

Ascomycota (lichenized and non-lichenized) on *Syagrus coronata* in the Caatinga biome: new and interesting records for Brazil and South America

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ABSTRACT — The Caatinga biome occupies most of the semiarid region of northeastern Brazil, with varied landscapes and notable endemism. Among the plants having significant importance in the Caatinga environment is the palm tree *Syagrus coronata*, which is known as the "life-saving plant" due to its high socio-biological and economic value. To better understand the mycota of the *Arecaceae*, collections were undertaken in the municipalities of Paulo Afonso and Nova Glória within the Raso da Catarina eco-region in the drylands ("sertão") of Bahia State, Brazil. Twenty species of *Ascomycota* were identified during the present work: three are new records for South America (*Diplodia galiicola*, *Seimatosporium corni*, and *Wojnowiciella viburni*); eleven are new records for Brazil (*Anthostomella caricis*, *Caryospora callicarpa*, *C. putaminum*, *Chaetomium subaffine*, *Diatrype bermudensis*, *Diatrypella persicae*, *Didymosphaeria massarioides*, *Eutypella fraxinicola*, *Munkovalsaria donacina*, *Oedohysterium sinense*, and *Pleospora calvescens*); while six are new records for Bahia State (*Dirinaria confusa*, *Lecanora achroa*, *Phaeosphaeria* sp., *Pleospora herbarum*, *Polymeridium julelloides*, and *Saccardoella macrasca*). *Syagrus coronata* represents a new botanical host for all taxa identified here.

KEY WORDS — *Pezizomycotina*, semiarid, taxonomy

Introduction

The Caatinga biome occupies most of the semiarid region of northeastern Brazil, with varied landscapes and notable endemism (Brasil 2015). Associated with the many Caatinga ecosystems are fungi and other microorganisms responsible for recycling nutrients through the decomposition of a wide variety of substrates—processes of great importance for maintaining natural nutrient recycling in the ecosystem (Christensen 1989, Dix & Webster 1995).

Among the many native plant species of significant importance in the Brazilian semiarid region is the palm tree *Syagrus coronata* (Mart.) Becc, commonly known as "licuri" or "ouricuri". It is considered a "life-saving plant" due to its high socio-biological and economic importance in the region. The licuri palm can withstand prolonged droughts and produces flowers and fruits for long periods during the year (Drumond 2007).

Biodiversity studies have become very relevant throughout the world (Wicklow & Carroll 1981, Norton 1986), although fungal diversity has been less intensively examined. Various species of fungi have been recorded only a single time, with little or nothing being known about their habitats and characteristics, or their biology (Crous 1993). Research focusing on the diversity and taxonomy of fungi associated with *S. coronata* has been extremely limited. Cruz & Gusmão (2009) reported only three microfungi colonizing that host; Santos & al. (2016), Vitória & al. (2016), and Santos & Vitória (2017) described and illustrated a total of 44 fungal species found on *S. coronata*. None of those studies however reported lichenized *Ascomycota*.

The lack of systematic research on the mycota inhabiting licuri palms stimulated undertaking more intensive studies to amplify our knowledge of the biodiversity of those organisms, their ecological roles, and their biotechnological potentials. The present study was designed to study the mycota of *S. coronata* in the Raso da Catarina ecoregion in the drylands of Bahia State (Caatinga biome). We present here new occurrence records of lichenized and non-lichenized *Ascomycota* for South America and Brazil.

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Materials & methods

The present study was undertaken within the Raso da Catarina ecoregion during the period between January/2015 and March/2016. The survey of the mycota of *Syagrus coronata* (licuri) involved collecting living leaves and leaf litter, as well as inflorescences, fruits, bracts, and pieces of the trunk showing fungal reproductive structures. Dead leaves still attached to the plants were also considered in the sampling. The samples were cut into pieces to facilitate their handling and transport and held in paper sacks (Kraft-type paper) identified with the host name, locality, and date. After collecting, the samples were analyzed in the Biological Sciences laboratory at UNEB – Campus VIII, and testimonial specimens deposited in the URM herbarium at the Federal University of Pernambuco – UFPE. Examinations of the surfaces of the samples were performed using a stereomicroscope (Zeiss); fragments of fungal structures were removed using a needle and mounted on slides (with coverslips) using lactophenol (containing cotton blue stain), Melzer reagent, and water. The slides were examined using a light microscope and the fungi measured using micrometric scale objectives and photographed (Zeiss). The identifications of the material were performed by consulting the specialized literature.

