

# NORDIC JOURNAL OF BOTANY

## Research article

### A new species of *Anthurium* (Araceae) from Mexico and resurrection of *Anthurium macdougallii*

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Nordic Journal of Botany

2022: e03737

doi: [10.1111/njb.03737](https://doi.org/10.1111/njb.03737)

Subject Editor and  
Editor-in-Chief: Torbjörn Tyler  
Accepted 7 November 2022  
Published 30 December 2022

*Anthurium hentricianum* Díaz Jim., Pérez-Farr. & Croat a new species belonging to *A.* section *Andiphilum* (Schott) Croat from the Sierra de Juárez, north of Oaxaca, Mexico is described and illustrated. This new species is characterized by its large size (up to 80 cm long), broadly sulcate petioles with acute margins, long geniculum (2.0–3.5 cm long) and broadly ovate to oblong-triangular blades (56–68 cm long) with basal, and primary lateral veins usually tinged red-purple on the lower surface. Based on a detailed review of herbarium specimens, and a comparison with specimens collected at the type localities of *A. andicola* Liebm. and *A. macdougallii* Matuda, we conclude that *A. macdougallii*, a taxon currently considered to be a synonym of *A. andicola* is a distinct species, and *A. oaxacamonticola* Matuda is synonymized to *A. macdougallii*. *Anthurium andicola* and *A. macdougallii* are re-described with a more complete description, using fertile, living and dry material collected at its type localities.

Keywords: *Anthurium andicola*, *Anthurium* section *Andiphilum*, Oaxaca, Veracruz

## Introduction

In the family Araceae, the Neotropical genus *Anthurium* Schott (subfamily *Pothoideae*) includes terrestrial, rupicolous, epiphytic and hemiepiphytic herbs, but they are poorly known (Croat 1983, 1988, Zotz 2013). The genus comprises 950 known species and is estimated to have more than 2000 species (Croat 2015, Boyce and Croat 2018). It is distributed in a wide array of vegetation types, from sea level to more than 2000 m a.s.l., from the western and north central region Mexico to northern Argentina and Paraguay, including the West Indies and Southern Brazil (Croat 1983). In Mexico, 64 *Anthurium* Schott taxa have been reported (including the two species added in this paper), with more than 55% (32 species and four infraspecific taxa) belonging to *A.* sect. *Andiphilum* (Schott) Croat, including five recently described species, viz. *A. ixtlanense* Díaz Jim., Pérez-Farr. & Croat (Díaz Jiménez et al. 2020), *A. luzense*



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Díaz Jim., Pérez-Farr. & Croat (Díaz Jiménez et al. 2020), *A. mittermeieri* Díaz Jim., M.Cedeño & Pérez-Farr. (Díaz Jiménez et al. 2022), *A. perezfarrerae* Díaz Jim. & Croat (Díaz Jiménez et al. 2021) and *A. tacotalpense* Díaz Jim. & Pérez-Farr. (Pérez-Farrera et al. 2022). The members of the section *Andiphilum* are characterized by its D-shaped to conspicuously and broadly sulcate petioles and mostly orange berries that have a pasty rather than a juicy gelatinous mesocarp, and especially large seeds (Croat and Hormell 2017, Carlsen and Croat 2019, Díaz Jiménez et al. 2020, 2021). Species in this section are mostly found in Mexico and Guatemala, with few species in Honduras and El Salvador (Croat and Hormell 2017, Díaz Jiménez et al. 2020).

*Anthurium andicola* Liebmann (Liebmann 1849) is endemic to Mexico and has been considered one of the most variable species within the section *Andiphilum* (Croat 1983, T.B. Croat et al. unpubl.). It is characterized by its broadly sulcate petiole, coriaceous, broadly ovate-deltoid or ovate-triangular blades, arcuate, parabolic or hippocrepiform sinus and prominently raised tertiary venation (Croat 1983, Croat and Acebey 2015). This species was described by Liebmann (1849) from a specimen collected on the slopes of the Pico de Orizaba volcano, near Santa María Alpatlahua, Veracruz, Mexico. In his revision, Croat (1983) mentions that the ripe berries of *A. andicola* are orange in color, and that the spathe on the infructescence is deciduous. He also considered *A. macdougallii* (Matuda 1951) and *A. oaxacamonticola* (Matuda 1956) as synonymous with *A. andicola*.

Derived from an exhaustive review of *Anthurium* specimens collected at different localities in southern Mexico, including the type localities of *A. andicola* and *A. macdougallii*, in addition to a detailed review of herbarium specimens, we determined that one of them corresponds to a new species and that *A. andicola* and *A. macdougallii* correspond to two different species, but that *A. oaxacamonticola* and *A. macdougallii* are the same species. Here, we describe and illustrate the new species and validate, illustrate and provide a more complete description of *A. macdougallii*, formally synonymize *A. oaxacamonticola* with *A. macdougallii* and re-described and illustrate *A. andicola*.

## Material and methods

Between 2019 and 2021, we collected specimens of the new species in a population at the Ejido La Luz, municipality of Ixtlán de Juárez, located in the Sierra Norte de Oaxaca (17°30'59"N, 96°22'46"W; 1830 m a.s.l.), and specimens of *A. andicola* in a population on the slopes of the Pico de Orizaba Volcano, locality Excola, municipality of Calcahualco, Veracruz, approximately 3 km from the municipality of Alpatláhuac (19°08'14"N, 97°07'47"W; 2037 m a.s.l.). *Anthurium macdougallii* was collected at its type locality, San José Tenango (16°16'52"N, 95°32'07"W; 1030 m), located in the Sierra Sur de Oaxaca. The specimens collected were examined and compared with material

deposited in the herbaria ENCB, F, HEM, HUAP, MEXU, MO, USF, WIS and XAL. The new species was described and illustrated using fertile, living and dry material, while the taxonomic description was prepared following the methodology by Croat and Bunting (1979), Croat (1983) and Díaz Jiménez et al. (2020). *Anthurium macdougallii* is re-evaluated and illustrated using fertile and living material, and *A. andicola* is re-described and illustrated, using fertile, living and dry material.

## Results

We concluded that the specimens collected at the Ejido La Luz, Ixtlán de Juárez and Sierra Norte de Oaxaca represented a new undescribed species based primarily on its large size, long cataphylls, thick and broadly sulcate petioles, broadly ovate to oblong-triangular blades and long inflorescences (description follows). The new species was collected in the same type locality as *A. ixtlanense*, *A. luzense* and *A. perezfarrerae*, three species of *A. sect. Andiphilum* recently described from Mexico (Díaz Jiménez et al. 2020, 2021).

