The Lichenologist **40**(6): 543–547 (2008) © 2008 British Lichen Society
doi:10.1017/S0024282908008104 *Printed in the United Kingdom*

Bactrospora flavopruinosa, a new lichen species from Bermuda

Franz BERGER and André APTROOT

Abstract: *Bactrospora flavopruinosa* F. Berger & Aptroot is described as a new lignicolous lichen from Bermuda, characterized by the yellow pruinose apothecia and filiform ascospores.

Key words: *Bactrospora*, Bermuda, *Roccellaceae*

Introduction

The genus *Bactrospora* Müll. Arg. (*Roccellaceae* Chevall.) comprises at least 29 species of predominantly corticolous lichens. It was revised by Egea & Torrente (1993), with additional taxa published by Egea & Torrente (1995), Egea *et al.* (1997), Kantvilas (2004), Ponzetti & McCune (2006) and Sparrius *et al.* (2006). *Bactrospora* is characterized by an ecorticate crustose thallus with *Trentepohlia* as photobiont, black apothecioid ascomata, carbonized excipulum extending below the hymenium, dichotomously branched paraphysoids, fissitunicate, and cylindrical eight-spored '*Bactrospora* type' asci with the following characteristics: an apical apparatus consisting of a conspicuous K/I + blue ring, basal part with a small oculus, 'masse axial' lacking and a peculiar form of the subapical thickening in broken asci. The ascospores are septate, colourless, acicular or cylindrical, often with special additional features such as a few marked constrictions or the tendency to break up into part-spores. Accordingly, the ascospores of *Bactrospora* species have been grouped into four types, *viz.* the "dryina", "homalotropa", "jenikii" and "patellarioides" types (Egea & Torrente 1993). The last type is the most common in the genus and describes long, cylindrical, pluriseptate, thin-walled, hyaline ascospores, which in most species fragment into smaller unicellular or pluricellular segments, fissuring along the septa. *Bactrospora* species occur in the tropics, subtropics and temperate areas in both hemispheres, with one of the centres of diversity (with 7 species) in the Caribbean.

As part of an ongoing revision of the lichen flora of Bermuda (F. Berger & S. LaGreca, unpublished) a conspicuous crustose lichen was detected on decorticated wood of the endemic *Juniperus bermudiana* L. The lichen macroscopically resembles the tropical lichen *Cresponea flava* (Vain.) Egea & Torrente, but microscopical study revealed that it is a new species of *Bactrospora*.

Bermuda is a group of *c.* 130 islands (the 'Bermuda Archipelago'), situated at 32°20′N and 64°45′W. The islands, basically fossilized dunes (Vacher & Rowe 1997), are roughly 900 000 years old, and are among some of the more isolated islands in the world, situated 960 km offshore from the nearest landmass, North Carolina, USA. Despite its geographical latitude, Bermuda supports a subtropical biota due to the direct influence of the Gulf Stream. Not surprisingly, the lichen flora of Bermuda has very close affinities to that of Florida.

The new *Bactrospora* species was collected in the Walsingham Jungle region (Hamilton Parish), one of Bermuda's last remaining primary-growth forests. The area by virtue

F. Berger: A–4794, Kopfing 130, Austria. Email: flechten.berger@aon.at
A. Aptroot: ABL Herbarium, G.v.d.Veenstraat 107, NL-3762 XK Soest, The Netherlands.

of its rough terrain of hard limestone, caused by the partially collapsed ceilings of big cave systems below, has escaped the strong developmental pressures that have altered so much of the archipelago. As this jungle is also in the lee of the prevailing westerly winds, it is quite protected, which contributes to its reputation as the most undisturbed, pristine forest on Bermuda. Walsingham is home to the most diverse and important local cryptogam communities (Britton 1918, Rendle 1936), including some endemic species. The new species described here may also be endemic to Bermuda.

