



## *Magnolia zoticla* (*Magnolia* sect. *Macrophylla*, Magnoliaceae): a new species from the southern Sierra Madre Oriental, México

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### Abstract

A new species of *Magnolia* from the southern Sierra Madre Oriental, Mexico, is described and illustrated, providing information about its habitat distribution, ecology, biogeography and conservation status. After 12 fieldwork expeditions near the border of the states of Hidalgo and Puebla, we have developed morphological, ecological and biogeographic data to support recognition of populations from Acaxochitlán, Hidalgo and Pahuatlán, Puebla as a distinct species of *Magnolia* sect. *Macrophylla*. A key to species of this section and a distribution map for Mexican taxa are provided. The species was assessed as critically endangered (CR).

**Keywords:** Cloud-forest species, Mexican endemic, Mexican flora, *Magnolia dealbata*

### Resumen

Se describe e ilustra una nueva especie de *Magnolia* del sur de la Sierra Madre Oriental, México, proporcionando información sobre su distribución, hábitat, ecología, biogeografía y estado de conservación de la especie. A través de 12 expediciones de trabajo de campo cerca de la frontera de los estados de Hidalgo y Puebla, se recabaron datos morfológicos, ecológicos y biogeográficos que apoyan el reconocimiento de las poblaciones de Acaxochitlán, Hidalgo y Pahuatlán, Puebla como una especie distintiva de *Magnolia* de la sección *Macrophylla*. Se proporciona una clave de las especies de esta sección y un mapa de distribución de los taxones mexicanos. La especie fue evaluada como en peligro crítico (CR).

**Palabras clave:** flora del bosques nuboso, Especie endémica mexicana, flora mexicana, *Magnolia dealbata*

### Introduction

Magnoliaceae are a well-defined family of evergreen and deciduous trees and shrubs with two genera and ca. 350 species (Azuma *et al.* 2001, Kim & Suh 2013, Vázquez-García *et al.* 2015). *Magnolia* comprises 99% of the species in the family (Weaver 1987, Doyle 1989, Vázquez-García *et al.* 2015, 2021, Sánchez-Velásquez *et al.* 2016) and is subdivided into 12 sections (Kim & Suh 2013, Wang *et al.* 2020).

*Magnolia* sect. *Macrophylla* Figlar & Nootboom (2004: 92) includes seven species that are characterized by large deciduous leaves with an auriculate to cordate base that are glaucous to pubescent on the underside, frequently with a purple spot at the base of the adaxial side of the petals and a stomatal number of four (Figlar & Nootboom 2004, Vázquez-García 1990, Vázquez-García 1994, Vázquez-García *et al.* 2015).

An isolated population of *Magnolia* was first found in Zotictla, southeastern Hidalgo, composed of about 25 trees in disturbed and highly fragmented cloud forest remnants. These differed from the others in phenology and some floral and foliar characteristics. The distribution of this new species is restricted to Acaxochitlán, Hidalgo and Pahuatlán, Puebla. However, a more detailed exploration is required in other forest remnants of neighboring municipalities in southeastern Hidalgo and northern Puebla, where additional populations of this species may occur. The present work describes and illustrates this new species of *Magnolia* sect. *Macrophylla*.

Fieldwork included twelve expeditions between June 2013 and April 2021, the earliest aimed to study pteridophytes in the cloud forest of Zotictla in southern Hidalgo. AH had seen the trees thriving there since her childhood, thanks to her father, a rural teacher, who moved to Zotictla with his family several years earlier. Soon after, morphological variation of populations of *Magnolia* section *Macrophylla* in the Sierra Madre Oriental (Querétaro, Hidalgo, San Luis Potosí) was studied as part of the master's thesis of MGL.

