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Notes on the lichen genus *Bacidia* s.l. (lichenized *Ascomycota*) in the Cape Verde Islands and new lichen records for the archipelago

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Abstract — Five species belonging in *Bacidia* s. l. are newly reported from Cape Verde Islands and discussed. Four species belong to *Bacidia*: *B. atlantica*, *B. polychroa*, *B. subincompta*, and *B. trichosperma*; and one species to *Bacidina*: *B. pallidocarnea*. Four other species are also newly reported: *Buellia dispersa*, *Cresponea flava*, *Fellhaneropsis vezdae*, and *Toninia submexicana*. The new combination *Bactrospora thyrsodes* is proposed for *Bacidia thyrsodes*.

Key words — Atlantic islands, biogeography, Macaronesia, new records, taxonomy

Introduction

Mies (1993) published a critical compilation of species belonging to *Bacidia* De Not., considered in a wide sense, found in the Cape Verde Islands. In his checklist, Mies cited five species without further comment, reporting three species (*Bacidia effusa*, *Bacidia* sp. A, and *Bacidia* sp. B) from just one island, *B. laurocerasi* from two islands, and *B. thyrsodes* from five islands.

The aim of our current paper is to revisit *Bacidia* s. l. in the Cape Verde archipelago in greater depth and to compare the distribution of the treated species in the Macaronesian archipelagos.

Material and methods

The Cape Verde Islands are situated in the Atlantic Ocean located near the west coast of Africa between 14°48' and 17°12' N, and 25°42' to 22°41'W.

This study is based on specimens identified as *Bacidia* collected on Cape Verdean islands and borrowed from the herbaria BM and M, as well as on samples collected by P. & B. v. d. B. in July 2006, from Santo Antão, São Tiago and São Vicente of the archipelago. These have been examined by stereomicroscope and light microscope using the standard techniques.

Results

The study of the available collections has shown that five species belonging in *Bacidia* s. l. occur in the Cape Verde Archipelago. One species, *Bacidia thyrsodes*, is excluded from *Bacidia* and a new combination is made. In addition, four species misidentified as *Bacidia* are reported as new for the lichen flora of Cape Verde.

Bacidia atlantica (Müll. Arg.) Zahlbr.

Thallus grey green, granular to areolate, areoles sometimes resembling squamulose when margins rise; surface disaggregating into goniocysts 30–60 µm wide; upper cortex prosoplectenchymatous. Algae chlorococcoid, 5–8 µm diam. Apothecia orange to reddish, 0.35–0.65 mm wide; with a well developed proper margin, paler than the disc; disc flat, finally slightly swollen, with a darker rim. Exciple colourless, prosoplectenchymatous, made of branched and anastomosed hyphae with cell lumina of 12 × 2–3.5 µm. Hypothecium prosoplectenchymatous, yellowish, reacting K+ intensifying, rubella-orange pigment present. Hymenium colourless, 60–70 µm thick; upper hymenium not differentiated, sometimes small crystals present that solve in KOH. Paraphyses not or slightly agglutinated, not anastomosed, apices not swollen, 1.5 µm thick. Asci clavate, 8-spored, 40–60 × 7–10 µm, *Bacidia*-type. Ascospores colourless, long bacilliform, not or slightly tapering to one end, (20–)22–39 × 2–3(–3.5) µm, with 3–5 septa. Pycnidia not seen.

Because of the thallus morphology, *B. atlantica* resembles the pantropical *B. medialis* (Tuck.) B. de Lesd. However, the rim of the exciple is pigmented pale orange-brown and ascospores are shorter and narrower in the latter.

This taxon was previously known only from Ascension Island, from where it was described. This is the first report of this species for the Cape Verde archipelago. Its current range suggests a tropical Middle Atlantic distribution, although it could have been overlooked elsewhere.

Specimens examined - **Santo Antão:** SW of Vila das Pombas, Figueiral de Paúl, SW part of the valley, Chã de Padre, small coffee plantation, scattered mixed trees, acidic outcrops, 25º 03.0' W, 17º 07.0' N, 195 m, on *Coffea*, 21.VII.2006. P. & B. v. d. Boom *36857* (hb. v. d. Boom). **São Tiago:** W of São Domingos, WNW of Rui Vaz, along path to "Monte Tchopa", E of telecommunication station, hilly area with mixed trees, 1035 m, on *Mangifera*, 8.VII.2006, P. & B. v. d. Boom *36424* (hb. v. d. Boom); ibid. on *Hibiscus*, P. & B. v. d. Boom *36418* (hb. v. d. Boom).

