



## *Salvia meera*, *S. rogersiana*, *S. santanae* and *S. concolor* var. *iltisii* (Lamiaceae), three new species and a variety from Jalisco, Mexico

### *Salvia meera*, *S. rogersiana*, *S. santanae* y *S. concolor* var. *iltisii* (Lamiaceae), tres especies nuevas y una variedad de Jalisco, México

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**Abstract.** As part of a major project on the genus *Salvia* in the state of Jalisco and adjacent areas, Mexico, 4 new taxa of *Salvia* L. are described and illustrated. Identification Keys for the related species and comparison tables of morphological characters are given. Three of them were tentatively proposed -but not formally published- as new species in the book *Flora de Manantlán*.

Key words: Jalisco, sect. *Angulatae*, sect. *Briquetia*, sect. *Dusenostachys*, Sierra de Manantlán.

**Resumen.** Como parte de un proyecto mayor del género *Salvia* en el estado de Jalisco y áreas colindantes, México, se describen e ilustran 4 nuevos taxa. Se proveen claves de determinación para las especies relacionadas y tablas comparativas de caracteres morfológicos. Tres de ellos fueron tentativamente propuestos -pero no formalmente publicados- como nuevas especies en el libro de *Flora de Manantlán*.

Palabras clave: Jalisco, sect. *Angulatae*, sect. *Briquetia*, sect. *Dusenostachys*, sierra de Manantlán.

## Introduction

The genus *Salvia* L. as traditionally accepted is not monophyletic; nonetheless, according to Walker et al. (2004, 2007), 3 different clades are recognized. One of these corresponding to subgenus *Calosphace* (Benth.) Benth., which grows from southern United States to northern Argentina and in the Caribbean Islands. This embraces almost all the Mexican species including those treated in this paper. For the 2 remaining clades, 1 is restricted to Eastern Asia and the second has species found in North America, Europe, Southern Africa and Middle East. Epling and coworkers (Epling, 1939; Epling et Mathias, 1957; Epling, 1960; Epling et Játiva, 1963, 1966, 1968) extensively worked on subgenus *Calosphace* and produced a classification that many users follow to date. This classification often reflects groupings defined more by similarity and practical characters rather than by systematic evolutionary assumptions. It is challenging due to the high number of doubtfully circumscribed sections.

Such classification divides the subgenus in 104 sections on the basis of shared morphological characters, but without a phylogenetic analysis that corroborates its validity as a natural group. Despite this, the trend by most users, is to keep using Epling's classification until a new proposal which reflects a better understanding of phylogenetic relationships is produced.

Vázquez-García et al. (1995), and specimens annotated by Ramamoorthy give evidence of at least 6 new *Salvia* L. species in the Sierra de Manantlán, Jalisco, Mexico: *S. brucebenzii*, *S. cuevasiana*, *S. mcvaughii*, *S. meera*, *S. santanae* and *S. vazquezii*; all these names lack of published protologues. The name annotation does not state how to recognize each taxon nor their taxonomic position within any of the infrageneric classifications proposed. As part of a major project, *Flora de Jalisco y Áreas Colindantes*, we have reexamined *Salvia* specimens from the Sierra de Manantlán, particularly those proposed as new taxa. We consider that what Ramamoorthy annotated as *S. cuevasiana* in *Flora of Manantlán* (Vázquez-García et al., 1995) belongs to an extreme of variation of *Salvia polystachya* Cav.; *S. brucebenzii* was published by Turner (2008) as *Salvia acerifolia* B. L. Turner based on a specimen from

Coalcomán, Michoacán; and *Salvia vazquezii* is formalized (Iltis et al., manuscript submitted). After examining the specimens corresponding to *S. meera*, *S. rogersiana*, and *S. santanae*, we agree that these deserve recognition as 3 new species, herewith described and illustrated; additionally we propose the Manantlán populations of *Salvia concolor* Lamb. ex Benth., as being part of a new variety.

## Description

***Salvia concolor* var. *iltisii*** J. G. González et A. Vázquez var. nov. Figs. 1, 2.

Type: **Mexico**. Jalisco. Mpio. Cuautitlán: at first stream crossing (and before rapid descent) of lumber road, 2 km S from San Miguel “meadows”, E-slope of the Sierra de Manantlán Central, 5.3 km S of Rincón de Manantlán, 17.5 km S of El Chante, 19°33'00" N, 104°12'15" W, 2 400 m, 12 Jan 1980 (fl, fr), *H. H. Iltis*, *P. Sorensen* and *P. Matekaitis 2623* (holotype: IBUG; isotypes: ENCB, MEXU, WIS not seen).

*Salvia concolor* Lamb. ex Benth. primo ad aspectu maxime simile, sed foliis tenuibus ad basin alte cordatis, calycibus flavovirentibus, calycum labio superiore longe caudato (cauda 3-4 mm longa) integro ad apicem.

Perennial herbs or subshrubs, erect, 1-2(-3) m tall, stems lax and slightly inclined, sparsely pilose, mainly on the ribs and with some pale orange sessile glandular dots. Petioles 7-13.2 cm long, glabrescent. Leaves ovate, 10-15 × 6-13 cm, deeply cordate at the base, acuminate at the apex, the margin finely serrate and sparsely bordered with straight simple hairs, both surfaces green, concolor, the adaxial surface sparsely covered with conical tiny hairs, the abaxial surface glabrous or with some appressed hairs spread on the veins, covered with pale orange sessile glandular dots (not visible to the naked eye), chartaceous texture. Inflorescences on terminal racemes, 25-38 cm long, each raceme with 9-25 verticillasters, these 1.5-2.5 cm apart from each other toward the base, verticillaster 6-12-flowered; floral axis profusely pilose and with tiny glandular capitate hairs. Floral bracts ovate-lanceolate, 5-6 × 1-2 mm, rounded or truncate at the base, long attenuate at the apex, yellowish-green, deciduous. Pedicels 4-6 mm long in flower, 9-12 mm long during fructification, covered with glandular capitate hairs longer than those present on the floral axis. Calyces 6-8 × 3-4 mm in flower, accrescent 10-15 × 4-6 mm in fructification, yellowish green, slightly darker on the dorsal line, the lips acute and unequal particularly during the fructification, the upper one 3.5-5 mm long, the lower one 2-3 mm long, both aristate at the apex, the aristae of the lower lobes 1.8-2 mm long, those from the upper lobe 3-4 mm long during fructification, the upper lip 5-veined, moderately covered with pale orange sessile glandular dots, occasionally covered

with tiny conical hairs on the inner surface toward the throat. Corollas dark blue with white nectar guides, sparsely pilose throughout its surface, with pale orange sessile glandular dots concentrated toward the lips; tube 20-22 mm long, slightly ventricose, 4.5-5.5 mm wide at its widest portion, not invaginated at the base, internally naked (epapillate); upper corolla lip 5-6.5 mm long, the lower one 5-6(-8) mm long, 5-6 mm wide. Stamens included; filaments 1-2 mm long, connectives 7.5-8.5 mm long, entire, theca 1-2 mm long; 2 staminodia relatively developed behind and above the insertion point of the filaments, 1 mm long, globose at the apex. Gynobasic horn 2-3 mm long; styles 25-26 mm long, abaxially and adaxially pilose toward the apex, the upper branch longer and exserted. Nutlets ovate, 2-2.3 × 1.3-1.4 mm, tan and dark brown marbled, smooth and glabrous.

## Taxonomic summary

**Distribution, habitat and phenology.** *Salvia concolor* var. *iltisii* grows in montane cloud forests at 2 400 m altitude, with *Abies religiosa* (Kunth) Schldl. et Cham., *Alnus jorullensis* Kunth, *Cirsium tolucanum* (B. L. Rob. et Seaton) Petr., *Montanoa andersonii* McVaugh and *Tillandsia* sp. It presents flowers and fruits in January.

