

Agave cremnophila

(Agavaceae), a new species from southeastern Oaxaca, Mexico

Abstract: A new species, *Agave cremnophila*, is described from Cerro las Flores in the state of Oaxaca, Mexico. It is a small-sized species in the group *Striatae* and is endemic to Oaxaca; the closest relatives, based on flower and leaf morphology, are *Agave dasyliroides* Jacobi & Bouché from the cliffs near Tepoztlán, Morelos the recently described *A. kavandivi* A. J. García-Mendoza & C. Chávez-Rendón from Cerro Kava Ndivi in western Oaxaca, and *A. stricta* Salm-Dyck from southern Puebla and northern Oaxaca. The addition of *Agave cremnophila* brings to 10, the total number of species in the *Striatae*, all found in Mexico.

Keywords: *Agave*, Agavaceae, *Striatae*, Oaxaca, endemic

Introduction

The genus *Agave* is wholly New World, consisting of roughly 245 named taxa (species, subspecies, varieties, and named hybrids) in continental North America with the rest occurring in the Caribbean and South America. According to García-Mendoza (2002), Mexico is home to the greatest number of taxa with about 150 species and 36 infra-specific taxa for a total of 186 taxa.

Gentry (1982) divided the genus into two subgenera, *Agave* (those with paniculate inflorescences) and *Littaea* (those with spicate inflorescences). For the subgenus *Littaea*, Gentry (1982) considered 8 groups (the equivalent of sections), including the group *Striatae* which, at the time, consisted of 3 species (4 taxa), *Agave dasyliroides* Jacobi & Bouché, *A. striata* Zucc. subsp. *striata*, *A. striata* Zucc. subsp. *falcata* (Engelm.) Gentry, and *A. stricta* Salm-Dyck, with none known to occur in Oaxaca at that time. There has been much more extensive exploration in Mexico resulting in the discovery of 6 new species in the group *Striatae* since the publication of Gentry (1982). These recently described species are *Agave albopilosa* I. Cabral, J. A. Villarreal, E. A. Estrada (2007); *A. grazielae* R. Galván & S. Zamudio (2013); *A. kavandivi* A. J. García-Mendoza & C. Chávez-Rendón (2013); *A. petrophila* A. J. García-Mendoza & E. Martínez (1998a, b); *A. rzedowskiana* P. Carrillo, R. Vega, & R. Delgadillo (2003); and, *A. tenuifolia* S. Zamudio & E. Sánchez (1995).

Recent exploration has resulted in the discovery of *Agave stricta* in Oaxaca, and the descriptions of *A.*

kavandivi and *A. petrophila* in the *Striatae* from Oaxaca. The addition of this latest taxon, *Agave cremnophila* G.D.Starr, Etter & Kristen *sp. nova*, brings to 10 the total number of species in the *Striatae* currently known from Oaxaca. *Agave cremnophila* is known to occur on the steep cliffs of Cerro las Flores north of Santiago Lachiguiri on the Isthmus of Tehuantepec in southern Oaxaca. *Agave kavandivi* is restricted to the steep slopes and rocky ledges on Cerro Kava Ndivi south of Santiago Yosondúa, Oaxaca. *Agave petrophila* is predominantly a cliff dweller with a wide-ranging distribution, documented from Guerrero, Puebla and Oaxaca and found on the steep cliffs and slopes of El Boquerón, canyon of the Río Mixteco, southwest of Huajuapán de León. *Agave stricta* generally grows on more open, exposed hills, and rocky, south facing slopes in Puebla and Oaxaca. There are some plants resembling *Agave petrophila* that can be found growing in cliff-like habitats in the Sierra Mixteca of the Valle de Tehuacán-Cuicatlán in northern Oaxaca. To date, these have not been observed in flower by the authors, so a positive determination cannot be confirmed.

Oaxaca has a rich and diverse flora, and García-Mendoza (2002) indicated that it is one of the major centers of agave diversity. With the description of *Agave cremnophila*, there are 35 described taxa (30 species, 2 subspecies, 2 varieties and 1 hybrid) documented within the state of Oaxaca. The agaves in Oaxaca occupy diverse and varied habitats, some species being generalists with a wide-spread distribution, while others are specialists with restricted distributions and habitats. Plants are found at elevations ranging from near sea level to above 2500 meters.

