

## Two new species of *Manfreda* Salisb. (Agavaceae) from the Yucatán Peninsula, Mexico

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HERNÁNDEZ-SANDOVAL, L. (Escuela de Biología, Facultad de Ciencias Naturales, Universidad Autónoma de Querétaro, Av. de las Ciencias s/n. Querétaro, 76230, Querétaro, México), R. ORELLANA AND G. CARNEVALI (Herbarium CICY, Unidad de Recursos Naturales, Centro de Investigación Científica de Yucatán, A.C., Colonia Chuburná de Hidalgo, Mérida 97200, Yucatán, México). Two new species of *Manfreda* Salisb. from the Yucatán Peninsula, México. J. Torrey Bot. Soc. 135: 168–177. 2008.—Two species of *Manfreda* Salisb. (Agavaceae) endemic to the Mexican Yucatán Peninsula are proposed as new. The new species, *Manfreda paniculata* L. Hernández, R. Orellana & Carnevali and *M. petskinii* R. Orellana, L. Hernández & Carnevali are characterized by the presence of long-lasting leaves, paniculate inflorescences, and flowers subtended by a single bracteole—the latter a unique character found within the family Agavaceae and probably within the order Asparagales. *Manfreda paniculata* is similar to *M. sileri*, differing from it by the presence of a stem, bulbils, leaves fleshier and more rigid, larger marginal teeth, with long flexible spine-like tip, pedicellated flowers, and shorter floral tube. *Manfreda petskinii* has been annotated in some herbaria as *M. scabra*, but the new species is similar to *M. variegata*, from which it differs by the presence of minutely pubescent and denticulate leaves, ascendant flowers, filament insertion at the mouth of the tube, and a thin style. However, both new species are most closely related to each other than any other species in the genus. *Manfreda petskinii* is acaulescent with narrower, linear-lanceolate leaves, finely serrulate margins and smaller than *M. paniculata*.

Key words: Agavaceae, *Manfreda*, panicle, Yucatán Peninsula Biotic Province (YPBP).

*Manfreda* Salisb. is a genus of Agavaceae in need of a critical revision. The last monograph was a thesis dissertation by Verhoek-Williams (1975) who recognized 19 species, but the study was not published. Later, Piña-Luján (1985a, 1985b, 1985c, 1986) published a series of accounts of the then known species based on Verhoek-Williams' (1975) study, including an improved key and many photographs. Eleven additional species have been proposed afterwards (e.g., Verhoek 1978, Lott-Williams and Verhoek 1991, García-Mendoza et al. 2000), and Verhoek (1998) recognizes 26

species. In a classical circumscription, the genus *Manfreda* is composed of monocarpic to polycarpic plants with basal rosettes, characteristic dark spotted or blotched leaves, spiciform inflorescences, solitary flowers with exerted stamens and style, and loculicidal capsules. The genus is distributed from Virginia and Texas in the U.S.A., throughout Mexico (except Baja California), and southwards into Honduras and El Salvador. Most species, occur in Central Mexico (Verhoek 1998). Some species of *Manfreda* are reputedly medicinal, or otherwise used as fish-poison ("barbasco"), as a vermifuge, as an antidote against snake venom, and to produce a soap or shampoo substitute (Verhoek 1978a). We discuss further uses of the plants in Yucatán in the ethnobotany section. Several species of *Manfreda* are cultivated in many different parts because their ease of growth, beautiful foliage and interesting flowers (Hannon 2002).

The phylogenetic position of *Manfreda* is widely disputed. A morphological phylogeny of the Agavaceae (Hernández-Sandoval 1993, 1995) indicates that *Manfreda* is the sister clade of a group containing the genera

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*Prochnyanthes* S. Watson, *Polianthes* L. and *Pseudobravoia* Rose. Some of the critical characters for these genera are the presence of two bracteoles subtending the flowers in all the genera, position of the stamens (exserted in *Agave* and *Manfreda*, inserted in *Prochnyanthes*, *Polianthes*, and *Pseudobravoia*), and the number of flowers at the last inflorescence unit or node (two for *Agave*, *Polianthes*, and *Prochnyanthes*, one for *Manfreda* and *Pseudobravoia*). Thus, this last character would seem to have evolved at least twice, one in the *Polianthes-Pseudobravoia* group and again in *Manfreda*, from which it has been suggested that by removing some misplaced species to other genera, three natural groups are formed, represented by the generic concepts of *Manfreda*, *Polianthes*, and *Prochnyanthes*.

