

Myxomycetes occurring on *Cecropia adenopus* (Cecropiaceae) in fragments of Atlantic Rainforest¹

Andrea Carla Caldas Bezerra^{2,4}, Antonia Aurelice Aurélio Costa³ and Laise de Holanda Cavalcanti³

Recebido em 29/10/2008. Aceito em 16/11/2010

RESUMO

(Myxomycetes ocorrentes em *Cecropia adenopus* (Cecropiaceae) em fragmentos de Floresta Atlântica). *Cecropia adenopus* (embaúba) é uma espécie nativa, frequente em bordas de matas e clareiras e tida como espécie pioneira em áreas recolonizadas. Apesar de ocorrer desde o México até a Argentina este substrato nunca tinha sido examinado com detalhe quanto à presença de Myxomycetes. No presente estudo, a mixobiota associada a folhas mortas de *C. adenopus* foi investigada em duas Unidades de Conservação da Floresta Atlântica, situadas no estado do Rio Grande do Norte. Cinco espécimes e um plasmódio foram obtidos diretamente no campo e 87 desenvolveram-se em 43,7% de 200 câmaras-úmidas, montadas com lâminas foliares e pecíolos separadamente. Quinze espécies de Myxomycetes foram identificadas e ilustradas. Os dois grupos predominantes pertencem às ordens Trichiales e Physarales. *Didymium columella-cavum* foi encontrado pela segunda vez no Brasil e no mundo.

Palavras-chave: Cecropiaceae, *Didymium*, micologia, Neotrópicos, taxonomia

ABSTRACT

(Myxomycetes occurring on *Cecropia adenopus* (Cecropiaceae) in fragments of Atlantic Rainforest). *Cecropia adenopus* (Ambay pumpwood) is a frequent native species on the edges of woods and clearings and is considered a pioneer species in re-colonized areas. Despite its distribution from Mexico to Argentina, this substrate has never been examined in detail regarding the presence of Myxomycetes. In the present study, the myxobiota associated with leaf debris of *C. adenopus* was investigated in two Atlantic Rainforest conservation units located in the Brazilian state of Rio Grande do Norte. Five specimens and one plasmodium were obtained directly from the field and 87 were developed in 43.7% of 200 moist-chamber cultures set up separately with blades and petioles. Fifteen species were identified and illustrated. The two predominant groups were representatives of Trichiales and Physarales. *Didymium columella-cavum* was recorded for the second time in Brazil and in the world.

Key words: Cecropiaceae, *Didymium*, mycology, Neotropics, taxonomy

Introduction

Myxomycetes are not considered phytopathogenic organisms (Agrios 1997; Nieves-Rivera 2000), but records are found in the literature regarding their occasionally harmful presence on some plant species of economic importance, such as living trunks of *Acer rubrum* L. (Ostrofsky & Shigo 1981), the terminal buds of *Paulinia cupana* Kunth. (Pereira 1984), and stems and leaves of *Solanum lycopersicum* L. (Cavalcanti *et al.* 1985; Cabrera-de-Alvarez *et al.* 1993), *Fragaria* sp. (Metlitskii *et al.* 2001), *Allium cepa* L. (Wordell Filho 2006), *Lactuca sativa* L. and *Petroselinum* sp. (Silva & Bezerra 2005).

A number of studies have addressed the association of myxomycetes with phanerogam families, genera and

species, such as living or decomposing palm trees (Mobin & Cavalcanti 1998/1999; 2000; Cavalcanti & Mobin 2004; Stephenson 2003) and species of *Quercus* L. (Wrigley de Basanta 1998), *Rizophora* L. (Stephenson 1988) and *Terminalia* L. (Bezerra & Cavalcanti 2007). Some of these studies have been conducted in northeastern Brazil with introduced species employed in urban tree-planting programs or native species found in different ecosystems.

