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Three new *Arthoniaceae* from Chapada do Araripe, Ceará, NE Brazil

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Abstract: Three new corticolous *Arthoniaceae* are described from the Chapada do Araripe, an isolated table mountain in the state of Ceará, in NE Brazil. *Arthonia stipitata*, lichenicolous on unidentified sorediate crusts, with red, tiny, stipitate apothecia, 3-septate ascospores, 10–12 × 3·0–3·5 µm. *Stirtonia lucida* with rather small ascigerous areas, lichexanthone and zeorin in the thallus, globose asci, ascospores 8 per ascus, ellipsoid, 17–19 × 8–10 µm, with occasionally some longitudinal septa. *Stirtonia ochracea* with rather small ochraceous ascigerous areas, thallus without secondary metabolites, ascospores 8 per ascus, (7–)9(–11)-septate, 47–55 × 14–20 µm. These species were found during a study aiming at an inventory of the lichen biodiversity of the Cerrado forests in the area, and were not found during earlier ecological studies in the Caatinga forests in the same area. *Stirtonia lucida* is the first species assigned to this genus which occasionally has some longitudinal septa in the ascospores. Such specimens might be confused with *Cryptothecia* species.

Key words: *Arthonia*, *Arthoniales*, Cerrado, corticolous, lichens, *Stirtonia*

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Introduction

The Chapada do Araripe is an isolated table mountain located at the confluence of the borders of Ceará, Pernambuco and Piauí States. The Araripe plateau, with altitudes ranging between 870–980 m (Siebra *et al.* 2011), comprises at least four different vegetation types, including rainforest patches and also areas of Caatinga, with Cerrado and Cerradão forests (Sampaio *et al.* 1981).

The epiphytic lichen flora in this Cerrado forest area is dominated by crustose lichens, with *Graphis* and *Polymeridium* the most speciose genera. The Cerrado is a lichen-rich vegetation because of its open structure. The angiosperm diversity is high (Ribeiro-Silva *et al.* 2012), but the lichen diversity of this biome is still largely unexplored (Cáceres 2007).

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During ecological studies on the corticolous lichen vegetation in the dry forests on this Chapada in 2011–2012, many undescribed species were found, especially *Arthoniales*, most of which have subsequently been described (Aptroot *et al.* 2013; Menezes *et al.* 2013*a*, *b*, *c*; Aptroot & Cáceres 2014). In these studies, a large number of trees was exhaustively sampled for crustose lichens. This paper reports new lichen species which were not found during these ecological studies, but were encountered during a subsequent project in 2012–2013, aimed at estimating the biodiversity of the crustose corticolous lichens in more humid forests on this Chapada. In addition to exhaustively sampling many trees, excursions were made to collect additional species, mainly along the tracks. Three new *Arthoniaceae* were found, and these are described below.

Material and Methods

Identification and descriptive work was carried out in Itabaiana, Universidade Federal de Sergipe, using a Leica EZ4 stereomicroscope and a Leica DM500 compound microscope, and also in Soest using an Olympus SZX7 stereomicroscope and an Olympus BX50 compound microscope with interference contrast, connected

to a Nikon Coolpix digital camera. Sections were mounted in tap water, in which all measurements were also taken. IKI reactions were seen by adding commercial undiluted Lugol's solution (Merck 9261). The specimens from this study are preserved in ISE. The chemistry of most specimens was investigated by thin-layer chromatography (TLC) using solvent A (Orange *et al.* 2001).

The Species

Arthonia stipitata M. M. E. Alves, Aptroot & M. Cáceres sp. nov.

MycoBank No.: MB 808289

Lichenicolous *Arthonia*, apothecia red, tiny, stipitate, ascospores 3-septate, 10–12 × 3·0–3·5 µm.

Type: Brazil, Ceará, Chapada do Araripe, Aeroporto antigo, área de regeneração, on bark of tree, 17 April 2013, *M. M. E. Alves* 1244 (ISE—holotype).

