Rodriguésia 75: e01802023. 2024
http://rodriguesia.jbrj.gov.br
DOI: http://dx.doi.org/10.1590/2175-7860202475056

Original Paper

Flora of Ceará, Brazil: Anacardiaceae

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Abstract

This study aimed to carry out a floristic-taxonomic inventory of the species of Anacardiaceae occurring in the state of Ceará, with a view to better understanding the diversity and geographical distribution of its representatives, as part of the "Flora of Ceará: knowing to conserve" Project. The study was based on the analysis of morphological characters of samples obtained in the field, herbarium collections and consultation of specialized bibliographies. In Ceará, Anacardiaceae is represented by 10 species belonging to eight genera: *Anacardium* (1), *Apterokarpos* (1), *Astronium* (2), *Schinopisis* (1), *Schinus* (1), *Spondias* (2), *Tapirira* (1) and *Thyrsodium* (1). The species were recorded in different phytophysiognomies, but occur preferentially in drier environments such as the Savanna, Steppic Savanna and Seasonal Deciduous Forest. *Astronium urundeuva* is the taxon with the highest number of records, occurring in 22 municipalities. *Apterokarpos gardneri* and *Spondias tuberosa* are endemic to Brazil, and the first is recorded only in the Northeastern region. Seven species were recorded in nine Conservation Units in Ceará. In identification key, morphological descriptions, comments on geographical distribution, ecology, phenology and uses, maps and illustrations of the species are presented.

Key words: *caatinga*, diversity, Sapindales, semiarid.

Resumo

O estudo objetivou realizar o inventário florístico-taxonômico das espécies de Anacardiaceae ocorrentes no estado do Ceará, visando um melhor entendimento da diversidade e distribuição geográfica dos seus representantes, como parte do Projeto "Flora do Ceará: conhecer para conservar". O estudo foi embasado na análise de caracteres morfológicos de amostras obtidas em campo, coleções de herbário e consulta a bibliografias especializadas. No Ceará, Anacardiaceae está representada por 10 espécies pertencentes a oito gêneros: *Anacardium* (1), *Apterokarpos* (1), *Astronium* (2), *Schinopisis* (1), *Schinus* (1), *Spondias* (2), *Tapirira* (1) e *Thyrsodium* (1). As espécies foram registradas em diferentes fitofisionomias, mas ocorrem preferencialmente em ambientes mais secos como Savana, Savana Estépica e Floresta Estacional Decídua. *Astronium urundeuva* é o táxon com o maior número de registros, ocorrendo em 22 municípios. *Apterokarpos gardneri* e *Spondias tuberosa* são endêmicas do Brasil, sendo a primeira registrada apenas na Região Nordeste. Sete espécies foram registradas em nove Unidades de Conservação do Ceará. Chave de identificação, descrições morfológicas, comentários sobre distribuição geográfica, ecologia, fenologia e usos, mapas e ilustrações das espécies são apresentados.

Palavras-chave: caatinga, diversidade, Sapindales, semiárido.

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Introduction

Anacardiaceae is one of the nine families of the Sapindales order and comprises 81 genera and 800 species, predominantly tropical or subtropical, but also occurring in the temperate zone of the planet (Pell *et al*. 2011). In Brazil, 15 genera and 64 species have been recorded, of which 18 (30%) are endemic (Silva-Luz *et al*. 2023). The representatives of Anacardiaceae are trees, shrubs, rarely subshrubs or climbers with alternate leaves, rarely opposite or verticillate, usually imparipinnate; inflorescences in panicles, racemes, pseudoracemes, thyrses, rarely solitary flowers, axillary or terminal; flowers unisexual and/or bisexual, dichlamydeous, actinomorphic, hypogynous; sepals deciduous or persistent; petals free; stamens 5–10(–12); ovary superior, (1–)3–5-carpelar, 1(–2–5)-locular; ovule 1 per locule; fruit drupe, samara or berry; seed with scarce or absent endosperm (Silva-Luz *et al*. 2023).

Several species of Anacardiaceae have economic importance, with emphasis on edible fruits, useful wood, ornamental use and the pharmaceutical industry (Fenner *et al*. 2006). The fruits of *Anacardium occidentale* L. (cashew), *Mangifera indica* L. (manga), *Spondias mombin* L. (cajá), *Spondias tuberosa* Arruda (imbu) and *Spondias purpurea* L. (seriguela) are used as food *in natura* or in the preparation of sweets, juices and ice cream (Souza & Lorenzi 2005; Lorenzi & Matos 2021). The wood of *Schinus terebinthifolia* Raddi (aroeira da praia) is widely used for poles, firewood, charcoal and for planting trees in streets and squares (Lorenzi & Matos 2021). *Astronium urundeuva* (M.Allemão) Engl. (aroeira) is used to cure skin, urinary and respiratory infections (Lorenzi & Matos 2021; Oliveira *et al.* 2022).

In Brazil, taxonomic and floristic studies on representatives of the Anacardiaceae have been carried out in different states such as Acre (Daly & Silveira 2008), Minas Gerais (Pirani 1987, 2003), Rio de Janeiro (Machado & Konno 2010), São Paulo (Silva-Luz 2011) and Pará (Hall & Gil 2017; Pereira *et al*. 2021). However, in northeastern Brazil, floristic studies on the Anacardiaceae are still incipient, having only been carried out in the states of Bahia (Santos *et al*. 2008) and Alagoas (Lyra-Lemos *et al*. 2010). In Ceará, Anacardiaceae species have only been mentioned in floristic lists (Silva *et al*. 2012; Loiola *et al*. 2015, 2020; Silveira *et al*. 2020a, b).

This study is part of the "Flora of Ceará: Knowing to Conserve Project" and aimed to carry out a floristic-taxonomic inventory of Anacardiaceae species, with a view to better understanding the diversity and geographical distribution of its representatives.

Material and Methods

The study was based on the comparative analysis of vegetative and reproductive characters of specimens deposited in the ASE, EAC, HCDAL, HUEFS, HUVA, MBM, NY and PEL herbaria (acronyms according to Thiers, continuously updated), samples obtained in the field between January 2022 and May 2023 and consultation of the literature. The identifications were made with the help of specialized bibliographies (Silva-Luz 2011; Silva-Luz *et al*. 2023), and confirmed with exsiccates identified by specialists, and images of type collections available on REFLORA (2023), JSTOR (2023) and speciesLink (CRIA 2023a). The authors of the species are according to The International Plant Names Index (IPNI 2022). In this study, only native species we considered.

The morphological characters were described based on Harris & Harris (2001). For each genus and their respective taxa, a specific terminology and pattern of description were adopted. The size of the flower includes the pedicel. Information on habit, habitat, phenology and popular names was obtained from labels on the exsiccates analyzed and/or from observations in the field.

The data on distribution in the world and in Brazil were obtained from specialized literature (Lorenzi 1992, 2002; Killean *et al*. 1993; Mitchell & Daly 1993; Carvalho 1994; Geilfus 1994; Mitchell 1995; Barrance *et al*. 2003; Silva-Luz *et al.* 2023). The distribution maps were drawn up in ArcGIS, based mainly on the records with original geographical coordinates.

Vegetation types for the state of Ceará were adapted from the classification of Figueiredo (1997) and the Technical Manual of Brazilian Vegetation (IBGE 2012): Vegetation Complex of the Coastal Zone (comprising Pioneer Psammophilous Vegetation, Forest behind Dunes, and Lowland Semideciduous Seasonal Forest), Neotropical Savanna (*Cerrado*), Semideciduous Seasonal Forest (Dry Forest), Steppic Savanna (*Caatinga* and/or *Carrasco*), Dense Ombrophilous Forest (Wet Forest), and Vegetation under Fluvial and/or Lacustrine Influence (Riparian Forest).

Results and Discussion

Eight genera and 10 native species of Anacardiaceae have been considered in the state of Ceará: *Anacardium occidentale* L., *Apterokarpos gardneri* (Engl.) Rizzini, *Astronium graveolens* Jacq., *Astronium urundeuva* (M.Allemão) Engl., *Schinopsis brasiliensis* Engl., *Schinus terebinthifolia* Raddi., *Spondias mombin* L., *Spondias tuberosa* Arruda, *Tapirira guianensis* Aubl. and *Thyrsodium spruceanum* Benth. Although *Lithraea molleoides* (Vell.) Engl. and *Schinus rhoifolia* Mart. has been cited for Ceará (Silva-Luz *et al*. 2023), no exsiccates were found in the databases consulted, so this taxon was not dealt with in this study.

The *Astronium graveolens* and *A. fraxinifolium* collections's analyzed did not present consistent differential vegetative and reproductive morphological characters and, therefore, were treated them both under the first name, as it was the oldest. It is worth noting that these taxa were considered conspecific by Blackwell & Dodson (1968) due to the overlap of characters related to leaf shape and type of indumentum. Although Santin (1989) considered these taxa distinct regarding aspects of the rhytidome (it forms plates that detach leaving depressions in *A. fraxinifolium* and in *A. graveolens* the plates detach without leaving a depression) and the embryo (*A. fraxinifolium* has a differentiated plumule in the median part of the hypocotyl-radicle axis and *A. graveolens* does not present this differentiation), this same author highlighted that the flowers and fruits do not present any characteristic that allows the separation of the two species. Given this fact, we suggest the need for a more detailed study of populations in various types of vegetation to verify whether or not they are simply phenotypic variations in response to different environmental factors.

