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Article

Croton L. (Crotonoideae, Euphorbiaceae) in a protected area in Northeast Brazil

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Abstract: *Croton* is the largest genus of Crotonoideae Burmeist. (ca. 1200 species), with approximately 300 species distributed in all the phytogeographic domains in Brazil. The Chapada of Araripe Environmental Protection Area (CA-EPA) is one of the largest protected areas in northeastern Brazil and comprises many different types of vegetation. Considering the expressive representation of *Croton* in that northeastern region and its morphological complexity, we carried out a taxonomic study of the species occurring in the CA-EPA. The analysis of collections deposited in regional herbaria, together with field observations, revealed 18 *Croton* species, five of which had never been cited as occurring in the study area; seven of those taxa are endemic to the Brazilian semiarid region. *Croton* species were recorded in all of the vegetation types in the CA-EPA, especially in the "carrasco" and "caatinga" vegetation. The plants habits, the shapes of their stipules, extrafloral nectaries, indumenta, and staminate and pistillate sepals were important characteristics for their differentiation.
Keywords: *Caatinga; Chapada do Araripe; Crotonoideae; new records.*

Croton L. (Crotonoideae, Euphorbiaceae) em uma área protegida do Nordeste do Brasil

Resumo: *Croton* é o maior gênero de Crotonoideae Burmeist. (ca. 1200 espécies), com aproximadamente 300 espécies distribuídas em todos os domínios fitogeográficos brasileiros. A Área de Proteção Ambiental da Chapada do Araripe (APA-CA) é uma das maiores áreas protegidas do nordeste brasileiro e compreende diversos tipos de vegetação. Considerando a expressiva representatividade de *Croton* no Nordeste, bem como sua complexidade morfológica, realizamos um estudo taxonômico das espécies ocorrentes na APA-CA. A análise de coleções depositadas em herbários regionais, juntamente com observações de campo, revelou 18 espécies de *Croton*, cinco das quais nunca haviam sido citadas como ocorrendo na área de estudo; sete desses táxons são endêmicos do semiárido brasileiro. As espécies foram registradas em todas as fitofisionomias da APA-CA, principalmente na vegetação de carrasco e caatinga. Os hábitos das plantas, as formas de suas estípulas, nectários extraflorais, indumentos e sépalas estaminadas e pistiladas foram características importantes à diferenciação.
Palavras-chave: *Caatinga; Chapada do Araripe; Crotonoideae; novos registros.*

Introduction

Croton L., the largest genus of Crotonoideae (Euphorbiaceae), comprises almost 1,200 species throughout tropical regions of the world. Its representatives are recognized as sharing clear or colored latex, tectors or glandular trichomes, tectors trichomes can be simple, stellate to lepidote; leaves often with acropetiolar or basilaminar nectaries, Inflorescence thyrsus-like with staminate flowers in the distal portion of the branch and pistillate flowers in the proximal portion, trichomes on the receptacle, curved stamens in the floral buds, and corolla reduced or absent in pistillate flowers (Webster 1993; Berry et al. 2005).

Croton species (popularly known as "marmeleiro" or "velame") are widely used in folk medicine in the semiarid region of northeastern Brazil (Roque et al. 2010) to treat stomach and intestinal disorders, allergies, nasal inflammations, and headaches (e.g., Morais et al. 2006, Ribeiro et al. 2014, Silva et al. 2015), and are known to have antimicrobial,

antibiotic, and healing properties (e.g., Lima et al. 2001, Ximenes et al. 2013, Daouda et al. 2014). Medina et al. (2009) demonstrated the efficiency of the essential oil extracted from *C. floribundus* to treat schistosomiasis. Additionally, *C. argyrophyllus* has the potential to combat chikungunya, dengue, zika and other arboviruses transmitted by *Aedes aegypti* (Linnaeus, 1762) (Cruz et al. 2017).

Brazil is one of the centers of endemism of the genus *Croton*, with approximately 300 species distributed in all of its states and phytogeographic domains (Berry et al. 2005; Caruzo et al. 2020). Approximately 110 species are found in northeastern Brazil (ca. 10% of the total diversity of the genus), with most of them occurring in the Caatinga domain (67) (Caruzo et al. 2020). Although *Croton* is one of the most taxonomically studied genera of the Crotonoideae family in Brazil (Secco et al. 2012), especially in the semiarid region (e.g., Carneiro-Torres 2009), there is still much to be discovered, as many new records and new species have recently been published (see Gomes et al. 2010; Carneiro-Torres et al. 2011; Rossine et al. 2020; Sodré & Silva 2022).

The high *Croton* richness and endemism in the Caatinga domain is relentlessly exposed to high levels of anthropic pressure. According to IBGE (2020), that domain showed continuous decreases in both grassland and forested vegetation cover between 2000 and 2018, with more than 35 thousand km² being impacted. Deforestation there has mainly been caused by harvesting firewood and pasture formation (MMA-Atlas 2007). Another worrying situation refers to the low number of legally protected areas in the Caatinga domain, especially in light of its significant territorial extension (Unidades de Conservação 2022).

The Chapada of Araripe Environmental Protection Area (CA-EPA) stands out as a sustainable-use conservation area occupying parts of three states in the Caatinga domain in northeastern Brazil. Despite having been established in 1997, the reserve still does not have a management plan and suffers from deforestation and degradation due to fire and pasture formation, resulting in ecosystem fragmentation (ICMBio 2015; Silva & Souza 2018). An increased knowledge of the occurrence and distribution of its biodiversity would help to identify target taxa for conservation, aid in establishing management strategies, allow the assessment of compliance with its conservation objectives, and help sustain human populations in the region without causing environmental degradation (Ragas 1995; Santos 2018).

Loiola et al. (2015) surveyed the phanerogamic flora of Chapada of Araripe and listed 480 species of Angiosperms belonging to 79 families – especially Fabaceae Lindley (95 spp.), Rubiaceae Jussieu (28 spp.), Euphorbiaceae Jussieu (27 spp.), Bignoniaceae Jussieu (22 spp.), and Asteraceae Berchtold & Jan Presl (19 spp.). *Croton* was the most numerous genus in the entire survey (14 spp.), reflecting its expressive representation in areas of caatinga, cerrado, and humid forest vegetation (Cordeiro et al. 2015; Caruzo et al. 2020) – the vegetation types predominating in the CA-EPA.

The species list first presented for the CA-EPA (Loiola et al. 2015) was not, however, definitive, as some of the municipalities included within the reserve were not included in the survey – making it important to undertake a more detailed and inclusive taxonomic study of the area. Considering then the expressive representation of *Croton* in northeastern Brazil, the morphological complexity of the genus, and the lack of specific studies of that taxon in Chapada of Araripe, we undertook a study of the taxonomic and geographic distribution of *Croton* species occurring in the CA-EPA.

Materials and Methods

1. Study area

The Chapada do Araripe Environmental Protection Area (CA-EPA) is a sustainable-use reserve located in the Araripe Basin area in the Caatinga domain; it was established in 1997 under federal jurisdiction within the scope of the National System of Conservation Areas – SNUC) (ICMBIO 2015). The reserve is centered at 7° S and 40°, covers 1,063,000 hectares, overlaps three states (Ceará, Pernambuco, and Piauí), and includes portions of 33 municipalities: Ceará – Abaiara, Araripe, Barbalha, Brejo Santo, Campos Sales, Crato, Jardim, Jati, Missão Velha, Nova Olinda, Penaforte, Porteira, Potengi, Salitre, Santana do Cariri; Pernambuco – Araripina, Bodocó, Cedro, Exu, Granito, Ipubi, Moreilândia, Ouricuri, Santa Cruz, Serrita, Trindade; Piauí – Caldeirão Grande, Curral Novo, Fronteira, Padre Marcos, Paulistana, Pio IX and Simões.

The characteristic climate of the CA-EPA region is hot tropical, with annual temperatures ranging between 23 and 27° C; the period between May and August is somewhat milder, with an average temperature of 21 to 25° C (IPECE 2009). The rainfall regime is irregular (varying from 700 to 1000 mm/year), with heavy concentrations of precipitation within just a few months of the year, with February being the wettest month. Elevations there can reach 850 to 1000 m a.s.l. The CA-EPA includes a number of different vegetation types: caatinga, carrasco, cerradão, cerrado, and humid forest (IBGE 2021).

1.1. Visits to herbaria and data collection

After an online survey of the digital platforms SpeciesLink (http://inct.splink.org.br/) and Reflora Virtual Herbarium (http://reflora.jbrj.gov.br/), seven herbaria were selected for visitation or loan requests. The EAC, HCDAL, HUEFS, IPA, UFP, HST (non-indexed), and PEUFR herbaria (acronyms according to Thiers 2021) contained a considerable number of *Croton* exsiccates from the CA-EPA, and the EAC, HCDAL, HST, and PEUFR herbarium were visited. Exsiccates from the UFP herbarium (UFPE) were analyzed on loan. The other herbaria were not visited for health and safety reasons, due to the SARS-CoV-2 pandemic.

1.2. Species identifications and descriptions

Species identifications and descriptions were made based on consultations with specialists, the specialized literature (Carneiro-Torres 2009; Silva et al. 2010; Sodré et al. 2019; Rossine et al. 2021), and by comparison with standard collections. The descriptions were developed through morphological analyses of the specimens and complemented with information provided on the herbarium labels. If the herbarium specimens from the conservation area were not sufficient to provide detailed descriptions, they were complemented with material collected in the same domain and close to the study region. The terminologies used were based on Hickey (1973), Radford et al. (1974), Harris & Harris (2001), Webster et al. (1996) and Lucena & Sales (2006). Illustrations of the specimens analyzed are provided to demonstrate details of relevant morphological structures. Comments concerning the habitats and geographic distributions of the species were based on information contained on the herbarium labels, from digitized databases, and from the published literature.

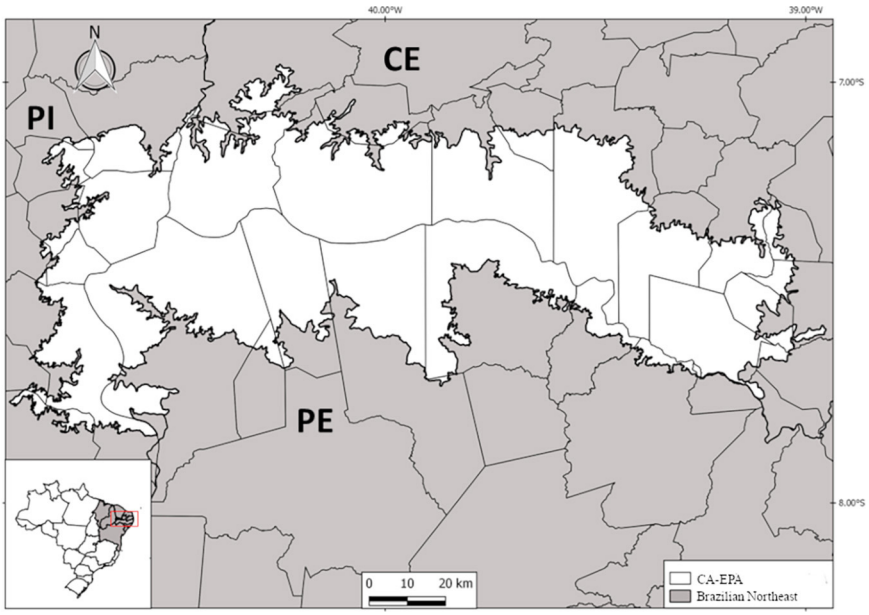

Figure 1. Map showing the location of the Chapada of Araripe Environmental Protection Area (CA-EPA).

1.3. Occurrence data and conservation status

Occurrence data for species were obtained through the analyzed exsiccates and from the SpeciesLink (https://specieslink.net/) and GBIF (https://www.gbif.org/) platforms. The current conservation status of the taxa were verified on the IUCN Red List. When not cited on the endangered species list, conservation data were inferred based on the B criterion of the International Union for Conservation Red List (IUCN 2017), using the GeoCAT platform (http://geocat.kew.org/) (Bachman et al. 2011).

1.4. Maps

The occurrence maps of the species were elaborated using the QGIS program (version 3.8) based on the geographic coordinates obtained for each species, using the shapefiles of Brazil, the northeastern region of that country, and the CA-EPA (available on the website of the Brazilian Institute of Geography and Statistics) (IBGE 2021).

Results

Eighteen species were recorded in the present work: *Croton adamantinus* Müll. Arg., *C. argyrophyllus* Kunth, *C. betaceus* Baill., *C. blanchetianus* Baill., *C. echioides* Baill., *C. floribundus* Spreng., *C. glandulosus* L., *C. grewioides* Baill., *C. heliotropiifolius* Kunth., *C. jacobinensis* Baill., *C. limae* A.P. Gomes, M.F. Sales P.E. Berry, *C. nepetifolius* Baill., *C. pedicellatus* Kunth., *C. sertanejus* Sodré & M.J.Silva, *C. suassunae* Y.Rossine & A.L. Melo, *C. tricolor* Klotzsch ex. Baill., *C. triqueter* Lam. and *C. urticifolius* Lam. Comparing the present survey with that conducted by Loiola et al. (2015), we found five addition new records for the CA-EPA (*C. floribundus*, *C. grewioides, C. sertanejus, C. suassunae*, and *C. urticifolius*). Among the 18 species surveyed in the study area, seven are endemic to the Brazilian semiarid region (*Croton adamantinus*, *C. blanchetianus*, *C. echioides*, *C. jacobinensis*, *C. limae*, *C. sertanejus* and *C. suassunae*).

It was verified that the collection effort in the CA-EPA area is more concentrated among the municipalities of Crato, Barbalha, Jardim, Jati, Brejo Santo, Santana do Cariri, Missão Velha and Nova Olinda, in the state of Ceará; and in the municipalities of Moreilândia, Exu, Araripina, Ipubi, Cedro, Ouricuri and Bodocó, in the state of Pernambuco. All the vegetation types present in the CA-EPA harbor *Croton* species – predominantly in caatinga and carrasco vegetation. *Croton heliotropiifolius* and *C. tricolor* were recorded in all vegetation types present in the CA-EPA, while *C. betaceus* and *C. floribundus* have records only in humid forest environments.

Considering their Extent of Occurrence (EOO), all the species encountered in this study are classified as of Least Concern (LC), based on the B criterion of the IUCN Red List.

In general, the characters most used for species differentiation were, habit, the presence/absence and type of extrafloral nectaries, stipule shape, sepal shape, and staminate petal and pistillate sepal shapes.

Croton L. Sp. Pl. 2: 1004. 1753.

Trees, shrubs, subshrubs or herbs, usually monoecious, with simple, stellate, multiradiate, fasciculate, dendritic and/or lepidote trichomes. Leaves simple, alternate, petiolate, usually with the presence of extrafloral nectaries at the base of the leaf blade or at the apex of the petiole. Presence of stipules. Inflorescence thyrsus-like, terminal, rarely axillary, usually bisexual, with pistillate flowers arranged in the distal portion and staminate in the proximal part of the axis. Staminate flowers pedicellate, dichlamydeous, sepals (5), petals (5), stamens 10 to numerous. Pistillate flowers pedicellate to subsessile, usually monochlamydeous, sepals (5), petals absent or vestigial, styles (3), free or fused at the base, 2-(4)-8 to multifid. Capsule entire or with tripartite columella.