Material and Methods

This paper is based on specimens collected in 2007 by the first author, deposited in ABL, LI, BM, and the private herbarium of the first author (hb. Berger). The specimens were examined using an Olympus SZX7 stereomicroscope and an Olympus BX50 compound microscope with interference contrast, connected to a Nikon Coolpix digital camera. Microscope sections were cut by hand and mounted in water. Sections and ascospores were also studied with 10% KOH added. The amyloidy was tested with Lugol's solution after pre-treatment of the sections with KOH.

The Species

Bactrospora flavopruinosa F. Berger & Aptroot sp. nov.

Species supra lignum *Juniperi bermudiana* incolens, praecipue apotheciis rotundis sessilibusque, marginibus propriis nigris prominentibus, discis cum pruina flava obtectis; ascosporis filiformis, numquam fracturatis, 9–15 septatis, '*patellarioides*–typus' dictis, 45–55 µm longis, 1·5–2·5 µm latis, apicibus obtusis recognita.

Typus: Bermuda, Hamilton Parish, Walsingham Nature Reserve, Tom Moore Trail, 32°20.7′N–6°42.75′W, on decorticated trunk of *Juniperus bermudiana*, 3 m alt., 2 November 2007, *F. Berger* & *S. LaGreca* (BM—holotypus; ABL, LI, hb. Berger 22353—isotypi).

(Fig. 1)

Thallus immersed in the upper layer of the wood, visible only as a superficial white patch with small yellow dots (*Trentepohlia*) on the bleached surface. In section it consists of a homoiomerous layer of only 20 µm, built up predominantly by algae with some short (3 × 2 µm) hyaline hyphae projecting occasionally from the upper surface. The outer side of this layer is partly free, partly covered by a thin coat of the woody substratum (endoxylous). This causes the mottled appearance under the hand lens. *Photobiont Trentepohlia*- like, forming branched filaments of broadly fusiform cells with rough walls, *c.* 11–18 × 7–9 µm.

Apothecia sessile, constricted below, to becoming nearly turbinate, round, 0·3–0·8 mm diam., *c.* 0·2 mm high; disc flat, covered by a farinaceous bright lemon pruina; margins pruinose (glossy black when abraded), often distinctly dentate. *Excipulum* dense, carbonized black, up to 150 µm thick closed below. *Epihymenium* covered by bright yellow crystals, remaining ochraceous in section when crystals have dissolved in KOH. *Hymenium* hyaline, not inspersed, 100–150 µm high, K/I+ blue. *Subhymenium* mottled brown. *Paraphysoids* repeatedly branched rather knobbly towards the tips, not anastomosing; apices not thickened, *c.* 2 µm wide. *Asci* cylindrical, 60–75 × 6–8 µm, tholus longer than wide, *Bactrospora*-type. *Ascospores* 8/ascus, overlapping, filiform, straight to only slightly curved, 9–15-septate, 45–55 × 1·5–2·5 µm, not fragmenting, ends rounded ['*patellarioides*' type (Egea & Torrente 1993)].

Pycnidia and conidia not observed.

Chemistry. Thallus: not tested by TLC Pruina: after adding KOH to the squash preparation, a yellow solution drifts away from the epihymenium, in which sheaves of sulphur-yellow needle-like crystals up to 25 µm long start to develop within 1 minute, beginning on the epihymenium and growing away from it. They fully dissolve again in the same KOH solution after a few more minutes. The chemistry of this pruina is assumed to represent the naphthopyrans, simonyellin and/or protosimonyellin, reported previously from similarly reacting yellow pruina in the species *Simonyella variegata* J. Steiner and *Cresponea flava* (Kalb 2004); both also belong to the family *Roccellaceae* (Kantvilas 2004).