The Ambay pumpwood (*Cecropia adenopus* Mart. ex Miq.) is a native species frequently found on the edges of woods and clearings, distributed from Mexico to Argentina and appearing in greater abundance in the Amazon region. It is considered a pioneer species in re-colonized areas. It belongs to the Cecropiaceae family, which encompasses six

¹ Parte da tese de Doutorado da primeira Autora

² Universidade Federal de Pernambuco, Centro de Ciências Biológicas, Programa de Pós-graduação em Biologia de Fungos, Departamento de Micologia, Recife, PE, Brasil

³ Universidade Federal de Pernambuco, Departamento de Botânica, Laboratório de Myxomycetes, Recife, PE, Brasil

⁴ Autor para correspondência: labmix@gmail.com

genera and 170 species and is characterized by a hollow, curly stem that ants (myrmecophila) use for shelter; spiral phyllotaxis; peltate, palmatilobed leaves, divided radially; and long petioles with a glandular pulvinule at the base (Braga 1953).

Leaves and fruit from the Ambay pumpwood are used in folk remedies for the treatment of diabetes as well as for coughs and bronchitis. The juice extracted from the root is a powerful diuretic. Juice from the buds is often used in the treatment of diarrhea, gonorrhoea and is employed by indigenous peoples on wounds produced by venomous insects. Ash from the stem is used to whiten clothes, make soap and purify sugarcane sap in the fabrication of sugar. In Brazil, the plant is normally known as “imbaúba”, originating from the term “ambaíba” from the indigenous Tupi language, meaning “tree with orifice” or “tree that does not serve for construction” (Braga 1953).

In studies on the soil and shoot debris carried out on the myxobiota in Atlantic Rainforest conservation units on the coast of the state of Rio Grande do Norte (Brazil), greater attention has been given to this species due to the frequent occurrence of myxomycetes on its leaves and branches.

Materials and methods

Study areas

Sampling was carried out in two areas. The first is the Estrela Woods Natural Heritage Private Reserve (06°22'10" - 06°22'43" S and 34°58'29" - 35°00'28" W, 1,833.12 ha, 4 m alt.) located in the city of Baía Formosa, state of Rio Grande do Norte. The location has a rainy tropical climate, with annual precipitation of 1400 mm and average relative humidity of 79% (IDEMA 2007). The physiognomy of the vegetation is typical of the Atlantic Rainforest, with large trees and contiguous crowns forming a canopy approximately 20 meters in height, with *C. adenopus* individuals in more illuminated areas, such as along the Gameleira trail (06° 22' 26" - 06° 23' 00" S and 35° 01' 25" - 35° 00' 55" W) and some points of the Pau-brasil, (06° 22' 43" - 06° 23' 19" S and 35° 00' 46" - 35° 01' 04" W), Pagão (06° 23' 11" - 06° 23' 19" S and 35° 00' 46" - 34° 59' 57" W) and Coca-cola (06° 24' 50" - 06° 25' 45" S and 34° 59' 57" - 34° 58' 32" W) trails.

The other sampling area was the Natal Dunes State Park (05°48'S - 05°53'S and 35°09'W - 35°12'W, 1,172.80 ha, 80 - 120 m alt.), the second largest urban park in Brazil, located in the city of Natal, Rio Grande do Norte. The climate is humid, with annual precipitation of 1200 mm. The park contains formations of dunes densely covered by sub-humid Atlantic Rainforest and a small stretch of the coastal tablelands (Freire 1990). It has large trees forming a canopy approximately 20 meters in height, with *C. adenopus* individuals in the lower arboreal stratum, particularly in more illuminated locations, such as the entrance of the Perobinha trail.

