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Echeveria xochipalensis (Crassulaceae), a new species from Guerrero, Mexico

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Abstract

Echeveria xochipalensis, from the state of Guerrero, Mexico, is described as a new species to science. It is related to species of ser. *Gibbiflorae*, particularly to both *E. fulgens* varieties, from which it is distinguished by its green to lilac-gray spatulate leaves, although they commonly are coppery tinged; the leaves are rigid and with entire margin (not crenate), the margin is yellow-hyaline; bracts oblanceolate with rigid consistency; corolla pink at base and orange at the apex and whitish filaments, ovaries and nectary scales.

Key words: *Echeveria*, *Gibbiflorae*, succulents, white leaf scars, Xochipala

Resumen

Se describe e ilustra a *Echeveria xochipalensis* del estado de Guerrero, México, como nueva especie para la ciencia. Se relaciona con las especies de la ser. *Gibbiflorae*, en particular con las dos variedades de *E. fulgens*, de las cuales se diferencia por sus hojas espatuladas de color verde a lila-grisáceas, aunque con frecuencia cobrizas, rígidas y con margen entero (no crenado), éste amarillo-hialino; brácteas oblanceoladas de consistencia rígida; corola de color rosa con ápice naranja y filamentos, ovarios y nectarios blanquecinos.

Introduction

In the genus *Echeveria* A. P. de Candolle (1828: 401), ser. *Gibbiflorae* (Baker) A. Berger (1930: 472) consists of approximately 36 described species, and while the limits for the majority of these taxa are more or less evident, *E. fulgens* Lemaire (1845: 8) shows a great uncertainty in its taxonomic delimitation. This is due to the insufficiency of diagnostic characters in the original description by C. Lemaire and therefore, E. Walther (1972: 159) was forced to re-describe *E. fulgens* to complete its description, also it lacks a specified type locality. In addition, there is an enormous morphological and morphometric variation found in specimens from different localities in Mexico which have all been associated with this name. Recently, new species in this series have been published which would probably have been associated with *E. fulgens*, but whose comparison has allowed their differentiation based on morphological diagnostic characters, biogeographical and phenological comparisons among others: *E. aurantiaca* J. Reyes, O. González & Brachet (Reyes *et al.* 2011: 70), *E. cerrograndensis* A. Vázquez & Nieves (Nieves-Hernández *et al.* 2014: 248), *E. munizii* Padilla-Lepe & A. Vázquez (Vázquez-García *et al.* 2014: 166), *E. perezcalixii* Jimeno-Sevilla & P. Carrillo (Jimeno-Sevilla & Carrillo-Reyes 2010: 303), *E. pistioides* I. García, I. Torres & Costea (García-Ruiz *et al.* 2016: 966), *E. purhepecha* I. García (García-Ruiz 2011: 63) and *E. roseiflora* J. Reyes & O. González (Reyes & González-Zorzano 2010: 22). From this perspective, the *E. fulgens* complex has started to break down into smaller and better diagnosable units. Following this trend, *E. xochipalensis* from specimens collected in the municipality of Eduardo Neri, in the Mexican state of Guerrero, is proposed as a new species to science. The description of the new taxon is based on morphological and geographical evidence.

Material and Methods

Through explorations made to the state of Guerrero, Mexico, during the revision of the genus *Echeveria* and, in particular, of ser. *Gibbiflorae*, specimens of this last series were located near the town of La Laguna on the road from Xochipala to Filo de Caballos. Several specimens were collected and deposited in the herbarium MEXU, while others were kept as living plants cultivated in greenhouses of the “Colección Nacional de Crasuláceas”, belonging to the “Instituto de Biología, Universidad Nacional autónoma de México”. Following comparisons with related species (herbarium and cultivated plants), morphological differences between them were identified.

Taxonomic treatment

Echeveria xochipalensis J.Reyes, de la Cruz-López & Vergara-Silva. *sp. nov.* (FIGS. 1–3)

Echeveria xochipalensis can be distinguished from the *E. fulgens* complex, by the white leaf scars on the stems, the entire leaf margins, adaxially channeled at the base and pseudo-petiolate, leaf color frequently in hues of copper, the yellowish to hyaline leaf margin, pinkish-orange corolla instead of orange-reddish, the whitish filaments, instead of yellowish in the two *E. fulgens* varieties, as well as whitish ovaries and nectary scales, instead of yellowish ones (Table 1). It also differs from *E. crenulata*, by its less branched inflorescences, shorter pedicels and pink-orange (vs pink-yellow) corolla.

Type:—MEXICO, Guerrero, municipality Eduardo Neri, 1960 m, about 2 kms southwest of La Laguna, along the road from Filo de Caballo to Xochipala, 11 November 2012, *J. Reyes 8132* (holotype, MEXU!).