Bacidia polychroa (Th. Fr.) Körb.

Most of the specimens identified as *B. polychroa* have been previously identified under *B. effusa* (Sm.) Trev., a synonym for *Bacidina assulata* (Körb.) S. Ekman, and *Bacidia laurocerasi* (Delise ex Duby) Zahlbr. *Bacidia polychroa* differs from *Bacidina assulata* in the size of ascospores, which are (30–)40–60(–75) × (2–)2.5–4 µm in the former, and (28–)32–49(–54) × 1–2 µm in the latter; the structure of the exciple, prosoplectenchymatous and paraplectenchymatous respectively; and asci. The differences between *B. polychroa* and *B. laurocerasi* are based on the non-soluble pigments and the size of ascospores. The former has a red pigment (polychroa-red according to Meyer & Printzen, 2000) in the exciple, hypothecium, and subhymenium, which reacts K+ purplish. This pigment is also present, mixed with a low concentration of bagliettoana-green pigment, in the epihymenium. *Bacidia laurocerasi* lacks the polychroa-red pigment in exciple, hypothecium, and subhymenium. However, a certain amount of rubella-orange pigment is found, which reacts K+ intensifying the yellow or orange colour. In the epihymenium, the pigment is a mixture of laurocerasi-brown and bagliettoana-green. Ascospores of *B. polychroa* are slightly shorter and wider than those of *B. laurocerasi*, although this is not the best character by which to distinguish these taxa.

Bacidia polychroa has a boreal to temperate distribution, mainly in areas with humid climate. This species has not been recorded from the Macaronesia, but a careful study of samples determined as *B. laurocerasi* would result in misidentifications of *B. polychroa*, basically because some authors have included the concept of the latter into *B. laurocerasi*.

Specimens examined - **Santo Antão:** S of Ribeira Grande, Corda, centre of village, outcrops and roadside trees along main road, 1060 m, on *Pinus*, 17.VII.2006, P. & B. v. d. Boom *36660* (hb. v. d. Boom); ibid., on *Acacia* sp., P. & B. v. d. Boom *36701* (hb. v. d. Boom). **São Nicolau:** Mt. Gordo, NW-Hang, an Säumen von *Euphorbia tuckeyana*, 24'21º W, 16'38º N, 940 m, Expos. NW, 29.IX.1988, B. Mies *960i* (M-0142068). **São Tiago:** W of São Domingos, Rui Vaz, centre of village, mixed trees and outcrops along small road, 825 m, on *Casuarina,* 07.VII.2006, P. & B. v. d. Boom *36336* (hb. v. d. Boom); ibid., on unidentified roadside tree, P. & B. v. d. Boom *36349* (hb. v. d. Boom). W of São Domingos, WNW of Rui Vaz, along path to "Monte Tchopa", E of telecommunication station, hilly area with mixed trees, 1035 m, on Mimosaceae, 8.VII.2006, P. & B. v. d. Boom *36440* (hb. v. d. Boom); ibid. on shrub, P. & B. v. d. Boom *36445* (hb. v. d. Boom); ibid. on unidentified big tree, P. & B. v. d. Boom *36448* (hb. v. d. Boom). W of São Domingos, N of Rui Vaz, along village, on rocky mountain, with some shrubs, 855 m, on shrub, 9.VII.2006, P. & B. v. d. Boom *36463*, *36498*, *36504* (hb. v. d. Boom). Monte Verde, just below top of the mountain, NW slope with acidic outcrops, shrubs and ±scattered small trees, 700 m, on shrub, 15.VII.2006, P. & B. v. d. Boom *36616* (hb. v. d. Boom); ibid. on rotting trunk of *Agave*, P. & B. v. d. Boom *36606* (hb. v. d. Boom). São Jorge das Orgãos, am Staum von *Ceratonia siliqua*, 630 m, Expos. NE, 16.IX.1988, B. Mies *840n* (M-0142052, 0142053).

Bacidia subincompta (Nyl.) Arnold

Features of the examined samples, such as the presence of bagliettoana-green pigment in the outer part of the exciple and upper hymenium, and reddish brown hypothecium, agree with *Bacidia subincompta*. However, the ascospores are slightly longer than European material; they measure 32–45 µm for 20–36 (–40) µm in European samples (Purvis et al. 1992, Llop 2007). The number of septa is also higher, 7 to 11 in the Cape Verdean samples for 5 to 7 in the European collections.