**Etymology.** This new variety honors Prof. Hugh H. Iltis, who has been instrumental in the establishment of the Reserva de la Biosfera Sierra de Manantlán (Jalisco and Colima, Mexico) and for his botanical exploration and knowledge of its flora.

**Additional material examined.** Mexico. Jalisco. Mpio. Cuautitlán: 5.3 km S of Rincón de Manantlán, 2 400 m, 12 Jan 1980 (fl), *Iltis 15202* (GUADA).

## Remarks

*Salvia concolor* belongs to Sect. *Dusenostachys* (Epling) Epling. This section is recognized by its leaves rounded or cordate at the base, 6 or more flowers per verticillaster, floral bracts deciduous, upper lip of the calyx with 5 to 9 veins, corolla tube ventricose, internally naked (epapillate) at the base, stamens included, and style pilose toward the apex. Currently 8 species are recognized; 6 species growing in Mexico and 2 restricted to southeastern Brazil. Section *Dusenostachys* needs further studies to support whether it is a monophyletic section.

Specimens of *S. concolor* var. *iltisii* were previously reported as *S. concolor* (Vázquez-García et al. 1995). Nonetheless, specimens from the Sierra de Manantlán differ in having thinner and deeply cordate leaves, floral bracts 5-6 mm long, calyces slightly shorter (12-15 mm in fruit), yellowish green, with the upper lobe long caudate (3-4 mm long) but entire (Table 1). *Salvia concolor* has thicker leaves with rounded or slightly cordate bases (except for some specimens from the states of Mexico, Morelos, and surroundings of Mexico city, which have cordate leaves: *Salazar s.n.* (MEXU 135793), *Engle et*

*Remington 87A* (MEXU), *Salazar 461* (MEXU); floral bracts 7-23 mm long, calyces 18-22 mm long in fruit, dark blue, with the upper lip long caudate but shorter (2-3 mm long) and with 2 lateral mucrons. Furthermore, *S.*

*concolor* inhabits the central region of Mexico: Mexico, D. F., Mexico State, eastern Michoacán and Morelos. The Manantlán populations are isolated from those of the typical variety.

Key for varieties of *Salvia concolor*

1a Leaves coarse, rounded at the base or slightly cordate; floral bracts 7-23 mm long; calyces 18-22 mm long, dark blue, with the upper lip long caudate (2-3 mm long) and with 2 lateral mucrons. Endemic to the Valley of Mexico, Puebla and eastern Michoacán .....*S. concolor* var. *concolor*

1b Leaves thin, deeply cordate at the base; floral bracts 5-6 mm long; calyces 12-15 mm long, yellowish green, with the upper lip long caudate (3-4 mm long) and entire, without lateral mucrons. Endemic to the Sierra de Manantlán.....*S. concolor* var. *iltisii*

**Table 1.** Comparison of morphological and distributional characteristics of *Salvia concolor* and *S. concolor* var. *iltisii*

Character	<i>S. concolor</i> var. <i>iltisii</i>	<i>S. concolor</i> var. <i>concolor</i>
Petiole length (cm)	7-13.2	3-8(-12)
Leaf dimensions (cm)	10-15 × 6-13	5-13(-20) × 3-12
Inflorescence length (cm)	25-38	14-30
Number of flowers per verticillaster	6-12	6-12
Floral bract length (mm)	7-23	5-6
Calyx length in fruit (mm)	10-15	18-22
Calyx color	Yellowish-green	Blue to purple
Shape of the upper lip of the calyces	Acute and long caudate (cauda 3-4 mm long)	Acute, long caudate and with 2 lateral mucrones (cauda 2-3 mm long)
Corolla tube length (mm)	20-22	20-25(-32)
Upper corolla lip length (mm)	5-6.5	4-7
Lower corolla lip length (mm)	5-8	(6-)8-10
Altitudinal range (m)	2400-2500	2650-3300
Habitat	Montane cloud forests	Montane cloud and pine forests
Distribution	Endemic to Sierra de Manantlán, Jalisco	Mexico D. F., State of Mexico, Puebla, and eastern Michoacán

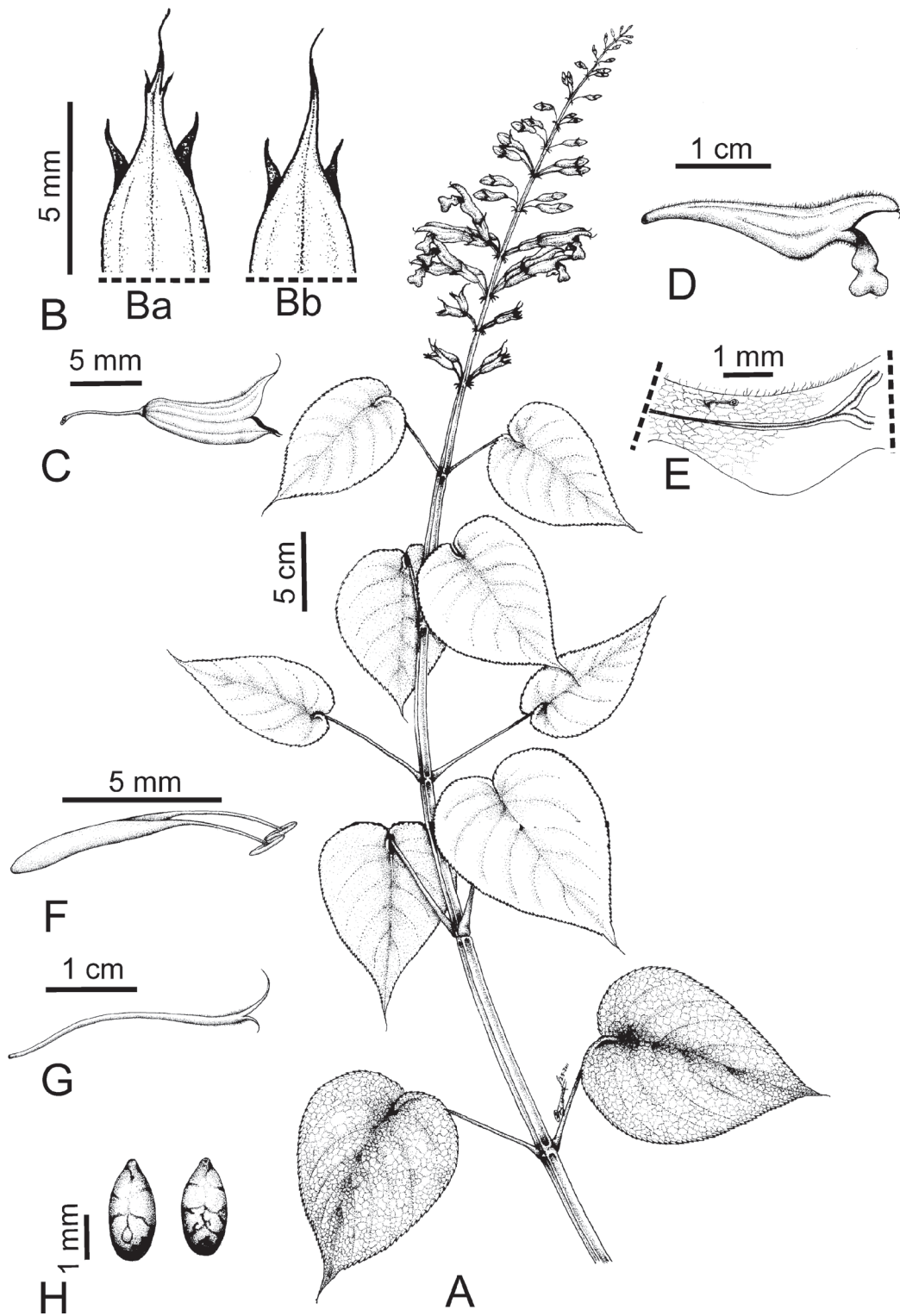
***Salvia meera*** Ramamoorthy ex J. G. González et Santana Michel sp. nov. Figs. 2, 3.

