



## *Monstera guzmanjacobiae* (Araceae), a new species from Mexico with notes on its reproductive biology

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### Abstract

The genus *Monstera* is represented in Mexico by nine species, of which five are reported for the region of Los Tuxtlas, Veracruz. During fieldwork between 2014 and 2019 in Los Tuxtlas, we discovered a previously undescribed species belonging to Sect. *Marcgraviopsis* and consisting of a third species from Mexico with a pendent habit. The new species *Monstera guzmanjacobiae*, is described taxonomically and illustrated, using color photographs of vegetative and reproductive features in living material. The behavior of flowering coincides with that observed in other species of *Monstera*. Both nitidulid beetles and drosophilid flies found inside the chamber may be the pollinators of *M. guzmanjacobiae*.

**Keywords:** *Monstera*, Araceae, Veracruz, Los Tuxtlas, Mexico

### Introduction

*Monstera* Adanson (1763: 470), is a genus of herbs exclusive to the Neotropics (Madison 1977; Zuluaga & Cameron 2018; Cedeño-Fonseca *et al.* 2018), consisting mostly of hemi-epiphytes and only rarely with a terrestrial habit (Madison 1977; Grayum 2003; Zotz 2013). The genus has an estimated 125 species (Boyce & Croat 2018) distributed from México to Bolivia, the Antilles, Trinidad, Guianas and Brazil, growing in tropical rainforest and humid forests between sea level and 2500 m elevation (Grayum 2003; Zuluaga & Cameron 2018; Cedeño-Fonseca *et al.* 2018).

In Mexico, *Monstera* is represented by nine species, four of section *Monstera*, three of sect. *Marcgraviopsis* Madison (1977: 72), and one species each of sections *Echinospadix* Madison (1977: 92) and *Tornelia* Madison (1977: 93) (Madison 1977; Croat & Acebey 2015). Seven species are found in the state of Veracruz, five of which grow in the region of Los Tuxtlas (Acebey & Krömer 2008; Croat & Acebey 2015), and four occurring sympatrically below 500 m elevation (M. Cedeño & P. Díaz Jiménez, pers. obs.). Section *Marcgraviopsis* in Mexico comprises three species; *Monstera acuminata* Koch (1855[App]: 4), *M. punctulata* (Schott) Schott ex Engl. (1879: 2) and *M. dubia* (Kunth) Engl. & K. Krause (1908: 117) (Madison 1977), although a fourth species, *M. florescanoana* Croat, T. Krömer & Acebey (2010: 81), placed in sect. *Monstera* by Croat *et al.* (2010), also seems to be a member of section *Marcgraviopsis* (see Zuluaga *et al.* 2019). The species of this section are characterized by their conspicuous heteroblastic development, with terrestrial seedlings similar to a stolon, subsequently becoming climber with their leaves adhering to the substrate (e.g., tree trunk or rocks) and overlapping each other (Madison 1977).