Collection, culturing and analysis of myxobiota

Myxomycete sporocarps were collected from branches and dead leaves (either fallen on the ground or stuck in bushes approximately 2 m above the ground) of *C. adenopus* (Figs. 1-3) individuals distributed in the interior and along the trails of the study areas between June 2004 and September 2006. Two hundred moist-chamber cultures were set up, with blades and petioles placed in disposable Petri dishes (9 cm) lined with sterilized filter paper soaked in distilled water. The cultures were maintained at room temperature (22° to 25°C) and examined on a weekly basis for a period of three months with the aid of a stereomicroscope (Schnittler & Stephenson 2002). Exsiccates representative of the material obtained in the field and laboratory were deposited in the UFP Herbarium of the Pernambuco Federal University. Identification of the specimens was based on morphological characters, following descriptions by Lister (1925), Martin & Alexopoulos (1969), Farr (1976), Lado & Pando (1997) and Mitchell (2004). Illustrations were based on the collected material. Taxonomic nomenclature and abbreviations of the names of the authors follow Hernández-Crespo & Lado (2005).

Results and discussion

The specimens obtained belong to species distributed among the genera of five families and are characterized below:

Trichiaceae

Arcyria cinerea (Bull.) Pers., Syn. Meth. Fung. 184 (1801)
≡ *Trichia cinerea* Bull., Herb. France pl. 477, f. 3 (1790)

Fig. 4

Selected material examined: **BRAZIL. Rio Grande do Norte:** Natal, Natal Dunes State Park. Perobinha trail, culture 15/IV/2004, sporulation 18/V/2004, A.C.C. Bezerra et al. (UFP 40257); *ibid*, culture 15/IV/2004, sporulation 7/VI/2005, A.C.C. Bezerra et al. (UFP 40263); *ibid*, 14/IV/2005, A.C.C. Bezerra et al. (UFP 40276); *ibid*, 15/IV/2005 A.C.C. Bezerra et al. (UFP 40278).

Arcyria insignis Kalchbr. & Cooke, in Kalchbrenner, Grevillea 10:143 (1882)

Selected material examined: **BRAZIL. Rio Grande do Norte:** Natal, Natal Dunes State Park. Perobinha trail, 9/IX/2006, blade *Cecropia* sp., A.C.C. Bezerra et al. (UFP 40283).

Hemitrichia pardina (Minakata) Ing, Myxomycetes Britain and Ireland 132 (1999)

≡ *Hemitrichia minor* var. *pardina* Minakata, in G.Lister, Trans. Brit. Mycol. Soc. 5:82 (1915)

Fig. 5

Table 1. Myxomycetes recorded (field/ moist-chamber culture) on dead leaves from *Cecropia adenopus* Mart. ex Miq. in the Natal Dunes State Park and Estrela Woods Natural Heritage Private Reserve, Rio Grande do Norte, Brazil.

Species	Petioles	Blades
<i>Arcyria cinerea</i> (Bull.) Pers.	-/2	-/7
<i>Arcyria insignis</i> Kalchbr. & Cooke	--	1/-
<i>Cribraria violacea</i> Rex	-/2	-/19
<i>Comatricha tenerrima</i> (M. A. Curtis) G. Lister	--	-/1
<i>Craterium leucocephalum</i> (Pers. ex J.F.Gmel.) Ditmar	--	1/-
<i>Diderma deplanatum</i> Fr.	--	-/1
<i>Diderma hemisphaericum</i> (Bull.) Hornem	--	-/4
<i>Didymium columella-cavum</i> Hochg., Gottsb. & Nann.-Bremek	-/3	-/22
<i>Didymium squamulosum</i> (Alb. & Schwein.) Fr.	--	1/-
<i>Hemitrichia pardina</i> (Minakata) Ing	--	-/21
<i>Lycogala epidendrum</i> (L.) Fr.	1/-	--
<i>Perichaena chryzosperma</i> (Curr.) Lister	--	-/1
<i>Perichaena depressa</i> Lib.	-/2	-/1
<i>Physarum melleum</i> (Berk. & Broome) Masee	--	-/1
<i>Physarum stellatum</i> (Masee) G. W. Martin	--	1/-
Total	1/9	5/77