Identification key of *Croton* species occurring in the CA-EPA

1. Extrafloral nectaries absent **2**

1'. Extrafloral nectaries present..... **12**

2. Leaf blade with serrated, sparsely serrated or crenate margins **3**

3. Indumentum with blackish trichomes; leaf blade with serrated to sparsely serrated margins, venation eucamptodromous; stamens 12; sepals of the pistillate flower unequal (3 large and 2 small) and with lacerated margins.....17. ***C. triqueter***

3'. Indumentum without blackish trichomes; leaf blade with crenate margins, venation actinodromous; stamens 10; sepals of the pistillate flower equal and with entire margins …….. .....18. ***C. urticifolius***

2'. Leaf blade with margins always entire **4**

4. Herb to subshrub, up to 1 m tall; leaf blade with mucronate apex; inflorescences up to 1.5 cm long .....13. ***C. pedicellatus***

4'. Shrubs to trees, 1–15 m tall; leaf blade with acute, acuminate or rounded apex; inflorescences 1.5–25 cm long..... **5**

5. Abaxial surface of the leaf blade with stellate, stellate-porrect, stellate-dendritic, stellate-lepidote, or fasciculate trichomes **6**

5'. Abaxial surface of leaf blade with lepidote trichomes ……..... **9**

6. Stipules lanceolate or oval-lanceolate.....**7**

7. Trees, branches with stellate-rotate trichomes, latex absent …… ……..... 6. ***C. floribundus***

7'. Subshrubs to shrubs, branches with stellate to stellate-porrect trichomes, latex translucent to orange.....9. ***C. heliotropiifolius***

6'. Stipules auriculate, reniform, or flabellate..... **8**

8. Sepals of the pistillate flower with stellate trichomes on the inner side, ovary with stellate trichomes; seed with rough surface ....10. ***C. jacobinensis***

8'. Sepals of the pistillate flower glabrous on the inner surface, ovary with lepidote trichomes; seed with smooth surface ....4. ***C. blanchetianus***

9. Abaxial surface of the leaf blade yellowish-silvery to silvery, never ferruginous…..……2. ***C. argyrophyllus***

9'. Abaxial surface of the leaf blade silvery or ferruginous..... **10**

10. Dioecious plants, pistillate sepals spatulate, style bifid .....15. ***C. suassunae***

10' Monoecious plants, pistillate sepals triangular or oblong, style multifid..... **11**

11. Staminate petals elliptic to oblong, pistillate sepals triangular, style 4-fid……..11. ***C. limae***

11'. Staminate petals linear-lanceolate, pistillate sepals oblong, style multifid.....16. ***C. tricolor***

12. Herbs to subshrubs..... **13**

13. Leaf blade with rounded base, margins crenate to serrate, apex acute, extrafloral nectaries short-stipitate, acropetiolar …….....…….7. ***C. glandulosus***

13'. Leaf blade with cuneate base, margins entire, and apex acuminate to apiculate, extrafloral nectaries sessile, acropetiolar. .....3. ***C. betaceus***

12'. Shrubs **14**

14. Leaf blade with margin entire **15**

15. Acropetiolar extrafloral nectaries 2, eucamptodromous venation, pistillate petals absent ……..... 5. ***C. echioides***

15'. Acropetiolar extrafloral nectaries 4–6, brochidodromous venation, linear pistillate petals …..... 14. ***C. sertanejus***

14'. Leaf blade with margins crenate to double crenate..... **16**

16. Multiradiate trichomes on the abaxial surface of the leaf blade; style 4-6-fid; ovary 4–5 × 4–5 mm..... 12. ***C. nepetifolius***

16'. Trichomes stellate to stellate-porrect on the abaxial surface of the limb, style bifid, ovary 2.0–2.5 × 2.0–2.5 mm …….....……..**17**

17. Bracts 0.7–0.9 mm long, extrafloral nectaries obconical to cylindrical .....8. ***C. grewioides***

17'. Bracts 2.0–3.0 mm long, extrafloral nectaries patelliform ..... 1. ***C. adamantinus***

1. *Croton adamantinus* Müller Argoviensis (1873: 115). LECTOTYPE (designated by Sodré et al. 2019):— BRAZIL. Minas Gerais, *campis montanis prope jequitinhonha in distr*., December 1824, *Riedel 1252* (LE00003049!) (Figure 2a, Figure 2c).

Shrub, 1.5–2 m tall, monoecious. Branches pubescent to glabrescent (at maturity), stellate, stellate-porrect, sessile, or stipitate trichomes; latex translucent. Leaves alternate, chartaceous; petiole 0.3–1 cm long, with stellate-porrect trichomes, 2 extrafloral nectaries at apex of petiole, patelliform, short to long-stipitate; stipules 0.5–0.7 cm long, linear, with stellate trichomes; leaf blade 1.2–4.3 × 2.8–8.0 cm, oval, base chordate, margins serrate, apex acute, adaxial surface pubescent to puberulent, abaxial surface woolly to densely pubescent, with stellate trichomes; venation eucamptodromous. Inflorescence 1.4–4.0 cm long, terminal, bisexual; bracts 2.0–3.0 mm long, linear to linear-lanceolate, margins entire, apex acute, glabrous to glabrescent. Staminate flower 2.0 × 2.3–2.8 mm, pedicel 1.6–3.1 mm long, receptacle hirsute, with stellate to stellate-porrect trichomes; sepals 0.9–1.2 × 1.2–2.7 mm, oval, fused at the base, margins entire, apex acute, external surface hirsute-pubescent, with stellate-porrect trichomes, internal surface glabrous; petals 0.8 × 1.5–1.7 mm, oval to lanceolate, glabrescent, margins entire, apex rounded; stamens 10–11. Pistillate flower 2.4–3.0 × 3.5–5.3 mm, pedicel 0.9–4.0 mm long, receptacle hirsute-pubescent, with stellate trichomes; sepals 1.1–2.0 × 2.4–5.3 mm, oval, margins entire, apex acute, external surface pubescent to glabrescent, internal surface hirsute-pubescent to glabrous, with stellate to stellate-porrect trichomes; petals absent. Ovary globose, 2.0–2.5 × 2.0–2.5 mm, hirsute-pubescent, with stellate trichomes; styles bifid. Capsule tomentous, columella with entire apex. Seed globose, ca. 3.0 × 3.0 mm, with surface smooth.

Specimens examined: BRAZIL. CEARÁ: Barbalha, estrada de seu Adão, 7°18'40"S, 39°18'15"W, 26.II.2012, fr., *C. G. Crepaldi, 30* (PEUFR); Barbalha, Estrada de seu Adão, carrasco da floresta nacional do Araripe, 7°18'40"S, 39°18'15"W, 27.I.2012, fr.,

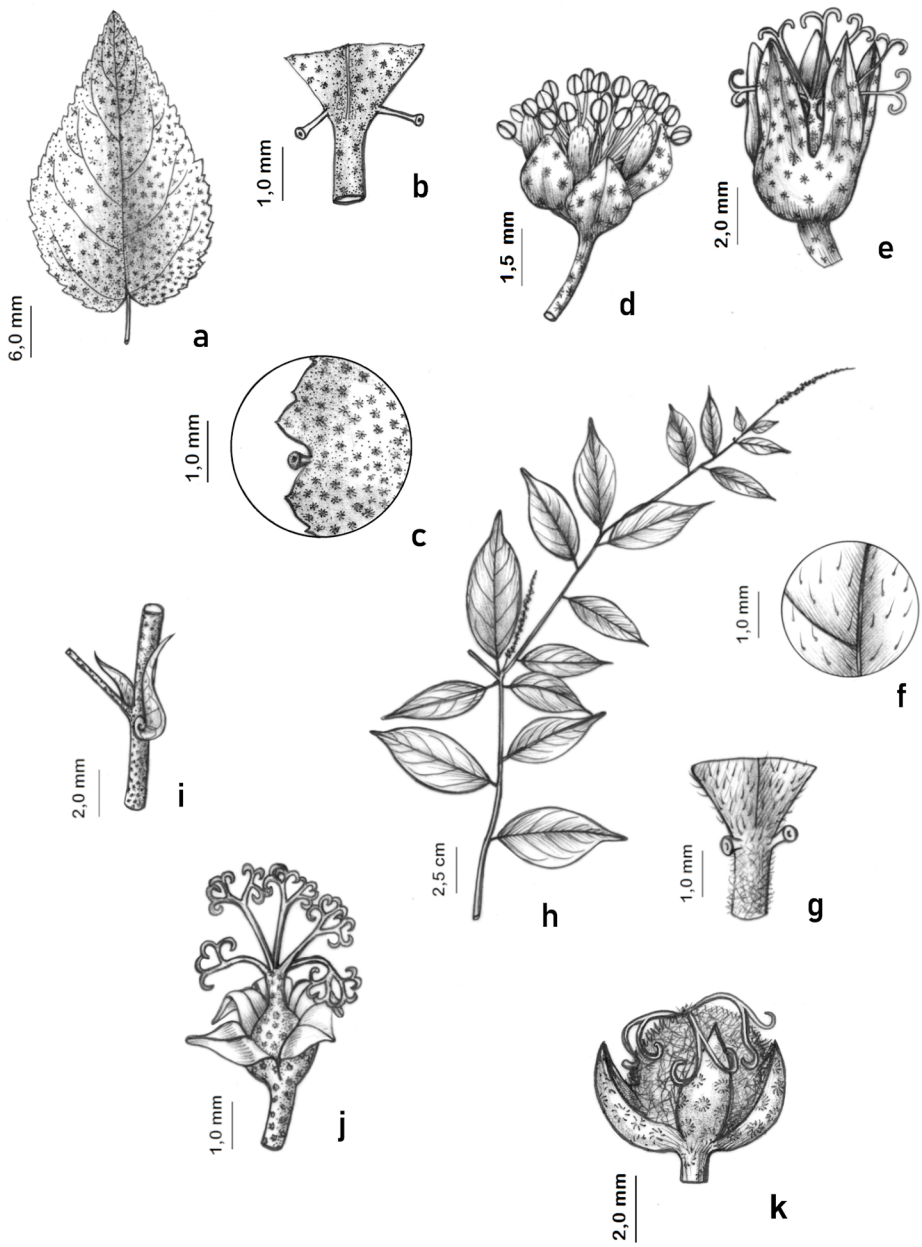

Figure 2. a-c: *Croton adamantinus* Müll. Arg. (Crepaldi C.G. 28) – a. Leaf blade. b-c. Extrafloral nectaries. d-e: *Croton argyrophyllus* Kunth. (K.C. Costa & M.J.N. Rodal 7) – d. Staminate flower. e. Pistillate flower. f-h: *Croton betaceus* Baill. (Walter B.M.T. et al. 6583) – f. Simple trichomes. g. Extrafloral nectaries. h. Habit. i-j: *Croton blanchetianus* Baill. (Araújo P. F. 115) – i. Petiolar stipule. j. Pistillate flower. k: *Croton echioides* Baill. (Oliveira S.F. 11) – k. Pistillate flower. Illustrator: Regina Carvalho.

C. G. Crepaldi, 28 (PEUFR); Barbalha, Estrada de seu Adão, carrasco da floresta nacional do Araripe, 7°18'40"S, 39°18'15W", 02.II.2012, *C. G. Crepaldi, 33* (PEUFR); Barbalha, Malhada Bonita, 7°18'40"S, 39°18'15"W, 02.II.2012 fr., *C. G. Crepaldi, 37* (PEUFR); Crato, 7°14'03"S, 39°24'34"W, 07.V.2019, *L. S. Oliveira, 1* (HST); Crato, Chapada do Araripe, 7°14'03"S, 39°24'34"W, 26.I.2000, fl., *L. W. Lima-Verde, 1907* (PEUFR); Crato, Chapada do Araripe, Saco do Martins, 13.I.1967, fl., *J. S. Sobrinho, 385* (HST); Jardim, Cacimba, 7°34'57"S, 39°17'53"W, 06.VI.2012, *C. G. Crepaldi, 76* (PEUFR); Jati, próximo ao sítio Bacefase, 7°46'08"S, 38°56'58"W, 04.IV.2013, fr., *R. A. Silva, 2752* (HVASF). PERNAMBUCO: Moreilândia, Serra da Mata Nova, Chapada do Araripe, 7°28'13"S, 39°27'58"W, 05.II.2017, *J. F. O. Souza, s.n.* (HCDAL).

Distribution, occurrence in the study area, and conservation status: *Croton adamantinus* is endemic to the Brazilian semiarid region, occurring in the northeastern (in states of Bahia, Ceará, Pernambuco, Piauí, Rio Grande do Norte and Sergipe) and southeastern (Minas Gerais State) areas of that country (Sodré et al. 2019, Caruzo et al. 2020, Riina et al. 2021). It is commonly found in areas of typical caatinga vegetation, as well as in carrasco in the CA-EPA region, at elevations

ranging from 555 to 927 m a.s.l. (Figure 3). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 743,049.059 km² and Area of Occupancy (AOO) of 872.000 km².
Notes: *Croton adamantinus* can be distinguished from the other species by having blade with serrate margins and a chordate base, as well as long-stipitate patelliform acropetiolar extrafloral nectaries.
Popular name: marmeleiro-de-rama; marmeleiro-de-carrasco.

2. *Croton argyrophyllus* Kunth (1817: 68). TYPE:—VENEZUELA, "crescit in aridis Novae Andalusiae juxta Punta, Araya, Maniquarez et cumana", s.d., *Humboldt s.n.* (Holotype: P P00669843!) (Figure 2d, Figure 2e).
Shrub, 1.0–1.2 m tall, monoecious. Branches glabrous to lepidote, latex absent. Leaves alternate, silver-green, membranous to chartaceous; petiole 0.2–1.8 cm long, lepidote, eglandular; stipules 0.13–0.5 cm long, lanceolate to linear-lanceolate, with lepidote trichomes; leaf blade 0.7–2.0 × 3.7–7.0 cm, elliptic to lanceolate, base slightly chordate, margins entire, apex acuminate, adaxial surface glabrescent, abaxial surface lepidote to glabrescent, indumentum yellowish-silvery to silvery, presence of lepidote trichomes on both faces, venation eucamptodromous. Inflorescence 1.5–10.5 cm long, terminal, bisexual; bracts 1.5–3.0 mm long, linear-lanceolate, margins entire, lepidote. Staminate flower 1.6–2.8 × 1.8–3.2 mm, pedicel 1.2–4.0 mm long, with lepidote receptacle; sepals, ca. 2.0 × 1.7 mm, oval, margins entire, apex acute, external surface lepidote, internal surface glabrous; petals, 2.0–2.3 × 0.5 mm, oblong to lanceolate, margins entire, apex rounded, external surface lepidote, internal surface glabrous; stamens 12–16. Pistillate flower 2.1–4.0 × 3.0–6.0 mm, pedicel 1.2–4.0 mm, receptacle lepidote; sepals 1.1–2.0 × 2.0–5.0 mm, oval, fused at base, margins entire, apex acute, external surface lepidote, internal surface glabrous to glabrescent, with stellate trichomes; petals absent. Ovary globose, 1.8–2 × 1 mm, lepidote; styles multifid, fused at their base, with stellate trichomes at their base. Capsule lepidote, columella with entire apex. Seed ellipsoid, 4.5–4.8 × 3 mm, surface smooth.

Specimens examined: BRAZIL. PERNAMBUCO: Exú, Serra das Abelhas, Chapada do Araripe, 07.V.2013, fl., fr., *M. E. Saraiva, 125* (HST).
Material examinado adicional: BRASIL. CEARÁ: Aiuaba, 6°26'08"S 40°11'32"W, 20.II.2014, *F. K. G. Silva & F. S. Araújo, 12* (EAC). PERNAMBUCO: Venturosa, Parque Pedra Furada, 8°34'30'S 36°52'45"W, 17.I.1998, fl., *K. C. Costa & M. J. N Rodal, 7* (PEUFR). BAHIA: Glória, ca. 4 km de olhos d'Água de Souza, 9°20'37"S 38°18'57"W, 26.IV.2001, fl., *L. P. Queiroz et al., 6529* (HST).
Distribution, occurrence in the study area, and conservation status *Croton argyrophyllus* occurs in Bolivia, Brazil, Colombia, and Venezuela in semiarid environments (Gomes 2006). In Brazil, the species is found in the northeastern region (AL, BA, CE, PB, PE, PI, SE) as well as in some northern states (RO, RR), growing in caatinga and Amazonian savanna vegetation (Caruzo et al. 2020). In the study area, *C. argyrophyllus* was recorded in carrasco and cerradão vegetation (Figure 3). The conservation status of *Croton argyrophyllus* was previously published in the IUCN Red List (2018) as of Least Concern.
Notes: *Croton argyrophyllus* can be confused with *C. limae*, *C. suassunae,* and *C. tricolor*, as they all have branches with a lepidote to glabrous indumentum, absence of glands on the petiole, blades with margins entire, lepidote trichomes on the leaves, stipules, bracts, ovaries, and the receptacles of the staminate and pistillate flowers. They can be distinguished, however, by the shape of the pistillate sepal (oval in *C. argyrophyllus* vs. triangular in *C. limae,* spatulate in *C. suassunae,* and oblong in *C. tricolor*).