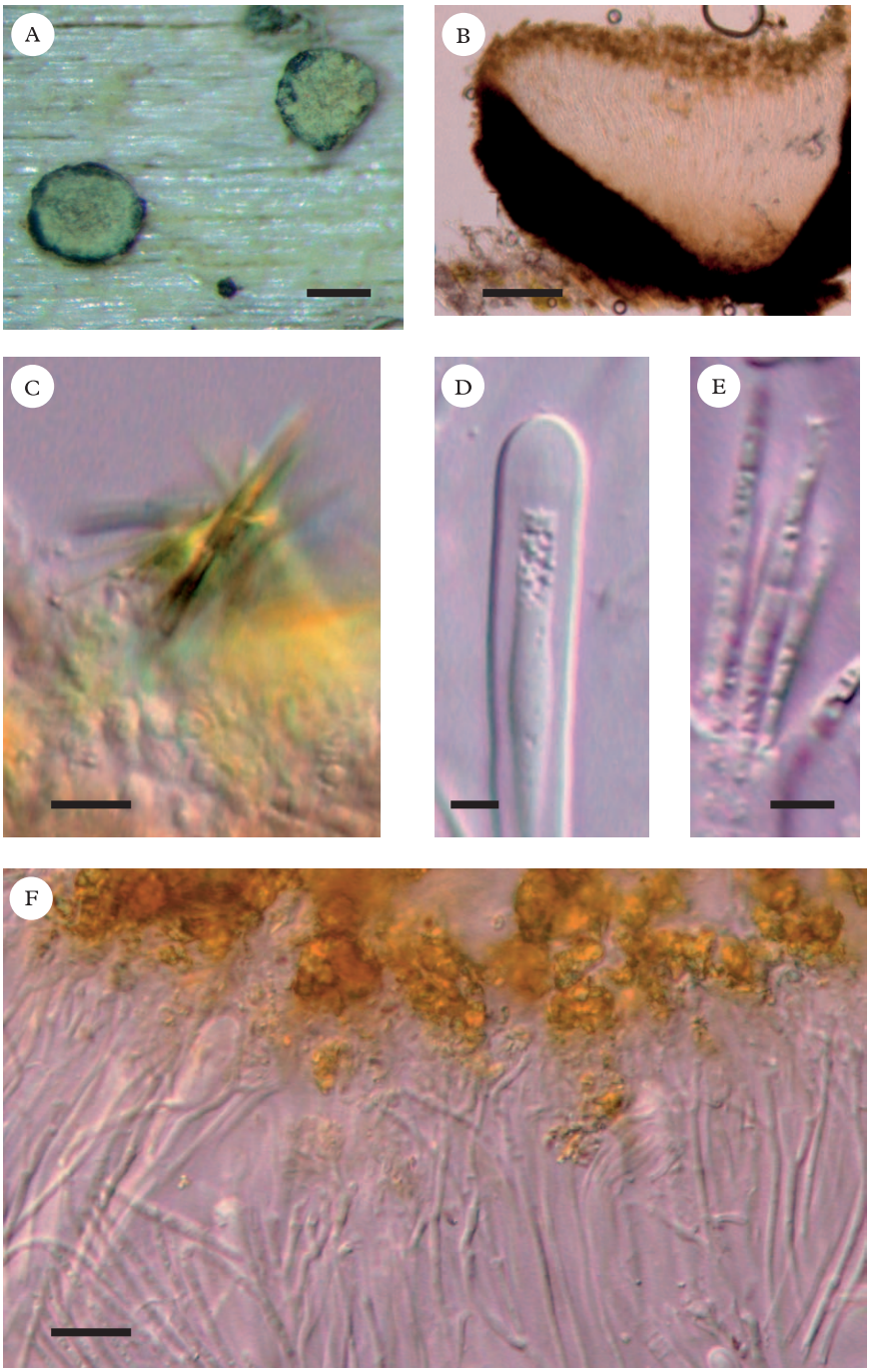

FIG. 1. *Bactrospora flavopruinosa* (isotype in ABL). A, thallus with apothecia showing yellow pruina; B, section through apothecium; C, crystals on epihymenium after adding KOH; D, ascus tip; E, ascospores emerging from broken ascus; F, hymenium showing branched paraphysoids and epihymenium coloration. Scales: A=0·5 mm; B=50 μm; C & F=10 μm; D & E=5 μm.