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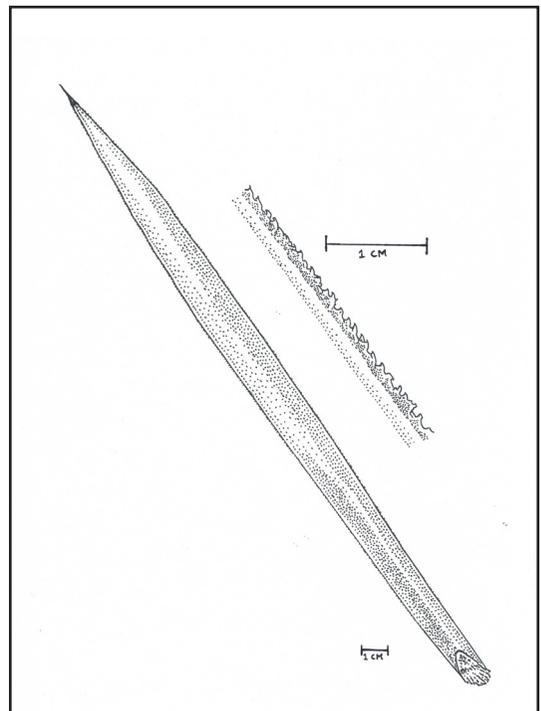
1. Specimen of *Agave cremnophila* grown from seed collected at the type locality and distributed by Rare Palm Seed.

Description

Agave cremnophila G.D.Starr, Etter, and Kristen **sp. nov.** Fig. 1.

Type: Mexico: Oaxaca: District of Tehuantepec, municipality of Santiago Lachiguiri, on the west side of the Cerro las Flores, approximately 11 kilometers north of Santiago Lachiguiri, 1240 meters. 27 May 2017. Starr 2017-013 (holotype: ARIZ, isotypes: MEXU, MO).

Plants perennial, caespitose, forming small colonies. **Rosettes** compact, hemispherical, 30–40 cm tall, 60–85 cm in diameter. **Leaves** 150–200 per individual rosette, 25–40 cm long by 1.2–2.7 cm wide at the widest point just above the middle, narrowly linear-oblancoolate, bright green to dark green, smooth and finely striate, denticulate-serrulate along the edge, 7–12 mm thick and quadrangular in cross section near the base, flattened towards the middle and tip, plane above and slightly convex below in upper one-half to two-thirds of the blade (Figs. 2–4). **Terminal spine** 9–11 mm long. **Inflorescence** 165–210 cm long, green and purplish red, **peduncle** 60–80 cm long, **spike** 105–130 cm long (Fig. 1); **floral bracts** narrowly long triangular



2. Leaf of *Agave cremnophila* including detail of the finely serrulate-denticulate margin.



3. A group of adult *Agave cremnophila* in habitat growing on cliffs at Cerro Las Flores.



4. An old *Agave cremnophila* with a considerable stem, growing with *Sedum macdougalii*.

attenuate from a deltoid base, 8–9.5 cm long. **Flowers** in pairs, pedicels 2–3 mm long; **flower buds** green flushed reddish purple at apex, 21–30 mm long by 9–10 mm wide; **flowers** yellowish green when open, broadly funnelform at anthesis, becoming narrowly campanulate after anthesis, 32–36 mm long (Figs. 5 & 6), **ovary** 12–13 mm long, neck absent, **tube** 7–9 mm long by 7–9 mm wide, **tepals** yellowish green inside, yellowish green and lightly flushed with reddish purple outside, **inner tepals** 13–16 mm long by 8 mm wide, **outer tepals** 14–16 mm long by 7–9 mm wide, **filaments** 37–42 mm long (Fig. 7). **Seed pods** 15–17 mm long by 7–8 mm wide; **seed** flattened, crescent-shaped, black, 2–3 mm long by 1.5–2 mm wide.

Phenology

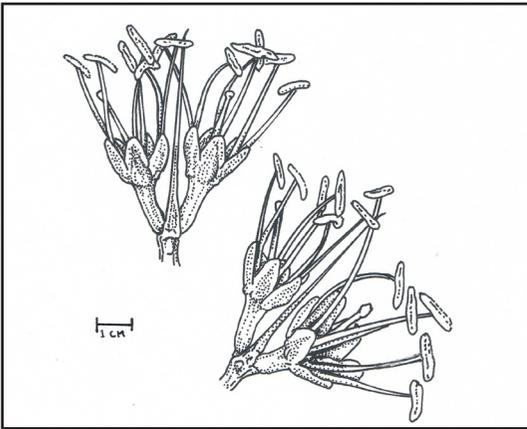
Agave cremnophila blooms in May and June with fruit setting in August to November.

