

**Three new species of buellioid lichens
(Caliciaceae, Ascomycota) from Cape Verde**

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Abstract

Amandinea santantaensis Elix & van den Boom, *Buellia rugulata* Elix & van den Boom and *Cratiria capeverdensis* Elix & van den Boom, from Cape Verde, are described as new to science.

Introduction

The Cape Verde archipelago is located in the North Atlantic Ocean, approximately 500 km W of Senegal. In 1976, Follmann and Mies began an investigation of the lichen flora of Cape Verde, culminating in the publication of a critical checklist of *c.* 300 taxa (Mies 1993). More recent papers reported additions to the flora as well as several new species (Giralt & van den Boom 2008; Llop & van den Boom 2009; Arup & van den Boom 2011; van den Boom 2012; Ertz & van den Boom 2012). The present study of buellioid lichens collected by the second author in 2006 revealed three new species: a saxicolous *Amandinea*, a saxicolous species of *Buellia sensu lato* and a lignicolous species of *Cratiria*. None of those species occurs in the Canary Islands, *c.* 1550 km to the north (Giralt & van den Boom 2011).

Material and methods

The study is based on specimens from the private herbarium of the second author; however, holotypes and many duplicates are deposited in CANB. Observations and measurements of photobiont cells, thallus and apothecial anatomy, asci, ascospores and pycnidia were made on hand-cut sections mounted in water and 10% KOH (K). Ascospore measurements were made in water at $\times 1000$ to an accuracy of 0.5 μm . Only free ascospores lying outside the asci were measured. Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Medullary sections were treated with 10% sulfuric acid (H_2SO_4), and apothecial sections with 50% nitric acid (N). Chemical constituents were identified by thin-layer chromatography (Elix 2020b) and comparison with authentic samples.

New species

1. *Amandinea santantaensis* Elix & van den Boom, sp. nov.
Mycobank No.: **MB 840877**

Fig. 1

Similar to *Amandinea prospersa* (Nyl.) Elix & H. Mayrhofer, but differs in having smaller *Buellia*-type ascospores, $9\text{--}13 \times 4\text{--}6.5 \mu\text{m}$.

Type: Republic of Cabo Verde (Cape Verde), Santo Antão, SW of Vila das Pombas, Figueiral de Paúl, NE part of valley, area of Lombo de Luzia, $17^\circ 07' 48''\text{N}$, $25^\circ 02' 42''\text{W}$, 180 m alt., on NW vertical wall among plantations with scattered mixed trees and acidic outcrops, *P. & B. van den Boom 36893*, 21.vii.2006 (holotype – CANB).

Thallus crustose, to 25 mm wide and 0.1 mm thick, continuous, rimose to rimose-areolate; areoles irregular, 0.2–1 mm wide, contiguous; upper surface pale yellow to pale yellow-brown, maculate, appearing eroded and pseudosorediate in places; prothallus marginal, yellow-white, \pm fimbriate or not apparent; medulla white, lacking calcium oxalate (H_2SO_4 -), I-; photobiont cells 5–15 μm wide. *Apothecia* 0.1–0.5 mm wide, abundant, lecidine, roundish, scattered,

broadly adnate then sessile; disc black, epruinose, weakly concave to weakly convex. *Excipulum* thick, persistent, concolorous or paler than the disc, initially raised above the disc, in section 17–30 μm thick; outer part brown-black, K-, N+ orange-brown, inner part brown. *Epihymenium* 7–10 μm thick, brown to dark brown, K-, N-. *Hypothecium* 50–100 μm thick, brown. *Hymenium* 50–60 μm thick, colourless, not interspersed; subhymenium 10–15 μm thick, pale brown, not interspersed. *Paraphyses* 1.5–2 μm wide, sparingly branched, with apices 4.5–5.5 μm wide and brown caps. *Asci* *Bacidia*-type, 8-spored. *Ascospores* *Buellia*-type, 1-septate, pale brown then dark brown, ellipsoid, $9\text{--}[11.7]\text{--}13 \times 4\text{--}[5.4]\text{--}6.5 \mu\text{m}$, straight, becoming constricted at the septum; ontogeny of type A; outer wall finely rugulate. *Pycnidia* rare, punctiform, immersed; ostiole black. *Conidia* curved, filiform, $22\text{--}32 \times 0.7 \mu\text{m}$. *Chemistry*: Thallus K-, P-, C-, UV+ orange; containing 4,5-dichlorolichexanthone (major).

Etymology: The species is named after the type locality.

