

Bonamia minima (Convolvulaceae): a new species from Brazil, with notes on leaf anatomy and pollen morphology

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Abstract: A new species of Convolvulaceae, *Bonamia minima* A.L.C. Moreira & Faria, is described and illustrated based on a collection made in 2012 from a region of high diversity in the Central Plateau of Brazil, in campo rupestre. The new species is most similar to *B. austinii* A.L.C. Moreira & Sim.-Bianch., the only congener with which it shares the combination of sericeous indumentum and bifurcate trichomes on the leaves. It can be distinguished from this species mainly by characteristics of the gynoecium, presenting a completely glabrous ovary. Details of its habitat, distribution, phenology, conservation status, and micromorphological aspects of the leaf and pollen are provided, along with a comparison to the most similar species.

Keywords: Campo rupestre, Cerrado, Neotropical biodiversity, Savannah, subshrub, Taxonomy

Introduction

Bonamia Thouars is a poorly understood and poorly defined genus of Convolvulaceae with approximately 70 species (POWO, 2025) of climbers and subshrubs found in North and South America, Africa, Madagascar, South and Southeast Asia, and Australia (Myint & Ward 1968, Staples 2012). In Brazil, there are eighteen species and two varieties of *Bonamia* recorded to date (Moreira *et al.* 2017, 2018, 2019a). They are distributed across the Atlantic Forest, Amazon Forest, Caatinga,

and especially in the Cerrado (Moreira & Simão-Bianchini 2020).

Previous taxonomic works have been performed by Verdcourt (1963, 1974), Myint and Ward (1968), Austin and Ghazanfar (1979), Austin and Cavalcante (1982), Austin and Staples (1985), Gonçalves (1987), and Breteler (1992). In these studies, the species of *Bonamia* were described as having free or partially free styles, non-acrescent sepals, dehiscent fruits, and ovate, obovate or ovate-cordate cotyledons. Regarding pollen morphology, *Bonamia* is clearly heterogeneous presenting at least two distinct pollen types (Hallier, 1897; Moreira *et al.*, 2019b). The sampling has so far been limited to a few species, and the circumscription of the genus has been subject to inconsistency over the years (Myint & Ward, 1968; Austin & Staples, 1985). Therefore, it is not surprising that studies suggest it is a polyphyletic group (Stefanovic *et al.*, 2002; Simões *et al.*, 2022). Since the nomenclatural revision has not yet been proposed, the new species in this study is treated as *Bonamia* as circumscribed by Myint and Ward (1968).

The specimens of *Bonamia* are rarely found in the herbaria and most are scarcely distributed in nature except for *B. agrostopolis* (Vell.) Hallier f. which has a wide distribution (Myint & Ward, 1968). Furthermore, the same authors noted that many

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species were described with a single specimen and are still only known from the type locality. This was also the case of a recently described species, *B. campestris* A.L.C. Moreira & Sim.-Bianch., from Tocantins, Brazil (Moreira *et al.*, 2017). The low number of collections and restricted distribution patterns are the main reasons why *Bonamia* is understudied (Myint & Ward, 1968).

Here, we describe and illustrate a new species of *Bonamia* currently known only from type location. Additionally, we provide notes on its habitat, distribution, phenology, conservation status assessment and micromorphological characteristics of leaf and pollen, as well as a comparison with similar species.

Methods and Materials

Morphology, distribution and conservation assessment

The present work is based on an herbarium specimen deposited in HEPH. Collections of specimens deposited at UB were also used to compare the closest species (acronym according to Thiers, 2025, continuously updated). Morphological characters of the specimens were analyzed with a 10–60 magnification Leica stereomicroscope (EZ4D), and the structures were photographed using the *Leica Application Suite EZ* software, version 1.6.0. The terminology used to describe flat or two-dimensional shapes follows Hickey (1988), and the terms referring to trichomes were adopted from Radford *et al.* (1974). The distribution map was produced with QGIS version 2.16.0 (QGIS Development Team, 2016). The IUCN Red List Categories and Criteria (IUCN, 2012) were followed to suggest the conservation status of the species.