https://doi.org/10.1017/S0024282908008104 Published online by Cambridge University Press

Discussion. Bactrospora flavopruinosa is a typical *Bactrospora* species in all anatomical details, but it is the first species of this genus with consistently pruinose apothecial discs. It is easily recognized by the combination of a very thin yellow-flecked white thallus, sessile round apothecia with the yellow pruinose discs, the characteristic reaction of the pruina in KOH observable under the microscope, the filiform, unfragmented spores and the substratum. Care should be taken not to confuse it with pruinose species of *Cresponea* in the field.

The combination of filiform ascospores ('*patellarioides*' type) with an amyloid excipulum is found in some other members of the genus: *B. patellarioides* (Nyl.) Almq., *B. brodoi* Egea & Torrente, *B. carneopallida* Egea & Torrente, *B. cascadensis* Ponzetti & McCune, and *B. mesospora* R. C. Harris. Within this group, *B. flavopruinosa* is also characterized by having the narrowest ascospores [1·5–2·5 μm *vs.* (2·5–)3–4·5 μm]. None of these species have pruinose apothecia.

Two further species of *Bactrospora* are known from Bermuda and are reported here for the first time from this archipelago. The most frequent is *B. myriadea* (Fée) Egea & Torrente, which otherwise has a disjunct distribution in the tropics. In Bermuda, it was found on bark of *Rhizophora mangle* L., dead leaves of *Sabal bermudana* L.H. Bailey and on wood of *Juniperus bermudiana*. The second and locally much rarer species is *B. denticulata* (Vain.) Egea & Torrente, which was found in Bermuda exclusively on wood of *Juniperus bermudiana.* It is otherwise reported only from the Caribbean and Florida. All Bermudian records are from undisturbed natural habitats. Both species are easily distinguished from *B. flavopruinosa* by their black apothecia and the combination of '*patellarioides*' type ascospores and non-amyloid exciple. *Bactrospora denticulata* has denticulate ascomata margins and ascospores longer then 70 μm. In the isotype collection, *B. flavopruinosa* is growing side by side with *B. myriadea*, but is easily distinguishable because of the yellow pruina of the former, although *B. myriadea* is reported by Egea & Torrente (1993: 247) rarely to have a whitish pruina on the apothecia. Two further *Bactrospora* species are known from Florida, *viz. B. mesospora* R. C. Harris and *B. macrospora* R. C. Harris. The first has much thicker ascospores, the latter a different spore type; none of these are close to the new species.

Ecology and distribution. Bactrospora flavopruinosa is known only from the type location where it was collected on a well-lit decorticated trunk of *Juniperus bermudiana* with a still firm but sun-bleached surface. The type location is situated close to a sheltered bay in a small gap inside the less disturbed lowland forest of Walsingham. As a thorough survey of this substratum has not been extended to other areas, not even to other parts of Walsingham Nature Reserve, no statement about the abundance of the new species can be given at this time.

The Walsingham Nature Reserve is the most important protected area of woodland on Bermuda. Beside other terrestrial and coastal ecosystems, this area bears a tiny remnant of the ancient type of forest, preserved with much effort as completely as possible. This forest is composed of endemic trees such as Bermuda Olivewood (*Cassine laneana*), which grows up to 12 m tall, Bermuda Cedar (*Juniperus bermudiana*), Bermuda Palmetto (*Sabal bermudiana*), White Stopper (*Eugenia monticola*) and Hackberry (*Celtis laevigata*). These are all relatively weak competitors against successful foreign invaders such as, for example, Allspice (*Pimenta dioica*), Fiddlewood (*Citharexylum spinosum*), Brazil Pepper tree (*Schinus terebinthifolius*) and the ubiquitous Surinam Cherry (*Eugenia uniflora*). While the indigenous species all represent good lichen substrata, the invaders, with the exception of Surinam Cherry, are uninhabitable because of their quickly exfoliating bark.