A phylogenetic analysis of the Agavaceae using the nrDNA ITS region (Bogler and Simpson 1996) suggests that *Agave* is paraphyletic if *Manfreda* is recognized. The phylogenetic structure of their most parsimonious cladograms indicates that the *Agave* subgenera, *Littaea* and *Agave*, are para- or polyphyletic and sister of a clade formed by *Manfreda*, *Polianthes*, and *Prochnyanthes*. Thiede and Eggli (1999, 2001), based on morphological and molecular data compilation, transferred the species of *Manfreda*, *Polianthes*, and *Prochnyanthes* to *Agave*. A more recent analysis (Good-Ávila *et al.* 2006) based on two plastid regions, *trnL* and *trnL-trnF*, shows *Manfreda* species inserted within *Agave* s.l., which would include both subgenera of *Agave*, along with *Manfreda*, *Polianthes*, and *Prochnyanthes*. Another recent paper by Bogler *et al.* (2006) summarizes and analyses morphological and molecular data available to date (nrDNA ITS, *ndhF*, *rbcL*), plus adding sequences of its own. The data sets were analysed independently and in combination. The resulting analyses also identify *Manfreda* as included within *Agave* s.l. However taxon sampling in all studies was not enough to clearly assess the position of *Manfreda* (e.g., a single species of the genus, *M. virginica* (L.) Salisb., was included in the combined analyses). All DNA studies so far have had limited number of taxa for the family, particularly from *Manfreda*. For example, Bogler and Simpson (1996) analyzed 25 species, including two of *Manfreda* and 11 outgroups, Good-Ávila *et al.* (2006) sampled 50 taxa, including 11 outgroups, and Bogler *et al.* (2006) included

24 taxa of Agavaceae s.l., and a single *Manfreda* species in the combined analysis. As currently understood, the family Agavaceae comprises ca. 300 species (297 sensu Good-Ávila *et al.*, 2006), which means that less than one sixth of all the species in the family have been sampled. It is well known that for the same number of characters, taxon sampling, proportional to the size of the total ingroup can have a dramatic influence in the final topology of a phylogenetic analysis (Bremer *et al.* 1999). Only a limited number of DNA regions and no data from other sources (e.g., anatomy, biochemistry) have been critically analyzed for phylogenetic implications. The data from the single morphological study (Hernández-Sandoval 1995) has not been analyzed in combination with the molecular data sets. Thus, the current morphology and both nuclear and plastid DNA analyses suggest that *Manfreda* should be treated as a clade of *Agave* s.l. or else as a para- or polyphyletic group and thus not worthy of generic recognition. An alternative approach could be the recognition of several smaller genera within the current circumscription of *Agave* s.l., a position that, given the high species diversity, we might favour.

Hence, until the classification of Agavaceae, particularly that of the subfamily Agavoideae becomes better understood with more evidence (molecular and morpho-anatomical datasets) and a better sampling of the family is achieved, we prefer to treat *Manfreda* in a conservative circumscription and distinct from the genus *Agave*.

Several names have been used for the *Manfreda* taxa occurring in the Mexican Yucatán Peninsula, among them *M. maculata* (Sosa *et al.* 1985, Orellana *et al.* 1985), *M. scabra* (Ort.) McVaugh (= *M. brachystachya* Rose), and *M. variegata* (Jacobi) Rose (e.g. Espejo-Serna and López-Ferrari 1992, Durán *et al.* 2000). The treatment of the genus for Flora Mesoamericana (Lott and García-Mendoza 1994) included a single species from the Yucatán Peninsula Biotic Province (YPBP), identified as *M. variegata* and reported as possibly introduced. A review of the genus *Manfreda* for our continuing studies of the YPBP flora has revealed that there are two wild species occurring in Yucatán, proposed here as new, taking into account floral and inflorescence characters as well as the geographic isolation, which might have promoted

differentiation from other *Manfreda* species elsewhere.

