



Placement of *Arthonia rubrocincta* in *Coniocarpon* (lichenized Ascomycota: Arthoniaceae), with an extended range for the species in southeastern North America and the Caribbean

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Abstract

Arthonia rubrocincta morphologically and anatomically fits the generic concept of *Coniocarpon* and is here transferred to the latter genus as *Coniocarpon rubrocinctum*. Specimens from southeastern United States and Bahamas were studied and the range of the species is found to extend north into North Carolina, USA and southeast to the Bahamas. Thatch palm (*Coccothrinax argentata*) is reported as a new phorophyte. An emended description based on examined material is presented for the species.

Keywords: Arthoniales, morphology, distribution, taxonomy

Introduction

Coniocarpon DC. is a genus of arthonioid crustose lichens (Order Arthoniales) that are often striking in appearance bearing bright red ascomata with pruinose disks. The genus was originally published by De Candolle (Lamarck & De Candolle 1805), but rejected against *Arthonia* Ach. as proposed in the International Code of Nomenclature for algae, fungi, and plants: Appendices I–VII (Turland *et al.* 2018). *Coniocarpon* was reinstated by Frisch *et al.* (2014) for the *Arthonia cinnabarina* species complex, based on molecular results. It currently contains seven species per Index Fungorum (www.indexfungorum.org).

A member of the *A. cinnabarina* complex not yet transferred to *Coniocarpon* is *Arthonia rubrocincta* G. Merr. ex Grube & Lendemer, a distinctive species seemingly restricted to the woody palm frond bases of *Sabal palmetto* (Walt.) Lodd. ex J. A. & J. H. Schult. in Florida and coastal Georgia of southeastern USA (Grube & Lendemer 2009). The species was first given the name *A. “rubro-cinctum”* to specimens collected and distributed by G.K. Merrill in his *Lichenes Exsiccati, second series* in 1925 without a description, rendering it invalid. Grube and Lendemer (2009) validated the taxon with a description nearly a century later. A literature search yielded two references to the name “*Coniocarpon rubrocinctum*” in published phylogenetic trees (Frisch *et al.* 2018, Thiyagaraja *et al.* 2020). These citations are both based on GenBank accession GU327684 (Nelsen *et al.* 2009), which is filed as *A. rubrocincta* (<https://www.ncbi.nlm.nih.gov/nuccore/GU327684>, accessed 1.XI.2022). Neither in Frisch *et al.* (2018) nor in Thiyagaraja *et al.* (2020) does *C. rubrocinctum* appear as a new combination, nor it is cited with an author or basionym, thus it is an invalid name. A search in MycoBank MycoBank (www.mycobank.org) and Index Fungorum online taxonomic databases yielded no listing of *Coniocarpon rubrocinctum*, further confirming that this combination has not yet been formally made.

Here we validate the combination *Coniocarpon rubrocinctum* formally along with an emended description based on studied material. We also present additional records, extending its range both northward to coastal North and South

Carolina, USA, and southward to the Bahamas in the Caribbean region. We also provide evidence that *C. rubrocinctum* is not only associated with *S. palmetto*, but also the palm *Coccothrinax argentata* (Jacq.) Bailey.

Materials & Methods

Material of *Arthonia rubrocincta* from DUKE, F, FH and NCU was examined at the University of North Carolina at Chapel Hill Herbarium (NCU). Loaned specimens included: labeled original material of the invalid name first established by Merrill (*Rapp* 31, FH), an isotype of the validly described name (*Lendemer 15506*, DUKE), and the voucher specimen of the submitted GenBank sequence (*Nelsen 4010*, F). Fresh material was collected in Bald Head Island Natural Area, North Carolina, USA, in December 2022 (*Perlmutter 4307*, NCU) for further comparison, and distributed to ASU, DUKE, MEXU, and WNC. Specimens were studied at NCU via examination of morphological features, microscopic examination of reproductive structures, and chemical spot testing. Character observations and measurements were compared against those in the protologue (Lendemer & Grube 2009) for verification. Material was examined using a Nikon SMZ 745T dissecting scope and a Nikon ALPHASHOT-2 YS2 compound microscope. Images were taken using a Samsung Galaxy S9 smart phone 12 MP camera through the eyepiece, then adjusted using the Microsoft Photos app (Microsoft Photos 2021.21120.8011.0, © 2020 Microsoft Corporation).

