



## Original Paper

# Flora of Espírito Santo: Clusiaceae

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### Abstract

We present here the treatment of Clusiaceae for the flora of the state of Espírito Santo, Brazil. Sixteen species are recognized: seven species of *Clusia*, four species of *Tovomita*, two species of *Garcinia*, two species of *Tovomitopsis*, and one species of *Symphonia*. A brief history of the Clusiaceae in Espírito Santo is presented, as well as descriptions, illustrations, and taxonomic commentary on the species.

Key words: Atlantic Forest, clusioid clade, Malpighiales, rocky outcrops.

### Resumo

Apresentamos aqui o tratamento de Clusiaceae para a flora do estado do Espírito Santo, Brasil. São reconhecidas dezesseis espécies: sete espécies de *Clusia*, quatro espécies de *Tovomita*, duas espécies de *Garcinia*, duas espécies de *Tovomitopsis* e uma espécie de *Symphonia*. É apresentado um breve histórico das Clusiaceae do Espírito Santo, além de descrições, ilustrações e comentários taxonômicos sobre as espécies.

Palavras-chave: Floresta Atlântica, clado clusioide, Malpighiales, afloramentos rochosos.

### Introduction

Clusiaceae is a monophyletic group represented by shrubs, trees or hemiepiphytes species, with exudate of different colors, opposite, usually glabrous leaves, without stipules; thyrsoids, terminal or axillary inflorescences, and uni- or bisexual flowers (Stevens 2007; Marinho *et al.* 2020). The family is inserted in the clusioid clade (Malpighiales), forming a sister group with Bonnetiaceae (Ruhfel *et al.* 2013). Clusiaceae has a tropical distribution and is composed of three tribes, 15 genera and ~800 species (Stevens 2001 onwards; Marinho *et al.* 2019).

The Clusiaceae of Brazil is represented by 11 genera and 147 species, of which 49 species are endemic to the country. In the state of Espírito Santo, the family is represented by genera *Clusia*, *Garcinia*, *Symphonia*, *Tovomita* and *Tovomitopsis* totaling 16 species (Marinho *et al.* 2020).

### Brief history of Clusiaceae in Espírito Santo

The first species of Clusiaceae based on specimens from Espírito Santo was proposed by Mariz & Weinberg (1982), *Clusia spiritu-sanctensis* G. Mariz & B. Weinberg (1982: 233). The species was described from specimens collected on rocky outcrops in the region of Vila Velha and resembled the *Clusia fluminensis* Planchon & Triana (1860: 349), which is cultivated in Brazil. This same region, now in the city of Domingos Martins, was also important for the knowledge of Clusiaceae in the state. The species *Clusia aemygdioi* Gomes da Silva & B. Weinberg (1985: 162) was described from specimens collected in the high forests of Domingos Martins (Gomes da Silva & Weinberg 1985). Both *C. spiritu-sanctensis* and *C. aemygdioi* are accepted species and are described in the present work. Gomes da Silva & Weinberg (1984)

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also described *Clusia marizii* Gomes da Silva & B. Weinberg (1984: 22) from specimens collected in riparian forests of Vargem Alta; today, this species is under the synonym of *Clusia organensis* Planchon & Triana (1860: 349).

The next contribution to the Clusiaceae of Espírito Santo took 27 years to happen. Rigueti *et al.* (2012) published a study on the fruit morphology in the recognition of *Clusia* species occurring in the state of Espírito Santo, where they presented diagnoses for the fruits, illustrations, photos of living specimens and identification keys for the fruits. Until the publication of this work, the other genera of Clusiaceae that occur in the state only appeared in floristic lists, but without any extensive taxonomic treatment. Four species of *Tovomita* were included in a review of the genus in the Atlantic Forest (Marinho *et al.* 2016), and *Tovomitopsis* was first recorded for the state by Zorzanelli *et al.* (2015), which also presented a diagnose and photos in the field. In this way, for the first time and almost 40 years after the first species described for the state, a taxonomic treatment of Clusiaceae for Espírito Santo is presented in the present work, including descriptions of the species, identification keys and field images.

### Material and Methods

We visited some important collections from the Espírito Santo state (CVRD, MBML, VIES) and also national and international herbaria, considering the most representative collections of Clusiaceae (ESA, INPA, K, NY, RB, SPF, UEC, acronyms following Thiers, continuously updated). Additional specimens from Espírito Santo were consult in online databases such as SpeciesLink

(<splink.org.br>) and ReFlora (<reflora.jbrj.gov.br>). The names of the authors of taxa follow those used in Flora e Funga do Brasil Project (2022).

## Results and Discussion

### Clusiaceae Lindl.

Clusiaceae plants can be shrubs, trees, or hemiepiphytes and secrete an exudate that can be translucent, white, yellow, greenish, orange, or red. The leaves are opposite, usually decussate, entire, and glabrous, without stipules. Secretory ducts can be conspicuous on the leaf blade or absent. The inflorescences are terminal or axillary, solitary flowers rarely occur, bracts and bracteoles can be present or absent. The flowers are uni- or bisexual, actinomorphic, usually 4–5(–8)-merous. The sepals are free or connate, usually decussate. The petals are free, decussate, or imbricate. The stamens are free or fused in synandrium or staminal tube, resin secretors or not, the anthers are longitudinal or poricidal, staminodes can be present or absent in staminate flowers, with resin secretion or not, and a pistillode can be present or absent in staminate flowers. The gynoecium is composed of a 2–5(–21)-locular ovary, style usually short, generally with large stigma; nectariferous disc can be present or absent, staminodes can be present or absent in pistillate flowers, with resin secretion or not. The fruits can be dehiscent or indehiscent, berries or fleshy capsules, septicidal or septifragal. The seeds can be surrounded by an aril or not, be vascularized or not. The aril is usually orange, occasionally white, yellow, or red (Stevens 2001 onwards; Stevens 2007; Marinho *et al.* 2020).

### Identification key for Clusiaceae genera in Espírito Santo

1. Hermaphroditic plants, terminal buds perulate, connate stamens forming a staminal tube..... 3. *Symphonia*
- 1'. Dioecious plants, terminal buds eperulate, free or connate stamens, but never forming a staminal tube..... 2
2. Axillary flowers, arranged in fascicles; berry fruits, non-arillate seeds..... 2. *Garcinia*
- 2'. Terminal flowers, solitary or arranged in thyrsoids; fruit capsule, arillate seeds.
  3. Leaf blades with tertiary veins usually inconspicuous *in vivo*; ovary with locules with numerous ovules; seeds with non-vascularized aril..... 1. *Clusia*
  - 3'. Leaf blades with tertiary veins usually conspicuous *in vivo*; ovary with locules 1-ovulate; seeds with vascularized aril..... 4
  4. Floral buds totally enclosed by the outer sepals; flowers without resin..... 4. *Tovomita*
  - 4'. Floral buds not enclosed by the outer sepals; flowers with resin..... 5. *Tovomitopsis*

## 1. *Clusia* L.

The species of *Clusia* are trees, shrubs, or hemiepiphytes, dioecious, rarely hermaphrodite, with eperulate terminal buds and a white or yellowish exudate. The leaves are opposite, glabrous, petiolate or sessile, with coriaceous or subcoriaceous leaf blades, secondary veins barely conspicuous or not, and secretory ducts conspicuous or not on the leaf blade. The inflorescences are terminal, thyrsoid or solitary flowers. The flowers are showy, often resinous. The calyx is free, 4–5 (–17) sepals. The corolla is free, 4–8 (–10) petals, usually opposed to sepals. The staminate flowers with 4–∞ stamens, free or fused in a synandrium, with resin secretors or not, anthers are longitudinal or poricidal, staminodes can be present or not, with resin secretors or not, and pistillode can be present or not. The pistillate flowers have of a

4–21-locular ovary, with short or absent styles, rarely conspicuous, terminal or subterminal stigma, papillose or smooth, staminodes can be present or not, with resin secretion or not. The fruits are dehiscent, carnose, septicidal capsules, persistent stigmas, sepals, petals, and staminodes, persistent or not. The seeds have a non-vascularized aril, orange or red.

*Clusia* has ~400 species. Seventy-nine species can be found in Brazil, of which 30 are endemic (Marinho *et al.* 2020). Most *Clusia* species are found in the northern region of Brazil, mainly in the Amazon phytogeographic domain. In the Southeast Region there are 17 species, distributed mainly in regions of Cerrado and Atlantic Forest. The six species of *Clusia* found in the state of Espírito Santo occur mainly in areas of rocky outcrops (*inselbergs*), high elevation in Atlantic Forest and *restingas*.

### Identification key for *Clusia* species in Espírito Santo

1. Staminate and pistillate flowers without resiniferous stamens or staminodes ..... 1.3. *Clusia melchiorii*
- 1'. Staminate and pistillate flowers with resiniferous stamens or staminodes ..... 2
  2. Staminate flowers with stamens with lateral thecae, connective higher than thecae, and central resiniferous staminodes; fruits with persistent sepals and staminodes ..... 1.4. *Clusia nemorosa*
  - 2'. Staminate flowers with stamens with apical thecae, connective at the same height as the thecae, and absent or radial resiniferous staminodes, forming a ring; fruits with sepals and staminodes early caducous ..... 3
    3. Staminate flowers with numerous stamens, fused, forming a conical synandrium; pistillate flowers with 1–3 series with numerous laminar resiniferous staminodes; staminodes without antherodes ..... 4
    - 3'. Staminate flowers with 7–40 stamens, free, clavate; pistillate flowers with one series of 5–7 clavate resiniferous staminodes; staminodes with antherodes ..... 5
      4. Leaf blade subsessile, petiole up to 5 mm long, leaf blade with rounded to obtuse base, midrib visible up to the apex of the leaf blade, secondary veins forming an angle of 40°–55° with the midrib ..... 1.1. *Clusia aemygdioi*
      - 4'. Leaf blade petiolate, petiole 9–35 mm long, leaf blade with base acute, cuneate, or attenuate, midrib visible up to 2/3 to the apex of the leaf blade, secondary veins forming an angle of 28°–45° with the midrib ..... 1.2. *Clusia hilariana*
      5. Leaf blade oblanceolate; flowers with petals vinaceous or red with white margin; fruit 2.5–3 cm long ..... 1.5. *Clusia organensis*
      - 5'. Leaf blade obovate; flowers with white petals with red internal base; fruit 3.5–4.5 cm long ..... 1.6. *Clusia spiritu-sanctensis*

