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Macambiras, the most northeastern of the xerophiles: taxonomy, distribution and potential

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Abstract: *Bromelia laciniosa* and *Encholirium spectabile* (Bromeliaceae) have vernacular names as macambira. Both species are restricted to the Northeast of Brazil, mainly in the Caatinga domain or in ecotonal regions with the Atlantic Forest and Cerrado. Macambira species have been reported for different uses in rural communities, ranging from ornamental plants, hedges, human and animal food, medicinal application, and raw material to manufacture handicrafts and utensils, besides ecological interaction with different animals. This study aims to present the taxonomic description, distribution data, habitat, phenology, taxonomic comments, and potential uses of *B. laciniosa* and *E. spectabile*. *Bromelia laciniosa* belonging to the subfamily Bromelioideae and *Encholirium spectabile* belongs to the subfamily Pitcairnioideae. Both species are xerophilous; i.e, they have morphological and physiological structures adapted to the semiarid climate. *Bromelia laciniosa* is a terrestrial species and can also inhabit rocky outcrops where organic matter is found, whereas *Encholirium spectabile* is a strictly rupicolous species. Given the importance of the species to the Northeast of Brazil, macambiras are also reported in visual arts, literary works, song lyrics, family surnames, nicknames, names of municipality, villages, riverside, waterfalls, and a scientific journal.

Keywords: *Bromelia laciniosa*, Bromeliaceae, *Encholirium spectabile,* Use Potential, Caatinga.

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Macambiras, as mais nordestinas das xerófilas: taxonomia, distribuição e potencialidades

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Resumo: *Bromelia laciniosa* e *Encholirium spectabile* (Bromeliaceae) são conhecidas popularmente, como macambira. As duas espécies são restritas ao Nordeste do Brasil, principalmente, no domínio da Caatinga ou em regiões ecotonais com a Mata Atlântica e Cerrado. As espécies de macambira têm sido reportadas para diferentes usos em comunidades rurais, que vão desde plantas ornamentais, cerca-viva, alimentação humana e animal, aplicação medicinal e matéria-prima para a fabricação de artesanatos e utensílios, além da interação ecológica com diferentes animais. O objetivo deste estudo é apresentar a descrição taxonômica, dados de distribuição, habitat, fenologia, comentários taxonômicos e potenciais usos de *B. laciniosa* e *E. spectabile*. *Bromelia laciniosa* pertencente a subfamília Bromelioideae e *Encholirium spectabile* pertence a subfamília Pitcairnioideae. Ambas as espécies são xerófilas, ou seja, possuem estruturas morfológicas e fisiológicas adaptadas ao clima semiárido. *Bromelia laciniosa* é uma espécie terrestre, podendo habitar também afloramentos rochosos onde se encontram matéria orgânica depositada, já *Encholirium spectabile* é uma espécie estritamente rupícola. Dada à importância das espécies para o Nordeste do Brasil, as macambiras são reportadas também nas artes plásticas, obras literárias, letras de músicas, como sobrenome de família, apelidos de pessoas, nome de município, povoados, ribeirões, cachoeiras e um periódico científico.

Palavras-chave: *Bromelia laciniosa*, Bromeliaceae, *Encholirium spectabile,* Potenciais de Uso, Caatinga.

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Introduction

The Bromeliaceae comprises 79 genera and 3,672 species (GOUDA et al., cont. updated.) and has a variety of habits, sizes, colors, and use potentials including: ornamental, food, fiber production, enzymes, besides having considerable ecological function within ecosystems (LEME; MARIGO, 1993; BENZING, 2000; MAURER, 2001; FALLER *et al.*, 2017; SOUZA *et al.*, 2017; SENA NETO *et al.*, 2017; CAMPOS *et al.*, 2019; SILVA *et al.*, 2019). The species are distributed in eight subfamilies and occur from the southern United States, through Central America, the Caribbean, covering South America to southern Argentina and Chile. In the African continent, there is a single species [*Pitcairnia felicina* (A. Chevalier) Harms & Mildbraed.] distributed on the east coast of Africa (SMITH; DOWNS, 1974; 1979; BENZING, 2000).