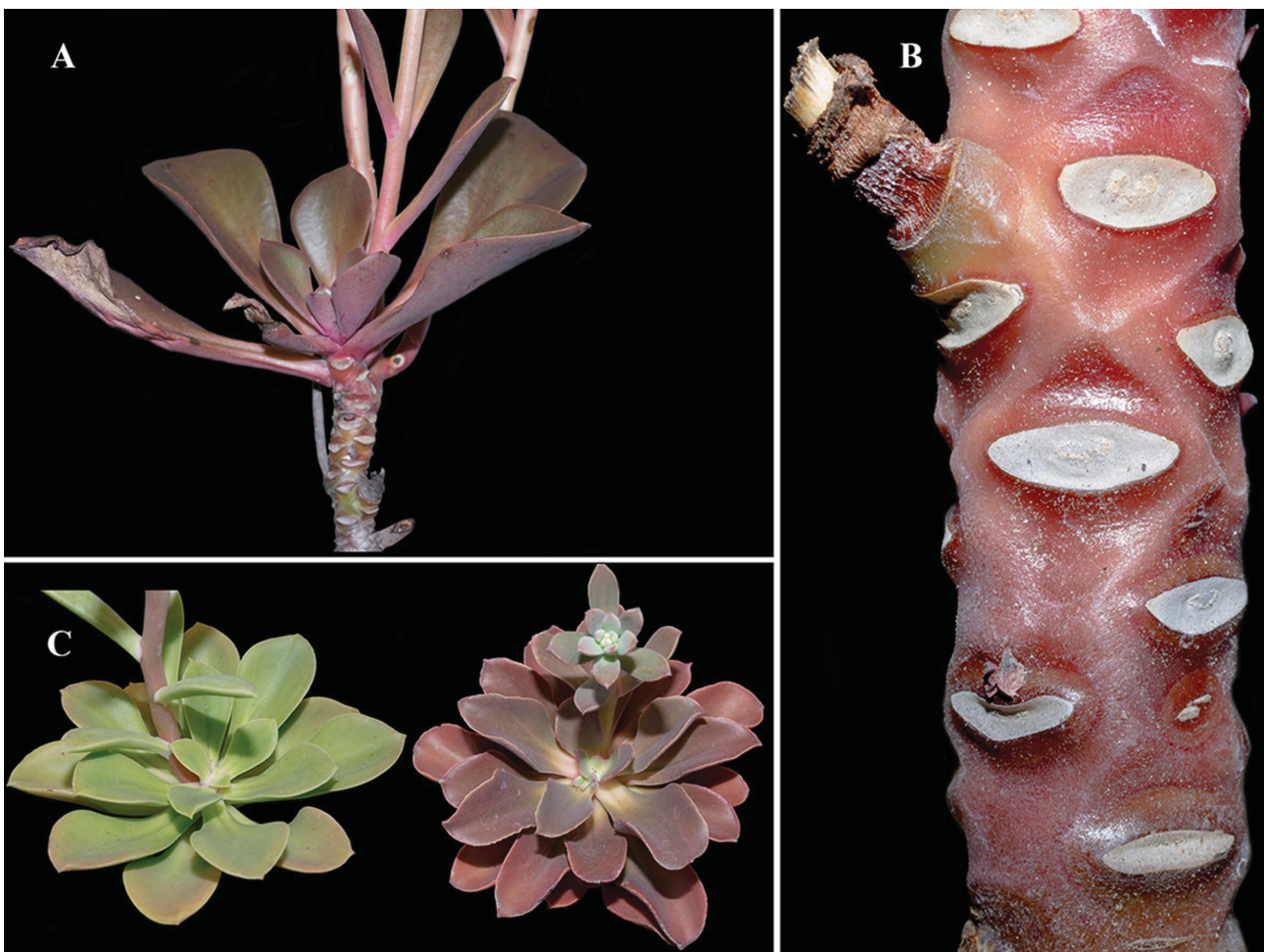


FIGURE 1. *E. xochipalensis*. A. Habit. B. Stem detail with white leaf scars. C. Leaf color variation. Photos: Luis Emilio de la Cruz.