The species with the highest number of records per municipality were *Astronium urundeuva* (23) and *Anacardium occidentale* (19), both of which occur mainly in vegetation of the type Steppic Savanna, Savanna and Vegetation Complex of the Coastal Zone (Lowland Semi-deciduous Forest). *Schinopsis brasiliensis* and *S. terebinthifolia* were the taxa with the most restricted distribution, with records in only two and one municipality, respectively. These species occur preferentially in the Steppic Savanna, Semideciduous Seasonal Forest and Lowland Semideciduous Seasonal Forest.

Seven species were recorded in 10 legally protected Conservation Areas in Ceará: Environmental Protection Area (EPA) Ponta Grossa (*Anacardium occidentale*), EPA Pacoti River (*A. occidentale*), Ecological Station (ES) of Aiuaba (*Astronium urundeuva*, *Schinopsis brasiliensis* and *Spondias tuberosa*), ES Pecém (*A. occidentale*), Araripe-Apodi National Forest (*A. occidentale*), Botanical Garden São Gonçalo of Amarante (*Tapirira guianensis*), State Botanical Park of Ceará (*Astronium urundeuva*), Cocó State Park (*Astronium urundeuva*, *Spondias mombin* and *Tapirira guianensis*), Ubajara National Park (*T. guianensis* and *Thyrsodium spruceanum*) and Private Natural Heritage Reserve (PNHR) Serra das Almas (*A. occidentale*).

Taxonomic treatment

Anacardiaceae R.Br., Narr. Exped. Zaire 431 (1818), nom. cons.

Dioecious, monoecious or polygamous, trees or shrubs; leaves alternate, simple or compound, imparipinnate, petiolate, without stipules; leaflets alternate, opposite or subopposite, sessile or with a petiolule, margin entire, serrate, crenate or crenate-serrate. Inflorescences axillary or terminal, thyrsoid or paniculate. Flowers unisexual and/or bisexual, dichlamydeous, actinomorphic, hypogynous, usually 5-merous, staminodes or pistillodes well developed, hypanthium sometimes present, sepals usually connate at the base, deciduous or persistent, sometimes enlarged in the fruit; petals free, prefloration valvate or imbricate; stamens 5–10, in 1 or 2 whorls, free or connate at the base; nectary disc annular, usually intrastaminal, sometimes absent; ovary pubescent, usually syncarpous, (1–)3–5-carpellate, 1(–2–5)-locular; ovule 1-locular. Fruit usually drupes, fleshy or dry, sometimes berries, winged or not, sometimes with a fleshy hypocarp.

Identification key of Anacardiaceae genus occurring in the state of Ceará

1. Leaves simple; drupe reniform; hypocarp present..... 1. *Anacardium occidentale*
1'. Leaves compound; berry, samaroid achene or drupe ovoid, broadly ellipsoid, globose, subglobose, oblong-ovoid, orbicular, obovoid; hypocarp absent.
    2. Petiole winged..... 5. *Schinus terebinthifolia*

2’. Petiole cylindrical.
3. Fruit samaroid achene or berry.
4. Branches smooth; leaflets with serrate margin; fruit berry .....3.1. *Astronium graveolens*
4’. Branches fissured; leaflets with entire margin; fruit samaroid achene.....
.....4. *Schinopsis brasiliensis*
3’. Fruit drupe.
5. Branches and inflorescence pubescent-ferrugineous; flowers with hypanthium; fruit pubescent, green to green-ferrugineous ..... 8. *Thyrsodium spruceanum*
5’. Branches grayish and inflorescence whitish, yellowish or greenish; flowers without hypanthium; fruits glabrous or sericeous, blackish, greenish, brown, yellow or pinkish-red.
6. Leaves with marginal vein.
7. Leaflet with intersecondary vein .....6.1. *Spondias mombin*
7’. Leaflet without intersecondary vein .....6.2. *Spondias tuberosa*
6’. Leaves without marginal vein.
8. Fruit winged ..... 3.2. *Astronium urundeuva*
8’. Fruit non winged.
9. Leaflet with crenate margin.....2. *Apterokarpos gardneri*
9’. Leaflet with entire margin .....7. *Tapirira guianensis*

1. *Anacardium occidentale* L., Sp. Pl. 1: 383 (1753). Figs. 1; 2a-d

Andromonoecious trees 2.5–16 m tall. Unarmed branches lenticellate, glabrous or sparsely pubescent, grayish. Leaves 3.2–14.9 cm long, simple, alternate, obovate to oblong, apex rounded to emarginate, base cuneate to rounded, rarely asymmetrical, margin entire, coriaceous; adaxial and abaxial surface glabrous; petioles 0.4–1.8 cm long, cylindrical, not winged, glabrous. Thyroids 7.5–19.6 cm long, terminal and axillary, pubescent; bracts ca. 0.6 × 1 cm, oblanceolate to obovate. Flowers pedicellate, sericeous; bracteoles ca. 3 × 1 cm, ovate to lanceolate, deciduous; sepals 0.3–0.4 × 0.1–0.3 cm, ovate to elliptic, green, adaxial side sparsely sericeous, abaxial side densely sericeous; petals 0.7–1.2 × 0.2 cm, lanceolate, cream-pink, adaxial side sericeous, abaxial side dense sericeous; stamens 8, heterodynamous; staminate flowers 0.4–1.3 × 0.3–0.5 cm; bisexual flowers 1.4–1.5 × 0.3–0.4 cm; ovary 0.1–0.2 × 0.15–0.3 cm, globose, glabrous, 1-carpellate, 1-locular. Drupe 2.5–3.2 × 1.9–2.2 cm, reniform, glabrous, grayish to brown, with a yellow, orange or red hypocarp.

Selected examined material: Aquiraz, trilha da Lagoa Encantada, 03º58’27’’S, 38º16’45’’W, 3.XI.2016, fl., *A.P. Negreiros et al. 52* (EAC). Barbalha, Floresta Nacional do Araripe-Apodi, 07°18’40”S, 39°18’15”W, 10.X.2000, fl., *I.R. Costa 72* (EAC). Barreira, 04º28’69’’S, 38º64’31’’W, 29.IX.2018, fl., *M.M.L. Mendeiros* (EAC 61762). Caririaçu, Sítio Bananeiras, 07°02’32”S, 39°17’01”W, 6.IX.2008, fl., *A.C.A. Morais 83* (EAC, HCDAL). Cascavel, comunidade quilombola Lagoa das Melancias, 04º24’50’’S, 38º24’39’’W, 9.XII.2016, fl., *J.C.M.S.M. Sobczak 287* (EAC). Caucaia, Duna Cumbuco, 03º36’43’’S, 38º46’02’’W, 3.XI.2018, fl., *G. Alves* (EAC 61874). Crateús, RPPN Serra das Almas, 05º08’50’’S, 40º54’98’’W, 9.VII.2017, *H.M. Meneses 240* (EAC). Crato, Floresta Nacional do Araripe-Apodi, 07º24’28’’S, 29º20’55”W, 4.IX.2001, fl., *I.R.Costa 380* (EAC). Eusébio, APA do Rio Pacoti, 03º85’28’’S, 38º42’24’’W, 19.IX.2017, fl., *S.T. Rabelo & L.X. Sampaio 7* (EAC). Fortaleza, Campus do Pici, Laboratório de Recursos Aquáticos LARAq, 03°44’26”S, 38°34’28”W, 28.II.2023, fl. and fr., *J.V.G Gama 2* (EAC); Campus do Pici, Praça Prisco Bezerra, 03°44’19”S, 38°34’10”W, 28.II.2023, fl. and fr., *J.V.G Gama 1* (EAC). Horizonte, Jardim, 07°34’57”S, 39°17’53”W, 23.X.2008, fl., *L.K.P Dutra & F.R Silva* (EAC 47350, HCDAL 4097). Icapuí, APA de Ponta Grossa, 04°42’47”S, 37°21’19”W, 29.IV.2000, fl., *Braga et al. 9* (EAC). Itapipoca, Lavaginha, 30.X.1995, fl., *A.M. Figueiredo* (EAC 23397). Jericoacoara, Serrote, 02°53’42”S, 40°26’57”W, 6.III.1997, fl., *L.Q.Matias 43* (EAC). Lavras da Mangabeira, talhado do Rio Salgado, 4.X.1980, fl. and fr., *A. Fernandes & F.J.A. Matos* (EAC 9030). Redenção, Fazendo Experimental Piroás, 04°13’33”S, 38°43’50”W, 4.IX.2015, fl., *J.C.M.S.M. Sobczak 90* (EAC). Russas, comunidade Lagoa dos Cavalos, 04º56’45’’S, 38º77’32’’W, 18.X.2018, fl., *L.Q.V. Braga* (EAC 62446). São Gonçalo do Amarante, Estação Ecológica do Pecém, 03°36’26”S, 38°58’06”W, 27.VIII.2005, fl., *I.J. Roberto 05* (EAC). Viçosa do Ceará, Serra das Flores, 4.VIII.2005, *L.W. Lima-Verde et al. 3407-07* (EAC).

Anacardium occidentale is distinct from other species of Anacardiaceae found in Ceará by its simple and coriaceous leaves, flowers

staminate and bisexual (andromonoecious plant), stamens heterodynamous and drupe reniform, with hypocarp yellow, orange or red.