Following the general lineage concept of de Queiroz (1998, 2007) we used morphological, ecological, genetic (Chávez-Cortázar *et al.* 2021) and biogeographical (Morrone *et al.* 2017) data as independent lines of evidence to support species status. Based on keys to species of *Magnolia* sect. *Macrophylla* (Vázquez-García *et al.* 2015, 2016, García-Morales *et al.* 2017) and specimens examined at IBUG, XAL, WIS and MEXU herbaria (acronyms according to Thiers 2020), we confirmed that the morphologically most similar species is *M. dealbata*. Recently collected material from Zotictla and Acaxochitlán and herbarium specimens at XAL were the basis of this morphological description. Major characters were contrasted against the single morphologically closest species, *M. dealbata*, occurring in the southern edge of the Sierra Madre del Sur province and one geographically nearby species, *M. vovidesii*, occurring in the intermediate area, at the eastern edge of the Trans-Mexican Volcanic Belt (Table 1). We used ArcMap 10.3 to plot coordinates of *M. sect. Macrophylla* obtained from field exploration, herbarium specimens and Global Biodiversity Information Facility database (GBIF 2020). A digital elevation model GMTED2010 and a layer of biogeographic provinces (Morrone *et al.* 2017) were added. The taxonomic key was adapted from Vázquez-García *et al.* (2016); we updated a map for *M. sect. Macrophylla* through examination of available specimens at pertinent herbaria and consulted the MEXU virtual collection. Habitat and phenology data were obtained from herbarium specimen labels, fieldwork and pertinent taxonomic literature. Conservation status was assessed using the IUCN Red List Criteria (IUCN 2019) and the information collected in fieldtrips. The extent of occurrence (EOO) and area of occupancy (AOO) were delimited from georeferenced records obtained in field explorations and some revised and analyzed GBIF records (GBIF 2020).

## Taxonomic treatment

*Magnolia zotictla* A.Sánchez-Gonz., Gut.-Lozano & A.Vázquez, *spec. nov.* (Fig. 1)

Type:—MEXICO. Hidalgo: Municipality Acaxochitlán, Zotictla, 0.3 km al SE de San Miguel del Resgate, bosque mesófilo de montaña, 1743 m, 20°13'32.5"N, 98°09'48"W, 5 May 2021 (fl & fr) *Gutiérrez-Lozano et al. 10186* (holotype: HGOM; isotypes: ENCB, IBUG, OAX).

*Magnolia zotictla* is morphologically more similar to the distant *M. dealbata* than to nearby *M. rzedowskiana*. It shares with the former habit size and large, deciduous, abaxially glaucous leaves. However, it differs from *M. dealbata* in having pubescent pedicels (vs. glabrescent), flowers with sepals erect (uncurled) at female phase (vs. curling outwards with petals maintaining a compact oblong conic shape), most petals strongly curled outward (vs. occasionally curling), stamens 1.3–1.8 (vs. 1.9–2.1 cm long), stigmas crowded, strongly curved outward and covering the carpels (vs. loose, slightly curved outward and exposing the carpels), young fruits velvety (vs. glabrescent), mature fruits pinkish-purplish to dark red (vs. dark greenish to yellowish), carpels densely pubescent (vs. glabrescent) and carpel beak acuminate to caudate with the stigmatic tip sometimes persistent during dehiscence (vs. acute to blunt with a deciduous stigmatic tip).

Deciduous trees, 10–25(–32) m, 10–100 cm in diameter, trunk erect and conical, crown sparse, top branched, bark scaly, fissured longitudinally and lenticels and leaf scars abundant. Stipules united 3/4 of the length of the petiole, oblong-lanceolate, with acute apex, densely scattered on the abaxial side, sericeous, glabrous adaxially. Petioles 5.0–7.0 cm long, 0.4–0.6 cm in diameter. Leaves obovate, acute at the apex, auriculate or cordate at the base, adaxially glabrous and green, abaxially white-glaucous (due to their sericeous epicuticular surface) with scattered white pubescence. Leaf blades 32.8–44.4 × 19.8–26.6 cm; midvein 3.2–4.2 mm in diameter. Bracts spatheaceous (2), ovate-oblong, densely

