A redescription of *Sporodochiolichen flavus* (lichenized sporodochial Ascomycetes)

Paul Diederich

Musée national d'histoire naturelle, 25 rue Munster, L–2160 Luxembourg, Luxembourg (paul.diederich@education.lu)

Diederich, P., 2013. A redescription of *Sporodochiolichen flavus* (lichenized sprodochial Ascomycetes). *Bulletin de la Société des naturalistes luxembourgeois* 114 : 55-58.

Abstract. The sporodochial lichen *Sporodochiolichen flavus* is characterized by a corticolous greyish thallus on which golden yellow sporodochia develop. Hyaline, cylindrical conidia are formed by fragmentation of elongate, septate conidiophores. The species probably belongs to the Arthoniales, but molecular data are needed to identify its phylogenetic position. It seems to be widespread in lowland tropical forests in Papua New Guinea and should be searched for in other tropical countries.

Key Words. Asexual lichens, lichenized hyphomycetes, sporodochia

1. Introduction

Aptroot & Sipman (2011) recently described the new genus *Sporodochiolichen* Aptroot & Sipman for four corticolous, sterile lichen species with a thin, crustose thallus, a myrmecioid photobiont and distinct, convex sporodochia producing predominantly 1-septate conidia. The four species have been collected in Papua New Guinea, and the generic type, *S. lecanoricus* Aptroot & Sipman, additionally in several other tropical countries. Ertz et al. (2013) re-examined the generic type of *Sporodochiolichen* and found that it belongs to the well-known and widely distributed *Tylophoron hibernicum* (D. Hawksw., Coppins & P. James) Ertz, Diederich, Bungartz & Tibell (syn. *Blarneya hibernica* D. Hawksw., Coppins & P. James), a species with a trentepohlioid, not myrmecioid photobiont, belonging to the Arthoniales (Ertz et al. 2011). *Sporodochiolichen* subsequently becomes a synonym of *Tylophoron*, and the three additional *Sporodochiolichen* species need to be transferred to other genera.

One of these, *Sporodochiolichen flavus* Aptroot & Sipman, is a remarkable, beautiful species that I collected together with André Aptroot in the type locality and in a second locality in Papua New Guinea in 1992. It develops bright golden yellow, cushion-like sporodochia on the bark of different trees in lowland tropical forests, including mangroves. As long as no fresh material is available allowing DNA sequencing, the phylogenetic position of the species cannot be determined, and therefore the species cannot be confidently combined in another genus. As the conidiogenesis of the species had not been described in the original description and as our observations on the photobiont deviate from those given by Aptroot & Sipman (2011), we present here a redescription of the species.

2. Material and Methods

The studied material is kept in the private collection of the author. Microscopical examination has been done in water, 5% KOH, and in a mixture of Congo Red, Phloxine B and 5% KOH after pigment removal in acetone. Macroscopic photographs have been taken using a Canon 40D camera and a Nikon BD Plan 10 microscope objective, StackShot (Cognisys) and Helicon Focus (HeliconSoft) for increasing the depth of field. Microscopic photographs were prepared using a Leica DMLB microscope and a Leica EC3 camera.

3. Results

Sporodochiolichen flavus Aptroot & Sipman, *Lichenologist* 43: 358 (2011) Figs 1–2

Type: Papua New Guinea, Madang Prov., Mouth of Boroi river near Bogia, alt. 1 m, on *Rhizophora* in mangrove forest, 21 July 1992, *A. Aptroot* 30426 (BR—holotypus, non vid.); same locality, same date, probably same tree, *P. Diederich* 11755 (herb. Diederich—topotypus).