By checking the herbaria specimens and specimens collected in the type localities of *A. andicola* and *A. macdougallii*, we also concluded that *A. macdougallii* is a valid species distinct from *A. andicola*, both of which required an updated taxonomic description using both fertile and living specimens. Both species have blades with the tertiary veins prominently raised and Croat (1983) considered them to be the same species, but *A. macdougallii* has a greater number of primary veins per side, different sinus and green immature fruits. Currently, *A. macdougallii* is an endemic species from the Sierra Sur de Oaxaca, while *A. andicola* is restricted to the central region of Veracruz and Sierra Norte de Oaxaca, Mexico. The review of herbarium specimens also allowed us to conclude that *A. macdougallii* and *A. oaxacamonticola* are the same species, therefore, we synonymize the latter species with *A. macdougallii*.

### *Anthurium hentrichianum* Díaz Jim., Pérez-Farr. & Croat, sp. nov. (Fig. 1)

A species similar to *A. andicola*, but differing in having longer vegetative and reproductive structures, cataphylls (10–18 versus 2–8 cm), geniculum (2.0–3.5 versus 1.5–3.0 cm), petioles (58.0–71.5 versus 16–47 cm) and blades (56–68 versus 17.0–37.5 cm), a spatulate, obovate or mitered sinus (versus arcuate, parabolic or hippocrepiform for *A. andicola*), more pairs of primary lateral veins (6–9 versus 3–5), longer peduncles (61–66 versus 16–40 cm), longer spadix (up to 21.3 versus 4.0–10.5 cm) and glossy dark green immature berries (versus violet-purple).

**Type:** Mexico. Oaxaca: Municipality Ixtlán de Juárez, Ejido La Luz, Bosque mesófilo, 17°30'59"N, 096°22'46"W, 1830 m a.s.l., 7 Nov 2019, Pedro Díaz Jiménez, M. Á. Pérez-Farrera & H. Gómez-Domínguez 1445 (holotype: HEM, isotype: UJAT).

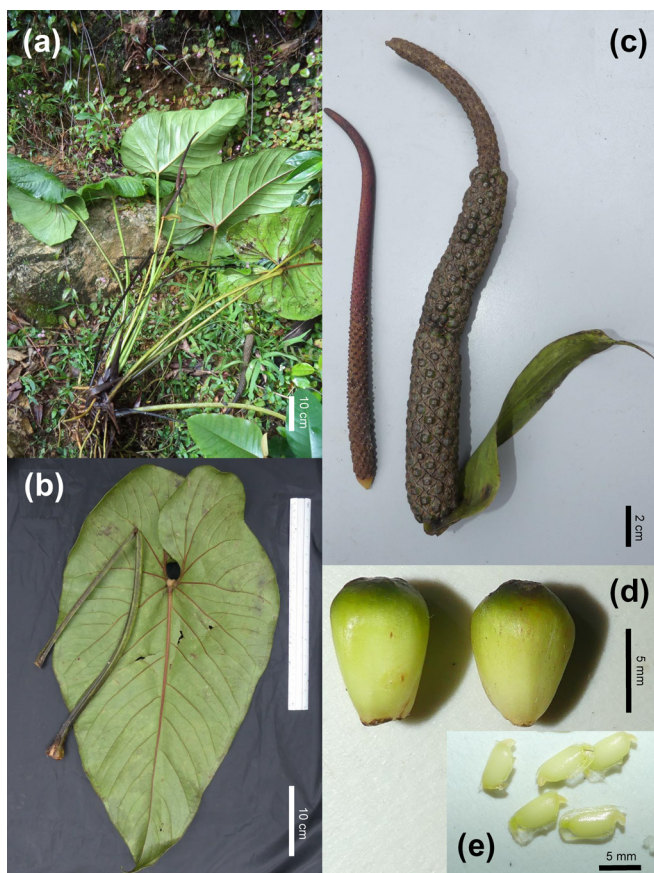


Figure 1. *Anthurium hentrichianum* sp. nov. (a) adult live plant (laying on ground), (b) abaxial view of the leaf blade showing basal, and primary lateral veins tinged red-violet, and broadly sulcate petiole, (c) inflorescence (left) in post-anthesis (male phase) and immature infructescence (right) showing the berries rising above the tepals, and the erect spathe, (d) immature berries showing truncate and rounded apex, (e) seeds with transparent mucilage. Photos by P. Díaz Jiménez.

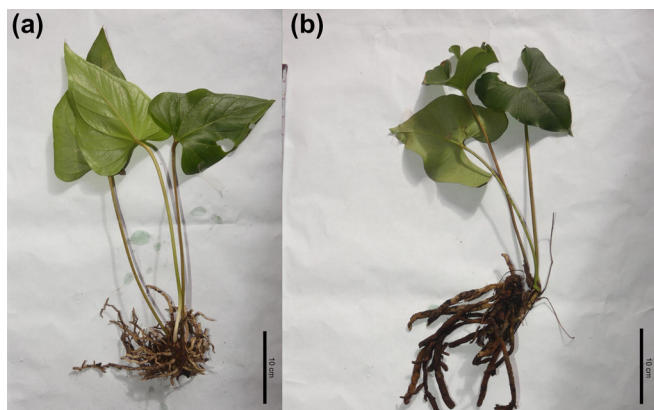


Figure 2. *Anthurium andicola* and *A. macdougallii*. (a) Juvenile live plant of *A. andicola* showing short posterior lobes and glossy blades on both surfaces, (b) juvenile live plant of *A. macdougallii* showing elongated posterior lobes and non-glossy blades on both surfaces. Photos by P. Díaz Jiménez.

### Etymology

This species is named in honor of the German botanist Dr rer. nat. Heiko Hentrich, designated expert in floral ecology and tropical botany, who conducts and funds field explorations to investigate Araceae in the Neotropics. Heiko is interested in the pollination of aroids with bisexual flowers, and orchids and many other plant species of various families pollinated by male and female orchid bees (Euglossini). The principal aim of his work is to gain knowledge about speciation processes and the reproductive isolation of sympatric plant species.