This species has a boreal to temperate distribution, and is known from Madeira (Hafellner 1995) and Canary Islands (van den Boom & Etayo 2006).

Specimens examined - **Santo Antão:** S of Ribeira Grande, SE of Corda, N of trail 203, from Chã de Mato to Losnã, small (secondary) trail to Fajã de Baixo, outcrops, bouldres and walls along trail, 25º 04.5' W, 17º 08.1' N, 975 m, on *Eucalyptus*, 18.VII.2006, P. & B. v. d. Boom *36774* (hb. v. d. Boom); ibid., Corda, centre of village, outcrops and roadside trees along main road, 25º 05.3' W, 17º 07.9' N, 1060 m, on *Acacia*, 18.VII.2006, P. & B. v. d. Boom *36941* (hb. v. d. Boom).

Bacidia trichosperma (Müll. Arg.) Zahlbr.

Thallus pale greyish to green, granulose; granules up to 50 µm wide; hypothallus byssoid. Apothecia flesh to yellowish cream, 0.25–0.50 mm diam.; proper margin slightly thick, disc flat to rather swollen. Exciple colourless to pale yellowish at the basis, prosoplectenchymatous, made of branched and anastomosed hyphae with cell lumina of 5–10 × 2–3 µm; margin with a byssoid aspect. Hypothecium prosoplectenchymatous, colourless to pale yellowish, rubella-orange pigment present. Hymenium colourless, 40–45 µm thick; upper hymenium not differentiated. Paraphyses not to slightly agglutinate, not branched, not anastomosed; apical cells not swollen, 1–1.5 µm thick. Asci clavate, 8-spored, 30–35 × 7 µm, *Bacidia*-type. Ascospores colourless, acicular, 20–27 × 1–2 µm, 3–5 septa. Pycnidia not seen.

The features of our sample do not fit any hitherto known European or North American species (Ekman 1996, Llop 2007). Its characteristics appear closest to *B. trichosperma*, as compared to the available information by Dodge (1953). Some characters of thallus and apothecia resemble those of *Bapalmuia* Sérus., although the ascus structure and ascospores are completely different.

This African species is known elsewhere only from the Usambara Mountains (Tanzania) in the west regions of the African continent (Dodge 1953).

Specimens examined - **São Tiago:** W of São Domingos, Rui Vaz, centre of village, mixed trees and outcrops along small road, 23º 36.0 W, 15º 02.1' N, 825 m, on *Eucalyptus*, 07.VII.2006, P. & B. v. d. Boom *36451* (hb. v. d. Boom).

Bacidina pallidocarnea (Nyl.) Vězda

This taxon is pantropical and foliicolous, but can also be found in subtropical and even wet-temperate areas (Lücking 2008). It has been found on the remains of *Agave* leaves in Cape Verde, which are ecologically similar to twigs.

Specimens examined - **São Vicente:** Monte Verde, just below top of the mountain, NW slope with acidic outcrops, shrubs and ±scattered small trees, 24° 56.0'W, 16° 52.2' N, 700 m, on rotting leaf of *Agave*, 15.VII.2006, P. & B. v. d. Boom *36600* (hb. v. d. Boom).

The next five species were misidentified as *Bacidia* but a careful examination has shown that the specimens represent very different genera from *Bacidia* s. l. In addition, most of them are new for the lichen flora of the Cape Verde Islands. We first propose a new combination for *Bacidia thyrsodes*:

Bactrospora thyrsodes (Stirt.) Llop & van den Boom **comb. nov.**
MycoBank 513119

≡ *Lecidea thyrsodes* Stirt., J. Linn. Soc. London, Bot. 14: 368, 1874;
Bacidia thyrsodes (Stirt.) Zahlbr., Cat. Lich. Univ. 4: 245, 1926.

Type: **CAPE VERDE. Sant Vincent**. 1987 (**holotype-bm** !)

= *Lecidea heterobola* Cromb., J. Linn. Soc. London, Bot. 16: 214, 1877

= *Bactrospora carneopallida* Egea & Torrente, Lichenologist 25: 226, 1993.