#### 1.1. *Clusia aemygdioi* Gomes da Silva & B. Weinberg, Bradea 4(12): 162. 1985. Fig. 1a

Shrubs or trees, up to 5 m tall; white exudate, scarce. Petiole subsessile, up to 5 mm long. Leaf blades 4.2–10 × 3.8–5 cm, dark green on adaxial side *in vivo*, dark brown on adaxial side *in sicco*, subcoriaceous, elliptical or obovate, base rounded

to obtuse, apex rounded and slightly obtuse, margin revolute. Midrib prominent on both sides, visible up to the apex of the leaf blade; secondary veins 1.5–2.5 mm apart from each other, slightly prominent on the adaxial side, forming an angle of 40°–55° with the midrib; inframarginal vein slightly conspicuous on the adaxial side,

crenate. Secretory ducts black or brown, slightly conspicuous on the adaxial side. Flowers solitary or grouped in thyrsoid inflorescences, terminal: ♂ 1–5 flowers, ♀ 1–3 flowers; peduncle 10–15 mm long; bracts 2, triangular, early caducous; bracteoles 4–6, ovate to triangular, subcoriaceous. Floral buds globose, green. Calicular bracts 4, 3.5–8 × 3.5–8 mm, decussate, coriaceous, rounded; sepals 4–6, 11–15 × 13–16 mm, decussate, rounded, subcoriaceous with hyaline margin, white greenish; petals 7–10, 18–30 × 15–17 mm, obovate, membranaceous, white or cream with red internal base. Staminate flowers with ∞-stamens, fused in a conical synandrium, yellow, 7.5–10 × 8–14 mm; apical anthers, poricidal, connective at the same height as the anthers; pistillode absent; staminodes resiniferous, forming a ring at the base of the

synandrium, 2–3 series. Pistillate flowers with ∞-staminodes, without antherodes, resiniferous, forming a ring at the base of the ovary, 2–3 series; ovary 15–20 mm long, 9–12-locular, stigmas subapical, connivent. Capsules 2.5–7.5 × 2.4–8 cm, sepals, petals and staminodes early caducous, subapical stigmas converging forming a crown on the apex of the fruit. Seed aril orange.

**Selected specimens:** Alfredo Chaves, estrada São Bento de Urânia a Alfredo Chaves, 16.V.1999, *G. Hatschbach 65253* (MO, SPF, UEC). Domingos Martins, Bom Jesus Costa Pereira, 5.VIII.1985, *A.G. Silva & B. Weinberg 1230* (UFP). Marilândia, Liberdade, 18.I.2006, *V. Demuner et al. 1663* (MBML, UEC). Mimoso do Sul, Pedra do Pontões, 12.X.2004, *D.R. Couto 193* (UEC). Santa Leopoldina, Bragança, 30.III.2006, *V. Demuner et al. 2163* (UEC). Santa Maria de Jetibá, Alto de São Sebastião, 14.XI.1999, *M.C. Assis et al. 582* (UEC).



**Figure 1** – a. *Clusia aemygdioi* – closed mature fruit. b-d. *Clusia melchiorii* – b. staminate flower; c. pistillate flower; d. closed mature fruit. e-f. *Clusia nemorosa* – e. staminate flower; f. open fruit. g-h. *Clusia organensis* – g. staminate flower; h. pistillate flower. i. *Clusia spiritu-sanctensis* – staminate flower. Only a-c and g-i are specimens from Espírito Santo. Photos: a-d, f. Lucas Marinho; e. Moabe Fernandes; g-i. Ana Cláudia Alencar.

Santa Teresa, Estação Biológica de Santa Lúcia, 1.II.1995, *L.D. Thomaz 1697* (HRCB, MBML). Serra, APA Mestre Álvaro, 22.XI.2009, *J.M.L. Gomes 3668* (UEC). Vargem Alta, RPPN Águia Branca, 28.VII.2018, *A.M. Assis et al. 4567* (VIES).

*Clusia aemygdioi* is endemic to Espírito Santo and occurs mainly in areas of tropical rain forest and can occasionally be found in rocky outcrops. Although CNCFlora (2022) places the conservation status of *Clusia aemygdioi* in the Endangered (EN) category, the data on sampling and distribution of the species are still insufficient. Thus, the conservation status of *Clusia aemygdioi* can be consolidated as Data Deficient (DD).

*Clusia aemygdioi* is similar to *Clusia hilariana*, mainly regarding its flowers and fruits. These species differ in that *Clusia aemygdioi* presents sessile petiole (up to 5 mm long) and elliptical or obovate leaves with a rounded or obtuse base and rounded and slightly obtuse apex, while *Clusia hilariana* has a larger petiole (9–35 mm long) and obovate leaves with acute, cuneate, or attenuate base and rounded, occasionally truncate apex.

### 1.2. *Clusia hilariana* Schltldl., *Linnaea* 8: 181. 1833.

Shrubs or trees, up to 6 m tall; cream exudate. Petiole 9–35 mm long. Leaf blades 5–18 × 2.5–9 cm, green to light green on both sides *in vivo*, brown on both sides *in sicco*, coriaceous, obovate, base acute, cuneate, or attenuate, apex rounded, occasionally truncate, margin slightly revolute. Midrib prominent on both sides, visible up to 2/3 to the apex of the leaf blade; secondary veins 2–4 mm apart from each other, prominent on both sides, forming an angle of 28°–45° with the midrib; inframarginal vein slightly conspicuous on adaxial side, crenate. Secretory ducts black, slightly conspicuous on adaxial side. Flower solitary or grouped in thyrsoid inflorescences, terminal: ♂ 1–3 flowers, ♀ 1 flower; peduncle 15–20 mm long; bracts 2, rounded or triangular, early caducous; bracteoles 2, triangular, subcoriaceous, crenate. Floral buds globose, green. Calicular bracts 2, ca. 2.5 × 3.5 mm, decussate, rounded or subglobose; sepals 4, 8–9 × 7–8 mm, decussate, rounded, subcoriaceous with hyaline margin, white greenish or purple; petals 5–7, 14–26.5 × 11.5–24 mm, obovate, membranaceous, white, pink, red, or white or cream with red internal base. Staminate flowers with ∞-stamens, fused in a conical synandrium, cream, yellow, or reddish, 8.5–12 × 6–6.5 mm;

anthers apical, poricidal, connective at the same height as the anthers; pistillode absent; staminodes resiniferous, forming a ring at the base of the synandrium, 2–3 series. Pistillate flowers with ∞-staminodes, without antherodes, resiniferous, forming a ring at the base of the ovary, 2–3 series; ovary 18–21 mm long, 5–7(–14)-locular, subapical, connivent stigmas. Capsules 3–6.5 × 2.8–6 cm, sepals, petals and staminodes early caducous, subapical stigmas converging and forming a crown on the apex of the fruit. Seed aril orange.

**Selected specimens:** Aracruz, 28.X.1992, *O.J. Pereira et al. 4046* (UEC). Conceição da Barra, APA DE Conceição da Barra, Praia de Meleiras, 5.X.2012, *A.M. Assis & J. Santos 3447* (VIES). Guarapari, 12.IX.1984, *O.J. Pereira 387* (VIES). Linhares, Reserva Biológica de Comboios, 10.X.1993, *O.J. Pereira & S. Pereira 5063* (VIES). São Mateus, Barra Nova, 22.X.2006, *L.F.T. Menezes 1573* (MBML). Vila Velha, Ponta da Fruta-Setiba, 13.IX.1982, *O.J. Pereira et al. 160* (UEC). Vitória, Reserva Ecológica de Camburi, 23.XII.1998, *A.M. Assis 679* (UEC).

*Clusia hilariana* occurs from the state of Rio de Janeiro to Rio Grande do Norte (Marinho *et al.* 2020). This species can be found mainly in *restingas* and the Atlantic Forest, occasionally being found in rocky outcrops. *Clusia hilariana* is assessed as a species of Least Concern (LC) according to the IUCN Red List (BGCI & IUCN 2019).

*Clusia hilariana* is morphologically similar to *Clusia aemygdioi*. These species have large and showy flowers, staminate flowers with stamens organized in a conical synandrium without pistillode, with resinous staminodes forming a ring at the base of the synandrium, and pistillate flowers with many carpels, large ovary, with resinous staminodes at the base of the ovary. The fruits are large and the persistent subapical stigmas in the fruit form a crown-like structure. The diagnostic characters of *C. hilariana* were discussed in the comments of *C. aemygdioi*.

### 1.3. *Clusia melchiorii* Gleason, *Bulletin of the Torrey Botanical Club* 58(6): 403. 1931.

Fig. 1b-d

Shrubs, trees, or treelets, up to 10 m tall; young branches peeling in rings; white or cream exudate. Petiole 4–11 × 1–2 mm, tightly crenate. Leaf blades 4–12 × 3–7 cm, green on adaxial side *in vivo*, light green on abaxial side *in vivo*, brown to light brown on both sides *in sicco*, coriaceous, obovate, base acute, cuneate, or decurrent, apex rounded or truncate, margin revolute. Midrib prominent on both sides, visible up to the apex of

the leaf blade; secondary veins 1.5–3 mm apart from each other, slightly prominent or inconspicuous on both sides, forming an angle of 40°–60° with the midrib; inframarginal vein slightly conspicuous or inconspicuous on the adaxial side, crenate. Secretory ducts inconspicuous. Flowers grouped in terminal thyrsoid inflorescences, with numerous flowers; peduncle 25–35 mm long; bracts 2, ovate to triangular, crenate, early caducous; bracteoles 4, ovate to triangular, crenate, persistent on fruit. Floral buds globose, green. Sepals 4, 3.8–4.5 × 3.7–4 mm, decussate, triangular-subrotund, subcoriaceous with hyaline margin, green; petals 4, 3.5–4.5 × 2.5–3.5 mm, obovate, fleshy, cream to yellowish green. Staminate flowers with numerous free stamens, yellowish green *in vivo*, not resiniferous, 2.5–4 mm long; anthers apical, caducous by longitudinal slits; pistillode absent. Pistillate flowers with 4 short non-resiniferous staminodes, linear, anantherous, early caducous; ovary 4-locular, 3–4 mm long, oblong, styles erect, short, connivent, stigma apical, connivent. Capsules submature with 10–15 × 5–8 mm, sepals persistent, petals and staminodes early caducous, stigmas apical. Seed aril orange.

**Selected specimens:** Domingos Martins, Chapéu, Rio Jucu Braço Norte, 8.XI.1993, *G. Hatschbach 59729* (MBM); Panelas, 6.VI.1993, *J.M.L. Gomes 3153* (UEC). Ibirapu, Lombardia, divisa Sta. Teresa/Ibirapu, 6.V.2005, *L. Kollmann et. al 7738* (UEC). Itaguaçu, Caparaó, 17.VII.2007, *L. Kollmann et. al 9922* (UEC). Santa Leopoldina, Pousada Pau-Apique, 23.X.2007, *V. Demuner et al. 4340* (UEC). Santa Teresa, Estação Biológica de Santa Lúcia, 9.XII.1993, *L.D. Thomaz 1696* (VIES); 8.XII.2016, *K.S. Valdemarin et al. 309* (UEC); 28.VII.1994, *C.C. Chamas & R.R. Santos 205* (UEC); São Roque do Canaã, Alto Misterioso, 16.VII.2006, *C. Esgario & A.P. Fortuna-Perez 46* (UEC).