Type: **Mexico**. Jalisco. Mpio. Cuautitlán: en el poblado del Aserradero de Manantlán, carretera para Puerta Pesada, Sierra de Manantlán, 1 520 m, 12 Dec. 1982 (fl, fr), *J. I. Calzada et G. Nieves H. 9545* (holotype: ZEA; isotype: XAL).

Species insignis ob corollas albas, folia anguste lanceolata serrata, flores 2 in verticillastri dispositi; bracteas anguste lanceolatas interdum lineares 1.2-1.4 mm longas, 0.1-0.2 mm latas, et calycum labiis superiores 3-venis.

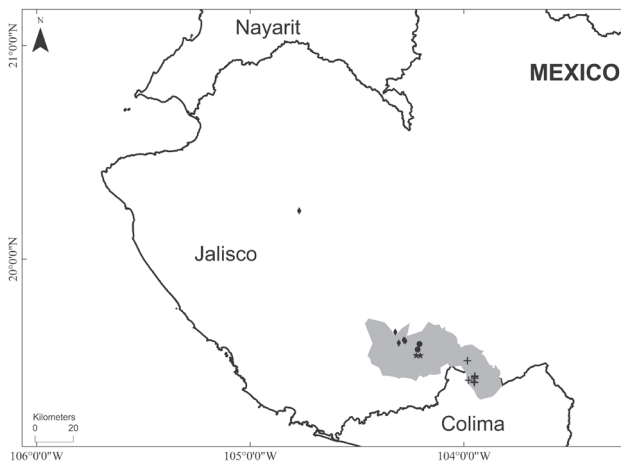
Perennial herbs, erect, (0.7-)1-2.4(-3) m tall; stems with whitish appressed and retrorse hairs, abundantly distributed on and between the ribs. Petioles 3-7 mm long, the middle portion of the adaxial surface sunken, pilose. Leaves lanceolate, 7-9.6 × 1.4-2.4 cm, attenuate at the base and the apex, the margin widely serrate, green on both surfaces, sparsely covered with appressed hairs on the veins and pale orange sessile glandular dots on both surfaces. Inflorescences arranged in terminal and

subterminal axillar racemes, 1-4.5 cm long, each one with 2 to 4 verticillasters, 7-9 mm apart from each other toward the base, verticillasters 2-flowered, floral axis profusely pilose. Floral bracts narrowly lanceolate or almost linear, 1.2-1.4 × 0.1-0.2 mm, attenuate at the base and the apex, the margin entire, green, densely pilose, soon deciduous. Pedicels 5-8.5 mm long, densely pilose. Calyx 1.3-1.5 cm long, 4-6 mm wide at the throat, yellowish green, the lips equal or subequal in length (2.5-5 mm long), the upper one 3-veined, with tiny appressed and antrorse hairs on the veins, between them and along the margin of the lips, internally verrucose and with tiny conical hairs. Corollas white, glabrous except sparsely to densely pilose on the upper lip and abaxial surface of the lower one; tube 2-2.2 cm long, (3-)4-5 mm wide at its widest portion, slightly ventricose and arcuate, not invaginated at the base, internally naked (epapillate); upper lip 5-6 mm long, the lower one 4.5-6.2 mm long. Stamens included; filaments 1.5-2 mm long; connectives 11.5-12.5 mm long, with an acute tooth at the middle; theca 2-2.2 mm long; staminodia



**Figure 1.** *Salvia concolor* var. *iltisii* J. G. González et A. Vázquez. A, general aspect; B, comparison between the apex of the calyces of *S. concolor* var. *concolor* (Ba) and *S. concolor* var. *iltisii* (Bb); upper view; C, valyx in fruit, lateral view; D, corolla; E, corolla section showing a filament and a staminodium; F, connective and theca of a stamen; G, style showing its 2 stigmatic branches; H, nutlets (A-H based on H. H. Iltis et al. 2623; drawn by O. Zuno-Delgadillo).





**Figure 2.** Distribution of the 4 new taxa: *Salvia concolor* var. *iltisii* J. G. González et A. Vázquez (★), *S. meera* Ramamoorthy ex J. G. González et Santana Michel (•), *S. rogersiana* Ramamoorthy ex J. G. González et Cuevas (◆) and *S. santanae* Ramamoorthy ex J. G. González et Guzmán-Hernández (+). The shaded area corresponds to the polygon of the Sierra de Manantlán Biosphere Reserve.

absent. Gynobasic horn 0.3-0.4 mm long; styles 2.2-2.4 cm long, abaxially and adaxially pilose toward the apex, the upper branch of the style longer and exerted, the lower one shorter and included. Nutlets ovate, 2-2.5 × (0.3-)9-1.1 mm long, pale orange or red, concolor, smooth, glabrous.

#### Taxonomic summary

**Distribution, habitat and phenology.** *Salvia meera* grows in pine-oak forests, from 1 500-1 800 m in altitude. Probably sharing habitat with *Abies guatemalensis* Rehder, *Alnus acuminata* Kunth, *Oreopanax sanderianus* Hemsl., *Pinus douglasiana* Martínez, *Quercus candicans* Née, *Q. excelsa* Liebm., *Q. obtusata* Humb. et Bonpl., and *Q. scytophylla* Liebm., according to records near its location. It presents flowers and fruits from late November to middle of December.

**Etymology.** We retain the name used by Ramamoorthy in Vázquez-García et al. (1995). *Meera* is the name of a Hindu woman between historical reality and myth; she lived during the sixteenth century and there are several songs and poems attributed to her (Subramanian, 2005).

**Additional material examined.** **Mexico.** Jalisco. Mpio. Cuautitlán: Sierra de Manantlán [Manantlán], above Haceradero [Aserradero], 5 900 ft [1 800 m], 23 Nov 1963 (fl, fr), *Boutin et Brandt 2505* (CAS seen as photograph, MEXU, MICH seen as photograph).