### Description

Terrestrial, up to 80 cm long; stem thick, to 21 cm long, 3.8 cm diam.; leaf scars 2.5–3.5 cm wide; roots thick, 1–5 mm in diam., greenish to whitish; cataphylls subcoriaceous, 10–18 cm long, yellowish-green, matte above, semi-glossy below, with a rounded rib in the middle, acuminate at apex, drying brown, weathering to a fibrous network at the base, persisting. Leaves with petioles erect to spreading, 58.0–71.5 cm long, 6–15 mm in diam., broadly sulcate with acute margins, weakly glaucous, yellowish-green, drying dark-brown; geniculum 2.0–3.5 cm long, 8–10 mm in diam., smooth or rarely striate (sometimes faintly tinged purple); blades broadly ovate to oblong-triangular, 56–68 × 26.0–37.5 cm, broadest at point of petiole attachment, acute or acuminate at apex, broadly lobed at base, coriaceous; anterior lobe 44.5–49.0 cm long, with margins broadly rounded; posterior lobes 15–17 × 13–16 cm, rounded at apex, overlapping; upper surface dark green glossy, lower surface light green matte to semi-glossy, drying matte green or brown semi-glossy on both surfaces; sinus spatulate, obovate or mitered, acute or rounded at apex; midrib raised above, diminished and flattened toward at the apex, acutely raised below; basal veins 6–7 pairs, the first pair free to base, the second to the third pairs coalesced 1.0–2.5 cm, third to fourth pairs of 3.5–5.0 cm and fourth to remaining of 5–8 cm; posterior rib naked; primary lateral veins 6–9 pairs, departing from midrib at 45–55° angle, sunken above, raised below; interprimary veins sunken above, raised below; midrib, basal and primary lateral veins usually tinged red-purple on lower surface; tertiary vein inconspicuous above and below; collective veins arising from the second or third pairs basal vein, sunken above, raised below, distance from the margin, 4–15 mm. Inflorescence erect, shorter than or equal to leaves; peduncle 61–66 cm long, 5–10 mm in diam., terete, yellowish-green; spathe moderately thick, subcoriaceous, yellowish or yellowish-green, oblong-lanceolate, 14.0–17.5 × 3.5–4.0 cm, acuminate at apex, rounded at base, inserted at 30–45° angle on peduncle; stipe 10 mm long in front, 7 mm long in back, faintly tinged red; spadix tapered, dark purple at anthesis, to 21.3 cm long, 10 mm in diam. at base, 4 mm in diam. at apex. Flowers rhombic to square, 2–3 × 1.4–2.7 mm, with sides ± straight or weakly sigmoid; 7–8 flowers visible in the principal spiral, 4–5 flowers visible in the alternate spiral; tepals brown to purple, minutely papillate, lateral ones 1.5–3.1 mm wide, with inner margin rounded. Pistils weakly emergent, purplish, 2.1–3.0 mm long longitudinally; stigma oblong, 0.2–0.4 mm long.

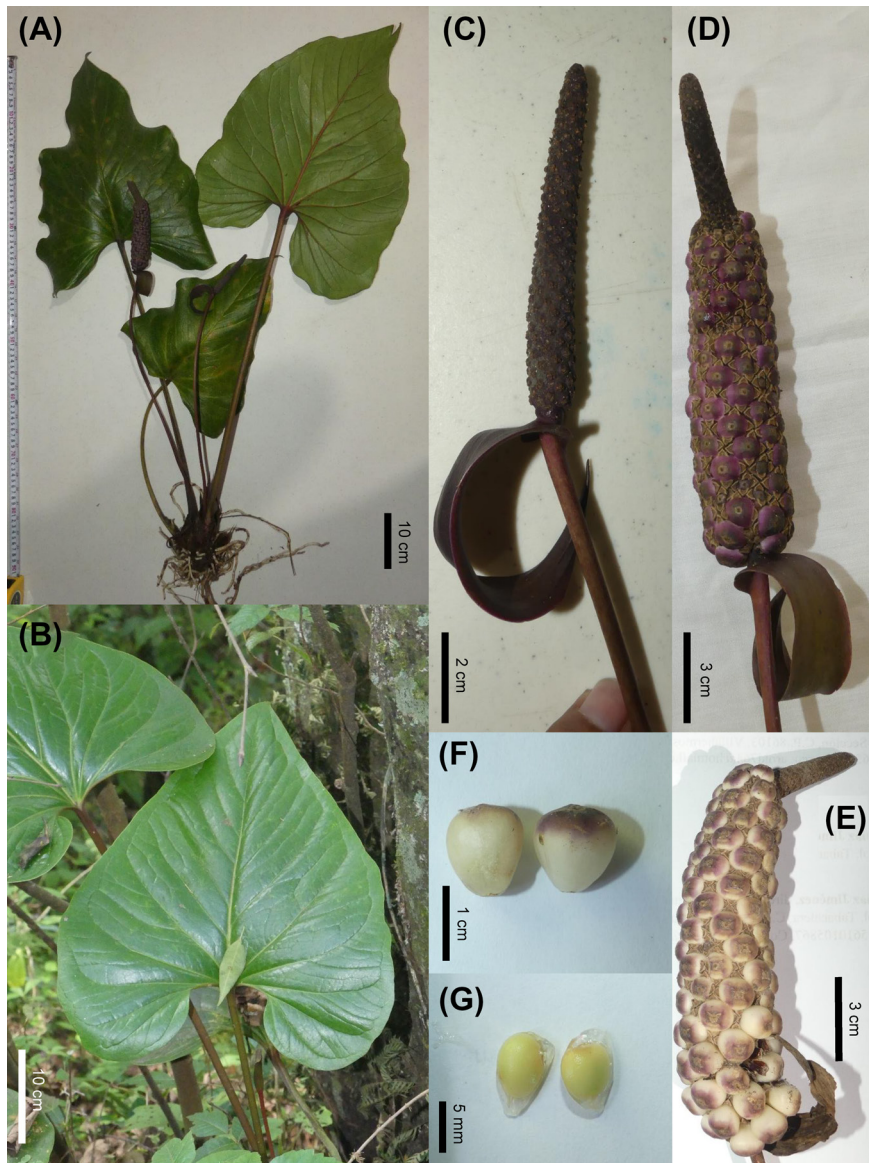


Figure 3. *Anthurium andicola*. (A) Adult plant showing blades with arcuate, parabolic or hippocrepiform sinus, (B) adaxial view of the leaf blade showing blade with hippocrepiform sinus and conspicuous tertiary venation, (C) inflorescence in anthesis (male phase) showing a portion of the brown peduncle, dark purple spathe and spadix, (D) immature infructescence showing the berries sunken between the tepals and violet-purple apically, and the reflex spathe, (E) mature infructescence showing persistent spathe, (F) mature berries showing truncate or rounded apex and light violet apically, (G) seeds with transparent mucilage. Photos by P. Díaz Jiménez.

Thecae ellipsoid. Infructescence pendent or erect, 28.0–32.5 × 2.2–2.4 cm; spathe erect and persistent, green; immature berries with a third or a quarter rising above the tepals, dark green, glossy, obovoid, truncate, rounded or ± acute and with four sharp edges at the apex, 7–10 × 5.0–6.2 mm; seeds 1 or 2, ± flattened, oblong, ± twice as long as wide, covered with a sticky and transparent mucilage in immature fruits, 5.0–7.2 × 2.5–3.5 mm.

#### **Distribution and habitat**

*Anthurium hentrichianum* is endemic to the municipality of Ixtlán de Juárez, Oaxaca, Mexico, at 1830 m a.s.l., in montane cloud forest (Fig. 5). It grows sympatric with other Araceae

such as *Anthurium ixtlanense*, *A. luzense*, *A. perezfarrerae*, *A. subovatum* Matuda (Matuda 1959) and *Monstera deliciosa* var. *sierrana* G.S. Bunting (Bunting 1965), all endemic to the Sierra Norte of Oaxaca.