Leaf anatomy

Fully developed leaves were subjected to herborization reversion process according to the protocols described by Smith and Smith (1942) and Meira and Martins (2003). The samples were embedded in methacrylate, sectioned using a rotary microtome, and stained with Toluidine

Blue (O'Brien *et al.*, 1964). Permanent slides were prepared and subsequently analyzed, and photographed under a light microscope.

Pollen morphology

The Scanning Electron Microscopy (SEM) analyses were performed with the pollen grains previously acetolyzed under ascending alcoholic series (50%, 70%, 80%, 90% and 100% ethanol). The preparation containing the pollen grains was dripped directly on the stubs, which after completely drying was sputtered with gold under high vacuum, in a camera of pulverization Blazers 050 SCD, and inserted in Scanning Electron Microscope MEV JSM-7100F for subsequent analysis. The descriptions follow Punt *et al.* (2007).

Taxonomic treatment

Bonamia minima A.L.C. Moreira & Faria, *sp. nov.*

Fig. 1.

Closely related to *B. austinii* A.L.C. Moreira & Sim.-Bianch. (Moreira *et al.* 2018) (Fig. 2, 3) by presenting short elliptic petiolate leaf and axillary inflorescence with white corolla but differing by its glabrous ovary, style with equal size and stigma fully globose. *Bonamia austinii* has an ovary with a hairy apex, styles of different sizes and globose to reniform stigmas.

Type: BRAZIL, Distrito Federal, Sobradinho dos Melos, 10.10.2012, *F.J. Carvalho, H. Moreira & M.R.V. Zanatta* 152 (holotype, HEPH!).

Perennial subshrubs, *c.* 17 cm high; stems tomentose on younger parts, bifurcate trichomes, brownish; internodes 0.2–0.9 cm long. Leaves alternate; petiole 1.5–2 mm long, tomentose; lamina narrow-elliptic, 0.8–2.2 × 0.2–0.7 cm, 3–4.3 times longer than wide, base attenuate, apex acuminate, coriaceous, adaxially sericeous, abaxially densely sericeous; venation camptodromous, midvein pilose on both sides, adaxially plane to impressed, abaxially raised, lateral veins 4–6, not visible adaxially, barely visible abaxially. Flower bud fusiform, tomentose