Thallus greyish, thin, dull, covering an area of several cm. *Mycobiont* hyphae sparse, often ascending, hyaline, smooth, 3.5–6 µm diam., not immersed in substratum. *Photobiont cells* subspherical to ellipsoid, 7.5–11.5 µm diam., single or rarely catenate, chloroplast indistinct in old herbarium material, some cells with an orange content, probably trentepohlioid. *Sporodochia* roundish, pulvinate, 0.2-0.5 mm diam., some elongate, occasionally confluent, golden yellow, non-stromatic; setae absent. *Conidiophores* strongly hydrophobic, almost impossible to study them in water, mixed with large quantities of a yellow pigment, best studied after pigment removal by acetone, macronematous, mononematous, crowded, forming pulvinate sporodochia, unbranched, straight or flexuous, hyaline, smooth to indistinctly rough-walled. *Conidiogenous cells* integrated, intercalary and terminal, determinate, cylindrical, fragmenting to form arthroconidia. *Conidia* catenate, cylindrical or oblong with truncate ends, hyaline, smooth to indistinctly rough-walled, thick-walled, with 1 or more transverse septa, not constricted at septa, rarely simple, 2–2.5 µm broad, cells 2.5–4.5 µm long, occasionally germinating and producing thin hyphae, 1–1.5 µm broad.

Chemistry. Yellow pigment KOH+ purple violet, UV+ red, following Aptroot & Sipman (2011) unidentified, Rf 5 in TDA.

Ecology and distribution. *Sporodochiolichen flavus* is known only from Papua New Guinea, where it grows on the bark of different trees in lowland tropical forests, including mangroves. As the species has been collected several times during two collecting trips, it is probably widespread in New Guinea and other tropical countries.

Additional specimens. **Papua New Guinea:** *Madang*: Gogol valley, Tgubi logging site, on bark in virgin lowland rainforest, 1992, *A. Aptroot* 33011 (BR, non vid.) & *P. Diederich* 12097 (herb. Diederich); Jais Aben, *c.* 10 km NW of Madang, on *Terminalia* in coastal *Cocos* plantation, 1995, *A. Aptroot* 38239 (BR, non vid.).

Fig. 1. *Sporodochiolichen flavus*, showing greyish thallus with golden yellow sporodochia (*Diederich* 11755, topotype). Scale bar: 200 µm.

4. Discussion

Macroscopically, *Sporodochiolichen flavus* might be mistaken for a sorediate species of *Caloplaca*. It is readily distinguished by the presence of sporodochia devoid of algal cells, but producing conidia, and not soralia. Similarly, the species differs from *Chrysothrix* by the presence of sporodochia, in addition to