3. *Croton betaceus* Baillon (1864: 341) LECTOTYPE (designated by Sodré et al. 2017):—BRAZIL. Ceará: sem local, 1838, *G. Gardner 1840* (G 00312269!) (Figure 2f, Figure 2h).
Herbs to subshrubs, 0.4–0.8 m tall, monoecious. Branches glabrescent to hispid, with stellate trichomes; latex translucent. Leaves alternate, membranous; petiole 0.3–1.5 cm long, 2 extrafloral nectaries, patelliform, sessile; stipules 2.0–3.0 mm long, oval-lanceolate, margins entire; leaf blade 1.6–3.9 × 3.5–10.4 cm, elliptic to oblong, base cuneate,

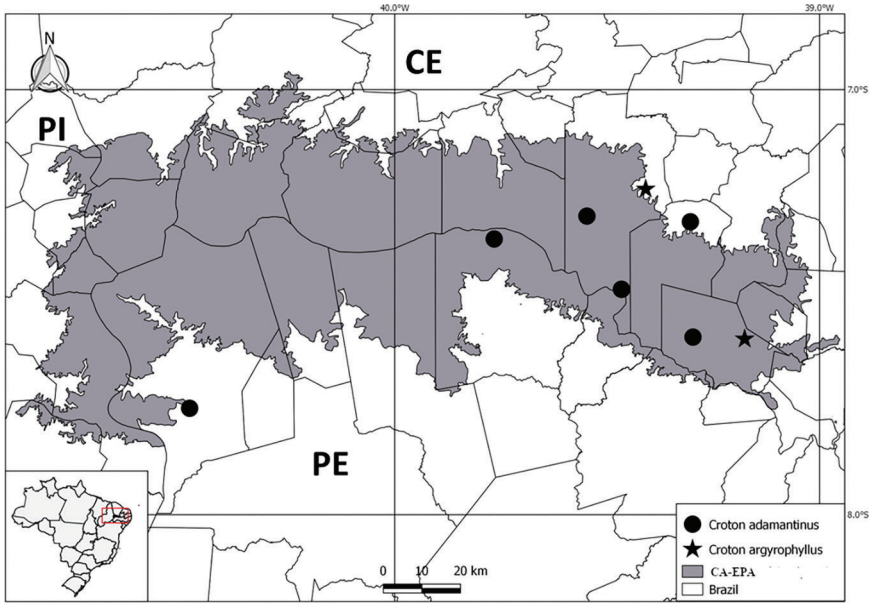

Figure 3. Distribution map of *Croton adamantinus* and *C. argyrophyllus* in the CA-EPA.

margins entire, apex acuminate to apiculate; adaxial face glabrescent to glabrous, with simple trichomes, abaxial face woolly, with stipitate stellate trichomes, venation eucamptodromous. Inflorescence 2.5–11.0 cm long, terminal to axillary, bisexual; bracts 1.0–1.5 mm long, oval-lanceolate, margins entire, apex acuminate, glabrous. Staminate flower 1.5–2.3 × 2.0–3.0 mm, receptacle glabrous to glabrescent, with sparse stellate trichomes; sepals ca. 1.1 × 0.9 mm, oblong to lanceolate, fused at their base, margins entire, apex acute, glabrous to glabrescent, with sparse stellate to stellate trichomes; petals 2.0 × 0.4 mm, elliptic, margins entire, apex acute, glabrous; 11 stamens. Pistillate flower 4.0 × 1.5–2.0 mm, greenish-yellow; sepals 0.6–0.4 × 1.3–2.5 mm, lanceolate to triangular, margins entire, apex acuminate, glabrous, petals absent. Ovary globose, 1.5–2.5 × 1.5–2.5 mm, hirsute, with stellate trichomes, stylets bifid, glabrous. Capsule hirsute, columella with tripartite apex. Seed ellipsoidal, ca. 2–3 × 3–3.6 mm, surface rough.

Specimens examined: BRAZIL. CEARÁ: Barbalha, ladeira de Santana do Cariri, 07.XII.2011, fr., *A. C. B. Santos et al., s.n., s.n.* (HCDAL); Crato, Sítio Guaribas, 18.XI.1998, fl., *E. B. Souza et al. 318* (EAC); Crato, estrada para o granjeiro, Sítio Caiana, Chapada do Araripe, 7°16'30"S 39°26'37"W, 21.I.2014, *B. M. T. Walter et al., 6583* (EAC); Crato, FLONA do Araripe, Guaribas, 14.I.1999, fl., fr., *A. M. Miranda & D. Lima, 3127* (HST).

Additional specimens examined: BRAZIL. CEARÁ: Ubajara, Portal Araticum, Planalto da Ibiapaba – Parna, 24.II.1999, *A. Fernandes et al., s.n.* (EAC); PIAUÍ: Bom Jesus, 17.XII.1977, *A. Fernandes & F. J. A. Matos s.n.* (EAC).

Distribution, occurrence in the study area, and conservation status: *Croton betaceus* occurs in Bolivia, Brazil, and Paraguay. It can be found in the northern, northeastern, midwestern, and southeastern regions of Brazil, growing in the Amazon, Caatinga, and Atlantic Forest (Caruzo et al. 2020). In the northeastern region, it occurs in the states of Bahia, Ceará, Maranhão, and Piauí (Caruzo et al. 2020). In the study area, *C. betaceus* occurs in areas of humid forest vegetation (Figure 4), being frequently recorded along roadsides. The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 3,820,163.055 km² and Endangered when considered its Area of Occupancy (AOO) of 412.000 km².

Notes: *Croton betaceus* can be easily recognized by having a glabrous to glabrescent indumentum on the adaxial face of the leaf blade, and by the presence of simple trichomes on that face, as well as by the leaf blade having a cuneate base and an acuminate to apiculate apex.

Popular name: vassoura-de-urubu.

4. *Croton blanchetianus* Baillon (1864: 301). LECTOTYPE: (designated by: Rossine et al. 2021):—BRAZIL. Bahia, without further locality, 1840, *J.S. Blanchet 3094* (P00623615!)) (Figure 2i, Figure 2j). Trees to shrubs, 1–8 m tall, monoecious. Branches hirsute-pubescent to woolly, glabrous at maturity, with stellate-porrect trichomes; latex translucent. Leaves alternate, membranous to papyraceous; petiole 0.5–1.7 cm long, eglandular; stipules 0.2–2.6 cm long, foliaceous, lanceolate to reniform, margins entire; leaf blade 0.2–7.0 × 1.2–13 cm, oval to oval-lanceolate, base chordate to rounded, margins entire, apex acute to acuminate, adaxial surface hispid, pubescent to glabrescent, with stellate-porrect to stellate-lepidote trichomes, abaxial surface hirsute-pubescent to pubescent, with stellate-porrect trichomes, venation eucamptodromous. Inflorescence 2.0–15 cm long, terminal, bisexual; bracts 1.2–3.2 mm long, linear to linear-lanceolate, hirsute, margins entire. Staminate flower 2.5–4.0 × 2.3–3.2 mm, pedicel 2.5–5.0 mm long, greenish yellow, with a lepidote to hirsute-lepidote receptacle; sepals with ca. 2.0 × 1.7 mm, oval, with lepidote or stellate-lepidote trichomes, margins entire, apex acute; petals 2.0–2 × 0.6–0.9 mm, oblong to obovate, margins entire, apex rounded, both faces hirsute to glabrescent; stamens 14–17. Pistillate flower 6.0–7.0 × 4.0 mm, pedicel 1.5–3.0 mm long, greenish-yellow, receptacle lepidote to hirsute-lepidote, with lepidote to stellate-porrect trichomes; sepals 2.5–4.0 × 0.6–1.6 mm, lanceolate, margins entire, apex acute, external surface lepidote to hirsute-lepidote, internal surface glabrous, with stellate trichomes; petals absent. Ovary globose, 2–2.5 × 2–2.5 mm, with

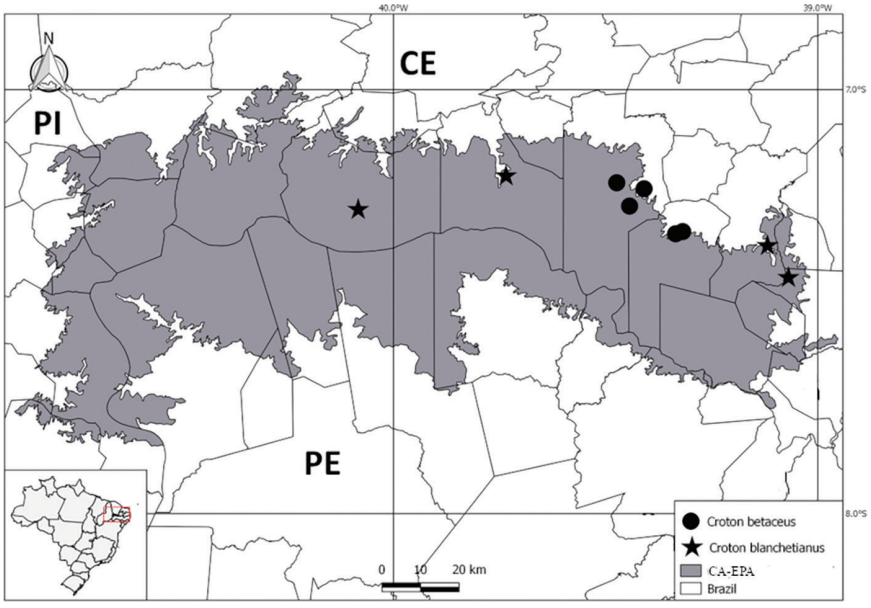

Figure 4. Distribution map of *Croton betaceus* and *C. blanchetianus* in the CA-EPA.

lepidote trichomes; stylets multifid, fused at their base in the form of a column. Capsule lepidote, columella with entire apex. Seed ellipsoidal, 4–6 × 3 mm, surface smooth.

Specimens examined: BRAZIL. CEARÁ: Brejo Santo, Chapada do Araripe, Torres de TV, 7°26'38"S 39°04'08"W, 11.I.2002, fl., *A. P. Fontana, 6285* (HVASF); Jati, Fazenda Oiti, Serra de São Francisco, 7°42'54"S 39°00'23"W, 04.IV.2013, fl., *R. A. Silva, 2725* (HVASF); Santana do Cariri, Subida do Pontal, nos arredores da cidade de Santana, 7°12'15"S 39°44'05"W, 23.I.2014, fl., *B. M. T. Walter et al. 6606, 6607* (EAC). PERNAMBUCO: Araripina, bacia do rio Brígida, topo da chapada, 14.VII.1994, *S. P. Flávia 149* (EAC); Cedro, 7°48'00"S, 39°09'16"W, 28.IV.2019, *Natalia s.n.* (HCDAL). PIAUÍ: Pio IX, cova donga, 6°50'15"S, 40°34'45"W, 21.II.1980, fl., *A. Fernandes s.n.* (EAC).

Distribution, occurrence in the study area, and conservation status: *Croton blanchetianus* is endemic to the Brazilian semiarid region, occurring in the northeastern (in the states of Alagoas, Bahia, Ceará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte and Sergipe) and southeastern (Minas Gerais State) regions of that country (Caruzo et al. 2020). It is found in the study area in arboreal caatinga vegetation, at elevations between 394 and 513 m a.s.l. (Figure 4). *Croton blanchetianus* was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 888,791.866 km² and Area of Occupancy (AOO) of 1,856.000 km².

Notes: *Croton blanchetianus* can be identified by having reniform foliaceous stipules, and stylets fused at their base.

Popular name: Marmeleiro-preto.

5. *Croton echioides* Baillon (1864: 334). TYPE:—BRAZIL. Bahia, s.d., *Blanchet 3718* (Holotype: P; isotypes: P, C, K, NY, GDC, BR, A) (Figure 2k).

Shrubs, 1.0–2.0 m tall, monoecious. Branches hirsute to glabrescent, with stellate to stellate-rotate trichomes; latex translucent. Leaves alternate, membranous; petiole 0.5–3.0 cm long, with 2 acropetiolar, patelliform, extrafloral nectaries; stipules 1.2–2.9 mm long, lanceolate, margins entire; leaf blade 1.0–6.6 × 2.0–10 cm, oval to elliptic, base chordate to rounded, margins entire, apex acute to emarginate; adaxial face hirsute to glabrescent, with stellate, stellate-porrect, or simple trichomes, abaxial face tomentose to velutinous, with stellate to stellate-porrect, sessile to stipitate trichomes; venation eucamptodromous. Inflorescence 4.0–27 cm long, terminal, bisexual; bracts 0.9–1.1 mm long, lanceolate, with trichomes, margins entire. Staminate flower 2.0–3.2 × 2.3–2.8 mm, pedicel 3.0–3.2 mm long, receptacle hirsute to glabrescent, with stellate to stellate-porrect trichomes; sepals 1.5–2.0 × 0.8–1.1 mm, elliptic to oblong, margins entire, apex acute, external surface hirsute to glabrous, with stellate trichomes, internal surface glabrous; petals 2.0 × 0.7–0.9 mm, spatulate, glabrous, margins entire, apex rounded; stamens 14–17. Pistillate flower 2.0–2.4 × 1.8–2.5 mm, sessile to subsessile, receptacle hirsute to glabrescent, with stellate trichomes; sepals 1.6–3.0 × 0.8–1.1 mm, elliptic to oval-lanceolate, external and internal surfaces glabrescent, margins entire, apex acute to rounded; petals absent. Ovary globose, 1.5–3.0 × 1.5–3.0 mm, with hirsute-pubescent, stellate trichomes; styles bifid. Capsule globose, pubescent, columella with entire apex. Seed oblong, ca. 5.0 × 2–3 mm, surface rough.

Specimens examined: BRAZIL. CEARÁ: Crato, Flona Araripe, 26.III.1999, *Lima-Verde 1314* (EAC). PERNAMBUCO: Bodocó, 12.II.1991, fl., *P. Lisboa et al. 4515* (EAC); Moreilândia, 7°37'51" S, 39°33'04" W, 11.III.1997, fl., *F. S. Cavalcanti et al. s.n.* (EAC).

Distribution, occurrence in the study area, and conservation status: *Croton echioides* is endemic to the Brazilian semiarid region, occurring in the Caatinga and Cerrado domains, in caatinga vegetation, rupestrian fields, and on rocky outcrops (Caruzo et al. 2020). It is found in the northeastern (in the states of Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí and Rio Grande do Norte) and southeastern (Minas Gerais State) regions of that country (Caruzo et al. 2020). The species can be found in the study area in carrasco and caatinga vegetation (Figure 5). The species was classified as least concern in relation to its extent of occurrence (EOO) of 1,386,692.021 km² and Area of Occupancy (AOO) of 804.000 km².