This species occurs from Honduras, through Colombia, Venezuela and the Guianas to Southeastern Brazil and Eastern Paraguay (Mitchell & Mori 1987). In Brazil, there are records in the Northern, Northeastern, Midwest and Southeastern regions in the Amazon, *Caatinga*, *Cerrado*, Atlantic Forest and Pantanal phytogeographic domains (Silva-Luz *et al.* 2023). In Ceará, the species has a wide distribution, being recorded in Neotropical Savanna, Steppic Savanna, Semideciduous Seasonal Forest, Vegetation Complex of the Coastal Zone (Lowland Semideciduous Seasonal Forest), Dense Ombrophilous Forest and Vegetation under Fluvial and/or Lacustrine Influence. The species has been recorded in five Conservation Units: Araripe-Apodi National Forest, PNHR Serra das Almas, EPA Pacoti River, EPA Ponta Grossa and ES Pecém.

The species was collected with flowers between February and December and with fruit between February and October.

Anacardium occidentale is economically important because its fruit (cashew nut) and hypocarp are edible and highly prized worldwide (Mitchel & Mori 1987). From the wall of the fruit it is possible to extract the liquid "CNS", used in the production of plastics, paints, resins and varnishes (Mitchel & Mori 1987). The stem and leaves have chemical constituents directly related to antioxidant activities (Silva *et al.* 2007). This species is indicated in the treatment of infectious, inflammatory and healing processes (Souza *et al.* 2022).

The vernacular names of this species are *cajueiro*, *cajueiro-ligeiro*.

2. *Apterokarpos gardneri* (Engl.) Rizzini, Leandra. 6: 40(-42) (1975). Figs. 1; 2e-f

Dioecious trees 4–7 m tall. Unarmed branches pendulous, lenticellate, pubescent, grayish, with abundant resin on the young branches. Leaves 5.8–26.5 cm long, compound, imparipinnate; petioles 0.7–4.1 cm long, cylindrical, nor winged, pubescent; leaflets 0.5–5 × 0.4–3.8 cm, opposite, oblong or ovate, base rounded or asymmetric,

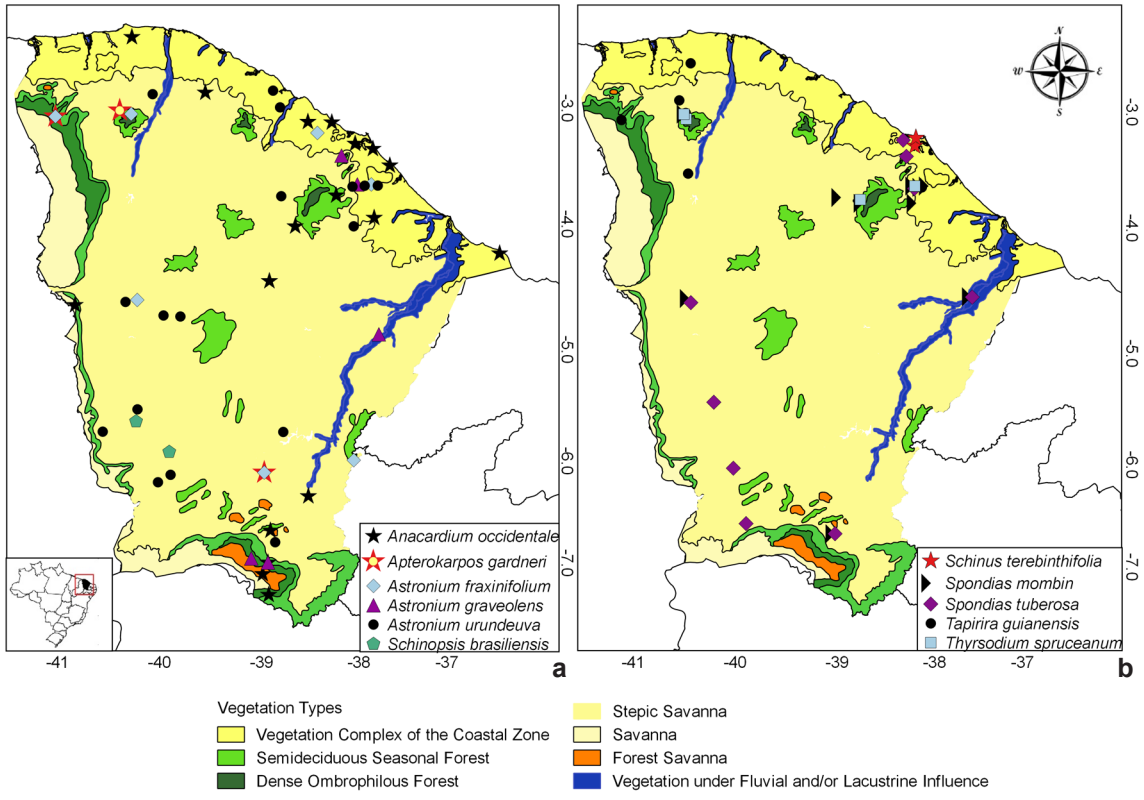

Figure 1 – a-b. Geographic distribution of Anacardiaceae in Ceará state.

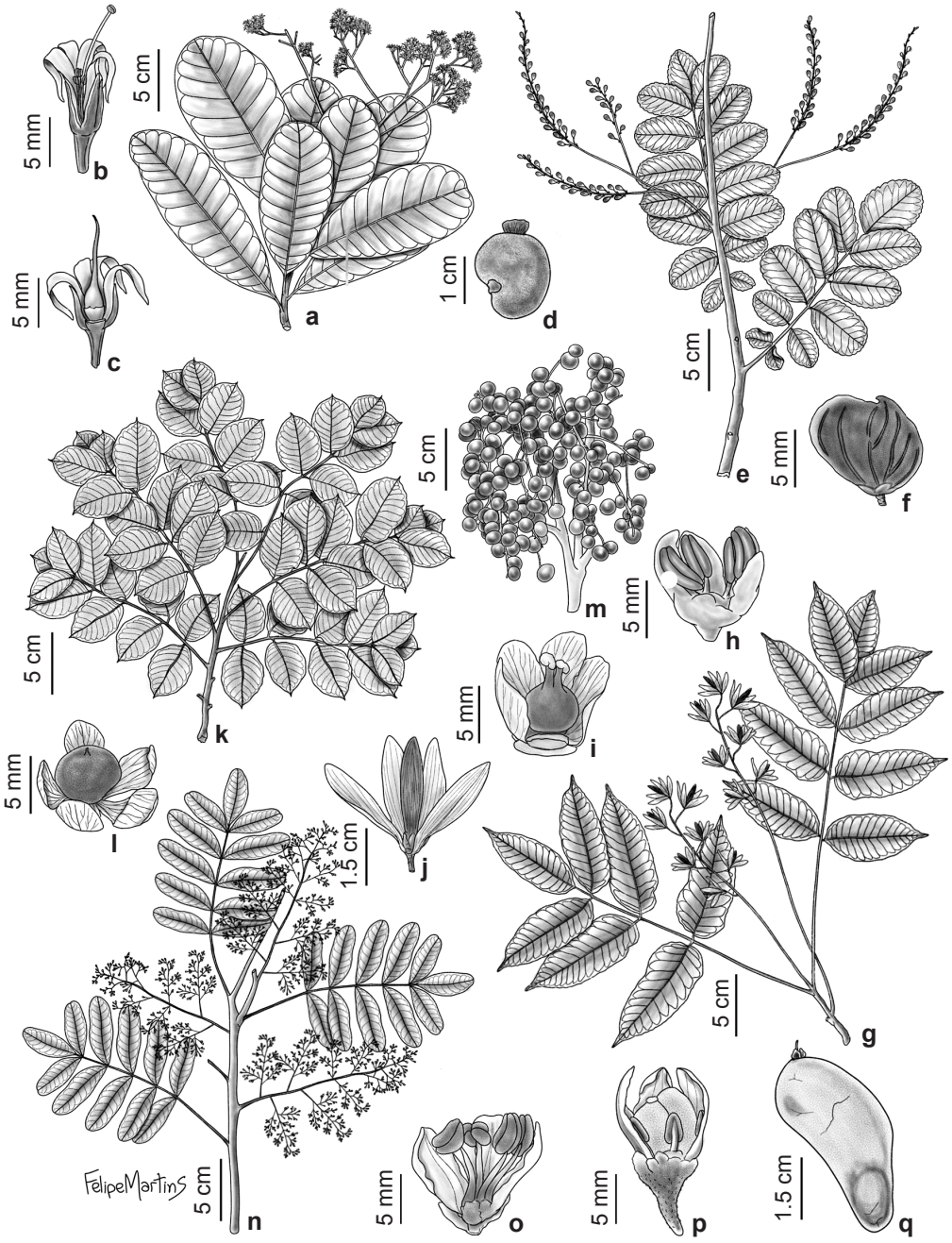

Figure 2 – a-d. *Anacardium occidentale* – a. flowering branch; b. staminate flower (lateral view); c. bisexual flower (longitudinal section; one sepal and one petal removed); d. reniform drupe. e-f. *Apterokarpos gardneri* – e. fruiting branch; f. drupe. g-j. *Astronium graveolens* – g. fruiting branch; h. staminate flower (longitudinal section, two petals and two sepals removed); i. pistillate flower showing only the pistil (longitudinal section, one petal and one sepal removed); j. fusiform berry (longitudinal section, one sepal and one petal removed). k-m. *Astronium urundeuva* – k. vegetative branch; l. fruit with persistent sepals; m. immature fruiting branch. n-q. *Schinopsis brasiliensis* – n. flowering branch; o. staminate flower (longitudinal section, two petals and two sepals removed); p. pistillate flower (longitudinal section, two petals and two sepals removed); q. samara. (a-d. *J.V.G. Gama 2*; e-f. *E. Silveira* (EAC 39326); g, j. *A.S.F. Castro 929*; h-i. *M.F. Mata* (EAC 13522); k. *J.V.X. Santos Filho* (EAC 64960); l-m. *J.C.M.S.M. Sobczak 92*; n-o. *M.A Figueiredo et al.* (EAC 37709); p. *L.W. Lima-Verde et al. 309*; q. *L.W. Lima-Verde* (EAC 37711).