The state of Bahia has 31 genera and 355 spp. found in the three phytogeographic domains: Atlantic Forest, Caatinga, and Cerrado (FORZZA *et al.*, 2020). The genus *Bromelia* L. has 70 species (GOUDA *et al.*, cont. updated), and in the state of Bahia, only 11 are found (MONTEIRO, 2020), *Encholirium* Mart. ex Schult. & Schult.f., 37 species are cataloged (GOUDA *et al.*, cont. updated) and Bahia with 10 spp. (FORZZA, 2020).

The terminology 'macambira' is a vernacular name of two species: *Bromelia laciniosa* Mart. ex Schult.f. belonging to the subfamily Bromelioideae, and *Encholirium spectabile* Mart. ex Schult. & Schult.f. of the Pitcairnioideae subfamily. Both species are xerophilous; i.e, they have morphological and physiological structures adapted to the semiarid climate. Because of this, Duque (2004) related xerophylism to a potentiality of plants in the Caatinga so that farmers could take advantage of these predicates as a strategy for living with the semiarid climate. In this way, xerophilous crops would be alternatives to the traditional cultivations carried out by the sertanejos (Denomination given to the native people of the region) since under semiarid conditions with long periods of drought and irregular rains and there are significant risks and harvests with low production in Brazilian semiarid regions (DUQUE, 2004).

Bromelia laciniosa and *E. spectabile* have different potential uses, ranging from use as ornamental plants to cultivated as a stock fence (BESSA, 1982; LIMA, 1996; ANGELIM *et al.*, 2007), animal feed (BESSA, 1982; LIMA, 1996; NUNES *et al.*, 2015; 2016), human consumption (NASCIMENTO *et al.*, 2012; JUVIK *et al.*, 2017), medicinal properties, and pharmacological activities (PFIRTER *et al.*, 1973; ALBUQUERQUE *et al.*, 2007; AGRA *et al.*, 2007; CARVALHO *et al.*, 2010; OLIVEIRA-JÚNIOR *et al.*, 2014), raw material for the manufacture of handicrafts and utensils, in addition to presenting an ecological relationship with vertebrates and invertebrates. The importance of these two species for the Brazilian Northeast population, macambira is reported in literary works, lyrics, visual arts, family surnames, people's nicknames, municipality name, villages, waterfalls, and this scientific journal.

In this way, the objective of this study was to present a taxonomic description of *Bromelia laciniosa* and *Encholirium spectabile*, besides the data on the distribution, habitat, phenology, taxonomic comments, potential uses, and other curiosities.

Material and Methods

The two species of macambira were studied systemically with monthly observations in the Milagres region, resulting in data on distribution, phenology, taxonomic description, and conservation status. The morphological characterization of the species was based on live plants in the field and plants deposited at the Herbarium of the Recôncavo da Bahia (HURB) from the Federal University of Recôncavo da Bahia (UFRB). Samples of the two species were deposited for conservation *ex-situ* at the Bromeliad Germplasm Bank of the Embrapa Cassava and Fruits (Embrapa Mandioca e Fruticultura), Cruz das Almas, Bahia, Brazil.

The distribution of both species (*Bromelia laciniosa* and *Encholirium spectabile*) was carried out with consultations to the virtual herbariums of website Reflora (http://reflora.jbrj.gov.br/reflora), SpeciesLink (http://splink.cria.org .br/) and Jabot (http://jabot.jbrj.gov.br/v3/consulta.php). For greater precision in identifying the two species, the exsiccates that showed doubts about the taxonomy were confirmed by images.

Results and Discussion

Bromelia laciniosa (Figure 1) and *Encholirium spectabile* (Figure 2) have vernacular names as macambira, macambira-de-flecha, macambira-da-pedra, or macambira-de-serrote, both are species of the family Bromeliaceae and the subfamilies Bromelioideae and Pitcairnioideae, respectively. The name macambira (*makambíra*) is of indigenous origin; the ambíra suffix derives from *i'mbira* ', which has Tupi origin and means "that which has fiber, fiber, filament" (http://www.oxforddictionaries.com/).

Taxonomy

Bromelia laciniosa Mart. ex Schult.f., Systema Vegetabilium 7 (2): 1278 (1830). (Figure 1).

