of the genus *Desmella* and regarded most of the other names, among them *D. superficialis*, as synonyms.

The specimens investigated in the present study revealed two different morphs of urediniospores, designated 'morph A' and 'B'. In morph A, found on *Thelypteris* spp. in French Guiana and Venezuela, the subglobose urediniospores measured 21.6–27×22.1–25.5 μm (24.4×23.8 μm). The spore wall became slightly thicker towards the apex [ca. 1.5–2(3) μm] and was covered by broadly conical spines ca. 2.3–4.5 μm (3.5 μm) apart and becoming smaller, wart-like and more densely spaced towards the hilum. The subglobose to globose urediniospores of morph B measured 23.5–26.7 μm (25.0 μm) in diameter, and had a thinner, evenly thick spore wall and more densely spaced spines. In Costa Rica, both morphs were found on *Nephrolepis*. *Nephrolepis* cf. *rivularis* bore only morph B while both morphs were found on *N.* sp.

Nephrolepis is also host to *Uredo nephrolepidis* Dietel, first collected in Colombia on *N. pendula* Raddi (Mayor 1914) and considered very closely related to *Desmella* by Sydow and Sydow (1918). The latter authors observed that the type of *U. nephrolepidis* bore two forms of urediniospores, one with a thicker wall and wart-like spines, the other one with a thinner wall and more delicate spines. It is possible that these forms coincide with morphs A and B. Their presence on a single specimen could indicate that they belong to a single but variable rust taxon or that two species are involved that caused a mixed infection.

Endophyllum guttatum (Kunze) Syd. & P. Syd.

Sinnamary canton, Piste de St. Elie, abandoned orchard at "Sentier de St. Elie", on *Cissus verticillata* Nicol. & Jar. (Vitaceae), 24 Jul 2009 (FG09/28. 0?, III).

This rust is often named *E. circumscriptum* Whetzel & Olive (Buriticá and Hennen 1980). Sydow and Sydow (1920) showed the identity of the *Aecidium guttatum* Kunze and *A. circumscriptum* Schwein. and proposed the new combination *E. guttatum*. I regard this as the correct name of the fungus. It is widespread in the neotropics (Farr and Rossman 2011) and has been reported, among others, from Suriname (Saccardo 1895) and Guyana (Hernández et al. 2005) on a number of *Cissus* spp. This is the first report from French Guiana on the new host *C. verticillata*.

Kweilingia divina (Syd.) Buriticá

Roura canton, Montagne de Kaw, rough road to Cascades de Fougassier, on cf. *Bambusa vulgaris* Nees (Poaceae), 28 Jul 2009 (FG09/74. II). Kourou canton, Montagne des Singes, on *Guadua latifolia* Kunth (Poaceae), 18 Jul 2009 (FG09/101. II).

Kweilingia divina is widespread in warm regions of the New World on members of Bambusoideae (Farr and Rossman 2011). *Guadua* was first reported as a host genus by de França et al. (2010). These are the first reports of *K. divina* from French Guiana; *G. latifolia* seems to be a new host species.

Phakopsora cf. *compressa* (Arthur & Holw.) Buriticá & J.F. Hennen

Approuague-Kaw canton, road through Montagne de Tresor near "degrade", on *Paspalum* sp. (Poaceae), 25 Jul 2007 (FG09/20. II).

The assignment of the present specimen to *P. compressa* is not entirely satisfactory as the urediniospores were larger than indicated by Cummins (1971). They measured 23.6–32.2×18.4–23 μm (27.7×20.9 μm) vs. 20–27(30)×15–19 μm; characters of paraphyses tallied well. *Phakopsora compressa* has not been reported to the author's knowledge from French Guiana.

Phakopsora phakopsoroides (Arthur & Mains) Buriticá & J.F. Hennen

Cayenne canton, Mt. Bourda, secondary forest at trail leading from SW to "Calvaire", on *Olyra* cf. *latifolia* L. (Poaceae), 14 Jul 2009 (FG09/79. II).

A widespread rust in the neotropics but not hitherto reported from French Guiana.

Phakopsora phyllanthi Dietel

St.-Laurent-du-Maroni canton, sealed road from St. Jean to Apatou, at bridge over Crique Serpent, on *Phyllanthus annuus* Schum. (Euphorbiaceae), 22 Jul 2009 (FG09/8. II). Maripasoula canton, Saül, trail head of hiking trail "Gros Arbre", on *P. annuus*, 5 Aug 2009 (FG09/33 II).

Phakopsora phyllanthi is widely distributed in the Asian tropics. The first New World reports were from Brazil, Venezuela, and Ecuador (Berndt et al. 2007). The species is new for French Guiana.

Phragmidiella bignoniacearum (W.T. Dale) Buriticá & J.F. Hennen in Buriticá

≡ *Cerotelium bignoniacearum* W.T. Dale

Kourou canton, Montagne des Singes, edge of clearing surrounding the look-out hut, on *Cydista aequinoctialis* (L.) Miers. (Bignoniaceae), 18 Jul 2009 (FG09/12. II).

This species is known from Trinidad, the West Indies, Panama, and Brazil on the type host *C. aequinoctialis*, on *Clytostoma* and an undetermined genus of Bignoniaceae. This is the first report from French Guiana. Hennen et al. (2005) reported that the uredinia were provided with inconspicuous paraphyses. Paraphyses were not described by Dale (1955) and were absent in the French Guianan material. The urediniospores measured 22–31.2×17.3–20.1 μm (24.9×18.5 μm) and became smooth towards the hilum.

Porotenus biporus J.F. Hennen & Sotão

Maripasoula canton, Saül, on *Memora* cf. *flavida* Bureau & K. Schum. (Bignoniaceae): Secondary forest along foot path between hamlet and airstrip, 6 Aug 2009 (FG09/92. (II), III). "Sentier de Mt. Fumée", 5 Aug 2009 (FG09/90. 0, I, II?, III).

This rust is new for French Guiana. It has been known from Brazil (Hennen and Sotão 1996).

Porotenus memorae F.C. Albuq.

Maripasoula canton, Saül, "Sentier de Mt. Fumée", on *Memora* cf. *racemosa* A.H. Gentry (Bignoniaceae), 5 Aug 2009 (FG09/91. (II), (III)).

Porotenus memorae has been known from Brazil (Farr and Rossman 2011). Hennen et al. (2005) noted its presence in French Guiana without indicating a voucher or reference. I was unable to find an original reference for the occurrence of *P. memorae* in French Guiana and consider it a new report. If the determination of *M.* cf. *racemosa* is correct, this will be a new host record.

Prospodium amapaensis J.F. Hennen & Sotão

Maripasoula canton, Saül: Foot path between hamlet and airstrip, on cf. *Memora* sp. (Bignoniaceae), 6 Aug 2009 (FG09/32. II, III). Quad-track near trailhead of "Sentier de Mt. Fumée", on cf. *Memora* sp., 4 Aug 2009 (FG09/41. [0, I], II, III).