#### **Similar species**

*Anthurium hentrichianum* is characterized by its large size, wide leaf scars, long cataphylls, broadly sulcate petioles with acute margins, long geniculum, broadly ovate to oblong-triangular blades with the posterior lobes often overlapping, a spatulate, obovate or mitered sinus, basal and primary lateral veins usually tinged red-violet on the lower surface, and long inflorescences. Apparently, it is

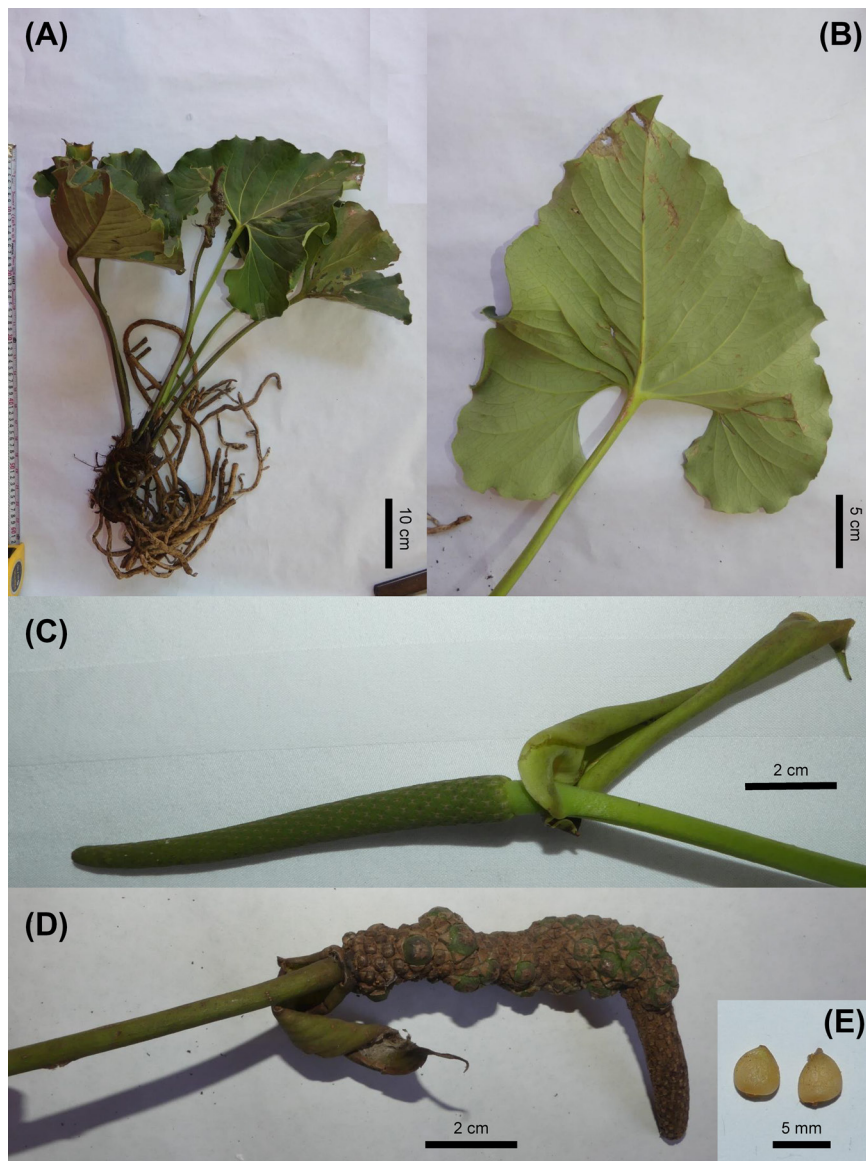


Figure 4. *Anthurium macdougalii*. (A) Adult live plant (laying flat) with immature infructescence, (B) abaxial view of the leaf blade wrinkled towards the margins, sinus birectiform and basal, and primary lateral veins whitish, and abaxial view of a portion of the petiole, (C) inflorescence in anthesis (female phase) showing green and reflexed spathe, green spadix and a portion of the peduncle, (D) immature infructescence with persistent spathe and a portion of the peduncle, (E) seeds. Photos by P. Díaz Jiménez.

a relative of *Anthurium andicola*, but that species differs from *A. hentrichianum* in having shorter cataphylls, shorter geniculum, shorter petioles, smaller leaves, arcuate, parabolic or hippocrepiform sinus, fewer pairs of primary lateral veins, tertiary veins that are prominently raised even on fresh material and shorter inflorescences (Liebmann 1849, Croat 1983; Table 1). *Anthurium hentrichianum* keys to *A. montanum* Hemsley (Hemsley 1879) in the Flora of Central America key (Croat 1983) but that species from southeastern Chiapas to Guatemala differs in having the anterior lobe usually straight to broadly concave (rarely broadly rounded) with the collective veins arising from the first pair of basal veins (Croat 1983), whereas *A.*

*hentrichianum* has the collective veins arising from second or third pair of basal veins.

### Taxonomic changes within the *Anthurium andicola* species complex

*Anthurium andicola* Liebm. (1849 p. 22)

**Type:** Mexico. Veracruz: Santa María Alpatlahua (NE of Coscomatepec) on slopes of Volcán Orizaba, 2500 m a.s.l. F. Liebmann s.n. (lectotype: K!) designated by Croat (1983) (Fig. 2A and 3).