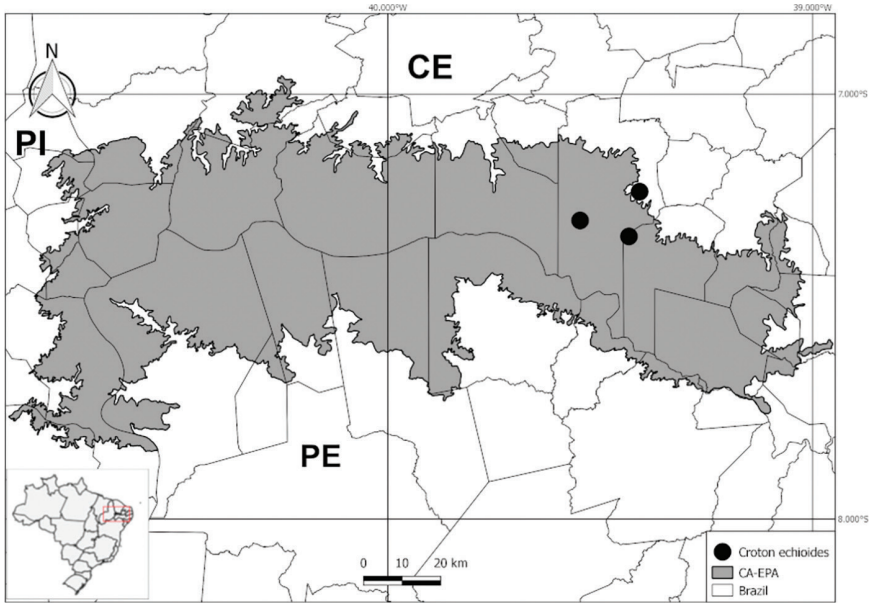

Figure 5. Distribution map of *Croton echioides* in the CA-EPA.

Notes: *Croton echioides* can be recognized by having staminate sepals 1.5–2.0 × 0.8–1.1 mm, elliptic to oblong, and staminate petals spatulate. **Popular name**: velame-preto, canela-de-velho, quebra-faca.

6. *Croton floribundus* Sprengel (1826: 873). NEOTYPE (designated by Caruzo & Cordeiro, 2007):—BRAZIL, São Paulo, *Sellow 171* (SP 18551!) (Figure 6a, Figure 6b).

Tree 2.0–15 m tall, monoecious. Branches hispid, flaky, glabrescent to glabrous, with stellate-rotate trichomes; latex absent. Leaves alternate, membranous to chartaceous; petiole 0.7 × 4.5 cm long, with stellate-rotate trichomes, eglandular; stipules 4.3–5.0 mm long, lanceolate, with stellate-rotate trichomes; leaf blade 0.9–6.5 × 3.5–16.0 cm, elliptic to oval, base oval to attenuated, margins entire, apex acuminate to acute, adaxial face scabridulous to glabrescent, with lepidote trichomes, abaxial face glabrescent, with stellate to stellate-rotate trichomes; venation eucamptodromous. Inflorescence 7.0 × 25 cm long, terminal, bisexual. Bracts 2.0–2.2 mm long, lanceolate. Staminate flower 3.5–4.0 × 3.5 mm, pedicel 4.0–4.3 mm long, receptacle hirsute-pubescent to lepidote, with stellate-rotate to stellate-lepidote trichomes; sepals ca. 3.0 × 1.9 mm, margins entire, apex acute, external surface hirsute-pubescent, with stellate-rotate to stellate-lepidote trichomes, internal surface hirsute, with stellate trichomes; petals ca. 3.0 × 1.1 mm, oblong,

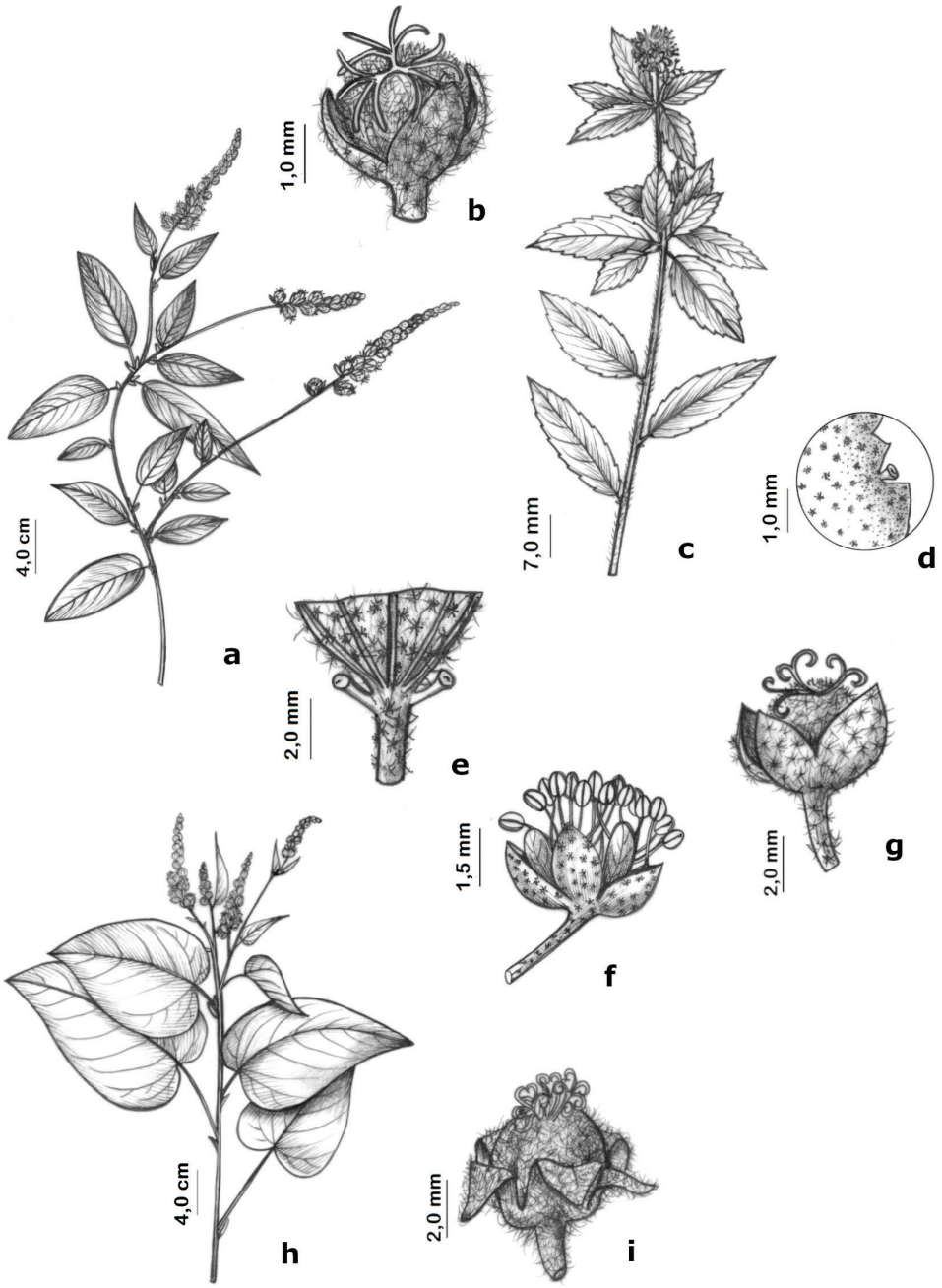

Figure 6. a-b: *Croton floribundus* Spreng. (Rocha E.S. s.n.) – a. Habit. b. Pistillate flower. c-d*: Croton glandulosus* L. (Lima-Verde L. W. et al. s.n.) – c. Habit. d. Extrafloral nectaries. e: *Croton grewioides* Baill. (Costa J.G.M. 1619) – e. Extrafloral nectaries. f-g: *Croton heliotropiifolius* Kunth. (Barros, I.O. 6) – f. Staminate flower. g. Pistillate flower. h-i: *Croton jacobinensis* Baill. (T. Plowman 12757) - h. Habit. i. Pistillate flower. Illustrator: Regina Carvalho.

hirsute, with sparse stellate trichomes, margins entire, apex acute; 13 stamens. Pistillate flower 6.5–7.0 × 5.5–6.7 mm, pedicel 0.5–1.0 cm long, receptacle lepidote to hirsute, with stellate-lepidote to stellate-rotate trichomes; sepals ca. 4.0 × 3.8 mm, oval, margins entire, apex acute, external surface lepidote, internal surface glabrous to glabrescent; petals absent. Ovary globose, ca. 3.5–3.5 mm, hirsute, with stellate-rotate trichomes; styles 4-fid. Capsule globose, muricate, columella with entire apex. Seed globose, ca. 5.0–6.5 × 5.0–6.5 mm, surface smooth.
Specimens examined: BRAZIL. Ceará: Crato, Sítio Venha Ver, Chapada do Araripe, Estrada do Belmonte, 7°14'03"S 39°24'34"W, 03.III.2017, *Campos, N. B. s.n.* (HCDAL).
Additional specimens examined: BRAZIL. CEARÁ: Guaramiranga, Subida p/ Mulungu, 13.V.2005, fr., *F. S. Cavalcanti, s.n.* (EAC); Ubajara, Sede Parna, Planalto Ibiapaba, 24.II.1999, *A. Fernandes, et al. s.n.* (EAC); PERNAMBUCO: São Benedito do Sul, Igarapeba, 11.I.1994, fr., *A. M. Miranda, 1152* (PEUFR); São Benedito do Sul, Igarapeba, 11.I.1994, fr., *A. M. Miranda, 1271* (HST).
Distribution, occurrence in the study area, and conservation status: *Croton floribundus* is native to South America, occurring in Brazil and Paraguay in rainforest and riparian forest regions, being commonly found in clearings and along forest edges (Caruzo & Cordeiro 2007; WCSP 2021). The species occurs in northeastern (AL, BA, CE, PB, PE), midwestern (DF, MG, MS), southeastern (ES, MG, RJ, SP), and southern (PA) Brazil, in the Atlantic Forest, riparian vegetation, semideciduous seasonal forests, ombrophilous forests, and anthropized areas (Caruzo et al. 2020). The species was recorded in the study region in humid forest and cerradão (Figure 7). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 2,310,783.550 km² and Area of Occupancy (AOO) of 1,992.000 km².
Notes: *Croton floribundus* can be distinguished from the other species in this study by its arboreal habit, by the presence of stellate-rotate trichomes on the petiole, and by the length of the pedicel of the pistillate flower (5.8–6.0 mm long).
Popular name: Capixingui.

7. *Croton glandulosus* Linnaeus (1759: 1275). LECTOTYPE (designated by Fawcett & Rendle, 1920):—JAMAICA, *Browne*, s.*n*. (Herb. LINN nº 1140.7) (Figure 6c, Figure 6d).
Herbs to subshrubs, 0.2–0.5 m tall, monoecious. Branches hispid to glabrescent, with stellate, stellate-dendritic to stellate-porrect trichomes; latex translucent. Leaves alternate, membranous; petiole 0.2–1.1 cm long, with stellate trichomes, 2 acropetiolar extrafloral nectaries, patelliform, short-stipitate; stipules 1.1–3.0 mm long, linear to oval-lanceolate, margins entire, stellate trichomes may be present; leaf blade 1.1–3.7 × 0.4–2.2 cm, oval to oval-lanceolate, base rounded, margins crenate to serrate, apex acute, adaxial face woolly, with stellate to stellate-dendritic trichomes; abaxial face hirsute tomentose, with stellate-dendritic to stellate-porrect trichomes; venation eucamptodromous. Inflorescence 1.2–4.0 cm long, terminal, bisexual; bracts ca. 1.2 mm long, lanceolate, margins entire, glabrescent, with sparse stellate-porrect trichomes. Staminate flower 1.2–2.1 × 1.2–2.0 mm, pedicel 0.8–2.0 mm long, receptacle hirsute; sepals ca. 0.9 × 0.7 mm, oval, margins entire, apex acute, external surface hirsute to glabrescent, with stellate trichomes, internal surface glabrous; petals ca. 1.1 × 0.6 mm, oval, margins entire, apex rounded, glabrous; stamens 11. Pistillate flower ca. 0.3 × 0.2 cm, pedicel ca. 0.5 mm long, receptacle hirsute, with stellate trichomes; sepals 2.5–4.0 × 0.5–1.0 mm, spatulate, margins entire, apex acute, external surface hirsute to glabrescent, with stellate to stellate-porrect trichomes, internal surface glabrous; petals absent. Ovary globose, 1–1.2 × 1–1.2 mm, with hirsute-pubescent, stellate trichomes, styles bifid, fused at the base. Fruit globose, columella with entire apex. Seed ellipsoidal, ca. 2.5–4 × 2 mm, surface smooth to slightly rough.
Specimens examined: BRAZIL. CEARÁ: Crato, baixa do maracujá, Chapada do Araripe, 7°14'03"S, 39°24'34"W, 02.II.1998, fl., *L. W. Lima-Verde, s.n.* (EAC); Crato, baixa do maracujá, Chapada do Araripe, 02.IV.1998, fl., fr., *L. W. Lima-Verde, et al. 982* (HCDAL). PERNAMBUCO: Moreilândia, sítio Zé de Belina, 10.V.2000, fl., *F. S. Cavalcanti 758* (EAC); Moreilândia, Serra da Mata Nova, Chapada

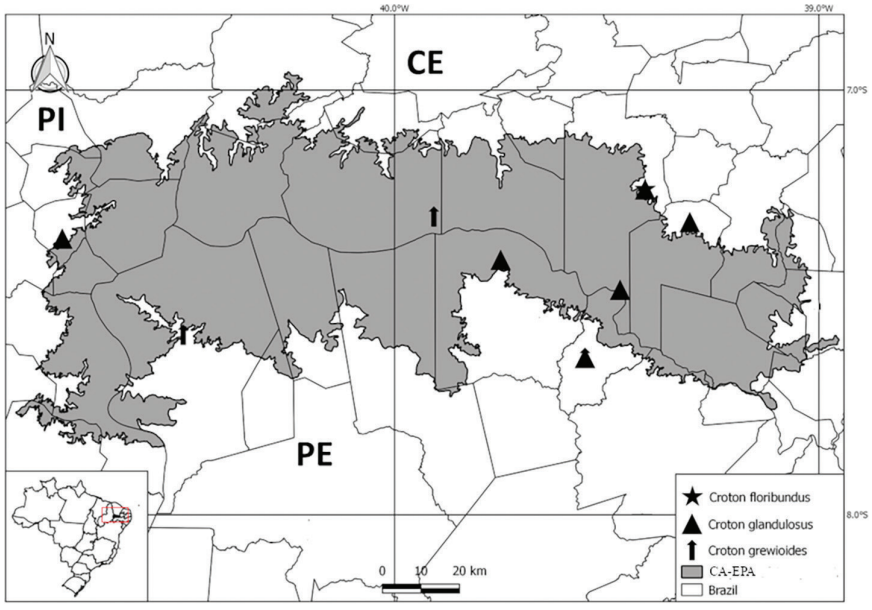

Figure 7. Distribution map of *Croton floribundus*, *C. glandulosus*, and *C. grewioides* in the CA-EPA.

do Araripe, 7°28'14"S 39°28'06"W, 18.III.2017, fr., *J. F. O. Souza, s.n.* (HCDAL).

Distribution, occurrence in the study area, and conservation status: *Croton glandulosus* is native to the Americas and widely distributed, being recorded from the southeastern area of the United States to Argentina (Govaerts et al. 2000, Sodré et al. 2019, Riina et al. 2021, WCSP 2021). *Croton glandulosus* can be found in all regions and in all the Brazilian states, including the Federal District, and in all its phytogeographic domains (Sodré et al. 2019, Caruzo et al. 2020). The species was recorded in the study area in areas of caatinga vegetation and in cerradão, generally in open environments and along roadsides (Figure 7). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 29,382,942.480 km² and Area of Occupancy (AOO) of 2,884.000 km².

Notes: *Croton glandulosus* can be recognized as herbs or subshrubs 20 to 50 cm tall, by the presence of two acropetiolar, short-stipitate patelliform extrafloral nectaries, and by the spatulate sepals of the pistillate flower.