(Fig. 1A–D)

Apothecia lichenicolous, locally bleaching the thallus of an unidentified sterile crustose lichen (possibly *Bacidina* or *Fellhanera*) with punctiform soredia and chlorococcoid algae, rather evenly dispersed, mostly round, convex, almost stipitate, 0·05–0·16 mm diam., 0·05–0·10 mm high, bright red, margins not differentiated. *Epihymenium* red, pigment KOH+ violet. *Hymenium* hyaline, but streaked with red pigment of the same colour as the epihymenium, with gel, IKI+ pale blue (hemiamyloid), filaments anastomosing. *Asci* pyriform to nearly globose, 17–25 µm diam. *Ascospores* 8 per ascus, hyaline, IKI+ brownish (dextrinoid), clavate, 3-septate, 10–12 × 3·0–3·5 µm, not constricted at the septum, ends slightly rounded, wall and septa thin.

Chemistry. Apothecia K+ violet, with an anthraquinone (no TLC performed).

Ecology and distribution. Lichenicolous on unidentified sterile lichen thalli (possibly *Bacidina* or *Fellhanera*) with small soredia and chlorococcoid algae on smooth bark of trees in Cerrado. Known only from Brazil.

Discussion. The genus *Arthonia* is very speciose, especially in the tropics. Several hundred species have been described, and at the moment it is often possible to recognize species but not to name them, as many of the descriptions are overlapping. A preliminary revision exists for only one tiny species group, *viz*. the lichenicolous species with red pigment (Grube *et al.* 1995). The new species belongs to this group and fits none of the species known so far. It is not even close to any known lichenicolous species with red pigment, as all known species have clearly macrocephalic ascospores and most are only 1-septate.

Additional specimens seen. **Brazil:** *Ceará*: same as the type, *M. M. E. Alves* 966 (ISE, ABL) & 1330 (ISE).

Stirtonia lucida M. M. E. Alves, Aptroot & M. Cáceres sp. nov.

MycoBank No.: MB 808290

Stirtonia with rather small ascigerous areas, lichexanthone and zeorine in the thallus, asci globose, ascospores 8 per ascus, ellipsoid, 17–19 × 8–10 µm, occasionally with some longitudinal septa.

Type: Brazil, Ceará, Chapada do Araripe, Aeroporto antigo, área de regeneração, on bark of tree, 17 April 2013, *M. M. E. Alves* 1342 (ISE—holotype; ABL—isotype).

(Fig. 1E–H)

Thallus spreading, covering an area of up to 5 cm diam., thin (*c*. 0·05–0·10 mm thick), dusty granular but not felty or byssoid, not continuous, pale greenish to ochraceous grey, consisting of thin, curly anastomosing hyphae, IKI+ blue (amyloid), surrounded by a white hyphal to byssoid hypothallus. *Alga Trentepohlia*, cells mostly elongated, 6–10 × 8–17 µm.

Ascigerous zones delimited, round to mostly elongated to irregular in outline, not raised above the thallus, 0·9–3·2 mm diam., *c*. 0·1–0·2 mm high, partly single but often partly fused in groups or rows, white pruinose (in section with pale brownish KOH− crystals), not dotted by the asci. *Interascal hyphae* thin, curly anastomosing, IKI+ blue (amyloid). *Asci* globose, IKI+ brownish (dextrinoid), with 8 ascospores, *c*. 50–60 µm diam. *Ascospores* hyaline, IKI+ brownish (dextrinoid), longitudinally septate or occasionally sparsely muriform, 5(–7) × 0–1(–2)-septate with in total 0–1(–4) longitudinal thick septa, ellipsoid, 17–19 × 8–10 µm, ends rounded, lumina more or less regular, terminal lumina