According to Hennen et al. (2005), this rust is only known from the type collection on an undetermined Bignoniaceae in the Brazilian state Amapá. Here, it is reported for the first time from French Guiana on cf. *Memora*. FG09/32 bore cyathiform uredinia and telia; on FG09/41, spermogonia and aecia(?) were found in addition. Spermogonia were old and occurred on bleached necrotic spots of the host leaves. The flat layer of sporogenous cells developed under the epidermis and was apparently not bounded by sterile cells (group I, type 2 according to Hiratsuka and Hiratsuka 1980). The sori considered to be aecia were *Uredo*-like and restricted to the leaf veins where they formed hymenial, orange to dull brown, pulverulent lesions. They did not show the basket-like morphology of the uredinia, but spores were most similar to the urediniospores. *Prospodium amapaensis* is likely macrocyclic and autoecious.

Puccinia arachidis Speg. var. *arachidis*

Aprouague-Kaw canton, Auberge Aprouague at Aprouague river SW of Regina, on *Arachis* sp. (Fabaceae), 8 Aug 2009 (FG09/102. II).

Puccinia arachidis is widely distributed on *Arachis hypogaea* L. and *A.* spp. but does not seem to have previously been reported from French Guiana.

Puccinia arechavaletae Speg.

Roura canton, Montagne de Kaw, rough road to Cascades de Fougassier, secondary forest bordering road, on *Serjania grandifolia* Sagot ex Radlk. (Sapindaceae), 28 Jul 2009 (FG09/70. III).

Puccinia arechavaletae is widespread and common on several genera and many species of Sapindaceae (Farr and Rossman 2011), but apparently has not been previously reported from French Guiana.

Puccinia chaetochloae Arthur

Kourou canton, golf course near Kourou Space Center, trail head of golf course hiking path, on *Pennisetum* sp. (Poaceae), 16 Jul 2009 (FG09/84. II, III).

The specimen had somewhat longer teliospores [37–51 μm (42.3 μm)] than reported for *P. chaetochloae* and approached *P. stenotaphri* Cummins in this character (Cummins 1971). As the remaining features tallied well with *P. chaetochlae*, it is assigned to the latter. It is a new report for French Guiana.

Puccinia cf. *deformata* Berk. & Curtis

Cayenne canton, Mt. Bourda, secondary forest along trail leading from SW to the "Calvaire", on cf. *Olyra* sp. (Poaceae), 14 Jul 2009 (FG09/87. II, (III)).

The non-flowering host grass could not be determined with certainty as *Olyra*, and the rust fungus revealed a few small differences from *P. deformata* as described by Cummins (1971). It is added as an uncertain new member to the rust mycobiota of French Guiana.

Puccinia geophilae Racib.

Maripasoula canton, Saül, foot path between hamlet and airstrip, on *Geophila cordifolia* Miq. (Rubiaceae), 6 Aug 2009 (FG09/38. II).

This is the first report of *P. geophilae* for French Guiana.

Puccinia hyptidis-mutabilis Mayor

Macouria canton, shoulder of road D 13 to Guatémala E of Kourou, ruderal vegetation, on *Hyptis* cf. *mutabilis* Briq. (Lamiaceae), 1 Aug 2009 (FG09/61. II, [III]).

Puccinia hyptidis-mutabilis is widespread in the neotropics but has not been previously reported from French Guiana.

Puccinia kourouensis R. Berndt, sp. nov. (Fig. 4a–c)

Etymology: Kourou, the type location.

Mycobank no. MB 800282

Puccinia mirandensis similis vel differt praecipue uredinio- et teliosporis majoribus.

Uredinia tiny, subepidermal, without bounding structures, liberating pale cinnamon-brown spore mass through ruptured epidermis. Urediniospores obovoid to broadly ellipsoid, 23.5–32.5×18–22.5 μm (26.9×20.3 μm), spore wall ca. 1.5 μm thick, golden or light brown, evenly covered by rather stout, sharp spines ca. 2.6–3.6 μm apart, 3–4 inconspicuous equatorial germ pores, without or with small caps. Telia abaxial on leaves, blackish brown, compact, not stromatic. Teliospores ellipsoid, clavate or almost cylindrical, 37–69.5×14–21.5 μm (50.5×18.8 μm), generally two-celled, occasionally one-celled, strongly to hardly constricted at the septum, distal cell ± equal in length to proximal one to considerably shorter, broadly ellipsoid, ovoid or subglobose, at apex rounded, broadly conical or subtruncate, proximal cell variable, similar to distal cell or to elongated and wedge-shaped, spore wall chestnut brown in distal cell, golden or pale brown in proximal cell, smooth or minutely rough punctate, sometimes with longitudinal ridges or folds, ca. 1.5(2) μm thick at side, to 8 μm at the apex, germ pores apical in distal cell, next to the septum in lower cell; pedicel short, stout, slightly thick-walled, golden, septum more darkly pigmented.

On leaves of *Scleria secans* Urb. (Cyperaceae).

Holotype (PC). Kourou canton, hiking path on golf course at Kourou Space Center, on *Scleria* cf. *secans*, 16 Jul 2009 (FG09/78. II, III.).

Similar species studied: *Puccinia scleriicola* Arthur: USA, Florida, between Cutler and Longview Camp, on *S. verticillata* Muhl., leg. JK Small & JJ Carter, 9–12 Nov 1903 (PUR 26921. II, III. Type!). *Puccinia mirandensis* Kern & Thurst. Venezuela, Miranda state, at km 20 of road from Petare to Santa Lucia, on *S. secans*, leg. Whetzel & Muller no. 3400, 13 Apr 1939 (BPI 844480 ex PACMA no. 702. II, III. With uredinia of *Uromyces scleriae* Henn. Type!).

Scleria secans has been reported to support *P. mirandensis* and *P. scleriicola* (e.g. Kern 1928; Kern and Thurston 1944). *Puccinia kourouensis* differs from the latter in larger urediniospores, the absence of three-celled teliospores and non-stromatic telia. *Puccinia mirandensis* resembles the present species closely (Fig. 4d–f) but has larger uredinio- and teliospores [II: 30–37(40)×22–27 μm (34.3×24.3 μm) vs. 23.5–32.5×18–22.5 μm (26.9×20.3 μm). III: 53–88×12.5–20 μm (70.6×16.4 μm) vs. 37–69.5×14– 21.5 μm (50.5×18.8 μm)]. In both species, teliospores are often rough-punctate or very finely verruculose. Additionally, some show inconspicuous longitudinal striae or ridges. The type of *P. scleriicola* showed occasional one- and three-celled teliospores and was very similar to *P. scleriae* (Pazschke) Arthur (= *Rostrupia scleriae* Pazschke) (Arthur 1917, 1920; Pazschke 1892).

Puccinia lateritia Berk. & Curtis

Mana canton, Awala-Yalimapo, road to Mana a few km E of Awala, on *Mitracarpus frigidus* K. Schum. (Rubiaceae), 21 Jul 2009 (FG09/98. III).

A widespread rust in the neotropics on members of tribe Spermacoceae (Rubioideae). This is the first report from French Guiana on a new host species.

Puccinia lygodii Arthur

Roura canton, rough road to "Degrad Eskol" at Crique Gabriel, on *Lygodium venustum* Sw. (Schizaeaceae), 27 Jul 2007 (FG09/23. II).