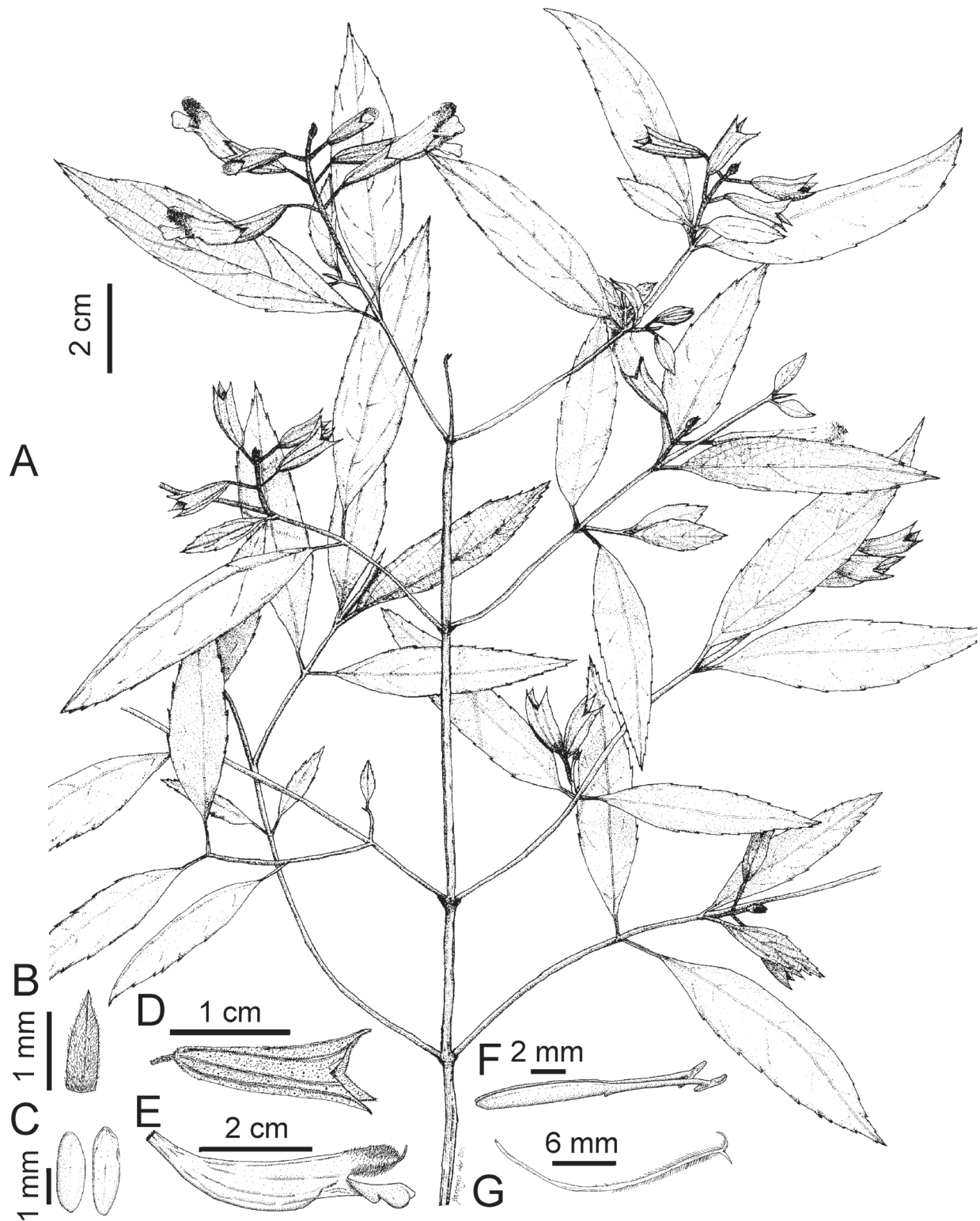
#### Remarks

The characters of *Salvia meera* fit well between Sect. *Tubiflorae* (Epling) Epling except for its striking white corollas with the lower lip as long as the upper one or longer, and its leaves narrower than those typical of such

group. This section is composed of shrubs or subshrubs with ovate leaves, acuminate at the apex and rounded or attenuate at the base, with 6 to 12 flowers per verticillaster, floral bracts deciduous, upper lip of the calyces 3-veined or sometimes 5-veined, corollas magenta with the tube straight and internally naked (epapillate), the upper lip of the corolla as long as the lower one or longer, the connective entire or with a short tooth in the middle and the style pilose. The taxa most related morphologically to *S. meera* are: *Salvia pringlei* Rob. et Greenm., and *S. tubifera* Cav. The first differs because of its ovate leaves (4-6 cm wide), inflorescences (3-)6-8(-12) cm long, 4 to 12 flowers per verticillaster, magenta corollas with the upper lip 1.2-1.5 cm long and the lower one 0.8-1.0 cm long; the second species, *S. tubifera* is recognized by its ovate leaves, 4-6.5 cm wide, inflorescences 7-14(-22), 2 to 6 flowers per verticillaster, calyces 0.6-0.9 cm long, corollas magenta with the tubes 1.8-2 cm long and the lower lip 0.2-0.4 cm long (table 2). Furthermore, the 3 species have different distributional patterns: *S. meera* is a restricted endemic species from the Sierra de Manantlán; grows in montane cloud forests from 1 500-1 800 m altitude; *S. pringlei* has wider distribution, endemic to eastern Jalisco and southern Nayarit from 400-750 m; *S. tubifera* inhabits high mountains from (1 900-)2 000-2 600(-3 000) m in Mexico and Guatemala (Table 2). The 3 species are found in Jalisco state, but do not share the same localities.

Salvias with entirely white corollas are unusual among the Mexican species (Ramamoorthy, 1984); from the approximately 300 species that are found in the country, 14 (4.67%) have entirely white corollas: *S. albiflora* M. Martens et Galeotti, *S. assurgens* Kunth, *S. decora* Epling, *S. diegoae* Mart. Gord. et Lozada-Pérez, *S. divinorum* Epling et Játiva, *S. durantiflora* Epling, *S. leninae* Epling, *S. leucantha* Cav., *S. meera*, *S. perblanda* Epling, *S. pericona* B. L. Turner, *S. pineticola* Epling, *S. rzedowskii* Ramamoorthy and *S. sphacelifolia* Epling. Other species like *S. coccinea* Buc'hoz ex Etl. (with typical red corollas), *S. purpurea* Cav. (with purple ones) and, *S. helianthemifolia* Kunth and *S. roscida* Epling (with sky blue ones), can exceptionally have white or very pale blue, almost white corollas.

Tripp and Manos (2008) postulated that white corollas can act as an evolutionary dead-end in *Ruellia* L. (Acanthaceae) according to the animal species they can exploit as pollinators. They built a cladogram of 40-55% of the species of *Ruellia*, and mapped floral characters on it, such as corolla color. The white corollas of *Ruellia* attract hawk moths and bats; they are the result of a likely irreversible loss of some pigments from species with red or purple corollas, which are pollinated by hummingbirds and bees, respectively. This irreversible loss diminishes the evolutionary potential of the species, since



**Figure 3.** *Salvia meera* Ramamoorthy ex J. G. González et Santana Michel. A, general aspect; B, floral bract, outer surface; C, nutlets; D, calyx in flower; E, corolla; F, connective and theca of a stamen; G, style (A-G based on *J. I. Calzada et G. Nieves H. 9545*; drawn by J. G. González-Gallegos).

**Table 2.** Character comparison between *Salvia meera*, *S. pringlei* and *S. tubifera*

Character	<i>S. meera</i>	<i>S. pringlei</i>	<i>S. tubifera</i>
Leaf shape	Lanceolate	Ovate	Ovate
Leaf width (cm)	1.4-2.4	4-6	4-6.5
Inflorescence length (cm)	1-4.5	(3-)6-8(-12)	7-14(-22)
Flowers per verticillaster	2	4-12	2-6
Floral bract length (mm)	1.2-1.4	6-11(-14)	3-4
Calyx length (mm)	13-15	(8-)11-14	6-9
Corolla color	White	Magenta	Magenta
Corolla tube length (mm)	20-22	20-22	18-20
Upper corolla lip length (cm)	0.5-0.6	1.2-1.5	0.4-0.6
Lower corolla lip length (cm)	0.45-0.62	0.8-1.0	0.2-0.4
Altitudinal range (m)	1500-1800	400-750	(1900-)2000-2600(-3000)
Habitat	Pine-oak forests	Tropical oak forests and tropical deciduous forests	Montane cloud forests
Distribution	Endemic to the Sierra de Manantlán, Jalisco, México	Endemic to eastern Jalisco and southern Nayarit, Mexico	Sparsely distributed in Guatemala and the half southern portion Mexico

lineages with red corollas are originated by lineages with purple ones in the cladogram and vice versa, but lineages with white ones are caused by any of the above, but can not give rise to a lineage with a different corolla color. It is worth noting the similarity between *Ruellia* and *Salvia* in terms of its high richness dominated by species with blue to purple corollas, fewer with red and very few with white or yellow ones, and the homoplasy of such character. Moreover, Coberley and Rausher (2008) found a probable deleterious

pleiotropic effect associated with the allele codifying for white corollas in *Ipomoea purpurea* (L.) Roth. This allele consists of an insertion of a transposable element into the exon of the chalcone synthase D gene, which is responsible for the beginning of the flavonoid pathway; the interruption of this pathway with the consequent lack of flavonoids could make the plants vulnerable to drought, UV radiation and herbivory. It is possible that there are similar processes in *Salvia* that limit the diversification of species with white corollas.