Remarks

The species is characterized by its continuous, rimose to rimose-areolate, pale yellow to yellow-brown, crustose thallus that contains 4,5-dichlorolichexanthone, its broadly adnate to sessile, lecidine apothecia, 0.1–0.5 mm wide, with *Buellia*-type ascospores, $9\text{--}13 \times 4\text{--}6.5 \mu\text{m}$, which become constricted at maturity and have a microrugulate outer spore-wall, and curved, filiform conidia, $22\text{--}32 \times 0.7 \mu\text{m}$. It closely resembles *A. prospersa*, known from acidic rocks in islands in the Caribbean Sea, western North America and tropical Australia (Imshaug 1955; Bungartz *et al.* 2007; Elix *et al.* 2017). However, *A. prospersa* differs in having larger *Orcularia*- then *Physconia*-type ascospores, $10\text{--}[13.5]\text{--}17 \times 5\text{--}[6.6]\text{--}8 \mu\text{m}$, and usually contains thuringione (major) and arthothelin (minor or trace). *Amandinea pilbarensis* Elix from monsoon tropical Australia has similar-sized *Buellia*-type ascospores, but it differs in having a white to pale cream thallus, shorter conidia, 12–20 μm long, and in containing thiophanic acid (Elix 2020a).

At present, *A. santantaensis* is only known from the type collection. Associated lichens include *Caloplaca demissa* (Körb.) Arup & Grube and several *Peltula* species including *P. euploca* (Ach.) Poelt, *P. obscurans* (Nyl.) Gyeln., *P. omphaliza* (Nyl.) Wetmore, *P. patellata* (Bagl.) Swinscow & Krog and *P. rodriguesii* (Cromb.) Büdel.

2. *Buellia rugulata* Elix & van den Boom, sp. nov.
Mycobank No.: **MB 840878**

Fig. 2

Similar to *Buellia herveyensis* Elix, but differs in having larger ascospores, $15\text{--}29 \times 8\text{--}13 \mu\text{m}$, and in containing terpenes in addition to atranorin.

Type: Republic of Cabo Verde (Cape Verde), Santiago, W of São Domingos, N of Rui Vaz near village, $15^\circ 02' 18''\text{N}$, $23^\circ 35' 42''\text{W}$, 855 m alt., on NW exposed vertical rock on rocky mountain with some shrubs, *P. & B. van den Boom 36478*, 9.vii.2006 (holotype – CANB; isotype – herb. van den Boom).

Thallus crustose, to 30 mm wide and 0.4 mm thick, continuous, rimose-areolate; areoles irregular, 0.1–0.8 mm wide, contiguous; upper surface creamy white to pale brown or yellow-brown, smooth, maculate; prothallus marginal, black or not apparent; medulla white, lacking calcium oxalate (H_2SO_4 -), I-; photobiont cells 5–15 μm wide. *Apothecia* 0.2–1 mm wide, lecidine, roundish, scattered or rarely confluent, broadly adnate then sessile; disc black, epruinose, flat but soon convex. *Excipulum* initially thick, concolorous with the disc, excluded in convex apothecia, in section 80–100 μm thick, cupular; outer part brown-black to deep red-brown, K-, N-, inner part pale red-brown. *Epihymenium* 8–10 μm thick, red-brown to brown, K-, N-. *Hypothecium* 100–250 μm thick, red-brown to dark brown. *Hymenium* 75–100 μm thick, colourless, not interspersed; subhymenium 10–15 μm thick, pale brown, not interspersed. *Paraphyses* 1.5–2 μm wide, sparingly branched, with apices 3–5.5 μm wide and pale brown caps. *Asci* *Bacidia*-type, 8-spored. *Ascospores* *Buellia*-type, 1-septate, pale brown then dark

brown, ellipsoid, 15–[23.0]–29 × 8–[10.1]–13 µm, straight, becoming weakly constricted at the septum; outer wall markedly rugulate. *Pycnidia* common, punctiform, superficial, 50–150 µm wide; ostiole brown-black. *Conidia* elongate-bacilliform, straight, 7–14 × 0.7 µm. *Chemistry*: Thallus K+ yellow, KC–, P+ pale yellow, C–, UV–; containing atranorin (major), 7β-acetoxyhopane-22-ol (minor), hopane-7β,22-diol (major).

Etymology: The species is named after the markedly rugulate outer wall of the ascospores.

Remarks

The species is characterized by its continuous, rimose-areolate, creamy white, crustose thallus that contains atranorin, its broadly adnate to sessile, lecideine apothecia, 0.2–1 mm wide, with *Buellia*-type ascospores, 15–29 × 8–13 µm, which become constricted at maturity and have a very strongly rugulate outer spore-wall, and elongate-bacilliform conidia, 7–14 × 0.7 µm. It closely resembles *B. herveyensis*, known from siliceous rocks in tropical Australia, and *B. dimbulahensis* Elix, occurring on siliceous rocks in northern Australia and Indonesia (Elix 2015). All three species have similar thalli, relatively large ascospores, and elongate-bacilliform conidia, and occur on siliceous rocks in the tropics. *Buellia dimbulahensis* differs from the other two species in having somewhat shorter ascospores, 14–23 µm long, and in containing 4,5-dichlorolichexanthone. *Buellia herveyensis* differs from *B. rugulata* in having shorter conidia, 8–11 µm long, and in lacking the terpenes present in the latter.