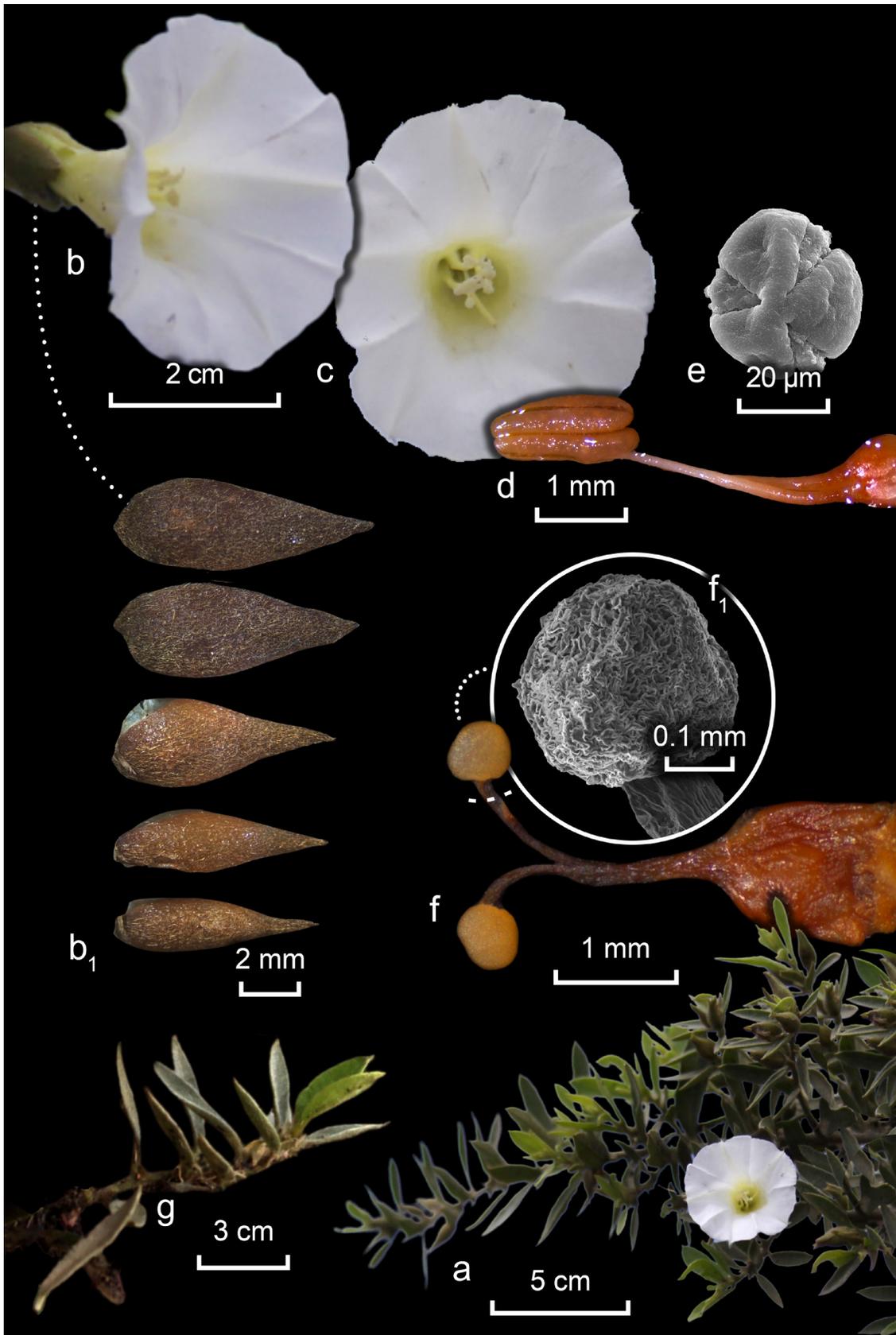


Fig. 1. *Bonamia minima* A.L.C. Moreira & Faria sp. nov.: **a.** Habit; **b.** Flower—lateral view; **b1.** Sepals; **c.** Flower—frontal view; **d.** Stamen; **e.** Polar view of pollen grain (SEM); **f.** Style; **f1.** Stigma under scanning electron microscopy; **g.** Branch (Photos by H. Moreira. (A, B, C e G; Designed by JV).