Key for *Salvia meera* and its morphologically closest relatives

- 1a Leaves lanceolate; inflorescences 1-4.5 cm long; floral bracts 1.2-1.4 mm long; corollas white. Endemic to the Sierra de Manantlán Jalisco ..... *S. meera*
- 1b Leaves ovate; inflorescences (3-)6-14(-22) cm long; floral bracts 3-11(-14) mm long; corollas magenta. Plants absent in the Sierra de Manantlán.
  - 2a Floral bracts 3-4 mm long; calyces 6-9 mm long; upper corolla lips 6-9 mm long, lower ones 2-4 mm long. Guatemala and almost throughout the Pacific slope of Mexico, from 2 000-2 600(-3 000) m.....*S. tubifera*
  - 2b Floral bracts 6-11(-14) mm long; calyces (8-)11-14 mm long; upper corolla lips 12-15 mm long, lower ones 8-10 mm long. Endemic to Jalisco and Nayarit, Mexico, from 400-750 m.....*S. pringlei*

Key for the mexican native salvias with entirely white corollas

- 1a Leaves adaxially white tomentose.
  - 2a Petioles 2-3 cm long; leaves ovate-deltoid, cordate at the base; calyces covered with minute glandular capitate hairs between eglandular longer ones. Endemic to Oaxaca.....*S. periconia*
  - 2b Petioles 0.1-1.5 cm long; leaves oblong-lanceolate or elliptic, cuneate or rounded at the base; calyces without glandular capitate hairs.
    - 3a Inflor escences in short (2-3 cm long) crowded terminal racemes. Endemic to the State of México.....*S. rzedowskii*
    - 3a Inflorescences in long racemes (15-40 cm long ) with verticillasters 1-2.5 apart.
    - 4a Calyces densely purple tomentose; corolla tubes 13-14 mm long. Widespread in Mexico and extensively cultivated worldwide as ornamental .....*S. leucantha*
    - 4b Calyces sparsely pubescent, green; corolla tubes 8-9 mm long. Endemic to Sinaloa .....*S. sphacelifolia*
    - 1b Leaves adaxially glabrous or sparsely covered with appressed or flexible curled hairs.
      - 5a Upper lip of the calyces 5 to 7-veined. Endemic to Michoacán.

- 6a Petioles 1.5-5 cm long; corolla tubes 12-14 mm long; floral axis, pedicel and calyx without glandular capitate hairs...  
.....*S. leninae*
- 6b Petioles 0.2-0.7(-1.3) cm long; corollas tube 5.5-6.5 mm long; floral axis, pedicel and calyx densely covered with glandular capitate hairs.....*S. assurgens*
- 5b Upper lip of the calyces 3-veined.
- 7a Corolla tubes 1.1 cm or longer.
- 8a Petioles 0.3-0.7 cm long; leaves narrowly lanceolate, 1.4-1.6 cm wide .....*S. meera*
- 8b Petioles (0.5-)1.5-5 cm long; leaves ovate, (2.1-)3-10 cm wide.
- 9a Leaves long attenuate at the base; calyces purple with the apices of the lower lobes long caudate; corolla tubes 2-2.2 cm long. Endemic to Oaxaca.....*S. divinorum*
- 9b Leaves truncate, rounded or subcordate at the base; calyces green or red with the apices of the lower lobes almost truncate or shortly acute but not long aristate, corolla tubes 1.2-2.9 cm long. Endemic to Michoacán or Guerrero.
- 10a Leaves glabrous on the upper surface, rounded or subcordate at the base; verticillasters 2-flowered, calyces red; corolla tube 2.4-2.9 cm long, internally epipillate, the upper lip 1.2-1.3 cm long and lower one 6.5-10 mm long. Endemic to Guerrero.....*S. diegoae*
- 10b Leaves covered with long hairs on the upper surface, rounded or truncate at the base; verticillasters 6-12-flowered, calyces green and sometimes tingled with purple; corolla tube 1-2 cm long, internally ornamented with 4 papillae, upper and lower lips 8-9 mm long. Endemic to Michoacán.....*S. leninae*
- 7b Corolla tubes shorter than 1 cm long.
- 11a Leaves cuneate at the base; corolla tubes internally naked at its base. Mainly from the Atlantic slope, from Veracruz to Chiapas.....*S. albiflora*
- 11b Leaves rounded or truncate at the base; corolla tubes internally ornamented with 1 or 2 papillae pairs at its base.
- 12a Lobes of the calyces connivent in fruit. Guerrero and Oaxaca.....*S. durantiflora*
- 12b Lobes of the calyces straight and separated in fruit
- 13a Calyces 3-4 mm long; corolla tubes 4-5 mm long. Pacific slope, from Nayarit to Oaxaca .....*S. decora*
- 13b Calyces 5-7 mm long; corolla tubes 8-10 mm long
- 14a Petioles 5-7 mm long; racemes 5-15 cm long. Endemic to Veracruz .....*S. pineticola*
- 14b Petioles 5-10 mm long; racemes 3-5 cm long. Endemic to Guerrero .....*S. perblanda*

***Salvia rogersiana*** Ramamoorthy ex J. G. González et Cuevas sp. nov. Figs 2 and 4

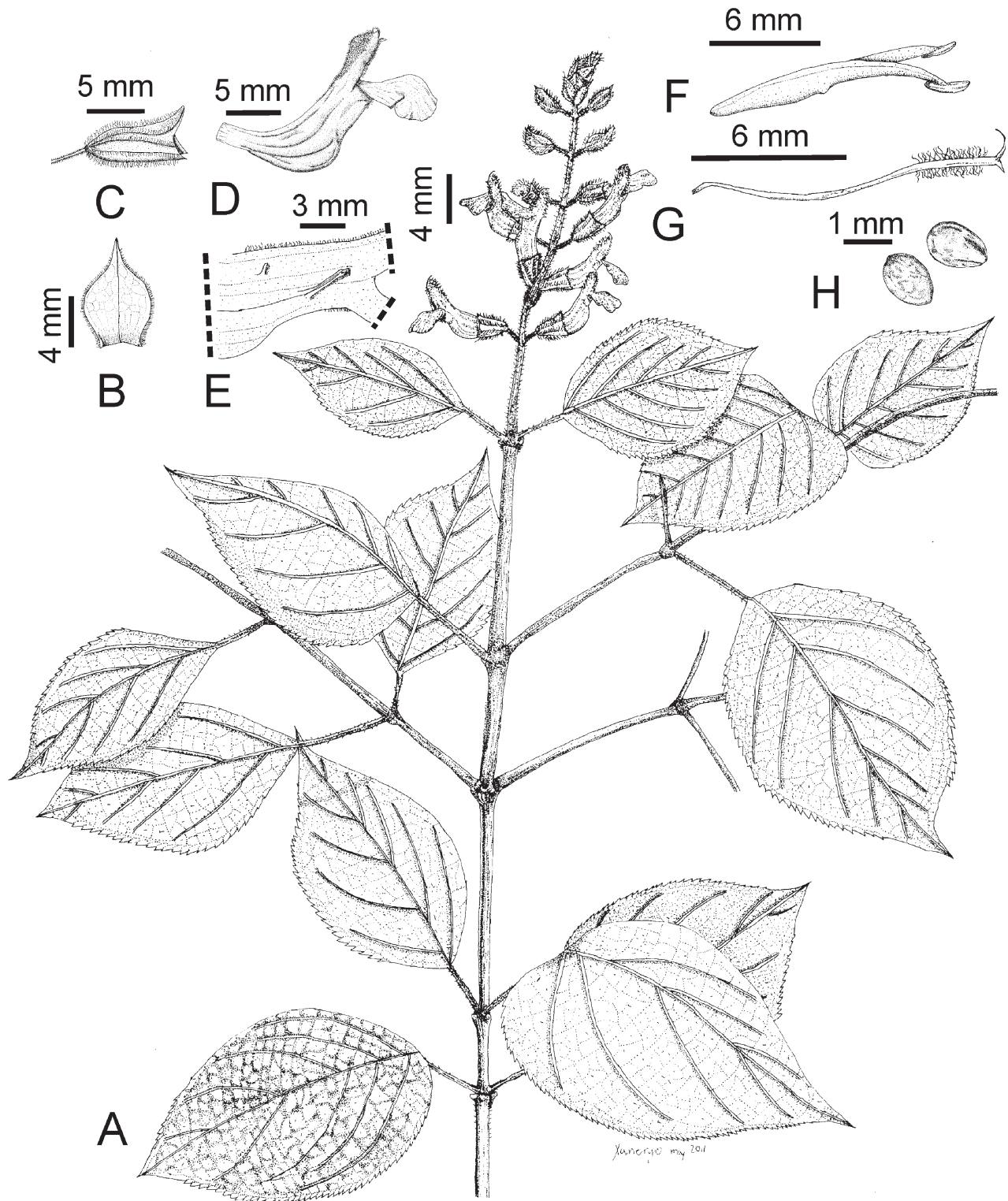
Type: **Mexico**. Jalisco, Mpio. Autlán de Navarro: 500-600 m de Corralitos por la brecha que sube a la Estación Científica Las Joyas, 19°37'37.4" N, 104°19'16.3" W, 1 780 m, 30 Oct 2010 (fl), J. G. González-Gallegos, F. J. Satana-M., A. S. Monroy-S. and A. Paizanii-G. 781 (holotype: IBUG; isotypes: ENCB, IEB, MEXU, ZEA, XAL).