At present this species is known from two collections from the island of Santiago. Associated lichens at the type locality include *Caloplaca scoriophila* (A.Massal.) Zahlbr., *Dirinaria appplanata* (Fée) D.D.Awasthi, *Lecanora sulphurella* Hepp, *Lichinella stipatula* Nyl., *Opegrapha subelevata* Nyl. and *Tephromela atra* (Huds.) Hafellner. At the second locality, *Buellia rugulata* is associated with several *Peltula* species, including *P. euploca* (Ach.) Poelt, *P. omphaliza* (Nyl.) Wetmore and *P. rodriguesii* (Cromb.) Büdel.

ADDITIONAL SPECIMEN EXAMINED

Republic of Cabo Verde (Cape Verde). ● Santiago, SE of Assomada, along road to Praia, between Picos and João Teves, 15°04'30"N, 23°37'24"W, 460 m alt., on W-exposed vertical outcrops on N-exposed slope, *P. & B. van den Boom 36561*, 13.vii.2006 (CANB).

3. *Cratiria capeverdensis* Elix & van den Boom, sp. nov. Fig. 3
Mycobank No.: **MB 840879**

Similar to *Cratiria dissimilis* (Nyl.) Marbach, but differs in having inflated, stunted isidia, longer ascospores, 14–24 µm long, and in containing arthothelin rather than norstictic acid.

Type: Republic of Cabo Verde (Cape Verde), Santiago, W of São Domingos, WNW of Rui Vaz, “Monte Tchopa”, near telecommunication station, 15°02'12"N, 23°37'30"W, 1085 m alt., on exposed roots of *Eucalyptus* in hilly area with low exposed outcrops and mixed trees, *P. & B. van den Boom 36411*, 8.vii.2006 (holotype – CANB; isotype – herb. van den Boom).

Thallus crustose, to 12 mm wide and 0.15 mm thick, continuous, rimose-areolate, becoming isidiate; isidia simple to subcoralloid, inflated at apices, to 0.6 mm high and 0.2 mm wide; upper surface off-white to pale grey-brown, scurfy, matt; prothallus not apparent; medulla lacking calcium oxalate (H₂SO₄–), I–; photobiont cells 7–20 µm wide. *Apothecia* 0.1–0.5 mm wide, abundant, lecideine, roundish, scattered, broadly adnate then sessile; disc black, epruinose, weakly concave then plane to convex. *Excipulum* initially thick, concolorous with the disc, excluded in older, convex apothecia, in section 50–60 µm thick; outer part brown-black, K–, N+ orange-brown, inner part brown. *Epihymenium* 10–12 µm thick, dark brown, K–, N–. *Hypohectium* 60–100 µm thick, brown to dark brown, to 200 µm thick when adjoining central stipe. *Hymenium* 40–65 µm thick, colourless, not interspersed; subhymenium 10–15 µm thick, pale brown, not interspersed. *Paraphyses* 1–2 µm wide, sparingly branched, with apices 4–5.5 µm wide and brown caps. *Asci* *Bacidia*-type, 8-spored. *Ascospores* *Cratiria*- then

Buellia-type, 1-septate, pale then dark brown, ellipsoid, 14–[19.5]–24 × 5–[8.3]–11 µm, straight, becoming constricted at the septum, juvenile spores with weak apical wall thickenings; ontogeny of type A; outer wall smooth. *Pycnidia* rare, punctiform, immersed; ostiole black. *Conidia* bacilliform, 3–4 × 0.7–1 µm.

Chemistry: Thallus, K–, C+ pale orange, P–, UV+ orange; containing arthothelin.

Etymology: This species is named after the type locality.

Remarks

The species is characterized by an off-white to pale grey-brown, rimose-areolate thallus, simple to subcoralloid isidia with inflated apices, a non-inspersed hymenium, *Cratiria*- then *Buellia*-type ascospores, 14–24 × 5–11 µm, with weak apical wall-thickenings and a smooth outer spore-wall, short bacilliform conidia 3–4 µm long, and by the presence of arthothelin. There are two other known isidiate species of *Cratiria* from Asia and the Pacific, *C. dissimilis* and *C. exalbida* (Kremp.) Marbach (Marbach 2000). Both differ from *C. capeverdensis* in having smaller ascospores, 10–20 × 5–8 µm, and in containing atranorin and norstictic acid. *Cratiria jamesiana* Elix & H.Mayrhofer, a saxicolous species from Ascension Island, is somewhat similar in having a warted upper surface and containing arthothelin and thuringione, but it differs in having an interspersed hymenium, pruinose discs and shorter *Physconia*- then *Buellia*-type ascospores, 15–20 µm long (Elix & Mayrhofer 2020).

At present this species is only known from the type collection. Associated lichens include a *Collema* sp., a *Physcia* sp., *Rinodina polymorphaespora* Giralt & van den Boom and *Sculptolumina japonica* (Tuck.) Marbach. The latter is a new record for Cape Verde.

Acknowledgement

Special thanks are due to Bern van den Boom for her important fieldwork.

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Figure 1. *Amandinea santantaoensis* (holotype in CANB). Scale = 1 mm.



Figure 2. *Buellia rugulata* (holotype in CANB). Scale = 1 mm.



Figure 3. *Cratiria capeverdensis* (holotype in CANB). Scale = 1 mm.