Etymology

The species is named for its cliff loving habit, using the Greek, *cremno-* meaning cliff, and the Greek *phil-* meaning loving (Fig. 7).



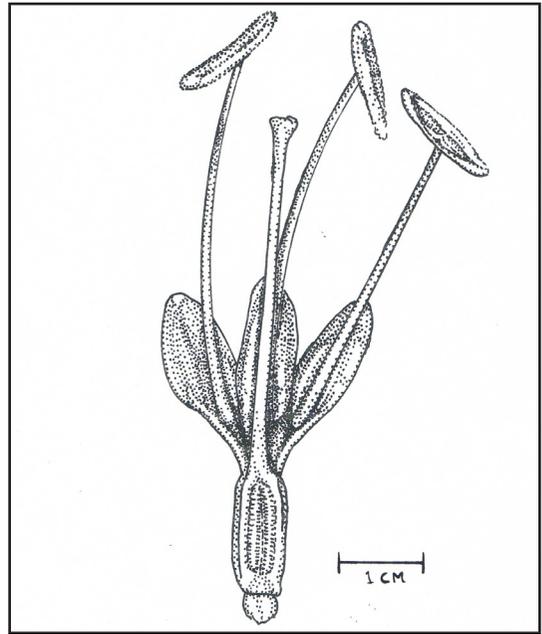
5. Flowers of *Agave cremnophila* showing the wide open tepals at anthesis and the cup shape tepals after anther dehiscence.



6. Life size detail of *Agave cremnophila* flowers. Illustration by Kim Duffek.

Distribution and Habitat

Agave cremnophila is endemic to the state of Oaxaca with its distribution restricted to the cliffs on the Cerro Las Flores north of Santiago Lachiguiri on the Isthmus of Tehuantepec (Fig. 8). The region is tropical deciduous forest and associated plants include: *Lonchocarpus emarginatus*, *Bursera excelsa*, *Pseudobombax ellipticum*, *Pseudosmodingium multifolium*, *Sideroxylon celastrinum*, *Annona squamosa*, *Ceiba parvifolia*, *Agave* aff. *seemaniana*, *Agave* aff. *ghiesbreghtii*,



7. Cross-section of *Agave cremnophila* flowers at around twice life size. Illustration by Kim Duffek.

Beaucarnea recurvata, *Clusia* sp., *Echeveria tencho*, *Acacia farnesiana*, *Erythrina lanata*, *Erythroxyllum rotundifolium*, *Arrabidaea costaricensis*, *Collubrina eilipitca*, *Lysiloma acapulcense* and *Hauya elegans*.



8. Clusters of *Agave cremnophila* populating the cliffs north of Santiago Lachiguiri.

Table 1. Comparison of *Agave cremnophila* with five other taxa from group *Striatae*.

	<i>Agave cremnophila</i>	<i>A. dasyliroides</i>	<i>A. kavandivi</i>	<i>A. petrophila</i>	<i>A. rzedowskiana</i>	<i>A. stricta</i>
Habit	caespitose	solitary	caespitose	caespitose	caespitose	caespitose
Height (cm)	30–40	30–50	30–50	50–60	20–40	40–70
Width (cm)	60–85	60–100	40–60	50–80	25–45	60–80
Number of leaves at maturity	150–200	70–100	60–80	>100	100–120	>100
Leaf color	medium green to deep green	green to green-glaucous	bluish green to yellowish green	glaucous to green-glaucous	green or glaucous-green	yellowish green, medium green, reddish
Leaf shape	linear-oblongeolate	linear-lanceolate	narrowly elliptic	linear	linear-triangular	linear, long-lanceolate
Leaf length (cm)	25–40	40–60	25–35	40–70	20–35	20–50
Leaf width (mm)	12–27	20–30	15–20	10–15	7–12	5–10
Leaf margin	finely serrulate-denticulate	minutely serrulate	finely denticulate	finely denticulate	minutely serrulate	scabrous-serrulate
Terminal spine (mm)	9–11	5–15	6–8	3–8	10–19	10–20
Inflorescence height (cm)	165–210	(150–) 200–260	60–150 (–250)	180–200	(42–) 70–170	(150–) 200–300
Peduncle length (cm)	60–80	100–160	20–80 (–130)	100–150	32–117	50–150
Spike length (cm)	105–130	50–100	40–70 (–120)	50–100	10–32 (–53)	100–150
Floral bracts (mm)	80–95	(40–) 65–100	(25–) 30–65	20–35	25–90	unknown
Flower color	yellowish green-greenish, tepals reddish purple in bud	greenish yellow with pink filaments	purple	greenish, tepal tip dark reddish	greenish purple	red to purplish
Flower length (mm)	35–36	25–39	25–33	20–25	22–24	25–30
Ovary length (mm)	12–13	9–13	10–14	7–10	7–9	8–14
Tube length (mm)	7–9	7–13	8–15	3–4	7–10	6–11
Tube width (mm)	8–9	9–12	9–12	5–7	9–10	9–10
Tepal length (mm)	13–16	9–13	10–14	9–11	4–8	7–10
Tepal width (mm)	7–9	6–7	4–7	2.5–4.5	2–6	3–6
Filament length (mm)	37–42	33–46 mm	30–47	27–30	28–38	28–37
Filament insertion	mid-tube	mid-tube	unknown	rim of tube	mid-tube	mid-tube
Ovary/tube ratio (average)	1.44–1.71 (1.575)	1–1.28 (1.14)	0.93–1.25 (1.09)	2.3–2.5 (2.4)	0.9–1.0 (0.95)	1.27–1.33 (1.3)
Ovary/tepal ratio (average)	0.81–0.92 (0.865)	1	1	0.77–0.91 (0.84)	1.13–1.75 (1.44)	1.14–1.4 (1.27)
Tube/tepal ratio (average)	0.54–0.56 (0.55)	0.78–1.0 (0.89)	0.8–1.07 (0.935)	0.33–0.36 (0.345)	1.25–1.75 (1.5)	0.85–1.1 (0.975)
Distribution	southeastern Oaxaca	north-central Morelos	west-central Oaxaca	northeastern Guerrero, north-western Oaxaca	southern Sinaloa, northern Jalisco, and northern Nayarit	southern Puebla and northern Oaxaca