Figure 1. *Bromelia laciniosa*. A) Habitat. B) Individual in fruiting. C) Inflorescence. D) Detail of the inflorescence. E) Lower bracts of the peduncle. F) Upper peduncle bracts. G) Flower. H) Androecium and gynoecium. I) Gynoecium. J) Conduplicate-spiral type stigma. K) Ovary in cross-section. L) Androecium. M) Petals. N) Sepal. Bars: C = 15 cm; D, G-I, K, M - 0.6 cm; E = 2.5 cm; F, L = 1 cm; N = 0.4 cm. Photos: A-B) A.J.A. Carvalho, C-N) E.H. Souza.

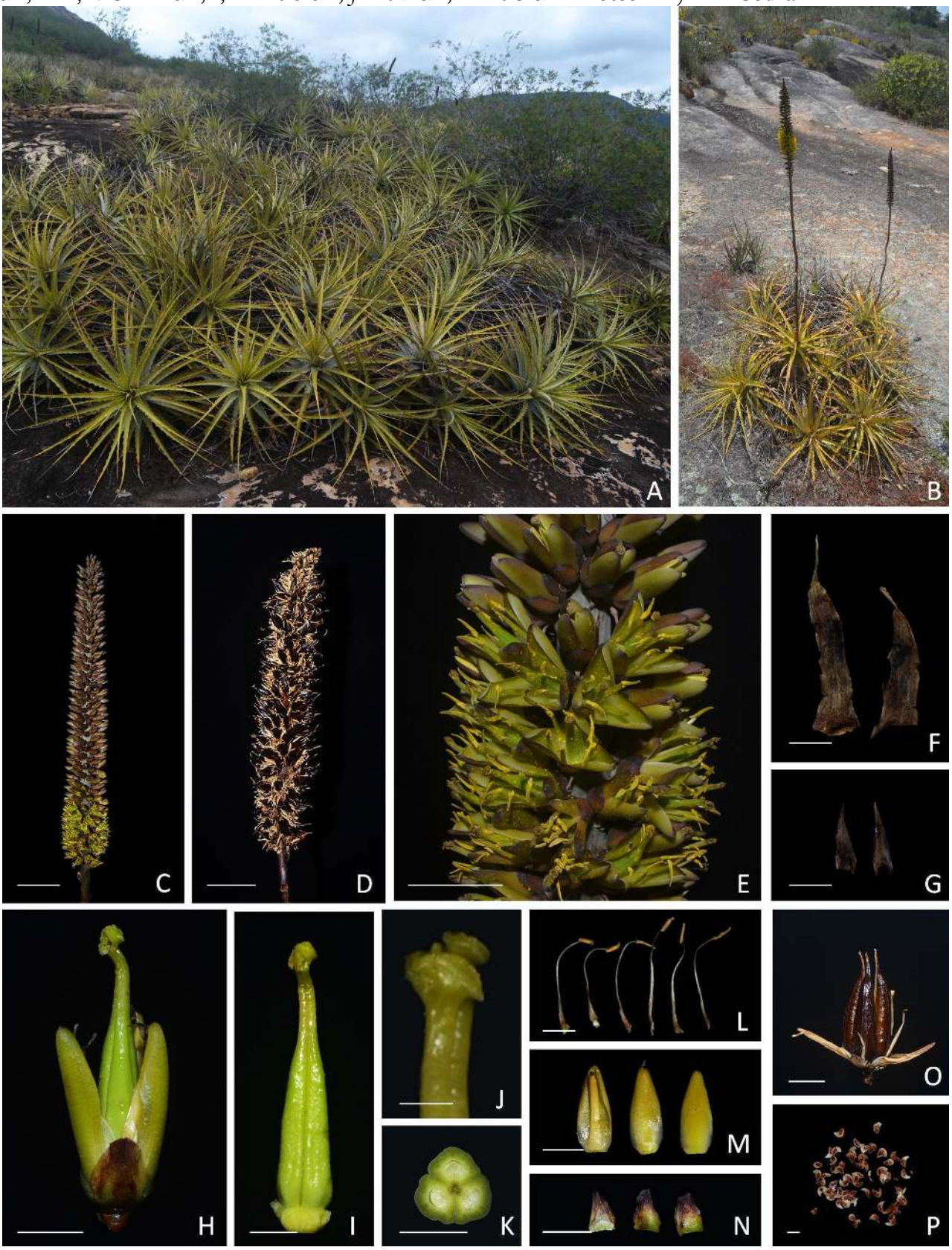


Plant terrestrial, propagated by stolons. ***Rosette*** open, abstent tank. ***Leaves*** 12–28, sub-erect, coriaceous, green to silvery green or reddish-pink; ***sheath*** 3.8–6 × 6 cm, widely ovate, serrated margins; ***blade*** 28–112 × 1.4–2.6 cm, linear, margins slightly revoluted, serrated, acute-attenuated apex; ***spines*** 4.5–8 mm long, antrorse or rarely retrorse through the leaf blade. ***Inflorescence*** (fertile portion) panicle, 15–38 cm long, robust, composed, pale pink rachis and branches, densely lepidote white; ***floral bracts*** 5–16 × 2.1–5 mm, triangular, pink to red, lepidote white, acuminate apex; ***peduncle*** 12.5–31 cm long, erect, greenish-pink or greenish-red, lepidote white to glabrescent; ***peduncle bracts*** 15.8–48 × 1–2.5 cm, elliptical at the base and linear at the distal portion, greenish-pink or greenish-red. ***Flowers*** 22–38 mm long, numerous, discreetly pedicellated; ***sepals*** 9–17.5 mm long, ovate, carinate, pink or lepidote white, slightly fimbriated margins, acute apex; ***petals*** 20–25.5 mm long, oblong pink to vinaceous with white margins, and base, adnate to the fillets by 6 mm, obtuse apex. ***Pistil*** equaling the stamens in length; ***ovary*** epigynous, cylindrical, white, densely covered by brown-colored trichomes; ***style*** 9 mm long; ***stigma*** conduplicate-spiral; ***Stamens*** included; ***filament*** 5.8–6.3 mm long, adnate to the petals; ***anthers*** yellowish. ***Fruits*** berry-type, fleshy, 3.5–5.8 × 1.4–2.5 cm, ellipsoid to globose, odorous, yellow when ripe, pilose surface. ***Seeds*** not seen.