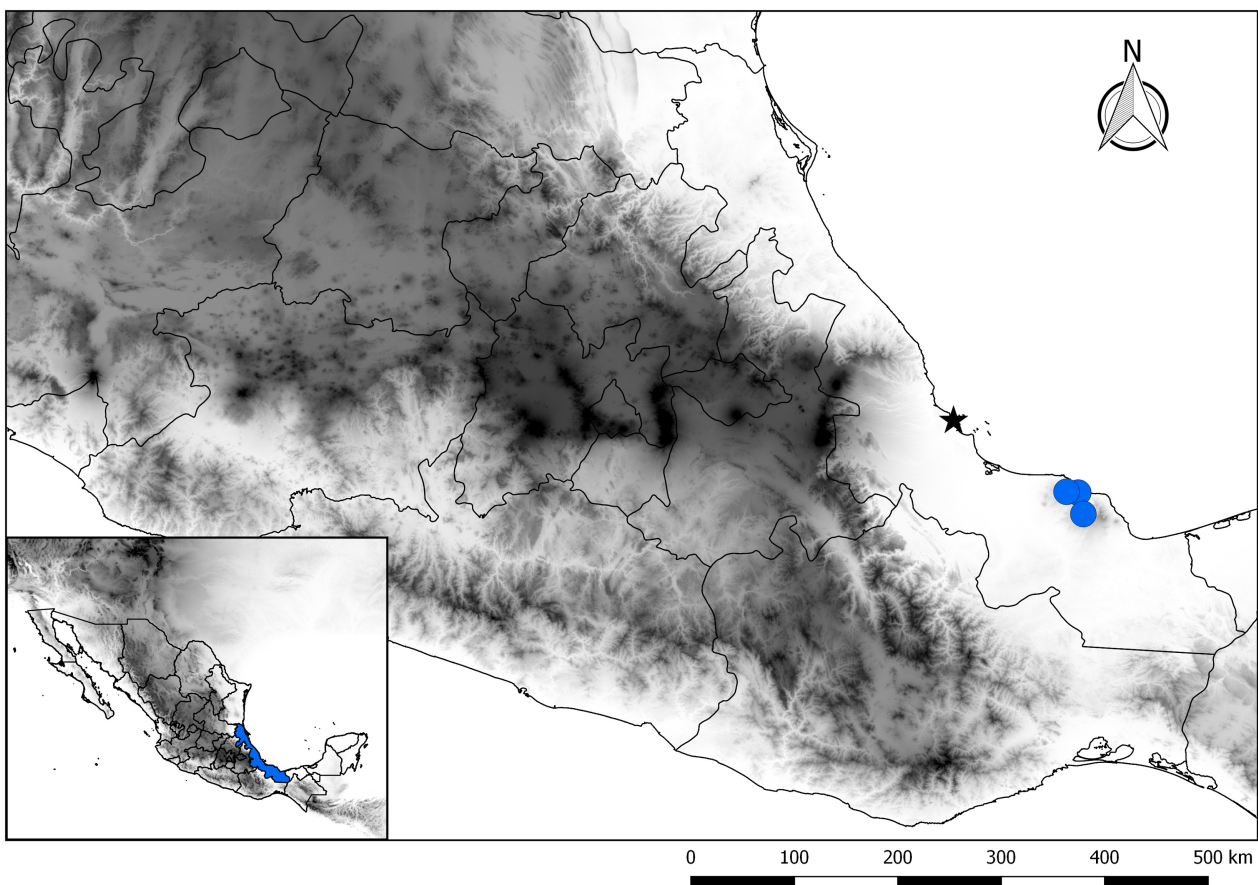
*Monstera* is the most morphologically and taxonomically complex aroid genus in the Neotropics (Grayum 2003; Zuluaga & Cameron 2018; Cedeño-Fonseca *et al.* 2018), and the number of new species is increasing (T. Croat, pers. comm.). During fieldwork in 2014 and 2019 in the region of Los Tuxtlas, Veracruz, we made three collections of

*Monstera* that did not correspond with any species previously described. In this paper, we describe and illustrate a new species of sect. *Marcgraviopsis* from Mexico which is notable for its pendent habit.

## Materials and methods

Specimens were collected from populations occurring in the municipality of Catemaco (18°25'N 95°07'W) between the locality La Palma and the road between Tebanca and Miguel Hidalgo, in Veracruz (Fig. 1). The localities are within the Los Tuxtlas biosphere reserve, between 10–700 m elevation. It is a sub-area of sustainable use of natural resources with fragments of high evergreen rainforest, large areas of grassland and some crops (CONANP 2006). The climate in the region is warm-humid, being one of the five areas of Mexico where the average annual rainfall exceeds 4,000 mm (Guevara *et al.* 2004).

The specimens collected were deposited in the herbaria MEXU, XAL and UJAT were examined, compared and the taxonomic description was prepared following the methodology of Madison (1997), Grayum (2003), Zuluaga & Cameron (2018), and Cedeño-Fonseca *et al.* (2018). Documentation of the living individuals was carried out at the collection locality by digital imaging of taxonomically important vegetative and reproductive features. The GeoCAT program was used to determine the conservation status of the species (Kew 2019), an open source tool to assess rapid geospatial analysis for potential Red Listing data (Bachman *et al.* 2011). Further, the IUCN Red List Categories and Criteria was consulted (IUCN 2012).



**FIGURE 1.** Map showing the collection sites (blue dots) of *Monstera guzmanjacobiae* sp. nov. at the state of Veracruz (highlighted in blue, inset), in the Gulf of Mexico. Veracruz city is showed with a star symbol.

## Taxonomy

*Monstera guzmanjacobiae* Díaz Jiménez, M.Cedeño, Zuluaga & Aguilar-Rodríguez, *sp. nov.* (Figs. 2–4).

*Monstera guzmanjacobiae* can be confused with the endemic Costa Rica species *Monstera luteyana* Madison and *Monstera maderaverde* Grayum & Karney from Honduras. However, in these species, the leaf blades are two to three times smaller and lack fenestrations (rarely present in *M. maderaverde*), and the flowers have truncate styles (vs. pyramidal and conical in *M. guzmanjacobiae*). In *M. guzmanjacobiae*, the yellowish coloration of the aril is unique and represents first record for the genus and for sect. *Marcgraviopsis*.