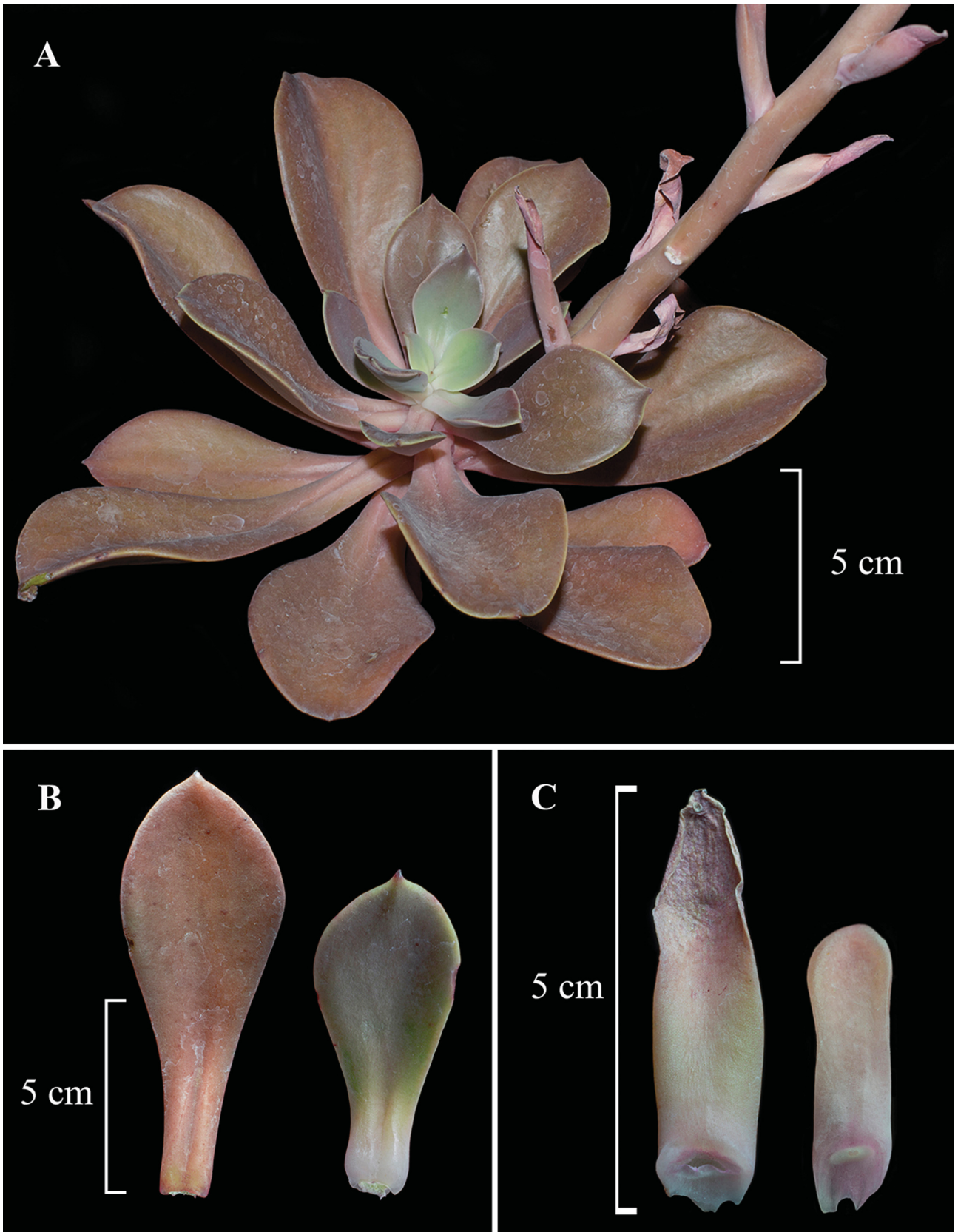


FIGURE 2. *Echeveria xochipalensis*. **A.** Rosette detail. **B.** Pseudo-petiolate and spatulate leaves. **C.** Variation in length and form of floral stem leaves. Photos: Luis Emilio de la Cruz.