In the 1940s, the Cedar Blight, a disastrous pest of the endemic *Juniperus bermudiana*, caused by accidentally introduced tiny scale insects, brought this useful and widespread Bermudian tree close to extinction.

Within a period of only 30 years, 99 per cent of the population was dead and largely cut down (Thomson 2004). Decorticated remnants of these resin-rich trees are still testament to this catastrophe. As the surface of this weathering-resistant wood did not alter much over decades, the dead trees that escaped the saw have turned into a suitable (and rather exclusive) substratum for some partly rare lichens such as *Arthopyrenia minor* R. C. Harris, *Bactrospora denticulata*, *B. myriadea*, *Caloplaca sarcopisioides* (Körb.) Zahlbr., *Chrysothrix xanthina* (Vain.) Kalb, *Hafellia bahiana* (Malme) Sheard, *H. disciformis* (Fr.) Marbach & H. Mayrhofer, *Nadvornikia hawaiiensis* (Tuck.) Tibell, *Protoparmelia isidiata* Diederich, Aptroot & Sérusiaux, as well as for some other, more common species with a broader range of substrata on Bermuda.

It will be of great interest to study the succession of ongoing lichen colonization of this very slowly rotting substratum in future decades. For this purpose, it would be very desirable to protect the remaining dead *Juniper* trees, if necessary by law, especially in Bermuda's protected areas such as Walsingham.

This work was supported by a grant to FB and S. LaGrece from the Bermuda Zoological Society. Jack Ward graciously provided access to, and fieldwork assistance, in Walsingham Jungle. This is contribution number 152 of the Bermuda Biodiversity Project (BBP), Bermuda Aquarium, Natural History Museum and Zoo. We thank Klaus Kalb for information on the identity of the chemistry of the pruina and the anonymous referees for their valuable comments.

References

Britton, N. L. (1918) *The Flora of Bermuda*. New York: Scribner's.

Egea, J. M. & Torrente, P. (1993) The lichen genus *Bactrospora*. *Lichenologist* **25:** 211–255.

Egea, J. M. & Torrente, P. (1995) *Melampylidium metabolum* belongs in *Bactrospora*. *Mycotaxon* **53:** 57–61.

Egea, J. M., Sérusiaux, E., Torrente, P. & Wessels, D. (1997) Three new species of Opegraphaceae (lichens) from the Namib Desert. *Mycotaxon* **61:** 455–466.

Kalb, K. (2004). New or otherwise interesting lichens II. *Bibliotheca Lichenologica* **88:** 301–329.

Kantvilas, G. (2004) A contribution to the Roccellaceae in Tasmania: new species and notes on *Lecanactis* and allied genera. *Symbolae Botanicae Upsalienses* **34**(1)**:** 183–203.

Ponzetti, J. & McCune, B. (2006) A new species of *Bactrospora* from northwestern North America. *Bryologist* **38:** 21–26.

Rendle, A. B. (1936) Notes on the flora of the Bermudas. *Journal of Botany* **74:** 42–50.

Sparrius, L. B., Saipunkaew, W., Wolseley, P. A. & Aptroot, A. (2006) New species of *Bactrospora*, *Enterographa*, *Graphidastra* and *Lecanographa* from northern Thailand and Vietnam. *Lichenologist* **38:** 27–36.

Thomas, M. L. H. (2004) *The Natural History of Bermuda*. Hamilton: Bermuda Zoological Society.

Vacher, H. L., & Rowe, M. P. (1997) Geology and hydrology of Bermuda. *Developments in Sedimentology* **54:** 35–90.

Accepted for publication 26 *June* 2008