Taxonomic Comparison

Of all the species in the *Striatae*, *Agave cremnophila* is vegetatively most similar to *A. dasyliroides* and *A. kavandivi*, and geographically closest to *A. kavandivi*, *A. petrophila*, and *A. stricta*, but can be distinguished from each by a combination of morphological characteristics (Table 1) as well as geographic distribution (Fig. 9). An examination of floral characteristics (Table 1) indicates that *Agave cremnophila* appears to be closest to *A. dasyliroides* and *A. kavandivi*. In the description for *Agave kavandivi*, Garcia-Mendoza, et. al. (2013) state that “*Agave kavandivi* is similar to *A. dasyliroides*, *A. stricta*, and *A. rzedowskiana*.” However, our examination of the floral measurements and ovary/tube, ovary/tepal, and tube/tepal ratios (Table 1) reveal that *Agave cremnophila*, *A. dasyliroides*, and *A. kavandivi* are clustered together as a primary

sub-group within the *Striatae*, while *A. rzedowskiana* and *A. stricta* are more distant. With its very short and relatively narrow tube, *Agave petrophila* appears to be an anomaly in the *Striatae*.

Agave cremnophila can be differentiated from the other five species in the *Striatae* that occur in southern Mexico individually.

— from *A. dasyliroides* in its growth habit (caespitose vs. solitary), number of leaves (150–200 v. 70–100), and distribution (southeastern Oaxaca vs. north-central Morelos).

— from *A. kavandivi* in leaf color (medium to deep green vs. yellowish green to bluish green), number of leaves (150–200 vs. 60–80), terminal spine length (9–11 mm vs. 6–8 mm), and distribution (southeastern Oaxaca vs. west-central Oaxaca).



9. Distribution of *Agave* series *Striatae* in Mexico.

— from *A. petrophila* by its shorter and wider leaves (25–40 cm by 1.2–2.7 cm vs. 40–70 cm by 1.0–1.5 cm), the longer terminal spine (9–11 mm vs. 3–8 mm), longer tube (7–9 mm vs. 3–4 mm), and distribution (southeastern Oaxaca vs. north-eastern Guerrero and north-western Oaxaca).

— from *A. rzedowskiana* by its larger size (60–85 cm across vs. 25–45 cm across), wider leaves (12–27 mm vs. 7–12 mm), longer tepals (13–16 mm vs. 4–8 mm), and distribution (southeastern Oaxaca vs. southern Sinaloa, northern Jalisco, and northern Nayarit).

— from *A. stricta* by the leaf width (12–27 mm vs. 5–10 mm), larger flowers (35–36 mm vs. 25–30 mm), longer tepals (13–16 mm vs. 7–10 mm), and distribution (southeastern Oaxaca vs. southern Puebla and northern Oaxaca).

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