The first rust fungus described on *Lygodium* was *Uredo lygodii* Har. collected in Brazil. Arthur (1924a) published

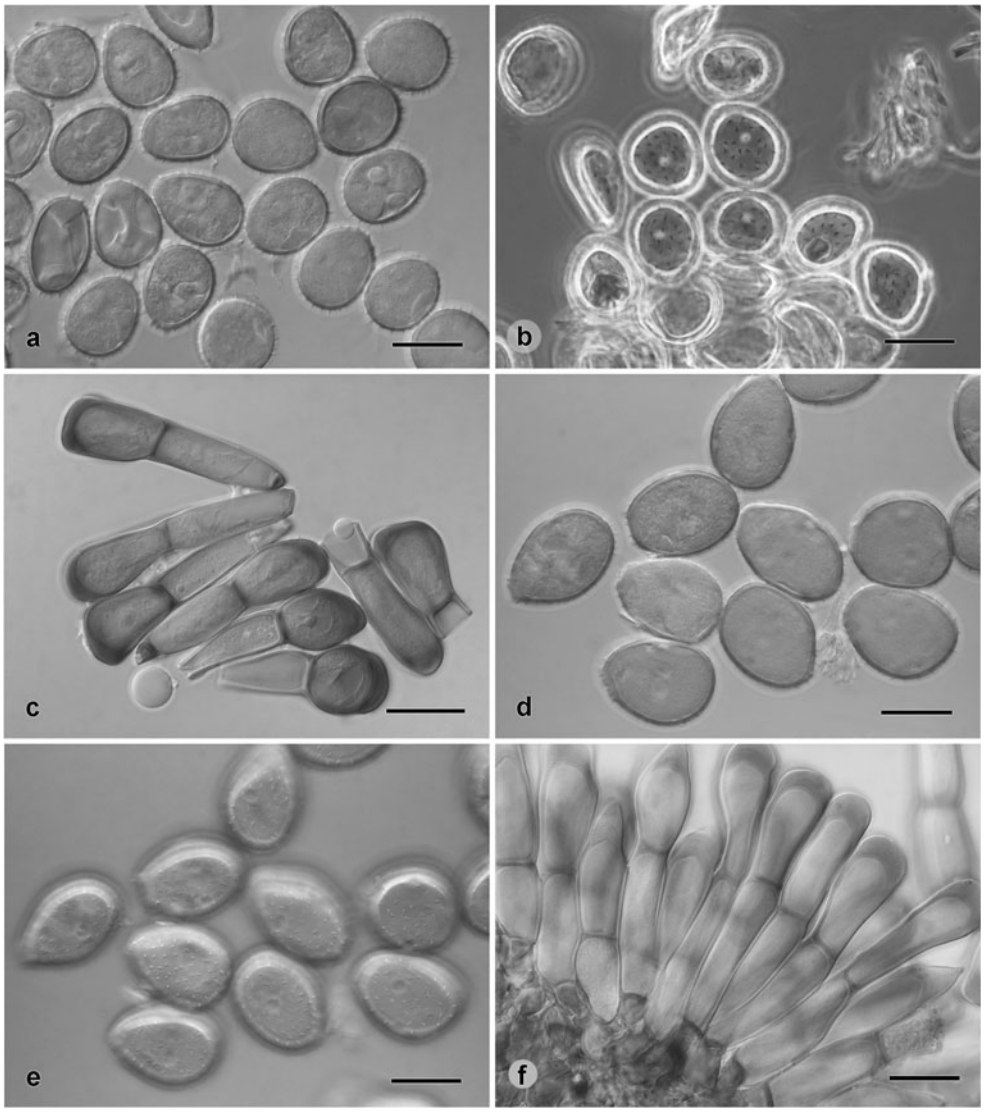

Fig. 4 *Puccinia kourouensis* (**a**–**c**). *P. mirandensis* (**d**–**f**). **a**, **d** Urediniospores in optical section. **b**, **e** Urediniospores, focus on spore surface. **c**, **f** Teliospores. Teliospores illustrated in Fig. 4c are longer than the average. *Bars* 20 μm

Puccinia lygodii Arthur based on another Brazilian specimen and Sydow (1925) erected *Milesina lygodii* H. Syd. based on a collection made in Guyana ("British Guiana"). He described the urediniospores as hyaline and the uredinia as bounded by a cellular peridium, characters that indicated the presence of a *Milesia* anamorph of the fern-dwelling genera *Milesina* or *Uredinopsis*. As the telial state was not described, *M. lygodii* is an illegitimate name. Faull (1932) investigated the type specimens of the three rusts described on *Lygodium* and observed that they were very similar in uredinial characters. He remained reluctant regarding the nature of the teliospores described by Arthur, writing that "The existence of stalked, septate spores … interpreted by Prof. Arthur as 'teliospores' would appear to make its [*Milesina lygodii*] inclusion in the genus *Milesia* untenable. … Further studies of these rusts … is needed before a final decision can be reached as to just where they belong." (Faull 1932, p. 122). Based on the unexpressed assumption that the rusts described on *Lygodium* represented the same fungal species, possibly a member of *Puccinia*, Faull excluded *M. lygodii* from *Milesina*.

The specimen from French Guiana bore only uredinia with slightly larger urediniospores than described by Arthur (1924a) and Sydow (1925), measuring 27–35×19–24 μm (30.5×21.5 μm) and showing 3–4 equatorial, superequatorial, or almost scattered germ pores. A peridium could not be detected even in young, closed uredinia. The epidermis was just lined above the uredinia with brown, amorphous material that was probably of fungal origin, but entirely distinct from the characteristic peridium defining *Milesia*. *Puccinia lygodii* has not been reported before from French Guiana.

Puccinia melampodii Dietel & Holw.

Mana canton, forest road to Angoulême near turn-off from RN 1 at km 206, on *Emilia sonchifolia* (L.) DC. (Asteraceae), 23 Jul 2009 (FG09/7. III). Maripasoula canton, Saül, on *E. sonchifolia*, 3 Aug 2009 (FG09/108. III). St.-Laurent-du-Maroni canton, sealed road from St. Jean to Apatou, on *E. fosbergii* Nicol., 22 Jul 2009 (FG09/9. III).

Maripasoula canton, Saül, on *Synedrella nodiflora* Gaertn., 3 Aug 2009 (FG09/34. III).

Puccinia melampodii is a common species in warm regions of the New World, but has not been reported before from French Guiana.

Puccinia oahuensis Ellis & Everh.

This rust was reported from French Guiana by Lenné (1990) on *Digitaria* sp.

Puccinia obliquo-septata Vienn.-Bourg.

Maripasoula canton, Saül, foot path between hamlet and airstrip, on *Olyra latifolia* L. (Poaceae), 6 Aug 2009 (FG09/43. II, III). St.-Laurent-du-Maroni canton, rough road leading to new sealed road from St. Jean to Apatou, not far from turn-off from RN 1, on *O. micrantha* H. B. & K., 22 Jul 2009 (FG09/80. II).

Both specimens tallied well with descriptions of *P. obliquo-septata* (Cummins 1971; Viennot-Bourgin 1958a, b), though uredinial paraphyses were not seen in FG09/43. This is the first French Guianan report of this species that has been known so far from Brazil, Paraguay (Cummins 1971), and Guyana (Hernández et al. 2005).