Taxonomy

Anthostomella caricis S.M. Francis, Mycol. Pap. 139: 15 (1975) FIG. 1A–C

DESCRIPTION—Francis (1975).

SPECIMEN EXAMINED—**BRAZIL. BAHIA: Paulo Afonso**, Juá village, 9°25.89'S 38°25.45'W, 380 m, on leaflets of *S. coronata*, 26.IV.2015, col. M.A.L. dos Santos (URM 92454).

DISTRIBUTION—United Kingdom (*Carex paniculata*, *C. pendula*, *Glyceria maxima*); Brazil (present study).

Caryospora callicarpa (Curr.) Nitschke ex Fuckel, Fungi rhenani exsic.: no. 1813 (1866) FIG. 1F

DESCRIPTION—Hawksworth (1982).

SPECIMENS EXAMINED—**BRAZIL. BAHIA: New Glória**, Brejo village, 9°21.85'S 38°27.43'W, 340 m, on fruit of *S. coronata*, 25.IX.2015, col. M.A.L. dos Santos (URM 92488). **Paulo Afonso**, Bogó village, 9°39.32'S 38°16.41'W, 331 m, on fruit of *S. coronata*, 26.V.2015, col. M.A.L. dos Santos (URM 92490). Juá village, 9°25.89'S 38°25.45'W, 380 m, on fruit of *S. coronata*, 26.X.2015, col. M.A.L. dos Santos (URM 92489).

DISTRIBUTION—United Kingdom (*Quercus* sp.); Brazil (present study).

Caryospora putaminum (Schwein.) Fuckel, Fungi rhenani exsic.: no. 998 (1865) FIG. 1D–E

DESCRIPTION—Barr (1990).

SPECIMEN EXAMINED—**BRAZIL. BAHIA: New Glória**, Brejo village, 9°21.85'S 38°27.43'W, 340 m, on fruit of *S. coronata*, 31.III.2016, col. M.A.L. dos Santos (URM 92486).

DISTRIBUTION—USA (*Carya glabra*, *C. ovata*, *Prunus americana*, *P. persica*); Japan (*P. mume*, *P. persica* var. *vulgaris*); India (*Cocos nucifera*); Italy (*P. persica*); Pakistan (*Dalbergia sissoo*, *Juglans regia*); Brazil (present study).

Chaetomium subaffine Sergeeva, Notul. syst. Sect. cryptog. Inst. bot. Acad. Sci.

U.S.S.R. 14: 148 (1961) FIG. 1G–H

DESCRIPTION—Wang & al. (2016).

SPECIMEN EXAMINED—**BRAZIL. BAHIA: Paulo Afonso**, Bogó village, 9°39.32'S 38°16.41'W, 331 m, on leaflets of *S. coronata*, 20.I.2015, col. M.A.L. dos Santos (URM 92443).

DISTRIBUTION—China (animal droppings, unknown plant); Netherlands (human finger); Brazil (present study).