*Salviae* sectione *Briquetia* Epling adscribenda, ex species sectionis inflorescentis compactis et brevibus, floribus 2 in verticillastris dispositi, calycibus 10 mm longis vel brevibus, calycum labiis superioribus truncatis ad apicem, corollarum tubis 15-17 mm longis distinguenda.

Perennial herbs, erect, (0.5-)0.8-1(-1.5) m tall, stems sparsely to densely pilose on and between the ribs, mainly on young stems. Petioles (1.4-)1.8-3(-4.5) cm long, sparsely to densely pilose. Leaves ovate or ovate-elliptic, (5-)7-9(-10) × (3.5-)4.5-6.5 cm, rounded and shortly cuneate at the base, acuminate at the apex, the margin serrate, sparsely covered with appressed hairs on both surfaces. Inflorescences arranged on terminal racemes, (5-)7-12(-17) cm long, 7-17 verticillasters per floral axis, 6-12(-15) mm apart from each other toward the base; verticillasters

2-flowered; floral axis densely pilose. Floral bracts ovate, 4-8(-9.7) × (2-)3-5 mm, truncate at the base, slightly rounded and abruptly caudate at the apex, the margin entire, foliose, densely covered with long flexible hairs on the outer surface and along the margin, the inner surface glabrous, the hairs eglandular, pluricellular and uniseriate with red septa giving its yellowish-red appearance, deciduous. Pedicels 2-3.5 mm long, thickly pilose. Calyces 7-9.5 × (4-)5-6 mm, yellowish green, concolor, the upper lip acute and bent upward, the apex with a truncate appearance, the lower lip truncate and with a tiny terminal tooth on each lobe (up to 0.2 mm long), the upper lip 3-veined, densely covered with long flexible hairs, the inner surface covered with short conical hairs, mainly toward the apex. Corollas dark blue to purple, glabrous except for the pilose upper lip and to a lesser extent the pilose abaxial surface of the lower lip; tube 15-18.3 cm long, 5.5-6 mm wide in its widest portion, arcuate, widely ventricose just after the lower lip, straight at the base, internally naked (epipillate); upper lip 5-6.7 mm long, lower lip (4.5-)6-8.6 × 8-8.4 mm. Stamens included; filaments (1.7-)2.3-3.3 mm long; connectives 7.8-13 mm long, not geniculate but with a short ventral tooth; thecae 1.4-2 mm long; 2 filiform





**Figure 4.** *Salvia rogersiana* Ramamoorthy ex J. G. González et Cuevas. A, general aspect; B, floral bract, outer surface; C, calyx in flower; D, corolla; E, corolla section showing a filament and a staminodium; F, connective and theca of a stamen; G, style; H, nutlets (A-H based on J. G. González-Gallegos et al. 781; drawn by J. G. González-Gallegos).

staminodia present behind and above the insertion point of the filaments. Gynobasic horn 0.5-1 mm long; styles 2.1-2.2 cm long, abaxially and adaxially pilose toward the apex, included except for the upper branch of the style, both branches purple, the lower branch acute. Nutlets ovate, 1.5-1.6 × 7-1.4 mm, reddish brown and dark brown marbled (concolor when immature), smooth and glabrous (with tiny appressed hairs on immature ones).

*Distribution, habitat and phenology.* *Salvia rogersiana* grows along dirt roads in montane cloud and in oak forests, within shaded humid ravines, from (1 100-)1 800-1 900 m altitude. It shares habitat with *Alnus jorullensis*, *Aphananthe monoica* (Hemsl.) J.-F. Leroy, *Cestrum confertiflorum* Schtdl., *Clusia salvinii* Donn. Sm., *Citharexylum mocinoi* D. Don, *Juglans major* (Torr.) A. Heller, *Otatea acuminata* (Munro) C. E. Calderón et Soderstr., *Prunus serotina* Ehrh. subsp. *capuli* (Cav.) McVaugh, *Symplocarpon purpusii* (Brandege) Kobuski, *Synardisia venosa* (Mast.) Lundell, *Tilia americana* L. var. *mexicana* Schtdl., *Trophis racemosa* (L.) Urb., *Bursera* sp, *Ficus* sp, *Trichilia* sp, and *Viguiera* sp. The species has flowers and fruits from middle June to December.

#### Taxonomic summary

*Etymology.* This species corresponds to what is registered as *S. mcvaughii* in Vázquez-García et al. (1995). However, we do not retain that name because it has already

been applied to another new species placed into sect. *Polystachyae* Epling (Bedolla-García et al., 2011). The species is dedicated to Rogers McVaugh's first name in recognition to his outstanding contributions to botany and the study of the Western Mexican flora, particularly the *Flora Novo-Galiciana*.

Additional material examined. **Mexico.** Jalisco. Mpio. Autlán de Navarro: Cerro Las Juntas, Estación Científica Las Joyas, 3 Aug 1986 (fl), *Cuevas 1471* (ZEA); Las Galeras, Estación Científica Las Joyas, 19°37'03" N, 104°16'28" W, 1 600-1 650 m, 3 Dec. 1996 (fl), *Cuevas et Sánchez 5452a* (IBUG, ZEA); parte alta de la cañada del Alentrisco, 600 m al S de Corralitos, 1 800-1 900 m, 19 Jun 1996 (fl), *Sánchez et Cuevas 118* (IBUG, ZEA); 11-12 km al SSE de Autlán, 2 km al S de Ahuacapán, 19°39'31" N, 104°19'14" W, 1 100 m, 24 Jul 1988 (fl, fr), *Santana and De Niz 3669* (ZEA). Mpio. Talpa de Allende: Triunfo, 19 km WSW of Talpa de Allende, along road to La Cuesta and Tomatlán, 1 555 m, 11 Sep 1986 (fl), *Breedlove et Anderson 64166* (MEXU).

#### Remarks

The characters of *Salvia rogersiana* match those of sect. *Briquetia* (see identification Key below and table 3). None of the other species within the section grows in the same region than *S. rogersiana* except for *S. mexicana*; however this species has not been found in the same locality.