apex rounded to truncate, cuspidate, margin crenate, chartaceous; adaxial and abaxial faces with sparse trichomes, veins pubescent; petioles 1–2 mm long. Panicles 7–45 cm, terminal, lax, pubescent; peduncle 1–6.5 cm long, pubescent; bracts 0.2–0.3 × 0.5 cm, lanceolate. Flowers unisexual, pedicellate, sericeous; bracteoles ca. 0.1 × 0.05 cm, lanceolate; sepals 0.1–0.2 × 0.5–0.1 cm, ovate, glabrous, yellowish-green; petals 0.1–0.15 × 0.05–0.1 cm, ovate, acute apex, glabrous, yellowish-green; staminate flowers 0.1–0.2 × 0.1–0.2 cm, 5 stamens, ca. 1 mm long; pistillate flower and ovary not observed. Drupe ca. 1 × 0.4 cm, orbicular, brownish.

Examined material: Farias Brito, assentamento Flor da América, 06°55'50"S, 39°33'56"W, 19.XI.2008, fl., *R.G. Ferreira 81* (EAC). Ubajara, Ibiapaba, 29.III.1995, fl., *F.S Araújo 612* (EAC, HCDAL); Chapada da Ibiapaba, 30.IV.1987, fl. and fr., *A. Fernandes et Matos* (EAC 15132). Viçosa do Ceará, Cocalzinho, 8.V.2003, fl. and fr., *A. Fernandes* (EAC 32509); 03°33'44"S, 41°05'32"W, 16.VI.2006, fl. and fr., *E. Silveira* (EAC 39326).

Apterokarpos gardneri is a notably distinct species, characterized by its pendulous branches with abundant resin on the young branches, as well as being the only species to have leaves with a crenate margin. Another striking feature is the lax panicle inflorescence.

This species is endemic to the Northeastern region of Brazil, with records in Bahia, Ceará, Pernambuco and Piauí in the *Caatinga* phytogeographic domain (Silva-Luz *et al*. 2023). In Ceará, the species was recorded in three municipalities in Neotropical Savanna and Steppic Savanna.

The species was collected with flowers in March, May, June and November; and with fruit in April and May.

The uses of this species were not recorded.

The vernacular name of this species is *aroeira brava*.

3. ***Astronium*** Schott, Syst. Veg., ed. 16 [Sprengel] 4(2, Cur. Post.): 404 (1827).

Deciduous trees; branches unarmed, grayish. Leaves compound, alternate, imparipinnate, membranaceous or chartaceous, petiolate; petioles cylindrical, not winged; leaflets subopposite, opposite or alternate, margin entire, serrate or crenate-serrate, slightly undulate, base asymmetrical or cuneate, concave or convex, primary vein prominent or flat on the adaxial side and prominent on the abaxial side. Inflorescences thyrsoid, axillary or terminal, pedunculate; bracts and bracteoles deciduous. Flowers 5-merous, unisexual, pedicel articulated or not; sepals free, larger than the petals in the female flowers; petals imbricated; stamens 5, homodynamous, between the lobes of the disk, anthers complanate or ovoid; 5 staminodes ca. 1 mm long in the female flowers; ovary 3-carpellate, 1-locular; ovule subapical; pistillode absent in the male flowers. Berry fusiform or drupe globose or ovoid, winged, surrounded by a persistent and enlarged calyx, brownish.

3.1. ***Astronium graveolens*** Jacq., Enum. Syst. Pl. 33 (1760). Figs. 1; 2g-j

Trees 1.5–8 m tall. Branches lenticellate, glabrous, grayish. Leaves 15.5–42 cm long; petiole 1–17 cm, pubescent; leaflets 2–16.3 × 1.2–8.2 cm, alternate, opposite or subopposite, oblong-lanceolate to ovate-lanceolate, apex long-acuminate, base asymmetrical, cuneate, concave or convex, oblique to truncate to subcordate, margin slightly serrate or crenate-serrate, undulate; adaxial and abaxial surfaces glabrous and with prominent veins; petiole 0.2–0.8 cm long. Thyroids 5.5–35 cm, axillary or terminal, pubescent; peduncle 0.2–4.5 cm long, pubescent; bracts 0.05–1 × 0.1–1.0 cm, oval, deltoid or oblong, pubescent. Flowers with inconspicuous pedicels, sericeous; bracteoles 0.05–0.15 × 0.05–0.1 cm, ovate, deltoid or oblong, glabrous; sepals 0.2–1.7 × 0.15–4 cm, ovate to elliptic, green, glabrous; petals 0.15–0.2 × 0.15–0.1 cm, lanceolate, apex acute to acuminate, cream, glabrous; staminate flower 0.05–0.35 × 0.2–0.25 cm, ca. 2 mm long; pistillate flower 0.05–2 × 0.2–1 cm; ovary 0.1–0.15 × 0.1 cm, ovoid, glabrous. Berry 1.2–1.5 × 0.2–0.3 cm, fusiform.

Examined material: Acarape, Garapa, 04°13'27"S, 38°42'30"W, 30.VIII.2002, *E.R. Silveira* (EAC 32140). Caucaia, 03°42'01"S, 38°53'18"W, 29.XI.2013, fl. and fr., *E.R. Silveira* (EAC 58390). Crateús, Belém da Serra, Cabeça da Onça, Serra Ibiapaba, 05°10'42"S, 40°40'39"W, 21.I.2007, fl., *Sebastião Carlo* (EAC 39786). Farias Brito, Assentamento Flor da América, 06°55'50"S, 39°33'56"W, 8.XI.2008, fl., *R.G. Ferreira 74* (EAC). Ibiapina, localidade de Quatis, trilha do Sítio Quatis para Cachoeira do Tope, divisa com município de São Benedito, 03°58'13"S, 40°50'27"W, 20.XII.2013, fl., *E.B. Souza et al. 2858* (EAC, HUVA). Jaguaribara, Fazenda Muriá, 03°43'02"S, 38°32'35"W, 21.VII.2005, *D. Macedo 41* (EAC). Lavras da Mangabeira, 06°45'08"S, 38°58'24"W, 21.IX.2013, fl. and fr., *J.T. Calixto Jr.* (EAC 54265). Maranguape, rodagem para Maranguape, 05°39'29"S, 38°37'12"W, 15.IX.1955, *A. Ducke 2489* (EAC). Meruoca, Sítio Lages dos Alexandrinos, 03°32'30"S, 40°27'18"W, 21.X.1998,

fl., *F.S. Cavalcanti* (EAC 28405). Missão Velha, Sítio Cachoeira, 07°14’58”S, 39°08’35”W, 25.X.2005, fl. and fr., *E.N. Silva 5* (EAC). Redenção, estrada para Serrinha, 29.X.1980, fl., *A. Fernandes* (EAC 4357). Viçosa do Ceará, Cocalzinho, Chapada da Ibiapaba, 21.VIII.1987, fl., *A. Fernandes & F.J.A. Matos* (EAC 15095).

Astronium graveolens is characterized by its leaflets with slightly serrate or crenate-serrate and undulate margins, both sides glabrous with prominent veins and, above all, by being the only species that has a fruit in fusiform berry. This is the main difference from *A. urundeuva*, which has fruit type globose or ovoid drupe.

The species has been recorded from Mexico to Brazil, Bolivia and Paraguay (Barrance *et al*. 2003). In Brazil, *Astronium graveolens* occurs in all regions in the Amazon, *Caatinga*, *Cerrado*, Atlantic Forest and *Pampa* domains (Silva-Luz *et al*. 2023). In Ceará, this species has been recorded in Neotropical Savanna, Steppic Savanna, Semideciduous Seasonal Forest, Dense Ombrophilous Forest and Lowland Semideciduous Seasonal Forest.

The species was collected with flowers and fruits between January and September.

The leaves and stem of *A. graveolens* have potential for the pharmaceutical industry, as they have antibacterial activity (Hernández *et al*. 2013). The wood is considered to be of very high quality and is used in construction and furniture making (Lorenzi 2002).

The vernacular names of this species are *gonçalo-alves*, *gonçaleiro*, *gonçalavo*.

