

Two new species of *Sinningia* (Gesneriaceae) endemic to Bahia, Brazil

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Abstract

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Two new species of *Sinningia* Nees (Gesneriaceae) occurring in the state of Bahia in northeastern Brazil are described and illustrated, i.e., *S. ganevii* Chautems & Mat. Perret and *S. sulphurea* Chautems & D.B.O.S. Cardoso. *Sinningia ganevii* is unique within the genus by its tubular-campanulate and light purple corollas borne in the upper axils of erect stems 20–60 cm long. *Sinningia sulphurea* is characterized by pale yellow corollas borne on short axillary pedicels arising from an erect stem. Both species are illustrated, featured with photographs and distribution map, and their IUCN conservation status assessed. Morphological features and pollination syndromes are discussed based on recent phylogenetic studies on the subtribe *Ligeriinae*.

Keywords

GESNERIACEAE – LIGERIINAE – Neotropical flora – Atlantic forest – Biodiversity – Taxonomy

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Introduction

Sinningia Nees is the fourth largest genus of the subfamily Gesnerioideae, which contains 77 genera and 1200+ species, mainly distributed in the New World (CLARK et al., 2020). The genus *Sinningia* is classified in the monophyletic tribe Gesnerieae and subtribe Ligeriinae (WEBER et al., 2013; OGUTCEN et al., 2021). It is characterized by a wide range of growth forms from minute rosette-like plants to subshrubs usually found growing on rocky substrate in shady and humid environments. Most species are characterized by having perennial tubers, annual flowering shoots, and axillary or terminal inflorescences (CHAUTEMS & WEBER, 1999). Corolla shapes range from tubular, funnel or campanulate with regular or bilabiate lobes and colors vary from white, purple, orange, red or pink. The broad variation in flower morphology matches the different pollination syndromes for bees, hummingbirds or bats that evolved repeatedly during the radiation of this group (PERRET et al., 2003, 2007).

Among the 76 species currently recognized in the genus *Sinningia*, 65 are endemic to Brazil (BFG, 2015; ARAUJO et al., 2020). The center of diversity of *Sinningia* is the rain- and semi-deciduous forests of the Atlantic Forest domain in the states of Paraná (18 spp.), São Paulo (25 spp.), Minas Gerais (21 spp.), Rio de Janeiro (29 spp.) and Espírito Santo (20 spp.) (PERRET et al., 2006; ARAUJO et al., 2020). With nine species recorded, the Bahia State in northeastern Brazil harbors a lower number of *Sinningia* species that are mainly restricted to the coastal stretch of humid forest in the southern part of the state (CHAUTEMS, 1991a). Only few species are known to occur in the mountains of central Bahia. *Sinningia harleyi* Wiehler & Chautems, for example, is endemic to the campo rupestre vegetation of the Chapada Diamantina, a northern extension of the Espinhaço Range from Minas Gerais (CHAUTEMS, 1991b). In addition, *S. barbata* (Nees & Mart.) G. Nicholson and a species pending to be identified, have been recorded in the Serra do Orobó, an isolated mountain range located east to the Chapada Diamantina (CARDOSO & QUEIROZ, 2008). However, the floristic diversity of these mountain ranges is understudied as suggested by the recent descriptions and discoveries of several new species in plant families such as *Araceae*, *Begoniaceae*, *Fabaceae*, *Melastomataceae*, *Ochnaceae* or *Rubiaceae* (HAIG et al., 2011; SALAS & CABRAL, 2012; SANTOS et al., 2013; SOUZA et al., 2014; CARDOSO & HARLEY, 2015; GREGÓRIO et al., 2015; ROMERO & WOODGYER, 2018). To further explore the *Gesneriaceae* diversity in central Bahia State, we revised specimens from the herbaria G, HUEFS, SPF, UESC and US. The review of this material and subsequent field work has resulted in the identification of two *Sinningia* species in need of description; one endemic to a small portion of the Chapada Diamantina and the other restricted to the Serra do Orobó. With such additions, the genus *Sinningia* contains so far 78 species.