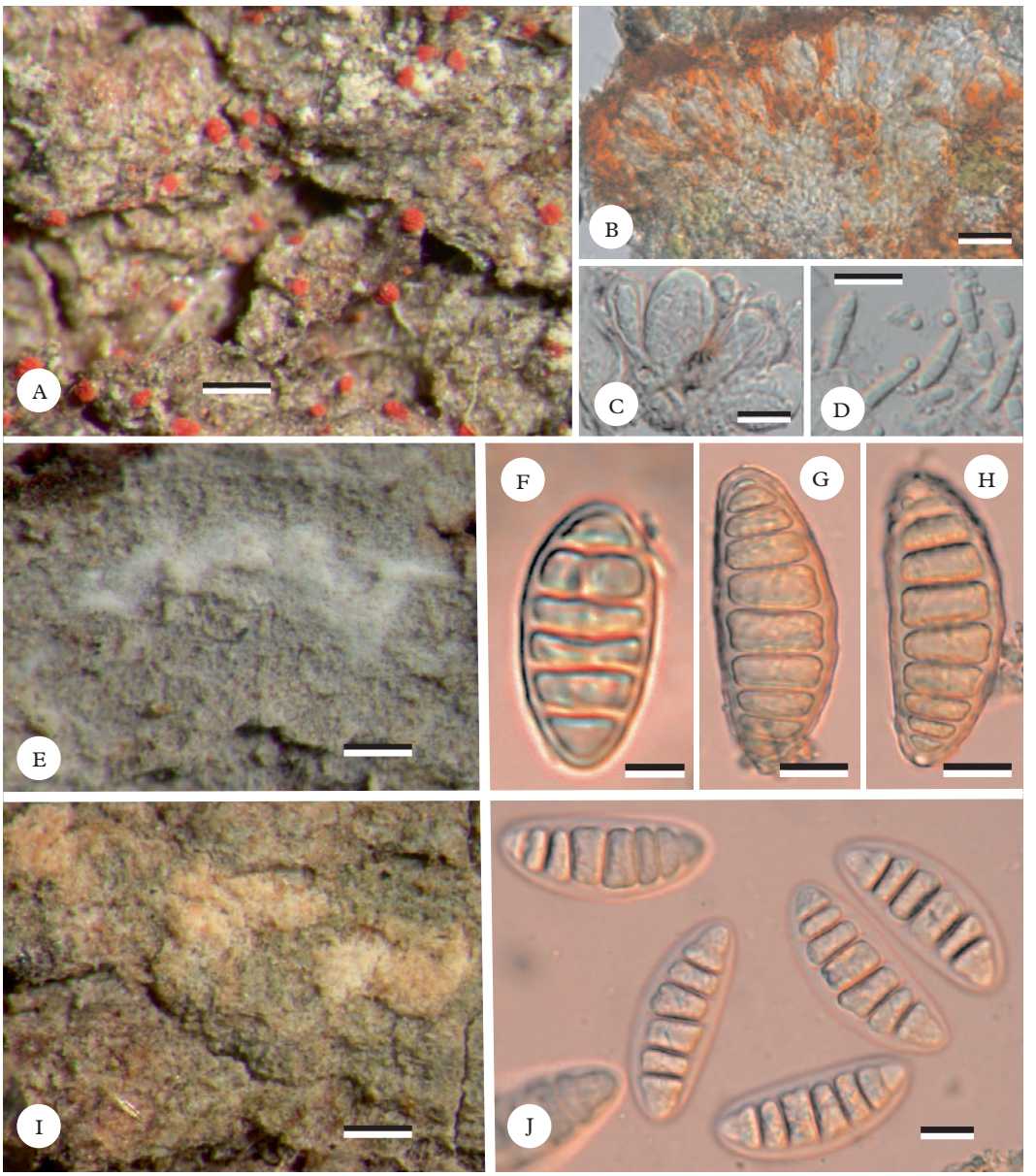

FIG. 1. A–D, *Arthonia stipitata*, holotype. A, habitus; B, section through apothecium; C, asci; D, ascospores; E–H, *Stirtonia lucida*, holotype. E, habitus; F–H, ascospores; I–J *Stirtonia ochracea*, holotype. I, habitus; K, ascospores. Scales: A, E & I = 0·5 mm; B–D & J = 10 μm; F–H = 5 μm. In colour online.

sometimes larger, sometimes smaller than the others, not macrocephalic.

Chemistry. Thallus C−, K−, KC−, P−, UV+ yellow, ascigerous areas UV+ white, strongly contrasting with the thallus. TLC: lichexanthone and zeorin.

Ecology and distribution. On smooth bark of trees in Cerrado. Known only from Brazil.

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Discussion. This species has ascospores that are reminiscent of other species of *Stirtonia*, with the thick longitudinal septa. This *Stirtonia* is the first species assigned to the genus with occasionally some longitudinal septa in the ascospores. Such specimens might be confused with *Cryptothecia* species. There is only one other *Stirtonia* known with lichexanthone, *viz*. *S. nitida* Xavier-Leite *et al.* 2014. This species differs, for example, by much larger (68–79 × 18–28 μm) ascospores and a smooth thallus. The chemistry is also rare in the genus *Cryptothecia*, in which it is known only from *Cryptothecia lichexanthonica* E. L. Lima *et al.* 2013, which differs by the much larger (55–75 × 22–28 μm) ascospores and smaller (generally under 1 mm diam.) ascigerous areas, and from *Cryptothecia assimilis* Makhija & Patw., which also has much larger ascospores and furthermore differs by the pyriform and pedicellate asci. Both have muriform ascospores with thinner septa.