**Type:**—MEXICO. Veracruz: Municipio Catemaco, La Palma, Selva alta perennifolia, 18°33'21"N, 95°03'35"W, 56 m, 31 May 2014, Pedro Díaz Jiménez & Valeria Guzmán Jacob 1305 (holotype XAL!, isotypes, MEXU!, UJAT!).

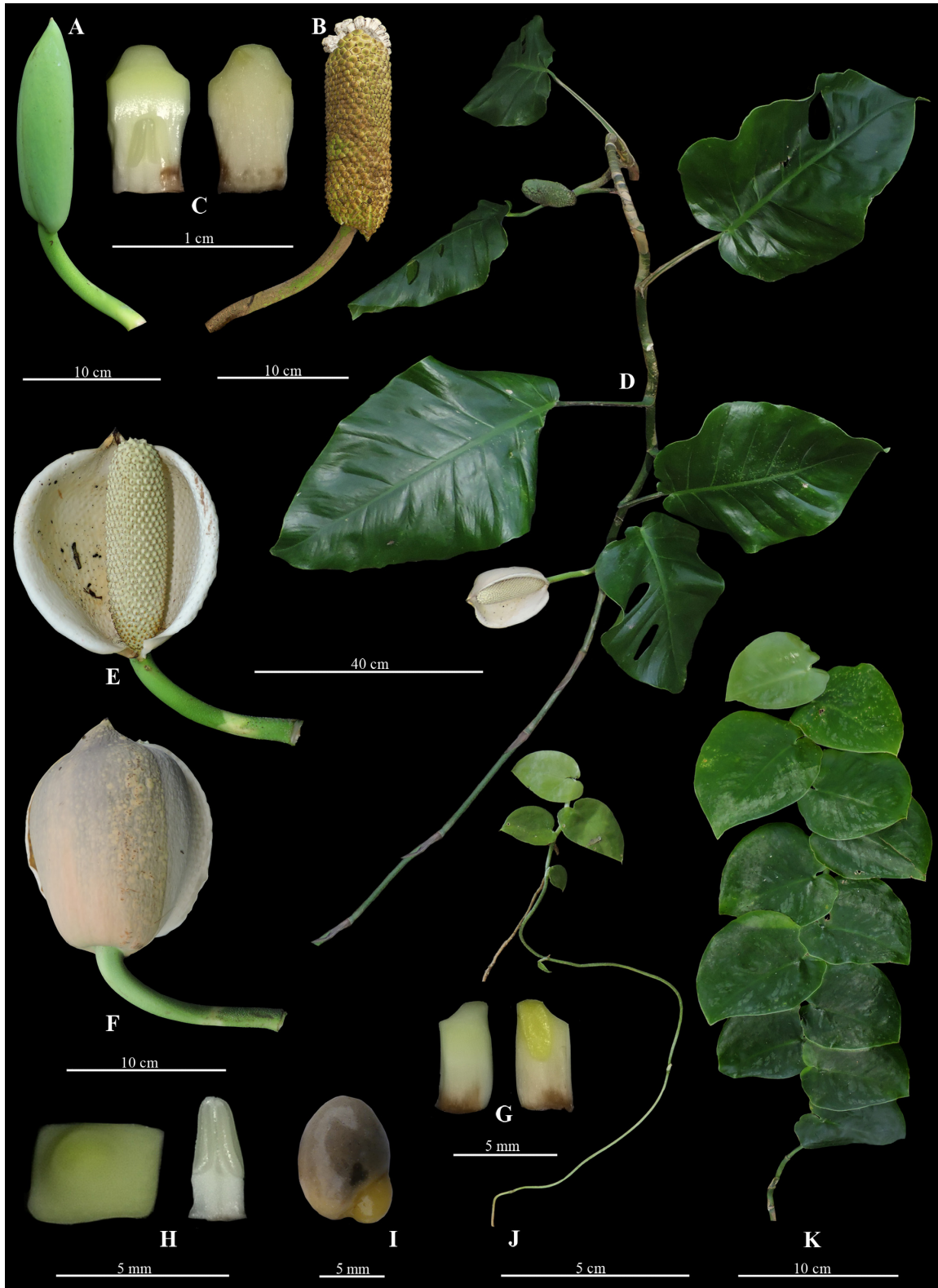
Hemiepiphytic herb, 1–25 m above the ground, stems appressed-climbing and ultimately pendent. **SEEDLING:** terrestrial, filiform. **JUVENILE PLANT:** **stem** terete, light-green, smooth, dorsiventrally compressed, internodes 4–8 cm long, 3–5 mm diam. **Leaves** completely adhering to surface of phorophyte; petiole not visible, 1.0–2.5 cm long; blade 6–9 × 5–8 cm, coriaceous, obovate, without fenestrations, occasionally with white spots abaxially, base cordate, apex short-acuminate. **ADULT PLANT:** anchor **roots** brown; feeder roots light beige, suberous, up to 35 cm long; internodes 6–12 cm de long, 0.8–2.5 cm diam., dark green, semiglossy, scaly or with a clear brown cuticle, thin, exfoliating, with few greenish pustules, rarely smooth, sulcate on one side; **leaves** erect or pendent; **petiole** opaque green, 15–25 (–30) cm long, glaucous and striated at the base, slightly white spots, smooth to geniculum, sheathed up to 1.5 cm before or to the base of geniculum; **sheath** marcescent, remnants as fibers, apical ligule 1.5–3.0 cm de long; **geniculum** 0.5–3.5 cm long, 0.4–1.0 cm diam., light green or dark, smooth or striate, terete; **blade** 18–59 × 15–37(–40) cm, ovate to widely elliptic, chartaceous or thinly coriaceous, cordate to semi-cordate at base, acute or acuminate at apex, dark green and glossy on the upper surface, bright light green on the lower surface, drying light brown on the upper surface, matte green on the lower surface; fenestrations usually only on one side, perforations 1–4, oblong-elliptic, margins blade entire; **midrib** sunken above, prominent below; **primary lateral veins** 5–9 per side, raised on the lower surface, whitish; tertiary veins parallel, connected near the middle of the blade up to margin. **Inflorescence** axillary, often solitary, rarely 2 per axil, rarely erect, inclined between 40–60°, on appressed-climbing or pendent stems; **peduncle** 5–20 cm long, 0.8–2.0 cm diam., green or yellowish, smooth to the apex, with greenish and white pustules at the base; **spathe** 15–19 × 12–15 cm, green prior to anthesis, at anthesis yellowish externally and white to creamy internally, coriaceous, cucullate, obtuse or mucronate at the apex, marcescent after anthesis, up to 1 cm longer than spadix and not enclosing it; **spadix** 8–16 cm long, 2–4 cm diam., white when immature, white-cream at anthesis; basal region of sterile flowers up to 2 cm in long, not decurrent on peduncle, tapering basally; **flowers** 5–7 mm long; ovary 4–5 × 3.5–4.0 mm, square and ribbed in longitudinal-section; style 3.5–4.0 mm long, 2.5–3.5 mm wide, pyramidal and conical, stigma linear, stigmatic secretion yellowish; stamens 1–6 mm long, filament laminar, anther 1.5–2.0 mm long; sterile flowers 4–6 mm long, with yellowish secretion. **Infructescence** with stylar cap green after anthesis, yellowish green at maturity; fruits with white pulp; seeds 6–9 × 5–7 mm, pale brown, with yellowish aril, ovate-oblong; hypocotyl thick and yellow.