The genus *Manfreda* has been characterized as presenting spicate inflorescences and caducous leaves (Verhoeck-Williams 1975, 1998). The two *Manfreda* species from the YBPB display conspicuously paniculate inflorescences, fleshy long-lasting leaves, and pedicellate flowers. Both species also differ from the rest of *Manfreda* in the presence of one or two separated bracteoles subtending the flowers. Even though these two species are different in many features, they seem to be more closely related to each other than to any other species of *Manfreda* or any other members of the subfamily Agavoideae. Thus, it is foreseeable that upon resolution of the relationships within the Agavoideae, these two species might be recognized as a supraspecific taxon within the subfamily.

#### Key to the species of *Manfreda* in the YBPB

1. Plants acaulescent or with a short stem with age; rosette 45–100 cm diameter; leaves somewhat rigid, 5–10 cm wide, lanceolate to lanceolate-triangular; dark, lustrous green, with dark reddish spots, glabrous, terminal spine conspicuous, soft; flowers with pedicels 3.5–4.5 mm long; stamens subparallel to slightly divergent at anthesis (forming a  $< 30^\circ$  angle to the style), inserted at the floral tube ..... *M. paniculata*
1. Plants always acaulescent, rosettes 30–50 cm diameter; leaves flaccid, less than 5 cm wide, linear-lanceolate to ensiform; glaucous, with white or reddish brown spots, minutely pubescent; terminal spine minute; flowers with pedicels  $\leq 2$  mm long; stamens widely divergent in anthesis (forming a  $> 45^\circ$  angle to the style), inserted at or very close to the floral tube mouth ..... *M. petskinil*

A species of *Manfreda*, under the name *Manfreda undulata* (Klotzsch) Rose (as *Agave undulata* Klotzsch) was cited by Standley (1930) as occurring in Yucatán. The data provided by this author are insufficient to determine to which of these two new species it should be referred. The type of *Manfreda undulata* is a mixed specimen of plants from *Agave* and *Manfreda*, and the flowers were

described “from memory” by Jacobi (Verhoeck-Williams, 1975).

***Manfreda paniculata* L. Hernández., R. A. Orellana & G. Carnevali, sp. nov.** TYPE: MEXICO. Yucatán: 3 km al N de Panabá rumbo a San Felipe, 5–10 m,  $21^\circ 18' 11''$  N;  $88^\circ 16' 37''$  W; 2 dic 2006, L. Hernández, R. Orellana and G. Carnevali 5815 (Holotype, CICY, Isotypes, MO, QMEX). Fig. 1.

Species haec *Manfreda petskinil* sed planta majoris, foliis brevioris, proportione latioribus, inflorescentia multilongiores 3-pinnata, flores conspicue pedicellatis differt. Verosimiliter affinis cum *Manfreda maculosa* sed inflorescentia paniculata, foliis perennis, paulo canaliculatis, folia margine conspicue denticulata, aculeo terminali non coriacea et breviter tubo florali recedit.

Succulent, caulescent, perennial rosettofilious plants; rosettes 20–40 cm tall, 45–100 cm diameter, monocarpic, the plant grows through the production of axillary rosettes and stolons, mature inflorescences often produce bulbils on some of the distal meristems; **rhizomes** cylindrical to oblong 5–30 cm long, erect at maturity; rest of old leaves and thick fibers at the apex; **roots** thick, succulent; **leaves** 20–70, lanceolate to lanceolate-triangular,  $20\text{--}55 \times 2.5\text{--}10.0$  cm, long-lasting, succulent (ca. 2.1 mm at the widest section of the leaf), channeled, the surface almost smooth, dark green, variegated with dark green to reddish brown spots, these more vivid on some individuals and on leaves exposed to bright light, apex long-attenuate with a flexible apical tip 1–2 cm long, apparently made-up of aggregated compacted fibers; margins sinuate, denticulate to spinulose with chartaceous teeth 0.5–1.0 mm in mature leaves. **Inflorescence** (1–)1.75–2.5(–3.8) m tall, paniculate; scape 0.5–1.8 m tall with 6–20 internodes, reddish-brown, glaucous; scape bracts 13–15 to ca. 2 cm long at the upper part, long triangular toward the base to deltoid, caducous, colored as leaves, rather succulent; reproductive part ovoid to pyramidal, 1–3 branched, rachis 0.2–2.0 m long; bracts subtending the branches triangular to deltate, 2–3 cm long; bracts subtending the floral peduncles deltoid, 2–4 mm long, papyraceous; bracteoles triangular, solitary, 1–3 mm long, papyraceous, pedicels 3.5–4.5 mm long. **Flowers** protandrous, solitary, almost geminate in some young branches, 3.0–3.5 cm long, pale dull