Taxonomy

Sinningia ganevii Chautems & Mat. Perret, **sp. nov.** (Fig. 1, 3).

Holotypus: BRAZIL. Bahia: Abaira, distrito de Catolés, sítio Palmeiras, Serra do Porco Gordo, 13°23'S 41°46'W, 25.IV.1992, fl., *Ganev 206* (SPF [SPF88316]!; iso-: HUEFS-10649!, US [US00590762]!).

Species with habit very similar to Sinningia harleyi Wiehler & Chautems, but differing by the presence of a short peduncle at the base of the cymes (0.4–0.5 cm long) and by having purple, tubular-campanulate corollas (vs. peduncle absent and bright red, tubular corollas in *S. harleyi*).

Herb 20–60 cm tall, arising from perennial, irregularly-shaped tuber, 1–4 cm in diam., saxicolous; stems 3–5 mm in diam., usually unbranched, greenish to vinaceous, pubescent with glandulous trichomes, internodes 1.5–8 cm long. *Leaves* 4–9 pairs, decussate, equal or slightly anisophyllous; petiole 1.5–3 cm long, green to reddish, pubescent with glandulous trichomes; blade 2.5–6.5(–11) × 1.8–4(–7) cm, ovate, apex acute, base rounded to subcordate, margin distinctly crenate to nearly dentate, membranaceous, green and puberulous with glandular trichomes above, paler and puberulous with glandular trichomes between the nerves, but pubescent on the nerves beneath, 6–9 pairs of lateral veins. *Inflorescence* frondose, composed of cymes reduced to 1 (rarely 2) flowers, arranged in opposite pairs in the apical 3–9 leaf axils. *Flowers* borne on a short peduncle, 0.4–0.5 cm long, with 2 bracts 0.4 × 0.2 cm at the base of a single, rarely 2, ascending pedicel, 1.3–1.8 cm long. *Calyx* campanulate, fused at base along 2–3 mm, lobes 7–9 mm long, lanceolate, c. 3 mm wide at base, margin entire, green, glandular pubescent. *Corolla* yellowish during bud stage, tubular-campanulate at anthesis, erect in calyx (i.e. aligned with axis of calyx), 3.5–4 cm long, 0.4–0.5 cm in diam. at base, tube 1–1.2 cm wide, dorsal side slightly arcuate, ventral side gradually expanding, light purple for most part, dark purple on the lobes inside, pubescent, lobes subequal, entire, 5–6 × 8–9 mm, patent to slightly revolute, throat cream to light violet with darker lines or fine dots or cream with pink dots. *Stamens* 4, included, filaments 1.5–1.8 cm long, white, glabrous, anthers coherent forming a rectangle, pollen cream, nectary composed of 5 whitish glands, the 2 dorsal ones fused at base, staminode greenish. *Gynoeceum* with a greenish ovary, style included, 1.5–2 cm, white, puberulous. *Fruit* a dry capsule, 8–10 × 0.5 mm; seeds ellipsoid, c. 0.5 mm long.

Etymology. – The species is named after Wilson Ganev, guide to the Catolés collaborative research expedition between K, SPF and HUEFS (1991/1992) and plant collector in the Chapada Diamantina; his activities were supported by the Royal Botanical Gardens, Kew and the University of São Paulo.