- Diatrype bermudensis*** Rappaz, Mycol. helv. 2(3): 440 (1987) FIG. 1I–J
 DESCRIPTION—Rappaz (1987).
 SPECIMEN EXAMINED—**BRAZIL. BAHIA: Paulo Afonso**, Juá village, 9°25.89'S 38°25.45'W, 380 m, on rachis of *S. coronata*, 17.VII.2015, col. M.A.L. dos Santos (URM 92494).
 DISTRIBUTION—United Kingdom (*Bambusa vulgaris*); Panama (*Guadua angustifolia*); Brazil (present study).
- Diatrypella persicae*** Rick, Brotéria 4(3): 162 (1905) FIG. 1K–L
 DESCRIPTION—Saccardo & Trotter (1913).
 SPECIMEN EXAMINED—**BRAZIL. BAHIA: New Glória**, Serrota village, 9°24.93'S 38°27.66'W, 473 m, on rachis of *S. coronata*, 26.IX.2015, col. M.A.L. dos Santos (URM 92494).
 DISTRIBUTION—Locality not informed, on branches of *Persica vulgaris*.
- Didymosphaeria massarioides*** Sacc. & Brunaud, Michelia 2(8): 592 (1882) FIG. 1M–N
 DESCRIPTION—Aptroot (1995).
 SPECIMEN EXAMINED—**BRAZIL. BAHIA: Paulo Afonso**, Juá village, 9°25.89'S 38°25.45'W, 380 m, on leaflets of *S. coronata*, 19.V.2015, col. M.A.L. dos Santos (URM 92480).
 DISTRIBUTION—Cosmopolitan (stems and roots of various plants).
- Diplodia galiicola*** Dissan., Camporesi & K.D. Hyde, Fungal Diversity 75: 54 (2015) FIG. 1O
 DESCRIPTION—Ariyawansa & al. (2015).
 SPECIMEN EXAMINED—**BRAZIL. BAHIA: Paulo Afonso**, Bogó village, 9°39.32'S 38°16.41'W, 331 m, on fruit of *S. coronata*, 30.III.2016, col. M.A.L. dos Santos (URM 90189).
 DISTRIBUTION—Italy (*Galium* sp.); Brazil (present study).
- Dirinaria confusa*** D.D. Awasthi, Bull. Soc. bot. France, Let. bot. 121(7–8): 56 (1975) FIG. 3A
 DESCRIPTION—Nash & al. (2004).
 SPECIMEN EXAMINED—**BRAZIL. BAHIA: New Glória**, Brejo village, on trunk of *S. coronata*, 9°21.85'S 38°27.43'W, 340 m, 10.I.2016, col. M.A.L. dos Santos (URM 92496).
 DISTRIBUTION—North, Central, and South America. In Brazil: Porto Alegre, Rio Grande do Sul, Sergipe, and Bahia (present study).
- Eutypella fraxinicola*** (Cooke & Peck) Sacc., Syll. fung. 1: 154 (1882) FIG. 2A–B
 DESCRIPTION—Vasilyeva & Stephenson (2006).
 SPECIMEN EXAMINED—**BRAZIL. BAHIA: Paulo Afonso**, Juá village, 9°25.89'S 38°25.45'W, 380 m, on rachis of *S. coronata*, 19.05.2015, col. M.A.L. dos Santos (MICOLAB 0051).
 DISTRIBUTION—U.S.A. (Georgia); India; Brazil (present study).
- Lecanora achroa*** Nyl., J. Bot. 14: 26 (1876) FIG. 3B
 DESCRIPTION—Nash & al. (2004).
 SPECIMEN EXAMINED—**BRAZIL. BAHIA: New Glória**, Brejo village, 9°21.85'S 38°27.43'W, 340 m, on bract of *S. coronata*, 27.III.2015, col. M.A.L. dos Santos (URM 92502).
 DISTRIBUTION—Pantropical, occurring in North, Central, and South America, Indian Ocean islands, Australia, New Zealand, Papua New Guinea. In Brazil: Alagoas, Ceará, Paraíba, Pernambuco, Rio Grande do Sul, Sergipe, and Bahia (present study).

Munkovalsaria donacina (Niessl) Aptroot, Nova Hedwigia 60: 346 (1995)

FIG. 2C

DESCRIPTION—Aptroot (1995).

SPECIMEN EXAMINED—**BRAZIL. BAHIA: New Glória**, Serrota village, 9°24.93'S 38°27.66'W, 473 m, on leaflets of *S. coronata*, 19.V.2015, col. M.A.L. dos Santos (URM 92463).

