

# *Echeveria michihuacana* (Crassulaceae), a new species from Michoacán, Mexico

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**Abstract.** *Echeveria michihuacana* (Crassulaceae), a new species for science, is described and illustrated. The new taxon is related to a group of species of *Echeveria* series *Gibbiflorae* from western Mexico, including *Echeveria dactylifera*, *Echeveria fulgens*, *Echeveria patriotica*, and particularly the recently published *Echeveria pistioides*. With the last species, *E. michihuacana* is similar in the shape and coloration of floral structures, as well as in its geographical distribution. In contrast, it differs from all of the aforementioned related species in having an evident stem, larger panicles and flowers, deep-red nectary scales, and absence of appendages on the inner side of the petals.

**Keywords:** Ciudad Hidalgo, *Gibbiflorae*, Mil Cumbres, taxonomy.

**Resumen.** Se describe e ilustra a *Echeveria michihuacana* (Crassulaceae) como nueva especie para la ciencia. El nuevo taxón está relacionado con un grupo de especies de *Echeveria* de la serie *Gibbiflorae* del occidente de México, incluyendo *Echeveria dactylifera*, *Echeveria patriotica*, y en particular, con la recientemente publicada *Echeveria pistioides*. Con esta última comparte la forma y coloración de las estructuras de la flor, así como su distribución geográfica. En contraste, difiere de los taxones relacionados por presentar un tallo evidente, panículas y flores más largas, escamas nectaríferas rojo intenso y por la ausencia de apéndices en la cara interna de los pétalos.

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The genus *Echeveria* DC. (Crassulaceae) is divided into 17 series based on morphological affinities (Kimmach, 2003). The lack of a comprehensive phylogeny for *Echeveria* results in poor understanding of relationships within and among the series of the genus, especially within *E. ser. Gibbiflorae* (Baker) A. Berger. This situation hinders the correct assignment of species to infrageneric groups since relationships can only be inferred by similarity. A genus-wide phylogeny and other data (i.e. DNA barcodes, ecology, palynology) are also needed to better establish the limits of wide-ranging, variable species

complexes, such as the one centered on *E. fulgens* Lem., which is broadly distributed in Mexico.

Series *Gibbiflorae* (incl. *E. ser. Grandes* E. Walther) is characterized by medium to large sized rosettes with broad and flat, sometimes linear-deltoid shaped leaves, inflorescences in panicles or thyrsoid clusters, and tubular (sometimes tending toward urceolate or campanulate) flowers with free styles and stigmas at anthesis, reddish to deep-purple styles, and relatively large, whitish, yellowish or reddish nectary scales (Kimmach, 2003; Meyrán & López, 2003; Pilbeam, 2008).

In December of 2015, during a revisionary study of series *Gibbiflorae* by our research team at the Jardín Botánico of the Instituto de Biología, UNAM (JB-IBUNAM), specimens of an unidentified species of *Echeveria* were collected in three geographical areas in the municipality of Ciudad Hidalgo in the state of Michoacán. The plants were cultivated in greenhouses at the JB-IBUNAM to measure and count their structures while comparing them with living material and herbarium specimens of related species at the MEXU herbarium (e.g. *E. dactylifera* E. Walther, *E. fulgens* Lem. and *E. patriotica* I. García & Pérez-Calix) and the protologue of *E. pistioides* I. García, I. Torres & Costea, (García-Ruiz et al., 2016). This morphological comparison allowed the identification of morphological traits to diagnose a new species.

### Species description

***Echeveria michihuacana*** de la Cruz-López, Reyes & Vergara-Silva, **sp. nov.** Type: Mexico, Michoacán, mpio. Ciudad Hidalgo, along the Mexico 15 highway from Morelia to Ciudad Hidalgo, near Mil Cumbres, 19°38'39.17"N, 100°47'10.21"W, 2564 m, Sep 2015 [–fl], *L. E. de la Cruz L. 184* (holotype: MEXU; isotype: MEXU). (Fig. 1, 2).

**Diagnosis:** *Echeveria michihuacana* is morphologically similar to *E. dactylifera*, *E. patriotica*, *E. pistioides* and, in some aspects, the *E. fulgens* complex. Morphologically, the species can be differentiated from these related taxa by having an evident caudex (2–30 cm long), large (4–30 cm) and often crenulated leaves, larger inflorescences, conoid-tubular flowers, red petals, deep red nectary scales, and the lack of epipetalous appendages.