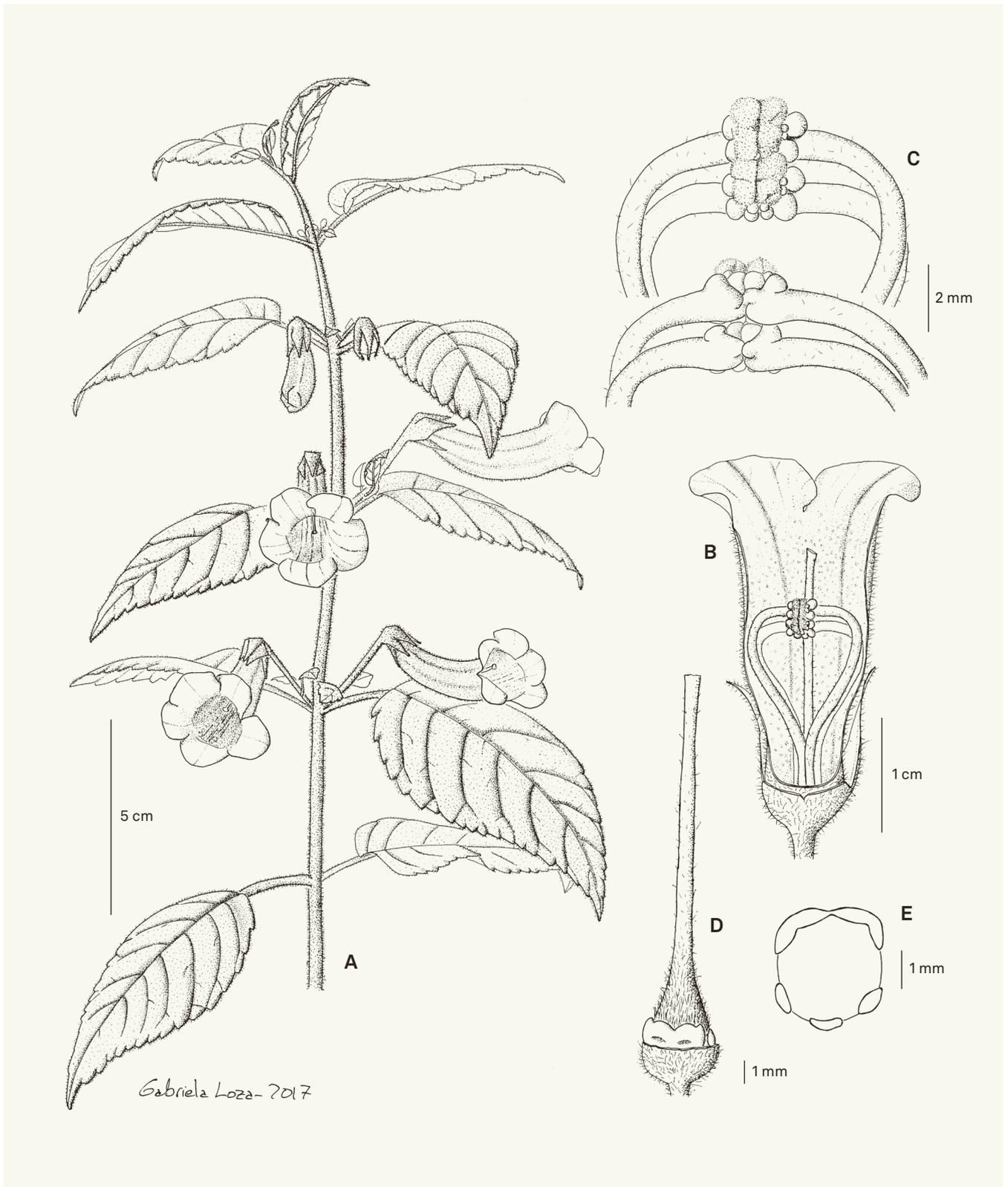


Fig. 1. – *Sinningia ganeyii* Chautems & Mat. Perret. **A.** Habit, flowering stage; **B.** Longitudinal cut of corolla showing androecium and gynoecium; **C.** Ventral and dorsal view of coherent anthers; **D.** Ovary and nectary, corolla removed; **E.** Schematic arrangement of the nectary glands. [Chautems 550, G] [Drawing: G. Loza]

Distribution and ecology. – *Sinningia ganevii* is known only from two locations in the district of Catolés within the municipality of Abaíra (578 km²), which is part of the massif Chapada Diamantina in Bahia State (Fig. 2). Scattered individuals were found growing between 950 and c. 1300 m on rocky (quartz) soil of the campo rupestre vegetation.

Phenology. – Flowering specimens were collected in April and May.