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 11/VI/2004, sporulation 25/VI/2004, A.C.C. Bezerra *et al.* (UFP 50262); *ibid*, sporulation 9/VII/2004, A.C.C. Bezerra *et al.* (UFP 50258); *ibid*, sporulation 9/IX/2004, A.C.C. Bezerra *et al.* (UFP 50578); *ibid*, sporulation 1/VII/2004, A.C.C. Bezerra *et al.* (UFP 50182); *ibid*, sporulation 9/VII/2004, A.C.C. Bezerra *et al.* (UFP 50382); *ibid*, sporulation 12/VII/2004, A.C.C. Bezerra *et al.* (UFP 50179).

Perichaena chryzosperma (Curr.) Lister, Monogr. Myceto-
zoa 196 (1894)

≡ *Ophiotheca chryzosperma* Curr., Quart. J. Microscop. Sci.
2:241 (1854)

Fig. 6

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 14/VI/2004, sporulation 09/VIII/2004, A.C.C. Bezerra *et al.* (UFP 50296).

Perichaena depressa Lib., Pl. Crypt. Arduenna 378 (1837)

Fig. 7

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 14/VI/2004, sporulation 25/VI/2004, A.C.C. Bezerra *et al.* (UFP 50266); culture 14/VI/2004, sporulation 9/IX/2004, A.C.C. Bezerra *et al.* (UFP 40247).

Liceaceae

Cribraria violacea Rex, Proc. Acad. Nat. Sci. Philadelphia
43:393 (1891)

Fig. 8

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 14/VI/2004, sporulation 05/VII/2004, A.C.C. Bezerra *et al.* (UFP 50193); *ibid.*, sporulation 08/IX/2004, A.C.C. Bezerra *et al.* (UFP 50378); *ibid.*, sporulation 05/VII/2004, A.C.C. Bezerra *et al.* (UFP 50374). Natal, Natal Dunes State Park, sporulation 11/IX/2006, A.C.C. Bezerra *et al.* (UFP 50563).

Lycogala epidendrum (L.) Fr., Syst. Mycol. 3: 80 (1829)

≡ *Lycoperdon epidendrum* L., Sp. Pl.: 1184. (1753)

Selected material examined: **BRAZIL. Rio Grande do Norte:** Natal, Natal Dunes State Park. Perobinha trail, 14/IV/2005, *Cecropia* sp., A.C.C. Bezerra *et al.* (UFP 40296).

Physaraceae

Craterium leucocephalum (Pers. ex J.F.Gmel.) Ditmar, in
Sturm, Deutschl. Fl. Pilze 1(1):21 (1813)

≡ *Stemonitis leucocephala* Pers. ex J.F.Gmel., Syst. Nat.
2:1467 (1792)

Selected material examined: **BRAZIL. Rio Grande do Norte:** Natal, Natal Dunes State Park. Perobinha Trail, 14/IV/2005, A.C.C. Bezerra *et al.* (UFP 40288).

Physarum melleum (Berk. & Broome) Masee, Monogr.
Myxogastr. 278 (1892)

≡ *Didymium melleum* Berk. & Broome, J. Linn. Soc., Bot. 14:83 (1873)
Fig. 9

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 14/VI/2004, sporulation 21/VII/2004, A.C.C. Bezerra *et al.* (UFP 50178); *ibid*, sporulation 29/VI/2004, A.C.C. Bezerra *et al.* (UFP 50202).

Physarum stellatum (Masse) G. W. Martin, Mycologia 39(4):461 (1947)

≡ *Lepidoderma stellatum* Masse, in Cooke, Grevillea 17:60 (1889)

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 14/VI/2004, sporulation 9/VIII/2004, A.C.C. Bezerra *et al.* (UFP 50210).