Puccinia palicoureae Mains

St.-Laurent-du-Maroni canton, sealed road from St. Jean to Apatou, hills not far from Maroni river, on *Palicourea guianensis* Aubl. (Rubiaceae), 22 Jul 2009 (FG09/10. II, III).

The rust has been reported on *P. guianensis* and *P.* spp. from Brazil and Belize. It is new for French Guiana.

Puccinia paraensis Dietel

Matoury canton, Matoury, Massif de Mirande, secondary forest close to parking lot of "Sentier de Mirande", on *Gouania blanchetiana* Miq. (Rhamnaceae), 15 Jul 2009 (FG09/47. II, III). Mana canton, Piste de Montagne de Fer (turn-off at km 200 of RN 1), on *G. blanchetiana*, 23 Jul 2009 (FG09/83. 0, I). Roura canton, Montagne de Kaw, rough road to Cascades de Fougassier, on *Gouania* sp., 28 Jul 2009 (FG09/73. 0, I, II, III). Maripasoula canton, Saül, trailhead of "Sentier de Mt. Fumée", on *Gouania* sp., 5 Aug 2009 (FG09/75. II, III).

In the New World, this rust has been known from Brazil (Jackson 1931) and Guyana (Hernández et al. 2005). Viennot-Bourgin (1953) reported it from Ivory Coast. Aeciospores of FG09/73 were considerably larger [32–38×27–33 µm (35.2×30.8 µm)] than indicated by Viennot-Bourgin (25–32×20–26, most commonly 29×23 µm). Measurements presented by Sotão et al. (2001) are intermediate. Dietel (1908) only described uredinio- and teliospores in the protologue.

Puccinia parianicola R. Berndt, sp. nov. (Fig. 5a–d)

Etymology: After the host genus *Pariana*.

Mycobank no. MB 800283

Spermogonia et aecia non observata. Uredinia in foliis amphigena sed praecipue abaxialia, subepidermalia, paraphysibus ca. 50–115×5–7(8) µm copiosis anguste cylindricis (usque ad subclavatis) rectis vel moderate incurvatis tenue et aureo tunicatis praedita; urediniosporae asymmetrice obovoideae, plus minusve subreniformes, (21)24–33×(14)17–21 µm

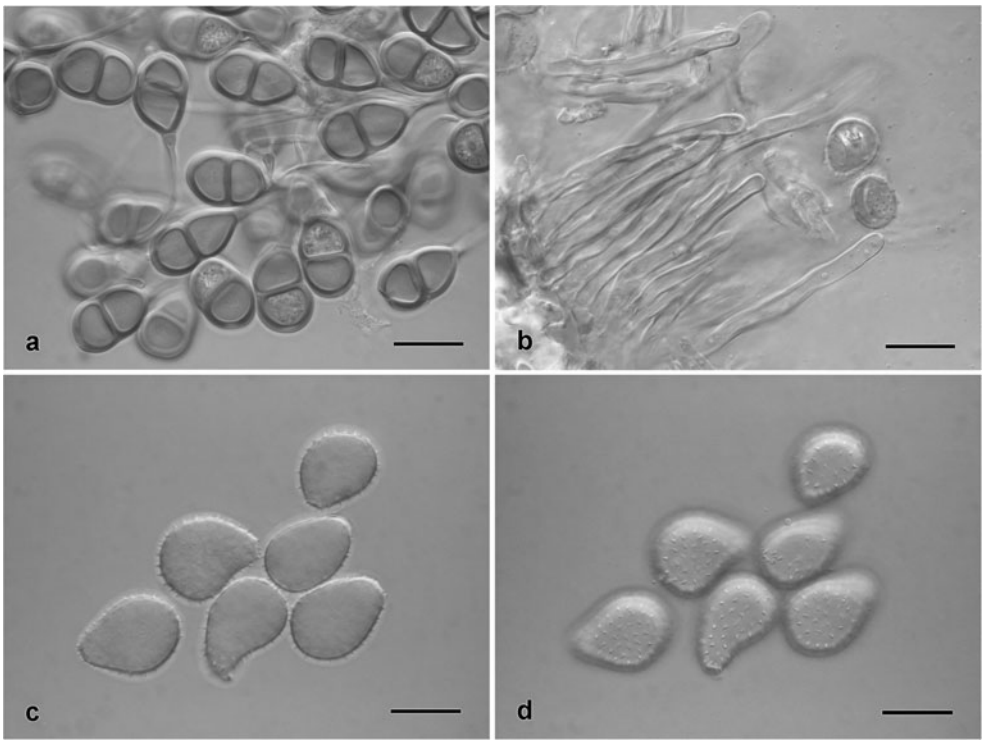

Fig. 5 *Puccinia parianicola*. **a** Teliospores. **b** Peripheral paraphyses of uredinia. **c** Urediniospores, optical section. **d** Urediniospores, focus on spore surface. *Bars* 20 µm

(25.7×17.5 μm), pariete 1–1.5 μm crasso pallide aureo, aequaliter echinulato spinis inter se 2–4 μm distantibus, poris germinationis (3?)4(5) indistinctis approx. aequatorialibus vel superaequatorialibus. Telia in foliis abaxialia subepidermalia pulvinata fibrosa vel subcompacta primum ferruginea deinde castanea vel nigrescentes; teliosporae ellipsoideae ad late ellipsoideae, 23–30×14–17 μm (26.2×15.3 μm), puccinioideae, pariete laevi pallide aureo ad aureo-brunneo indistincte bilaminato 1.5–2 μm crasso, in apice ca. 3 μm, poris germinationis apicali et juxta septum, secundum maturitatem basidiis germinantes, pedicello hyalino vel subhyalino tenue tunicato usque ad 120 μm longo. In foliis *Parianae campestris* Aubl. (Poaceae).

Spermogonia and aecia not observed. Uredinia amphigenous, predominantly abaxial on leaves, subepidermal, small, more or less rounded, overarched by torn rigid host epidermis, paraphyses copious in periphery of uredinia, fewer interspersed among spores, slenderly cylindric (to subclavate), straight or slightly bent inwards, ca. 50–115×5–7(8) μm, with thin or slightly thickened, golden to light brown wall; urediniospores asymmetrically obovoid, generally more or less kidney-shaped, (21)24–33×(14)17–21 μm (25.7×17.5 μm), spore wall 1–1.5 μm thick, pale golden brown, evenly echinulate by delicate spines ca. 2–4 μm apart, germ pores rather obscure, (3?)4(5) in approx. equatorial to superequatorial position, without caps. Telia abaxial on leaves, subepidermal, rounded and pulvinate, with fibrous texture or subcompact, first ferrugineous, later becoming chestnut or blackish brown; teliospores ellipsoid to broadly ellipsoid, 23–30×14–17 μm (26.2×15.3 μm), puccinioid with horizontal septum, spore wall smooth, 1.5–2 μm thick, at apex about 3 μm, pale golden to golden brown, indistinctly two-layered or showing a gradient between the darker inner and the more faintly pigmented outer wall, germ pores apical and close to septum in proximal cell, without caps, spores germinating upon maturity; pedicels inserted at spore base, slender, up to 120 μm long, hyaline to subhyaline, more or less thin-walled.

On leaves of *Pariana campestris* Aubl. (Poaceae).