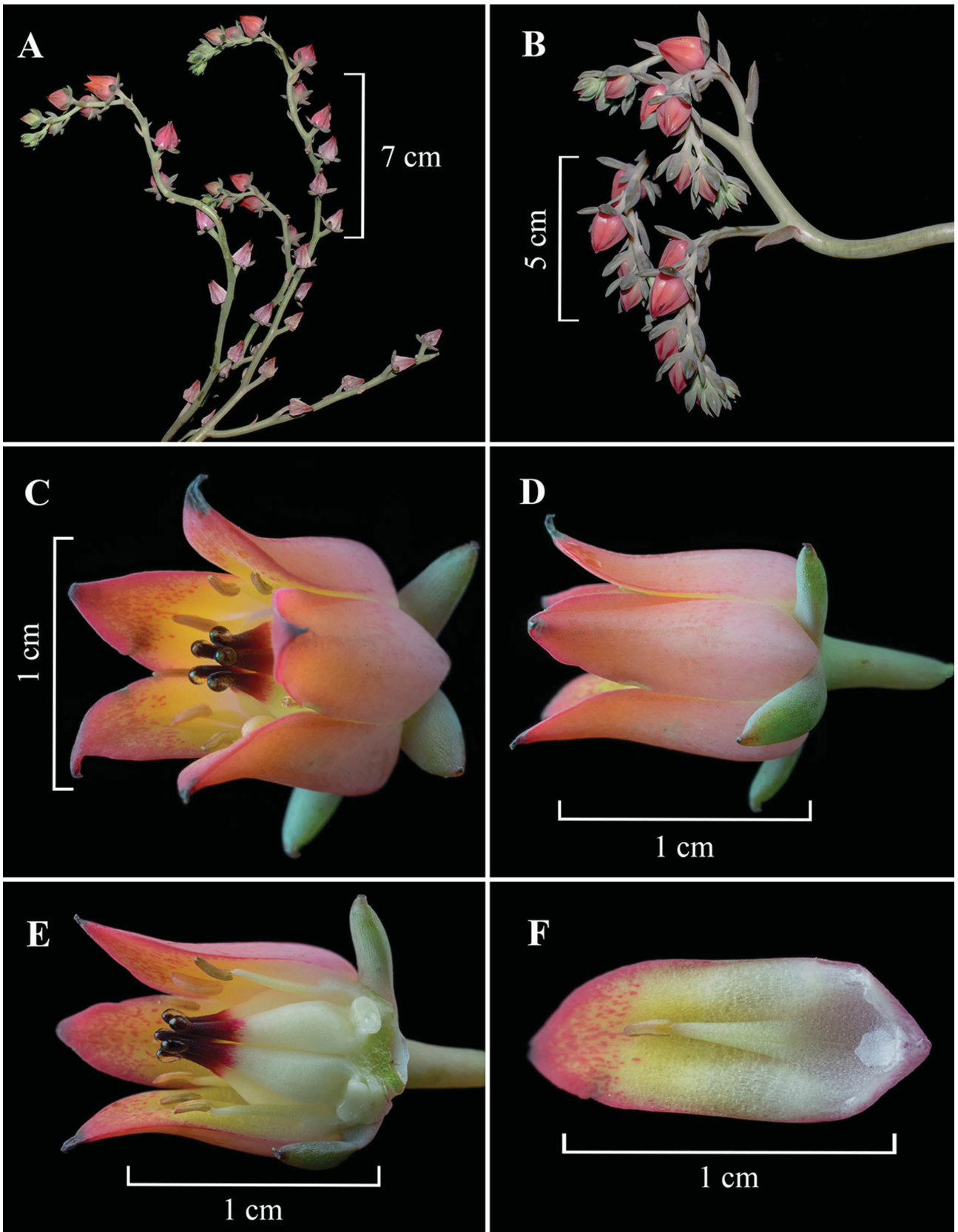


FIGURE 3. *Echeveria xochipalensis*. **A.** Inflorescence. **B.** Detail of inflorescence. **C.** Front view of the corolla and calyx segments. **D.** Side view of the corolla. **E.** Dissected flower, view of the androecium and gynoecium segments. **F.** Internal view of the petal. Photos: Luis Emilio de la Cruz.

TABLE 1. Morphological comparison between *E. xochipalensis*, *E. crenulata* and *E. fulgens* varieties.

Character/Taxon	<i>E. xochipalensis</i> sp. nov.	<i>E. crenulata</i>	<i>E. fulgens</i> var. <i>fulgens</i>	<i>E. fulgens</i> var. <i>obtusifolia</i>
Stem				
Length	Up to 7 cm	Up to 30 cm	5–25 cm	Up to 5 cm
Rosette				
Diameter	20 cm	Up to 40 cm	Up to 30 cm	Up to 20 cm
Leaves				
Shape	Spatulate	Oblanceolate–obovate	Obovate to oblanceolate	Spatulate, widely obovate
Base of the leaves	Pseudo-petiolate	Pseudo-petiolate	Subsessile, winged	Pseudo-petiolate, winged
Length	2.5–11.5 cm	4–20 cm	4–15 cm	15.5–6.5 cm
Color	Green, copper, lilac–gray, reddish	Light green	Light green to Glaucous	Green
Margin	Entire	Entire to crenulate	Crenate or crenulate	Ondulate, crenate, crenulate
Margin color	Yellowish or hyaline	Reddish	Reddish or hyaline	Hyaline
Inflorescence				
Number of inflorescences	1–4	1–2	1–3	1–3
Length	50–70 cm	Up to 90 cm	Up to 70 cm	Up to 30 cm
Bracts				
Consistency	Rigid	Soft	Soft	Soft
Corolla				
Length	1.2–1.25 cm	1.4–1.7 cm	1–1.6 cm	1–1.3 cm
Shape	Tubular, slightly urceolate	Tubular	Tubular	Tubular
Color	Orange–pink	Pink–Yellow	Orange–red	Reddish
Filaments				
Color	White	White	Yellow	Yellow
Carpels				
Ovaries color	Whitish	White	Light yellow	White
Styles color	Wine–red	Wine–red	Wine–red to deep purple	Wine–red
Stigmas color	Green	Green	Green	Green
Nectaries color	White	White	Yellow or whitish	White
Nectaries shape	Elliptic–reniform	Reniform	Reniform	Elliptic–reniform
Geographical distribution				
	Guerrero	Morelos, Estado de México	Estado de México, Morelos, Michoacán	Estado de México, Morelos

Plant perennial, glabrous, solitary. Main roots somewhat thickened, secondary ones fibrous. Stem erect, simple, up to 7 cm tall, 1–1.3 cm in diameter, brown-reddish at the base and green to pinkish at the apex, with white leaf scars. Rosette lax, up to 20 cm in diameter. Leaves spatulate, pseudo-petiolate, basal leaves green, lilac-gray, or copper colored with pinkish hues, apical leaves greenish, 2.5–11.5 cm long, 1.7–4 cm wide, adaxial surface channeled at base, abaxial surface slightly keeled, only the apical leaves slightly pruinose, apex obtuse to rounded, shortly mucronate, color reddish, margin entire, yellow to hyaline in apical leaves. Floral stem erect, panicle axillary, 1–4 per rosette or more, 50–70 cm long, 1–1.35 cm wide at the base with oblanceolate leaves, quickly deciduous, rigid, ascending, 2–5 cm long, 0.5–0.7 cm wide, spurred, margin entire, apex obtuse, reddish with orange hues. Inflorescence paniculate with up to 4 cincinni of up to 25 cm long, light green, slightly pruinose, bracteoles lanceolate, 0.5–0.7 cm long, 0.17–0.22 cm wide, green to yellowish, spurred, apex acuminate, slightly pruinose. Pedicels 0.5–0.6 cm long, 0.2 cm thick, pale green, slightly pruinose. Calyx 5 sepals, basally fused, deltoid-lanceolate, unequal, 0.5–0.8 cm long, 0.2–0.4 cm wide at the base, 0.2 cm thick, olive green, apex acute, slightly pruinose. Corolla pentagonal in frontal view, slightly urceolate in lateral view, 1.2–1.25 cm long, 0.9–1 cm wide at the base, petals lanceolate, dorsally keeled,