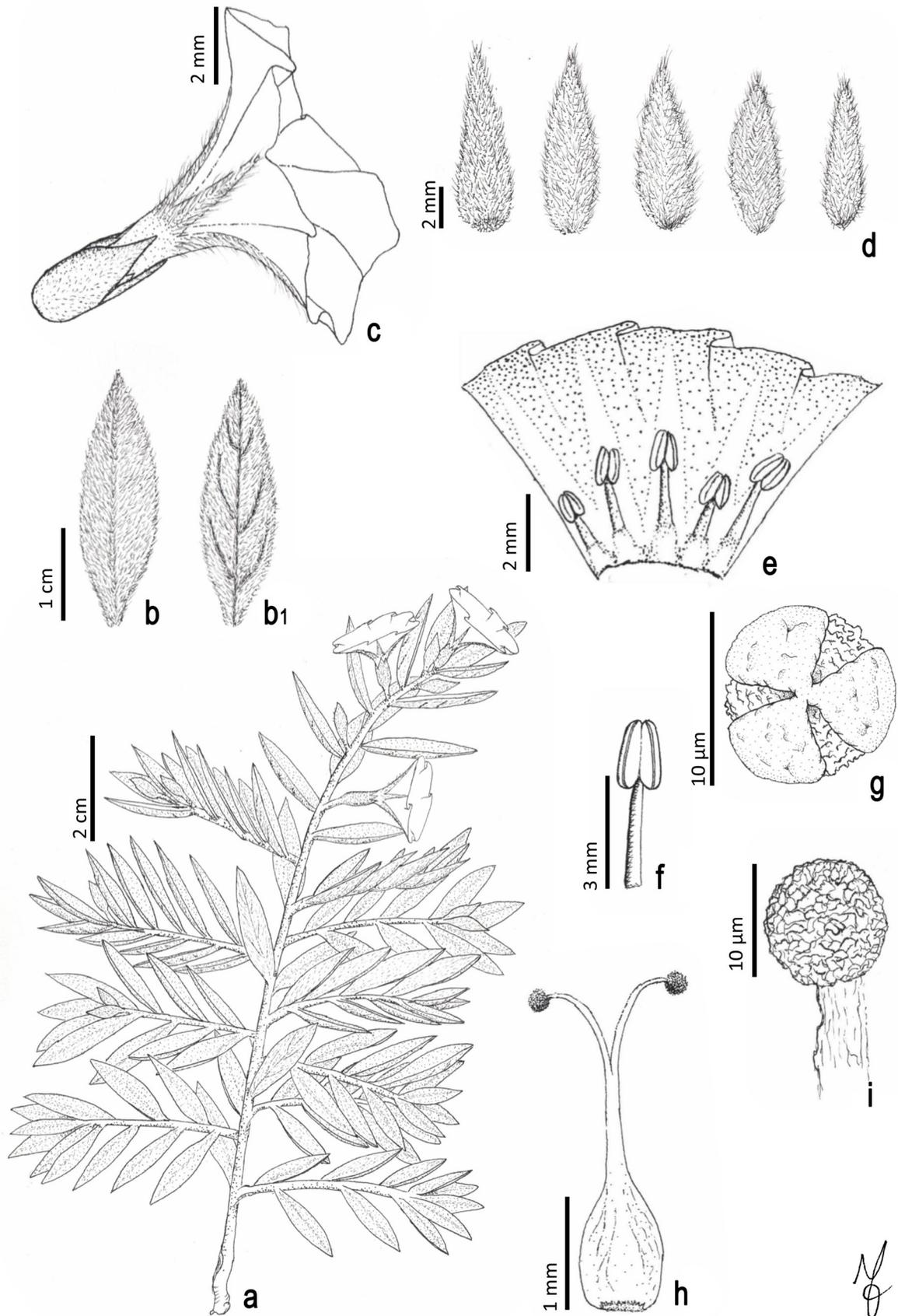


Fig. 2. *Bonamia minima* A.L.C. Moreira & Faria sp. nov.: **a**. Habit; **b**. Leaf–adaxial surface; **b1**. Leaf–abaxial surface; **c**. Flower–lateral view; **d**. Sepals; **e**. Corolla with stamen, longitudinal section; **f**. Stamen; **g**. Pollen grain; **h**. Gynoecium; **i**. Stigma (drawn from the holotype by MC)

with simple trichomes, 0.3–0.5 mm long; solitary flowers to dichasial cyme congested at the apex of the branches of 1–3 flowers, axillary, congested in the terminal portions of the rachis; peduncle 1–3 mm long, sparsely tomentose; bracts linear, usually longer than the peduncle, 1.6–2.9 mm long, tomentose, persistent in flowers. Sepals 5, lanceolate, apex acute, the two outer ones 7.9–8 × 2.9–3.3 mm, the inner ones 6.1–6.5 × 1.8–2.8 mm, tomentose, margins entire. Corolla infundibuliform, white, mid-petaline bands with simple and adpressed trichomes. Stamens 5, unequal, 3 longer, 4.3–5.2 mm long, and 2 shorter, *c.* 3.4 mm long; anthers cream-coloured, 2.3 mm long; pollen 3-colpate, apertural; ectexina perforate with small granule regularly scattered, membrane ornamented with small spiny ubisch bodies. Ovary globose, glabrous, style bifurcate, *c.* 10.2 mm in total length, *c.* 6.1 mm long until the bifurcation, after bifurcation *c.* 4.1 mm long, each one with a globose stigma. Fruit not seen.

Flowering and fruiting: Flowering material were collected in October. The fruiting period is unknown.