FIG. 1. *Manfreda paniculata* L. Hernández, R. Orellana & Carnevali. A. Flowering rosette. B. Axillary, adventitious branches at the basal nodes of peduncle. C. Flower during protandrous phase, longitudinal section: note filament insertion point. D. Fruiting panicle, upper half. E. Secondary branch showing different floral phenophases.

greenish yellow, glaucous outside, shiny pale green inside; perianth tube 6–8 mm long, narrow funnellform; perianth lobes  $15\text{--}20 \times 1.5\text{--}3.5\text{--}(4)$  mm, ovate-lanceolate, apex obtuse, cucullate, tepal lobes reflexed during the

staminate phase of the flower, then erect, presenting incurved margins at maturity, apex with a tuft of glandular white trichomes, denser at the external part; stamens diverging from the style up to  $30^\circ$  at anthesis from the

style, insert at the base of the perianth tube, filaments filiform 4.0–5.5 cm long, dark shiny reddish-brown; anthers ca. 1.5 cm long, yellow to reddish, dorsifixed, versatile, curved after pollen dehiscence. **Ovary** cylindrical to fusiform 1.5–1.8 cm long, colored as the external part of tepals, angulate to striate, style filiform, 5.0–5.5 cm long, colored as stamens; stigma clavate to capitate, 3-lobed, 0.5 mm thick. **Fruits** capsular, oblong to obpyriform, 2.5–4.0 cm long, dark brown to almost black upon maturity, often with persistent perianth parts; seeds lunate,  $6.0\text{--}9.0 \times 4\text{--}6$  mm, black, shiny, marginate.

**Paratypes:** MEXICO. **Campeche:** Mpio. Campeche, Pich, ca. 45 m,  $19^{\circ} 29' 05''$  N;  $90^{\circ} 07' 06''$  W, 30 Mar 1998, *B. Faust and P. Ucan 1023* (CICY). **Yucatán:** Mpio. Panabá, 1 km al N de Panabá rumbo a San Felipe, 5–10 m, 19 Mar. 1991, *R. Orellana 861* (CICY); Mpio. Calotmul, approx.  $21^{\circ} 01' 08''$  N;  $88^{\circ} 10' 28''$  W, no date, *G. Gaumer 959* (F, photo seen); Mpio. Mérida, Mérida, 8–10 m, cultivated at a garden at Colonia México,  $21^{\circ} 01' 01''$  N;  $89^{\circ} 36' 00''$  W, 29 Mar. 1982, *R. Orellana 86* (CICY, XAL). CICY, Jardín Botánico Regional, 8–10 m,  $21^{\circ} 01' 42''$  N;  $89^{\circ} 38' 17''$  W, 30 Mar. 1999, *R. Orellana 954* (CICY); UACH, Temozón Norte, 6–8 m,  $21^{\circ} 03' 52''$  N;  $89^{\circ} 35' 41''$  W, 9 Jun 1987, *P. Colunga 350, 351* (CICY). **Quintana Roo:** Mpio. J. M. Morelos, Chichankanab, 47 m, approx.  $19^{\circ} 52' 36''$  N;  $88^{\circ} 46' 14''$  W, no date, *G. Gaumer 1543* (F, photo seen);  $1^{\circ} 18' 46''$  N;  $88^{\circ} 16' 44''$  W,