Encholirium spectabile Mart. ex Schult. & Schult.f., Systema Vegetabilium 7 (2): 1233 (1830). (Figure 2).

Plant rupicolous, propagating through rhizomes and stolons, forming large clumps. ***Rosette*** open, orbicular, tank absent. ***Leaves*** sub-erect to curved, coriaceus, densely hirsute; ***sheath*** 3.5–4.5 × 3–5.5 cm, widely ovate, brownish; ***blades*** 30–60 × 1.5–2 cm, strictly triangular, attenuated towards the apex, green or yellowish-green, strongly serrated margins; ***spines*** 3–10 mm long, antrorse, distally retrorse or antrorse and retrorse arranged. ***Inflorescence*** (fertile portion) racemous, 40–80 cm long, simple (rarely branched), cylindrical, numerous flowers, sub-congest to congest; ***floral bracts*** 10–12 × 3–4 mm, narrowly triangular-ovate, attenuated towards the apex, brown to dark pink. ***Peduncle*** 80–200 cm long, erect, green or greenish-brown; ***peduncle bracts*** 3–27 × 0.5–2 cm, narrowly triangular, attenuated towards the apex, brownish-green, serrated, partially covering the peduncle, acute apex. ***Flowers*** erect-patent, pedicelete; pedicel 5–11 mm long; ***sepals*** 6–8.2 mm long, ovate, ecarinate, greenish to brownish, obtuse apex; ***petals*** 14–16 mm long, narrowly elliptical, yellowish-green, obtuse apex. ***Pistil*** exceeding the stamens; ***ovary*** 0.8–1.3 cm long, narrowly sub-pyramidal, green; ***style*** 5.2–7.8 mm long; ***stigma*** conduplicate-spiral. ***Stamens*** external; ***filament*** 2.1–2.6 cm long; ***anthers*** yellowish. ***Fruits*** capsule type, 1.6–2.7 cm long, dark green when immature, brownish-black when ripe. ***Seeds*** 2–4 mm long, sickle wings present.