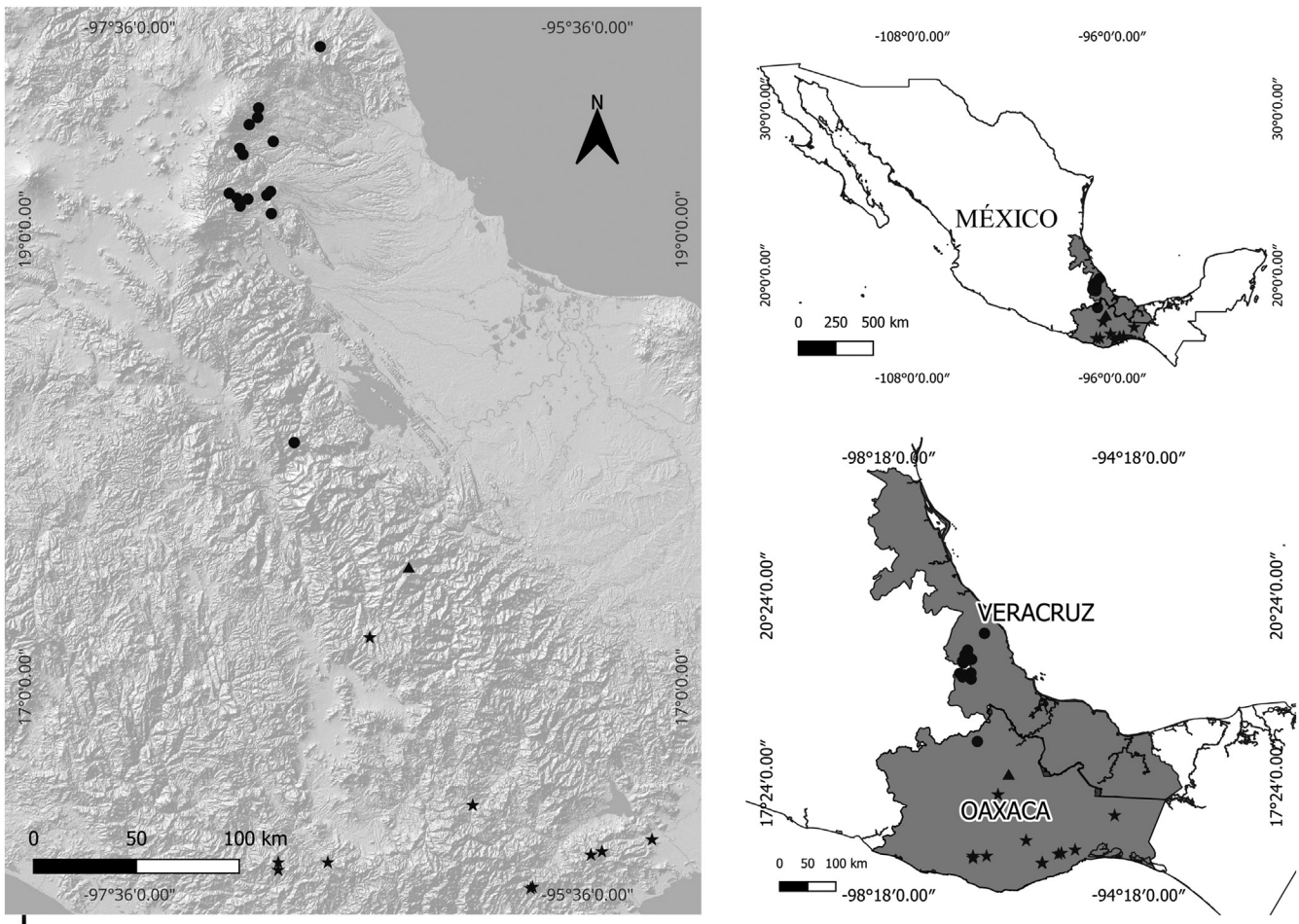


Figure 5. Map showing distributions of *Anthurium andicola* (black circles), *A. hentrichianum* (black triangle) and *A. macdougallii* (black stars).

**Taxonomic synonyms:** *Anthurium cucullatum* C. Koch. (1853).

***Anthurium andicola* var. *cucullatum* (C. Koch) Engl. (1879 N. 97)**

*Anthurium chochotlensis* Matuda (1975 p. 11). Type: Mexico. Oaxaca: Chochotla (probably Santa María Chilcotla at 18°14'N; 96°49'W). Huautla de Jimenez, E. Matuda 38620 (holotype: MEXU).

**Description**

Terrestrial, epiphytic or rupicolous, up to 65 cm long; stems less than 20 cm long; leaf scars 1.6–1.8 cm wide; roots thick, up to 5 mm in diam., descending, whitish and greenish; cataphylls subcoriaceous, 2–8 cm long, tinged red more intense at margins and apex, with a sharp rib in the middle, acuminate at apex, minutely apiculate, drying medium brown, weathering to a fibrous network at base. Leaves with petioles erect to spreading, 16–47 cm long, 3.2–8.0 mm in diam., sharply sulcate, weakly glaucous,

Table 1. Morphological comparison of *A. andicola*, *A. macdougallii* and *A. hentrichianum*, and their distribution.

Trait	<i>A. andicola</i>	<i>A. macdougallii</i>	<i>A. hentrichianum</i> sp. nov.
Petiole length (cm)	16–47	25–60	58.0–71.5
Geniculum length (cm)	1.5–3.0	1.0–1.7	2.0–3.5
Sinus shape	Arcuate, parabolic or hippocrepiform	Birettiform or reniform	Spathulate, obovate or mitered
Primary lateral veins	3–5 per side, whitish glossy or tinged red-purple on lower surface	6–8 per side, whitish on lower surface	6–9 per side, tinged red-purple on lower surface
Peduncle length (cm)	16–40	15–32	61–66
Spadix length (cm)	4.0–10.5	10.0–16.5	Up to 21.3 cm
Colour of immature berries	Violet-purple	Dark green, not glossy	Dark green, glossy
Seed shape	Broadly ellipsoid to subrounded	Subrounded to oblong	Oblong, ± twice as long as wide
Distribution	Mexico (Oaxaca and Veracruz)	Mexico (Oaxaca)	Mexico (Oaxaca)

dark green or glossy brown; geniculum 1.5–3.0 cm long, 5–9 mm in diam., flattened adaxially with sharp margins, glossy, whitish or tinged red; blades broadly ovate-deltoid or ovate-triangular, coriaceous, narrowly acuminate at apex (rarely rounded), usually prominently lobed at base (rarely merely obtuse), 17.0–37.5 × 13.0–28.5 cm, broadest at point of petiole attachment; anterior lobe 16–36 cm long, margins broadly rounded; posterior lobes 7.5–15.0 × 9.0–13.5 cm; sinus arcuate, parabolic or hippocrepiform; upper surface dark green glossy, lower surface light green glossy to yellowish-green glossy; midrib convexly raised above, diminished and flat at apex, more acutely raised below; basal veins 3–6 pairs, the first free to base, those remaining coalesced 1.0–4.5 cm, posterior rib naked, weakly curved, outer margin scarcely turned up; primary lateral veins 3–5 per side, departing from midrib at 25–40°, straight to collective vein, sunken above, raised below; interprimary veins sunken above, raised below; tertiary vein prominent above, obscure below (drying prominent on both surfaces); midrib, basal and primary lateral veins whitish and glossy or tinged red-purple and glossy on lower surface; collective veins arising from the first basal vein or from one of the lowermost primary lateral veins, sunken above, raised below, distance from the margin, 4–11 mm, sometimes the second pair of basal veins running almost to apex. Inflorescence erect, shorter than or equal to leaves; peduncle 16–40 cm long, 4–6 mm in diam., terete, sometimes with a single ridge, tinged reddish or brown and glossy; spathe reflexed at anthesis (rarely horizontal), thin, dark purple to brown, glossy or medium green, narrowly ovate to ovate-lanceolate, 5.0–8.5 × 2–3 cm, narrowly acuminate at apex, rounded to subcordate at base, inserted at 45° angle on peduncle; spadix tapered, green heavily tinged purple or dark purple at anthesis, 4.0–10.5 cm long, 5–9 mm in diam. at base, 2–5 mm in diam. at apex. Flowers square 3.0–3.6 mm in both directions, with sides straight parallel to spirals, weakly to jaggedly sigmoid perpendicular to spirals; 5–6 flowers visible in the principal spiral, 6–7 flowers visible in the alternate spiral; tepals matte, weakly punctate, very minutely papillate, lateral ones 2.1–2.2 mm wide, with inner margin broadly rounded. Pistils weakly emergent, green to purplish (paler than tepals); stigma linear, ca 7 mm long, with large, clear droplets ca 1 month before stamens emerge. Lateral stamens emerging from base of styles, followed by alternates in rapid progression; leading stamens preceding the next in the series by 2 or 3 spirals; anthers white to pale yellow, ca 0.7 × 0.8 mm, held over pistil then retracting and held at sides of pistil; thecae ellipsoid, somewhat divaricate. Pollen yellow, fading to white. Infructescence pendent, 4–13 × 2.5–3.5 cm; spathe reflexed and persistent; immature berries violet-purple apically, light violet apically when ripe and white at base, obovoid, rounded or truncate at apex, 9.5–13.5 × 8.1–10.5 mm; mesocarp fleshy, white; seeds 1 or 2, flattened, broadly ellipsoid to subrounded, greenish-white, covered with a sticky and transparent mucilage in mature fruits, 6.0–8.2 × 6.1–7.0 mm.