Popular name: gervão-branco, carvão-branco.

8. *Croton grewioides* Baillon (1864: 365). LECTOTYPE (designated by Sodré et al. 2019):—BRAZIL. Bahia, 1840, *J. S. Blanchet 3100* (P00623585!) (Figure 6e).

Shrubs, 0.8–2.0 m tall, monoecious. Branches glabrous to glabrescent, with translucent latex. Leaves alternate, membranous; petiole 2.0–8.0 mm long, with stellate to stellate-porrect trichomes, 2 extrafloral nectaries, patelliform; stipules 1.2–3.0 mm long, elliptic, deciduous at maturity; leaf blade 0.8–2.4 × 0.8–6.0 cm, oval, rarely rounded, base rounded, margins crenate, with obconic to cylindrical glands on the margins, apex acute, rarely rounded, adaxial face slightly hispid to sparse-pubescent, with stellate-porrect and stellate-dendritic trichomes, abaxial face tomentose, with stellate-porrect trichomes; venation eucamptodromous. Inflorescence 1.0 × 5.5 cm long, terminal, bisexual; bracts 0.7–0.9 mm long, entire, linear to lanceolate, with stellate to stellate-porrect trichomes. Staminate flower 2.4–2.7 × 2.2–2.8 mm, pedicel 1.3–2.0 mm long, receptacle hirsute, with stellate-porrect trichomes; sepals 0.6–1.1 × 1.2–1.4 mm, oval, outer surface hirsute, with stellate-porrect to stellate-dendritic trichomes, inner surface glabrous to glabrescent, with sparse stellate-porrect trichomes; petals 0.6–0.8 × 1.2–1.3 mm, oblong, glabrous, margins entire, apex rounded; stamens 10–11. Pistillate flower ca. 2.0 × 2.4 cm, pedicel 1.5–2.1 mm long; sepals 0.7–1.1 × 1.9–2.1 mm, lanceolate to oval-lanceolate, hirsute, with stellate to stellate-porrect trichomes, margins entire, apex acute; petals absent. Ovary globose, 2–2.3 × 2–2.3 mm, hirsute, with stellate to stellate-porrect trichomes; styles bifid. Capsule globose, puberulent, columella with entire apex. Seed globose, 2.5–3 × 2.4–2.8 mm, surface smooth.

Specimens examined: BRAZIL. CEARÁ: Crato, sítio Venha Ver, Chapada do Araripe, 7°14'03"S 39°24'34"W, 09.III.1995, *M. A. P. Silva, et al. s.n.* (HCDAL). PERNAMBUCO: Exu, topo da rampa, início do planalto, Chapada do Araripe, 01.02.1984, *G. Fotius & S. Iêdo, 3727* (IPA).

Additional specimens examined: BRAZIL. PERNAMBUCO: Belo Jardim, Estrada do Araçá, 26.V.1993, *A. M. Miranda, et al. 747* (PEUFR); Buíque, Fazenda Brejo de São José, próximo às inscrições rupestres, VII.2005, fl., fr., *A. M. Laurênio & A. P. S. Gomes, 2018* (PEUFR); Ibimirim, estrada Ibimirim-petrolândia, 11.XII.1995, fl., *A. M. Laurênio et al. 288* (PEUFR); Ibimirim, Serra Negra, proximidades do Sítio Oliveira, 22.III.1994, fl., fr., *S. I. Silva, 351* (PEUFR). PIAUÍ: Canto do Buriti, Pajeú, 09.XII.1979, fl., *M. R. Dellaco, s.n*. (PEUFR); Pedro IV, depois de Sertão de dentro, 01.III.1980, *A. J. Castro et al. s.n.* (PEUFR).

Distribution, occurrence in the study area, and conservation status: *Croton grewioides* is native to South America, occurring in Brazil, Bolívia and Peru. (Silva et al. 2010, Sodré et al. 2019, Riina et al. 2021); it occurs widely in all the states of the northeastern region of Brazil and can also be found in Minas Gerais State in southeastern Brazil (Sodré et al. 2019, Caruzo et al. 2020, Riina et al. 2021). The species was recorded in areas of caatinga and carrasco vegetation in the region and is frequently found along roadsides (Figure 7). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 5,489,855.241 km² and Area of Occupancy (AOO) of 924.000 km².

Notes: *Croton grewioides* can be identified by the presence of obconic to cylindrical extrafloral nectaries on the margins of the leaf blade, and by the absence of stipules on mature branches. The species has a characteristic cinnamon scent, as noted by collectors on most herbarium specimen labels.

Popular name: canelinha-de-cheiro, canelinha.

9. *Croton heliotropiifolius* Kunth (1817: 83). TYPE: —PERU. "in Calidis apricis Prov. Bracamorensis prope pagum Chamaya et in ripa fluminis 114 Chinchipe, alt. 210 hex", s.d., *A. von Humboldt & A. Bonpland, s.n.* (Holotype: P P00669881) (Figure 6f, Figure 6g).

Subshrubs to shrubs, 1.0–2.0 m tall, monoecious. Branches hirsute-hispid to hirsute-pubescent, with stellate to stellate-porrect trichomes; latex translucent to orange. Leaves alternate, membranous, papyraceous or chartaceous; petiole 0.2–3.0 cm long, eglandular; stipules 1.8–3.0 mm long, oval-lanceolate, margins entire; leaf blade 0.9–6.3 × 1.9–11 cm, oval, oval-lanceolate to obovate, base ovate to rounded, margins entire, apex acute to acuminate, adaxial surface hispid, sparse-pubescent to pubescent, abaxial face hispid to velutine, with stellate, sessile, or stipitate trichomes; venation eucamptodromous. Inflorescence 1.5–17 cm long, terminal, bisexual; bracts 0.8–2.3 mm long, lanceolate, with stellate trichomes; margins entire. Staminate flower ca. 3.0 × 2.0 mm, pedicel 2.0–3.2 mm long, receptacle hirsute to glabrescent; sepals ca. 1.8 × 1.0 mm, ovate, margins entire, apex acute, external surface bristly to glabrescent, with sparse stellate trichomes, internal surface glabrous; petals 2.0–2.2 × 0.8–0.9 mm, oblong, margins entire, apex rounded, glabrous; stamens 15–17. Pistillate flower 2.5–6.0 × 1.5–2.5 mm, pedicel 0.5–1.5 mm long, receptacle hirsute to hirsute-pubescent, with stellate trichomes; sepals ca. 2.0 × 0.8 mm, lanceolate, margins entire, apex acute, external face hirsute, with stellate trichomes, internal face glabrous; petals absent. Ovary globose, 1–2 × 1–2 mm, hirsute-pubescent, with stellate to stellate-porrect trichomes; styles bifid. Capsule villous with columella with tripartite apex. Seed ellipsoidal, 4.0–4.5 × 2.0 mm, surface smooth.

Selected specimens: BRAZIL. CEARÁ: Crato, estrada do belmonte, sítio Venha Ver, Chapada do Araripe, 7°14'03"S, 39°24'34"W, 22.II.2017, fr., *N. B. Campos, 29* (HCDAL); Chapada do Araripe, 7°14'03"S, 39°24'34"W, 25.I.2000, *L. W. Lima-Verde, 616* (PEUFR); Jardim, 7° 29' 36"S 39°22'02"W, 31.VIII.2012, *R. S. Sousa, & L. G. S. Nascimento, 195* (PEUFR); Santana do Cariri, Geoparque Pedra do

Cariri, 7°07'18"S 39°41'42"W, 23.I.2014, fl., *C. E. B. Proença et al. 4708* (UB). PERNAMBUCO: Exú, Serra do Araripe, além do Exú velho, 06.V.1971, fl., *E. P. Heringer et al., 603* (PEUFR); Moreilândia, Serra da Mata Nova, Chapada do Araripe, 7°28'17"S, 39°28'14"W, 03.IV.2016, *J. F. O Souza, s.n.* (HCDAL).

Distribution, occurrence in the study area, and conservation status: *Croton heliotropiifolius* is native to Brazil, occurring in other countries in South America, Central America, and Mexico (WCSP 2021). It occurs in all of the states of northeastern Brazil and has also been recorded in the midwestern (DF, GO) and southeastern (MG) regions of that country (Caruzo et al. 2020). In the study area, *C. heliotropiifolius* can be found in the vegetation types of caatinga, carrasco, cerradão, and cerrado, at elevations ranging from 511 to 1327 m a.s.l. (Figure 8). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 2,154,331.304 km² and Area of Occupancy (AOO) of 1,968.000 km².

Popular name: velame.

10. *Croton jacobinensis* Baillon (1864: 302). LECTOTYPE (designated by Rossine et al. 2021):— BRAZIL. Bahia, Jacobina, 1845, *J.S. Blanchet 3661* (P (P00623531!) (Figure 6h, Figure 6i).

Shrubs to subshrubs, 0.9–2.0 m tall, monoecious. Branches pubescent, sparse-pubescent to glabrescent, with stellate trichomes; latex translucent. Leaves alternate, membranous; petiole 0.3–9.5 cm long, pubescent, woolly to glabrescent, with stellate trichomes, eglandular; stipule ca. 1.0 cm long, foliaceous, lanceolate, auriform to flabelliform, margins entire; leaf blade 1.5–10.6 × 2.9–24.5 cm, cordate, base chordate, margins entire, apex acuminate, adaxial surface puberulent, slightly hispid or glabrescent, with fasciculated stellate trichomes, abaxial surface sparse-pubescent, with stellate to fasciculate, sessile or stipitate trichomes, venation actinodromous. Inflorescence 2–15 cm long, terminal, bisexual; bracts 2–3 mm long, oval-lanceolate, margins entire, apex acute. Staminate flower 4.5–5.0 × 3.5–4.0 mm, pedicel 5.0–7.0 mm long, receptacle pubescent, with stellate trichomes; sepals ca. 3.2 × 1.3 mm, entire, oval, external surface pubescent, internal surface hirsute-pubescent, with stellate, stellate-lepidote to stellate-stipitate trichomes on both surfaces; petals ca. 2.2 × 1.2 mm, oval, external and internal surfaces pubescent, with stellate trichomes; stamens 15–16. Pistillate flower 4.8–7.0 × 4.2–4.8 mm, pedicel 0.7–1.5 mm long, receptacle densely pubescent, with stellate trichomes; sepals ca. 4.2–6.0 × 2.2 mm, entire, oval, margins entire, apex acute, outer surface densely pubescent, inner surface hirsute-pubescent to densely pubescent, with stellate to stellate fasciculate trichomes on both sides; petals absent. Ovary globose, 2.5–3 × 2.5–3 mm, hirsute pubescent to densely pubescent, with stellate trichomes, sessile to stipitate; styles multifid. Capsule pubescent, columella with entire apex. Seed globose, 4.0–8.0 × 4.0–8.0 mm, surface rough.

Specimens examined: BRAZIL. CEARÁ: Barbalha, trilha do pensador, Cariri, 04.II.2011, fl., *M. S. Macedo, s.n.* (HCDAL); Barbalha, 03.03.2018, fl., *A. K. L. S. Pereira, s.n*. (HCDAL); Crato, 11.III.1997, fl., *E. Silveira, s.n.* (EAC); Crato, arredores da Escola Agrícola Federal, 26.V.1993, *M. Andrade-Neto, 32* (EAC); Crato, arredores do Crato, 09.III.1987, *A. Fernandes & Edilberto, s.n.* (EAC); Crato, Chapada do Araripe, 7°14'03"S, 39°24'34"W, 21.XII.1978, *A. Fernandes et al., s.n.* (EAC); Crato, clube recreativo granjeiro, saída do clube, margem direita da estrada, 30.VIII.1998, fl., *M. I. B. Loiola et al., 489* (PEUFR); Crato, estrada para o granjeiro (clube). Sítio Caiana, arredores da cidade de Crato, Chapada do Araripe, 7°16'30"S 39°26'37"W, 21.I.2014, fr., *B. M. T. Walter et al., 6579* (EAC); Jardim, cerrado da FLONA do Araripe, 7°34'57"S, 39°17'53"W, 03.XI.2012, *C. G. Crepaldi, 35* (PEUFR); Crato, Parque Nacional do Araripe, 7°14'03"S, 39°24'34"W, 19.I.1983, fl., *T. Powman, 12757* (EAC); Crato, FLONA do Araripe, Guaribas, 14.I.1999, fl., fr., *A. M. Miranda*, *3140* (HST). PERNAMBUCO: Exu, bacia do Rio Brígida, encosta da Chapada, 16.07.1994, *F. S. Pinto, 214, 224* (EAC); Moreilândia, serra da Mata Nova, 7°30'58" S, 39°29'12"W, 12.II.2016, *J. F. O. Souza, s.n.* (HCDAL).

Distribution, occurrence in the study area, and conservation status: *Croton jacobinensis* is endemic to Brazil, restricted to the semiarid

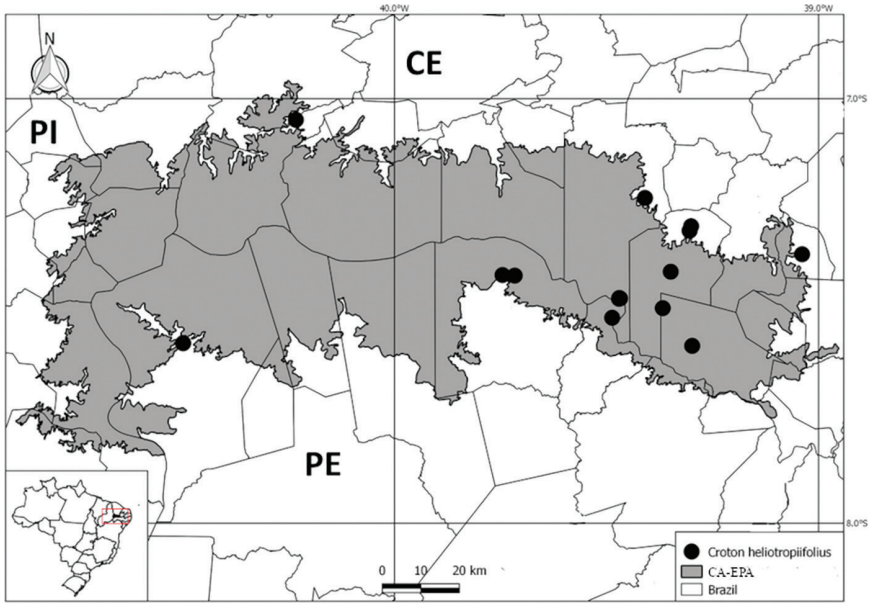

Figure 8. Distribution map of *Croton heliotropiifolius* in the CA-EPA.

region, occurring in the states of Bahia, Ceará, Paraíba, Pernambuco, Piauí and Rio Grande do Norte (Caruzo et al. 2020). The species has also been recorded in Minas Gerais state in southeastern Brazil (Caruzo et al. 2020). The species was recorded in the study area in regions of altered humid forest vegetation and is commonly found along forest edges and riverbanks (Figure 9). It was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 933,844.969 km² and Endangered when considered its Area of Occupancy (AOO) of 488.000 km².

Notes: *Croton jacobinensis* can be identified by having cordate leaves, auriform or flabelliform foliaceous stipules, and a densely pubescent receptacle in the pistillate flower.

Popular name: velame-preto, marmeleiro-preto.

11. *Croton limae* A. P. Gomes, M. F. Sales & P. E. Berry (2010: 206). TYPE:—BRAZIL. Bahia, Município Andaraí, Pai Inácio, 18 fevereiro 1997, *M. L. Guedes 5857* (Holotype: HUEFS!; isotypes: CEPEC, IBGE, MO, NY, PEUFR, USP) (Figure 10a, Figure 10b).