Perennial herb, glabrous, solitary or with lateral shoots, caulescent, main roots somewhat thickened, secondary roots fibrous; stems erect or somewhat decumbent, 2–30 cm long and 1–3.5 cm in diameter, reddish brown at base and green at apex, with light brown leaf scars; leaves in a spiral arrangement forming a lax rosette up to 50 cm in diameter, obovate to lanceolate-oblancoelate, green with red margins or completely reddish in the dry period, 4–30 cm long, 1.6–3.3 cm wide at the base and 2.3–10 cm wide at widest point below the apex, pseudo-petiolate and winged at the base,

adaxial surface canaliculate, abaxial surface keeled, only the apical leaves slightly pruinose, apex obtuse to rounded, mucronate, margins entire to crenate, reddish; inflorescence 1–3 panicles per rosette, 50–120 cm long or more and 1.8 cm wide at the base, with 2–5 cincinni each, peduncles ascending, up to 20 cm in length, light pink to reddish; bracts 10–30, ascending, arranged in a spiral, deciduous, oblanceolate, 1.7–9.7 cm long, 0.6–4.6 cm wide, with obtuse apex, spurred, green with red margins; bracteoles lanceolate, 0.5–1.1 cm long, 1.5–4 mm wide, green with pink dyes, spurred, apex acuminate; pedicels 3–8 mm long, 2.5–3 mm thick, pink; calyx of 5 sepals, these fused at the base, linear-deltoid, reflexed, unequal, 0.7–1.6 cm long, 3.5–6 mm wide at the base and 2 mm thick, green, apex acuminate, pink, slightly pruinose; corolla conoid-tubular in bud, tubular-urceolate at anthesis, rounded to slightly pentagonal in transection, 1.8–2.15 cm long, 1.6–1.95 cm wide at the base, 0.9–1.25 cm wide at the apex, segments ovate-lanceolate, dorsally slightly keeled, fused at the base, imbricate, apex acute and slightly reflexed, 6.5–8 mm wide at the base, orange or pink, internally yellow with reddish margins and apex, somewhat thickened at the sides of the epipetalous filaments, nectar cavity reduced; androecium included, stamens 10, 5 episepalous, 1.4–1.7 cm in length, 5 epipetalous slightly shorter, filaments yellow, anthers 1.5–3 mm in length, pale yellow; gynoecium included, carpels 5, free, 1.4–1.7 cm long, 3–3.8 mm wide at the base, nectary scales lunate-reniform, 4 mm wide and 1.5–2 mm tall, deep red, ovaries white to pale yellow, styles wine-red to dark purple, stigmas green; fruit with 5 divergent follicles, with numerous reddish seeds.

**Distribution and habitat.**—The new taxon is known only from three localities in the eastern part of the state of Michoacán. It is common in roadside *Pinus* sp. forest along the road from Morelia to Ciudad Hidalgo (near Mil Cumbres and Huajúmbaro) and at two nearby localities on the road from Ciudad Hidalgo to Ucareo (near Los Azufres).

**Phenology.**—Flowering occurs from October to January.

**Etymology.**—The specific epithet refers to the word “michihuacán,” the Nahuatl word for Michoacán, to which the taxon seems to be



FIG. 1. *Echeveria michihuacana*. A. Habit. B. Young leaves. C. Stem and reddish winter leaves. (Photographs by L. E. de la Cruz-López.)

restricted. In Nahuatl, “michihuacán” means “lugar de pescadores” (fishermen’s place).

**Additional specimens examined.** MEXICO. Michoacán: Mpio. Hidalgo, along the highway from Ciudad Hidalgo to Jeráhuaro de Juárez, 5 km SW of Los Azufres, 19°45'50.12"N, 100°41'45.99"W, 2646 m, *L. E. de la Cruz 184–5* (MEXU); Mpio. Hidalgo, along the highway from Ciudad Hidalgo to Jeráhuaro de Juárez, 8 km SW of Los Azufres, 19°45'21.84"N, 100°41'15.145"W, 2521 m, *L. E. de la Cruz 184–6* (MEXU).