sericeous on the abaxial side. Pedicel (uppermost internode) 1.1–1.8 × 1.7–1.9 cm, glabrescent and usually glaucous towards the apex, the adjacent internode glabrescent, 3.8–5.3 × 1.5–1.7 cm. Flowers terminal, solitary, hermaphrodite, white when young, cream-yellowish when mature. Sepals 3, oblong-elliptic, truncate at the base with an acute apex, greenish yellowish, glabrous and often glaucous, 14.1–18.7 × 4.4–7.1 cm. Outer petals 3, oblong-elliptical, with acute apex, abruptly attenuate at the base, white, blades glabrous, 11.4–24.1 × 5.6–11.4 cm. Inner petals 10.4–21.7 × 4.7–8.4 cm. Floral axis 6.4–7.1 cm long. Stamens 337–478, linear, creamy white, rounded to obtuse at the apex, truncate at the base. Gynoecium ovoid, yellowish, pubescent, carpels arranged in a spiral, 1.5–1.6 × 0.2–0.21 cm; carpels 89–127, flattened, white, glabrous, 1.7–1.9 × 0.3–0.4 cm (Fig. 3). Polyfollicles 7.3–11.3 × 5.3–6.4, ovoid. Seeds 1–2 per carpel, 1.2–1.6 × 0.7–1.0 cm, ovoid to oblong or subpyramidal, with an obtuse base and apex and red sarcotesta. Fruit stalk 1.1–1.8 long, 1.2–1.9 cm in diameter.