Type: **SPAIN. Islas Canarias: Lanzarote**, Mirador del Rio, c. 400 m, rocas volcánicas, 13 January 1990, J. M. Egea (**holotype**-mub, isotype-gzu)

Some samples identified as *Bacidia thyrsodes* or *Bacidia* cf. from B. Mies' collection in M appear to be conspecific with *Bactrospora carneopallida*. The study of the type material of *Bacidia thyrsodes* showed that the specimen was also conspecific with *Bactrospora carneopallida*. Because the epithet *thyrsodes* has priority over *carneopallida*, we propose the new combination *Bactrospora thyrsodes* as the correct name for the taxon (McNeill et al. 2006: Art. 11.4).

This species was previously cited from Cape Verde by Egea & Torrente (1993b) as *Bactrospora carneopallida*. Its distribution ranges from Macaronesia to the European Atlantic coast (Paz-Bermúdez & López de Silanes 1998).

Specimens examined - **Sal:** Algudeiro, N Santa Maria, an Basaltblöcken, Substrat: Fels, Basalt, 22'56° W, 16'37° N, 10 m, Expos. N, 17.X.1988, B. Mies *1040b*, *1040c*, *1040d1* (M-0142072, 0142080, 0142076). **Santo Antão:** Fontainhas, N-Küste, an Basalt, Substrat: Fels, Basalt, 25'06° W, 17'12° N, 260 m, Expos. N, 21.X.1988, B. Mies *1191n* (M-0142070). Ibid., S side above village, N exposed slope with acidic outcrops along trail, 25'06° W, 17'11° N, 245 m, 20.VII.2006, P. & B. van den Boom *36811* (hb. v.d. Boom). **São Vicente:** NW-Hang des Mt. Verde, Punta Antonio Gomes, an Tuffblöcken, 50 m, 11.IX.1986, B. Mies *14d2* (M-0142069).

Buellia dispersa A. Massal.

This taxon has a disjunct distribution; it is known from the Mediterranean area and drier inner alpine valleys (Scheidegger 1993), Canary Islands (Hafellner 1995), and southwest North America (Bungartz et al. 2002).

Specimens examined - **Sal:** Mt. Grande, S unterhalb der Spitze, an Tuffit, Substrat: Fels, 22'54º W, 16'49º N, 370 m, Expos. E, 08.XI.1988, B. Mies *1059d* (M-0142074, 0142079); ibid., NE-Hang, an Tuffit, Substrat: Fels, Tuffit, 22'54º W, 16'49º N, 350 m, Expos. NE, 08.X.1988, B. Mies *1063g1* (M-0142078).

Cresponea flava (Vain.) Egea & Torrente

The examined specimens were misidentified as *Bacidia thyrsodes,* but the type collection of the latter proves to belong to the related genus *Bactrospora* A. Massal. (see above). *Cresponea* differs from *Bactrospora* in having conglutinated and frequently anastomosed paraphysoids (Grube 1998). *Cresponea flava* has a disjunct distribution in the Tropics, being known from southeast Asia, South America, and both African coasts (Egea & Torrente 1993a).

Specimens examined - **Brava:** Vinagre, Bewässerunsgebiet der W-Küste, Strassenbäume und Totholz, Substrat: Baum, 24'41º W, 14'52º N, 100 m, Expos. E, 10.XI.1988, A. Kalnins *1274c* (M-0142077). **São Nicolau:** NW des Mt. Bissau, Ribeira zum Rib. Madeira Vermelha, an Basalt des Flussbettrands, Substrat: Fels, Basalt, 24'15º W, 16'37º N, 120 m, Expos. N, 11.XI.1988, B. Mies *1077d1* (M-0140271).

Fellhaneropsis vezdae (Coppins & P. James) Sérus. & Coppins

This is the first report of this taxon from the Cape Verde archipelago. Foliicolous and corticolous collections were previously reported from Madeira (Sérusiaux 1996) and Topham & Walker (1982) found it on bark in the Canary Islands.

Specimens examined - **São Vicente:** Monte Verde, just below the top of the mountain, NW slope with acidic outcrops, shrubs and ±scattered small trees, 24º 56.0' W, 16º 52.2' N, 700 m, on *Casuarina*, 15.II.2006, P. & B. v. d. Boom *36598* (hb. v. d. Boom).

Toninia submexicana B. de Lesd.

This taxon was hitherto known only from North and South America (Timdal 1992). It differs from all previously reported species of *Toninia* in Cape Verde by its grey epithecium reacting K + violet and ascospore morphology.