Trees to shrubs, 1.0–10.0 m tall, monoecious. Branches lepidote to glabrous, with lepidote trichomes. Leaves alternate, membranous; petiole 0.2–2.3 cm long, with lepidote to stellate-lepidote trichomes, eglandular; stipules 0.4–2.5 mm long, oval to oval-lanceolate, margins entire; leaf blade 0.8–3.3 × 2.0–7.5 cm, base slightly chordate, oval, margins entire, apex acute, adaxial and abaxial faces lepidote, silvery; venation eucamptodromous. Inflorescence terminal, monoecious; bracts 1.0–1.1 mm long, oval to oval-lanceolate, lepidote, with lepidote trichomes, margins entire. Staminate flower ca. 2.3 × 2.5 cm, subsessile, receptacle lepidote; sepals ca. 0.8 × 1.0–1.1 mm, oval, fused at base, external surface lepidote, internal surface glabrous; petals 4–4.2 × 0.8–1.0 mm, elliptic to oblong, with lepidote trichomes on the outer surface. Pistillate flower ca. 3.0 × 2.8 mm, subsessile, receptacle lepidote; sepals ca. 1.2 × 1.7–2.0 mm, triangular, fused at base, margins entire, apex acute, external surface lepidote, internal surface glabrous; petals absent. Ovary globose, 2.0–2.8 × 2.0–2.8 mm, lepidote; styles 4-fid, united at their base. Capsule globose, columella with entire apex. Seed globose, 4.0–5.0 × 4.0–5.0 mm, surface smooth.

Specimens examined: BRAZIL. CEARÁ: Crato, área de cerrado da Chapada do Araripe, 7°14'03"S, 39°24'34"W, 09.IV.2013, *B. V. Almeida, s.n.* (HCDAL). PERNAMBUCO: Moreilândia, Serra da Mata Nova, Chapada do Araripe, 7°28'10"S, 39°28'02"W 29.V.2016, *J. F. O. Souza, s.n.* (HCDAL). PIAUÍ: Padre Marcos, Serra Velha, 08.IV.1993, fl., *M. E. Alencar, s.n.* (EAC). PERNAMBUCO: Ipubi, Serrolândia, 20.IV.2017, fr., *J. E. L. Torres & W. B. Santos, 76* (HST).

Distribution, occurrence in the study area, and conservation status: *Croton limae* is endemic to the Brazilian semiarid region, occurring in the northeastern area of that country in the states of Bahia, Ceará, Paraíba, Pernambuco, Piauí and Sergipe, in typical caatinga vegetation and carrasco (Caruzo et al. 2020). The species occurs in the study area in caatinga and carrasco vegetation at elevations between 420 and 967 m a.s.l. (Figure 9). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 327,115.107 km² and Endangered when considered its Area of Occupancy (AOO) of 228.000 km².

Notes: *Croton limae* can be confused with *C. argyrophyllus*, *C. suassunae,* and *C. tricolor,* as discussed in the observations concerning the species *C. argyrophyllus*.

Popular name: marmeleiro-branco, marmeleiro.

12. *Croton nepetifolius* Baill., Adansonia 4: 344.1864. LECTOTYPE (designated by Sodré et al. 2019):—BRAZIL. Minas Gerais: s.d., *Saint-Hillaire cat. B2 2115* (P 00634517!) (Figure 10c, Figure 10e).

Herbs to shrubs, 0.6–2.0 m tall, monoecious. Branches hirsute to glabrescent, glabrous when mature, with stellate-porrect trichomes; latex translucent. Leaves alternate, membranous to chartaceous; petiole 0.3–1.8 cm long, with obconic and subsessile extrafloral nectaries at the apex; stipules 0.3–0.9 cm long, linear-lanceolate; leaf blade 0.5–6.1 × 1.0–10.3 cm, oval, base slightly chordate, margins double crenate, presence of obconic extrafloral nectaries, apex acute to acuminate,

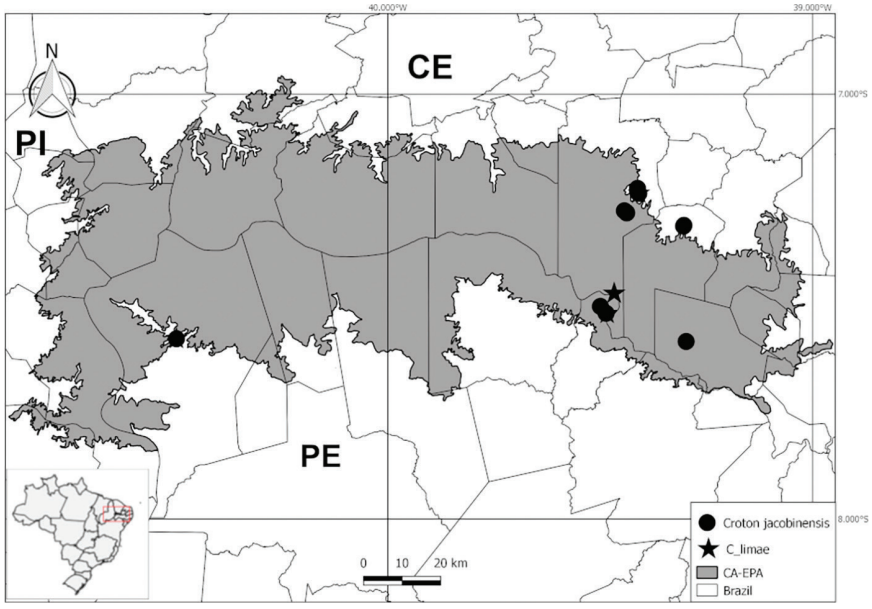

Figure 9. Distribution map of *Croton jacobinensis* and *C. limae* in the CA-EPA.

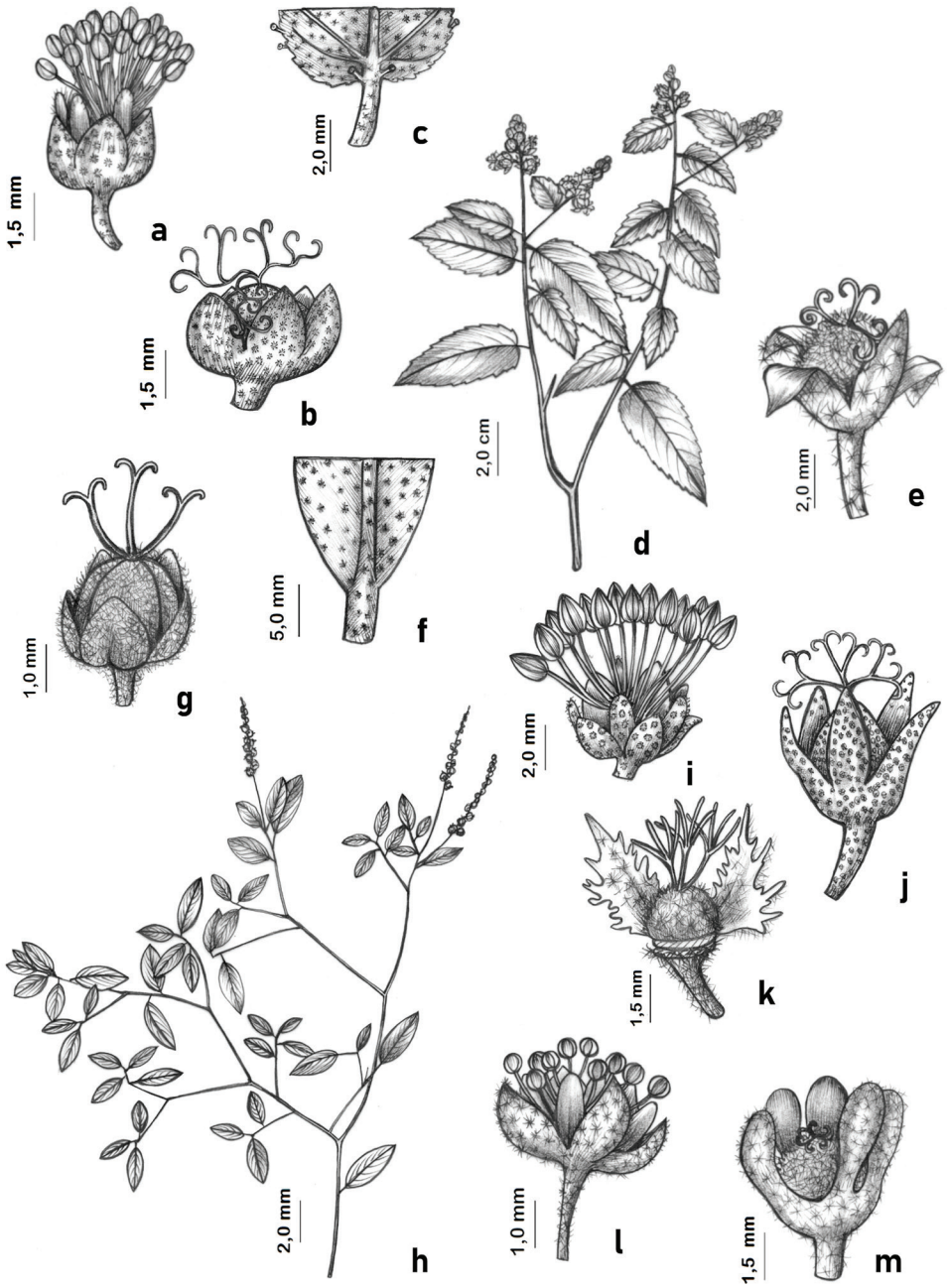

Figure 10. a-b: *Croton limae* A.P.Gomes, M.F.Sales & P.E.Berry. (J. E. L. Torres & W. B. Santos, 76) – a. Staminate flower. b. Pistillate flower. c-e: *Croton nepetifolius* Baill. (Morais Mendonça et al. s.n.) – c. Extrafloral nectaries. d. Habit. e. pistillate flower. f-g*: Croton pedicellatus* Baill. (Cavalcanti F. S. & Andrade M 33 (106) – f. Trichomes at the base of the leaf blade. g. Pistillate flower. h: *Croton suassunae* Y. Rossine & AL Melo. (T.R. Leite 9131) 9 1 - h. Habit. i-j: *Croton tricolor*. Klotzsch. ex bail. (A. Fernandes & F. J. Matos) – i. Staminate 2 flower. j. Pistillate flower. k: *Croton triqueter* Lam. (Cavalcanti F.S. s.n.) – k. Pistillate flower. 3 l-m: *Croton urticifolius* Lam. (A.M. Miranda 1192) – l. Staminate flower. m. Pistillate flower. Illustrator: Regina Carvalho.

adaxial face hirsute-hispid to hirsute-pubescent, with stellate-porrect trichomes, abaxial face hirsute-pubescent, with multiradiate stellate trichomes, venation actinodromous. Inflorescence 0.8–5.0 cm long, terminal, bisexual; bracts ca. 3 mm long, linear-lanceolate, with stellate trichomes. Staminate flower 1.7–3.0 mm long, pedicel 0.8–1.0 mm long, cream-colored, hirsute to glabrescent; sepals 1.2–1.7 mm long, oval, margins entire, apex acute, hirsute to glabrescent, with stellate trichomes on outer surface and apical portion of inner surface; petals 0.9–1.8 mm long, oblong, margins entire, apex acute to rounded, glabrous; stamens 10–12. Pistillate flower 3.8–5 mm long, pedicel 3.2–4.0 mm long, receptacle pubescent; sepals 1.1–2.9 mm long, oblong, margins entire, apex acute, hirsute-pubescent to glabrescent on the outside and glabrescent on the inside, with stellate trichomes on both faces; petals absent. Ovary globose, 4–5 × 4–5 mm, hirsute-pubescent, with stellate trichomes; styles 4–6-fid. Capsule tomentous with columella with entire apex. Seed globose, 4.0–5.5 × 4.0–5.5 mm, surface smooth.

Selected specimens: BRAZIL. CEARÁ: Barbalha, trilha da cruz vermelha, 7°27'32"S, 39°20'18"W, 11.VII.2007, fl., *M. A. P. Silva,*

et al. s.n. (HCDAL); malha bonita, Cariri, 07.XII.2011, *A. B. C. Santos, s.n.* (HCDAL); Crato, Chapada do Araripe, 7°14'03"S, 39°24'34"W, 26.III.1999, *L. W. Lima-Verde, 1322* (PEUFR), São Mindimba, Chapada do Araripe, 07.III.2007, fl., *E. R. Silveira & F. S. Cavalcanti, 1061* (EAC); Jardim, carrasco da FLONA, 7°34'57'S, 39°17'53"W, 09.II.2012, *C. G. Crepaldi, 45* (PEUFR). PERNAMBUCO: Moreilândia, Serra da Mata Nova, Chapada do Araripe, 7°28'11"S 39°28'00"W, 06.II.2016, *J. F. O. Souza, s.n.* (HCDAL).

Distribution, occurrence in the study area, and conservation status: *Croton nepetifolius* is native to Brazil, also occurring in Bolivia and Venezuela (Sodré et al. 2019, Riina et al. 2021, WCSP 2021). The species can be found in all northeastern Brazilian states and in Minas Gerais in the southeast, in the Caatinga and Atlantic Forest domains (Sodré et al. 2019, Caruzo et al. 2020). The species is commonly found in the study area along trails and forest edges and roadsides in carrasco, caatinga and cerrado environments, at elevations ranging from 535 to 922 m a.s.l. (Figure 11). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 2,678,427.208 km² and Area of Occupancy (AOO) of 480.000 km².

Notes: *Croton nepetifolius* can be identified by the presence of subsessile obconic extrafloral nectaries at the apex of the petiole, leaf blades with crenate margins, with the presence of obconic extrafloral nectaries, and the abaxial face of the blade with multiradiate stellate trichomes. Its leaves have a strong odor.

Popular name: velame, marmeleiro-preto.

13. *Croton pedicellatus* Kunth (1817: 75). TYPE:—PERU. "Crescit in ripa fluminis Amazonum juxta cataractum Rentemae in Provincia Bracamorensi, alt. 200 hex.", s.d., *Humboldt s.n.* (Holotype: P) (Figure 10f, Figure 10g).

Herbs to subshrubs, 0.3–1.0 m tall, monoecious. Branches hirsute-hispid, glabrescent at maturity, with stellate, stellate-rotate, stellate-porrect, and stellate-stipitate trichomes; latex translucent. Leaves alternate, membranous; petiole 0.2–0.8 cm long, eglandular; stipules 1.0–2.2 mm long, oval, with stellate trichomes; leaf blade 0.4–0.8 × 1.8–3.6 cm, oblong to lanceolate, base attenuated to rounded, margins entire, apex mucronate, adaxial face pubescent to velutinous, with stellate, stellate-fasciculate to stellate-dendritic trichomes, abaxial face hirsute-pubescent to pubescent, with stellate to stellate-dendritic, sessile, or stipitate trichomes; venation eucamptodromous. Inflorescence 0.8–1.5 cm long, terminal, bisexual; bracts 1.0–3.0 × 0.3–0.4 mm, oval-lanceolate, hirsute-pubescent, with stellate trichomes. Staminate flower 2.0–4.0 × 2.0 mm, pedicel 1.0–2.0 mm long, receptacle hirsute to hirsute-pubescent; sepals ca. 1.8 × 1.1 mm, oval, margins entire, apex acute, external surface hirsute-pubescent, with stellate to stellate-dendritic trichomes, internal surface glabrous; petals ca. 1.2 × 0.7 mm, oblong, margins entire, apex acute, external surface hirsute to glabrous, internal surface glabrous, many trichomes concentrated along the margins; stamens 12. Pistillate flower 3.0–4.0 × 2.0–2.3 mm, pedicel 0.8–1.1 mm long, receptacle pubescent to hirsute-pubescent; sepals ca. 1.0–1.2 × 1.0 mm, oval, outer surface hirsute-pubescent, with stellate to stellate-dendritic trichomes, inner surface glabrous; petals vestigial. Ovary globose, 2.3–3.5 × 2–3.8 mm, hirsute-pubescent, with stellate trichomes; styles bifid, free from each other, with stellate trichomes. Capsule hirsute, columella with entire apex. Seed globose, ca. 2.5–3.5 × 2.5–3.5 mm, surface rough.