Didymiaceae

Diderma hemisphaericum (Bull.) Hornem., Fl. Dan. 33:13 (1829)

≡ *Reticularia hemisphaerica* Bull., Herb. France pl. 446, f. 1 (1790)

Fig. 10

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 14/VI/2004, sporulation 09/VII/2004, A.C.C. Bezerra *et al.* (UFP 50371); *ibid*, sporulation 09/VIII/2004, A.C.C. Bezerra *et al.* (UFP 50790); *ibid*, sporulation 10/IX/2004, A.C.C. Bezerra *et al.* (UFP 50787); *ibid*, sporulation 08/IX/2004, A.C.C. Bezerra *et al.* (UFP 50379)

Diderma deplanatum Fr., Syst. Mycol. 3:110 (1829)

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 14/VII/2004, sporulation 27/VII/2004, A.C.C. Bezerra *et al.* (UFP 50782)

Didymium columella-cavum Hochg., Gottsb. & Nann.-Bremek., Proc. Kon. Ned. Akad. Wetensch., C. 92(1):73 (1989)

Fig. 11

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 11/VI/2004, sporulation 9/VII/2004, A.C.C. Bezerra *et al.* (UFP 50368); *ibid*, sporulation 15/VII/2004, A.C.C. Bezerra *et al.* (UFP 50177); *ibid*, sporulation 10/IX/2004, A.C.C. Bezerra *et al.* (UFP 50376); *ibid*, sporulation 9/VIII/2004, A.C.C. Bezerra *et al.* (UFP 50783); *ibid*, sporulation 9/VIII/2004, A.C.C. Bezerra *et al.* (UFP 50210); *ibid*, sporulation 3/VIII/2004, A.C.C. Bezerra *et al.* (UFP 50375). Natal, Natal Dunes State Park, Gameleira Trail, sporulation 11/IX/2006, A.C.C. Bezerra *et al.* (UFP 40896).

Didymium squamulosum (Alb. & Schwein.) Fr., Symb. Gasteromyc. 19 (1818)

≡ *Diderma squamulosum* Alb. & Schwein., Consp. Fung. Lusat. 88 (1805)

Fig. 12

Selected material examined: **BRAZIL. Rio Grande do Norte:** Natal, Natal Dunes State Park. Perobinha trail, 14/IV/2005, *Cecropia* sp., A.C.C. Bezerra *et al.* (UFP 40290).

Stemonitaceae

Comatricha tenerrima (M.A.Curtis) G.Lister, Guide Brit. Mycetozoa, ed. 4 39 (1919)