### **Distribution and habitat**

*Anthurium andicola* is endemic to Mexico (Oaxaca and Veracruz), at elevations of 1400–2400 m a.s.l., in deciduous forest, montane cloud forest, oak forest and pine-oak forest (Fig. 5).

### **Phenology**

All specimens with inflorescences at anthesis and post-anthesis were collected between February and August, and between October and December, and the specimens with infructescence between February and June, and August, October and December.

### **Similar species**

*Anthurium andicola* is an endemic species of *A.* sect. *Andiphilum* from Mexico. It is a highlands species and is characterized by broadly sulcate petiole, coriaceous, broadly ovate-deltoid or ovate-triangular blades with arcuate, parabolic or hippocrepiform sinus, the prominently raised tertiary venation, dark violet-purple spadix at anthesis and its berries which are violet-purple apically, white towards the base when ripe with a white mesocarp (Table 1). In his revision, Croat (1983) mentioned that the mature berries of *A. andicola* were orange with orange mesocarp and that the spathe of the infructescence was deciduous. However, we observed that the berries of the specimens collected at the type locality, in addition to the specimens reviewed, were violet-purple apically when ripe, white at the base (Fig. 3E, F) and the spathe in the infructescence is persistent (Fig. 3D, E). Another character that Croat (1983) did not mention in the description of *A. andicola* is the reddish coloration of the midrib, basal and primary veins seen in some individuals. In the type locality, most of the collected individuals had this coloration.

*Anthurium andicola* represents one of the few species with a different coloration of its berries when ripe than those recorded in most of the species within section *Andiphilum* (Croat and Hormell 2017, Carlsen and Croat 2019). Its blades with the tertiary veins prominently raised have been considered a characteristic of *A. andicola*, which separates it from other Mexican species (Croat 1983, Croat and Acebey 2015); however, *A. macdougallii*, also has blades with the tertiary veins prominently raised. It is possible that the collection by Thomas B. Croat 48215 (MO) from Teotitlán de Flores Magón, Oaxaca, represents a different taxon than *A. andicola*. However, the shape of blades are similar and its tertiary venation is prominently raised, the immature infructescence is green apically and yellow at the base, and the berries are exposed almost to the middle. In *A. andicola* the immature berries are violet-purple and they are sunken between the tepals. A collection from Alta Verapaz, Guatemala (Thomas B. Croat 90221, MO) had also been misidentified as *A. andicola*. In that collection the blade is narrower and longer, the spathe almost ovate-triangular, narrowly acuminate towards the apex, moreover almost twice as long as the spadix, therefore, *A. andicola* is a distinct species which is apparently restricted to the central region of Veracruz and Sierra Norte de Oaxaca in Mexico.

The specimens from the state of Chiapas, Estado de México, Guerrero and some collections from the Sierra Norte and Sur of Oaxaca, incorrectly identified as *A. andicola* (Croat 1983, Croat and Acebey 2015), should be studied carefully by comparing the different populations and herbarium specimens. It is possible that *A. andicola* represents a set of populations or complex of species that later with molecular or anatomical studies could be better defined. Other such examples of species showing considerable variability that have not been studied in detail include *A. huixtlense* Matuda (Matuda 1950), *A. montanum*, *A. schlechtendalii* Kunth (Kunth 1841), *A. seleri* Engler (Engler 1898) and *A. verapazense* Engler (Engler 1905).

#### Specimens examined

Mexico, Oaxaca: Mun. Mazatlán Villa de Flores, San Pedro de los Encinos, 18°04'10"N, 96°52'49"W, 2345 m a.s.l., 23 Apr 2002, Xochitl Munn-Estrada & F. Mendoza 2271 (MEXU, MO, TEX, XAL). Veracruz: Mun. Acajete, San Gabriel, ejido San Pedro, terracería al Encinal, 19°31'54"N, 97°02'09"W, 1700 m a.s.l., May 1993, C. Gallardo H. et al. 3631 (XAL); Mun. Alpatláhuac, cascada de Alpatláhuac, 19°06'10"N, 97°06'59"W, 1990 m a.s.l., 28 Oct 2008, D. Jimeno-Sevilla 525 (MEXU, MO, XAL); Mun. Calcahualco, in rupibus pr. Alpatlahua, 2286 m a.s.l., Jul 1841, F.M. Liebmans s.n. (MO); Mun. Calcahualco, barranca Coapa, 19°08'N, 97°05'W, 1650 m a.s.l., 8 Mar 1971, R. Hernández M. & R. Cedillo T. 1129 (F, GH, MEXU, XAL); Mun. Calcahualco, barranca entre Coscomatepec y Calcahualco, 1600 m a.s.l., Dec 1980, M. Cházaro B. 1447 (F, XAL); Mun. Calcahualco, 500 m al SE de Calcahualco, barranca Coapa, 19°08'N, 97°05'W, 1750 m a.s.l., 13 May 1985, J.L. Martínez-Pérez 116 (XAL); Mun. Calcahualco, 1 km al W de Excola, camino al Banco, 19°08'N 097°05'W, 1900 m a.s.l., 24 Apr 1985, J.L. Martínez 20 (MEXU, XAL); Mun. Calcahualco, camino a Ahuatepec, 19°08'00"N, 97°05'00"W, 1600 m a.s.l., 20 Mar 1986, J.L. Martínez 1187 (XAL); Mun. Calcahualco, Cañada río Ayohuixtla, 1 km al NW de Itzapa, 19°09'30"N, 97°09'50"W, 2170 m a.s.l., 10 Oct 2001, A. Rincón G. & C. Durán 2737 (XAL); Mun. Coatepec, La Cortadura, falda E del Cofre de Perote, 19°29'24"N, 97°2'24"W, 2100 m a.s.l., 24 May 2007, G. Castillo-Campos 22871 (XAL); Mun. Coscomatepec, near bridge over río Jamapa on highway 125 from Coscomatepec to Huatusco, ca 4 miles NE of Coscomatepec, 19°04'12"N, 096°58'48"W, 1400 m a.s.l., 23 Aug 1977, T.B. Croat 43933 (MO); Mun. Coscomatepec, 5 km antes de Calcahualco, 19°10'N, 96°59'W, 1540 m a.s.l., 17 Nov 1981, F. Vázquez B. 358 (XAL); Mun. Coscomatepec, ca 2.4 mi. W of Coscomatepec along gravel road to Tetelzingo, 1829 m a.s.l., 4 Jul 1982, J. Utley & K. Utley 6928 (USF); Mun. Huatusco, puente sobre el río Japama, 15 km al SW de Huatusco, 1400 m a.s.l., 11 Oct 1964, J. Rzedowski 19049 (ENCB); Mun. Huatusco, Tepampa, 19°09'N, 97°00'W, 1600 m a.s.l., 23 Feb 1980, S. Avendaño R. 595 (XAL); Mun. Ixhuacán de los Reyes, 2 km. sobre el camino Ixhuacán-Patlana, 1800 m a.s.l., 23 Oct 1982, J. Márquez & M. Cházaro B. 56 (WIS); Mun. Ixhuacán de los Reyes, 4 km antes de llegar a Ixhuacán viniendo por Pocitos, 1500 m