The new species is placed in *Echeveria* series *Gibbiflorae* due to its possession of diagnostic characters for the series such as inflorescences organized in simple secund racemes or more frequently paniculate-thyrsoïd clusters, styles

reddish, wine-red or deep purple (never yellow or green), and the styles and stigmas free at anthesis (Moran, 1974; Kinnach, 2003; Meyrán & López, 2003; Pilbeam, 2008). Some authors (García-Ruiz & Pérez-Calix, 2007) segregate series *Retusae* E. Walther from series *Gibbiflorae*, and the new taxon might be better placed in the former series. However, the main distinction between the two series (i.e., acaulescent habit in series *Retusae* vs. caulescent habit in series *Gibbiflorae*) appears to be an artificial distinction.

Within series *Gibbiflorae*, preliminary phylogenetic analyses (de la Cruz-López et al., unpubl. data) and morphology suggest the existence of

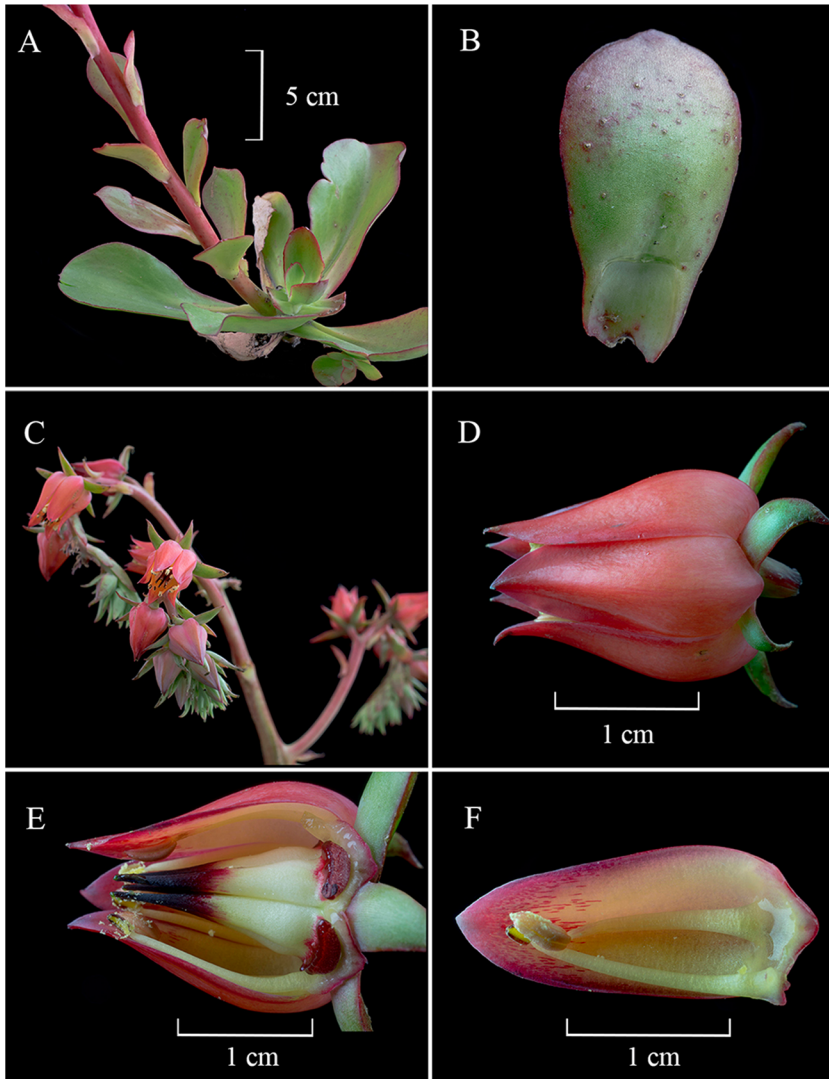


FIG. 2. *Echeveria michihuacana*. A. Rosette. B. Bracts. C. Detail of inflorescence. D. Lateral view of flower. E. Internal view of flower, highlighting carpels and deep red nectary scales. F. Inner face of petals without appendages in epipetalous filaments. (Photographs by L. E. de la Cruz-López.)

two main groups. One group is formed by species from southern Mexico with relatively small flowers and usually white or yellow ovaries and nectary scales. The second group, to which *E. michihuacana* seems to be more closely allied, is composed of species from western Mexico with relatively large flowers and carpels and usually yellow or reddish nectary scales, and includes *E. cante* Glass & Mend.-Garc., *E. cerrograndensis* A.Vázquez & Nieves, *E. dactylifera* E.Walther, *E. novogaliciana* J.Reyes, Brachet & O.González, *E. marianae* I.García & Costea,