*Clusia melchiorii* has disjunct distribution in the Guyana Shield (Brazil, Colombia, Guyana and Suriname) and in eastern Brazil, in the states of Bahia and Espírito Santo, occurring in montane to upper montane elfin forests in the Guyana Shield and in rocky outcrop areas, *restingas* and Tabuleiro forests in Bahia and Espírito Santo. *Clusia melchiorii* is assessed as a species of Least Concern (LC) according to the IUCN Red List (BGCI & IUCN 2019).

In Espírito Santo, *C. melchiorii* is a species easily recognized by its small cream to yellow-green flowers, with numerous stamens and without pistillode in the staminate flowers and 4-locular ovary with slightly prolonged styles, which become more visible in the fruits. In addition, *C. melchiorii*

is the only species of the genus *Clusia* in Espírito Santo that has the epidermis of the apex of young branches peeling in rings.

**1.4. *Clusia nemorosa*** G. Mey., Prim. Fl. Esseq. 203. 1818. Fig. 1e-f

Shrubs or trees, up to 12 m tall; exudate white. Petiole 2–3.7 cm long. Leaf blades 6–12 × 3–9.5 cm, light green on both sides *in vivo*, bright, light brown to dark brown on both sides *in sicco*, subcoriaceous, oblong or obovate, base acute to cuneate, apex rounded, margin slightly revolute. Midrib prominent on both sides, visible up to 3/4 to the apex of the leaf blade; secondary veins 2.5–3.5 mm apart from each other, prominent on both sides, forming an angle of 35°–40° with the midrib; inframarginal vein slightly conspicuous on the adaxial side, crenate. Secretory ducts inconspicuous. Flower solitary or grouped in thyrsoid inflorescences, terminal: ♂ 1–3 flowers, ♀ 1–3 flowers; peduncle 10–13.7 mm long; bracts 2, triangular, crenate; bracteoles 2, triangular, crenate. Floral buds globose, white or white reddish. Calicular bracts 2, 1–1.5 × 1–1.5 mm, decussate, subcoriaceous, rounded; sepals 4–6, 8–10 × 5.5 mm, decussate, rounded, subcoriaceous with hyaline margin, white or reddish; petals 4–6, 18–20 × 15–17 mm, obovate, membranaceous, white with red internal base. Staminate flowers with ∞-stamens, free, filiform, yellow, up to 5 mm long; thecae lateral, longitudinal, connective higher than the anthers; pistillode absent; staminodes resiniferous in the center, resin yellow. Pistillate flowers with ∞-staminodes, resiniferous, forming a ring at the base of the ovary; ovary 10–15 mm long, 4–8-locular, stigmas apical. Capsules oblong, 2–5 × 1.5–3.5 cm, sepals, petals, staminodes, and stigmas persistent. Seed aril orange to red.

**Selected specimens:** Conceição da Barra, área 135 da Aracruz Celulose S.A., 10.VI.1992, *O.J. Pereira et al. 3516* (VIES); Parque Estadual de Itaúnas, *O.J. Pereira et al. 6151* (VIES). Jaguaré, Giral, 17.I.2009, *L. Kolmman & R.S. Lopes 11462* (UEC). Linhares, Reserva Natural Vale, 26.VII.2012, *G.S. Siqueira 763* (CVRD). Nova Venécia, Pedra do Cristalino, 18.XII.2014, *R.J. Trad & M.F.D.J. Trad 577* (UEC).

*Clusia nemorosa* is a species with wide distribution in Brazil, occurring in all regions, except in the Southern Region of Brazil. There may be populations of *C. nemorosa* with gynodioecious flowers, but these populations have not yet been found in Espírito Santo. In Espírito Santo it is found mainly in *restingas*, tropical rain forests and rocky outcrops. *Clusia nemorosa* is assessed as a species

of Least Concern (LC) according to the IUCN Red List (BGCI & IUCN 2019). Vernacular name: *clusia-capelinha*, *clusia-purunga*.

*Clusia nemorosa* differs from all species of *Clusia* of Espírito Santo in that it presents staminate flowers with filiform stamens, with lateral thecae, connective higher than the thecae, and central resinous staminodes.

**1.5. *Clusia organensis*** Planch. & Triana, Ann. Sci. Nat., Bot. 13, série IV: 349. 1860.

= *Clusia marizii* Gomes da Silva & B. Weinberg, Bradea 4: 22. 1984. Fig. 1g-h

Shrubs or trees, up to 5 m tall; exudate white or cream. Petiole 6–12 × 1.5–2.5 mm. Leaf blades 3.5–13 × 1.5–5.5 cm, dark green on adaxial side *in vivo*, light green on abaxial side *in vivo*, brown to light brown on both sides *in sicco*, subcoriaceous, oblanceolate, base acute or attenuate, apex rounded or cuneate, margin slightly revolute. Midrib prominent on both sides, visible up to 2/3 to the apex of the leaf blade; secondary veins 2.5–3 mm apart from each other, slightly prominent on both sides, forming an angle of 30°–45° with the midrib; inframarginal vein slightly conspicuous, crenate. Secretory ducts black, conspicuous on the adaxial side. Flowers grouped in thyrsoïd inflorescences, terminal: ♂ 3–19 flowers, ♀ 3 flowers; peduncle 6–11 mm long. Floral buds globose, greenish. Sepals 4(–6), 6–6.5 × 4.5–6.5 mm, decussate, rounded, subcoriaceous with hyaline margin, green; petals 5(–6), 12.5–13 × 10–11 mm, obovate, membranaceous, vinaceous or red with white margin. Staminate flowers with 7–15(–22) free stamens, clavate, yellow *in vivo*, resiniferous, resin yellow, 3–4 × 2–3 mm; thecae apical, longicidal, connective at the same height as the anthers; pistillode fungiform, stigmas 5, 3.5–5 mm long, connivent. Pistillate flowers with 5–7 staminodes, resiniferous, resin yellow, 3.5 mm long; ovary 5-locular, 4–7 mm long, ovoid-oblong, stigmas apical, connivent. Capsules 2.5–3 × 1.5–2 cm, fusiform, sepals, petals and staminodes early caducous, stigmas apical connivent. Seed aril orange.

**Selected specimens:** Alfredo Chaves, São Bento de Urânia, 8.XI.1994, *G. Hatschbach & J.M. Silva 61167* (UEC). Afonso Cláudio, Pedra dos Três Pontões, 18.V.2007, *A.P. Fontana et al. 3369* (MBML). Águia Branca, Córrego do Trinta, 25.IV.2006, *V. Demuner et al. 2205* (UEC). Cachoeiro de Itapemirim, Burarama, 21.V.2016, *R.C. Forzza et al. 8806* (UEC). Castelo, Parque Nacional do Forno Grande, 30.X.2004, *L. Kollmann et al. 7193* (MBML). Domingos Martins,

Parque Estadual Pedra Azul, 20.XI.2013, *A.C.S. Dal col et al. 206* (VIES). Ibitirama, Pedra Roxa, 25.X.2012, *T.B. Flores & O.R. Campos 1571* (UEC). Itaguaçu, Alto Misterioso, 6.XI.2007, *L. Kollmann et al. 10127* (UEC). Iúna, Serra do Valentim, 27.VIII.2011, *J.P.F. Zorzanelli & J.H. Carvalho Filho 86* (VIES). Mimoso do Sul, Conceição do Muqui, 20.VIII.2009, *D.R. Couto et al. 1247* (VIES). Nova Venécia, Serra de Cima, 11.XI.1953, *A.P. Duarte & C. Gomes 3663* (UEC). Santa Maria de Jetibá, Garrafão, 11.X.2008, *T.S. Lorencini et al. 77* (UEC). Santa Teresa, Estação Biológica de Santa Lúcia, 03.XII.1989, *M. Zortea* (UEC 207735). Vargem Alta, RPPN Água Branca, 1.X.2018, *A.M. Assis et al. 4695* (VIES).

*Clusia organensis* is endemic to the Southeast Region of Brazil and occurs mainly in tropical rain forests and can occasionally be found in rocky outcrops. *Clusia organensis* is assessed as a species of Least Concern (LC) according to the CNCFlora Red List (2022).

*Clusia organensis* has staminate flowers formed by free and claviform stamens, covered with resin and with a central pistillode, similar to the staminate flowers of *Clusia spiritu-sanctensis*. These species differ in that *Clusia organensis* has subcoriaceous and oblanceolate leaf blades, and flowers with vinaceous petals, or red with white margin, while *Clusia spiritu-sanctensis* has coriaceous and obovate leaf blades, and flowers with petals that are white with red internal base. Some populations of *C. organensis* that occur in Rio de Janeiro may have flowers with white or cream petals.

**1.6. *Clusia spiritu-sanctensis*** G. Mariz & B. Weinberg, Bradea 3(29): 233–238. 1982.

Fig. 1i

Shrubs, trees, or hemiepiphytes, up to 12 m tall; exudate white or cream. Petiole 5–9 × 1–2 mm, tightly crenate. Leaf blades 2.5–16 × 1.5–12 cm, green on adaxial side *in vivo*, light green on abaxial side *in vivo*, brown to light brown on both sides *in sicco*, coriaceous, obovate, base acute, cuneate, or decurrent, apex rounded or truncate, margin revolute. Midrib prominent on both sides, visible up to the apex of the leaf blade; secondary veins 1.5–2.5 mm apart from each other, slightly prominent or inconspicuous on both sides, forming an angle of 30°–50° with the midrib; inframarginal vein slightly conspicuous or inconspicuous on the adaxial side, crenate. Secretory ducts inconspicuous. Flowers grouped in thyrsoïd inflorescences, terminal: ♂ 5–9 flowers, ♀ 3 flowers; peduncle 15–25 mm long; bracts 2, ovate to triangular, crenate, early

caducous; bracteoles 2, ovate to triangular, crenate, early caducous. Floral buds globose, green. Sepals 4, 6.5–10 × 8.5–11.5 mm, decussate, rounded, subcoriaceous with hyaline margin, green; petals 5, 14–16 × 12–13.5 mm, obovate, membranaceous, white with red internal base. Staminate flowers with 30–40 free stamens, clavate, yellow *in vivo*, resiniferous, resin orange to red, 2–3.5 × 1–2.5 mm; anthers apical, longicidal, connective at the same height as the anthers; pistillode fungiform, poorly developed, at the same height or below the height of the stamens, stigmas 5, ca. 2 mm long, connivent. Pistillate flowers with 5 staminodes, resiniferous, resin orange to red, 3.5 mm long; ovary (4–)5(–6)-locular, 5–10 mm long, oblong, stigma apical, connivent. Capsules 3.5–4.5 × 1.5–3 cm, sepals, petals and staminodes early caducous, stigmas apical. Seed aril orange.