Dimensions (length and width) of up to ten ascomata per specimen were measured to the nearest 0.1 mm. Hand-cut sections of ascomata were mounted in water and 10% KOH solution. Ascoma sections of selected specimens were tested for amyloidy using Lugol's solution with and without KOH pretreatment (K/I and I, respectively). Hymenial height was measured using up to three sections per specimen. Dimensions of up to ten asci (width and height), ascospores and conidia (width and length for both) per specimen were also measured, and number of cells per spore were counted, examined at 400× magnification. The above morphometric traits are reported as (minimum–) mean (–maximum), followed by number of measurements (*n*).

Spot tests were performed on thalli and ascomatal slide sections of examined specimens to verify published chemistry of *A. rubrocincta*: psoromic acid (PD+ golden yellow, K–) in the thallus and a quinoid pigment (K+ violet then fading) in the excipuloid layer (Grube & Lendemer 2009).

Taxonomy

Coniocarpon rubrocinctum (G. Merr. ex Grube & Lendemer) Perlmutter, R. Miranda & Bungartz *comb. nov.* (Fig 1)
Mycobank No. MB847702

Basionym:—*Arthonia rubrocincta* G. Merr. ex Grube & Lendemer (2009: 9).

Type:—UNITED STATES. Florida: Collier County, Fakahatchee Strand State Preserve, vicinity of Ranger Station, disturbed roadside vegetation and shaded swampy hardwood forest, on petioles of *Sabal palmetto*, 4 March 2009, *J.C. Lendemer 15506* (**holotype** NY 01133735, n.v.; isotypes distributed as Lichens of Eastern North America Exsiccati #351, DUKE!).

Description:—*Life form* lichenized fungus. *Thallus* endoperidermal to epidermal, thin, effuse; *surface* whitish or greenish gray, in older specimens pale tan, smooth, occasionally with reddish or orange pigment crystals and areas of pinkish staining; *prothallus* brown, often as contact lines. *Photobiont* trentepohlioid alga, endoperidermal; *cells* (7.8–) 11.7 (–18.2) × (5.2–) 8.3 (–15.6) μm (*n* = 39), in short branched chains. *Ascomata* dispersed, sessile, elongate to furcate, lirellate with ±straight branches and acute tips, (0.4–) 1.0 (–1.6) × (0.2–) 0.3 (–0.5) mm (*n* = 60); *disk* flat, brown, often covered with whitish pruina; *margin* thick, coated with red or orange pruina.

In section ascoma (104–) 139 (–208) μm high (*n* = 6). *Excipuloid layer* lateral, (26–) 56 (–130) μm (*n* = 12) wide, dark brownish and infused with reddish pigment crystals. *Epithecium* (13–) 21 (–26) μm (*n* = 8) thick, brownish; *hymenium* hyaline, yellowish in thick sections, (52–) 64 (–91) μm high (*n* = 10); *hypothecium* pale brownish, (22–) 42 (–104) μm thick (*n* = 8). *Asci* abundant, clavate, (39.0–) 53.3 (–78.0) × (10.5–) 17.0 (–34.0) μm (*n* = 60), 8-spored, stipe short or indistinct, *tholus* (4.0–) 8.5 (–15.0) μm thick (*n* = 10); *ascospores* narrowly obovate, hyaline, smooth, faintly verrucose and appearing grayish and granular when postmature, macrocephalic, (4–)5-celled, (15.5–) 22.0 (–26.0) × (4.0–) 5.5 (–8.0) μm (*n* = 60). *Pycnidia* frequent, ±globose, partly immersed, (52–) 80 (–140) μm in diameter (*n* = 9), wall brown; *conidia* bacilliform, mostly straight, hyaline, (4–) 6.4 (–9) × ~1 μm (*n* = 10).