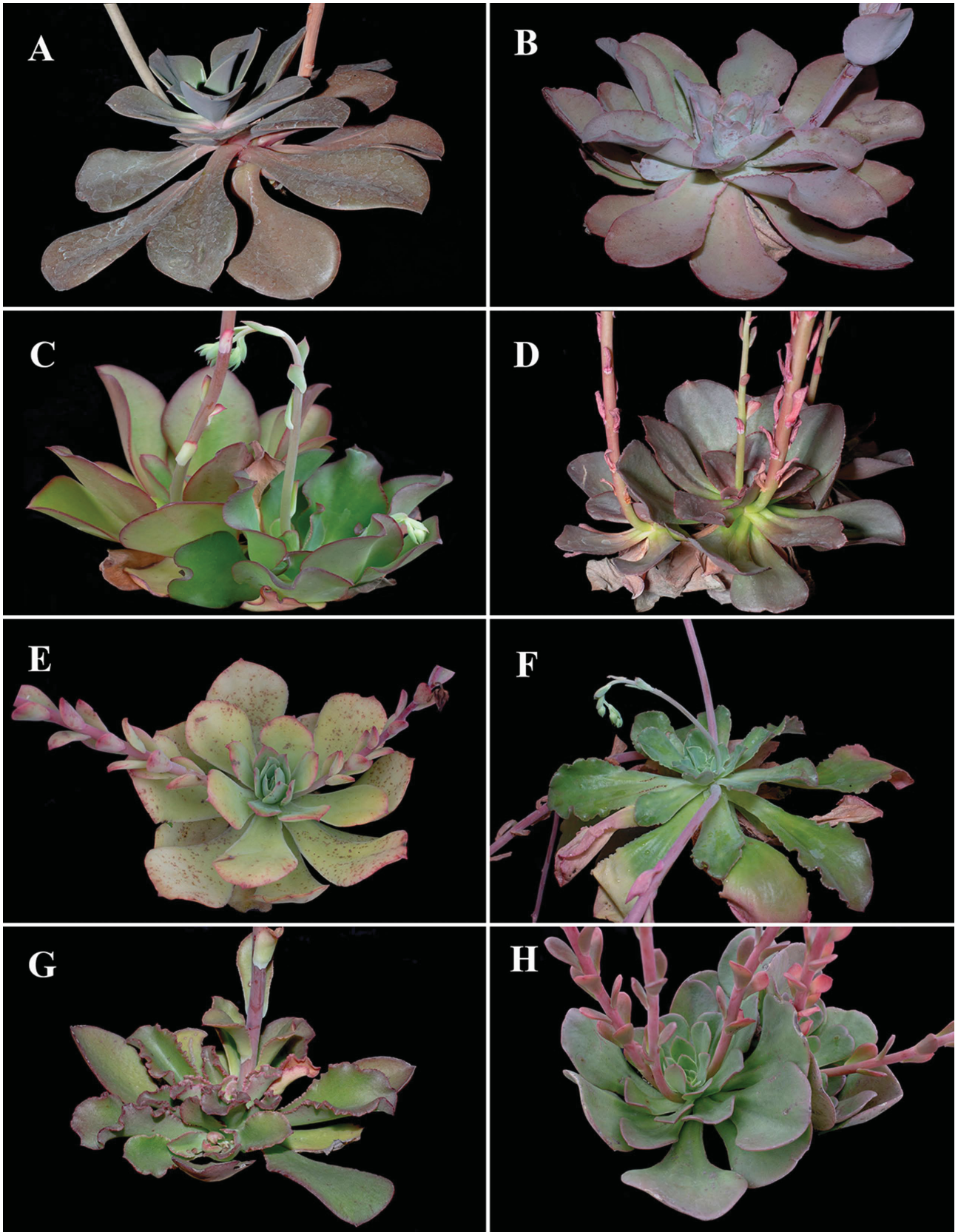


FIGURE 4. Diversity in habit and morphology of leaves inside the *E. fulgens* complex. **A.** *E. xochipalensis*, **B–H.** Specimens from different localities associated to *E. fulgens*. Photos: Luis Emilio de la Cruz.