#### Key for *Salvia mexicana* and *S. rogersiana*

- 1a Petioles 1-10 cm long, leaves 6-18(-20) cm long; floral bracts 6-12 mm long; calyx 18-17(-20) mm long; upper lip of the corolla 13-14(-19) mm long, lower one 12 mm long.....*S. mexicana*  
 1b Petioles 1.8-2.7 cm long, leaves (6-)7-9(-10) cm long; floral bracts 4-5.2 mm long; calyx 7-9.5 mm long; upper lip of the corolla 5-6.5 mm long, lower one (4.5-) 6-6.6 mm long .....*S. rogersiana*

***Salvia santanae*** Ramamoorthy ex J. G. González et Guzmán-Hernández sp. nov. Figs. 2, 5

Type: **Mexico.** Jalisco. Mpio. Tolimán: 1-1.5 km al N de El Terrero, 12-13 km al NE de Minatitlán, 19°27'13" N, 103°56'56" W, 2 300 m, 4 Sep 1990 (fl), *L. Guzmán-H. et R. Cuevas-G. 1091* (holotype: ZEA; isotype: WIS not seen).

Species habitu cum *Salvia longispicata* M. Martens et Galeotti aemulans optime congruens, sed differt floribus 2-4 in verticillastris dispositi bracteas persistentibus, calycibus 7-9 mm longis et corollarum tubis (9-)1-15 mm longis (vs. flores 6-18 in verticillastris dispositi bracteas caducas, calyces 5-6.5 mm longos, corollarum tubos 5-8 mm longos).

Perennial herbs, erect (0.6-)1-1.5 m tall, stems with flexible retrorse hairs between the ribs, puberulent on the ribs. Petioles 3-4.5(-9) cm long, thin, sparsely covered

with tiny appressed hairs. Leaves ovate-elliptic, (6-)10.5-13.5 × (3.5-)6-8.5 cm, long-cuneate at the base, acuminate at the apex, the margin serrate (the teeth regularly 3-5 mm wide at the base), green, both surfaces barely covered with appressed hairs, concentrated mainly on the veins. Inflorescences of axillary or terminal racemes, (10-)15-20 cm long, each one with 11 to 15 verticillasters, these spaced 6-10 mm toward the base, verticillasters 2 or 4-flowered (rarely 5-flowered); floral axis glabrous. Floral bracts narrowly lanceolate, (1.8-)2-4 × 0.5-1.3 mm, green, truncate at the base, aristate at the apex, the margin entire, foliose, glabrescent, persistent. Pedicels 2.5-4 mm long, covered with flexible retrorse hairs and light orange sessile glandular dots, the hairs pluricellular and uniseriate with purple septa. Calyces 7-9 mm long, 3-4 mm wide at the throat, the dorsal portion dark green and the ventral one yellowish green, both lips 2-3(-5) mm long, acute and

**Table 3.** Character comparison between *Salvia rogersiana* and *S. mexicana*

Character	<i>S. rogersiana</i>	<i>S. mexicana</i>
Petiole length (cm)	(1.4-)1.8-3(-4.5)	7-13.2
Leaf dimensions (cm)	(5-)7-9(-10) × (3.5-)4.5-6.5	10-15×6-13
Inflorescence length (cm)	(5-)7-12(-17)	30-50
Number of flowers per verticillaster	2	10-12
Floral bract length (mm)	4-8(9.7)	6-12(-20)
Calyx length (mm)	7-9.5	8-17(-20)
Aspect of the calyx at its apex	Truncate (the upper lip bent backward)	Acute (lips straight forward)
Corolla tube length (mm)	15-18.3	15-25
Upper corolla lip length (mm)	5-6.7	13-14(19)
Lower corolla lip length (mm)	(4.5-)6-8.6	12-16
Altitudinal range (m)	(1100-)1800-1900	(1300-)1700-2600(-2900)
Habitat	Montane cloud and oak forests	Pine-oak and oak forests
Distribution	Endemic to western Jalisco	Widespread in Mexico, almost in all the states except for those from the California and Yucatán Peninsulas

**Table 4.** Character comparison between *Salvia santanae* and *S. longispicata*

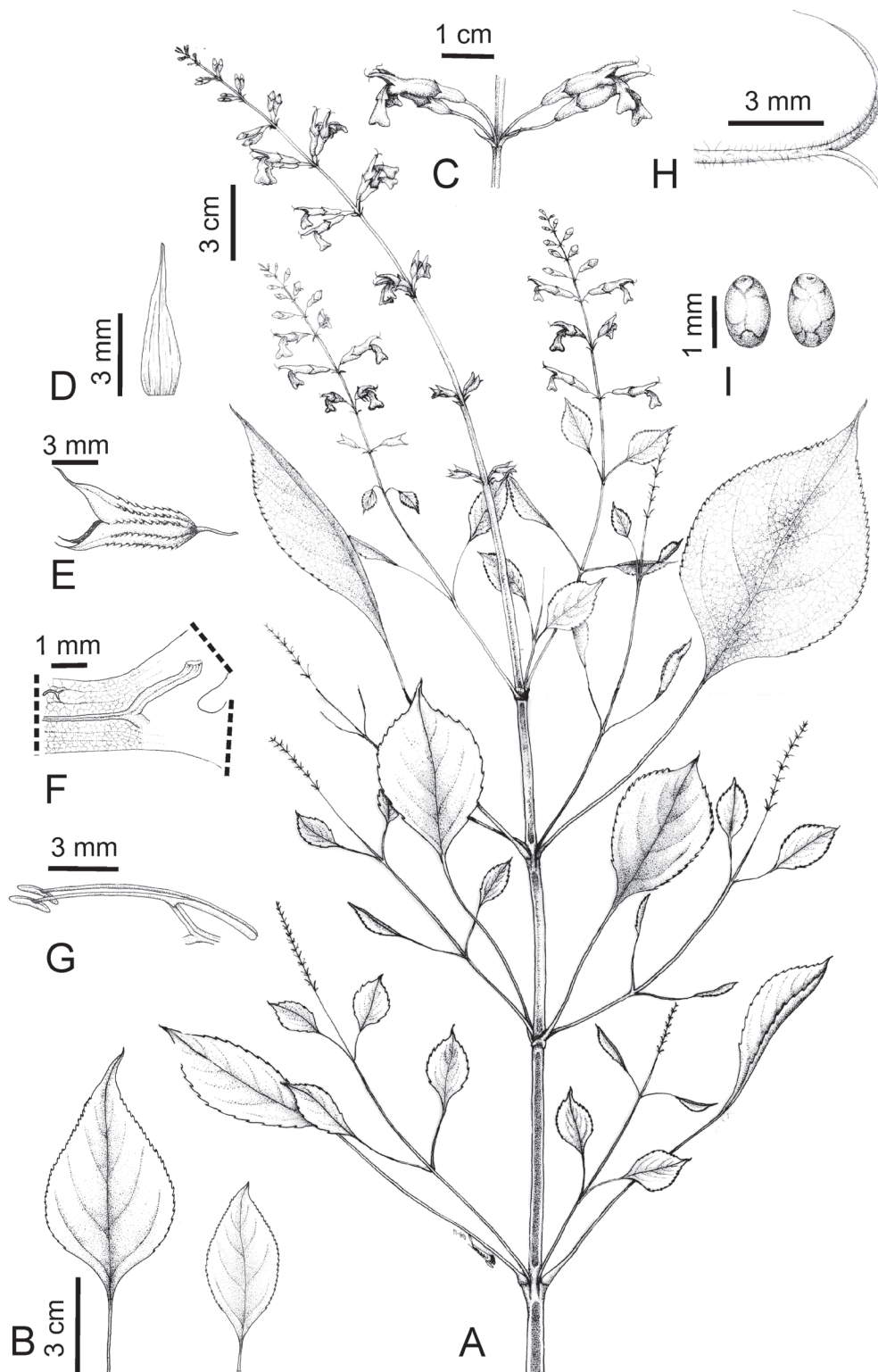
Character	<i>S. santanae</i>	<i>S. longispicata</i>
Petiole length (cm)	3-4.5(-9)	(1-)2-4(-4.5)
Leaf dimensions (cm)	(6-)10.5-13.5 × (3.5-) 6-8.5	4-8(-11) × 3-8
Inflorescence length (cm)	10-15(-20)	15-30
Flowers per verticillaster	2-4(-10)	6-12(-18)
Floral bract dimensions (cm)	(1.8-)2-4 × 0.5-1.3	(2-)4-7 × (1-)2-3
Floral bract duration	Persistent	Mostly deciduous
Calyx length (mm)	7-9	5-6.5
Corolla tube length (mm)	(9-)10-15	5-8
Upper corolla lip length (mm)	6-7	(3-)4.5-5
Style length (mm)	15-16	8-9(-10)
Altitudinal range (m)	(1800-)2100-2300	(700-)1000-1900(-3400)
Habitat	Montane cloud and oak forests	Tropical deciduous forests and secondary vegetation
Distribution	Endemic to the Sierra de Manantlán, Jalisco, México	Widespread in Mexico, almost in all the states except for those from the California and Yucatán Peninsulas