**Etymology.** The name refers to the broadly paniculate inflorescences typical of this species.

**Phenology and reproductive biology.** Flowers from November to March; fruits from November to April. Flowers are produced asynchronously among individuals in the same population, from November to March. Despite the large number of flowers, few fruits are set from the all the flowers, suggesting the requirement of vector-assisted pollination, as previously documented for other *Manfreda* species (Eguiarte 1983). Vegetative reproduction is by stolons and inflorescence bulbils. The stolons in large, mature, flowering rosettes may develop into lateral basal inflorescences, which in these cases arise for the

ground. The plants seem to resist fire under natural conditions.

**Distribution and habitat.** In open areas with limestone rocky shallow soils (“tzekel” in Mayan), growing associated with secondary tropical subdeciduous forests, often found at the surroundings of sink holes (“cenotes” or “dzonot”) or lakes, from 5–130 m altitude. The species seems restricted to the NE portion of the Mexican Yucatán Peninsula. The species is often cultivated (see below) and has been found in villages far removed for where natural populations are known to occur, such as Mérida, Mama, Dzityá (Yucatán State), and Pich (Campeche State), west of the populations known with certainty to be wild.

**Taxonomic relationships.** *Manfreda paniculata* is most unusual in the genus due to its huge, broadly paniculate inflorescences, solitary flowers subtended by a single bracteole, pedicellate flowers, and the production of bulbils. However, the flowers are typical of the genus *Manfreda* with stamens inserted at the base of the tube. Furthermore, the foliar texture, color, and spots are typical of the genus *Manfreda*, as well as the lack of a terminal, lignified spine. Fig. 2 compares the tube/tepale ideograms (sensu Gentry, 1972) of the two new taxa depicting the relative dimensions of the corolla tube and lobes. Fig. 3 provides a comparison of the leaf margins of the two new species. *Manfreda paniculata* is similar to *M. sileri* Verhoeck from which it differs by the presence of leaves fleshier and more rigid with shallow channels, larger marginal teeth, a soft spine-like tip, and shorter floral tube. *Manfreda haumiensis* (Boye-Petersen) Verhoeck, a larger plant with a spine-like tip, from the states of Morelos, Mexico, and Guerrero, differs from *M. paniculata* in the simple inflorescences (up to 3.8 m tall) and the longer perianth lobes (2.0–4.6 cm vs. 1.5–2.0 cm in *M. paniculata*).

**Ethnobotany.** *Manfreda paniculata* is reputed as medicinal, the leaves are used against headaches. It is also often grown as an ornamental, and it can be seen growing at houseyards and botanical gardens with few differences from those plants in the wild. It is locally known as “Pets’k’inil macho” (*B. Faust and P. Ucan 1023*, CICY) in Campeche, while in Yucatán it has been recorded as