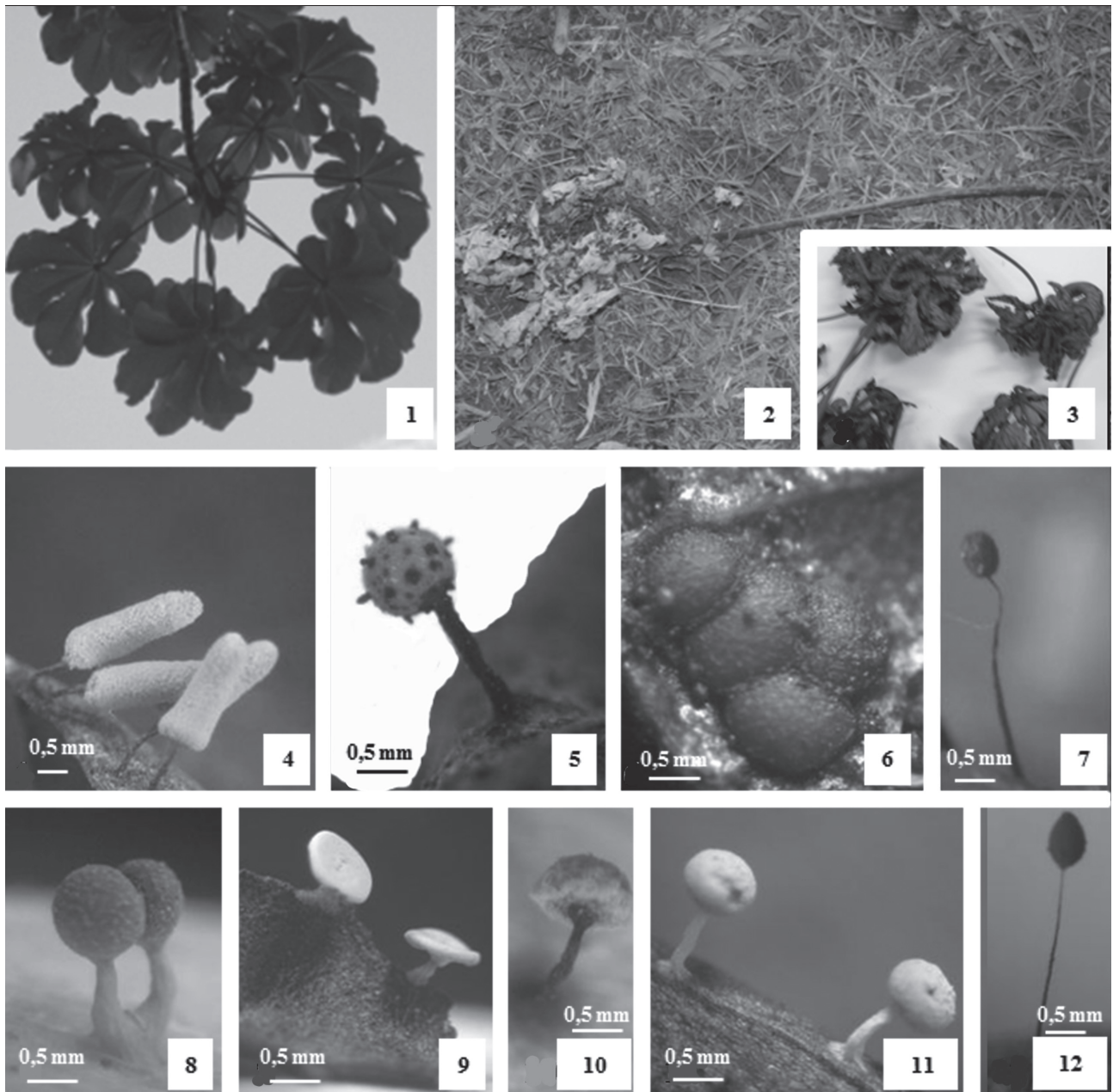
≡ *Stemonitis tenerrima* M.A.Curtis, Amer. J. Sci. Arts 6:352 (1848)

Fig. 13

Selected material examined: **BRAZIL. Rio Grande do Norte:** Baía Formosa, RPPN Estrela Woods, Gameleira trail, culture 14/VI/2004, sporulation 23/VII/2004, A.C.C. Bezerra *et al.* (UFP 50197).

On eight expeditions to the study areas between 2004 and 2006, five specimens and one plasmodium were obtained directly from the field on *C. adenopus* leaves that had fallen to the ground and 87 specimens were developed in 43.7% of the moist-chamber cultures set up separately with blades and petioles. On these collections, 10 genera and 15 species were represented, most belonging to Physarales (47%) and Trichiales (33%). In the cultures set up with leaf blades, *H. pardina*, *C. violacea* and *D. columella-cavum* predominated (Figs. 5; 8; 11), representing 80.5% of the specimens. More than half (60%) of the species were recorded only once either in the field or in the laboratory. Most of the species recorded in the present study are commonly cited as foliicolous, except *Arcyria cinerea* (Fig. 4), which does not have a substrate preference.