*E. munizii* Padilla-Lepe & A.Vázquez, *E. patriotica* I.García & Pérez-Calix, *E. perezcalixii* Jimeno-Sevilla & P.Carrillo, *E. pistioides* I.García, I.Torres & Costea, *E. purhepecha* I.García, *E. roseiflora* J.Reyes & O.González, *E. rulfiana* Jimeno-Sevilla, Santana Mich. & P.Carrillo and *E. subrigida* Rose.

Among the species of the “western Mexico group” of series *Gibbiflorae*, *E. michihuacana* resembles *E. dactylifera*, with which it shares large rosettes and green, red-margined leaves that tend to become completely red in winter

(November to February). *Echeveria michihuacana* differs from *E. dactylifera* in its tubular-urceolate (vs. tubular-campanulate) corolla, deep red (vs. yellow) nectary scales, purple (vs. reddish) styles, and in lacking appendages in the epipetalous filaments (vs. appendages present) (Table I; Fig. 3). *Echeveria michihuacana* is also morphologically related to *E. patriotica* I. García & Pérez-Calix in terms of floral dimensions, especially in the length of the corolla (Table I), stamens (1.7 cm vs 1.4–1.6 cm) and carpels (2 cm vs 1.2–2 cm), but the former is easily distinguished by having a pinkish to orange-red

TABLE I. MORPHOLOGICAL COMPARISON OF SPECIES RELATED TO *E. MICHIHUACANA*.\*

Character/Taxa	<i>E. michihuacana</i>	<i>E. dactylifera</i>	<i>E. fulgens</i>	<i>E. patriotica</i>	<i>E. pistioides</i>
Stem					
Length	2–30 cm	Up to 9 cm	5–25 cm	(18)–20 cm	2–15 cm
Rosette					
Diameter	Up to 50 cm	35.5 cm	Up to 30 cm	10–(26)–35 cm	14–50 cm
Leaves					
Color of mature leaves	Green, red in dry season	Green to reddish	Glaucous	(Yellowish), reddish	Light green to emerald green, glaucous at base
Shape	Obovate to lanceolate–oblanceolate	Lanceolate–oblanceolate	Obovate to oblanceolate	Oblong–obovate to spatulate	Obovate–spatulate, widely obovate, obcordate
Margin	Entire, crenate or crenulate	Entire	Crenate or crenulate	Entire	Entire, crenulate in young leaves
Margin color	Red	Red or hyaline	Redish or hyaline	(Hyaline), reddish	Same as leaves or red, less frequently hyaline
Corolla					
Length	1.8–2.15 cm	2.3 cm	1–1.6 cm	1.8–(1.9)–2.0–(2.3) cm	1.2–1.6 cm
Width at base	1.6–1.95 cm	1.0 cm	0.8–1 cm	(1.2)–1.4 cm	0.95–1.1 cm
Lateral shape	Conoid–tubular	Tubular–urceolate	Tubular	Cylindrical–urceolate	Pentagonal–conical in bud, cylindrical–urceolate at anthesis
Frontal shape	Cylindrical–pentagonal	Cylindrical–pentagonal	Pentagonal	(Cylindrical–pentagonal)	Cylindrical
Outer petal color	Orange–pink at base, reddish at apex	Pink at base, yellow at margin and apex	Orange–red	White to cream at base, orange–red at apex	Cream to light pink at base, pink–orange to reddish in the rest
Petal inner face appendices	Absent	Present (cylindrical)	Absent	Present (cylindrical)	Absent
Nectaries					
Nectary length	1.5–2 mm	3 mm	1–1.5 mm	1 mm	1 mm
Nectary shape	Lunate–reniform	Lunate–reniform	Reniform	Reniform	Rectangular, reniform or bilobed
Nectaries color	Deep red	Yellow	Yellow or whitish	Red–purple	Cherry red
Flowering time	October–January	December	October–January	October–January	November–January
Geographic distribution	Center of Michoacán	Aguascalientes, Durango, Sinaloa	Estado de México, Michoacán, Morelos	South of Jalisco	Center of Michoacán

\*Measurements in brackets for *E. patriotica* were taken from García-Ruiz and Pérez-Calix (2007). Measurement data for *E. pistioides* was taken from García-Ruiz et al., (2016).