DISTRIBUTION—Australia (*Calamus australis*); Brazil (*Saccharum officinarum*, *Bambusoideae*, and present study), Central African Republic (*Coffea canephora*), China (*Althaea rosea*, *Trachycarpus fortunei*); Columbia (unknown plant); France (*Pseudosasa japonica*); India (*Acacia* sp., *Adhatoda vasica*, *Ailanthus altissima*, *Annona squamosa*, *Cajanus cajan*, *Careya arborea*, *Citrus aurantiifolia*, *Clerodendrum infortunatum*, *C. phlomidis*, *Duranta erecta*, *Ficus racemosa*, *Hibiscus* sp., *Ipomoea carnea*, *Mallotus philippinensis*, *Morus alba*, *Nerium odorum*, *Pistacia indica*, *Tectona grandis*); Japan (*Phyllostachys bambusoides*); USA (*Platanus* sp., *Wikstroemia* sp., *Zea mays*); Namibia (*Vachellia reficiens*); Paraguay (*Coffea arabica*); Papua New Guinea (*Bambusoideae*); Philippines (*Premna cumingiana*); Portugal (*Arundo donax*); Myanmar (*Litchi chinensis*); Sierra Leone (unknown).

Oedohysterium sinense (Teng) E. Boehm & C.L. Schoch, Stud. Mycol. 64: 59 (2009)

FIG. 2D–F

DESCRIPTION—Boehm & al. (2009).

SPECIMEN EXAMINED—**BRAZIL. BAHIA: New Glória**, Serrota village, 9°24.93'S 38°27.66'W, 473 m, on leaflets of *S. coronata*, 28.II.2015, col. M.A.L. dos Santos (MICOLAB 0052).

DISTRIBUTION—North America (Boehm, unpubl. data), Europe, China, and South Africa, on decorticated hardwood trees and structures.

***Phaeosphaeria* sp.**

FIG. 2G–H

DESCRIPTION—Shoemaker & Babcock (1988).

SPECIMEN EXAMINED—**BRAZIL. BAHIA: New Glória**, Serrota village, 9°24.93'S 38°27.66'W, 473 m, on leaflets of *S. coronata*, 28.II.2015, col. M.A.L. dos Santos (MICOLAB 0054).

DISTRIBUTION—Cosmopolitan.

Pleospora calvescens (Fr. Ex Desm.) Tul. & C. Tul., Select. Fung. Carpol. 2: 266 (1863)

FIG. 2I–L

DESCRIPTION—Webster & Lucas (1959).

SPECIMEN EXAMINED—**BRAZIL. BAHIA: New Glória**, Brejo village, 9°21.85'S 38°27.43'W, 340 m, on rachis of *S. coronata*, 10.I.2016, col. M.A.L. dos Santos (URM 92491).

DISTRIBUTION—Germany, Austria, Azerbaijan, Bulgaria, Denmark, England, Mauritius, Pakistan, U.S.A. (New York); Brazil (present study).

Pleospora herbarum (Pers.) Rabenh., Klotzschii Herb. Viv. Mycol., Ed. Nov,

Ser. Sec., Cent. 6: no. 547 (1857)

FIG. 2M–P

DESCRIPTION—Zhang & al. (2012).

SPECIMEN EXAMINED—**BRAZIL. BAHIA: Paulo Afonso**, Juá village, 9°25.89'S 38°25.45'W, 380 m, on leaflets of *S. coronata*, 29.III.2015, col. M.A.L. dos Santos (URM 92513).

DISTRIBUTION—Cosmopolitan.

Polymeridium julelloides E.L. Lima, M. Cáceres & Aptroot, Lichenologist 45: 548 (2013) FIG. 3C

DESCRIPTION—Aptroot & al. (2013).

SPECIMEN EXAMINED—**BRAZIL. BAHIA: New Glória**, Serrota village, 9°24.93'S 38°27.66'W, 473 m, on petiole of *S. coronata*, 27.VI.2015, col. M.A.L. dos Santos (URM 92504).

DISTRIBUTION—South America, Africa, Australia, New Caledonia, and Japan. In Brazil: Pernambuco, Sergipe, Santa Catarina, and Bahia (present study).

Saccardoella macrasca (Sacc.) M.E. Barr, Mycotaxon 51: 218 (1994)

FIG. 2Q–S

DESCRIPTION—Tsui & al. (1998).

SPECIMENS EXAMINED—**BRAZIL. BAHIA: Paulo Afonso**, Bogó village, 9°39.32'S 38°16.41'W, 331 m, on petiole of *S. coronata*, 11.VII.2015, col. M.A.L. dos Santos (MICOLAB 0056).

DISTRIBUTION—Taiwan (substrate not cited); Brazil (plant not identified, and present study).