**Selected specimens:** Água Doce do Norte, 12.III.2010, *R.C. Forzza 5803* (SPF). Águia Branca, Córrego do Rochedo, 16.XII.2014, *R.J. Trad & M.F.D.J. Trad 565* (UEC). Aracruz, Picuã, 30.X.2011, *T.F. Sagrillo & C.L. Dalmonch 60* (MBML). Cachoeiro de Itapemirim, 14.I.1985, *J.R. Pirani 1143* (SPF). Colatina, Alto Moacir, 12.VII.2006, *V. Demuner et al. 2582* (MBML). Domingos Martins, Panelas, 6.VI.1993, *J.M.L. Gomes 1960* (VIES). Governador Lindenberg, Pedra de Santa Luzia, 23.VIII.2006, *V. Demuner et al. 2693* (MBML). Guarapari, 24.V.2015, *A.C.S. Dal col 329* (VIES). Ibirapu, Mosteiro Zen Budista, 26.V.1990, *J.M.L. Gomes 1143* (VIES). Linhares, Reserva Natural Vale, 26.X.2010, *T.B. Flores & G. Siqueira 947* (VIES). Marilândia, Liberdade, 18.I.2006, *V. Demuner et al. 1642* (MBML). Nova Venécia, APA Pedra do Elefante, 6.XI.2015, *N.T.L. Pena et al. 521* (VIES). Piúma, Ilha do Meio, 24.IV.2010, *F.L. Santos et al. 159* (MBML). Presidente Kennedy, Praia das Neves, 28.IV.1997, *O.J. Pereira et al. 5840* (VIES). Santa Leopoldina, Colina Verde, 30.V.2007, *V. Demuner et al. 4109* (MBML). Santa Teresa, Estação Biológica de Santa Lúcia, 7.IV.2006, *L. Kollmann et al. 8852* (MBML). Serra, APA Mestre Álvaro, 10.III.2012, *P.H.D. Barros et al. 254* (VIES). Vila Velha, Convento da Penha, V.1981, *B.M.T. Weinberg 201* (R). Vitória, Campus, da UFES, 19.IX.2002, *T.A. Pancotto et al* (VIES 19251).

*Clusia spiritu-sanctensis* occurs throughout the state of Espírito Santo and in the northern region of the state of Rio de Janeiro. This species occurs in *restingas*, tropical rain forest, and rocky outcrops. *Clusia spiritu-sanctensis* was assessed as Data Deficient (DD) in the red list of Espírito Santo (Fraga *et al.* 2019).

*Clusia spiritu-sanctensis* is very similar to *Clusia fluminensis* Planch. & Triana, a species that occurs naturally in Rio de Janeiro and is also

cultivated as ornamental. These species differ mainly in their distribution and in that *C. spiritu-sanctensis* presents staminate flowers with 30–40 stamens and reduced pistillode, at the same height or less than the stamens, while *C. fluminensis* presents staminate flowers with 10–15 stamens and a well-developed pistillode, greater than the height of the stamens. Vegetatively, *C. spiritu-sanctensis* presents strongly crenate (keeled) petiole and midrib, while *C. fluminensis* presents slightly crenate petiole and midrib.

*Clusia spiritu-sanctensis* has greater morphological similarity with *Clusia organensis*; to distinguish these taxa, see the comments under *Clusia organensis*.

## 2. *Garcinia* L.

*Garcinia* is composed of shrubs, treelets and medium-sized trees with eperulate terminal buds. The species secrete a white to yellowish exudate and can be monoecious, dioecious, gynodioecious or andromonoecious (Leal *et al.* 2013). The leaves are opposite, glabrous, occasionally membranaceous or more often subcoriaceous to coriaceous, with conspicuous primary, secondary and tertiary veins. The inflorescences are axillary fascicles. Flowers can be unisexual or bisexual, with 2–4(–5) sepals fused at the base and 2–4(–6) free petals. Staminate flowers have numerous free stamens, in fascicles or not, inserted over a central disc; the anthers are longitudinal or rarely pericidal, with an inconspicuous connective; some species have pistillode. Bisexual flowers have fewer stamens than staminate flowers, and in some species these stamens are sterile, and the flowers are functionally pistillate. The ovary is (1–2)–3-locular, syncarpic, with short or absent style. Fruits are yellow to orange berries when mature, often edible for humans. Seeds are only 1–4 per fruit, cylindrical, without aril.

*Garcinia* has pantropical distribution with about 240 currently recognized species (Stevens 2001), of which 15 occur in Brazil, although only seven of these are native to the country (Muniz 2020; Mouzinho *et al.* 2022). The other species found in Brazil are cultivated to obtain the fruits, which are sold or consumed locally. Two native species occur in Espírito Santo, in addition to three exotic species: *Garcinia intermedia* (Pittier [1912: 454] Hammel (1989: 927), *G. mangostana* Linnaeus (1753: 444) and *G. xanthochymus* Hooker.f. (1874: 269), which will not be included in the present taxonomic treatment.

### Identification key for *Garcinia* species in Espírito Santo

1. Young branches slightly rough to finely papillose; leaves with abaxial surface slightly rough; fragrant flowers; ellipsoid fruit, rostrum short ca. 1 mm long or absent ..... 2.1. *Garcinia brasiliensis*
- 1'. Young branches smooth; leaves with abaxial surface smooth; non fragrant flowers; subglobose, globose to ellipsoid fruits, with conspicuous rostrum ca. 5 mm long ..... 2.2. *Garcinia gardneriana*

#### 2.1. *Garcinia brasiliensis* Mart., Flora 24(2): 34. 1841.

Trees or shrubs, 3–12 m tall; young branches slightly rough to finely papillose; exudate yellow. Petiole 5–17 × 1–2 mm, slightly canaliculate. Leaf blades 5–17 × 2.5–8 cm, opaque on both sides *in sicco*, subcoriaceous to coriaceous, ovate to elliptic, often asymmetric, base rounded or attenuated, apex acuminate, margin entire, slightly revolute, abaxial surface, slightly rough. Midrib prominent on both sides; secondary veins 1–2.5 mm apart from each other, forming an angle of 70°–80° with the midrib. Flowers fragrant, grouped in fascicle inflorescences, axillary, 3–15 flowers, androdioecious plants. Floral buds globose, whitish green. Sepals 4–5, ca. 2 × 1.5 mm, subglobose to globose, membranaceous with entire margin, whitish green; petals 4–5, ca. 3.5 × 2.5 mm, obovate, white. Staminate flowers: stamens 20–30, 2–2.5 mm long., whitish. Hermaphroditic flowers: stamens like staminate flowers; ovary 3-locular, 3–2.5 mm long, ovoid; stigma calyptriform, ca. 0.8 × 2 mm. Berries ca. 2.5 cm long, ellipsoid, indehiscent, stigma persistent, rostrum short ca. 1 mm long or absent. Seeds 1–3.

**Selected specimens:** Aracruz, Santa Cruz, 15.X.1991, *V. Souza 215* (SPF). Conceição da Barra, Floresta Nacional do Rio Preto, 4.XII.2019, *A. Alves-Araújo 1967* (VIES). Guarapari, Parque Estadual Paulo César Vinha, 2.II.1995, *O.J. Pereira & L.H.M. Aquino 5361* (VIES). Linhares, Reserva Florestal da CVRD, 22.IX.1980, *D.A. Folli 257* (NY). Santa Teresa, Estação Biológica de Santa Lúcia, 11.VIII.1993, *L.D. Thomaz 1695* (MBML, VIES). São Mateus, Bairro Liberdade, 16.I.2008, *R.F.A. Martins et al. 147* (MBML). Vila Velha, Interlagos II, 29.I.1984, *B. Weinberg s.n.* (MBML 6466).

*Garcinia brasiliensis* can be found in *restinga* forests on the coast of the Northeast, Southeast and South regions (Mouzinho *et al.* 2022).

The two species of *Garcinia* that are native to Espírito Santo can be easily differentiated through the surface of young branches, which in *G. brasiliensis* are rough or even papillose, and smooth in *G. gardneriana*. Furthermore, the species can be distinguished by the shape of the fruit, which is ellipsoid in *G. brasiliensis*

and globose to ellipsoid in *G. gardneriana*, and by the rostrum of the fruit, absent or short in *G. brasiliensis* and well developed (2–6 mm) in *G. gardneriana*. However, rostrum morphology may be variable between species (Bittrich 2003), and therefore should be used in combination with other characters. Additionally, *G. brasiliensis* is apparently the only Brazilian species of *Garcinia* that has perfumed flowers (Van den Berg 1979), a fact that can be useful for identifying species from Espírito Santo during fieldwork. Vernacular names: bacupari, guanandi, guanandi-da-areia.

#### 2.2. *Garcinia gardneriana* (Planch. & Triana) Zappi, Kew Bull. 48: 410. 1993.

= *Rhedia gardneriana* Planch. & Triana, Ann. Sci. Nat. Bot., Sér. 4, 14: 321. 1860. Fig. 2a-b

Treelets or shrubs, 3–10 m tall; young branches smooth; exudate whitish yellow. Petiole 5–15 × 1–2 mm, slightly canaliculate. Leaf blades 5–15 × 2.5–6 cm, opaque on both sides *in sicco*, membranaceous to subcoriaceous, elliptical, oblong, or lanceolate, base attenuate, apex subacuminate to acuminate to acute, margin entire, slightly revolute, abaxial surface smooth. Midrib prominent on both sides; secondary veins 1–2 mm apart from each other, forming an angle of 75°–85° with the midrib. Flowers not fragrant, grouped in fascicle inflorescences, axillary, 7–15 to many flowers, androdioecious plants. Floral buds globose, whitish green. Sepals 2, ca. 2 × 1.5 mm, globose, membranaceous with entire margin, whitish green; petals 4, ca. 6 × 4 mm, obovate to subglobose, white to cream. Staminate flowers: stamens 10–16, 4–6 mm long, whitish; pistillate flowers: staminodes in 1–2 series, similar to stamens of staminate flowers; ovary 2–3-locular, 2.5–3 mm long, obovoid; stigma disciform or with 2–3 lobes, 1–3 mm diameter. Berries ca. 3.5 cm long, subglobose, globose to ellipsoid, indehiscent, stigma persistent, rostrum conspicuous ca. 5 mm long. Seeds 1–2.

**Selected specimens:** Castelo, Parque Estadual do Forno Grande, 12.VI.2004, *L. Kollmann et al. 6771* (MBML); 2.V.2008, *R. Goldenberg 1049* (SPF). Linhares, Reserva Natural da Vale do Rio Doce, 10.XII.2000, *D.A. Folli*

3774 (INPA); 8.IX.2004, *D.A. Folli 4921* (INPA). Santa Teresa, Estação Biológica de Santa Lúcia, 20.X.1993, *L.D. Thomaz 1795* (MBML); 21.X.1993, *L.D. Thomaz 933* (MBML); 11.VIII.1993, *L.D. Thomaz* (MBML 7305).