**Distribution, habitat and conservation status:**—*Monstera guzmanjacobiae* is endemic to the Los Tuxtlas region, Mexico. It is known from the municipality of Catemaco between La Palma and the road between Tebanca and Miguel Hidalgo, at elevations from sea level to 400 m, in high evergreen rainforest, edge and the interior of the forest, as well as in live tree fences and in abandoned areas of secondary vegetation (locally known as “acahuales”). According to the IUCN Red List Categories and Criteria, the species is considered in CR and EN.

**Phenology:**—Flowering and fruiting was recorded in February, March, April, May, June and November.

**Floral ecology and reproductive biology:**—At the beginning of the flowering sequence (female phase), the spathe unfolds slightly, creating a chamber between the spathe and the spadix with a narrow opening that forms when the edge of the spathe peels away (Fig. 4D). At the base, a second access to the flowers is created when a small hole is opened. At this time, the stigmas of the sterile flowers secrete a sticky transparent resin and emit a strong fruity odor (similar to “that of ripe melon”). The stigmas of all the flowers become receptive when they secrete a transparent to slightly yellowish fluid. In the hours or days that follow, the spathe continues inflating and gradually, expanding its opening. Before anthesis ends, the stigmas wither, the anthers emerge and the pollen is released, and then the spathe opens completely. Small insects, nitidulid beetles and drosophilid flies have been observed inside the floral chamber, and male euglossine bees (*Euglossa* sp.) flying and walking outside the spathe (Fig. 4D). According to the flowering

behavior of the inflorescence and to that documented in other *Monstera* species (Chouteau *et al.* 2007; Prieto & Cascante-Marín 2017), it is possible that only beetles and flies are their pollinators. Once the fruits mature, a large number of ants of the genus *Acromyrmex* sp. visit the infructescences, apparently to feed on the white pulp that covers the seeds (Figs. 4B, C).