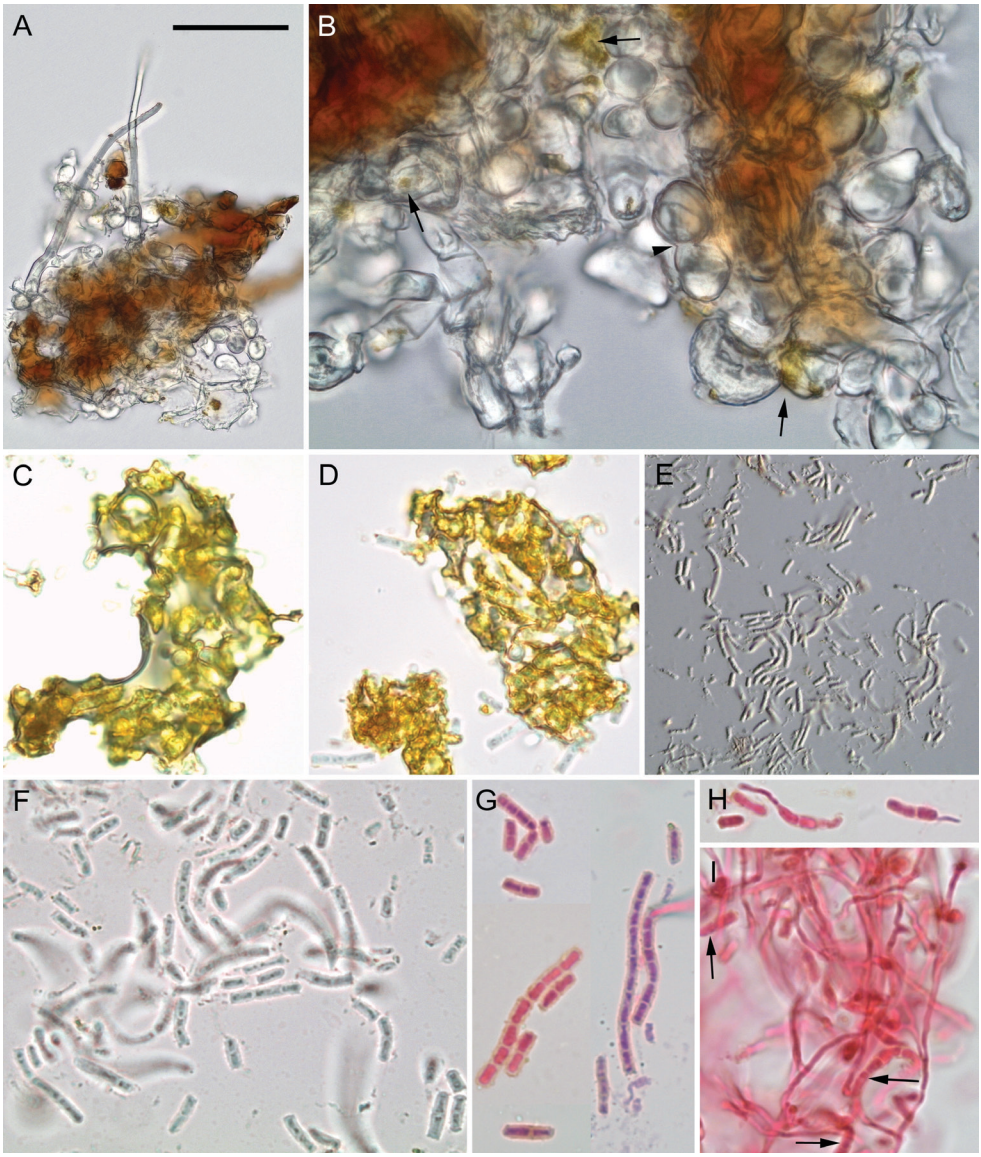

Fig. 2. *Sporodochiolichen flavus* (*Diederich* 11755, topotype). A, Section through thallus, in water, showing ascending mycobiont hyphae and ellipsoid photobiont cells. B, Section through thallus at a higher magnification, showing some photobiont cells with an orange content (arrows), and catenate conidia (arrowhead pointing to septum). C, Section through sporodochium, in water, showing hydrophobic conidiophores surrounded by air. D, Section through sporodochium, in 5% KOH, most conidiophores (except some at the bottom) embedded in yellow pigment. E, Conidiophores after pigment removal by acetone (DIC). F, The same, at a higher magnification, showing conidiophores fragmenting to form conidia. G, Conidia stained with a mixture of Congo Red, Phloxine B and 5% KOH, showing thick wall. H, Germinating conidia. I, Germinating conidia (arrows) producing an abundant, thin mycelium. Scale bar (the same for all photos): A, E: 50 µm, all other photos: 20 µm.

the K+ purple violet reaction of the yellow pigment, a reaction unknown in that genus.

Sporodochia are heavily encrusted by a yellow pigment that Aptroot & Sipman (2011) tried to identify by TLC, but without success. These sporodochia are strongly hydrophobic and can hardly be examined microscopically in water. Conidiogenesis is best studied after pigment removal by acetone. Conidiophores are composed of catenate, cylindrical cells and easily fragment to result in conidia of a variable number of cells. The exceptional fragility of these conidiophores facilitates the dispersal of conidia, either by animals or by the wind.