a.s.l., 22 Jun 1986, M. Cházaro B. & P. Padilla 3724 (WIS, XAL); Mun. Ixhuacán de los Reyes; 3 km al NW de Ixhuacán camino a cerro Boludo, 19°21'18"N 097°07'06"W, 01 Feb 1996, G. Castillo-Campos et al. 14618 (XAL); Mun. Ixhuacán de los Reyes, 19°19'42"N, 97°06'14"W, 2182 m a.s.l., 7 Dec 2009, M. Castañeda-Zárate & S. Ramos Castro 335 (XAL); Mun. Juchique de Ferrer, La Cima, Plan de las Hayas, 1700 m a.s.l., 21 Jun 1972, R. Hernández M. 1585, 1596 (MEXU, F); Mun. Juchique de Ferrer, cerro de Villa Rica, cerca de Mundo Nuevo, 19°48'N 096°46'W, 1550 m a.s.l., 7 May 1981, G. Castillo-Campos et al. 1853 (F, XAL); Mun. Teocelo, between Teocelo and Ixhuacán, ca 22 km SW of Coatepec, ca 3 km before Ixhuacán, 19°23'7"N, 96°58'18"W, 1 Aug 1993, P. Hietz & U. Seifert 791 (XAL); Mun. Xico, entre Coatitlán y Ixóchitl, 19°27'32"N 097°04'36"W, 2300 m a.s.l., 22 Oct 1986, Miguel Cházaro B. & Patricia Hernández de Ch. 4118 (MO, WIS, XAL).

#### *Anthurium macdougallii* Matuda (1951 p. 373–374)

**Type:** Mexico. Oaxaca: Tenango, 1300–1700 m a.s.l., 1 Dec 1951, T. MacDougall s.n. (holotype: MEXU!) (Fig. 2B and 4).

**Taxonomic synonym:** *Anthurium oaxacamonticola* Matuda (1957 p. 344). Type: Mexico. Oaxaca: vic. La Gloria, near the Oaxaca-Chiapas border, T. MacDougall s.n. 5 Mar, 1953 (holotype: MEXU!).

#### Description

Terrestrial, epiphytic or rupicolous, up to 60 cm long; stem thick, to 14 cm long, 4.7 cm in diam.; leaf scars to 2 cm wide; roots thick, up to 10 mm diam., whitish and brown when wet; cataphylls coriaceous, 5.5–7.0 cm long, drying brown, weathering to a fibrous network at base, persisting. Leaves mostly erect; petioles erect, 25–60 cm long, 5–9 mm in diam., flattened or sulcate adaxially with acute margins, green or with dark spots, drying dark brown; geniculum 1.0–1.7 cm long, 5.5–11.0 mm in diam., flattened adaxially and weakly sulcate; blades ovate-triangular to widely ovate or ± reniform, coriaceous, wrinkled to undulate towards the margins in adult individuals, acute and apiculate at apex (apiculum up to 2 mm long), deeply and broadly lobed at base, 18–33 × 19–32 cm, broadest at base; anterior lobe 17.5–23.0 cm long, with margins broadly undulate; posterior lobes 9–12 × 7–12 cm, rounded at apex; sinus birectiform or reniform, very wide ovate, more or less arched at the apex; upper surface dark green semiglossy, lower surface light green, drying light brown on both surfaces; midrib raised above, diminished and flat at apex, raised below, light green to whitish above and below; basal veins 6–9 pairs, the first pair free to base, the second to the third pairs coalesced 1.2–2.6 cm, third to the fourth pairs for 1.7–2.0 cm and from the fourth to the ninth pairs united in a single point, whitish and 1st–4th raised above and below; posterior ribs naked, 3.5–6.5 cm; primary lateral veins 6–8 per side, departing from midrib at 40–50°, raised above and below, whitish above and below; tertiary venation visible on both sides, prominently raised below, dark green; collective veins arising from the fourth or sixth pairs of basal



veins, sunken above, raised below, distance from the margin, 5–12 mm. Inflorescence erect, shorter than or equal to leaves; peduncle 15–32 cm long, 3.0–5.3 mm diam., terete, dark green; spathe lanceolate, moderately thick, green or dark purple, up to 3.5–10.0 cm × 1–2 cm, acuminate at apex, rounded at base; spadix tapered, purple or dark purple at anthesis, 5–11 cm long, 7–10 mm in diam. at base, flowers rhombic 2–3 mm wide, with sides weakly sigmoid to straight, 4–5 flowers visible in the principal spiral, 5–6 flowers visible in the alternate spiral; lateral tepals up to 2.5 mm wide, minutely papillate, with inner margin rounded to ± straight. Pistils weakly emergent, up to 2 mm long; stigma linear or oblong, up to 1 mm long. Stamens up to 3 mm long; filaments broad, slightly longer than tepals at anthesis. Infructescence erect, 7–14 × 1.5–3.0 cm in diam.; immature berries partially sunken between the tepals, dark green, not glossy, orange when ripe, obovoid, rounded at apex, as immature 5–7 × 3.5–6.0 mm; seeds 2, flattened, subrounded to oblong, covered with a sticky and transparent mucilage in immature fruits, 5.0–5.5 mm long.

#### **Distribution and habitat**

*Anthurium macdougallii* is endemic to Mexico, known only from the Sierra Sur de Oaxaca and Chimalapas region (sierra atravesada), Oaxaca, Mexico, at elevations of 1000–2200 m a.s.l., in montane cloud forest, pine-oak forest, oak forest and tropical deciduous forest (Fig. 5).