Selected specimens: BRAZIL. CEARÁ: Barbalha, sítio arqueológico, 18.IX.1992, fl., *L. P. Félix, 5387* (EAC); Crato, arredores da escola agrotécnica federal do Crato, 06.V.1993, *Cavalcanti FS & M. Andrade N. 33* (EAC); Crato, Chapada do Araripe, estrada casa sede, 7°14'03"S 39°24'34"W, 01.IV.1998, *L. W. Lima-Verde, et al. s.n.* (EAC); Crato, estrada Nova Olinda/Crato, Chapada do Araripe, 7°10'30"S, 39°35'27"W, 12.II.2007, *D. S. Carneiro-Torres, 868* (HUEFS).

Distribution, occurrence in the study area, and conservation status: *Croton pedicellatus* is native to the Americas, occurring in countries in South and Central America, and in Mexico (Carneiro-Torres 2009). The species is widely distributed in the northern (TO), northeastern (BA, CE, MA, PB, PI, RN, SE), midwestern (GO, MT, MS), southeastern (MG, RJ, SP), and southern (PR) states in Brazil, in Caatinga, Cerrado, and Atlantic Forest environments (Caruzo et al. 2020). It can be found

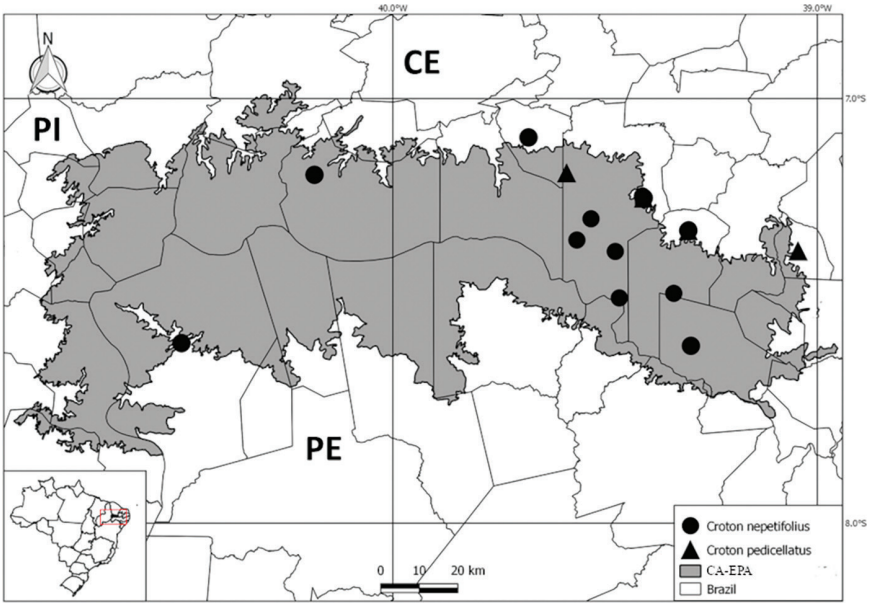

Figure 11. Distribution map of *Croton nepetifolius* and *C. pedicellatus* in the CA-EPA.

in the study area in typical caatinga and carrasco vegetations, and along roadsides (Figure 11). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 20,247,469.523 km² and Area of Occupancy of 1,476.000 km².

Notes: *Croton pedicellatus* can be distinguished from the other species by having an oblong to lanceolate leaf blade with a mucronate apex, stellate-dendritic trichomes on the external faces of the staminate and pistillate sepals and vestigial pistillate petals.

Popular name: velame, velaminho, batata-de-teiú.

14. *Croton sertanejus* Sodré & M.J.Silva (2022: 14–38) TYPE: BRAZIL. Bahia, Oliveira dos Brejinhos, 6 km ao Sul da cidade pela vicinal "Corredor da Barra"; 12°22′02.7″ S, 42°54′14.3″W; 884 m a.s.l.; 20/XII/2017; fl.; R.C. Sodré, A.O. Souza & U.S. Amaral 3350; (Holotype: BOTU; isotypes: CEPEC, NY, TEPB, UFG).

Shrubs, 1.5–2.0 m tall, monoecious. Branches tomentose with multiradiate to stellate-porrect trichomes; latex translucent. Leaves alternate, membranaceous, petioles 0.4–1.7 cm long, with multiradiate or stellate-porrect trichomes, 4–6 patelliform nectary glands, subsessile, stipules 0.5–0.8 × 0.15–0.3 mm, triangular, lanceolate or linear with stellate-porrect trichomes; leaf blades 2.2–8.9 × 1.2–4.7 cm, elliptic, ovate to oval-lanceolate, base obtuse or rounded, margin entire, apex acute, obtuse, mucronate to apiculate, adaxial surface hirsute, simple, stellate or stellate-porrect trichomes; venation brochidodromous. Inflorescence 2.8–16 cm long, terminal, bisexual, bracts 0.4–1.0 × 0.4–0.7 mm, triangular or oval, margins entire, apex acute, hirsute indumentum, stellate-porrect trichomes. Staminate flower 5–8 mm long; pedicel 1.6–4.7 mm long, receptacle tomentose with stellate-porrect trichomes; sepals 1.4–2.0 × 0.9–1.3 mm, ovate, fused at the base, margins entire, apex acute, external surface tomentose, with stellate porrects trichomes, internal surface glabrous; petals 2.0–2.9 × 0.6–1.2 mm, obovate, glabrous, margins entire, apex rounded, stamens 15–25. Pistillate flowers 3.5–5.3 mm long, pedicels 0.8–1.5 mm long, receptacle pubescent to tomentose, with stellate-porrect to multiradiate trichomes; sepals 1–1.7 × 0.6–0.8 mm, ovate, margins entire, apex acute, external surface pubescent to tomentose with stellate to stellate-porrect trichomes, internal surface sparsely pubescent to glabrescent; petals 0.5–1.3 × 0.5–0.4 mm, lineares, glabrous. Ovary subglobose, 1.2–1.4 × 1.3–1.8 mm, tomentose, with stellate-porrect trichomes; styles 6-fid. Capsule globose, columella with entire apex. Seed ellipsoid, 4.8–4.9 × 3–3.1 mm, with smooth surface.

Specimens examined: BRAZIL. CEARÀ: Campos Sales, Várzea da Vaca, II/1839, fl., *G. Gardner 2441* (K). PERNAMBUCO: Bodocó, arredores da cidade; 12/II/1991; fl., *P. Lisboa & C. Silva 4515, 34* (EAC).

Distribution, occurrence in the study area, and conservation status: *Croton sertanejus* is endemic to the is endemic to the Brazilian semiarid region, being recorded in the states of Bahia, Ceará, Minas Gerais, Paraíba, Pernambuco, Piauí and Sergipe, in areas of scrub/forest vegetation, sometimes associated with rocky outcrops, between 160 and 930 m. a.s.l. (Sodré & Silva, 2022); in the study area the species can be found in carrasco vegetation (Figure 12). The species was classified as Least Concern according to Sodré & Silva (2022).

Notes: As it is a recently described species, the records identified as *C. sertanejus* are still few, but we believe that the occurrence of this species in CA-EPA is not rare. *Croton sertanejus* is a recently described and illustrated species (Sodré & Silva, 2022), so it was not illustrated in the present work.

15. *Croton suassunae* Y. Rossine & A.L. Melo (2020: 249–253). TYPE: BRAZIL. Bahia, Rio de Contas, road to fazenda Marion, from Rio de Contas, 13°37'38"S, 41°45'25"W, 912 m, 3 Feb 2004, *Harley, R. M. et al., 54794* (Holotype: CEPEC!; isotypes: ASE, HUEFS, JPB, K) (Figure 10h).

Shrubs, 1.5–3.0 m tall, dioecious. Lepidote branches; latex not seen. Leaves alternate, chartaceous; petiole 2.0–7.0 mm long, eglandular; stipules 7 × 2 mm, lanceolate, with lepidote trichomes; leaf blade 2.0–4.3 × 1.5–2.5 cm, oval to elliptic, base rounded to chordate, margins entire, apex acute, adaxial face with stellate trichomes, abaxial face lepidote, venation eucamptodromous. Inflorescence axillary, unisexual; bracts 0.3–0.6 mm long, lanceolate, with stellate-lepidote trichomes. Staminate flower with pedicel ca. 2.0 cm long, receptacle lepidote; sepals ca. 1.3 × 3.1 mm, oval, fused at the base, margins entire, apex acute, with lepidote trichomes; petals 1.5–0.6 mm long, oblong, with simple trichomes, margins entire, apex rounded; stamens 10–15. Pistillate flower 5.0–5.2 × 4.5–5.0 mm, pedicel 1.0–3.0 mm, receptacle lepidote; sepals ca. 2.0–2.5 × 0.5 mm, spatulate, with lepidote trichomes, margins entire, apex rounded to acute; petals vestigial. Ovary globose, with lepidote trichomes; styles bifid, free. Capsule globose, columella entire. Seed ellipsoidal, surface smooth.

Specimens examined: BRAZIL. CEARÁ: Crato, 25.VI.2010, *T. R. Leite, s.n.* (HCDAL); Crato, 25.VI.2010, *T. R. Leite, s.n.* (HCDAL).

Distribution, occurrence in the study area, and conservation status: *Croton suassunae* is endemic to the Brazilian semiarid region, being recorded in the states of Bahia, Ceará, Pernambuco, and Piauí, in areas of arboreal and shrubby caatinga vegetation, cerrado, semideciduous forests, and anthropized areas (Rossine et al. 2020). The species was found in the study area in carrasco vegetation (Figure 13). The species was classified as Least Concern according to Rossine et al. (2020).

Notes: *Croton suassunae* resembles *C. argyrophyllus*, *C. limae,* and *C. tricolor*, from which it was differentiated (as described above) in *C. argyrophyllus*. As it is a recently described species, the records identified as *C. suassunae* are still few, but we believe that the occurrence of this species in CA-EPA is not rare.

16. *Croton tricolor* Klotzsch ex Baillon (1864:291). LECTOTYPE (designated by VanEe 2011): —BRAZIL. Minas Gerais, 1816, *A. F. C. P. Saint-Hilaire cat. C1, n. 92.* (P 00634797!) (Figure 10i, Figure 10j).

Shrubs, 1.5–2.5 m tall, monoecious. Branches glabrous to lepidote; latex translucent. Leaves simple, alternate, membranous to chartaceous; petiole 0.4–0.7 cm long, eglandular; stipules 0.4–0.9 cm long, with lepidote trichomes; leaf blade 1.5–3.2 × 3.5–10 cm, oval to lanceolate, base rounded to attenuated, margins entire, apex acute, adaxial face lepidote to glabrescent, ferruginous, with lepidote trichomes on the blade and (sometimes) stellate-porrect trichomes on the main vein, abaxial face lepidote, venation eucamptodromous. Inflorescence 1.4–9.5 cm long, terminal, bisexual; bracts 0.2–0.5 cm long, oval to lanceolate, with lepidote trichomes. Staminate flower 3.5–4.5 × 4.0–5.0 mm, pedicel 3.0–5.2 mm long, receptacle lepidote; sepals 1.8–2.8 mm, ovate, fused at the base, margins entire, apex acute, external surface lepidote, internal surface glabrous, glabrescent, or hirsute, with stellate trichomes; petals 2.0–3.0 mm, linear-lanceolate, external surface lepidote, internal

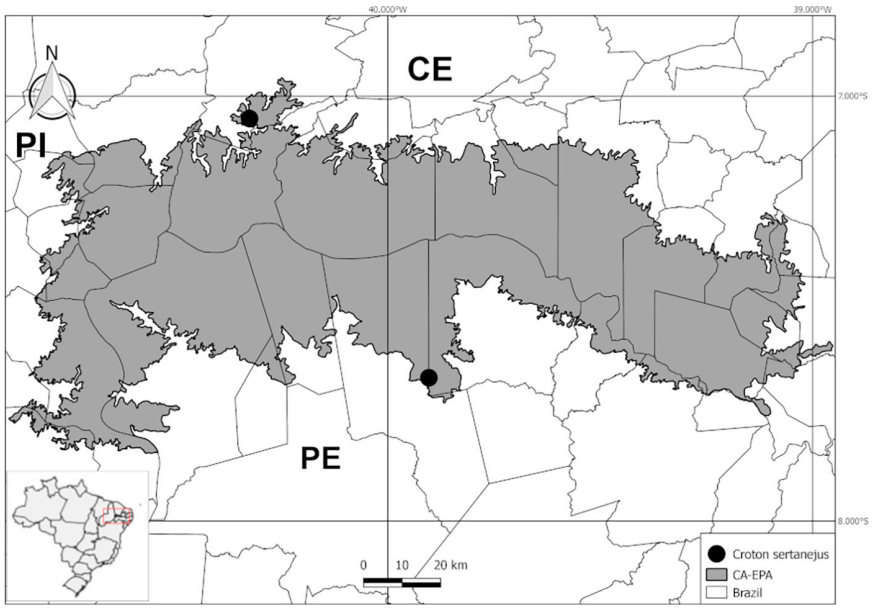

Figure 12. Distribution map of *Croton sertanejus* in the CA-EPA.

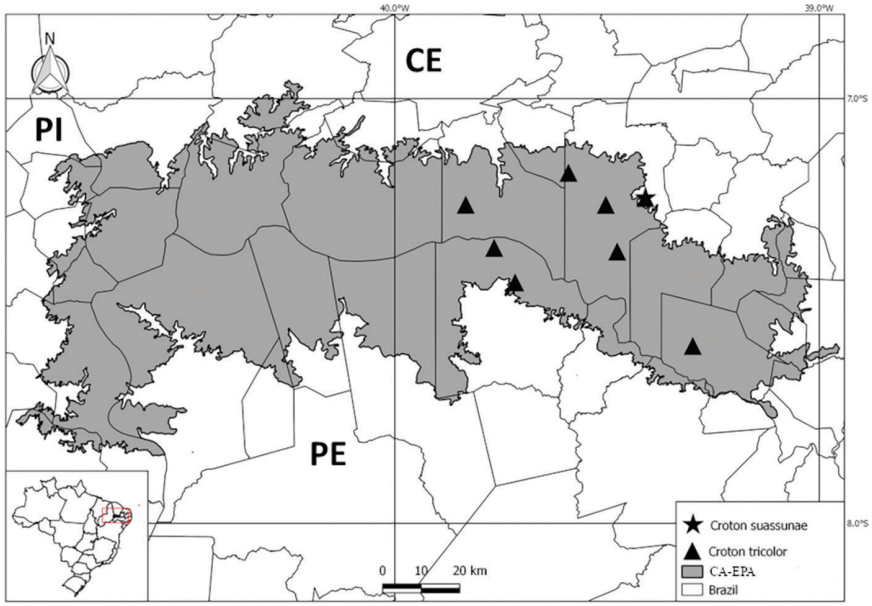

Figure 13. Distribution map of *Croton suassunae* and *C. tricolor* in the CA-EPA.

surface glabrous; 14–15 stamens, with stellate trichomes. Pistillate flower 2.8–3.0 × 5.0–6.0 mm, pedicel 2.8–3.0 mm, silvery, receptacle lepidote; sepals 0.4–0.7 cm long, oblong, margins entire, apex rounded, internal surface glabrescent, with stellate trichomes, external surface lepidote; petals absent. Ovary globose, 2–3.5 × 2–3.5 mm, with lepidote trichomes; styles multifid, with stellate trichomes. Capsule lepidote, columella with entire apex. Seed globose, 3.5–4.5 × 3.5–4.5 mm, surface smooth.