Holotype (PC). Matoury canton, Matoury, Massif de Mirande, "Sentier de Mirande", on *Pariana campestris* (Poaceae), 15 Jul 2009 (FG09/81. II, III). Isotype ZT Myc.

Puccinia parianicola is similar to *P. bambusarum* Arthur that also occurs on *Pariana* (Hennen and Figueiredo 1981) and to *P. obliquo-septata* that was described on *Olyra* sp. (Viennot-Bourgin 1958a, b). It differs from the former in the presence of paraphyses, kidney-shaped urediniospores, and longer teliospore pedicels. From the latter, it is distinguished by smaller, kidney-shaped, and more delicately echinate urediniospores, by smaller teliospores with a less thickened apex, and by differently shaped uredinial paraphyses. *Pariana* and *Olyra* are closely related and belong to the same tribe, Olyreae of Bambusoideae (Grass Phylogeny Working Group 2001).

Sotão et al. (2001) mentioned the presence of uredinial paraphyses in rust specimens on *Pariana* determined as *P. bambusarum*. It remains to be investigated whether these specimens in fact belong to *P. parianicola*.

cf. *Puccinia peperomiae* J.C. Lindq.

Kourou canton, Montagne des Singes, rain forest hiking trail, near hut on clearing close to parking lot, on *Piper hostmannianum* C. DC. (Piperaceae), 17 Jul 2009 (FG09/16. II).

Piper hostmannianum is type host of *Crossopsora piperis* from which the present rust differs in uredinia lacking paraphyses and urediniospores with a more distantly and coarsely aculeate wall. Other rust fungi described on Piperaceae from the New World are *Uredo peperomiae* Henn., *U. piperis* Henn. and *P. peperomiae*. Sydow and Sydow (1924) studied the types of both *Uredo* spp. and considered them to represent a single species, *U. peperomiae*. The latter was tentatively regarded as the uredinial state of *P. peperomiae* by Lindquist (1953). The specimen from French Guiana is provisionally assigned to *P. peperomiae* based on similar, deeply immersed uredinia. It differs from *P. peperomiae* by considerably longer urediniospores [25–39×18.5–22.5 μm (30.2×20.6 μm) vs. 20–25×18–20 μm]. Quite likely the knowledge on the distribution and host range of the named rust fungi of Piperaceae is incomplete or incorrect because of uncertainty regarding synonymy and possible misidentifications (cf. Lindquist 1952, p. 225). Along with *C. piperis* (this paper), this is the first rust reported on Piperaceae from French Guiana.

Puccinia polysora Underw.

Puccinia polysora was listed by Lenné (1990) for French Guiana on *Tripsacum latifolium* Hitchc.

Puccinia subcoronata Henn.

Mana canton, Awala-Yalimapo, road to Mana a few km E of Awala, on *Cyperus* sp. (Cyperaceae), 21 Jul 2009 (FG09/17. II, III). Kourou canton, near "Degrad Saramaka", at Kourou river inlet, on *Cyperus* sp., 18 Jul 2009 (FG09/49. II).

First report from French Guiana of this widespread rust in the neotropics.

Puccinia thaliae Dietel

Cayenne canton, Cayenne Botanical Garden, on *Canna indica* L. (Cannaceae), 30 Jul 2009 (FG09/93. II, III). Mana canton, Awala-Yalimapo, near "Maison de la Nature", on *Maranta rupicola* Andersson (Marantaceae), 20 Jul 2009 (FG09/67. II).

In the specimen on *Canna*, urediniospores measured 28.2–44.0×19.9–25.6 μm (33.9×22.3 μm). They were evenly echinulate and germ pores could not be discerned. The measurements tally well with data in Dietel (1899) (28–40×20–25 μm), León Gallegos and Cummins

(1981) (27–43×18–24 μm) and Sydow and Sydow (1904) (27–40×20–25 μm). Hennen et al. (2005) described shorter urediniospores (21–32×18–25 μm). The specimen on *M. rupicola* had smaller urediniospores than the one on *Canna* [22.9–32.9×16.3–19.6 μm (28.8×18.2 μm)] and showed 2(3) equatorial and opposite or equidistant germ pores. The echinulate spore wall revealed bald patches proximal to the pores or covering them.

Puccinia cannae Henn. and *P. thaliae* were described on *Canna* (Cannaceae) and *Thalia* (Marantaceae), respectively. The host families are sister groups in the Zingiberales (Kress 1990; Prince 2010). Sydow and Sydow (1904) emphasized that both rusts were closely similar, and Arthur (1915) synonymized them giving priority to *P. thaliae*. The differences observed between the specimens on *Maranta* and *Canna* from French Guiana indicate that the rusts are specifically distinct. This could mean that *P. thaliae* and *P. cannae* are indeed different species, and that specimens on Marantaceae (*Thalia* and *Maranta*) belong to the former, and those on Cannaceae (*Canna*) to the latter. The types and more ample material from all reported host genera need to be studied to settle this question. Both rust specimens from French Guiana are assigned to *P. thaliae*, the one on *Canna* only provisionally. *Puccinia thaliae* and *P. cannae* have not been reported before from French Guiana.

Puccinia urbaniana Henn.

Cayenne canton, Cayenne Botanical Garden, on *Stachytarpheta* cf. *jamaicensis* (L.) Vahl (Verbenaceae), 30 Jul 2009 (FG09/94. III).

Puccinia urbaniana is widespread in the neotropics. This is the first report from French Guiana.

Sphenospora smilacina Syd. (Fig. 6a, b)

Maripasoula canton, Saül, near trailhead of "Sentier de Mt. Fumée", on *Smilax* sp. (Smilacaceae), 5 Aug 2009 (FG09/36. (II), III).

Sphenospora smilacina is the only known member of *Sphenospora* on Smilacaceae, and the present specimen is the first report of this species for French Guiana. Teliospores germinated in two different manners. In the majority of the investigated spores, the protoplasts of the spore cells fragmented into four cells (Fig. 6a) which was interpreted as formation of internal basidia. Other teliospores developed ordinary external basidia by apical elongation of the teliospore cells (Fig. 6b). Formation of sterigmata and basidiospores was only observed in the external basidia but not in the internal ones.

Uredo anthurii (Har.) Sacc.

Cayenne canton, Mt. Bourda, foot path between "Calvaire" and sea shore, on *Syngonium podophyllum* Schott (Araceae), 14 Jul 2009 (FG09/105. II).

Spores of *U. anthurii* measure 29–37×18–26 μm and have a nearly colorless, 1–1.5 μm thick and moderately echinulate wall according to Arthur (1924a, b). In the present specimen, spores measured 26.5–37×20–25.5 μm (32.2×22.5 μm). *Uredo monstericola* Kern, Thurst. & Whetzel is similar with slightly larger spores (29–40×19–29 μm) (Kern et al. 1934). This is the first report of *U. anthurii* from French Guiana on a new host genus and species. The genera *Syngonium*, *Anthurium* (type host genus of *U. anthurii*) and *Monstera* (type host genus of *U. monstericola*) belong to different subfamilies of Araceae (Cabrera et al. 2008).

Uredo condylocarpi H.S. Jacks. & Holw.