Seimatosporium corni Wijayaw., Camporesi & K.D. Hyde, Fungal Diversity 73: 100 (2015)

FIG. 2Q–S

DESCRIPTION—Senanayake & al. (2015).

SPECIMENS EXAMINED—**BRAZIL. BAHIA: New Glória**, Brejo village, 9°21.85'S 38°27.43'W, 340 m, on fruit of *S. coronata*, 19.V.2015, col. M.A.L. dos Santos (URM 90193). Serrota village, 9°24.93'S 38°27.66'W, 473 m, on fruit of *S. coronata*, 21.XI.2015, col. M.A.L. dos Santos (URM 90194). **Paulo Afonso**, Juá village, 9°25.89'S 38°25.45'W, 380 m, on fruit of *S. coronata*, 26.X.2015, col. M.A.L. dos Santos (URM 90191). Bogó village, 9°39.32'S 38°16.41'W, 331 m, on fruit of *S. coronata*, 30.III.2016, col. M.A.L. dos Santos (URM 90192).

DISTRIBUTION—Italy (*Cornus* sp.); Brazil (present study).

Wojnowiciella viburni (Wijayaw., Yong Wang bis & K.D. Hyde) Crous, M. Hern.-Restr. & M.J. Wingf.,

Persoonia 34: 201 (2015)

FIG. 2X,Y

DESCRIPTION—Crous & al. (2015).

SPECIMENS EXAMINED—**BRAZIL. BAHIA: New Glória**, Brejo village, 9°21.85'S 38°27.43'W, 340 m, on leaflets of *S. coronata*, 19.V.2015, col. M.A.L. dos Santos (URM 90196). Brejo village, 9°21.85'S 38°27.43'W, 340 m, on leaflets of *S. coronata*, 21.II.2015, col. M.A.L. dos Santos (URM 90195). **Paulo Afonso**, Juá village, 9°25.89'S 38°25.45'W, 380 m, on leaflets of *S. coronata*, 17.VII.2015, col. M.A.L. dos Santos (URM 90197).

DISTRIBUTION—China (*Viburnum utile*); Brazil (present study).

Discussion

The species *Diplodia galiicola*, *Seimatosporium corni*, and *Wojnowiciella viburni* discussed here are first records for South America, having been previously reported for the first time in Italy and China (Ariyawansa & al. 2015; Crous & al. 2015; Senanayake & al. 2015). *Seimatosporium corni* had wider conidia and darker median cells than cited in the original description, which may be related to regional climatic conditions and/or the physiology of the palm tree host. *Diplodia galiicola* and *W. viburni* demonstrated morphological characteristics conforming to their original descriptions. The present study records the first occurrences of the species *Anthostomella caricis*, *Caryospora callicarpa*, *C. putaminum*, *Chaetomium subaffine*, *Diatrype bermudensis*, *Diatrypella persicae*, *Didymosphaeria massarioides*, *Eutypella fraxinicola*, *Munkovalsaria donacina*, *Oedohysterium sinense*, and *Pleospora calvescens* for Brazil. *Phaeosphaeria* sp. and *Pleospora herbarum* demonstrated wide distributions on a large number of substrates; in Brazil, those *Ascomycota* have been documented for the states of Rio de Janeiro, São Paulo, and Tocantins (Farr & Rossman 2018; Mendes & Urben 2018). *Saccardoella macrasca* was encountered by Almeida & al. (2017) in Paraíba State on unidentified plants; we report here its first record for Bahia. The lichenized *Ascomycota* *Dirinaria confusa*, *Lecanora achroa*, and *Polymeridium julelloides*, are documented here for the first time for Bahia.

The palm tree *S. coronata* (licuri) represents a new botanical host for all of the fungal species recorded in the present study. The trunk of that palm is heavily laden with leaf petioles that persist after shedding older leaves, providing micro-sites that can accumulate organic material and humidity – providing satisfactory conditions for colonization by microorganisms such as fungi (Drumond 2007; Castro & al. 2016).