FIG. 3. Comparison of rosette and flower morphology in *Echeveria michihuacana* and related species. A. *E. michihuacana*. B. *E. dactylifera*. C. *E. fulgens*. D. *E. patriotica*. E. *E. pistioides*. (Photographs by L. E. de la Cruz-López.)

corolla (vs. bicolored, white or cream at the base and reddish in the upper half), as well as by the absence of appendages on the inner side of the petals (Fig. 3A, D).

The flowers of *E. michihuacana* are most similar to those of *E. pistioides*. The two species share a tubular-conoid corolla in bud and tubular-urceolate corolla at anthesis, pinkish-orange petals, deltoid-elongate ovaries, deep red to purple styles, green stigmas, deep red nectary scales, and the lack of appendages on the inner side of the petals (Fig. 3A,,E; Table I). On the other hand, the new

species differs from *E. pistioides* particularly in the caudex 2–30 cm long (vs. 2–15 cm), the leaves oblanceolate (vs. widely obovate), the inflorescences less strikingly pruinose, and often somewhat longer (50–120 cm vs. 30–90 cm), and the flowers 1.8–2.15 cm long (vs. 1.2–1.6 cm).

The new species has been mistakenly identified as *E. fulgens* Lem. in herbaria (e.g., *C. Delgadillo 12*, MEXU), and indeed some characters of *E. michihuacana* are shared with the *E. fulgens* complex, such as the presence of a stem, oblanceolate leaves with red or brown-reddish margins

that are frequently undulate-crenate, and the reddish flowers. However, *E. michihuacana* differs from the *E. fulgens* complex by having deep-red (vs. yellow or whitish) nectary scales (Walther, 1972; Pérez-Calix, 2008), as well as by the additional characters listed in Table I.

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- APPENDIX 1.** Specimens examined of four species of *Echeveria* that are closely related to *E. michihuacana*; all of the cited collections are from Mexico.
- Echeveria dactylifera*: SINALOA:** Durango-Mazatlán highway, Espinazo del Diablo, *J. Reyes S. 6274* (MEXU).
- Echeveria fulgens*: ESTADO DE MÉXICO:** Mpio. Amanalco, volcanic rocks 1 Km south of San Juan Amanalco, 2340 m, Quercus scrub, *A. García-Mendoza et al. 6123*, 8 Dec 1995 (MEXU); **Michoacán:** Mpio. Zitácuaro, 3.78 km north of San Felipe de Los Alsati. 19°31'20.1"N, 100°21'59.7"W, 2147 m, pine-oak forest, *D. Álvarez et al. 14,683*, 17 Nov 2014; between Cd. Hidalgo and Mil Cumbres, km 232, old México-Nogales highway, *C. Delgadillo 12*, 15 Dec 1965 (MEXU); mpio. Zacapu, west of Angostura, matorral pedregoso, *A. Grimaldo 422*, 18 Nov 1988 (MEXU); mpio. Uruapan, malpais (lava fields) of Capacúaro, forest of Quercus, 2250 m, *E. Pérez-Calix 3544*, 9 Dec 1996 (MEXU); mpio. Pátzcuaro, 2 km southeast of Cerro del Estribo, oak forest, 2230 m, *J. Espinosa 2436*, 8 Dec 1986 (MEXU); mpio. Zacapu, El Pinal, near Santa Gertrudis, oak forest on basaltic lava stream, 2100 m, *H. Díaz y A. Grimaldo 4498*, 6 Nov 1987 (MEXU); **Morelos:** Mpio. Huitzilac, ± 1 km southwest of Huitzilac, pine-oak forest, on volcanic rocks, 2550 m, *E. Pérez-Calix & I. García 3966*, 25 Oct. 1999 (MEXU).
- Echeveria patriotica*: Michoacán:** between Palo Dulzal and Palo Herrado along road from Quitupan to Santa María del Cerro, 2322 m, *J. Reyes S. 6813* (MEXU).
- Echeveria pistioides*: Michoacán:** Mpio. Tzitzio, aproximadamente 1 km al SE de Piedras de Lumbre, 1950 m, *J. Etter y M. Kristen 4191* (MEXU).