Roura canton, Coralie forest road departing from RN 1 shortly SE of Cacao crossing, on cf. *Odontadenia* sp. (Apocynaceae), 8 Aug 2009 (FG09/4. II). Mana canton, Piste de Montagne de Fer (turn-off at km 200 of RN 1), on undetermined Apocynaceae, 23 Jul 2009 (FG09/85. II).

Uredo condylocarpi has been known from Brazil where it occurs on *Condylocarpus* spp. (Buriticá 1999). This is the first report from French Guiana, probably on a new host genus, *Odontadenia*. In FG09/4, the paraphyses were rod-like and up to 160 μm long. Spores measured 24–32×17–20.5 μm (27.2×19.2 μm). In FG09/85, paraphyses did not exceed 130 μm and most reached only 90 μm. Urediniospores measured 27.5–38×18–23.5 μm (32.8×21.7 μm). The characters of both specimens were quite similar to those of *Crossopsora stevensii* whose uredinial paraphyses seem to be shorter, however (generally ≤80 μm; in FG09/30, a few up to 100 μm). Buriticá (1999) is most probably right in his prediction that *U. condylocarpi* is a member of *Crossopsora*.

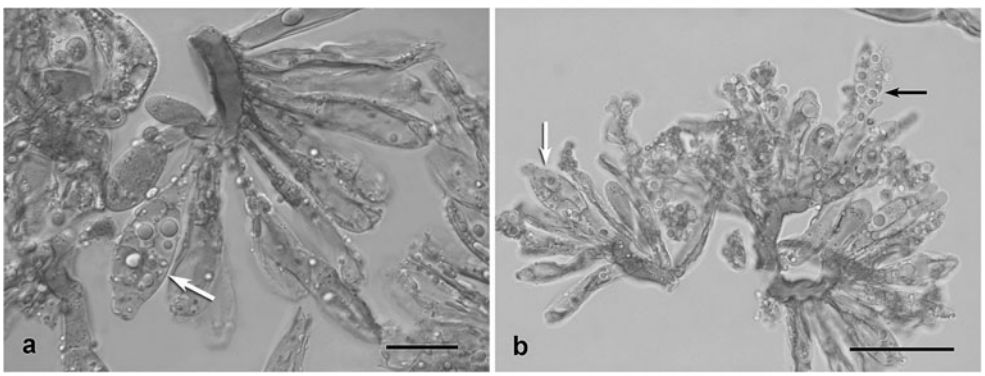

Fig. 6 *Sphenospora smilacina*. **a** Meristematic basal cell with akropetally arranged stalked teliospores. The fragmented protoplasts of a two-celled teliospore (*arrow*) indicate internal basidium formation. *Bar* 20 μm. **b** Three meristematic cells with teliospores that germinate with external basidia (*black arrow*) or show fragmented protoplasts (*white arrow*). *Bar* 50 μm

Uredo rolliniae W.T. Dale

On *Rollinia exsucca* A. DC. (Annonaceae): Roura canton: RN 2 to Regina, forest road ca. 19 km SE of Cacao intersection, 8 Aug 2009 (FG09/124. II). RN 2 to Regina, Coralie, side road to Cacao, 8 Aug 2009 (FG09/125. II). Road D6 to Kaw, side road to Fougasier, 28 Jul 2009 (FG09/122. II). Iracubo canton, side road from RN 1 west of Iracubo, 19 Jul 2009 (FG09/112. II). St.-Laurent-du-Maroni canton, St. Jean, road to Plateau des Mines, 22 Jul 2009 (FG09/117. II). Mana canton, Piste de Montagne de Fer at km 200 of RN 1, 23 Jul 2009 (FG09/120. II).

Uredo rolliniae has been known from Trinidad and the West Indies (Farr and Rossman 2011). It is new for French Guiana.

Uredo cf. *secamones* (Wakef. & Hansf.) Gjærum (Fig. 7a, b)

Kourou canton, near "Degrad Saramaka" at Kourou river, on *Odontadenia perrottetii* (A. DC.) Woods. (Apocynaceae), 18 Jul 2009 (FG09/11. II).

The uredinial specimen showed subglobose, evenly echinulate urediniospores (Fig. 7b), but disclosed its affiliation with the genus *Hemileia* by superstomatal sori comprising a number of inflated sporogenous cells arranged like the segments of an orange. The sporogenous cells exhibited a characteristic brush-like appearance caused by the remnants of spore pedicels of discharged urediniospores (Fig. 7a).

None of the *Hemileia*- and related *Uredo* spp. listed by Ritschel (2005) on Apocynaceae is known on *Odontadenia*, and only two of them, *U. secamones* and *U. scitula* (Syd.) Cummins, have evenly aculeate, symmetric urediniospores. The present rust has smaller spores and thinner spore walls than *U. scitula*. From *U. secamones*, it seems to differ only in slightly smaller spores [18–23×15–22 μm vs. 20.5–26 μm (23.6 μm) diam.]. Unfortunately, type material of *U. secamones* is unavailable (Ritschel 2005). Both *U. secamones* and *U. scitula* are only known from Africa on *Secamone* R. Br. (subfam. Secamonoideae) and *Periploca* L. (subfam. Periplocoideae). *Odontadenia* Benth. is a member of subfam. Apocynoideae and restricted to the New World (Endress and Bruyns 2000). The present specimen is provisionally left with *U. secamones* because of the morphological similarity. Its occurrence in the neotropics on another subfamily of Apocynaceae indicates that it may represent a distinct species. *Uredo secamones* would be new for French Guiana and the New World on a new host genus.

Uredo sp.

Mana canton, Awala-Yalimapo, a few km E of Awala on cultivated land along road to Mana, on *Scleria* sp. (Cyperaceae), 21 Jul 2009 (FG09/18. II). Kourou canton, golf course next to the golfers' home, on *Scleria* sp., 1 Aug 2009 (FG09/63. II).

The present species differs from other rust fungi on *Scleria* in the New World in paraphysate uredinia that liberate the spores through a small pore or slit of the epidermis. It also differs from *Puccinia scleriae* and *P. scleriicola* in larger, more coarsely echinulate urediniospores, from *P. mirandensis* in smaller urediniospores, and from *Uromyces scleriae* in urediniospores that are not thickened apically. The paraphyses were peripheral, narrowly cylindrical to narrowly club-shaped, and formed a peridium-like layer lining the epidermis. In FG09/63, club-shaped paraphyses also occurred in the hymenium. The rust is left unnamed as it could not be compared with authentic material of all rust species described on *Scleria* in the Old World.

Uromyces anguriae H.S. Jacks. & Holw.

Maripasoula canton, Saül, connecting trail between water treatment plant and trailhead of "Sentier Mt. Fumée", on *Helmontia cardiophylla* Harms (Cucurbitaceae), 5 Aug 2009 (FG09/59. II).

Additional material studied: Brazil, Petropolis, Rio de Janeiro, on *Anguria warmingiana* Cogn. (det. EP Killip), leg. EWD & MM Holway (Plants of South America no. 1432), 29 Dec 1921 (BPI 0000719. II, III. Type!).

The specimen was compared to the type of *U. anguriae* which revealed identical urediniospores. *Uromyces anguriae* is a new report for French Guiana on a new host genus and species.

Uromyces appendiculatus (Pers.) Unger var. *appendiculatus*

Mana canton, Awala-Yalimapo, dune vegetation near "Maison de la Nature", on *Vigna luteola* (Jacq.) Benth. (Fabaceae), 20 Jul 2009 (FG09/66. II).