In Brazil, *Garcinia gardneriana* occurs from the Amazon to Rio Grande do Sul, in most of the states, and inhabits mainly *terra firme* forests, riverbanks, seasonal forests, ombrophilous forests and *restingas*. Although there are no concrete data about populations of *G. gardneriana*, it is possible to assume that the species is not under immediate threat of extinction due to its wide distribution and occurrence in several different environments.

To recognize *Garcinia gardneriana*, and differentiate it from similar plants, see the taxonomic commentaries on *G. brasiliensis*. Vernacular names: bacupari, guanandi-branco, guanandi-do-morro.

### 3. *Symphonia* L.f.

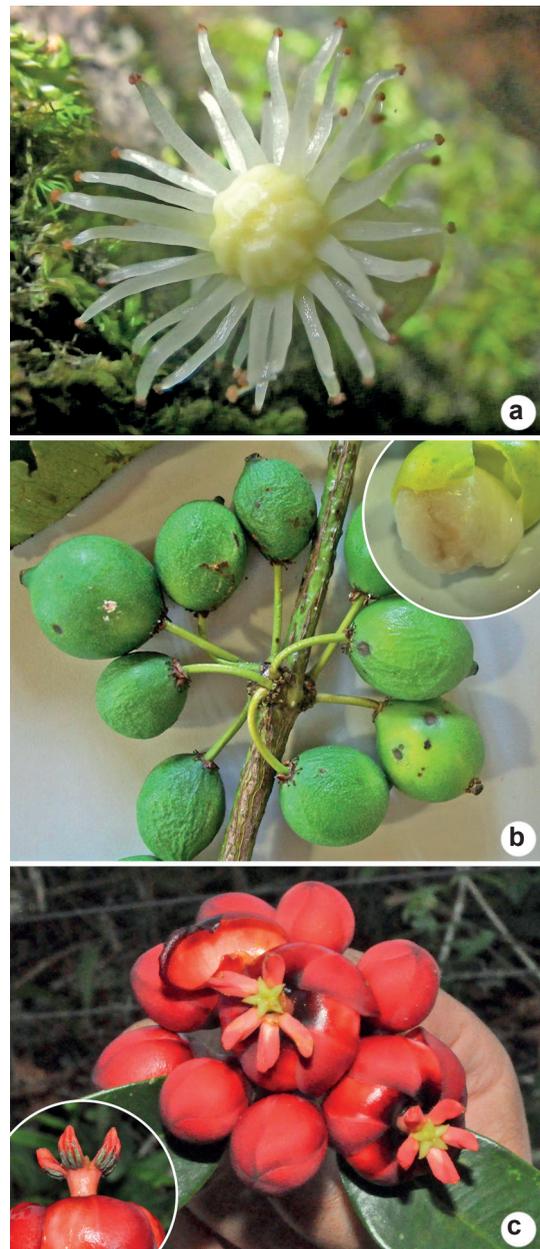
The species of *Symphonia* are trees, hermaphroditic, with perulate terminal buds, and secrete a yellow exudate. The leaves are opposite, glabrous, petiolate, leaf blade subcoriaceous, intersecondary and tertiary veins conspicuous. The inflorescences are terminal or axillary, cymose or solitary flowers. The flowers are bisexual. The sepals are free, 5-merous. The petals are free, 5-merous, usually alternate to sepals. The androecium is organized in fascicles, each formed by five fused stamens, united in the base, and forming a staminal tube surrounding the style. The anthers are long with glandular connective. The ovary is 5-locular, syncarpous. The fruits are globose indehiscent, with style and stigmas persistent. The seeds are exarillate.

*Symphonia* has ~22 species. Only *Symphonia globulifera* is found in Brazil. This species occurs in all regions of the country, except in the south (Muniz 2020).

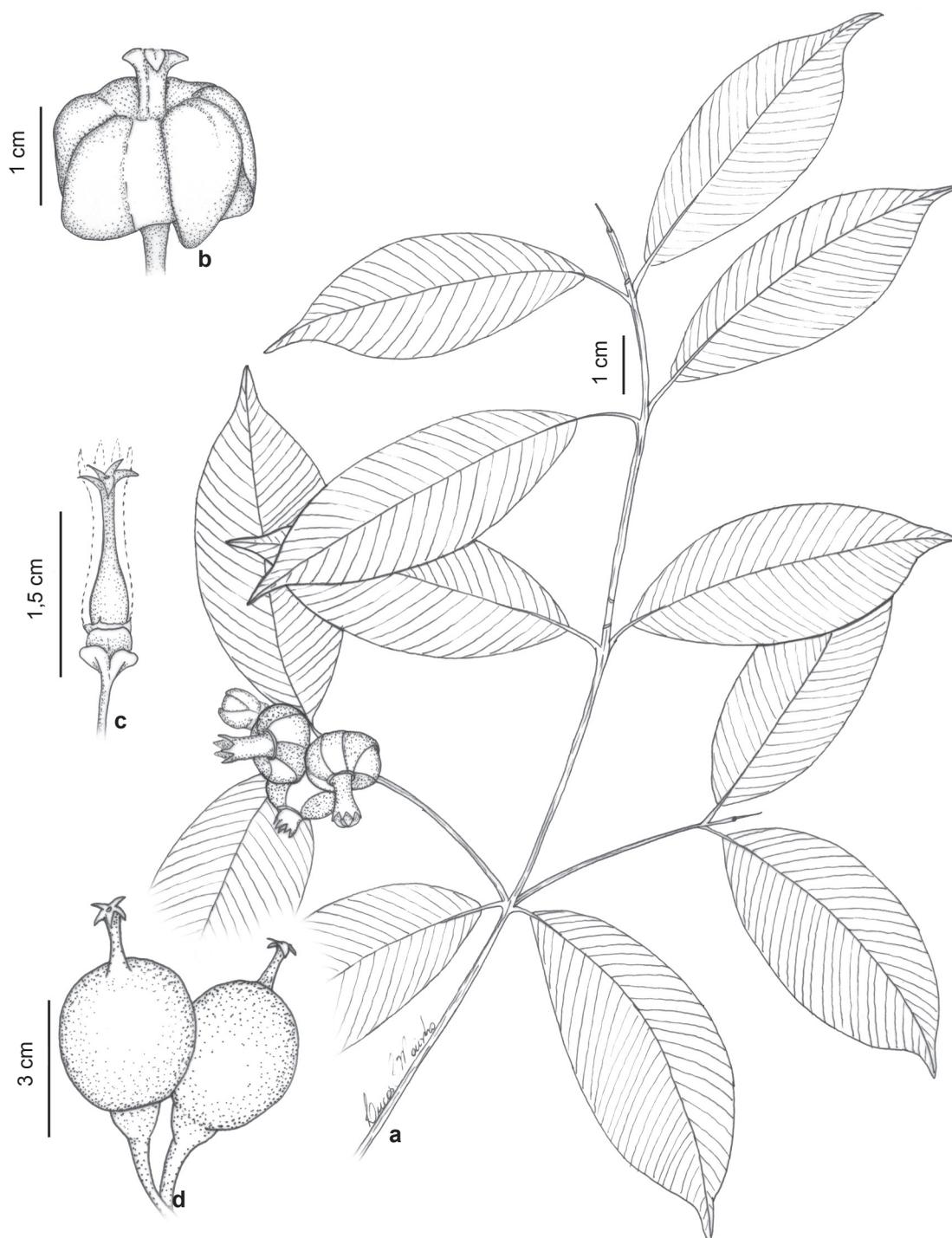
#### 3.1. *Symphonia globulifera* L.f., Suppl. Pl. 302. 1781 [1782]. Figs. 2c; 3

Trees, 3–15 m tall; exudate yellow. Petiole 5–10 × 1–2 mm, slightly canaliculate. Leaf blades 3–9.5 × 1.5–3 cm, light green *in vivo*, light green to light brown on both sides *in sicco*, subcoriaceous, oblong or elliptical, base cuneate or decurrent, apex acuminate, margin entire. Midrib prominent on abaxial side, visible up to the apex of the leaf blade; secondary veins 1.5–2.5 mm apart from each other, forming an angle of 75°–80° with the midrib; intersecondary veins

parallel to secondary veins, prominent on both sides *in sicco*, inframarginal vein inconspicuous. Flowers grouped in umbelliform inflorescences, terminal: 3–12 flowers, bisexual flowers. Floral buds subglobose, red. Sepals 5, 2.5–5 × 4–5 mm,



**Figure 2** – a-b. *Garcinia gardneriana* – a. flower; b. immature fruits arranged in an axillary fascicle, detail showing a mature fruit. c. *Symphonia globulifera* – inflorescence, detail showing the staminal tube. Photos: a. Louis Nusbaumer; b. João Paulo Zorzanelli; c. Christian da Silva.



**Figure 3** – a-d. *Symphonia globulifera* – a. branch with open flowers; b. flower; c. flower staminal tube removed, showing the pistil; d. immature fruits. Drawing by Lucas Marinho from a southern Bahia specimen.

deltoids, membranaceous with entire margin, vinaceous; petals 5, 10–15 × 10–12 mm, apex rounded, base truncate, subcarnose, margin entire, red. Stamens 5, fused forming a staminal tube surrounding the style, 10–15 mm long, yellow; ovary 5-locular, 25–30 mm long, oblong; style 5, 5–10 mm long, fused, yellow; stigma 5, free. Berries ca. 2.5 cm long, globose, indehiscent, style and stigmas persistent. Seeds 1–8.

**Selected specimens:** Colatina, Estrada da Colônia Águia Branca, 5.V.1934, *J.G. Kuhlmann 304* (NY). Conceição da Barra, Parque Estadual de Itaúnas, 30.III.2000, *O.J. Pereira & A.M. Assis 6085* (VIES). Fundão, Propriedade José Murilo Coutinho, 16.IV.1999, *I.D. Rodrigues 50* (VIES). Guarapari, Parque Estadual Paulo Cesar Vinha, 8.VII.2015, *D.T. Wandekoken et al. 50* (VIES). Linhares, Reserva Florestal da CVRD, 10.IV.2006, *M.A. Pinho-Ferreira et al. M641* (UEC). Piúma, base do Morro do Aghá, 16.II.1999, *R. Mello-Silva 1593* (NY). São Mateus, Liberdade, 24.IV.2014, *A.F.A. Scheidegger et al. 1* (VIES). Vila Velha, Barra do Jucu, 24.III.1981, *sr. José* (MBML 6341).

*Symphonia globulifera* can be easily recognized by the presence of yellow exudate and showy red flowers (Fig. 2c). In the state of Espírito Santo, *Symphonia globulifera* can be found mainly in *restingas* and tropical rain forest. *Symphonia globulifera* is assessed as a species of Least Concern (LC) according to the IUCN Red List (BGCI & IUCN 2019). Vernacular name: guanandi.