3.2. *Astronium urundeuva* Engl., Bot. Jahrb. Syst. 1(1): 45 (1880). Figs. 1; 2k-m; 3a-e

Trees 7–20 m tall. Branches lenticellate, pubescent, grayish. Leaves 11–38.5 cm long; petiole 1–5.3 cm long, pubescent; leaflets 1–7.5 × 0.8–3.7 cm, opposite or subopposite, sessile or with short petiole, oblanceolate, lanceolate or elliptic, apex acute, acuminate, obtuse or mucronate, margin entire, slightly serrate, base asymmetric, cuneate, convex or truncate, adaxial surface glabrous, abaxial surface sparsely pubescent, dense pubescent only on primary vein; petioles 0.1–0.5 cm long. Thyroids 8.5–34.5 cm, axillary or terminal, reddish-cream; peduncle 0.8–5.5 cm long, pubescent; bracts 0.1–0.3 × 0.05–0.2 cm, ovate, deltoid or oblong, concave, scarlet, pubescent. Flowers with inconspicuous pedicels, sericeous; bracteoles 0.05–0.1 × 0.05–0.1 cm, ovate, deltoid or oblong, glabrous; sepals 0.07–0.7 × 0.05–0.4 cm, cream or purple, ovate or oblong, deciduous; petals 0.1–0.6 × 0.05–0.3 cm, cream, ovate or elliptic; staminate flowers 0.15 × 0.15 cm; pistillate flower 0.15 × 0.1 cm, ovary ovoid, glabrous. Drupe 0.3–0.5 × 0.2–0.5 cm, globose or ovoid, brownish. **Examined material**: Acarape, Garapa, 04°14’30”S, 38°38’04”W, 20.X.2012, fl. and fr., *E. Silveira* (EAC 53036; HUEFS). Aiuaba, Estação Ecológica de Aiuaba, Alecrim, 6.VIII.1996, fl., *E.L. Paula-Zárate et al. 273* (EAC); Lagoa do Rosio, 06°34’25”S, 40°07’25”W, 16.VIII.1991, fl. and fr., *M.A. Figueiredo et al 448* (EAC). Caridade, Campos Belos, 04°13’56”S, 39°11’33”W, 8.VII.2008, *M.O.T. Menezes 69* (EAC). Caucaia, Parque Estadual Botânico do Ceará, 03°44’10”S, 38°39’11”W, 15.II.2005, *K.L.P. Batista & M.G.A. Lima* (EAC 34776). Crateús, Bairro Santa Luzia, próx. Barragem, 05°12’18”S, 40°39’W, 5.XI.2009, fl. and fr., *S. Quesado Jr.* (EAC 45743); Tapuio, 05º12’07’’S, 40º49’87W, 10.VII.2017, fl., *H.M. Meneses* (EAC 61713). Crato, Sítio Fundão, 07°14’03”S, 39°24’34”W, 10.VIII.1993, fl., *M.A. Figueiredo & M. Mata* (EAC 20089). Flecheirinhas, margem da BR-222, 1.IX.1979, fl. and fr., *F.J.A. Matos* (EAC 6896). Fortaleza, Campus do Pici, UFC, 03°43’02”S, 38°32’35”W, 21.XII.2009, *L.M.B. Oliveira 2* (EAC); Parque Estadual do Cocó, 03º74’43’’S, 38º48’66’’W, 30.VII.2019, fl., *S.M. Morais & F.F.S. Lopes* (EAC 62695). Guaiúba, Fazenda da UECE, 04°02’23”S, 38°38’14”W, 17.XII.2009, fl. and fr., *L.M. Oliveira 2* (EAC). Guaramiranga, Sítio Salva-Vidas, 04°15’16”S, 38°59’31”W, 26.IX.2008, *L.W. Lima-Verde 3526* (EAC). Iguatu, 06°21’ 34”S, 39°17’55”W, 6.VIII.1988, fl. and fr., *M.A.M. Bandeira* (EAC 14988). Independência, Livre nos Deus, 24.VI.1983, fl., *M.A. Figueiredo* (EAC 12177). Maranguape, Sítio Recanto do Sossego, 03°53’27”S, 38°41’08”W, 30.XI.2000, fl. and fr., *G.N. Maia* (EAC 30220). Meruoca, 03°32’30”S, 40°27’18”W, 27.VIII.2000, fl. and fr., *M.S. Queiroz* (EAC 29851); Palestina, Sítio São Gonçalo, 03º37’47’’S, 40º27’44”W, 4.XI.2017, fl. and fr., *A.F.B. Silva 122* (EAC). Morada Nova, 05°06’24”S, 38°22’21”W, 10.XII.1987, fl. and fr., *A. Miguel* (EAC 48661). Novo Oriente, Planalto da Ibiapaba, 3.VII.1991, *F.S. Araújo 495* (EAC). Parambu, Altamira, 06º02’34’’S, 40º40’21’’W, 10.VII.2016, fl., *M.R.K.G. Mota 19* (EAC). Paraipaba, Boa Vista, 03º22’35’’S, 39º11’45’’W, 15.X.2021, fl., *J.V.X. Santos Filho* (EAC 64960). Pentecoste, Fazenda Experimental Vale do Curu, 03º48’36’’S, 39º20’24’’W, 18.VIII.2015, fl., *C.C. Oliveira 79* (EAC 60719). Quixadá, Fazenda Não Me Deixes, 04º48’53’’S, 38º58’31’’W, 13.VI.2016, *C.C. Oliveira 119* (EAC). Quixeré, Fazenda Mato Alto, 16.IX.1996, fl., *L.W. Lima-Verde et al. 314* (EAC). Tauá, Tecelão, bacia do riacho Carrapateira, 05°24’33”S, 40°04”10”W, 23.VIII.2014, fl. and fr., *R.C. Gomes* (EAC 57345). Tururu, comunidade quilombola de Água Preta, 03°34’51”S, 39°26’14”W, 15.IX.2015, fl., *J.C.M.S.M. Sobczak 92* (EAC).

Figure 3 – a-e. *Astronium urundeuva* – a. habit; b. vegetative branch; c. flowering branch; d. pistilate flowers; e. mature fruiting branch. f-h. *Schinopsis brasiliensis* – f. branch with leaves and inflorescence; g. flowering branch; h. fruiting branch. i. *Spondias mombin* – i. rhytidome. (a-j. *R.T. Queiroz*).

Astronium urundeuva is characterized by having lenticellate and pubescent branches, leaflets with a glabrous adaxial surface, a sparsely pubescent abaxial surface and dense pubescence only on the primary vein and, mainly and drupe.

Astronium urundeuva occurs from the extreme northwest of Argentina (Castiglioni 1975), Bolivia (Killeen *et al*. 1993), Paraguay (Lopez *et al.* 1987). In Brazil, the species has been recorded in all regions of the country in the *Caatinga*, *Cerrado*, Atlantic Forest, *Pampa* and *Pantanal* phytogeographic domains (Silva-Luz *et al*. 2023). In Ceará, the species has been recorded in Semideciduous Seasonal Forest, Dense Ombrophilous Forest, Steppic Savanna and Lowland Semideciduous Seasonal Forest. It was found in three Conservation Units: ES Aiuaba, State Botanical Park of Ceará and Cocó State Park.

The species was collected with flowers and fruit between May and December.

In Brazil, *A. urundeuva* is widely used in folk medicine for its astringent, balsamic, analgesic, healing, anti-inflammatory and antibacterial properties (Pareyn *et al*. 2018). However, due to the presence of small amounts of alkyl phenols, the use of fruits, leaves, bark or other parts of the plant should be carried out with caution, as they can cause allergic dermatitis in sensitive people (Camillo 2018; Henriques *et al*. 2018). The plant has ornamental potential and is suitable for urban afforestation and the recovery of degraded areas (Pareyn *et al*. 2018). Its flowers are an important dry season food resource for many insects (Maia-Silva *et al*. 2012).

The vernacular name of this species is *aroeira*.

4. *Schinopsis brasiliensis* Engl., *Fl. bras.* (Martius) 12(2): 404, t. 87 (1876). Figs. 1; 2n-q; 3f-h

Dioecious trees 9–20 m high. Thorny branches fissured-lenticellate, glabrous or slightly pubescent, grayish. Leaves 14.5–27 cm long, compound, imparipinnate, coriaceous; petioles 1–3.5 cm long, cylindrical, not winged, pubescent; leaflets 1.2–4.4 × 0.7–1.8 cm long, opposite to subopposite, sessile, narrowly elliptic, apex rounded or emarginate, base cuneate, margin entire, adaxial and abaxial faces glabrous. Panicles 4–25 cm long, terminal or subterminal, pubescent; bracts 0.1–0.2 × 0.05–0.1 cm, oval, deltoid or oblong, pubescent. Flowers staminate and bisexual, pedicellate, sericeous; bracteoles 0.05–0.15 × 0.05–0.1 cm, triangular, glabrous; sepals 0.05–0.1 × 0.05–0.15 cm, green to yellowish-green, ovate or deltoid, both sides glabrous; petals white, 0.1–0.2 × 0.1–0.15 cm, oblong or elliptic, obtuse apex, glabrous; 5 stamens; staminate flowers 0.1–0.2 × 0.1–0.15 cm; pistillate flowers ca. 0.4 × 0.3 cm; ovary ca. 0.25 × 0.2 cm, ovoid, glabrous. Samaroid achene 3–4 × 1.5–1.8 cm, falcate, winged dry, green to brownish.