Figure 2. *Encholirium spectabile*. A) Habitat. B) Individual with inflorescence. C) Inflorescence with buds and flowers open in the basal portion. D) Inflorescence with fruits. E) Detail of inflorescence. F) Upper peduncle bracts. G) Floral bracts. H) Flower. I) Gynoecium. J) Conduplicate-spiral type stigma. K) Ovary cross-section. L) Androecium. M) Petals. N) Sepals. O) Ripe fruit. P) Seeds. Bars: C-D = 7 cm; E = 3 cm; F-H, L-O = 1 cm; I, K = 0.5 cm; J = 0.2 cm; P = 0.3 cm. Photos: AP) E.H. Souza.

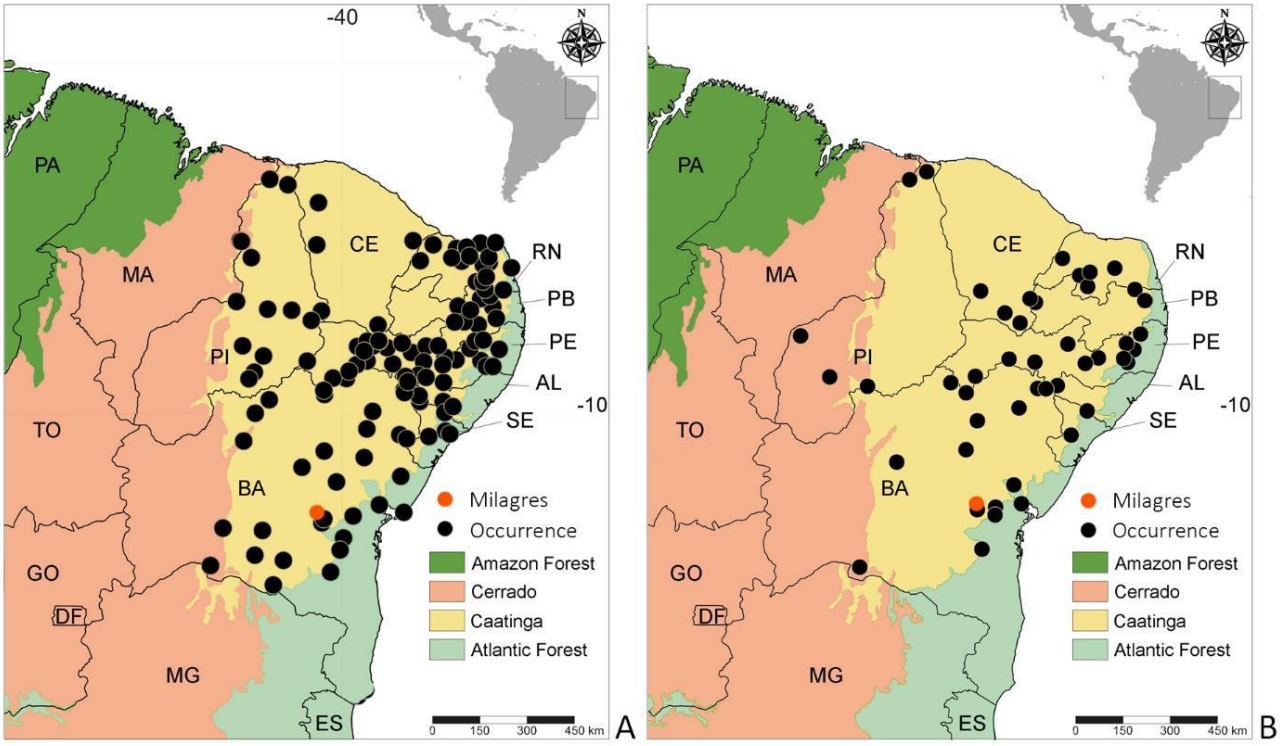


Distribution and habitat

Bromelia laciniosa and *E. spectabile* are endemic to the Northeast of Brazil, occurring mainly in the Caatinga domain or in ecotones with the Atlantic Forest and Cerrado or in restinga areas (Figure 3). Both species are well distributed throughout the region, with several collection points (Figure 3). The state of Maranhão is the only one that has few collections of both species, occurring at the border of the state (Figure 3), possibly due to the predominance of Cerrado vegetation and few areas of Caatinga.