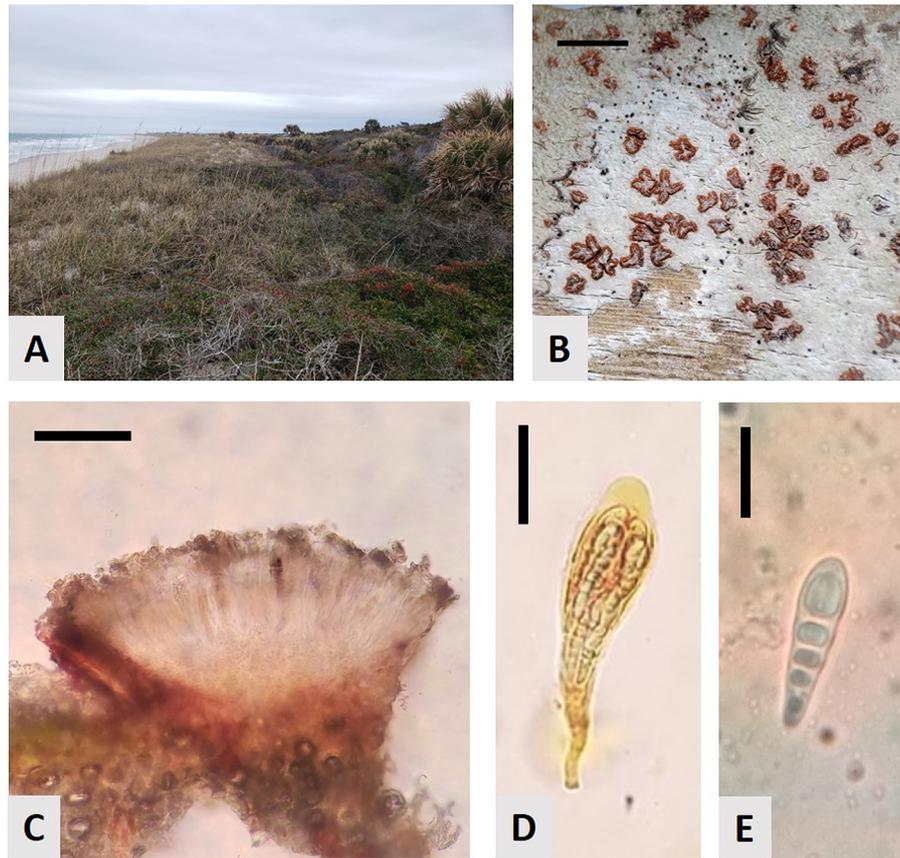


FIGURE 1. *Coniocarpon rubrocinctum*. A. Coastal habitat with phorophyte *Sabal palmetto* on right (Bald Head Island, North Carolina). B. Thallus from South Carolina showing prothallus, ascomata and pycnidia (Perlmutter 182a). C. Ascomatal section in water (Perlmutter 4307). D. Asci with spores in K/I (Anonymous s.n.). E. Ascospore in water (Perlmutter 4307). Scale bars: B = 2.0 mm; C = 50 µm; D = 20 µm; E = 10 µm.

Chemistry:—Thallus UV–, K–, C–, KC–, PD+ golden yellow (psoromic acid); excipular pigment K+ magenta then fading; epithecium pigment dissolving in K. AMYLOIDITY: epithecium I+ blue, K/I+ dark blue; hymenium I+ blue or turning red, K/I+ dark blue or green in high concentrations; ascus protoplasm I–, K/I+ yellow-orange; ascus wall I–, K/I–. A hemiamyloid ring in the tholus of the asci not seen.

Substrate, ecology and distribution:—Found on woody palm frond bases in coastal, subtropical environments in southeastern North America (Florida to North Carolina) and the Caribbean (Bahamas).