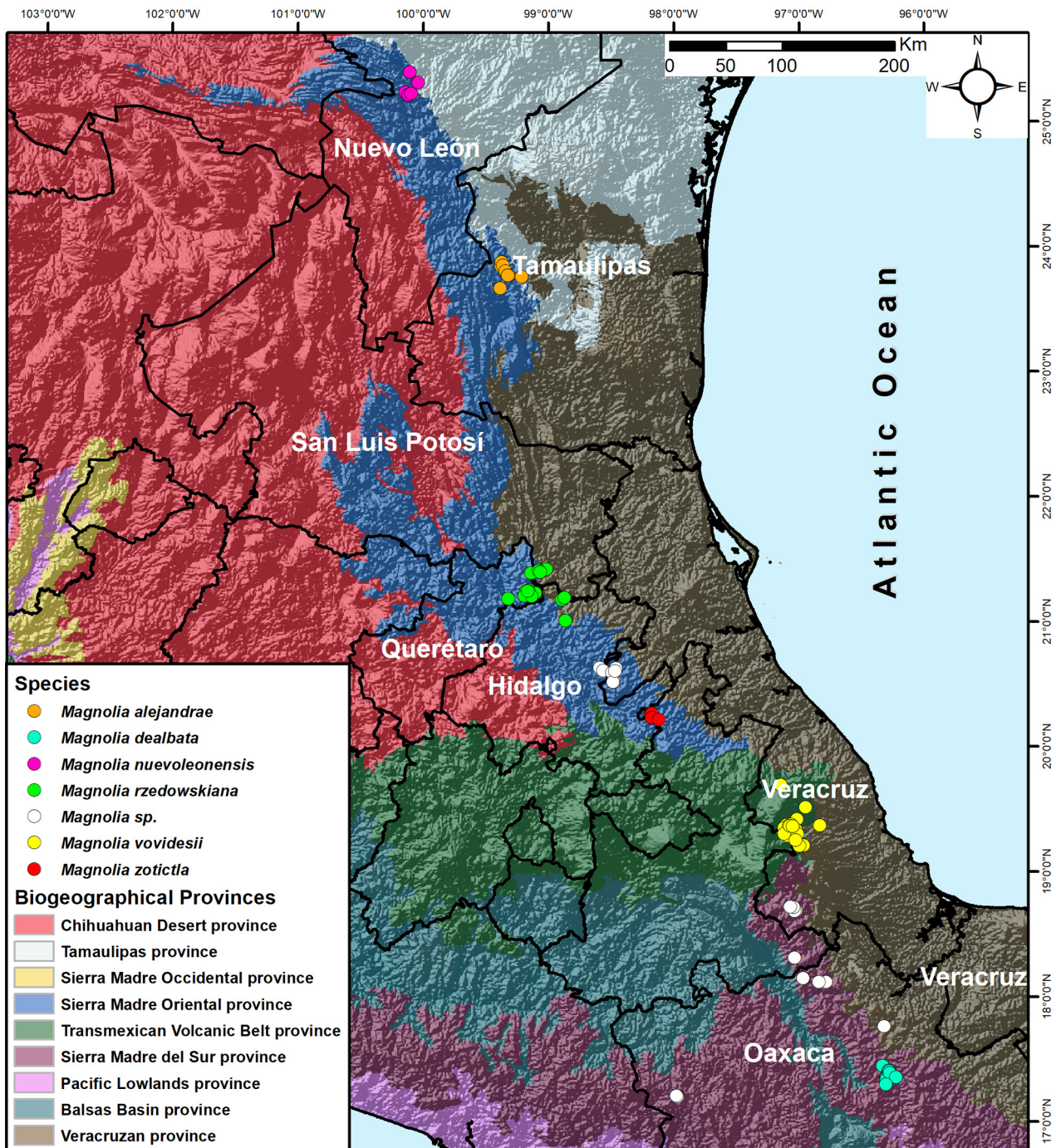


FIGURE 1. Allopatric distribution of *Magnolia* section *Macrophylla* within the Mexican biogeographic provinces (Morrone *et al.* 2017).

**TABLE 1.** Morphological and ecological differences among *Magnolia dealbata*, *M. vovidesii* and *M. zoticla*.

	<i>M. dealbata</i>	<i>M. vovidesii</i>	<i>M. zoticla</i>
Leaves (cm)	38–56(–70) × 20–25 (–35)	(24–)40–55(–70) × 15–30	32.3–58.5 × 6.1–31.7
Pedicels	Glabrescent	Glabrescent	Pubescent
Flower			
Diameter (cm)	30–52	25–38	24–49
Outer petals (cm)	15.0–24.0 × 8.0–10.0	12.0–18.0 × 6.0–7.0	11.4–24.1 × 5.6–11.4
Purple-blotch at base of petals	Absent	When present, on inner and outer whorls, broad and pale to dull purple	Absent
Stamens			
No.	290–430	308–352	337–478
Length (cm)	1.9–2.1	1.0–1.9	1.3–1.8
Styles			
Shape	Cylindrical, elongate	Cylindrical, shortly elongate	Cylindrical, elongate
Color	White	Creamy white	White
Apex	Round to truncate	Round	Round to truncate
Disposition	Mostly straight	Curved outward to geniculate	Mostly straight
Density	Tight	Loose to tight	Tight
Fruit			
Size (cm)	8.0–15.0 × 4.5–9.0	10.0–12.0 × 4.5–7.0	7.3–11.3 × 5.3–6.4
Pubescence	Glabrescent	Glabrous	Velvety
Color	Dark greenish to yellowish	Green	Pinkish, purplish to dark red
No. of carpels	80–105	(60–)70–78	89–127
Distribution	MEXICO: Sierra Norte de Oaxaca	MEXICO: Central Veracruz	MEXICO: Hidalgo/Puebla border
Latitude (N)	17°18'–17°31'	19°12'–19°25'	20°13'–20°16'
Elevation (m)	1380–2145	1600–1700	1743–1869
Biogeographic province.	Sierra Madre del Sur (northern edge)	Trans Mexican Volcanic Belt (eastern edge)	Sierra Madre Oriental (southern edge)
Representative trees	<i>Clethra</i> sp., <i>Liquidambar styraciflua</i> , <i>Magnolia oaxacensis</i> , <i>Pinus chiapensis</i> , <i>Quercus laurina</i> ,	<i>Liquidambar styraciflua</i> , <i>Styrax</i> sp., <i>Ternstroemia</i> sp., <i>Weinmannia</i> sp.	<i>Alnus acuminata</i> , <i>Alsophila firma</i> , <i>Clethra</i> sp., <i>Liquidambar styraciflua</i> , <i>Pinus</i> sp., <i>Quercus</i> sp.

\* Environmental data obtained from INEGI (2005) and biotic information from Vázquez-García *et al.* (2013), Domínguez-Yescas *et al.* (2020).