Specimens examined - **Fogo**: Cha das Caldeiras, N-Hang des Pico Novo, an Phonolith und über Feinerde, Substrat: Felse, Phonolith, Erde, 24'21º W, 14'57º N, 2675 m, Expos. N, 02.XI.1988, B. Mies *1241f1* (M-0142073).

Key to the species of *Bacidia* s. l. and allied species from Cape Verde

1a. Exciple carbonaceous, asci *Arthonia*-type **2**
1b. Exciple not carbonaceous, asci of different type **3**
2a. Paraphysoids branched, ascospores (30–)35–60(–65) × 3–4(–4.5) µm, 3–9 septate ..... ***Bactrospora thyrsodes***
2b. Paraphysoids not branched, sometimes anastomosed, ascospores 15–22(–24) × (4–)4.5–5.5 µm, 3(–5) septate ..... ***Cresponea flava***
3a. Ascus *Byssoloma*-type, paraphyses branched and anastomosed, exciple red brown ..... ***Fellhaneropsis vezdae***
3b. Ascus type different, paraphyses not branched and anastomosed **4**
4a. Ascus *Lecanora*-type, exciple paraplectenchymatous, paraphyses with a swollen apical cell, 4–5 µm thick ..... ***Bacidina pallidocarnea***
4b. Ascus *Bacidia*-type, exciple prosoplectenchymatous, paraphyses without a swollen apical cell. **5**
5a. Margin of exciple and upper hymenium olivaceous to blackish green, K+ green and N+ violet ..... ***Bacidia subincompta***
5b. Margin of exciple and upper hymenium not green **6**
6a. Exciple and hypothecium reddish purple, K+ purple, ascospores (30–)40–60(–75) × (2–)2.5–4 µm, (5–)7–15 septate ..... ***Bacidia polychroa***
6b. Exciple and hypothecium colourless to yellowish, ascospores smaller **7**
7a. Ascospores (20–)22–39 × 2–3(–3.5) µm, 3–7 septate, apothecia orange to reddish, disc with a darker rim ..... ***Bacidia atlantica***
7b. Ascospores 20–27 × 1–2 µm, 3–5 septate, apothecia fleshy to yellow cream, evenly pigmented ..... ***Bacidia trichosperma***

Discussion

The genera *Bacidia* and *Bacidina* are represented by five species, all new for the lichen flora of Cape Verde. The number of species representing *Bacidia* s. l. varies considerably across the Macaronesian archipelagos: Canary Islands 16 species, Madeira 10 species and Azores 5 species (Hafellner 1995, 1999, 2002, 2005; van den Boom & Etayo 2006, Llop et al. 2007). Although Cape Verde is sometimes not included in Macaronesia (Vanderpoorten et al. 2007), despite the distance between the archipelagos, the number from Cape Verde is similar to Azores, but the composition of species is completely different, even though there are few coincidences with the other islands (Canary Islands and Madeira).

Biogeographically, the species of *Bacidia* s. l. show three distributional patterns. A Macaronesian-Mediterranean distribution is shown by *Bacidia polychroa*, *B. subincompta*, *Bacidina pallidocarnea,* and *Fellhaneropsis vezdae*. These species grow on the Mediterranean pluviseasonal oceanic bioclimate belt.

This belt is occupied by laurisilva or bush communities that replace the forest after alteration (Duarte et al. 2005). *Bacidia atlantica* represents a Mid-Atlantic endemism (Mies & Lösch 1995), as it occurs only in Ascension Island and Cape Verde. The third pattern (as shown by *Bacidia trichosperma*) corresponds to a tropical distribution, basically including mainland Africa. Other species from the archipelago with a similar distribution include *Heterodermia isidiophora* (Nyl.) D.D. Awasthi (Mies & Lösch 1995). Vanderpoorten et al. (2007) also suggests an affinity of the Cape Verde cryptogamous flora with that of continental Africa.

Those aforementioned species not belonging to *Bacidia* s. l. show a different distribution pattern, except for *Toninia submexicana*. They are growing on the Mediterranean xeric or desert belt, showing a tropical to subtropical arid distribution. In addition, these species are saxicolous. This pattern occurs equally among bryophytes from the driest Macaronesian islands (González-Mancebo et al. 2008). *Toninia submexicana* has a disjunct distribution, as it was known from North and South America (Timdal 1992). This species grows above the Mediterranean pluviseasonal oceanic belt, which has a drier climate.

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