Selected examined material: Aiuaba, Estação Ecológica de Aiuaba, 06°37’70’’S, 40°13’47’’W, 4.IX.1996, fl., *M.A Figueiredo et al. 643* (EAC); Arara, 06°35’54”S, 40°10’76”W, 4.IX.1996, fr., *L.W. Lima-Verde* (EAC 37711, HUEFS 144953); 12.VIII.1982, fl., *F. de Assis Viana* (EAC 11945, MBM 101638); Parambu, Assentamento Esperança, 14.VI.2000, fl., *A.S.F. Castro 873* (EAC); Fazenda Lira, 06°12’40”S, 40°41’40”W, 18.VI.2008, *R.G. Ferreira 25* (EAC). Penaforte, sítio Baixio do Couro, BR 116, eixo norte, 07º48’29”S, 39º04’46”W, 18.VIII.2009, fl. and fr., *A.P. Fontana et al. 6106* (HVASF).

Schinopsis brasiliensis is a species easily recognized by its fissured-lenticellate, glabrous or slightly pubescent branches, leaflets small (1.2–4.4 × 0.7–1.8 cm), coriaceous and fruit samaroid achene, falcate.

Schinopsis brasiliensis occurs in Bolivia (Killeen 1993) and Paraguay (Michalowski 1953). In Brazil, its occurrence has been confirmed in all regions of the *Caatinga* and *Cerrado* phytogeographic domains (Silva-Luz *et al*. 2023). In Ceará, the species has been recorded in Neotropical Savanna, Steppic Savanna and Semideciduous Seasonal Forest. The species has been recorded only in ES of Aiuaba.

Schinopsis brasiliensis was collected with flowers between February and September and with fruit in September.

The tincture of *S. brasiliensis* resin, in small doses, has tonic properties and the young leaves have antihistamine and neurasthenic properties (Carvalho 2009). In Ceará’s Cariri region, the Kariri-Xocó and Xocó Indians use the crushed and boiled bark to relieve toothaches and earaches (Carvalho 2009). Also according to this author, the species has heavy, high-quality wood, with high natural durability in an outdoor environment. This species is also ecologically important, as it is suitable for recovering degraded areas and its floral resources are important food sources for bees during the dry season (Sampaio *et al*. 2005; Carvalho 2009). Due to the high rate of exploitation, the species was mentioned on the National List of Endangered Brazilian Flora Species in 2012 (CNCFlora 2012); however, this situation has been

reversed and the species is currently assessed as Least Concern (LC) (CNCFlora 2023).

The vernacular names of this species are *baraúna*, *braúna*, *braúna-do-sertão*.

5. *Schinus terebinthifolia* Raddi, Mem. Mat. Fis. Soc. Ital. Sci. Modena, Pt. Mem. Fis. 18: 399 (1820). Figs. 1; 4a-c

Dioecious trees 3–15 m tall. Unarmed branches lenticellate, pubescent, grayish. Leaves 12–34 cm long, compound, imparipinnate, chartaceous; petiole 1.5–3.5 cm long, usually winged, pubescent or glabrous; leaflets 1.5–8.5 × 1.1–3.3 cm, opposite or subopposite, sessile, terminal leaflet sometimes with petiole winged, obovate, ovate, oblong, elliptic or broadly elliptic, apex obtuse or acute, sometimes mucronate, margin entire, irregularly crenate-serrate, base asymmetric, cuneate, decurrent, adaxial face sparsely pubescent and abaxial face pubescent. Panicles 14–29.5 cm long, axillary or terminal, cream-green; bracts 0.05–0.15 × 0.05–0.1 cm, deltoid, pubescent. Flowers unisexual, pedicellate, sericeous; bracteoles 0.05–0.1 × 0.05 cm, deltoid or lanceolate, pubescent; sepals 0.05–0.5 × 0.1–0.5 cm, oval or oblong, glabrous, green; petals 0.15–0.2 × 0.1–0.2 cm, cream, oblong, obovate or ovate, apex rounded or obtuse, both sides glabrous; stamens 8–10, heterodynamous; staminate flowers 0.2–0.3 × 0.1-0.2 cm; pistillate flowers 0.25–0.3 × 0.2 cm; ovary ca. 0.1 × 0.1 cm, globose or irregularly globose, glabrous. Drupe ca. 0.5 × 0.5 cm, globose and slightly flattened in length, reddish-pink.

Selected examined material: Fortaleza, Universidade Estadual do Ceará, Campus do Itaperi, 03°47'09"S, 38°33'09"W, 27.VII.2015, fr., *K.L. Oliveira & L.M. Araújo* (EAC 58353); Horto de Plantas Medicinais da UFC, Campus do Pici, Ceará, 03°43'02"S, 38°32'35"W, 14.V.2007, fl., *F.S. Cavalcanti & O. Deusdênia* (EAC 41627); 03°43'02"S, 38°32'35"W, 15.VII.1994, fl., *R. Veloso* (EAC 21279, ASE 17000); Campus do Pici, 03°74'50"S, 38°57'49"W, 25.V.2023, fl., *J.V.G. Gama & H.P. Nascimento 3* (EAC); Messejana, Rua Joaquim Felício 116, 03°43'02"S, 38°32'35"W, 11.XI.2002, fr., *S. Leopoldina* (EAC 38705); 03°43'02"S, 38°32'35"W, 14.II.2006, fl. and fr., *F.J.A. Matos* (EAC 38703, 38704); Guajiru, 03°43'02"S, 38°32'35"W, 18.III.1999, fl., *A.S.F Castro 672* (EAC).

Schinus terebinthifolia's main characteristics are its generally winged petioles and drupe.

Schinus terebinthifolia has been recorded in Argentina, Brazil, Paraguay and Uruguay (Carvalho 1994; Lorenzi 2002). In Brazil, the species occurs in all regions and in the *Caatinga*, *Cerrado*, Atlantic Forest and *Pampa* phytogeographic domains (Silva-Luz *et al.* 2023). In Ceará, the species was recorded predominantly in Lowland Semideciduous Seasonal Forest.

The species was collected with flowers between February and July and with fruits between February and November.

Schinus terebinthifolia has pharmacological uses, with anti-inflammatory, antispasmodic, diuretic, antileucorrheal, emmenagogue, astringent, healing, balsamic, bactericidal (Ávila 2013) and antioxidant (Oliveira *et al*. 2020) actions. The essential oils of this species are rich in sesquiterpenes and could be a promising source of active compounds for innovative therapeutic and/or preventive strategies against cancer (Bendaoud *et al*. 2010).

The vernacular name of this species is *aroeira-pimenteira*.

6. *Spondias* L., Sp. Pl. 1: 371 (1753).

Hermaphroditic, sometimes and andromonoecious e evergreen trees; branches unarmed, fissured-lenticellate, glabrous, grayish. Leaves compound, imparipinnate, membranaceous, chartaceous or coriaceous, petiolate; petioles cylindrical; leaflets opposite or subopposite, entire margin slightly undulate, base asymmetrical, venation craspedodromous, primary vein prominent and secondary veins slightly prominent on the abaxial side, intersecondary veins present or absent, marginal vein. Inflorescence in a congested panicle, axillary or terminal, pedunculate; bracts and bracteoles persistent or deciduous. Flowers 5-merous, bisexual, with articulated pedicels; sepals connate only at the base; petals valvar; stamens (8–)10, heterodynamous, between the lobes of the disk, anthers ovoid-complanate; ovary 3–5-carpellate; ovule apical. Drupe, globose oblong-ovoid or obovoid; epicarp yellow-orange, purplish-red or greenish.

6.1. *Spondias mombin* L., Sp. Pl. 1: 371 (1753). Figs. 1; 3i; 4d-h

Hermaphroditic tree 6–10 m tall. Branches fissured-lenticellate, glabrous, grayish. Leaves 6–36.5 cm long, petiole 1.6–7.3 cm long; leaflets 2–12 × 1–4.8 cm long, lanceolate, oblong or elliptic, apex acute, acuminate, base asymmetrical, margin entire, flat to slightly undulate, glabrous on both sides, with intersecondary veins; petioles 0.2–0.8 cm long. Panicles 12–28 cm long, axillary

Figure 4 – a-c. *Schinus terebinthifolia* – a. flowering branch; b. staminate flower; c. drupe. d-h. *Spondias mombin* – d. flowering branch; e. intersecondary vein. f. staminate flower (two petals and two sepals removed); g. pistillate flower; h. drupe. i-l. *Spondias tuberosa* – i. flowering branch; j. staminate flower; k. pistillate flower; l. drupe. m-o. *Tapirira guianensis* – m. flowering branch; n. staminate flower (side view, two petals and two sepals removed); o. drupe. p-r. *Thyrsodium spruceanum* – p. fruiting branch; q. staminate flower (longitudinal section, one petal and one sepal removed); r. drupe. (a-b. *J.V.G. Gama et al. 3*; c. *R.M. Menezes 1*; d. *Leila* (EAC 52773); e-f. *F.Y.E.C. Dias* (EAC 064411); g. *S.M. Morais & F.F.S. Lopes* (EAC 63061); h. *H.M. Meneses 96*; i. *Mozarina & Telma* (EAC 38700); j-k. *F.K.G. Silva & F.S. Araújo 7*; l. *F.F.S. Lopes & S.M. Morais* (EAC 64238); m. *M.I.B. Loiola et al. 1940*; n. *E.M.P. Lucena et al. 330*; o. *V.S. Gomes & K. Ribeiro* 1113; p-q. *A.P. Silveira & R.F. Oliveira 777*).

or terminal, glabrous, cream; bracts ca. 0.1 × 0.05 cm, lanceolate or linear. Flowers 0.15–0.5 × 0.15–0.3 cm; bracteoles ca. 0.05 × 0.05 cm, deltoid; sepals 0. 05–0.1 × 0.05 cm, deltoid; petals 0.1–0.3 × 0.1–0.15 cm, ovate or obovate, apex acute, glabrous, cream; stamens 10; ovary 0.1–0.1 cm long, ovoid, glabrous. Drupe 1.5–3.5 × 1–3 cm, oblong-ovoid, glabrous, green to yellowish.