Distribution and habitat: As far as we are aware, *Bonamia minima* is exclusively found in areas of *campo rupestre* (rupestrian grasslands) in the northern region of the Distrito Federal (Fig. 4), within the Central Plateau of Brazil, in the Cerrado biome. The *campo rupestre* is characterized by predominantly herbaceous-shrub vegetation, with occasionally small, stunted trees. This phytophysiognomy occurs in a mosaic of microreliefs with exposed rocky outcrops, where species adapted to nutrient-poor, acidic soils thrive. These soils are typically shallow, with low water retention capacity, causing rapid drainage of rainwater into nearby streams and rivers (Ribeiro & Walter, 2008). The habitat of *B. minima* is situated at an altitude of approximately 1,200 m, within a transitional climatic zone that includes both Aw (tropical savanna with a dry winter) and Cwa (subtropical with a dry winter

and hot summer) climates, according to Köppen's classification. The land use in this region includes a mosaic of natural vegetation, rocky outcrops, and areas modified for agriculture, pasture, and urban development. While the *campo rupestre* remains largely associated with rocky formations and nutrient-poor soils, surrounding areas have been increasingly utilized for human activities, leading to a fragmented landscape where native vegetation coexists with cultivated fields, infrastructure and expanding settlements. Notably, there are no nearby conservation units, which intensifies the species vulnerability and highlights its immediate risk of extinction.

Etymology: The specific epithet *minima*, derived from the Latin *minimus*, refers to the small size of the plant compared to other species of the genus. Its total size does not exceed 20 cm in height, with its delicate leaves measuring approximately 2.2 cm.

Conservation status: *Bonamia minima* has not yet been evaluated against the IUCN (2012) criteria due to the limited knowledge of its distribution as only the type collection is known. However, *B. minima* is likely at great risk of extinction once the location where the type specimen was collected is near the administrative region of Paranoá, an urban center undergoing rapid expansion. Satellite images from 2012 and 2024 reveal significant landscape transformations in the area, including a marked increase in urban development, road expansion and fragmentation of native vegetation. The images indicate that previously continuous vegetation patches have been replaced by new residential areas, agricultural fields and infrastructure, leading to habitat loss and increased environmental pressures. Furthermore, we have been unsuccessful to recover the type population, at different times of the year, despite numerous attempts. Given the lack of sufficient data on its population size, distribution, and ecological requirements, we recommend that *B. minima* be classified as Data Deficient (DD) under the IUCN criteria.

Notes: The size of the single plant sampled does not exceed 20 cm in height, yet it was certainly in the adult stage, which is marked by the presence of a woody base and flowers in full anthesis, including opened anthers with pollen grains. Samples of *B. minima* and *B. austinii* were recently included in a molecular phylogeny of the genus (in prep. Moreira *et al.*), where the two similar species emerged as sister taxa and allied to a group composed of other species from the *Cerrado*. Unlike *Bonamia minima*, *B. austinii* is a subshrub, with erect to decumbent branches, greenish to ferruginous, internodes 0.8-2 cm long, and a hairy ovary. Comparative morphological characteristics of *Bonamia minima* and other species of the genus are presented in Table 1.

Identification key for species related to *Bonamia minima*

- 1. Ovary glabrous 2
- 1. Ovary fully or partially pilose 3
- 2. Branches glabrous; inflorescences in a terminal glomerule-like, flowers lilac *B. campestris*

- 2'. Branches tomentose; inflorescences in an axillary cyme, flowers white *B. minima*
- 3. Stems sericeous; sepals oval and concave *B. sericea*
- 3'. Stems tomentose; sepals lanceolate and plane ... 4
- 4. Ovary pilose only at the apex; seeds brown *B. austinii*
- 4'. Ovary fully pilose; seeds black *B. krapovickasii*

Leaf anatomy

In frontal view, epidermal cells are polygonal with various shapes and sizes, having straight anticlinal walls on both surfaces (Fig. 4a & b). Leaves amphistomatic, with anisocytic stomata (Fig. 4a). Trichomes are found on both sides of the leaf (Fig. 4a & b). They are non-glandular of two morphological types: simple (unicellular, straight/elongated -Fig. 4c, g, j) or bifurcate (“Y-shaped” - Fig. 4d & e). In cross-section, the stomata are located at the same level as the other epidermal cells and delimit small substomatal chambers (Fig. 4e & f).