#### 4. *Tovomita* Aubl.

*Tovomita* species are usually dioecious trees with few underwood shrub species and eperulate

terminal buds. They are easily recognized by the presence of prop roots and yellowish exudate. The leaves are chartaceous to coriaceous, always shiny and grouped at the apex of the branches. The flowers are unisexual and organized in terminal inflorescences with a dichasial or thyrsoid arrangement and articulated pedicels. The central flower of the dichasium always opens first and usually does not have an articulated pedicel. The floral bud oblong, globose, or cylindrical, with different apex types. The flowers are usually inconspicuous: white, greenish, or pale yellow, becoming brownish when senescent, without resin. The flowers may have two or four sepals; however, the outer pair always covers the entire floral bud. The staminate flower has free stamens and an inconspicuous pistillode; pistillate flowers have staminodes similar to the stamens and ovary 4–5(–7)-carpellate. The ovary will give rise to a fleshy capsule containing a seed in each valve. The seed has a fleshy aril which can be yellow, orange or red.

*Tovomita* has 56 species distributed from Costa Rica to the Amazon region of Bolivia (Marinho *et al.* 2021a; Nobre *et al.* 2022). In Brazil, the genus occurs in the Amazon and Atlantic Forests, reaching the state of Rio de Janeiro (Marinho *et al.* 2020). Most species occur in the eastern portion of the Amazon Forest, and only 11 species occur in the east of Brazil, of which seven are endemic to the Atlantic Forest (Marinho 2020a). In Espírito Santo, locally known as *guanandi*, is represented by four species.

#### Identification key for *Tovomita* species in Espírito Santo

1. Shrubs or treelets, leaf blade narrowly elliptic; oblong floral buds, free styles; epicarp asperous and brownish fruit.....4.1. *Tovomita fructipendula*
- 1'. Trees, lanceolate, obovate to oblong leaf blade; globose floral buds, fused or absent styles; epicarp smooth and green fruit ..... 2
  2. Purplish-red leaf blades *in sicco*, secondary veins 10–12 pairs, intersecondary veins slightly thinner than the secondary; ≤ 20 stamens ..... 4.2. *Tovomita guianensis*
  - 2'. Grayish or copper-coloured leaf blades *in sicco*, secondary veins ≥ 16 pairs, intersecondary veins similar to the secondary; > 40 stamens ..... 3
    3. Copper-coloured leaf blades; pale yellow petals, terete filaments, yellowish ≥ 4 mm long, anthers ≥ 1 mm long.....4.4. *Tovomita riedeliana*
    - 3'. Grayish to copper-coloured leaf blades; white petals, subclavate filaments, white < 2 mm long, anthers < 0.5 mm long .....4.3. *Tovomita leucantha*

**4.1. *Tovomita fructipendula*** (Ruiz & Pav.)

Cambess., Mém. Mus. Paris. 16: 419. 1828.

= *Tovomita brasiliensis* (Mart.) Walp., Repert. Bot.

Syst. 1: 392. 1842. Fig. 4a-c

Shrubs or treelets up to 7 m tall, exudate abundant. Petioles 0.6–0.8 cm long, green or reddish. Leaf blades 2.7–9 × 1–3 cm, greenish *in sicco*, young leaves sometimes purplish-red adaxially *in vivo* and *in sicco*, chartaceous, narrowly elliptic, base convex to decurrent, apex acuminate. Venation: secondary veins ca. 12 pairs, 2–4 mm apart from each other, immersed adaxially, slightly prominent abaxially, straight near the margin; intersecondary veins present, similar to the secondary veins; intramarginal vein absent. Inflorescences: ♂ a lax 9-flowered thyrsoid, lacking primary flower, ♀ a 3-flowered dichasium. Pedicels 10–18 mm long. Floral buds 5–7 mm long, oblong, apex rounded. Sepals 2, 6–8 × 2–4 mm, oblong, apex rounded, green; petals 4, 6–11 × 2.5–5 mm, rounded to oblong, reflexed, apex rounded, oblong to oblanceolate, reflexed, apex rounded, white to light yellow. Staminate flowers with 45–50 stamens, 4–7 mm long, isodynamous; filaments terete, white; anthers ca. 0.5 mm long, white; pistillode inconspicuous, white. Pistillate flowers with 45–50 staminodes; ovary 6–7 mm long, 4-locular, white, styles free ca. 3 mm long, stigmas 4. Capsules 2.1–2.3 × 1.8 cm, 4-septate, globose when closed, epicarp asperous, brownish when immature and mature, mesocarp orangish to red; sepals, petals, staminodes and stigmas persistent; styles free 3–4 mm long. Seed aril orange.

**Selected specimens:** Conceição da Barra, Reserva Biológica de Córrego Grande, 28.VIII.2012, fr., *T.B. Flores & G.O. Romão 1250* (CVRD). Guarapari, Parque Estadual Paulo César Vinha, 26.VI.1999, fl., *O. Zambom & A.M. Assis 344* (VIES). Linhares, Reserva Natural CVRD, 17.IX.1987, fr., *G. Martinelli 12222* (CVRD, RB). Santa Maria de Jetibá, Belém, 30.I.2003, fl., *L. Kollmann 5951* (MBML). Santa Teresa, Nova Lombardia, 3.X.2002, fr., *R.R. Vervloet et al. 1131* (MBML). São Mateus, Liberdade, 20.X.2007, fl., *A.G. Oliveira 178* (VIES). Venda Nova do Imigrante, propriedade de Audir Cesati, 30.I.2008, fl. ♀, *M. Simonelli et al. 1442* (MBML). Vitória, Jardim Camburi, 17.X.2000, fl. ♀, *A.M. Assis 857* (VIES).

*Tovomita fructipendula* is widely distributed in South American countries, occurring from the coast of Venezuela to the central region of Bolivia (Marinho 2019). The species has a disjunct distribution between the Amazon and the Atlantic Forest (from Rio Grande do Norte to Rio de Janeiro), with tree and shrub individuals

found throughout its entire distribution. In Brazil, *T. fructipendula* occurs in almost all states in the northern region, except Roraima and Rondônia, and in the northeast region, except Ceará, Piauí and Sergipe, in addition to Espírito Santo and Rio de Janeiro (Marinho 2020a). In Espírito Santo, it occurs in areas of *florestas de tabuleiro* and *várzea* (Rolim *et al.* 2016).

*Tovomita fructipendula* is distinguished from other species in Espírito Santo by its smaller size, usually shrubby, small and narrow leaves (Marinho *et al.* 2016), in addition to brown and asperous fruits (Fig. 4b), which do not occur in other species of *Tovomita* in the state. Some specimens from the Duas Bocas Biological Reserve (*Fraga 2304*) and the Augusto Ruschi Biological Reserve (*Rossini 377*, *Rossini 469*, *Vervloet 2167*) have small and narrow leaves, but the fruits have smooth epicarp, contrasting with the typical asperous fruits of *T. fructipendula*. For the precise identification of these specimens, it is necessary to collect materials with floral buds or flowers. *Tovomita fructipendula* has been frequently identified as *T. brasiliensis*, a synonym, and was assessed as Least Concern (LC) according to the IUCN Red List (BGCI & IUCN 2019). Vernacular name: guanandi-mirim.

**4.2. *Tovomita guianensis*** Aubl., Hist. Pl. Guiane 2: 956, pl. 364. 1775.= *Tovomita brevistaminea* Engl. in Mart., Eichler & Urb. (eds.), *Fl. bras.* 12(1): 446. 1888.

Fig. 4d-f

Trees up to 6 m tall, exudate scarce. Petioles 0.7–1.1 cm long, green. Leaf blades 7.2–10.9 × 3–4.8 cm, purplish red *in sicco*, subcoriaceous, lanceolate to oblong, base convex to decurrent, apex acuminate to slightly apiculate. Venation: secondary veins 10–12 pairs, 4–10 mm apart from each other, immersed adaxially, prominent abaxially, slightly arcuate near the margin; intersecondary veins present, one or two per intercostal area, slightly thinner than the secondary veins; intramarginal vein present. Inflorescences: ♂ a lax 9-flowered thyrsoid, lacking primary flower, ♀ a 3-flowered dichasium. Pedicels 7–17 mm long. Floral buds 4–5 mm long, globose, apex rounded. Sepals 2–4, 4–7.5 × 4–5 mm, rounded, apex rounded, green to pale yellow; petals 4, 4–6.5 × 3–4.5 mm, globose to elliptic, deflexed, apex acute, pale yellow. Staminate flowers with 15–20 stamens, ca. 2 mm long, heterodynamous; filaments subclavate, yellow; anthers ca. 0.4 mm long; pistillode ca. 0.8 mm long, conical, yellow. Pistillate flowers with 16–20 staminodes; ovary ca.

4 mm long, 4-locular, yellow, stigmas 4, sessile. Capsules 2–2.3 × 0.9–1.3 cm, 4-septate, globose when closed, epicarp smooth, green when immature

and mature, mesocarp reddish; sepals, petals and staminodes persistent; rostrum present ca. 6 mm long. Seed aril orange.



**Figure 4** – a-c. *Tovomita fructipendula* – a. staminate flower; b. closed mature fruit; c. open fruit without three seeds. d-f. *Tovomita guianensis* – d. staminate flower; e. closed mature fruit; f. open fruit. g-i. *Tovomita leucantha* – g. staminate flower with drops of exudates on stamens; h. closed mature fruit; i. open fruit without two seeds. j-k. *Tovomita riedeliana* – j. senescent staminate flower; k. young leaves with reddish petioles and unusual shape, detail showing a mature leaf with a common shape. Only g, j and k are specimens from Espírito Santo. Photos: a. Rafael Barbosa; b. Lidyanne Aona; c. Roberta Silva; d. Karenia Pimenta; e, k. Lucas Marinho; f. Christian da Silva; g. João Paulo Zorzanelli; h. Marcus Nadruz; i. Leandro Cardoso; j. Ana Cláudia Alencar.

**Examined specimens:** Conceição da Barra, Reserva Biológica de Córrego Grande, 17.IV.2010, fr., *I.R. Oliveira et al.* 39 (VIES); 30.IV.2011, fr., *M. Ribeiro et al.* 512 (RB, SAMES, VIES); 30.IV.2011, fr., *W.B. Silva et al.* 5 (VIES)

**Additional specimens examined:** BRAZIL. BAHIA: Una, REBIO de Una, 20.VI.2013, fl. ♀, *L.C. Marinho et al.* 456 (CEPEC, HUEFS). PERNAMBUCO: Igarassu, Usina São José, 12.X.2013, fl. ♂, *L.C. Marinho et al.* 482 (CEPEC, HUEFS).