#### **Phenology**

The specimens with inflorescence in anthesis were collected between February and May, and in July and December, and with infructescence in February, March, July, September, November and December.

#### **Similar species**

*Anthurium macdougallii* was described by Matuda (1951) from a specimen collected by Thomas MacDougall (s. n.) in the Sierra Sur de Oaxaca. This species was placed in the synonymy of *A. andicola* by Croat (1983). He assumed that *A. macdougallii* corresponded to a variation of *A. andicola* with the posterior lobes directed inward and a birettiform (meaning square in outline with a broadly rounded apex; Croat and Bunting 1979) or reniform sinus. Although both species usually have ovate-triangular or reniform and coriaceous blades, with prominently raised tertiary venation and broadly sulcate petiole with sharp margins, in juvenile individuals of *A. macdougallii* the sinus is parabolic with elongated posterior lobes and its blades are opaque or slightly glossy on both surfaces, while in *A. andicola* the sinus is often arcuate with very short posterior lobes and its blades are very glossy at both surfaces (Fig. 2A, B). Furthermore, in adult individuals of *A. macdougallii* the blades are wrinkled towards the margins (Fig. 4A, B), it has a greater number of basal and primary veins per side and the immature fruits are green (Table 1). Another notable distinguishing character of *A. andicola* is the reddish coloration of the petioles, geniculum and venation of some individuals, whereas in *A. macdougallii* the petioles and geniculum are greenish and the venation whitish.

#### **Specimens examined**

México, Oaxaca: Mun. San Carlos Yautepec, Dto. Yautepec, 6.4 km al SE del Camarón, carr. a Tehuantepec, 1075 m a.s.l., 20 Sept 1988, Rafael Torres C. & C. Martínez R. 12578 (MEXU); Mun. San Carlos Yautepec, Dto. Yautepec, Santiago Lachivía (camino de serradero), 2200 m a.s.l., 22 Mar 1972, E. Matuda 38421 (MEXU); Mun. San Jerónimo Coatlán, Dto. Miahuatlán, 11.7 km al SW de San Jerónimo Coatlán, 16°12'N, 096°57'W, 2050 m a.s.l., 12 Dec 1987, Álvaro Campos V. & R. Torres 792 (MEXU); Mun. San Jerónimo Coatlán, Dto. Miahuatlán, Cerro Neblina, 25 km al SE de San Jerónimo Coatlán, 2000 m, 19 Apr 1990, Abisaí García Mendoza et al. 4639 (MEXU); Mun. San Jerónimo Coatlán, Dto. Miahuatlán, 11.5 km al SW de San Jerónimo Coatlán, brecha a Piedra Larga, 16°14'N, 096°57'W, 2200 m a.s.l., 15 Mar 1989, Griselda Toriz & Álvaro Campos V. 815 (MEXU); Mun. San José Tenango, Cerro de Tenango, 1000 m a.s.l., Feb 1952, T. MacDougall 26027 (MEXU); Mun. San José Tenango, Cerro de Tenango, Feb 1952, T. MacDougall s.n. (F, MEXU); Mun. San José Tenango, 3 km antes de llegar a San Miguel Tenango, 16°16'52"N, 095°32'07"W, 1030 m a.s.l., 27 Nov 2021, Pedro Díaz Jiménez et al. 1611 (HEM). Mun. San Miguel Tenango, distrito de Tehuantepec, Cerro Tenango, al N de San Miguel Tenango, el cual está a 41 km al SO de la entrada a Buenos Aires, 16°16'N, 095°35'W, 7 Nov 1990, Rafael Torres C. et al. 13845 (MEXU); Mun. San Pedro Coatlán, Dto. Miahuatlán, 4.8 km al SW de San Pedro Coatlán, camino Miahuatlán-Piedra Larga, 1530 m a.s.l., 8 Feb 1983, R. Torres C. et al. 2208 (MEXU); Mun. Santa Catarina Ixtepeji, Dic 1957, Anonymous s.n. (MEXU); Mun. Santa María Ecatepec, distrito de Yautepec, Cerro Zapote, a .88 km en LR (325N) de Santa María Zapotitlán, 16°07'12"N, 095°50'50"W, 1600 m a.s.l., 16 Mar 2006, Kenia Velasco Gutiérrez & R. Aragon 1289 (SERO). Mun. Santa María Ecatepec, distrito de Yautepec, arroyo Coyote, a 2.74 km en LR (E) de San Juan Acaltepec, 1601 m a.s.l., Kenia Velasco Gutiérrez et al. 4608 (MEXU); Mun. Santa María Ecatepec, distrito de Yautepec, arroyo El Infierno, a 2.15 km en LR (NW) de San Juan Acaltepec, 1507 m a.s.l., Kenia Velasco Gutiérrez et al. 4627 (MEXU); Mun. Santa María Chimalapa, Cerro Azul, cultivada en el jardín Sciaky, ciudad de Oaxaca, 7 Jul 1984, Abisaí García Mendoza & Fco. Martínez 1431 (MEXU); Mun. Santa María Ecatepec, 3 km antes de llegar a Santa María Zapotitlán, 16°07'33"N, 095°50'19"W, 1585 m a.s.l., 16 May 2016, M.Á. Pérez-Farrera 3476 (HEM); Mun. Santo Domingo Tehuantepec, 'Cerro Tres Cruces' al S de el Limón, a 11.1 km al SW del entronque carr. Tehuantepec-Oaxaca-Buenos Aires, 9 Dec 1983, Rafael Torres C. 4280 (MEXU, MO); Mun. Santo Domingo Tehuantepec, 5 km al NO de Buenos Aires, camino a Tenango, 9 Jul 1988, C. H. Ramos et al. 116 (MEXU).

**Acknowledgements** – We thank Gaspar Moreno Méndez, José García González and A. Fabian José Pérez for their help in the field; Erasmo Oscar Ameca-Juárez for making the map and Nelly del Carmen Jiménez Pérez, Alma Deysi Anacleto Rosas and Nahúm Muñiz Chavarría for their help for processing the specimens in

the herbarium UJAT. MAPF thank to anonymous donors to Montgomery Botanical Center for financial support.

*Funding* – MAPF thank to anonymous donors to Montgomery Botanical Center for financial support through systematic cycad mexican project.

### Author contributions

**Pedro D. Jiménez:** Data curation (equal); Investigation (equal); Methodology (equal); Writing – original draft (equal); Writing – review and editing (equal). **Miguel A. Pérez-Farrera:** Data curation (equal); Funding acquisition (equal); Investigation (equal); Validation (equal); Visualization (equal); Writing – original draft (equal); Writing – review and editing (equal). **Thomas B. Croat:** Data curation (equal); Methodology (equal); Validation (equal); Writing – original draft (equal); Writing – review and editing (equal). **Pedro A. Aguilar-Rodríguez:** Data curation (equal); Validation (equal); Writing – original draft (equal); Writing – review and editing (equal).

### Data availability statement

This article contains no additional data.

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