Although numerous plant parts were sampled, ascomycetes were only encountered on the leaf blades, leaflets, petiole, bracts, and fruits. According to Pinruan & al. (2007), the morphologies of palm trees can influence fungal colonization due to nutrient availability on their different substrates. Petioles, leaf blades, and trunks are rich in cellulose and lignin, favoring ascomycete species that require long periods of time to develop fruiting structures (ascomas). Leaflets are rich in starches and sugars, and the availability of humidity and the volumes of plant tissues and vascular bundles there favor colonization by anamorphic species that have shorter life cycles (Pinruan & al. 2007).

The incorporation of new data considering the geographic and demographic distributions of plants can provide important indirect evidence of the richness of fungal communities. The spatial distribution of fungal diversity is not necessarily dependent, however, on the biogeographic patterns of plant distributions in light of their abundance and diversity in soils throughout the world (Tedersoo & al. 2014). Ascomycota are found in essentially all ecosystems, although they have been only poorly documented in the Caatinga domain of Brazil, making research in that area relevant and important.

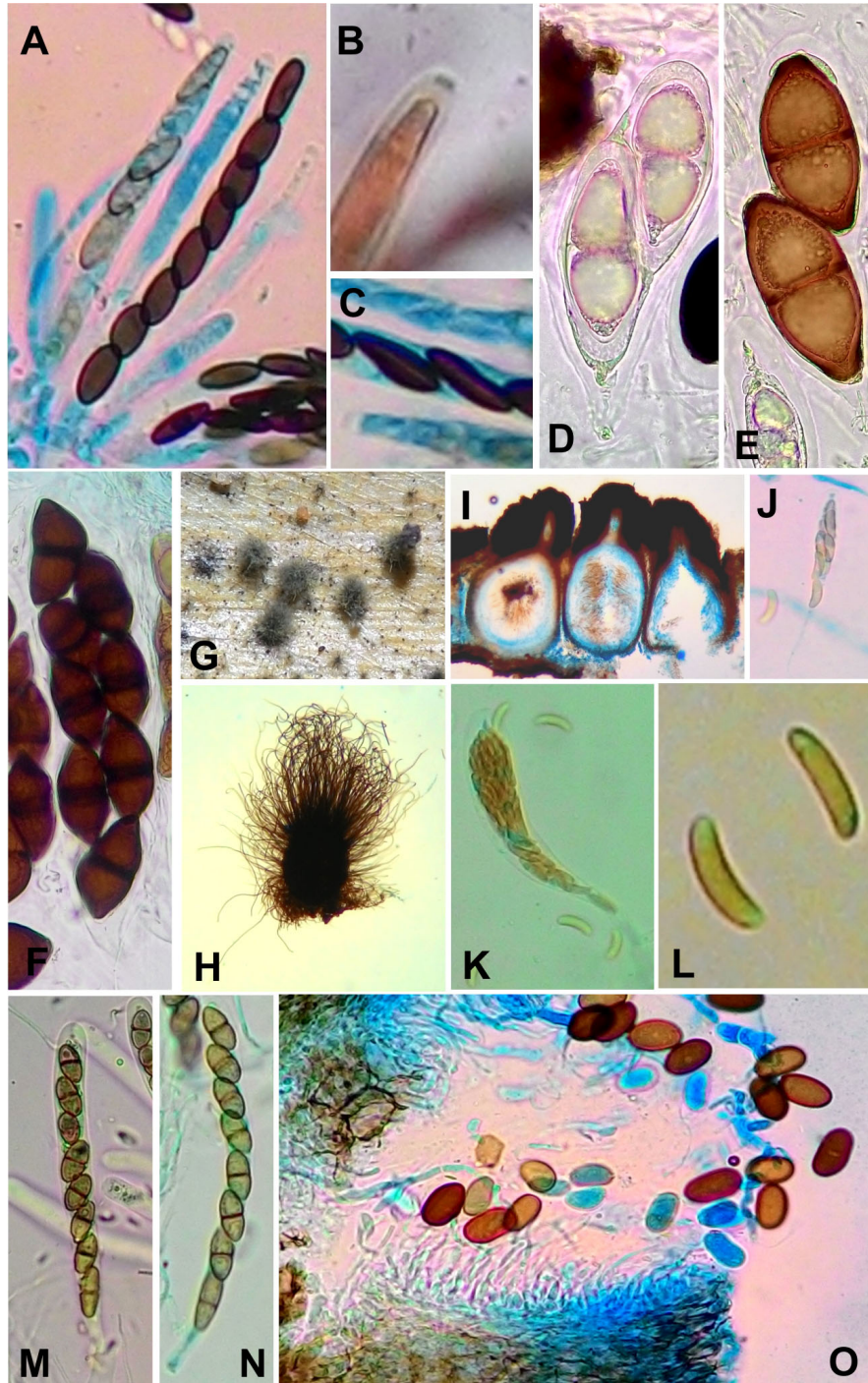


FIGURE 1. A–C: *Anthostomella caricis*; D, E: *Caryospora putaminum*; F: *Caryospora callicarpa*; G, H: *Chaetomium subaffine*; I, J: *Diatrype bermudensis*; K, L: *Diatrypella persicae*; M, N: *Didymosphaeria massarioides*; O: *Diplodia galiicola*.