Additional specimens examined:—BAHAMAS. Cat Island. On leaf stem of thatch palm [*Coccothrinax argentata*], 9 July 1903, *Anonymous s.n.* (NCU). UNITED STATES. Florida: Collier County, off James Scenic Drive 6.5 mi NNW of Ranger Station at Gate 12 along Tram Rd, 26°0.69'N, 81°24.35'W, on palmetto leaf sheath, 02 March 2009, *M.P. Nelsen 4010* (F); Orange County, Sanford, on palmetto shafts, May 1908, *S. Rapp 31* (FH); North Carolina: Brunswick County, Bald Head Island State Natural Area, behind East Beach in dune swale on palmetto frond base, 20 December 2022, *G.B. Perlmutter 4307* (NCU); South Carolina: Horry County, North Myrtle Beach, Hilton Hotel, behind strand on base of palmetto frond, 18 October 2010, *G.B. Perlmutter 182-a* (NCU).

Discussion

All examined specimens were found to match both the isotype and protologue in terms of morphological, anatomical, and chemical characters, confirming that they represent the same species, namely *Coniocarpon rubrocinctum*. Specimen averages of measured characters (ascomata, photobiont, ascomatal structures, asci, spores, pycnidia and conidia) lay within the ranges in the protologue for *A. rubrocincta*. Most ascospores in the *Nelsen* specimen, which is the source of the GenBank sequences, were postmature, showing as grayish, collapsed and grainy with septa dissolved. However, mature spores were also observed, which match those in the other specimens as well as the protologue. Most

spores in all specimens were 4-septate. The *Nelsen* specimen was also distinct with ascomatal disks largely lacking pruina and the PD reaction being weak, both of which could be due to its age and condition. However, TLC results on all specimens confirmed presence of psoromic acid, also indicated by thallus spot tests. The recently collected North Carolina specimen will be analyzed molecularly and sequences will be compared with those of the *Nelsen* specimen to verify that they are conspecific.

The protologue describes *Coniocarpon rubrocinctum* (as *Arthonia rubrocincta*) as being restricted to Florida and the Georgia coast on *Sabal palmetto*. Study of the present material increases the range of the species northward to the North Carolina coast and southeastward to Cat Island of the Bahamas in the Caribbean. We also provide evidence that this lichen grows on thatch palm, *Coccothrinax argentata*, which has a distribution similar to *S. palmetto* in southeastern North America and the Caribbean (Govaerts & Dransfield 2005). Our findings add to the knowledge of the ecology and distribution of *C. rubrocinctum* as coastal-oceanic Neotropical-subtropical North American, growing on shaded to exposed woody palm frond bases. In addition to specimens here studied, a search of specimen records in the Consortium of Lichen Herbaria online repository (www.lichenportal.org) yielded additional records from coastal South Carolina. Given this evidence, we expect that future collections will provide a more complete geographical range and phorophyte associations of *C. rubrocinctum*.

As noted in Grube & Lendemer (2009), *C. rubrocinctum* is distinguished from *C. cinnabarinum* (DC.) Wallr., which is reported from southeastern North America (Lendemer *et al.* 2016, Lücking *et al.* 2011, Seavey *et al.* 2017), by ascomata shape as lirellate-furcate with pointed ends as opposed to round to irregular, narrower spores and the production of psoromic acid. Both Grube & Lendemer (2009) and Lücking *et al.* (2011) recognize *C. cinnabarinum* as a species complex with varying ascomatal morphology in need of further study.

Coniocarpon rubrocinctum was also reported from Brazil (Cáceres *et al.* 2014). However, the spores are reported as smaller and fewer septate than is usual for the species, including specimens examined in this study. Also, the thallus image in Cáceres *et al.* (2014, Fig. 4C), shows widely irregular ascomata that are not elongate nor furcate as are ascomata in our examined material. The Brazilian record thus appears to belong to another species.

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