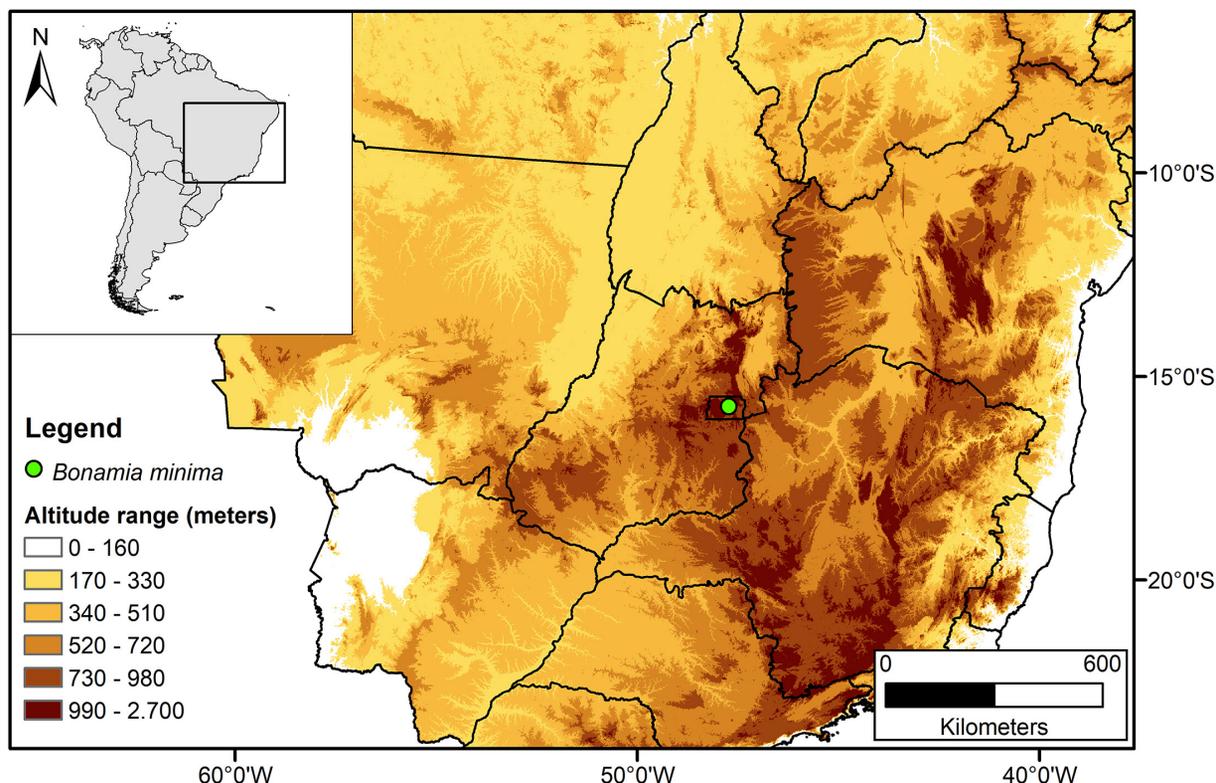


Fig. 3. Distribution map of *Bonamia minima* A.L.C. Moreira & Faria sp. nov.