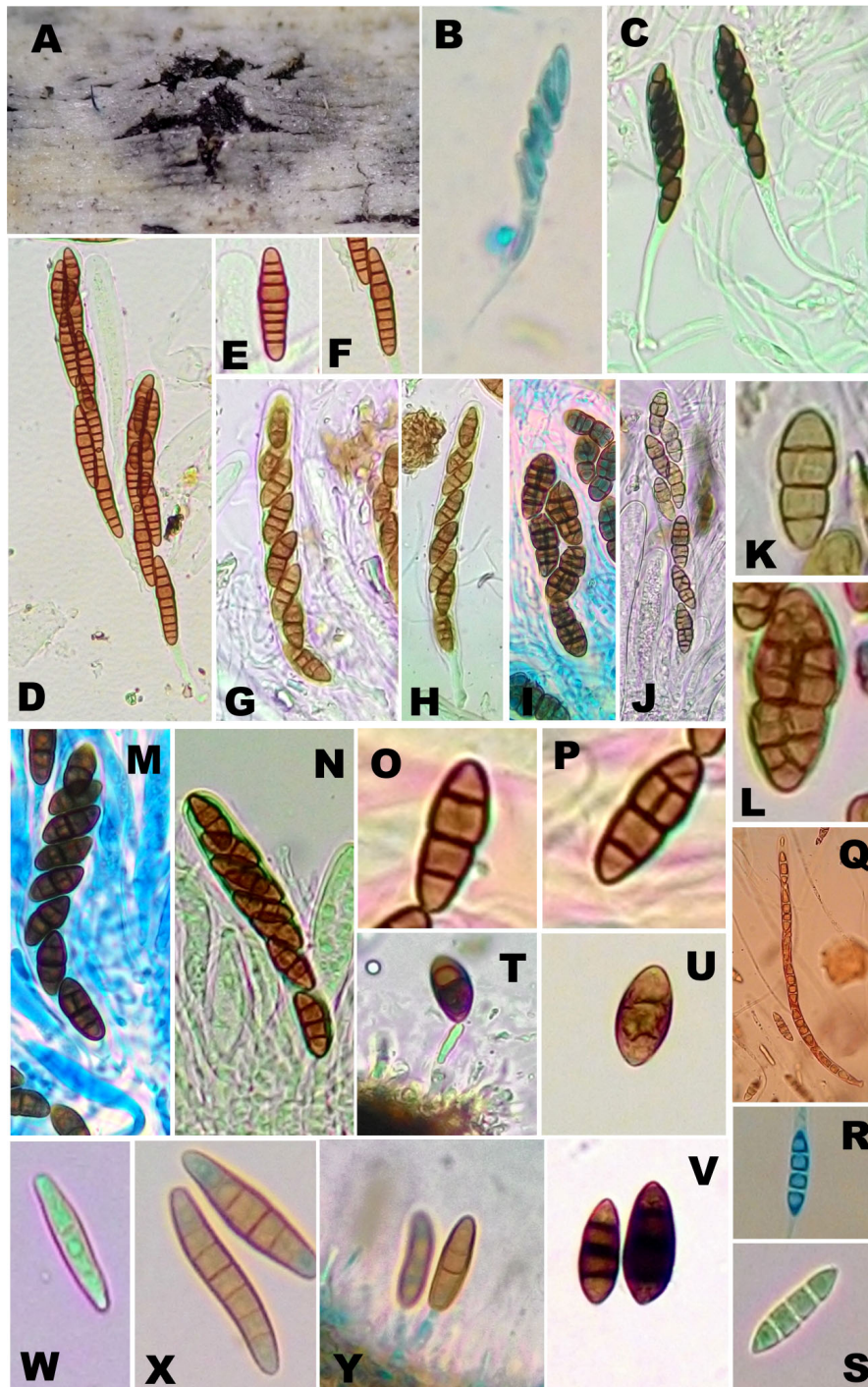


FIGURE 2. A, B: *Eutypella fraxinicola*; C: *Munkovalsaria donacina*; D–F: *Oedohysterium sinense*; G, H: *Phaeosphaeria* sp.; I–L: *Pleospora herbarum*; M–P: *Pleospora calvescens*; Q–S: *Saccardoella