Examined material: Brejo Santo, próximo à estrada que dá aecesso ao Povoado de São Felipe, 07º26"50"S, 39º03'50"W, 11.X.2012, fl., *D.G. Oliveira et al. 565* (HVASF). Caridade, Fazenda Feijão, 25.IX.1990, fl., *B. Freitas* (EAC 16821, NY 1030813). Crateús, Jatobá Medonho, 05°10'59"S, 40°50'51"W, 5.X.2017, fl., *H.M. Meneses 249* (EAC). Crato, Campo Alegre, 22.V.2002, veg., *F.S. Cavalcanti 873* (EAC). Fortaleza, Campus do Pici, Departamentode Biologia, UFC, 31.V.2005, fr., *A. Carvalho & V.B. Marques 1* (EAC); Campus da UECE, Itaperi, 03°43'02"S, 38°32'35"W, 7.VII.2009, fl., *M.P. Acciolly* (EAC 44919); Parque Estadual do Cocó, 03°00'00"S, 38°48'68"W, 22.VII.2019, fr., *S.M. Morais & F.F.S. Lopes* (EAC 63061). Limoeiro do Norte, 05°09'10"S, 38°06'25"W, 23.II.2019, fr., *J.M.A. Silva* (EAC 62197). Mulungu, Sítio Jardim, mata do Damásio, 18.XII.2008, fl., *L.W. Lima-Verde 3574* (EAC). Pacoti, Sítio Olho d'Água dos Tangarás, 22.XII.2007, *L.W. Lima-Verde 3420-07* (EAC). Redenção, Fazenda Experimental Piroás, 04°13'33"S, 38°43'50"W, 3.X.2015, fl., *JCMSM Sobczak 124* (EAC). Ubajara, 03°51'10"S, 40°53'21"W, 11.XI.2019, fl., *F.Y.E.C. Dias* (EAC 64411).

Spondias mombin is similar to *S. tuberosa* in that they share leaflets with entire and slightly undulate margins and panicled flowers; however, it differs from the latter in having leaflets with an asymmetrical base (*vs*. symmetrical to obtuse-oblique) and intersecondary veins (*vs*. absent).

Spondias mombin is native to tropical America, occurring from Mexico to Brazil (Geilfus 1994). In Brazil, the species has been recorded in the Northern, Northeastern, Midwestern and Southeastern regions in the Amazon, *Caatinga*, *Cerrado* and Atlantic Forest phytogeographic domains (Silva-Luz *et al*. 2023). In Ceará, the species has been recorded in areas of Semideciduous Seasonal Forest, Lowland Semideciduous Seasonal Forest and Steppic Savanna. This species was registered only in Cocó State Park.

The species was collected with flowers between May and December and with fruits between February and July.

Spondias mombin is a species of commercial interest. Its fruit, popularly known as *cajá*, is consumed fresh or processed into pulp, juice, jam, nectar and ice cream (Souza & Lorenzi 2005). The leaves and bark contain compounds with action against bacterial b-lactamases (Coates *et al*. 1994), anti-herpetic action (Corthout *et al*. 1991, 1992), antibiotic (Ajao *et al*. 1984, 1985) and oxytocic (Offiah & Anyanwu 1989). The wood is very susceptible to insect attack and is therefore used to make coffins (Hueck 1972).

The vernacular names of this species are *cajazeira*, *cajá-mirim*, *cajarana*.

6.2. *Spondias tuberosa* Arruda, in Koster, Trav. Braz. 496 (sp. dub.). Figs. 1; 4i-l; 5a-e

Hermaphroditic and andromonoecious tree 4.5–6 m tall. Branches fissured-lenticellate, glabrous, slightly pubescent on young branches, grayish. Leaves 7–23.5 cm long; petiole 1.5–5.7 cm long, glabrous; leaflets 2–8.4 × 1.2–3.5 cm, ovate, oblong or elliptic, apex acuminate, base symmetrical to obtuse-oblique, margin entire, revolute, slightly undulate, glabrous on both sides, intersecondary veins absent; petioles 0.1–0.5 cm long. Panicles 6.5–25.5 cm long, axillary or terminal, glabrous, cream; bracts 0.1–0.2 × 0.05–0.1 cm, lanceolate. Flowers 0.1–0.6 × 0.1–0.3 cm; bracteoles 0.75–0.1 × 0.05 cm, deltoid; sepals 0.05–0.1 × 0.05–0.1 cm, deltoid, pubescent; petals 0.2–0.35 × 0.1–0.15 cm, ovate or obovate, acute apex, glabrous, white or greenish-white; stamens 10; ovary ca. 0.15 × 0.1 cm, ovoid, glabrous. Drupe 1.3–4 × 0.8–3.2 cm, obovoid, greenish.

Selected examined material: Aiuaba, Estação Ecológica de Aiuaba, IBAMA, 06°34'25"S, 40°07'25"W, 11.IV.2014, fr., *C. Lima & T. Renato* (EAC 56039). Cariri, Potengi, 4.IV.2005, fr., *Ana Raquel* (EAC 34887). Caucaia, Tucunduba, 16.III.1997, fr., *A.S.F. Castro 301* (EAC). Crateús, Tapuio, 05°13'75"S, 40°49'19"W, 7.II.2017, fl., *H.M. Meneses 96* (EAC). Crato, estrada Crato - Iguatu, 11.III.1997, fl. and fr., *F.S. Cavalcanti* (EAC 24729, PEL 18064). Guaramiranga, Sítio Guaramiranga, 27.II.2006, fl. and fr., *Mozarina & Telma* (EAC 38700). Limoeiro do Norte, 05°09'39"S, 38°05'56"W, 23.II.2019, fr., *J.M.A. Silva* (EAC 62198); 05°08'44"S, 38°05'53"W, 16.VII.2017, fl., *L.M. Nogueira* (EAC 60564). Maracanaú, 17.IX.1994, fl. and fr., *P. César* (EAC 21339). Tauá, Cococá, 23.X.1981, fl., *M.A.F. Gomes* (EAC 10808).

Spondias tuberosa can be easily recognized by its leaflets without intersecondary veins. These characteristics differ from *S. mombin*, the closest species, which has leaves with intersecondary vein.

Spondias tuberosa is a species endemic to Brazil, found in the Northeastern and Southeast regions in the *Caatinga* and *Cerrado*

Figure 5 – a-e. *Spondias tuberosa* – a. habit; b. branched stem; c. leaflet; d. inflorescence; e. fruiting branch. f-g. *Tapirira guianensis* – f. leaves; g. fruiting branch; h-i. *Thyrsodium spruceanum* – h. inflorescence with pistilate flowers; i. fruiting branch. (a-e. *M.I.B. Loiola*; f-i. *R.T. Queiroz*).

phytogeographic domains (Silva-Luz *et al.* 2023). In Ceará, the species has been recorded in areas of Neotropical Savanna and Steppic Savanna. This species was registered only in the ES of Aiuaba.

The species was collected with flowers and fruit between February and October.

Spondias tuberosa has phytochemical groups in its leaves and bark that are relevant to the pharmaceutical industry, such as tannins, saponins, resins, sterols and triterpenes, flavonoids and alkaloids, with analgesic, hypoglycemic, anti-inflammatory (Siqueira *et al.* 2016; Sameh *et al*. 2018) and antimicrobial properties (Melo *et al*. 2014) and, for the most part, has no toxicological effects (Barbosa *et al*. 2016). The species is also used in folk medicine to treat different diseases such as diabetes, lipid disorders, diarrhea, inflammation, conjunctivitis, venereal diseases, menstrual cramps, placental delivery, kidney infection, throat disorders and anti-emetic (Lins Neto *et al.* 2010). The woody tuber, known as the xylopodium, is edible and is eaten fresh or made into preserves (Cavalcanti *et al.* 2000, 2004; Batista *et al*. 2015). The wood is used as firewood (Arévalo-Marín *et al*. 2015).

The vernacular names of this species are *umbuzeiro*, *umbu*, *imbuzeiro*, *tapereba*.