Additional specimen seen. **Brazil:** *Ceará*: Chapada do Araripe, Riacho do Meio, on bark of tree, 2013, *M. M. E. Alves* 1603 (ISE).

Stirtonia ochracea M. M. E. Alves, Aptroot & M. Cáceres sp. nov.

MycoBank No.: MB 808292

Stirtonia with rather small ochraceous ascigerous areas, thallus without secondary metabolites, ascospores 8 per ascus, (7–)9(–11)-septate, 47–55 × 14–20 μm.

Type: Brazil, Ceará, Chapada do Araripe, on bark of tree, 15 May 2012, *M. M. E. Alves* s. n. (ISE—holotype).

(Fig. 1I & J)

Thallus spreading, covering an area of up to 5 cm diam., very thin (less than 0·01 mm thick), mostly continuous but bark cells often visible through the thallus, pale grey, consisting of thin, curly anastomosing hyphae, IKI−, not surrounded by a hypothallus. *Algae Trentepohlia*, cells mostly elongated, 7–12 × 8–16 μm.

Ascigerous zones delimited, round to mostly elongated to irregular in outline, distinctly raised above the thallus, 0·4–1·2 mm diam., *c.* 0·1–0·2 mm high, partly single but often partly fused in groups or rows, ochraceous (in section with pale brownish KOH− crystals), not dotted by the asci. *Interascal hyphae* thin, curly anastomosing, IKI−. *Asci* globose, IKI-, with 8 ascospores, *c.* 60–80 μm diam. *Ascospores* hyaline, IKI+ brownish (dextrinoid), (7–)9(–11)-septate, 47–55 × 14–20 μm, ends rounded, wall *c.* 2 μm thick, lumina more or less regular, terminal lumina smallest.

Chemistry. Thallus C−, K−, KC−, P−, UV−, ascigerous areas UV+ pink. TLC: no substances detected.

Ecology and distribution. On smooth bark of trees in Cerrado. Known only from Brazil.

Discussion. *Stirtonia* is a small, mainly palaeotropical genus with only six species known so far from the Neotropics (Aptroot 2009; Xavier-Leite *et al.* 2014). This new species is mainly characterized by the ochraceous ascigerous areas, which are distinctly raised above the thallus. It is somewhat similar to *Stirtonia obvallata* (Stirt.) A. L. Sm. in the brownish thallus with rounded ascigerous zones, the absence of secondary metabolites, and in ascospore dimensions, but that species differs by white ascigerous zones which are not raised above the thallus. Other *Stirtonia* species with raised, rounded ascigerous zones all have a thallus containing secondary metabolites, and all have white or whitish ascigerous zones.

Discussion

There are many studies on sampling effects, but only one (Cáceres *et al.* 2007) targets corticolous crustose lichens in the tropics. The present study on the Chapada do Araripe in NE Brazil shows that many species are restricted to a certain forest type within a given area. The new species were encountered during a project aimed at estimating the biodiversity of the crustose corticolous lichens in Cerrado forests, in the same area where previous work was carried out in the Caatinga forests. The obvious explanation for this is the patchiness of distributions: some

species occur widely over the area, others only very locally.

It can safely be predicted that some further undescribed corticolous crustose lichens are still present in the area. The best chance to detect these is probably by collection by specialists in specific taxonomic groups, such as *Arthoniales*, *Graphidaceae* or pyrenocarps. In addition, the macrolichens, as well as saxicolous and terricolous microlichens, have not yet been researched in any detail. That these may yield many additional taxa is beyond question. Occasional samples studied suggest that the number of undescribed species may be lower than in the corticolous microlichens, but some remarkable range extensions of species described from elsewhere are expected. Among the saxicolous lichens seen was, for example, *Toninia massata* (Tuck.) Herre, which is a new record for South America and the Southern Hemisphere.

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