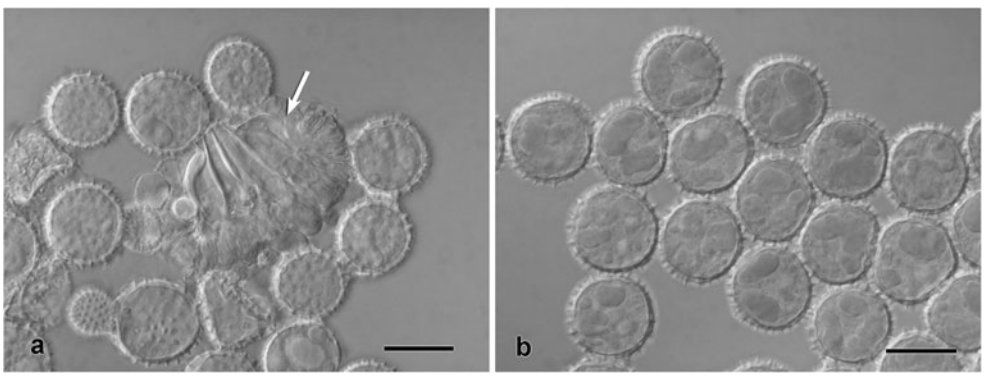

Fig. 7 *Uredo* cf. *secamones*. **a** Urediniospores and a uredinial sorus composed of inflated meristematic cells (*arrow*). The meristematic cells are covered with remnants of pedicels of discharged urediniospores that give the sorus a brush-like appearance. **b** Urediniospores. *Bars* 20 μm

The specimen resembled *U. appendiculatus* var. *appendiculatus* in urediniospores of similar size [26–35.5×19–24.5 μm (30.7×21.9 μm) vs. (20)24–30(33)×(18)20–27(29) (Cummins 1978)] and exhibiting a smooth patch of the spore wall associated with the germ pores (Klebahn 1914). They differed slightly in superequatorial pores. *Uromyces vignae* Barcl. has similar urediniospores [(23)25–30(32)×20–23 μm (Cummins 1978)] with subapical germ pores and lacking smooth patches (e.g., Guyot 1957; Cummins 1978). Sydow and Sydow (1910) synonymized *U. appendiculatus* with *U. vignae-luteolae* Henn. described on *V. luteola*. It has been reported on this host from Congo, Argentina, Colombia, and Ecuador (Guyot 1957). This is the first report of *U. appendiculatus* var. *appendiculatus* from French Guiana.

Uromyces euphorbiae Cooke & Peck

Maripasoula canton, Saül, road sides within hamlet, on *Euphorbia hirta* L. (Euphorbiaceae), 3 Aug 2009 (FG09/103. II, III). Mana canton, Awala-Yalimapo, near "Maison de la Nature", on *E. hirta*, 19 Jul 2009 (FG09/104. II, III).

A widespread and common species but not reported previously from French Guiana.

Uromyces herterianus Dietel

On *Spermacoce verticillata* L. (Rubiaceae): Kourou canton, golf course next to Kourou Space Center, 16 Jul 2009 (FG09/89. II, III). Kourou canton, Montagne des Singes, parking lot and trailhead of "Sentier de Mirande", 17 Jul 2009 (FG09/95. II, III). Roura canton, Montagne de Kaw, rough road to Cascades de Fougassier, 28 Jul 2009 (FG09/13. II, III).

This rust fungus has not been reported before from French Guiana. It is known on the same host species, *S.* (= *Borreria*) *verticillata*, from Argentina and Uruguay (Farr and Rossman 2011). In Brazil, it has been found on *Spermacoce* sp. (Hennen et al. 2005). Dietel (1937) described the teliospores as smooth, which was confirmed by Lindquist (1982). In the present specimens, the teliospores were covered by inconspicuous, small, flat and densely situated warts or bore a few longitudinal or oblique ridges. Cummins (1952) described *U. wolfii* Cumm. with verrucose teliospores from *Borreria* in Venezuela. This rust is probably microcyclic and seems to have more coarsely warted teliospores than the specimens investigated here.

Uromyces cf. *neotropicalis* J.R. Hern. & Aime

Maripasoula canton, Saül, "Sentier de Mt. Fumée", on *Cayaponia rigida* Cogn. (Cucurbitaceae), 6 Aug 2009 (FG09/42. II, III).

The specimen resembled *U. neotropicalis* described from Guyana on *C. selysioides* C. Jeffrey and an undetermined cucurbit (Hernández et al. 2005). It seems to differ slightly in umbonate teliospores and an orange brown spore wall that is slightly thicker than reported in *U. neotropicalis*. The rust is preliminarily assigned to *U. neotropicalis* which would be a new report for French Guiana.

Uromyces niteroyensis Rangel

Iracoubo canton, old road parallel to RN 1 ca. 15 km W of Iracoubo, a few km E of Crique Roches Blanches, on *Setaria* cf. *tenax* Desv. (Poaceae), 19 Jul 2009 (FG09/48. II, III).

Uromyces niteroyensis is a new report for French Guiana.

Uromyces scleriae Henn.

St.-Laurent-du-Maroni canton, new sealed road from St. Jean to Apatou, on *Scleria* sp. (Cyperaceae), 22 Jul 2009 (FG09/86. II).

Uromyces scleriae is a new report for French Guiana.

Uromyces cf. *poliotelis* Syd.

Maripasoula canton, Saül, footpath between hamlet and airstrip, on *Selysia* cf. *prunifera* (Poepp. & Endl.) Cogn. (Cucurbitaceae), 6 Aug 2009 (FG09/65. II, III).

The present specimen is very similar to descriptions of *U. poliotelis* but appears to differ slightly in shorter teliospores. *Uromyces poliotelis* would be a new report for French Guiana.

Uromyces wulffiae-stenoglossae Dietel

Mana canton, Awala-Yalimapo, trail from "Maison de la Nature" to seashore, on *Wulffia baccata* (L.) Kuntze (Asteraceae), 19 Jul 2009 (FG09/14. (II), III). Kourou canton, golf course at Kourou Space Center, next to golfers' home, on *W. baccata*, 1 Aug 2009 (FG09/62. II, III).

This is the first report of this rust species for French Guiana. The urediniospores had two large bald patches around the opposite, more or less equatorial germ pores, a character that apparently has not been described.

Rust species to be excluded from the French Guianan mycobiota

Dicheirinia guianensis Cummins

This species was described by Cummins (1937) from Guyana ("British Guiana") and is listed by Farr and Rossman (2011) for French Guiana referring to Spaulding (1961). In the latter reference, the rust is only reported from Guyana. It has to be excluded from the French Guianan list of rust fungi.

Hapalophragmium angylocalycis Vienn.-Bourg.

Hapalophragmium angylocalycis, considered synonymous with *H. deightonii* Cummins, is listed for French Guiana by Farr and Rossman (2011). It was described by Viennot-Bourgin (1958a) from the Republic of Guinea ("Guinée Française"), West Africa, and has to be excluded from the French Guianan list of rust fungi.