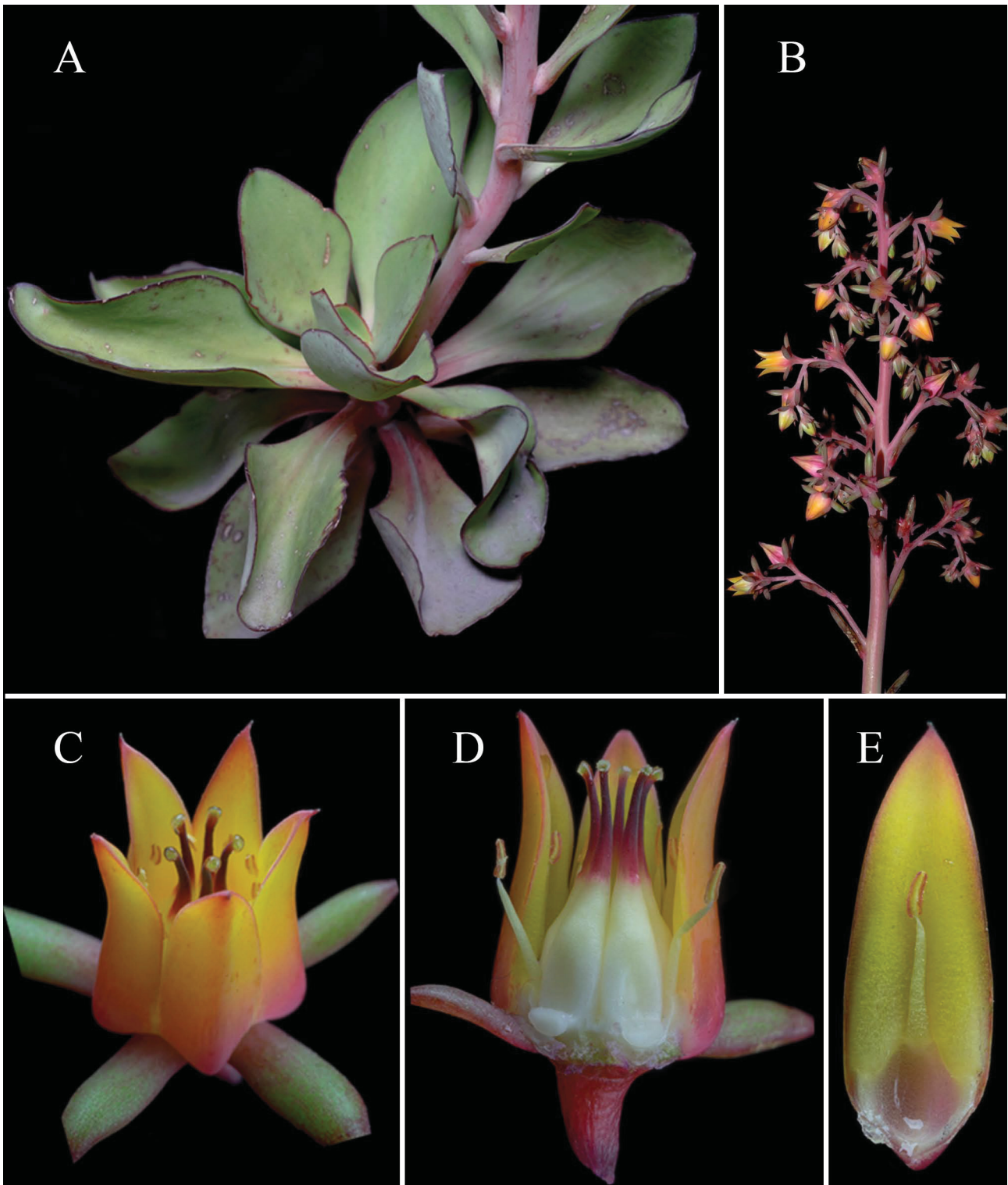


FIGURE 5. *Echeveria crenulata*. A. Rosette. B. Inflorescence. C. Flower. D. Dissected flower, view of ovaries and nectaries. E. Internal view of petal. Photos: Luis Emilio de la Cruz.

united at the base, imbricate, apex acute, slightly deflexed, 0.4 cm wide at the base, pink at the base, orange at the apex, internally tricolored, white at the base, yellow in the middle and reddish at the apex, nectary cavity prominent; androecium shorter than corolla tube, stamens 10, 5 antisepalous, 0.8 cm long, 5 epipetalous, slightly shorter, filaments white with slight yellowish hue, anthers 0.2 cm long, yellow; gynoecium with 5 carpels, free, 0.75–1 cm long, 0.25–0.3 cm wide at the base, nectaries reniform, 0.18–0.2 cm wide, 0.1–0.15 cm tall, white, ovaries white, styles wine red, stigmas wine-red with green apex; fruits follicles with numerous reddish seeds (Figs. 1–3).

Phenology:—Flowers from October to December in habitat.

Distribution and habitat:—*Echeveria xochipalensis* is only known from the type locality. It grows in *Quercus magnoliifolia* Née (1801: 268) forest, somewhat disturbed by adjoining areas of maize fields; other associated species are *Lysiloma acapulcensis* Kunth (Bentham) (1844: 83), *Juniperus flaccida* Schlechtendal (1838: 495), *Ipomoea murucoides* Roemer & Schultes (1819: 248), *Gnaphalium* sp., *Salvia* spp., among others. Further field work is needed in order to find other localities for the present new taxon.