Selected specimens: BRAZIL. CEARÁ: Crato, mata úmida da FLONA, 7°14'03"S, 39°24'34"W, 11.II.2012, *C. G. Crepaldi, 57* (PEUFR); Jardim, cacimbas – FLONA, 7°34'57"S, 39°17'53"W, 09.II.2012, *C. G. Crepaldi, 42* (PEUFR). PERNAMBUCO: Moreilândia, Chapada do Araripe, Serra da Mata Grande, 7°37'51"S, 39°33'04"W, 28.IX.2016, *A. P. Fontana, 9648* (HUEFS); Exu, Chapado do Araripe, Serra do Ingá, 7°21'06"S, 39°45'58"W, 04.IV.2021, *R. M. Harley, 54161* (HUEFS).

Distribution, occurrence in the study area, and conservation status: *Croton tricolor* is native to Brazil, also occurring in other South American countries (Gomes 2006; Carneiro-Torres 2009). The species occurs in all of the states in northeastern Brazil, being also recorded in the southeastern (MG, SP) and southern (PR) regions of

that country in Caatinga, Cerrado, and Atlantic Forest environments (Caruzo et al. 2020). *Croton tricolor* can be found in the study region in areas of caatinga, carrasco, and cerradão vegetation (Figure 13). The conservation status of *Croton tricolor* was previously published in the IUCN Red List (2018) as Least Concern.

Notes: *Croton tricolor* can be confused with *C. argyrophyllus*, *C. limae,* or *C. suassunae*, their differentiation was discussed in the notes concerning *C. argyrophyllus*.

Popular name: marmeleiro.

17. *Croton triqueter* Lamarck (1786: 214). SYNTYPE: —BRAZIL. Prov. Rio de Janeiro, 1767, *P. Commerson s.n*. (P00634801!, P00634800!) (Figure 10k).

Shrubs to subshrubs, 0.5–1.5 m tall. Woolly to glabrescent branches, with stellate trichomes; latex translucent. Leaves simple, alternate, membranous; petiole 0.2–6.5 cm long, pubescent, hispid to glabrescent, eglandular; stipules 0.6–1.0 cm long, entire, oval-lanceolate, with stellate trichomes; leaf blade 0.7–10.8 × 2.5–17.5 cm, oval, base rounded to truncated, margins serrate or sparsely serrate, apex acuminate, adaxial surface scabrous to glabrescent, with stellate trichomes, abaxial surface hirsute-hispid to hirsute-pubescent, with blackish stellate trichomes; venation eucamptodromous. Inflorescence 2.0–4.0 cm long, terminal, bisexual, bracts 0.6–1.2 cm long, lanceolate to linear-lanceolate, margins entire, apex acuminate, with blackish stellate trichomes. Staminate flower 3.0–4.0 × 4.0–4.2 mm, pedicel 2.3–2.5 mm long, receptacle hirsute-pubescent, with blackish stellate trichomes; sepals 2.0–3.0 mm long, oval, fused at the base, margins entire, apex acute, external surface hirsute-pubescent, with blackish stellate trichomes, internal surface glabrescent, with sparse stellate trichomes; petals 1.5–2.5 mm long, spatulate, margins entire, apex rounded, external and internal surfaces glabrescent, with sparse stellate trichomes; stamens 12. Pistillate flower ca. 0.4 × 0.5–1.2 cm, green with dark spots, pedicel 1.1–1.5 mm long, receptacle hirsute-pubescent, with blackish stellate trichomes; sepals (5 – (3 + 2)), unequal, 3 larger (ca. 3.0–4.0 mm long), oval, margins lacerated, and 2 smaller sepals, inconspicuous, external surfaces hirsute-pubescent, internal surfaces hirsute to glabrescent, with stellate to stellate-porrect trichomes; petals absent. Ovary globose, ca. 2–3 × 2–3 mm, hirsute-pubescent; styles 4-fid, fused at their base. Capsule sparsely pubescent, columella with entire apex. Seed globose, 3–4 × 3–4 mm, surface reticulate.

Specimens examined: BRAZIL. CEARÁ: Crato, Guaribas – FLONA, fl., 20.II.1999, *F. S. Cavalcanti, s.n.* (EAC). PERNAMBUCO: Exu, bacia do Rio Brígida, fazenda Mata Fresca, encosta de Chapada, 16.VII.1994, *F. S. Pinto s.n.* (EAC).

Additional specimens examined: BRAZIL. CEARÁ: Maranguape, Pó de Serra Úmida, Mucuna de Cima, 10.IV.1997, *A. S. F. Castro, s.n.* (EAC); Meruoca, Serra da Meruoca, Santo Antônio dos Fernandes, 3°34'29"S 40°29'39"W, 23.VI.2009, fl., *E. M. Marreira et al., 20* (EAC); Ubajara, Parque Nacional de Ubajara, 11.III.2014, *M. I. B. Loiola & F. R. S. Tobosa, 2200* (EAC); ALAGOAS: Palmeira dos índios, Faz, 9°21'04"S 36°40'12"W, 16.VIII.2001, fl., fr., *R. P. Lyra-Lemos, 5774* (HST).

Distribution, occurrence in the study area, and conservation status: *Croton triqueter* is widely distributed in the Neotropical region, occurring in Argentina, Bolivia, Brazil, Colombia, Mexico, Paraguay, Peru, and Venezuela (Caruzo & Cordeiro 2007; Carneiro-Torres 2009). The species occurs in the northeastern (AL, BA, CE, MA, PB, PE, RN, SE), midwestern (MS), southeastern (ES, MG, RJ, SP), and southern (PR, RS, SC) regions of Brazil, growing in Caatinga, Cerrado, Atlantic Forest, and Pantanal environments (Caruzo et al. 2020). The species was recorded in the study area in areas of humid (altered) forest (Figure 14). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 33,923,720.971 km² and Area of Occupancy (AOO) of 1,868.000 km².

Notes: *Croton triqueter* can be distinguished from the other species by having blackish stellate trichomes on the abaxial surface of the limb,

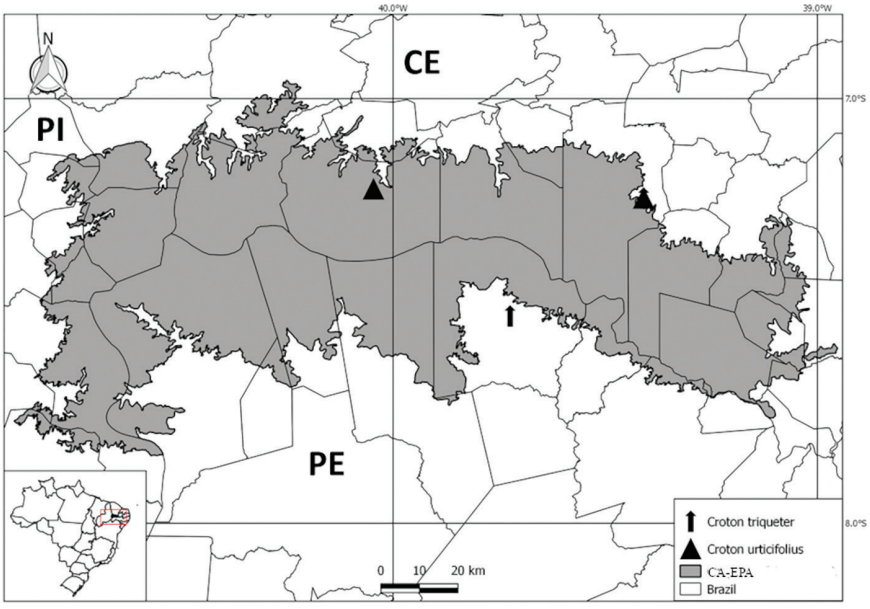

Figure 14. Distribution map of *Croton triqueter* and *C. urticifolius* in the CA-EPA.

the bracts, receptacle, and staminate sepals, as well as on the receptacle of the pistillate flower. The species can also be distinguished from the others by the sepals of the pistillate flowers of unequal size (3 larger and two smaller, inconspicuous).
Popular name: malva-da-flor-preta.

18. *Croton urticifolius* Lamarck (1786: 213). TYPE: —BRAZIL. Bahia, "M de Commerson a trouvè cette plante dans le Brésil (v.s.)" *Commerson, s.n*. (A) (Holotype: A) (Figure 10l, Figure 10m).
Herbs to shrubs, 0.4–2.0 m tall, monoecious. Branches hirsute, hispid to glabrescent, with stellate trichomes; latex translucent. Leaves alternate, membranous to chartaceous; petiole 0.2–2.5 cm long, with stellate to stellate-porrect trichomes, eglandular; stipules entire, elliptic; leaf blade 0.9–5.4 × 2.0–6.5 cm, oval, base oval to rounded, margins crenate to double crenate, apex acute to acuminate, adaxial surface pubescent, sparse-pubescent to glabrescent, with stellate, stellate-porrect to simple trichomes, abaxial face hirsute pubescent to tomentose, with stellate to stellate-porrect trichomes; venation actinodromous. Inflorescence 2.2–9.0 cm long, terminal, bisexual; bracts 1.1–5.0 mm long, lanceolate to oval-lanceolate, margins entire, apex acute. Staminate flower 1.3–2.5 × 1.7–3.5 mm, pedicel 0.8–2.8 mm, receptacle hirsute to glabrescent, with sparse stellate trichomes; sepals 1.0–1.7 × 0.7–1.0 mm, oval, hirsute to glabrescent; petals (5), 1.2–2.0 × 0.3–1.8 mm, oblong, margins entire, apex acute to rounded, inner and outer faces glabrescent to glabrous, with stellate trichomes; 10 stamens. Pistillate flower 3.3–4.0 × 3.0–4.0 mm, pedicel 4.0–0.8 mm long, receptacle hirsute-pubescent, with stellate to stellate-porrect trichomes; sepals 3.4–2.6 × 1.2–1.7 mm, oblong to spatulate, margins entire, apex rounded, external surface hirsute to hirsute-pubescent, with stellate to stellate-porrect trichomes, internal surface glabrous. Ovary globose, 1.5–2.1 × 1.2–2.5 mm hirsute-pubescent; styles multifid, free. Capsule pubescent, columella with entire apex. Seed oblong, 2.5–4.0 × 2.0–2.2 mm, surface rough.
Specimens examined: BRAZIL. CEARÁ: Crato, Chapada do Araripe, 7°14'03"S, 39°24'34"W, 25.II.1999, *L. W. Lima-Verde, 1301* (PEUFR); Crato, Minguiriba, Cariri, 10.I.2012, *A. C. A. Morais-Mendonça & E. N. C. Seixas, 279, 280* (HCDAL).
Additional specimens examined: BRAZIL. Ceará, Guaramiranga, Sítio Sinimbu, 4°10'30"S 38°33'21"W, 11.II.2003, *A. P. Silveira & R. F. Oliveira, 739* (EAC); Guaramiranga, Pico Alto, Sítio Gameleira, região centro-sul, 23.I.2008, fl., fr., *E. S. Rocha, s.n*. (EAC); Novo Oriente, Morro dos Três Irmãos, 20.II.1989, *F. S. Araújo, s.n.* (EAC); Ubajara, escritório do ICMBio, 3°30'11"S, 40°33'49"W, *M. I. B. Loiola et al., 1525* (EAC); Ubajara, Jaburuna/Sul, 21.II.1995, *F. S. Araújo, 1126* (EAC); Ubajara, Planalto da Ibiapaba, 27.I.1996, *A. B. Araújo, 1158* (EAC). PERNAMBUCO: Venturosa, Parque Pedra Furada, 8°34'30'S 36°52'45"W, 18.VI.1998, fl., *K. C. Costa, 46* (PEUFR).
Distribution, occurrence in the study area and conservation status: *Croton urticifolius* occurs in a number of South American countries: Bolivia, Brazil, Guyana, and Venezuela (Lucena 2001). The species has been recorded in the northern (TO), northeastern (AL, BA, CE, PB, PE, PI, RN, SE), and southeastern (ES, MG, RJ) regions of Brazil, in Caatinga, Cerrado and Atlantic Forest vegetation (Flora do Brasil 2020). The species is generally found in the study area in typical caatinga and carrasco vegetation (Figure 14). The species was classified as Least Concern in relation to its Extent of Occurrence (EOO) of 1,914,814.199 km² and Area of Occupancy (AOO) of 716.000 km².
Notes: *Croton urticifolius* can be distinguished from the other species by the presence of ten stamens in the staminate flower.

Discussion

Regarding the collection effort in the CA-EPA region, Loiola et al. (2015) related the fact that the most collected municipalities are close to university campuses, such as the Universidade Regional do Cariri, in the state of Ceará, and the Universidade Vale do São Francisco (UNIVASF) and the Serra Talhada campus of Universidade Federal Rural de Pernambuco (UFRPE-UAST) in the state of Pernambuco, the presence of these research centers in nearby regions directly influences the collection effort in these municipalities.

All the vegetation types present in the CA-EPA harbor *Croton* species – predominantly in caatinga and carrasco vegetation. *Croton heliotropiifolius* and *C. tricolor* were recorded in all vegetation types present in the CA-EPA, which corroborates the wide distribution these species present in different domains (i.e.: Caatinga, Cerrado and Atlantic Forest), not only in the Northeast region but also other regions of Brazil (Caruzo et al. 2020). In contrast, *C. betaceus* and *C. floribundus* have records only in humid forest environments, which also corroborates the distribution data for these species, as both are generally found in Amazon Rainforest and Atlantic Forest areas (Caruzo et al. 2020). The Caatinga has the highest number of endemic species among the Seasonally Dry Tropical Forest and Woodland (SDTFW), as observed for *Croton*, since this domain comprises a high diversity and endemism for the genus in Brazil (Fernandes & Queiroz, 2018).

Of the 18 species of *Croton* found in the CA-EPA, only *C. glandulosus* and *C. tricolor* are on the international list of threatened species (IUCN, 2022); in the period of the study by Loiola et al. (2015) none of the 14 *Croton* species included in the survey had information about their conservation status recorded in an online database, which highlights the lack of studies, and also of dissemination related to this theme, which ends up making it even more difficult to implementation of conservation strategies aimed at these species and the environments in which they inhabit.

In the specieslink platform (specieslink.net/search), 22 names accepted in *Croton* for the Chapada of Araripe area are listed, however in this list *C. suassunae* and *C. sertanejus* are not contemplated and, during the curse of the present work, it was elucidated that four species (*C. ceanothifolius*, *C. cerinodentatus*, *C. luetzelburgii*, *C. sclerocalyx*) were wrongly identified and do not occur in the study area. This highlights the importance of taxonomic work carried out by specialists in the groups and how it is crucial to consider that the survey, both in the field and in the herbarium, conducted with taxonomic expertise carried out by specialists, increases the chance of finding more realistic data with greater reliability in the identifications (Bebbera et al. 2010).

From a morphological point of view, the similarity between some species makes their taxonomic delimitations difficult. *Croton echioides,* and *C. sertanejus* stand out, for example, by having shrub habit, leaf blade with margins entire and extrafloral nectaries on the petiole. Easily diagnosed species, on the other hand, such as *C. floribundus*, *C. jacobinensis,* and *C. triqueter*, were also considered.

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Associate Editor

Carmen Zickel

Author Contributions

Joesili Oliveira: design, collections and visits to the herbaria, creation of the database, reading, writing and review.

Yuri Rossine: reading, writing, reviewing, correcting the manuscript.

Rayane Ribeiro: conception, co-orientation, reading, revision, correction of the manuscript.

Sarah Athiê-Souza: conception, supervision, reading, revision, correction of the text and research funding.

Conflicts of Interest

We, the authors, declare that we have no conflicts of interests related to the publication of this manuscript.

Data Availability

URL of the dataset: https://data.scielo.org/dataset.xhtml?persistentId=doi:10.48331/scielodata.JL9HLA&version=DRAFT

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