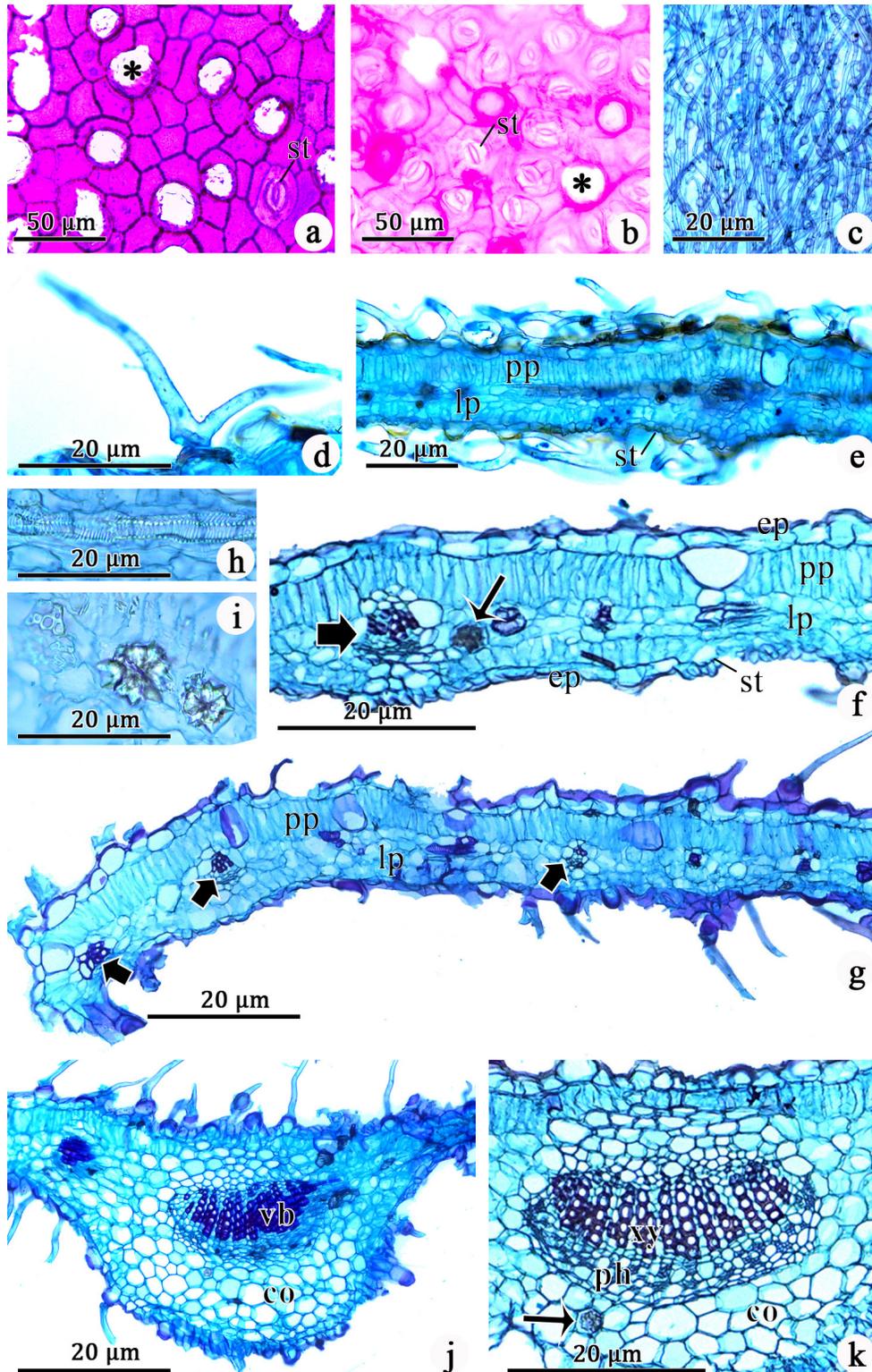


Fig. 4. Leaf anatomy of *Bonamia minima* A.L.C. Moreira & Faria sp. nov. **a.** Adaxial surface showing polygonal cells with straight anticlinal walls, anisocytic stomata and basal cells of trichomes (asterisks); **b.** Abaxial surface; **c.** Trichomes on adaxial surface; **d.** Detail of "Y-shaped" non-glandular trichome. **e.** Cross-section of lamina showing trichomes on both surfaces; **f.** Dorsiventral mesophyll showing the epidermis, palisade and lacunose parenchyma, stomata with small substomatal chamber, vascular bundle and druse. **g.** Leaf margin. Notice larger epidermal cells on the adaxial surface and distribution of vascular bundles along the lacunose parenchyma; **h.** Detail of a vessel with scalariform wall thickening; **i.** Druses in the mesophyll; **j.** General view of the prominent midrib showing trichomes on both surfaces, cortical parenchyma and a single vascular bundle; **k.** Detail of the vascular bundle on the midrib showing primary xylem and primary phloem (* – basal cells of trichomes, **co** – cortex, **ep** – epidermis, **lp** – lacunose parenchyma, **pp** – palisade parenchyma, **ph** – primary phloem, **st** – stomata, thick arrow – vascular bundles, thin arrow – druses, **vb** – vascular bundle, **xy** – primary xylem).

Epidermal cells are covered by an evident cuticle on both surfaces (Fig. 4f & g). The epidermal cells vary from oval to flattened, with the cells on the abaxial surface being relatively smaller than those on the adaxial side (Fig. 4f & g). The mesophyll is dorsiventral consisting of a single layer of elongated cells forming the palisade parenchyma in the adaxial surface, and three to four layers of smaller and round cells occupying the lower half portion of the mesophyll (Fig. 4e–g). Druses are observed in the lacunose parenchyma (Fig. 4f, i).