Discussion

The Guianan rust mycobiota

The Guianas may be among the least investigated regions for rust fungi in the neotropics. Only the rusts of Guyana

have been covered by a checklist (Hernández et al. 2005) that comprises 55 species of which 24, including 4 new ones, were contributed by the authors of the inventory. For Suriname, only 9 rust species are listed by Farr and Rossman (2011), and in French Guiana, only 2 have been known to my knowledge. This paper provides a list of the rust fungi of French Guiana totalling 68 species. Sixty-six of these were collected during a single, 5-week field expedition that covered only a restricted area of French Guiana. Among the additions, 6 species have so far been recognized as new, 4 belonging to *Dasyspora* (Beenken et al. 2012) and 2 to *Chaconia* (Berndt and Beenken, in preparation). In the present paper, the new species *Aecidium plukenetiae Puccinia kourouensis* and *P. parianicola* are added. A few specimens could not be determined with certainty due to ignorance of the host identity or to unclear species descriptions. It is beyond the scope of a checklist to solve all taxonomical problems related to the treated species. Nevertheless, this study identified rust fungi on *Scleria*, Piperaceae, Cannaceae/Marantaceae, and Araceae as groups in need of revision and may incite further studies.

French Guiana and Guyana share only 21 rust species according to present data. This is less similarity than one might have expected for two regions geographically rather closely located. The dissimilarity is probably mainly caused by the incompleteness of available inventories but also pronounced floristic differences between Guyana and French Guiana regarding the taxonomic composition of the flora (De Granville 1988; Funk et al. 2007; ter Steege et al. 2000; ter Steege 2011) and species numbers. The vascular flora of Guyana totals ca. 7,100 species whereas French Guiana counts some 5,400 and Suriname ca. 5,000 species (Funk et al. 2007). The higher number in Guyana may not only be due to the larger size of the country but also its much greater diversity of habitats (ter Steege 2011).

The ratio between numbers of rust species and vascular plant species has been used to infer the level of mycofloristic knowledge of a region (Hennen and McCain 1993). Present species numbers result in rust–plant ratios of 1:81 (French Guiana), 1:129 (Guyana), and 1:554 (Suriname). These ratios are much lower than those calculated for reasonably well investigated neotropical countries like Puerto Rico (1:16), Cuba (1:27), or Brazil (1:42) (Berndt 2012). If one assumes that ratios should be similar in comparable biomes of the neotropics, numbers of rust species will likely rise considerably in the Guianas, especially in Suriname, as soon as collecting is intensified and expanded to cover less accessible regions. Presently, it is still premature to analyze the diversity and composition of the Guianan rust mycobiota in the neotropical context. Some interesting observations may be pointed out nonetheless. In French Guiana, the genera *Puccinia* and related *Uromyces* contribute together 27 species or ca. 40 % of rust fungi. This is a low percentage compared to other countries of the neotropics, where these genera account for ca. 50 % of rust fungi in Brazil, 58 % in Costa Rica, and 57 % in Cuba. In southern Africa, 59 % of the rusts belong to *Puccinia* or *Uromyces*, and in northern temperate Austria even 74 % (Berndt 2008; Schmiedeknecht 1984). These figures support the hypothesis that *Puccinia* and *Uromyces* are relatively more speciose in temperate regions than in tropical or warm areas (Schmiedeknecht 1984), but also indicate that differences exist among neotropical countries. The outstandingly low percentage in French Guiana may be explained by the preponderance of tropical lowland rain forest where *Puccinia* and *Uromyces* species appear to occur only scarcely. Raveneliaceae is presently known in French Guiana by a single species, *Sphenospora smilacina*. Members of Raveneliaceae are centered on leguminous hosts and constitute an important component of the rust mycobiota of tropical and subtropical dry forests, savannahs, and shrub. The scarcity of these habitats in French Guiana may account for a low number of appropriate hosts and the paucity of Raveneliaceae.

New characters of known species

This paper provides novel information on a number of known rust fungi concerning spore characters, new spore states, haustorial morphology, and basidium formation.

Haustoria

Haustoria of tropical rust fungi have so far received little attention, but available results indicate a greater morphological variability than described from extra-tropical rusts (Beenken and Berndt 2010; Berndt 1995; Heath and Bonde 1988). Here, haustoria of *Cerotelium sabiceae* and *Chaconia ingae* are described for the first time. *Cerotelium sabiceae* showed D-haustoria with an enucleate haustorial body, while the respective haustorial mother cells (HMCs) contained the dikaryon. Most rust fungi whose haustorial morphology is known show a different situation. In their D-haustoria, the nuclei migrate from the HMCs through the haustorial neck into the haustorial body (cf. Littlefield and Heath 1979, chapter 4/II, and literature therein; Baka and Lösel 1998; Berndt et al. 1994; Berndt and Oberwinkler 1995; Mims et al. 1989, 2001). Up to now, HMCs retaining the nuclei have only been described in members of *Ravenelia*, *Uromycladium*, and *Puccinia* (Berndt 1995, 1997, 2010). Their occurrence in members of *Cerotelium*, *Crossopsora*, *Hamaspora*, *Masseeëlla*, *Phragmopyxis*, *Sorataea*, and *Sphaerophragmium* (Berndt, unpublished results) indicates a wide distribution of this haustorial character among rust fungi. So far, only rust fungi from the tropics or other warm regions have revealed this haustorial type. In all cases, the haustorial

bodies were small, worm-like, or almost filiform, and may not provide enough space for the dikaryon.

The parasitic mycelium of *Chaconia ingae* comprised intracellular hyphae and D-haustoria. The latter were formed by HMCs that were produced laterally on the intracellular hyphae. This kind of parasitic mycelium has been known in members of *Esalque*, *Phakopsora*, *Ravenelia*, and *Spumula* (Berndt 1996, 1997; Berndt et al. 2007; Heath and Bonde 1988) belonging to the families Chaconiaceae, Phakopsoraceae, and Raveneliaceae. All species known to possess this kind of intracellular mycelium grow in warm or tropical regions, but data are still too scarce to discern a clear pattern.

Teliospore germination

Teliospores of *Sphenospora* species have only been known to germinate with external basidia. Here, the formation of internal basidia is described for the first time in *S. smilacina*. Teliospores with internal basidia occurred together with teliospores which produced external basidia. The formation of internal basidia has been the rationale to separate a number of rust genera from similar ones with external spore germination, for example *Chrysella*, *Chrysocyclus*, and *Chrysopsora* from *Puccinia* and *Uromyces*. The presence of both modes of germination in a single rust specimen indicates plasticity of this character, and the possibility that germination is influenced by environmental factors. Therefore, it may not be justified to erect rust genera solely on this character.

New hosts of known species

New hosts are reported for 11 rust species. Among these, the fern-dwelling *Desmella aneimiae* is particularly notable. It has been known on ca. 22 fern genera (Farr and Rossman 2011, Berndt, unpublished data) belonging to a number of different families. Mangelsdorff (2011) noted the rust on 13 host species belonging to 10 genera in Panama. In the present study, 3 new host genera and 7 new host species were added from French Guiana. The wide host range and the observation that urediniospores of the investigated specimens belonged to two morphs indicate that *D. aneimiae* may comprise more than one species. It would be worthwhile to pursue this hypothesis by a more detailed study.

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