Aptroot & Sipman (2011) described the photobiont as myrmecioid, with cells 3–4 µm in diam. Shortly after collecting the species, I examined fresh material and confirmed the absence of photobiont cells in sporodochia. However, I did not examine the thallus at that time and thus cannot give an accurate description of the photobiont. In 20-years old herbarium specimens, numerous roundish to ellipsoid photobiont cells have been observed in the thallus, but unfortunately they do not contain any visible well-conserved chloroplasts. They are much larger than those observed by Aptroot & Sipman (2011). As some photobiont cells contain an orange, not green pigment, and as catenate photobiont cells have been observed, they most probably belong to *Trentepohlia*, but this hypothesis needs to be confirmed when new material is collected. Myrmecioid algal cells were also described by Aptroot & Sipman (2011) for *Sporodochiolichen lecanoricus* (i.e. *Tylophoron hibernicum*) although this species is associated with *Trentepohlia*.

The species needs to be compared with other sporodochial lichens, especially those with a *Trentepohlia* photobiont (e.g. Diederich & Coppins 2009). *Reichlingia* differs by a byssoid thallus producing dark brown conidiophores in loose tufts, not forming real sporodochia. Species of *Milospium* produce dark brown terminal conidia that are lobate with unevenly thickened walls or spirally bent. *Sclerococcum griseosporodochium* Etayo and *Spiloma auratum* Sm. produce brown, mainly 2–3-celled conidia. *Tylophoron* species produce dark brown conidia, except *T. hibernicum* (D. Hawksw., Coppins & P. James) Ertz, Diederich, Bungartz & Tibell that produces (0–)1-septate, hyaline conidia (Ertz et al. 2011). *Sporodochiolichen flavus* differs from *T. hibernicum* by a different conidiogenesis, different secondary metabolites and a much thinner, hardly visible thallus, on which bright golden yellow sporodochia develop. No species in these genera have a conidiogenesis comparable to that of *S. flavus*, in which conidiophores break in fragments of variable length representing conidia. No similar non-lichenized genera were found in Ellis (1971, 1976) and Seifert et al. (2011). As the photobiont most probably belongs to *Trentepohlia* and as the species resembles several sporodochial lichens in the Arthoniales discussed above, *S. flavus* is provisionally included in the Arthoniales. The phylogenetic position, and consequently the decision in which genus the species should be transferred, can only be identified when fresh material becomes available, allowing DNA sequencing.

Acknowledgement

I warmly thank Damien Ertz, Emmanuël Sérusiaux and Uwe Braun for interesting discussions on *Sporodochiolichen flavus*.

Literature

Aptroot, A. & H. J. M. Sipman, 2011. *Sporodochiolichen*, a new genus of tropical hyphomycetous lichens. *Lichenologist* 43: 357–362.

Diederich, P. & B. J. Coppins, 2009. *Reichlingia* Diederich & Scheid. (1996). In C. W. Smith et al. (eds.) The lichens of Great Britain and Ireland, The British Lichen Society: 790–791.

Ellis, M. B., 1971. Dematiaceous hyphomycetes. Commonwealth Mycological Institute, Kew.

Ellis, M. B., 1976. More dematiaceous hyphomycetes. Commonwealth Mycological Institute, Kew.

Ertz, D., F. Bungartz, P. Diederich & L. Tibell, 2011. Molecular and morphological data place *Blarneya* in *Tylophoron* (Arthoniaceae). *Lichenologist* 43: 345–356.

Ertz, D., E. Fischer, D. Killmann, T. Razafindrahaja & E. Sérusiaux, 2013. *Savoronala*, a new genus of Malmideaceae (Lecanorales) from Madagascar with stipes producing sporodochia. *Mycol. Progress*, DOI 10.1007/s11557-012-0871-5.

Seifert K., G. Morgan-Jones, W. Gams, B. Kendrick, 2011. The genera of hyphomycetes. CBS Biodiversity Series no. 9: 1–997. CBS-KNAW Fungal Biodiversity Centre, Utrecht, Netherlands.