**FIGURE 2.** *Monstera guzmanjacobiae* sp. nov. **A.** Young inflorescence; **B.** Infructescence with stylar caps mostly already detached; **C.** Complete flower (left) in lateral view showing an immature stamen; gynoecium in longitudinal-section (right); **D.** Adult plant showing pendent inflorescence and developing flagellum; **E.** Open inflorescence in ventral view; **F.** Open inflorescence in dorsal view; **G.** Sterile flowers, lateral view; **H.** Style and stigma seen from above (left); immature stamen (right); **I.** Seed, lateral view; **J.** Stolon-like seedling transforming into a juvenile shingle-leaved plant at its apex; **K.** Juvenile plant shingle leaved climbing plant.



**FIGURE 3.** *Monstera guzmanjacobiae* sp. nov. **A.** Habit of plant ascending on a tree to over 25 m; **B.** Habit of plant pendent from a living fence in a pasture area; **C.** Scaly pendent stems (*i*), petiole striate at the base (*h*); **D.** Inflorescences on ascending stems; **E.** Young stem showing petioles with glaucous base, marcescent petiolar sheath (*m*) and apical projecting ligule 1.5 cm long (*n*); **F.** Completely terete geniculum; **G.** Base of the petiole with green and white projections.

**Eponymy:**—The species is named in honor of Mexican biologist Valeria Guzmán Jacob from the Göttingen University, who helped to collect the type specimen.

**Additional specimens examined (paratypes):**—MEXICO. Veracruz: Municipio Catemaco, La Palma, Acahual (con elementos de selva alta perennifolia), 18°33'12"N, 95°03'41"W, 30 m, 20 September 2018, *Pedro Díaz Jiménez, P. Adrián Aguilar Rodríguez & M. Montano Alarcón* 1427 (MEXU; UJAT); Municipio Catemaco, Tebanca, relicto de selva alta perennifolia, 18°22'13"N, 95°00'56"W, 361 m, 25 February 2019, *Pedro Díaz Jiménez & M. Montano Alarcón* 1429 (XAL).



**FIGURE 4.** *Monstera guzmanjacobiae* sp. nov. **A.** Detachment stylar layer of a mature infructescence; **B** and **C.** Exposed seeds surrounded with white pulp, with numerous foraging ants of the genus *Acromyrmex* sp.; **D.** Euglossine bee (*Euglossa* sp.), visiting the inflorescence at the beginning of the female phase of anthesis.

**Notes:**—In Los Tuxtlas region, although one of the most studied sites in Mexico (Guevara *et al.* 2004), *M. guzmanjacobiae* had not been previously collected. This new species differs from others in the genus by the ligule of the petiole sheath 1.5–3 cm in length, the adult leaf blade with fenestrations (1–4 perforations) often only on one side or lacking fenestrations, the inflorescence erect or inclined, the flowers with a conical pyramidal style, the seeds with a yellowish aril and with a thick yellow hypocotyl. A unique feature in *M. guzmanjacobiae* is the yellowish coloration of the seed aril and the thick, yellow hypocotyl.

*Monstera guzmanjacobiae* is the third species of *Monstera* in Mexico reported to have a flowering on pendent stems and the fourth within sect. *Marcgraviopsis*. Although is similar to *M. luteynii* Madison (1977: 207) and *M. maderaverde* Grayum & Karney (2012: 66), endemic species from Costa Rica and Honduras respectively, both species have non-fenestrate blades (rarely in *M. maderaverde*) and flowers with truncate style. In addition, this last species belongs to sect. *Tornelia*. The pendent habit also occurs in the Mexican species *M. tuberculata* Lundell, although the latter has leaf blades two to three times smaller, rarely fenestrate, and the inflorescences are completely pendent (inclined between 40–60° and rarely erect in *M. guzmanjacobiae*). Adults plants of *M. guzmanjacobiae* have leaf blades similar to those of pre-adult *M. punctulata*. However, in this last species the fenestrations have varied sizes and some reach the edge of the blades.



**FIGURE 5.** Characteristic growth of *Monstera luteynii* Madison in Costa Rica. **A.** Branching pendent habit; **B.** Stem collected with entire cordate leaves; **C.** Stem and base of petioles densely verrucose with light brown pustules; **D.** Densely striate and scaly geniculum.

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