*Tovomita guianensis* has a disjunct distribution between the Amazon and Atlantic Forests and is widely distributed in South America, occurring from the coast of Venezuela to the central region of Bolivia (Marinho 2019). In Brazil, *T. guianensis* occurs in Amapá, Amazonas, Maranhão and Pará, in the Amazon region; Alagoas, Bahia, Pernambuco and Espírito Santo, in the Atlantic Forest (Marinho *et al.* 2016). In Espírito Santo, the species is known for only three specimens from lowland forests in the north of the state, the southern limit of species.

Among the species of Espírito Santo, *Tovomita guianensis* is the only one with intersecondary veins that are slightly thinner than the secondary ones. In a herbarium, the specimens take on a purplish-red coloration which is also characteristic of the species. *Tovomita guianensis* is recognized for its globose floral buds, yellow and subclavate stamens and staminodes (Fig. 4d), in addition to fruits with smooth epicarp (Fig. 4e). *Tovomita guianensis* had been identified as *T. brevistaminea*, a synonym (Marinho 2020a). The species was not assessed for its conservation status in the state of Espírito Santo but was assessed as a species of Least Concern due to its wide distribution (Marinho & Beech 2019).

**4.3. *Tovomita leucantha*** (Schltdl.) Planch. & Triana, Ann. Sci. Nat., Bot. 14, série IV: 278. 1860. Fig. 4g-i

Trees up to 10 m tall, exudate abundant. Petioles 1.3–2.8 cm long, green or reddish. Leaf blades 6.5–17 × 3–8 cm, generally grayish to cooper-coloured *in sicco*, coriaceous, obovate to oblong, base decurrent, apex rounded. Venation: secondary veins 22–40 pairs, 1.8–3 mm apart from each other, prominent in both surfaces, straight near the margin; intersecondary veins present, similar to the secondary veins; intramarginal vein present. Inflorescences: ♂ a lax 3–9-flowered thyrsoid, lacking primary flower, ♀ a 3-flowered dichasium. Pedicels 12–30 mm long. Floral buds 6–7 mm long, globose, apex rounded. Sepals 4, 9.5–15 × 6.5–12, rounded to oblong, apex rounded, green; petals 4–6, 11–20 × 6–11 mm, oblanceolate to oblong,

deflexed, apex rounded, white. Staminate flowers with 60–70 stamens, 1.5–2 mm long, isodynamous; filaments subclavate, white; anthers ca. 0.5 mm long, yellow; pistillode inconspicuous, white. Pistillate flowers with 60–70 staminodes; ovary ca. 4 mm long, 4-locular, yellow, stigmas 4, sessile. Capsules 2.5–4 × 2.5 cm, 4-septate, globose when closed, epicarp smooth, green when immature and mature, mesocarp greenish becoming reddish; sepals, petals and staminodes caducous; rostrum present ca. 4 mm long. Seed aril orange to reddish.

**Examined specimen:** Irupi, reserva florestal próxima ao sítio São Judas Tadeu, 20°18'55"S, 41°34'02"W, 30.X.2018, fl., *J.P.F. Zorzanelli* 1805 (VIES).

**Additional examined specimens:** BRAZIL. MINAS GERAIS: Marliéria, 7.V.1998, *M.G. Bovini et al.* 1369 (RB). RIO DE JANEIRO: Rio de Janeiro, estrada da Vista Chinesa, 17.VII.2014, *L.C. Marinho* 888 (RB).

*Tovomita leucantha* is endemic to the Atlantic Forest of the Southeast region of Brazil, not occurring only in the state of São Paulo (Marinho *et al.* 2016; Marinho 2020a). In Espírito Santo, the species is known for a single specimen collected on the montane forest of Irupi, south of the state (Fig. 4g). *Tovomita leucantha* was assessed as Endangered in the red list of Espírito Santo (Fraga *et al.* 2019), especially due to the low number of localities in which it can be found.

*Tovomita leucantha* is recognized by its obovate leaves with obtuse apex, greyish *in sicco*, coriaceous and with numerous secondary veins (22–40 pairs). The stamens are subclavate, similar to those of *T. guianensis*, but white, like the petals (Fig. 4g). Some immature specimens of *T. riedeliana* are similar to *T. leucantha* but the latter can be distinguished by the subclavate stamens (*vs. terete* in *T. riedeliana*) and short anthers (ca. 0.5 mm *vs.* ca. 1 mm in *T. riedeliana*).

**4.4. *Tovomita riedeliana*** Engl., *Fl. bras.* 12(1): 449. 1888. Fig. 4j-k

Trees up to 20 m tall, exudate abundant. Petioles 2.2–3.5 cm long, green or reddish. Leaf blades 7.5–15.5 × 3–7 cm, copper-coloured *in sicco*, subcoriaceous, oblong to obovate, base convex to decurrent, apex acuminate. Venation: secondary veins 16–20 pairs, 3–4 mm apart from each other, prominent abaxially, immersed adaxially, straight near the margin; intersecondary veins present, similar to the secondary veins; intramarginal vein present. Inflorescences: ♂ a lax 15-flowered thyrsoid, lacking primary flower, ♀ a 3-flowered dichasium. Pedicels 13–55 mm long. Floral buds 5.5–8 mm long, globose, apex

rounded. Sepals 2–4, 5.5–8.5 × 5–6.5 mm, rounded to oblong, apex rounded, light green; petals 4, 6.5–9 × 6–7 mm, rounded to oblong, reflexed, apex rounded, pale yellow. Staminate flowers with 45–50 stamens, 4–5 mm long, isodynamous; filaments terete, yellowish; anthers ca. 1 mm long, yellow; pistillode inconspicuous, yellow. Pistillate flowers with 45–50 staminodes; ovary ca. 4 mm long, 4-locular, yellow, styles fused 1.5–2 mm long, stigmas 4. Capsules 3.5–4 × 1.5–2.5 cm, 4-septate, pyriform when closed, epicarp smooth, green when immature and mature, mesocarp red to purplish red; sepals, petals and staminodes caducous; rostrum present ca. 3 mm long. Seed aril orange.

**Selected specimens:** Cariacica, Reserva Biológica Duas Bocas, 21.X.2008, fl., *P.H. Labiak et al. 5007* (MBML, RB, UPGB). Domingos Martins, floresta ciliar do Rio Jacú, 25.I.2001, fl., ♂, *O.J. Pereira & E. Espindula 6829* (VIES). Linhares, Reserva Natural da CVRD, 22.X.2004, fl., ♂, *D.A. Folli 4964* (CVRD). Marilândia, Liberdade, 13.VII.2006, fr., *V. Demuner et al. 2620* (MBML). Santa Leopoldina, fazenda Caioba, 24.X.2007, fl., *V. Demuner et al. 4400* (MBML). Santa Maria de Jetibá, na encosta às margens do Rio Santa Maria, 30.X.2000, fl., *O.J. Pereira & E. Espindula 6523* (VIES). Santa Teresa, Santa Lúcia, 25.II.2014, fl. ♀, *L.C. Marinho & J. Molino 800* (CEPEC). Sooretama, Reserva Biológica de Sooretama, 18.VII.1969, *D. Sucre 5717* (RB). Vila Pavão, estrada para Cristalina, 9.VI.2015, *L.C. Marinho et al. 1027* (CEPEC).

*Tovomita riedeliana* is endemic to the Atlantic Forest, occurring from the coast of Pernambuco to Rio de Janeiro, with the exception of Sergipe (Marinho *et al.* 2016; Marinho 2020a). In Espírito Santo, *T. riedeliana* occurs in areas of *florestas de tabuleiro* (Rolim *et al.* 2016) with

higher incidence in riparian forests, and some individuals have been found growing in an area of seasonally dry submontane forest (Marinho *et al.* 2016). The species was assessed as a species of Least Concern (Marinho & Beech 2019). Vernacular name: guanandi-amarelo.

### 5. *Tovomitopsis* Planch. & Triana.

The species of *Tovomitopsis* are dioecious trees or shrubs, with a white-yellowish exudates, and eperulate terminal buds, and conspicuous prop roots. The leaves are membranaceous, chartaceous, subcoriaceous or coriaceous, grouped at the apex of the branches, and can present black dots or not. The thyrsoid inflorescences are terminal and bearing small, yellowish to greenish flowers, which offer resin to pollinators (Bittrich *et al.* 2003). The flowers of the genus have small external sepals, not covering the floral bud, which distinguishes it from *Tovomita*. The flowers also are unisexual with staminodes in the pistillate flowers, and pistillodes in the staminate flowers. Stamens and staminodes are free and covered by the resin. The ovary is 4-carpellate, and will give rise to capsular and fleshy fruits. The seeds have an orange to reddish aril.

*Tovomitopsis* has only two species, which are endemic to the Brazilian Atlantic Forest (Marinho 2020b). They are distributed in the Southeast and Southern regions, with its southern limit in the state of Paraná. *Tovomitopsis saldanhae* had been considered endemic to Rio de Janeiro, with possible occurrence in other states in the Southeast (Marinho 2020b). Here we confirm the occurrence of the species in Espírito Santo.

### Identification key for *Tovomitopsis* species in Espírito Santo

1. Leaf blades chartaceous, black dots absent on the abaxial surface..... 5.1. *Tovomitopsis paniculata*
- 1'. Leaf blades subcoriaceous to coriaceous, black dots present on the abaxial surface .....  
..... 5.2. *Tovomitopsis saldanhae*

#### 5.1. *Tovomitopsis paniculata* (Spreng.) Planch. & Triana, Ann. Sci. Nat., Bot., sér. 4, 14: 262. 1860.

Fig. 5a-d

Shrubs or trees up to 4(–12) m tall, exudate scarce. Petioles 1.8–3.5 cm long, green. Leaf blades 5–11.5 × 1.7–4 cm, greenish *in sicco*, chartaceous, black dots absent on the abaxial surface, elliptic to slightly obovate, base decurrent, apex obtuse to slightly acuminate. Venation: secondary veins ca.

15 pairs, 2–3 mm apart from each other, prominent abaxially, immersed adaxially, straight near the margin; intersecondary veins present, similar to the secondary veins; intramarginal vein present. Inflorescences: ♂ a lax 9–18-flowered thyrsoid, lacking primary flower, ♀ a 3-flowered dichasium. Pedicels 8–13 mm long. Floral buds ca. 5 mm long, globose, apex rounded. Sepals 4, the outer 2–3 × 3 mm, rounded to deltoid, apex rounded to

acuminate, green; the inner ca.  $4 \times 5$  mm, rounded, apex rounded, greenish; petals 4,  $8\text{--}11 \times 6$  mm, rounded to oblong, apex rounded, yellowish green. Staminate flowers with ca. 22 stamens, ca. 2 mm long; filaments subclavate, pale yellow; anthers yellow; pistillode not seen. Pistillate flowers with ca. 18 staminodes; ovary 4-locular, green, stigmas 4, sessile, white. Capsules ca.  $2.6 \times 1.9$  cm, 4-septate, pyriform when closed, sometimes falcate, epicarp smooth, green when immature and green-pinkish when mature, mesocarp red; sepals and petals persistent, staminodes caducous; rostrum absent.