Conservation status. – *Sinningia ganevii* has a geographic range in the form of an Extent of Occurrence of less than 5,000 km² and a minimum Area of Occupancy of less than 500 km². It is only known in little patches of campo rupestre vegetation threatened by fires and grazing. The protection of its habitat in the “Área de Proteção Ambiental Serra do Barbado” is not effective [<https://g1.globo.com/bahia/noticia/2013/10/incendio-atinge-areas-da-regiao-oeste-e-da-chapada-diamantina-na-bahia.html>]. The new species is therefore assigned a provisional status of “Endangered” [EN B1ab(i,ii,iii)+2ab(i,ii,iii)] using the IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – This species is very similar in habit and leaf shape to *Sinningia harleyi* (CHAUTEMS, 1991). Material collected in the 1990’s was identified and stored in the herbaria HUEFS, K and SPF under this name, however, a closer examination by the first author revealed the strikingly different corolla morphology (see diagnosis above). Preliminary phylogenetic results support a sister-group relationship between *S. ganevii* and *S. harleyi* and suggest a case of recent evolutionary transition between hummingbird for the latter and bee syndromes for *S. ganevii* (SERRANO-SERRANO et al., 2017: fig. S4). Based on the present distribution of the two species with occurrences registered at only a few km away, this speciation event may have happened in sympatry. So far, *S. ganevii* was found in a small area in the municipality of Abaíra at elevations between 900 and 1300 m, whereas *S. harleyi* occurs in a wider extension of the Chapada Diamantina including the municipalities of Abaíra, Jussiapé and Rio de Contas, at elevations between 900 and 1500 m (Fig. 2). The area around the locality of Catolés harbors a rich and poorly known flora as suggested by many recently described species in other families as detailed in the Introduction.

Additional specimens examined. – BRAZIL. Bahia: Abaíra, Riacho do Piçarrão de Osmar Campos, 13°23'S 41°48'W, 8.V.1994, *Ganev* 3229 (HUEFS, SPF, UESC, US); Abaíra, Distrito Catolés, Chemin de Arapiranga a Catolés, campo rupestre, 13°23'20"S 41°47'43"W, 956 m, 1.V.2012, *Perret et al.* 51 (G, VIES). [BRAZIL]: cultivated in CJBG from *Perret et al.* 51, 7.XI.2012, *Chautems* 550 (G).