Etymology:—The specific epithet makes reference to the village of Xochipala in the state of Guerrero, Mexico.

Discussion

The new taxon belongs to series *Gibbiflorae* which is characterized by glabrous plants with short or more or less long stems; medium-sized to large rosettes, more or less lax; wide and flat leaves sometimes with a pseudo-petiolate or sessile base; inflorescences one or more, scorpioid cymes or more frequently paniculate-cymose; corollas of 1–3 cm in length, gibbous or not, segments pruinose or not farinose; styles wine colored or purple (never yellow, orange or green; Luis E. de la Cruz-López, pers. obs.) and free styles and stigmas at anthesis (Moran 1974, Kimmach in Eggl 2003, Meyrán & López 2003, Pilbeam 2008). Some authors recognize series *Retusae* E. Walther (1972: 150) where the new taxon would be better positioned since it shares many of its own characteristics with *E. fulgens* var. *fulgens* and *E. fulgens* var. *obtusifolia* (Rose) Kimmach (1997: 51), particularly with reference to the reproductive structures (FIG. 5. B–H). However, the delimitation of both ser. *Retusae* and ser. *Gibbiflorae* is still not clearly established, partly because of the lack of a molecular phylogeny reflecting the relationships in *Echeveria*, supporting the location of lineages that would allow a phylogeny-based classification of the genus and its infrageneric categories. For this reason, we chose to use the criteria of Moran (1974), Kimmach (in Eggl 2003) and Meyrán & López (2003), including the members of ser. *Retusae* in ser. *Gibbiflorae*, at least until these groups are properly defined.

Echeveria xochipalensis, as well as *E. fulgens* var. *fulgens* and *E. fulgens* var. *obtusifolia*, have a short but evident stem, where the leaves are arranged in a more or less loosely arranged rosette (FIG. 1. A), but unlike other specimens of the *E. fulgens* complex, the stem is erect and exhibits large white leaf scars (FIG. 1. B). Moreover, the leaves are spatulate instead of obovate or oblanceolate as in *E. fulgens* (FIG. 2. B, Table 1). The pseudo-petiolate leaf trait from *E. xochipalensis* is rare in *E. fulgens* even when they can be narrowed at the base (sessile), but leaves are frequently flat and winged (FIG. 4. B–H). Leaves and bracts in the new species present rigid consistency, instead of soft and fragile as in both *E. fulgens* varieties. Another trait that differentiates it from other species is the entire, hyaline or yellowish margins, since both *E. fulgens* varieties usually displays wavy, crenate or crenulated leaves. Additionally, variation in leaf color was observed in *E. xochipalensis*, coppery or purple-grayish hues or rosettes with completely light green leaves are common, although in the dry season the leaves can become completely reddish, unlike the *E. fulgens* complex where leaf color variation is restricted to glaucous or greenish-yellowish hues (Table 1).

In summary, the vegetative characteristics of the new species resemble even more *E. crenulata* Rose (1911: 295) than *E. fulgens*, since the leaves are arranged more or less loose on the stem, by its pseudo-petiolate adaxially channeled leaves (FIG. 5, Table 1), which differs from *E. xochipalensis* by panicle inflorescences and pink–yellow (at base and apex, respectively) corolla (FIG. 5). However, the inflorescences of the new taxon and those of *E. fulgens* are very similar in length and form as well as in the dimensions and shape of the bracts, but the consistency of the latter ones in *E. xochipalensis* is rigid, similar to the one of the leaves (Table 1). The flowers also relate it to the *E. fulgens* complex; they are very similar, particularly with respect to the length, width, tubular shape and the orange coloration of the petals, but it has to be noted that the color of both ovaries and nectaries are whitish instead of yellowish (FIG. 6. B–H), as mentioned in the description of *E. fulgens* in E. Walther's monography (1972). Additionally, filaments in *E. xochipalensis* are white versus yellow in *E. fulgens* var. *fulgens* (FIG. 6) and *E. fulgens* var. *obtusifolia* (FIG. 7).

Additional specimens examined

E. crenulata: **MEXICO. Morelos:** municipality Yecapixtla, along the sides of the road, km 11 of Xochitlán-Ocuituco highway near Xochitlán, 1736 m, 18°52'50.74"N, 98°48'48.2"W, 1 January 2016, L. E. de la Cruz-López 182 (MEXU).