Bromelia laciniosa is a terrestrial species occurring in rocky outcrops, where organic matter is found, whereas *Encholirium spectabile* is a rupicolous species.

Figure 3. Distribution map of *Bromelia laciniosa* (A) and *Encholirium spectabile* (B) based on data from exsiccates available in virtual herbariums.



Phenology

The flowering of *Bromelia laciniosa* occurs mainly between the months of February and April, with fruiting between March and September. *Encholirium spectabile* blooms almost all year, with peak flowering in the months of November and December and from June to July and the fruiting period between the months of March and August.

Taxonomic Comments

Bromelia laciniosa is synonymous with *Agallostachys laciniosus* (Mart. ex Schult. & Schult.f.) K.Koch (MONTEIRO, 2020). This species has long stolons as a form of asexual reproduction, serrated leaves with antrorse or rarely retrorse spines along the leaf blade, green, silvery green, and in flowering, the

central leaves become pink or reddish-pink. The inflorescence is pedunculated, pink or reddish-pink, 15–38 cm long (Figure 1C-D). The flowers are numerous (Figure 1C-D), with pink or whitish-lepidote sepals and acute apex (Figure 1N). The petals are pink to vinaceous with whitish margins and base (Figure 1G, M). The fruits are pilose and have an intense sweet odor when ripe and turn yellow.

Encholirium spectabile can be recognized for its strictly rupicolous habit, forming large clumps on the rocky outcrops. This species is the morphologically most variable and widely distributed species. The leaves are strongly hirsute and have an orbicular rosette. The inflorescence is racemous, cylindrical in shape, with many flowers (Figure 2B-C). The peduncle is long and reach almost 2 meters in length. Because of this, the species is known as "macambira-de-flecha".

Over the years, many published names are here synonymized under *Encholirium spectabile* [*E. bahianum* L.B.Sm. & R.W.Read, *E. densiflorum* Ule, *E. harleyi* L.B.Sm. & R.W.Read, *E. hoehneanum* L.B.Sm., *E. lutzii* L.B.Sm., *E. paraibae* L.B.Sm. & R.W. Read, *E. patens* L.B.Sm., *E. pernambucanum* L.B.Sm. & R.W. Read, *E. rupestre* Ule, *Dyckia spectabilis* (Mart. ex Schult. & Schult.f.) Baker and *Puya saxatilis* Mart.] (FORZZA, 2020). Forzza (2005) reported that all published names over the years for the "complex *spectabile*" were described based on characteristics frequently used in the taxonomy of the genus. However, these descriptions were based on only one material that was often found at the end of flowering, floral bud, or even in fruit (FORZZA, 2005). Due to the significant variability, Forzza (2005) suggested the maintenance of a one species, with remarkable morphologic variable occurring throughout the domain of the Caatinga.

Potentials and Uses

Both species have been reported for different uses in rural communities, ranging from ornamental plants to hedge. The use of hedges on the sides of highways is mainly to prevent erosion since its root is of the fasciculate type, making soil erosion difficult (BESSA, 1982; LIMA, 1996; ANGELIM *et al.*, 2007).

The *sertanejos* used to burn both species and use them providing as food resource for cattle (BESSA, 1982; LIMA, 1996; NUNES *et al.*, 2015; 2016) or food resource for human consumption (NASCIMENTO *et al.*, 2012; JUVIK *et al.*, 2017), mainly in periods of vegetation suffering from drought. *B. laciniosa* leaves are rich in proteins (4.9%), starch (2.8%), and calcium (1.1%) (MANERA; NUNES, 2001). Farmers use the leaves as supplementary fodder for food (LIMA, 1996; ANGELIM *et al.*, 2007; SANTO *et al.*, 2012).

The Centro Vocacional de Tecnologia Fundo de Pasto (CVT Fundo de Pasto), sponsored by CNPq and implemented by Instituto Federal de Educação Ciência e Tecnologia Baiano (IF Baiano) and Escola Família Agrícola do Sertão, has used *B. laciniosa* in the composition of agro-ecosystems resilient to drought to food resource for herds (CARVALHO *et al.*, 2020). Also, the leaves are dried, crushed, and mixed in cooking in some communities (AGRA *et al.*, 2007). The base of the leaves of *E. spectabile* is the

edible part and rich in carbohydrates (28.7%), some proteins (0.7%), and lipids (0.8%) (NASCIMENTO *et al*., 2012). The flour made from dried leaves is also used to prepare a type of couscous, and from the base of its leaves, a dough is extracted, from which a type of bread is made (ANGELIM *et al*., 2007).