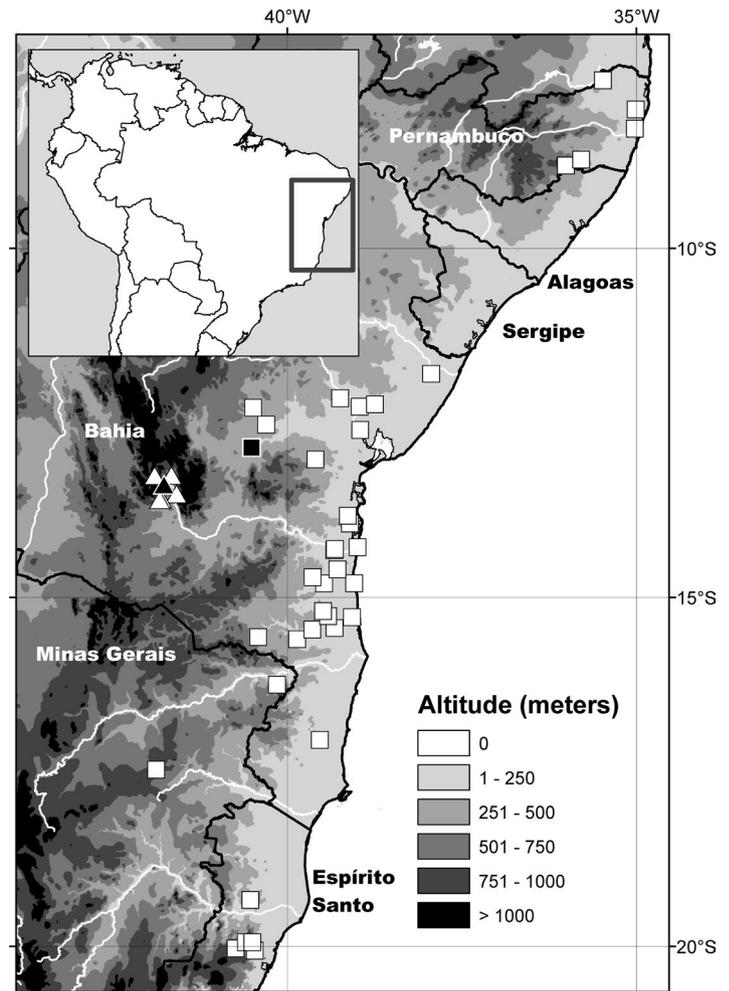


Fig. 2. – Distribution of *Sinningia ganevii* Chautems & Mat. Perret (black triangle) and *S. sulphurea* Chautems & D.B.O.S. Cardoso (black square), including their related species *S. harleyi* Wiehler & Chautems (white triangle) and *S. barbata* (Nees & Mart.) G. Nicholson (white square).

***Sinningia sulphurea* Chautems & D.B.O.S. Cardoso, sp. nov.** (Fig. 4).

Holotypus: BRAZIL. Bahia: Itaberaba, ARIE da Serra do Orobó, Fazenda Leão dos Brejos, 12°51'01"S 40°30'59"W, 398 m, 15.VII.2006, *Queiroz, Cardoso & Messias* 12277 (HUEFS-110686!; iso-: G [G00412505]!).

Sinningia sulphurea is morphologically related to *S. barbata* (Nees & Mart.) G. Nicholson, but differs by having numerous underground round tubers around 5 mm diam. (vs. a single tuberous base measuring 2–3 cm diam.), stem 15–32 cm tall (vs. 30–70 cm tall), crenate leaf margin (vs. serrate), pubescent calyx lobes (vs. glabrous), and yellow, tubular-campanulate corolla (vs. white, greenish or yellowish, tubular and strongly ventricose corolla).

Herb 15–32 cm tall, usually terrestrial, underground storage system with numerous round tubers, c. 5 mm diam.; stem



Fig. 3. – Image featuring the similar erect habit of *Sinningia ganevii* (left) and *S. harleyi* (right) and their distinct floral morphology corresponding to bee and hummingbird pollination syndrome, respectively.

[Cultivated in CJBG] [Photo: M. Perret]

semi-prostrate or erect, usually unbranched, greenish, densely pubescent, internodes 3–6 cm long. *Leaves* 3–7 pairs, decussate, isophyllous; petiole 2.5–5 cm long, green on both sides, with eglandular trichomes; lamina elliptic, base attenuate, apex obtuse, margin crenate, adaxially puberulous, abaxially shortly pubescent, 6–8 pairs of veins. *Inflorescence* frondose, composed of cymes composed of 1–3 flowers in the axils of the 1–4 upper leaf pairs. *Flowers* subtended on erect pedicels, 2.2–3 cm long, green, pubescent. *Calyx* campanulate, shortly fused at base, lobes 2.2–2.7 × 0.9–1.1 cm, broadly ovate, broadly cordate at base and winged at their junction, acuminate at apex, green, pubescent adaxially. *Corolla* obliquely inserted in the calyx, tubular-campanulate, ventricose, 3.5–4.9 cm long, outside yellow and pubescent, reddish trichomes toward the base of the tube, dorsally forming 2 longitudinal grooves, throat yellow with fine vinaceous streaks ventrally, lobes plain yellow, ventral one with diffuse vinaceous streaks at base. *Stamens* 4, included, filaments 2.2–2.8 cm long, anthers coherent by their apex and side, forming a rectangle, pollen white, nectary formed by 2 dorsal separate glands, c. 1.5 mm long. *Gynoecium* with a conical, densely pubescent ovary, style 2.6–2.8 cm long, puberulous, stigma stomatomorphic. *Fruit* a dry capsule, 1.3–1.6 cm long, greenish outside, dehiscent, the two valves opening 180° at maturity, cream inside; seeds spheroid-fusiform, c. 0.4 mm long, brown.

Etymology. – The name refers to the pale-yellow color of the corollas, an uncommon trait in the genus *Sinningia*.