The specimens form a set of species that are associated with *C. adenopus* for the first time. However, some species of the myxobiota studied can be considered rare or at least uncommon in microenvironments. *Didymium columella-cavum*, for example, is recorded for the second time for both Brazil and the world and was previously known only from a description made by Hochgesand *et al.* (1989) at two sites in São Paulo state on palm leaves and mosses. Nonetheless, this was one of the species with the greatest number of records in the present study (over 20 specimens). The relative diversity of myxomycetes fructifying on *C. adenopus* leaves may be attributed to the long, hollow petiole and palmed venation blade as well as lobed margins that, upon drying, roll up and form a natural moist chamber, similar to that observed by Stephenson (2003) studying



Figures 1-12. *Cecropia adenopus* Mart. ex Miq. 1. View of upper stratum of Ambay pumpwood individual. 2-3. Blade and leaf petiole fallen on the ground. 4. *Arcyria cinerea* (Bull.) Pers. 5. *Hemitrichia pardina* (Minakata) Ing. 6. *Perichaena depressa* Lib. 7. *Cribraria violacea* Rex. 8. *Physarium melleum* (Berk. & Broome) Massee. 9. *Diderma hemisphaericum* (Bull.) Hornem. 10. *Didymium columella-cavum* Hochg., Gottsb. & Nann.-Bremek. 11. *Didymium squamulosum* (Alb. & Schwein.) Fr. 12. *Comatricha tenerrima* (M.A.Curtis) G.Lister.

myxomycetes associated with the palm tree *Rhopalostylis* in New Zealand. In collections carried out at the Tapacurá Ecological Station in Pernambuco state (Brazil) in 2007, (I. N. Ferreira, personal communication), five species of myxomycetes were obtained from a single dead unidentified *Cecropia* individual. However, despite possessing such characteristics and being distributed from Mexico to Argentina, particularly in the Amazon region, no studies were found in the literature reporting that *C. adenopus* or any other species of the genus has served as substrate for the development of myxomycetes.

Acknowledgments

The authors are grateful to the staff of the Myxomycetes Laboratory (LABMIX) for help in both the field and laboratory, especially Alissandra Nunes, David Lemos, Fátima Bezerra, Glauciane Damasceno, Inaldo Ferreira, Juciara Tenório, Leandro Agra, Marcio Rufino and Wendell Medrado; to the administration of the Estrela Woods Natural Heritage Private Reserve and Natal Dunes State Park for support during the collection period; to the Conselho Nacional de Desenvolvimento Científico

e Tecnológico (CNPq) for financial support; and to the Departamento de Botânica of the Universidade Federal de Pernambuco for the physical support.