**Examined specimens:** Iúna, Serra do Valentim, 11.XII.2011, fr., *J.P.F. Zorzanelli 224* (VIES); 19.I.2012, fl., ♂, *J.P.F. Zorzanelli & A.E. Silva 289* (VIES). Santa Maria de Jetibá, 30.X.2000, fl., ♂, *O.J. Pereira 6613* (VIES).

**Additional examined specimens:** BRAZIL. PARANÁ: Adrianópolis, fazenda Mato Preto, 13.XI.2007, fl. ♂, *J.M. Silva & J. Cordeiro 6176* (HUEFS). RIO DE JANEIRO: Guapimirim, granja Monte Olivete, 20.XII.1995, fl. ♂, *J.M.A. Braga et al. 3145* (RB, UEC). Nova Iguaçu, Reserva Biológica do Tinguá, 9.XI.1994, fl. ♂, *L. Sylvestre et al. 958* (RBR).

*Tovomitopsis paniculata* occurs in all states in the Southeast, in addition to the state of Paraná (Marinho 2020b). The species was recorded for the first time in Espírito Santo by Zorzanelli *et al.* (2015) in the highland forest of the Serra do Valetim, Iúna. *Tovomitopsis paniculata* was assessed as Endangered by Fraga *et al.* (2019), mainly due to its restricted distribution, which is reflected on the low number of samples in herbaria.



**Figure 5** – a-d. *Tovomitopsis paniculata* – a. young leaf in adaxial view; b. staminate flower; c. pistillate flowers and buds; d. prop roots. e-g. *Tovomitopsis saldanhae* – e. branch with mature and immature fruits; f. staminate flower, note the two pairs of petals of different sizes; g. pistillate flower and buds, note the black dots on the abaxial leaf surface. Only a-c are specimens from Espírito Santo. Photos: a. José Elvino Nascimento Jr.; b-c. João Paulo Zorzanelli; d. Gabriel Marcusso; e. Rodrigo Freitas; f. Rodrigo Penati; g. Luciano Pedrosa.

**5.2. *Tovomitopsis saldanhae*** Engl., *Fl. bras.* 12(1): 457. 1888.

= *Clusia angustifolia* Engl., *Fl. bras.* 12(1): 420. 1888. Fig. 5e-g

Shrubs or trees up to 8(–12) m tall, exudate scarce. Petioles 1.4–3.3 cm long, green. Leaf blades 4.2–11.5 × 1.5–3.2 cm, greenish to copper *in sicco*, subcoriaceous to coriaceous, black dots present on the abaxial surface, obovate, base decurrent, apex rounded. Venation: secondary veins 10–16 pairs, 4–6 mm apart from each other, prominent abaxially, immersed adaxially, straight near the margin; intersecondary veins present, similar to the secondary veins; intramarginal vein present. Inflorescences: ♂ a lax or congested 15-flowered thyrsoid, lacking primary flower, ♀ a 9-flowered dichasium. Pedicels 4–8 mm long. Floral buds ca. 5.5 mm long, globose, apex rounded. Sepals 4, the outer ca. 3 × 3.5 mm, rounded to deltoid, apex rounded, green; the inner ca. 5 × 3.5 mm, rounded to oblong, apex rounded, greenish; petals 4, 7–7.5 × 6.5 mm, rounded to oblong, apex rounded, white. Staminate flowers with ca. 21 stamens, ca. 2 mm long; filaments subclavate, yellow; anthers yellow; pistillode conical, yellowish. Pistillate flowers, staminodes not seen; ovary 4-locular, green, stigmas 4, sessile, white. Capsules 2.2–3 × 1.5–2.3 cm, 4-septate, globose to pyriform when closed, slightly falcate, epicarp smooth, green when immature and pink when mature, mesocarp reddish to greenish; sepals and petals persistent, staminodes caducous; rostrum absent.

**Selected specimens:** Fundão, Goiapaba-Açu, 25.VII.2000, fl. ♀, *V. Demuner et al.* 1238 (MBML). Ibitirama, Pedra Roxa, 25.X.2012, fr., *T.B. Flores & O.R. Campos* 1562 (MBML, VIES). Itaguaçu, Caparaó, 17.VII.2007, fr., *L. Kollmann et al.* 9947 (MBML). Santa Teresa, Estação Biológica de Santa Lúcia, 27.I.2000, fr., *V. Demuner & E. Bausen* 638 (MBML); Nova Lombardia, 18.II.2003, fl. ♂, *R.R. Vervloet et al.* 1849 (MBML).

**Additional examined specimens:** BRAZIL. RIO DE JANEIRO: Petrópolis, morro da Carangola, 22.XII.1822, fl. ♂, *A.F.M. Glaziou* 13576 (P).

*Tovomitopsis saldanhae* is recognized especially by its subcoriaceous to coriaceous leaves with black dots on the abaxial face (Fig. 5g). The species was assessed as Critically Endangered due to the low number of mature individuals in each subpopulation (Fraga *et al.* 2019).

The limits between *T. saldanhae* and *T. paniculata* are unclear (Marinho *et al.* 2021b), since the leaf morphology appears to be largely plastic according to the altitudinal variation and distance from the coast. What we know for now

is that *T. saldanhae* occurs in regions with high altitude, while *T. paniculata* has a preference for lowland forests.

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### Specimens List

Alves M 2311 (4.1). Alves-Araújo A 1967 (3.1). Amorim AM 7153 (4.4), 7578 (4.4). Assis AM 679 (1.2), 857 (4.1), 3447 (1.2), 4567 (1.1), 4695 (1.5). Assis MC 582 (1.1). Barros PHD 254 (1.6). Bausen E 127 (4.4). Boudet Fernandes HQ 1465 (5.2). Bovini MG 1369 (4.3). Braga JMA 3145 (5.1). Chamas CC 205 (1.3). Couto DR 193 (1.1), 1247 (1.5). Cruz TA 25 (5.2). Dal col ACS 206 (1.5). Demuner V 166 (4.4), 289 (4.1), 294 (4.1), 523 (4.4), 595 (4.4), 625 (4.4), 638 (5.2), 1238 (5.2), 1449 (4.1), 1494 (4.4), 1554 (4.4), 1642 (1.6), 1663 (1.1), 2163 (1.1), 2205 (1.5), 2582 (1.6), 2620 (4.4), 2693 (1.6), 4109 (1.6), 4340 (1.3), 4400 (4.4), 4905 (4.4). Dias HM 770 (5.2). Duarte AP 3880 (4.4), 3663 (1.5). Esgario C 46 (1.3). Farias GL 55 (4.4). Flores TB 947 (1.6), 1250 (4.1), 1562 (5.2), 1571 (1.5). Folli DA 257 (3.1), 2068 (4.1), 2882 (4.1), 3774 (3.2), 4921 (3.2), 4964 (4.4). Fontana AP 1453 (4.4), 1781 (4.1), 3369 (1.5). Forzza RC 5803 (1.6), 8806 (1.5). Glaziou AFM 13576 (5.2). Goldenberg R 1049 (3.2). Gomes JML 1143 (1.6), 1960 (1.6), 3153 (1.3), 3668 (1.1). Guedes ML 3571 (3.1). Hatschbach G 51425 (4.1), 59729 (1.3), 61167 (1.5), 61559 (4.1), 65253 (1.1). Kollmann L 665 (4.4), 757 (4.4), 780 (4.1), 784 (4.4), 902 (4.4), 1146 (4.1), 1513 (4.1), 4103 (4.4), 4366 (4.4), 4399 (4.4), 4704 (4.1), 4909 (4.1), 5066 (4.4), 5285 (4.1), 5297 (4.4), 5916 (4.1), 5951 (4.1), 6771 (3.2), 7193 (1.5), 7738 (1.3), 8852 (1.6), 9922 (1.3), 9947 (5.2), 10127 (1.5), 11462 (1.4). Kuhlmann JG 304 (3.1). Labiak PH 5007 (4.4). Lima HC 2938 (4.1), 2939 (4.1). Lopes LCM 54 (4.1). Lorencini TS 77 (1.5). Lorenzoni D 22 (4.1). Luz AA 446 (4.4). Mansano VF 451 (4.4). Marinho LC 456 (4.2), 482 (4.2), 706 (4.4), 800 (4.4), 888 (4.3), 1027 (4.4), 1044 (4.1). Martinelli G 12222 (4.1). Martins RFA 147 (3.1). Mello-Silva R 1593 (3.1). Menezes LTF 1573 (1.2). Oliveira AG 178 (4.1), 236 (4.1), 539 (4.1). Oliveira IR 39 (4.2). Pancotto TA (1.6). Pena NTL 521 (1.6). Pereira OJ 160 (1.2), 5361 (3.1), 387 (1.2), 2171 (4.1), 3516 (1.4), 3863 (4.1), 4046 (1.2), 4186 (4.1), 4403 (4.1), 4726 (4.1), 5840 (1.6), 6085 (3.1), 6151 (1.4), 6523 (4.4), 6613 (5.1), 6829 (4.4). Pinho-Ferreira MA M641 (3.1). Pirani JR 1143 (1.6). Ribeiro M 106 (4.1), 110 (4.1), 512 (4.2). Rodrigues ID 50 (3.1). Rossini J 420 (4.4), 450 (4.1). Sagrillo TF 60 (1.6). Santos FL 159 (1.6). Scheidegger AFA 1 (3.1). Silva AG 1230 (1.1). Silva IA 25 (4.4). Silva JM 6176 (5.1). Silva WB 5 (4.2). Simonelli M 1442 (4.1). Siqueira GS 174 (4.1), 763 (1.4). Souza V 215 (3.1). Sucre D 5717 (4.4). Sylvestre L 958 (5.1). Thomaz LD 933 (3.2), 1689 (4.4), 1691 (4.4), 1692 (4.1), 1693 (4.1), 1694 (4.4), 1695 (3.1), 1696 (1.3), 1697 (1.1), 1699 (4.4), 1795 (3.2), nn (3.2). Trad RJ 565 (1.6), 577 (1.4). Valdamarin KS 309 (1.3). Vervloet RR 160 (4.1), 704 (4.4), 713 (4.4), 753 (4.1), 1131 (4.1), 1268 (4.4), 1428 (4.4), 1452 (4.4), 1706 (4.1), 2149 (4.4), 2242 (4.1), 2507 (4.4). Weinberg BMT 201 (1.6), nn (3.1). Zambom O 344 (4.1), 352 (4.1). Zortea M (1.5). Zorzanelli JPF 4 (5.1), 86 (1.5), 224 (5.1), 289 (5.1), 1805 (4.3).

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