7. *Tapirira guianensis* Aubl., Hist. Pl. Guiane 1: 470, t. 188 (1775). Figs. 1; 4m-o; 5f-g

Dioecious trees or shrubs, 3–15 m tall, evergreen. Branches fissured-lenticellate, pubescent, grayish. Leaves 19.5–39 cm, chartaceous, compound, imparipinnate; petiole 3.5–7.5 cm long, cylindrical, not winged, glabrescent; leaflets 3.4–13 × 1.5–4.8 cm, opposite or subopposite, petiolate, obovate or elliptic, sometimes oblong, apex straight or acuminate, base obtuse, cuneate or decurved, margin entire, slightly undulate, adaxial surface sparsely pubescent and abaxial surface pubescent; petioles 0.3–1 cm long. Panicles 9.5–20 cm long, axillary, pubescent, greenish-yellow; bracts 0.05–0.15 × 0.05–0.1 cm, triangular, lanceolate or oval. Flowers pedicellate, without hypanthium; bracteoles 0.05–0.1 × 0.05–0.1 cm, lanceolate or oval, pubescent; sepals 0.05–0.1 × 0.05–0.1 cm, broadly oval or orbicular, apex acute to rounded, sparsely sericeous on the adaxial surface, sparsely pubescent on the abaxial surface, glabrous, green, yellowish trichomes, not hyaline; petals 0.05–0.25 × 0.05–0.1 cm, lanceolate or ovate, obtuse apex, glabrous on both sides, yellowish-white or greenish-white; stamens 8–10; staminate flowers 0.15–0.3 × 0.1–0.2 cm; pistillate flowers 0.1–0.35 × 0.1–0.2 cm, 5 style, free; undifferentiated stigma; ovary 0.1–0.2 × 0.05–0.1 cm, ovoid, sparse-sericeous, 4–5-carpellate, 1-locular. Drupe 0.4–1.2 × 0.5–0.8 cm, ovoid, sericeous, green or brownish.

Selected examined material: Fortaleza, Campus do Pici UFC, próximo à cantina da Química, 03°44’48”S, 38°34’36”W, 4.V.2016, fr., *R.A.C. Silva* (EAC 59334); Campus do Itaperi, UECE, 03°47’52”S, 38°33’29”W, 1.II.2019, fr., *E.M.P. Lucena et al. 330* (EAC); Parque Estadual do Cocó, 03°74’46”S, 38°48’78”W, 13.XII.2019, fl., *F.F.S. Lopes & S.M. Morais* (EAC 64238). Granja, Ibuaçu, sopé da serra de Ubatuba, 1.I.2006, fl. and fr., *A.S.F. Castro 1670* (EAC). São Benedito, 7.III.1981, fr., *A. Fernandes & E. Nunes* (EAC 9863). São Gonçalo do Amarante, Jardim Botânico de São Gonçalo do Amarante, 03°34’08”S, 38°53’15”W, 26.X.2017, fl. and fr., *V.S. Sampaio et al. 182* (EAC); Tianguá, entrada para o Sítio do Bosco, 03°39’19”S, 40°59’18”W, 27.IV.2012, fr., *M.I.B. Loiola et al.1618* (EAC). Ubajara, Parque Nacional de Ubajara, portão neblina, 03°50’24”S, 40°57’03”W, 11.III.2014, fl., *M.I.B. Loiola & F.R.S. Tabosa 2201* (EAC); portão Neblina próximo ao Teleférico, 03°50’13”S, 40°53’56”W, 23.IV.2014, fr., *M.I.B. Loiola 2249* (EAC); no caminho da lanchonete para o bondinho, 03°50’27”S, 40°54’28”W, 23.VIII.2012, fl., *M.I.B. Loiola 1918* (EAC); Sítio Murimbeca, 03°51’16”S, 40°55’16”W, 29.XI.1997, fl. and fr., *M.A.C. Paulo* (EAC 26067). Viçosa do Ceará, Brejo Grande, 6.XII.1979, fl., *E. Nunes & P. Martins* (EAC 7590, ASE 17111).

Tapirira guianensis is distinct from other Anacardiaceae species occurring in Ceará by its branches fissured-lenticellate, pubescent; leaves chartaceous, leaflets sparsely pubescent on the adaxial side and pubescent on the abaxial side, and mainly, by flowers without hypanthium and drupe sericeous.

Tapirira guianensis is a widespread species in Central and Latin America (Lorenzi 1992; Mitchell 1995). In Brazil, it has been recorded in all regions of the Amazon, *Caatinga*, *Cerrado*, Atlantic Forest and *Pantanal* phytogeographic domains (Silva-Luz *et al*. 2023). In Ceará, the species was found in areas of Dense Ombrophilous Forest, Semideciduous Seasonal Forest, Lowland Semideciduous Seasonal Forest and Vegetation under Fluvial and/or Lacustrine influence. The species has been recorded in the Botanical Garden São Gonçalo do Amarante, Cocó State Park and Ubajara National Parque.

The species was collected with flowers between January and December, and with fruits between February and October.

Tapirira guianensis has phytochemical components in its seeds, such as tannin and two alkylphenolic derivatives with cytotoxic activity (Barros *et al*. 1970; David *et al*. 1998; Correia *et al*. 2003). In folk medicine, the leaves are used to treat dermatosis and syphilis (Correia 1999) and the bark extract against leprosy and diarrhea. The wood is used in shipbuilding, carpentry, joinery, fence production, beams, tool handles and brooms (Carvalho 2006). This species is also indicated as a melliferous plant (Correia 1999).

The vernacular names of this species are *pau-pombo*, *cupiúva*.

8. *Thyrsodium spruceanum* Benth., Hooker's J. Bot. Kew Gard. Misc. 4: 17 (1852).

Figs. 1; 4p-r; 5h-1

Dioecious trees 5–10 m tall. Branches fissured, pubescent-ferrugineous with milky exsidate. Leaves 29–60 cm long, compound, imparipinnate, discolorous; petiole 2–12 cm long, cylindrical, not winged, pubescent; leaflets 4–19.5 × 2.4–9.1 cm, alternate to subopposite, coriaceous, oblong to elliptic; base oblique to cuneate, margin entire, slightly undulate, apex cuspidate, glabrous, abaxial surface rusty. Thyroids 24–36.5 cm long, axillary or terminal, pubescent-ferrugineous; bracts 0.1–0.5 × 0.1–0.2 cm, ovate to triangular. Flowers pedicellate; hypanthium shallowly cupuliform; bracteoles 0.15–0.3 × 0.1–0.2 cm, ovate to triangular; sepals 0.25–0.4 × 0.1–0.2 cm, triangular, apex acute, adaxial side densely pubescent, rusty, abaxial side sparsely sericeous with hyaline trichomes; petals 0. 2–0.35 × 0.1–0.2 cm, lanceolate, adaxial side densely pubescent, ferrugineous and hyaline trichomes, abaxial side sericeous, hyaline and yellowish trichomes; staminate flower 0.4–0.6 × 0.2–0.4 cm; pistillate flower and ovary not observed. Drupe 1.5–2.0 × 1.0–1.8 cm, broadly ellipsoid or subglobose, pubescent, green to green-ferrugineous. **Selected examined material**: Aratuba, 7 km da cidade, estrada para Baturité próximo a Pindoba, 31.XII.2000, fl., *A.S.F. Castro 919* (EAC); Guaramiranga, Sítio Arvoredo, 12.II.2002, fr., *A.P. Silveira & R.F. Oliveira 777* (EAC 40565); Sítio Sinimbi, 07°17'49,8"S, 38°55'59"W, 1.XII.2003, fl., *V.S. Gomes & K. Ribeiro 1113* (EAC). Ibiapina, 3 km da cidade sede, encosta de Ibiapina, 25.XII.2005, fl., *A.S.F. Castro 1649* (EAC). Itapipoca, Comunidade Quilombola de Nazaré, 03º33'31"S, 39º33'09"W, 9.XII.2017, fl., *JCMSM Sobczak 750* (EAC). Pacoti, Sítio Stª Madalena, 9.X.1980, fl., *P. Martins & E. Nunes* (EAC 8971). Ubajara, Portão Planalto, PARNA de Ubajara, 22.I.1999, fl., *A. Fernandes et al.* (EAC 27839).

Thyrsodium spruceanum is easily distinguished from other species by having leaves discolorous, with abaxial surface ferrugineous, branches and inflorescences pubescent-ferrugineous, flowers with hypanthium and fruit pubescent, green to green-ferrugineous.

Thyrsodium spruceanum is a South American species, distributed in Brazil, Colombia, Guyana, French Guiana, Suriname and Venezuela (Mitchell & Daly 1993). In Brazil, it occurs in the Northern, Northeastern and Southeastern regions in the Amazon and Atlantic Forest phytogeographic domains (Silva-Luz *et al*. 2023). In Ceará, the species has only been recorded in Ombrophilous Dense Forest areas and only in one conservation unit, Ubajara National Park.

The species was collected with flowers between January and December, and with fruit in February.

The uses of this species were not recorded.

The vernacular names of this species are *cajazeira brava*, *cajueiro bravo*, *pau pombo*.

Acknowledgements

We would like to thank the National Council for Scientific and Technological Development (CNPq), for the scholarship granted to the first author and the productivity scholarship granted to MIBL (Process 306723/2023-9). We are grateful to Fundação Cearense de Apoio ao Desenvolvimento Científico e Tecnológico (FUNCAP), for the Postdoctoral scholarship granted to FDSS (Process 150120/2023-0), and for the financial support for the field expeditions (Process MLC-0191-00147.01.00/22, Edital Mulheres na Ciência). LMS is grateful to CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior), for the schorlaship (Financial Code 001). To Rubens Teixeira de Queiroz, for providing photographs of the species.

Data availability statement

In accordance with Open Science communication practices, the authors inform that all data are available within the manuscript.

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Area Editor: Dra. Válquíria Dutra
Received on October 28, 2023. Accepted on March 25, 2024.