References

- Agrios, G.N. 1997. **Plant Pathology**. Lonfon, Academic Press.
- Bezerra A.C.C. & Cavalcanti L.H. 2007. Mixobiota corticícola de *Terminalia catappa* L. (Combretaceae). **Sitientibus Serie Ciências Biológicas** 7: 154-160.
- Braga, R. 1953. **Plantas do Nordeste, especialmente do Ceará**. Fortaleza, Centro de Divulgação Universitária - Estudos e Ensaios Biblioteca de Divulgação e Cultura Publicação.
- Cabrera-de-Alvarez, M.G.; Mazzanti-de-Castanon, M.A. & Cundom, M.A. 1993. Suffocation of tomato seedings by a true slime mold (Myxomycetes), in the northeast of Argentina. **Fitopatologia** 28:10-15.
- Cavalcanti, L.H & Mobin, M. 2004. Myxomycetes associated with palm trees at the Sete Cidades National Park, Piauí State, Brazil. **Systematics and Geography of Plants** 74: 109-127.
- Cavalcanti, L.H.; Correia, A.M.S. & Porto, K.C. 1985. O Herbário de Myxomycetes (Gymnomycota) da UFPE. Pp 189-199. In: **Anais do 33º Congresso Nacional de Botânica** Brasília, DF. 1982. São Paulo, Sociedade Botânica do Brasil.
- Farr, M.L. 1976. **Myxomycetes**. Flora Neotropica. Mon. 16. New York, The New York Botanical Garden.
- Freire, S.M.B. 1990. Levantamento florístico do Parque Estadual das Dunas de Natal. **Acta Botanica Brasilica** 4: 41-59.
- Hernandez-Crespo, J.C. & Lado, L. 2005. **An on-line nomenclatural information system of Eumycetozoa**. <http://www.nomen.eumycetozoa.com> (Acesso em 14/07/07).
- Hoehgesand, E.; Gottsberger, G. & Nannenga-Bremekamp, N.E. 1989. A new species and a new variety of *Didymium* from São Paulo State, Brazil. **Proceedings. Koninklijke Nederlandse Akademie van Wetenschappen.Ser.C, Biological and Medical Sciences** 92: 73-79.
- IDEMA. 2007 (Instituto de Desenvolvimento Econômico e Meio Ambiente do Rio Grande do Norte). Rio Grande do Norte. **Informativo Municipal**: Baía Formosa. Natal, IDEMA.
- Lado C. & Pando F. 1997. **Flora Micológica Ibérica. Myxomycetes I.V.2**. Berlin, Cramer.
- Lister A. 1925. **A monograph of the Mycetozoa**. 3ª. ed., Londres, British Museum of Natural History.
- Martin, G.W. & Alexopoulos, C.J. 1969. **The Myxomycetes**. Iowa, University of Iowa Press.
- Metlitskii, O.Z.; Undritsova, I.A.; Lakhov, V.S. & Sviridov, V.D. 2001. Slime mold of Strawberry. **All-Russian Institute of Breeding and Technology of Horticulture and Nurseries** 11: 35-36.
- Mitchell, D. 2004. A key to corticolous Myxomycota. **Systematics and Geography of Plants** 74: 261-285.
- Mobin, M. & Cavalcanti, L.H. 1998/1999. Myxomycetes sobre buriti (*Mauritia vinifera* L. f; Arecaceae). **Revista da Universidade do Amazonas, Série Ciências Biológicas** 2/3: 43-51.
- Mobin, M. & Cavalcanti, L.H. 2000. Myxomycetes em Carnaúba (*Copernicea prunifera*, Arecaceae). **Acta Botanica Brasilica** 14: 71-75.
- Nieves-Rivera A.M. 2000. Are myxomycetes phytopathogens? **Inoculum** 51: 2-4.
- Ostrosky, A. & Shigo, A.L. 1981. A myxomycete isolated from discolored wood of living red maple. **Mycologia** 73: 997-1000.
- Pereira, L.V. 1984. Nova doença fúngica do guaranázeiro causada por um mixomiceto. **Fitopatologia Brasileira** 9: 161-163.
- Schnittler, M. & Stephenson, S.L. 2002. Inflorescences of Neotropical herbs as a newly discovered microhabitat for myxomycetes. **Mycologia** 94: 6-20.
- Silva, G.S. & Bezerra, J.L. 2005. Ocorrência de *Fuligo septica* em alface e coentro de caboclo. **Fitopatologia brasileira** 30: 439-439.
- Stephenson, S.L. 1988. Distribution and ecology of Myxomycetes in the temperate forests I: patterns of occurrence in the upland forests of Southwestern Virginia. **Canadian Journal of Botany** 66: 2187-2207.
- Stephenson, S.L. 2003. Myxomycetes associated with decaying fronds of nikau palm (*Rhopalostylis sapida*) in New Zealand. **Journal of Botany** 41: 311-317.
- Wordell Filho, J.A.; Rowe, E.; Gonçalves, P.A.; Debarba, J.F.; Boff, P. & Thomazelli, L.F. 2006. **Manejo fitossanitário na cultura da cebola**. Florianópolis, Epagri.
- Wrigley de Basanta, D. 1998. Myxomycetes de la corteza de *Quercus ilex*. **Anales del Jardín Botánico de Madrid** 56(1): 3-14.