macrasca*; T–V: *Seimatosporium corni*; W–Y: *Wojnowiciella viburni*.

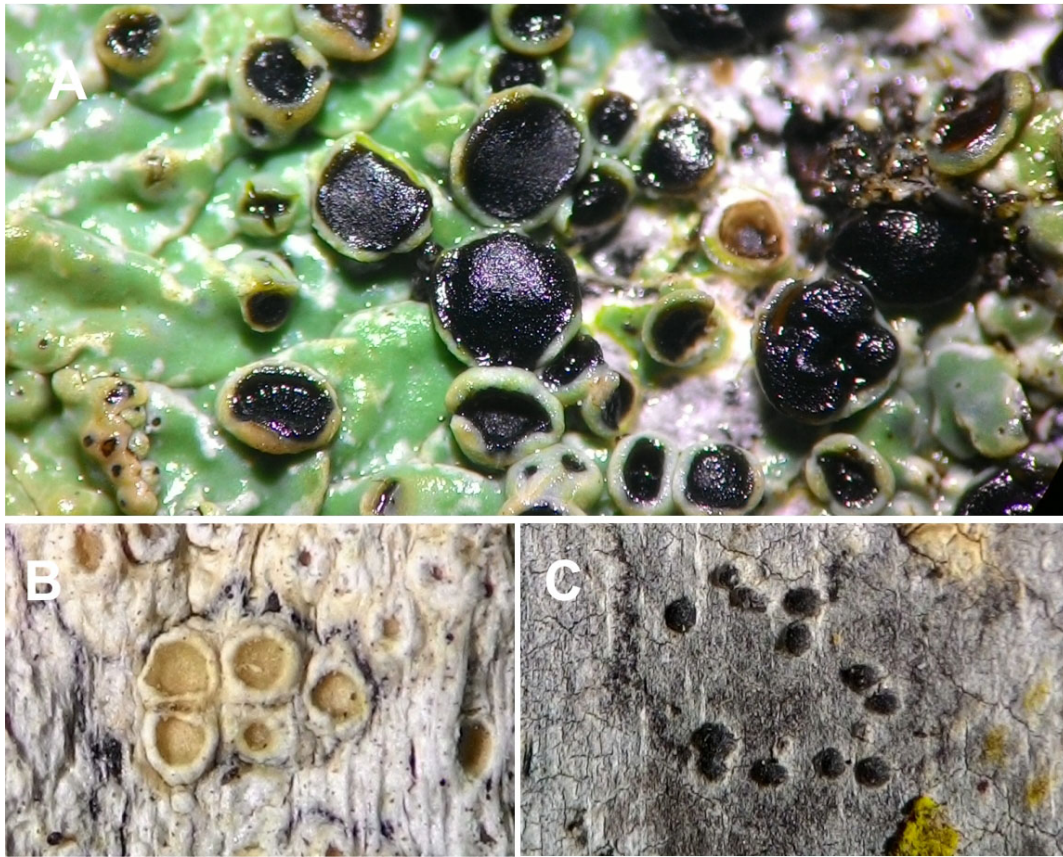


FIGURE 3. A: *Dirinaria confusa*; B: *Lecanora achroa*; C: *Polymeridium julleloides*.

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