Both species have medicinal applications and pharmacological activities (PFIRTER *et al*., 1973; ALBUQUERQUE *et al*., 2007; AGRA *et al*., 2007; CARVALHO *et al*., 2010; OLIVEIRA-JÚNIOR *et al*., 2014) with the presence of flavonoids, tannins, saponins, steroids, and triterpenoids (RIBEIRO *et al*., 2006). Also ther is a study that demonstrates the existence of chemical compounds that have anticancer activities (LEWIS; HANSON, 1991).

Encholirium spectabile is also widely used as a raw material for the manufacture of handicrafts and utensils; for example, the long peduncle has been reported in the production of bottle stoppers, and the leaves are used in the extraction of natural fibers for the production of ropes, nets and local handicrafts (ROQUE; LOIOLA, 2013).

Encholirium spectabile has ecological relationship with vertebrates and invertebrates. Silva-Jorge *et al*. (2014) reported that *E. spectabile* provides shelter for a rare species of gecko (*Hemidactylus agrius* Vanzolini, 1978) in the Caatinga domain of Rio Grande do Norte State. Queiroz *et al*. (2016) studying the pollination system of the species, reported that bats are the main pollinators and that their flowers remain open during the day and night with continuous production of nectar.

Other curiosities

Due to importance of these species to the Northeast of Brazil, macambira is also reported in the visual arts so well exposed on the screens by Percy Lau in the Caatinga. Also, in literature, song lyrics, family surnames, people's nicknames, municipality names, villages, waterfalls, and a scientific journal.

The municipality of Macambira is located in the state of Sergipe (10º39'5" S and 37º32'27" W, 282 m) with 137.4 km² and an estimated population of 6,230 inhabitants. Macambira has four districts: Ipueiras, Santana, São Gonçalo, and Várzea (PMM, 2021). This municipality also has a waterfall that bears the same name and, on June 9, 2020, the Macambira waterfall was recognized as the Intangible Cultural Heritage of the State of Sergipe (ALESE, 2020). It was also a battle that involved the Lampião gang in Ceará territory in 1927 (COUTINHO, 2014).

In the book "Os Sertões" (1902), Euclides da Cunha narrates the Canudos blattle (1896 - 1897). When presenting the landscape, the Caatinga, the battles in the hinterland of Bahia, it refers to the macambira many times. There are family surname records that already lived in Canudos before the arrival of Antônio Conselheiro; he designated a deadly battle in a valley of the Macambira stream, a tributary of the Vaza-Barris river. The plant is called "respected" by "inextricable clumps", leaves as a sword that left the soldier's uniforms, soldiers in Canudos, which defeated left the tatters of his clothes on "feline claws"

of macambira Also described: *"No pino dos verões, um pé de macambira é para o matuto sequioso um copo d'água cristalina e pura"* and food resource for cattle:

> *[...] Incendeia-os, batendo o isqueiro nas acendalhas das folhas ressequidas para os despir, em combustão rápida, dos espinhos. [...] vêem-se, correndo de todos os lados, em tropel moroso de estropeados, os magros bois famintos, em busca do último repasto (CUNHA, 1902, p. 58).*

The classic forró by Petrúcio Amorim, eternalized in the voice of Flávio José: Tareco and Mariola mentions the macambira "*Só que eu nasci entre o velame e a macambira*" (Flávio José & Petrúcio Amorim, YouTube).

Finally, Revista Macambira is a semiannual scientific journal created in 2017 by the Laboratory of Public Policies, Ruralities, and Territorial Development, a research group of the Instituto Federal de Educação Ciência e Tecnologia Baiano (IF Baiano). It aims to promote the production of original scientific research focused on the following themes: Agroecology, Rural Education, Education in Agroecology, Environmental Education, Education and Work, Education and Diversity, Public Policies, Agrarian Studies, and Peasant Identity, Solidarity Economy and Development, and related topics.

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