Distribution and ecology. – *Sinningia sulphurea* is known only from a single location in the Serra do Orobó in the municipality of Itaberaba (Fig. 2). This mountain is considered as a side elevation somewhat isolated from the large range of Chapada Diamantina located to the west (CARDOSO & HARLEY, 2015). It culminates at 1,014 m. The Serra do Orobó mountain range lies within the Caatinga domain. Several vegetation types are found according to altitudinal gradients, with shrubby caatinga with palm trees commonly occurring at lower altitude, dry forest fragments dominating between 400 and 700 m, followed by submontane humid forest between 700 and 850 m and savanna-like vegetation or campo rupestre surrounding the mountain peak (CARDOSO & QUEIROZ, 2008). *Sinningia sulphurea* grows on the ground of forest fragments with trees up to 20 m tall. Populations of a few dozen individuals were observed growing among small rocks mixed with plant litter. The vegetation of the area was described as Seasonally Dry Tropical Forest by CARDOSO & QUEIROZ (2008).

Phenology. – Flowering specimens were collected in June and July.

Conservation status. – *Sinningia sulphurea* has a geographic range in the form of an Extent of Occurrence of less than 100 km² and its Area of Occupancy is estimated to be less than 10 km². It is known to exist at only a single location part of the protected area known as “ARIE (Área de Relevante Interesse Ecológico) Serra do Orobó”. Uncontrolled fires were recently reported in this locality despite its protection. The new species is therefore assigned a provisional status of “Critically Endangered” [CR B1ab(i,ii,iii)+2ab(i,ii,iii)] using the IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – Habit and floral morphology of *Sinningia sulphurea* are quite similar to *S. barbata* (Nees & Mart.) G. Nicholson. However, *S. sulphurea* differs in having underground storage system composed of numerous tiny spherical tubers (Fig. 4), a shorter habit, a denser indumentum on stem, leaves and calyx, and pale-yellow corollas that are not strongly ventricose and narrowed just below the lobes. Phylogenetic results based on the analyses of four DNA regions support a sister-group relationship between *S. sulphurea* and *S. barbata* (SERRANO-SERRANO et al., 2017: fig. S4). *Sinningia sulphurea* is restricted to the Serra do Orobó area, whereas *S. barbata* has a much wider distribution between the states of Espírito Santo and Pernambuco in the humid forest that are part of the Mata Atlântica domain (Fig. 2). In the Serra do Orobó, *S. sulphurea* is distributed in dry forest around 400 m, whereas *S. barbata* is registered in submontane humid forest above elevations of



Fig. 4. – *Sinningia sulphurea* Chautems & D.B.O.S. Cardoso. **A.** Habit in the wild; **B.** Flower close-up; **C.** Underground storage system with numerous round tubers; **D.** Holotype at HUEFS. [A: Cardoso et al. 2066; B: cultivated in CJBG] [Photos: A: Domingos Cardoso; B: M. Perret; C: M. Peixoto] [D: © Universidade Estadual de Feira de Santana, scanned in G]

700 m. The Serra do Orobó lies within the drier vegetation type belonging to the Caatinga domain where several endemics have recently been described (CARDOSO & HARLEY, 2015), but its summit is characterized by higher precipitation that facilitates the existence of a more humid forest (CARDOSO & QUEIROZ, 2008). The speciation event between *S. sulphurea* and *S. barbata* may have been favored by these contrasting climatic conditions.

Yellow colored corollas are found in a few other *Sinningia* species that do not occur in Bahia state and they differ by their rosette habit (*S. richii* Clayberg), the long pedicellate flowers (*S. conspicua* (Seem.) G. Nicholson) or the spicate inflorescence (*S. lutea* Buzatto & R.B. Singer, currently treated as a form of *S. allagophylla* (Mart.) Wiehler).

Additional specimen examined. – BRAZIL. Bahia: Município Itaberaba, ARIE da Serra do Orobó, Fazenda Leão dos Brejos, 12°51'01"S 40°30'59"W, 398 m, 16.VI.2007, Cardoso et al. 2066 (G, HUEFS).

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