The vascular system in the leaf blade is composed of relatively small bundles immersed in the middle of the mesophyll (Fig. 4f & g). Vessel elements show annular or scalariform wall thickenings (Fig. 4h). The midrib is prominent, forming a greater curvature on the abaxial surface and a flat outline on the adaxial surface (Fig. 4j).

The midrib shows non-glandular trichomes on both surfaces (Fig. 4j). The cortex is formed by isodiametric parenchymatic cells, some of which contain druses (Fig. 4j & k). The vascular system

Table 1. Comparison of *Bonamia minima* with other similar *Bonamia* species with prostrate to erect habit, narrow leaves, and sessile flowers.

Characters	<i>B. krapovickasii</i> A.L.C. Moreira & Sim.-Bianch.	<i>B. campestris</i> A.L.C. Moreira & Sim.-Bianch.	<i>B. sericea</i> (Griseb.) Hallier f.	<i>B. austinii</i> A.L.C. Moreira & Sim.-Bianch.	<i>B. minima</i> A.L.C. Moreira & Faria
Stem color and indumentum	Yellowish to ferruginous/tomentose	Brown/ glabrous	Yellowish/ sericeous	Greenish to ferruginous/tomentose	Yellowish or brownish/tomentose or glabrescent
Leaf shapes	Elliptic, base cuneate to rounded, apex rounded	Elliptic, base rounded, rarely truncate or cordate, apex obtuse, mucronate	Elliptic, elliptic-lanceolate or elliptic-ovate, base acute or attenuate, apex obtuse to acute	Elliptic to narrowly elliptic, base cuneate to rounded, apex acute to rounded	Narrow-elliptic, base attenuate, apex acuminate
Sepals shape and vestiture	Lanceolate/pilose	Obovate / glabrous	Ovate-acuminate, concave/pubescent	Lanceolate/tomentose	Lanceolate/tomentose; apex acute
Inflorescence type and number of flowers	Axillary cymes, dichasial of 1–5 flowers	Terminal, glomeruliform with c. 20 flowers	Axillary cymes, dichasial of 2–3 flowers	Axillary cymes, dichasial of 1–3 flowers	Axillary cymes, dichasial of 1–3 flowers
Corolla color	White	Lilac	White	White	White
Ovary indumentum	Pilose	Glabrous	Pilose only at the apex	Pilose only at the apex	Glabrous
Seed color	Black	Brown	Black	Brown	Not seen

is characterized by a single vascular bundle (Fig. 4j & k). The vessel elements are organized in radial rows intermingled with rows of parenchymatic cells, while the sieve-tube elements are diffuse or diffuse in aggregate and associated with larger parenchymatic cells (Fig. 4k).

Anatomical notes

Unlike other genera of Convolvulaceae (e.g., *Ipomoea*, *Merremia* (*Distimake* and *Camonea*), *Stictocardia* – Leite, 2001; Martins *et al.*, 2011; Olanon *et al.*, 2018) and other *Bonamia* species (e.g., *B. ferruginea* – Silva, 2004) that shows a glandular or a mixture of glandular and non-glandular trichomes, only non-glandular trichomes were observed in *B. minima*. Besides this variation in indumentum, secretory structures may also have taxonomic significance in the genus since laticifers were reported in *B. ferruginea* (Silva, 2004) but not observed in our anatomical sections of *B. minima*. Most other anatomical features observed in *B. minima* are similar to *B. ferruginea* and other taxa within Convolvulaceae (Paes & Mendonça, 2008). In Convolvulaceae, leaf anatomical characters have been explored in several studies (Austin & Staples, 1985; Leite, 2001; Traiperm *et al.*, 2017; Chitchak *et al.*, 2018). The diversity and distribution of trichomes and secretory structures (e.g., laticifers, crystals) are frequently found to have taxonomic value, as also demonstrated in this study. Nevertheless, additional anatomical investigations of *Bonamia* species are necessary to further explore if there are specific anatomical traits with taxonomic significance for the genus.

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