shortly aristate, the upper lip 3-veined, the veins with the same pubescence as the pedicel and glandular-punctate between them, with a scaly appearance due to a thickened at the insertion point of the hairs and its dark purple color. Corollas dark blue or purple with white nectar guides on the lower lip, the upper lip densely pilose, mainly at the ventral surface, the lower lip abaxially pilose, the rest glabrous; tube (9-)1-15 mm long, 2-3 mm wide at its widest portion, ventricose and slightly invaginated at the base, internally naked (epapillate); upper lip 6-7 mm long, the lower lip equal or subequal in length and 8-8.5 mm wide. Stamens included; filaments 2-2.5 mm long; connectives 9-9.5 mm long, straight and with an acute tooth bending backwards at the middle portion; thecae 1.1-1.2 mm long;

2 staminodia present behind and above the attachment of the filaments to the corolla. Gynobasic horn 0.5-0.7 mm long; styles 15-16 mm long, abaxially and adaxially pilose (hairs with purple septa), the branches purple and exserted. Nutlets ovate, 1.3-1.4 × 0.7-0.8 mm, light brown, almost concolor, smooth and glabrous.

*Taxonomic summary*

*Distribution, habitat and phenology.* *Salvia santanae* inhabits montane cloud forests and oak forests from (1 800-)2 100-2 300 m, in karstic calcareous soils in massif Cerro Grande. It grows together with *Clethra fragrans* L. González et R. Ramírez, *Dendropanax arboreus* (L.) Decne. et Planch., *Oreopanax peltatus* Linden, *O. xalapensis* (Kunth) Decne. et Planch., *Quercus candicans*



**Figure 5.** *Salvia santanae* Ramamoorthy ex J. G. González et Guzmán-Hernández. A, general aspect; B, leaves; C, floral node; D, floral bract, outer surface; E, calyx in flower; F, corolla section showing a filament and a staminodium; G, connective and theca of a stamen; H, apex of the style with its 2 stigmatic branches; I, nutlets (A-I based on L. Guzmán-H. et R. Cuevas-G. 109; drawn by O. Zuno-Delgadillo).



Née, *Q. castanea* Née, *Q. crassipes* Humb. et Bonpl., *Q. laurina* Bonpl., *Q. obtusata* Bonpl., *Symplocos citrea* Lex. ex La Llave et Lex., *Styrax ramirezii* Greenm, and *Ternstroemia lineata* DC. The species has flowers and fruits from September to March.

**Etymology.** We retain the name suggested by Ramamoorthy in Vázquez-García et al. (1995), the name is to honor Francisco J. Santana-Michel for his contribution to the knowledge of the flora of Jalisco and Colima (Mexico).

**Additional material examined.** Mexico. Jalisco. Mpio. Tolimán: 9 km al NE de Minatitlán, 2-4 km al SO de El Terrero, 19°26'00" N, 103°58'38" W, 1 750-1 900 m, 13 Oct 1988 (fl, fr), *Cuevas et López 3323* (ZEA, WIS); 17-18 km al NNE de Minatitlán, 2 km al S de La Laguna, 19°31'28" N, 103°59'00" W, 2 100-2 200 m, 18 Dec 1988 (fl, im fr), *Cuevas et Núñez 3463* (ZEA); Cerro Grande, 19°25'19" N, 103°57'01" W, 1 806 m, 7 Dec 2008 (fl), *González et Vázquez 231* (IBUG, MEXU); 12-13 km al ENE de Minatitlán, 2 km al NO de El Terrero, 19°26'57" N, 103°57'00" W, 2 300 m, 16 Mar 1993 (im fr), *Muñoz et Vázquez 35* (ZEA, WIS); El Terrero, 2 200 m, 25 Nov 1992 (im fr), *Navarrete 312* (ZEA, WIS); La Ciprecera, 2 km al NO de El Terrero, 12-13 km al ENE de Minatitlán, 19°26'57" N, 103°57'00" W, 2 280 m, 19 Nov 1993 (fl, im fr), *Santana et al. 6286* (ZEA).

#### Key for *Salvia longispicata* and *S. santanae*

1aVerticillasters 6–12 (or rarely 18)-flowered, with deciduous floral bracts; calyces 5-6.5 mm long; corolla tube 5-8 mm long, with the upper lip (3-)4.5-5 mm long; style 8-10 mm long.....*S. longispicata*  
1bVerticillasters 2–4 (rarely 10)-flowered, with persistent floral bracts; calyces 7-9 mm long, corolla tube (9-)10-15 mm long, with the upper lip 6-7 mm long; style 15-16 mm long.....*S. santanae*

#### Acknowledgments

We thank the curators and colleagues from the herbaria consulted: ENCB, GUADA, IBUG, IEB, MEXU, ZEA and XAL; and the following herbaria for providing free online photographs of specific specimens we asked for: CAS and MICH, especially to Richard Rabeler, Senior Collection Manager, and Heather Huggins, Imaging Specialist, both from MICH, and M. A. Wetter, Senior Academic Curator from WIS. We also thank Servando Carvajal from Herbario Luz María Villarreal de Puga, Instituto de Botánica, Universidad de Guadalajara-CUCBA for comments about the Latin diagnoses. We are grateful to Oswaldo Zuno-Delgadillo for the 2 illustrations provided (*Salvia concolor* var. *iltisii* and *S. santanae*). Lourdes Rico-Arce (Herbarium, Royal Botanic Gardens Kew) and 2 anonymous reviewers improved greatly the paper with their suggestions. Financial support was provided by CONACYT, COECYTJAL and the Universidad de Guadalajara, Mexico.

#### Remarks

The morphology of *Salvia santanae* is closely related to that of *S. longispicata* M. Martens et Galeotti (see identification key below). Both species differ in their ecology: *S. santanae* grows preferably in montane cloud forests and to a lesser extent in oak forests, above 1 800 m; while, *S. longispicata* inhabits tropical deciduous forest or secondary vegetation along roadsides and dirt roads, it can be rarely found in oak forests or oak-pine forests, generally from 1 000-1 900 m. While *S. santanae* is endemic to Cerro Grande, Jalisco, in contrast *S. longispicata* can be found in almost all the Mexican states except for those from the California and Yucatán Peninsulas.

We have observed an interesting peculiarity in the morphology between *S. santanae* and *S. longispicata*: the purple thickened bases at the insertion point of the hairs on the calyces, a peculiar character of *S. santanae*, it is also present in some populations of *S. longispicata*, particularly from those which inhabit the eastern face of Sierra de Coalcomán (Michoacán), down from Paso Malo to Aguililla, in facing of the Balsas Depression.

We propose *S. santanae* as a member of Sect. *Angulatae*, as it is distinct from the other species included in that section by its persistent floral bracts and corolla tubes 10 mm or longer.

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