**Distribution and ecology:**—Distributed on the southern edge of the biogeographic province of Sierra Madre Oriental (on the border between the states of Hidalgo and Puebla). A few magnolia trees still thrive wild in ravines or hills within highly fragmented, disturbed and open cloud forest remnants. Occasionally they form small groups but mostly are isolated near crops or home orchards, among widely spaced houses and bordered by secondary cloud forest vegetation dominated by *Liquidambar styraciflua* Linnaeus (1753: 999; Altingiaceae) and *Alnus acuminata* Kunth (1817: 20; Betulaceae). Most *Magnolia* trees are close to or within the hilly villages of the Acaxochitlán Municipality, Santa Catarina, Toxtla and Zoticla, the last with three barrios: Centro, Tlaloc and Yeloxóchitl. Another population was found in the town of Ahila, Pahuatlán Municipality, Puebla. The largest population of this species was at Zoticla, 25 trees. Santa Catarina had 15, Ahila 11 and Toxtla 5.



**FIGURE 2.** *Magnolia zotictla* (A–D): A. Flower bud in female phase. B. Stamens and stigmas. C. Flower in female phase. D. Flower in male phase. *Magnolia dealbata* (E–H): E. Flower bud in female phase, F. Stamens and stigmas. G. Flower in female phase. H. Flower in male phase. Photographs A–D by Arturo Sánchez. Photographs E–H by Reyna Domínguez.



**FIGURE 3.** *Magnolia zotictla* (A–C): A. Mature fruit, B–C. During and after dehiscence. *Magnolia dealbata* (D–F): D. mature fruit, E–F. During and after dehiscence. A–C Photographs by Arturo Sánchez. D–F Photographs by Reyna Domínguez.



**FIGURE 4.** *Magnolia zotictla*. Trees with dehiscent fruits from Zotictla, Hidalgo. Photographs: Arturo Sánchez



**FIGURE 5.** *Magnolia zotictla* in Zotictla, Acaxochitlán. A. Habitat. B. Fragmented and steep landscape. C. Roadside. D. Adriana Gisela & Sra. Esther Santos, neighborhood of Zotictla. E. Arturo Sánchez and Marisol Gutiérrez. F. Trees near the Church at Zotictla. Photographs (A–D & F) by Arturo Sánchez. E. by Adriana Hernández.



**Phenology:**—During the study period, it was observed that the production of leaves begins in February, and the production of flower buds begins in the first week of March. The ripening of the fruits was observed from the end of April and the beginning of May. Falling of leaves for this species is from November to January. In *M. rzedowskiana*, flower buds appear at the end of April and beginning of May.

**Ethnobotany:**—In the ancient cultures of America and Asia, magnolias were known for their ornamental and pharmacological use, essentially to alleviate various types of human pathologies (Pfaffman 1975, Dodd 1980, Gutiérrez-Carvajal 1993, Gutiérrez and Vovides 1997, Satyajiy *et al.* 2002, Vázquez-García *et al.* 2015). This species is known locally as magnolia, *eloxóchitl* or *yeloxóchitl* (cornflower in Náhuatl), and its showy and fragrant flowers are usually collected for sale locally. The most important use in the region is to prepare floral infusions to treat heart problems, nerve problems and scars. It is also used as an ornamental plant. A few people from Santa Catarina, Toxtla and Zotictla sell the petals largely on Sunday in the local markets of Hidalgo (Actopan, Pachuca, San Miguel Resgate and Tulancingo), Puebla (Honey, Pahuatlán), Veracruz (Poza Rica and Tuxpan), and Mexico City (Sonora traditional market). A kg of petals sells at \$4–6 USD for use as infusions.

**Conservation status:**—*Magnolia zotictla* has a narrow distribution, found only in the towns of the Acaxochitlán, Hidalgo (Santa Catarina, Toxtla and Zotictla) and Pahuatlán municipalities in Puebla (Ahila). The habitat is highly fragmented and disturbed, and trees are mostly isolated. The four populations observed have fewer than 60 adult individuals in total. Only a few seedlings and juveniles were observed inside the forest (E. Méndez, pers. comm., 6 July 2020). In addition to this, it was observed that the flowers are collected without control because they are showy and have a pleasant smell; the local people are well acquainted with this plant species but have no interest or concern for its conservation. It was observed that the trees fall easily during the hurricane season or when the wind and rain are intense. Small mammals and birds eat the seeds. Thus, it is suggested that it should be immediately listed in some risk category within the Official Mexican Standard (NOM-059-2010). According to the IUCN criteria (IUCN 2019), the species meets four different criteria [A2ad, B1ab(iii, v), B2ab(iii), C2a(i)] and should be assigned to the critically endangered category.