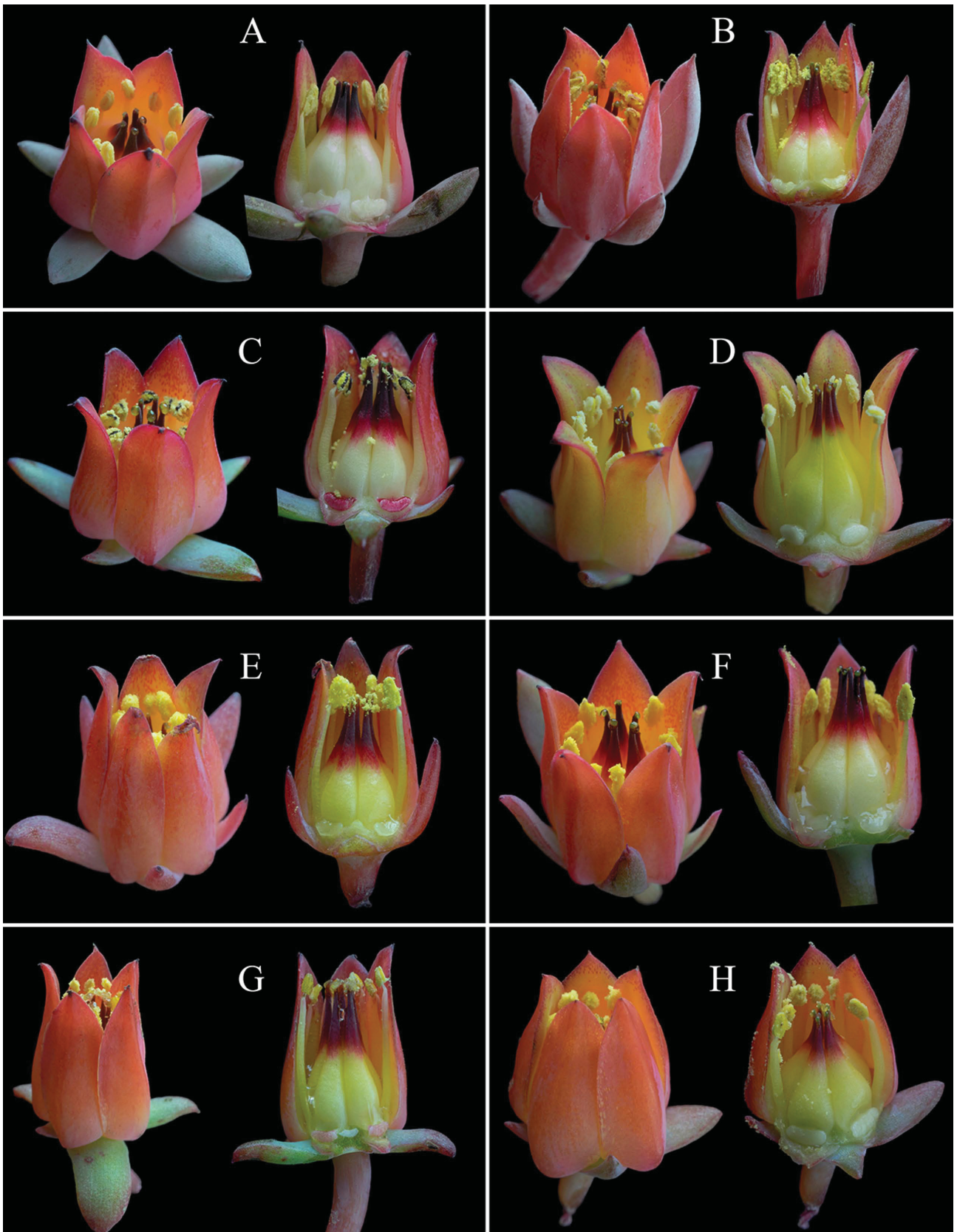


FIGURE 6. Morphological diversity in floral structures of representatives of the *E. fulgens* complex. **A.** *E. xochipalensis*, **B–H.** Specimens from different localities associated to *E. fulgens*. Photos: Luis Emilio de la Cruz.



FIGURE 7. Morphological comparison between: A. *E. xochipalensis* and B. *E. fulgens* var. *obtusifolia*. Photos: Luis Emilio de la Cruz.

E. fulgens: **MEXICO. Estado de México**: municipality Amanalco, volcanic rocks 1 km south of San Juan Amanalco, 2340 m, *Quercus* scrub, 8 December 1995, A. García-Mendoza et al. 6123 (MEXU); **Michoacán**: municipality Ciudad Hidalgo, km 232 between Cd. Hidalgo and Mil Cumbres, old México-Nogales highway, 15 December 1965, C. Delgadillo 12 (MEXU); municipality Pátzcuaro, 2 km southeast of Cerro del Estribo, oak forest, 2230 m, 8 December 1986, J. Espinosa 2436 (MEXU); municipality Uruapan, malpaís (lava fields) of Capacúaro, forest of *Quercus*, 2250 m, 9 December 1996, E. Pérez-Calix 3544 (MEXU); municipality Zacapu, El Pinal, near Santa Gertrudis, 2100 m, oak forest on basaltic lava stream, 6 November 1987, H. Díaz y A. Grimaldo 4498 (MEXU); west

of Angostura, matorral pedregoso, 18 November 1988, *A. Grimaldo 422* (MEXU); municipality Zitácuaro, 3.78 km north of San Felipe de Los Alzati, pine-oak forest, 2147 m, 19°31'20.1"N, 100°21'59.7"W, 17 November 2014, *D. Álvarez et al. 14683* (MEXU).

E. fulgens var. *obtusifolia*: **MEXICO. Morelos.** municipality Huitzilac, ± 1 km southwest of Huitzilac, on volcanic rocks, 2550 m, pine-oak forest, 25 October 1999, *E. Pérez-Calix & I. García 3966* (MEXU).

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