**Notes:**—*Magnolia zotictla* lacks the purple spot at the base of the petals usually found on *M. dealbata* and differs from *M. rzedowskiana* in the size of the petals, number of stamens and carpels and size of the fruits (Table 1). The most obvious difference in flowering time is that *M. zotictla* begins two months earlier than the two aforementioned species. *Magnolia zotictla* and *M. dealbata* occur at different latitudes 20°13'–20°16'N vs. 17°18'–17°31'N and in contrasting biogeographic provinces (Morrone *et al.* 2017, Domínguez-Yescas *et al.* 2020), the former at the southern edge of the Sierra Madre Oriental vs. the latter at the northern edge of the Sierra Madre del Sur, separated by the Trans-Mexican Volcanic Belt. The emergence of this volcanic chain may have formed a natural barrier and secured their isolation, preventing gene flow and favoring allopatric radiation of three species *M. zotictla*, *M. vovidesii* and *M. dealbata*, each one now in different biogeographic provinces (Ibarra-Martínez 2020).

**Additional specimens examined:**—MEXICO. Hidalgo: Municipio de Acaxochitlán, Santa Catarina town, orchard field of ornamental plants, towards surrounding mountains, 1884 m, 21°14'20.5"N, 98°10'59"W, 5 May 2021, *Hernández-Álvarez 250* (CHAP); same as previous locality, near a road and stream of uninhabited land, close to disturbed mountain cloud forest, 5 May 2021, *Gutiérrez-Lozano 297* (HGOM, IBUG). Puebla: Pahuatlán Municipality, Ahila town, ornamental *Magnolia* tree outside a house, bordering secondary cloud forest vegetation, 1657 m, 20°15'26.1"N, 98° 10'58.2"W, 5 May 2021, *Gutiérrez-Lozano 298* (CHAPA, IBUG), same locality, tree close to the previous one, 5 May 2021, *Gutiérrez-Lozano 298b* (MEXU, ENCB).

### Key to species of *Magnolia* sect. *Macrophylla*

1. Mature fruit broadly ovoid to subglobose .....2.
- Mature fruit, oblongoid, ovoid or ellipsoid .....3.
2. Leaves 50–110 cm long; petals 20 to 23 cm long; gynoecium 4 cm long; stamens (300–)350–580; carpels (44–)50–80; carpel valve margin wide, 0.4–0.5 (–0.7) cm thick; growing at 150–300 m (United States: AL, AR, GA, KY, LA, MS, NC, OH, TN, and VA)..  
..... *M. macrophylla*
- Leaves 25.0–35.0(–40.0) cm long; petals 10.0–11.0 cm long; gynoecium 2.0 cm long, stamens 200–220; carpels 30–40; carpel valve margin narrow, 0.2–0.3 cm thick; growing at 1500–1700 m (Mexico: Nuevo León)..... *M. nuevoleonensis*
3. Carpel beak <0.7 cm.....4.
- Carpel beak 1.0–1.5 cm .....5.
4. Multi-trunked shrub or lax trees 8.0–10.0 (–12.0) m; fruit cylindrical to ellipsoid; carpels 20–25(–50), growing below 150 m (United States: Florida) ..... *M. ashei*
- Single upright trees 8.0–25.0 m; fruit rhomboid-ovoid; carpels 50–65; growing at 800–1950 m (Mexico)..... *M. rzedowskiana*
5. Carpels 42–78.....6.

- Carpels 80–127 .....7.
- 6. Stamens 192–216, carpels 42–54 (México: Tamaulipas) ..... *M. alejandrae*
- Stamens 308–352, carpels 60–78 (Mexico: Veracruz) ..... *M. vovidesii*
- 7. Fruit dark green to yellow, young fruits glabrescent; stamens 1.9–2.1 cm long; carpels acute to blunt, the tip deciduous (Mexico: Oaxaca) ..... *M. dealbata*
- Fruit pinkish-purplish to dark red, young fruit velvety; stamens 1.3–1.8 cm long; carpels acuminate to caudate, the tip sometimes persistent during dehiscence (Mexico: Hidalgo/Puebla border) ..... *M. zoticlla*

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