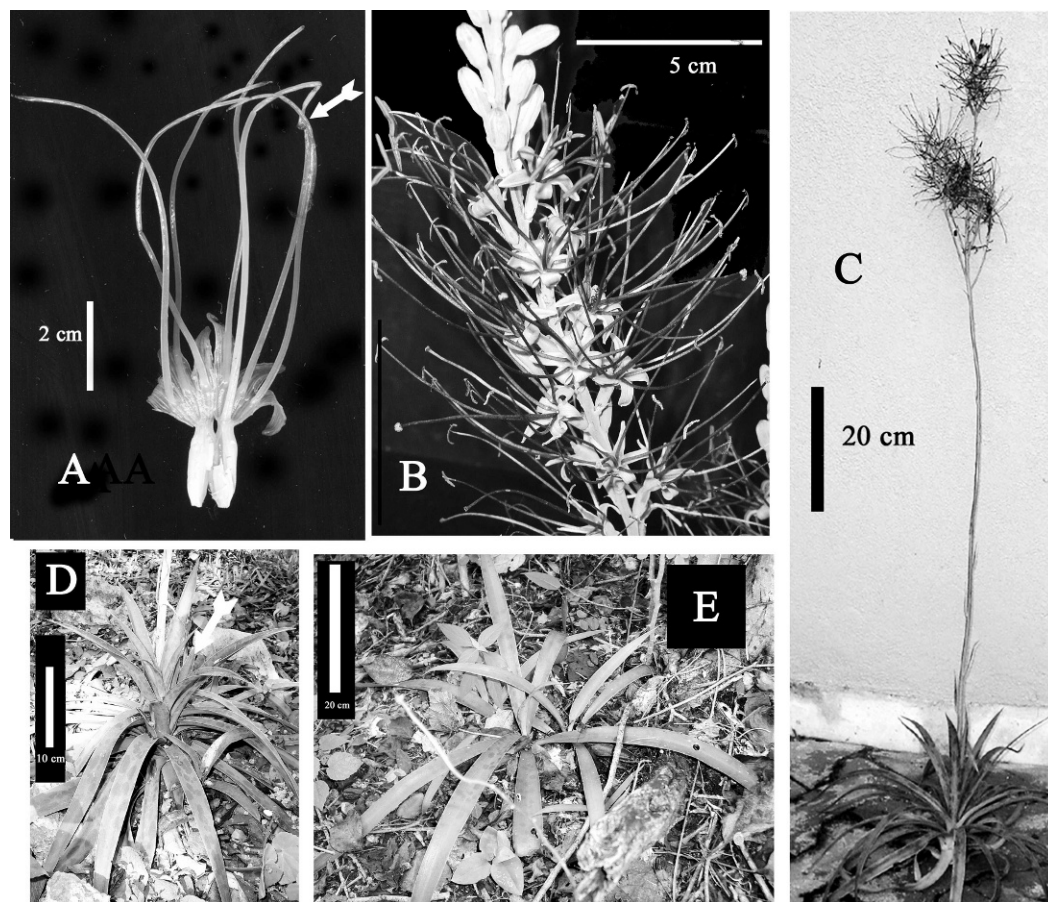


FIG. 2. *Manfreda petskinil* R. Orellana, L. Hernández & Carnevali. A. Flower during gynandrous phase, longitudinal section: note filament insertion point; arrow points stigma. B. Portion of inflorescence with several flowers showing different phenophases. C. Flowering plant: note paniculate inflorescence. D. Mature rosette; arrow points to new growth emerging from the axils of the central leaves of flowering rosette; cultivated plant E. Immature plants under deep shade in habitat.

“hunpets’kinil” (el que se mancha o estampa con el sol” or “he or she who becomes spotted with the sun”) and Xpets’kinil (“la que pesca el sol”) fide Sr. Francisco Góngora interviewed by R. Orellana (Sept 30, 1982 at the village of Mama, Yucatán). Souza Novelo (1940) recorded the common names “xix-ki” (“garbage agave”) and “hunpets’k’in’ki” (an

alternative spelling of “hunpets’kinil”, the genus namesake in the Yucatán Peninsula).

***Manfreda petskinil*** R. Orellana, L. Hernández & Carnevali, sp. nov. TYPE: MÉXICO: Yucatán: Municipio Izamal, Cenote Xcholac (Xcolak, sic!) 14–15 km. al E de Izamal por la vía a Tunkás, aprox. 20° 54' 50" N, 88° 50' 00" W, 20–50 m.s.m. 28 enero 2007, G. Carnevali and I. M. Ramírez 7206 (Holotype CICY; Isotypes MO, QMEX). Fig. 4.

Species haec *Manfreda paniculata* L. Hernández, R. Orellana & Carnevali sed plant et flos parviore, foliis longioris proportione angustiore inflorescentia multibreuiore, floriis sessilis differt. Verosimiliter affinis *Manfreda scabra* sed foliis perenniis, inflorescentia paniculata, stylo filiforme recedit.

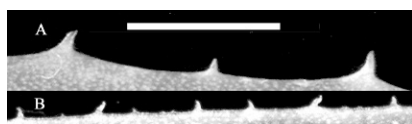


FIG. 3. Comparison of leaf-margins of the new manfredas. A. *Manfreda paniculata*. B. *Manfreda petskinil*.

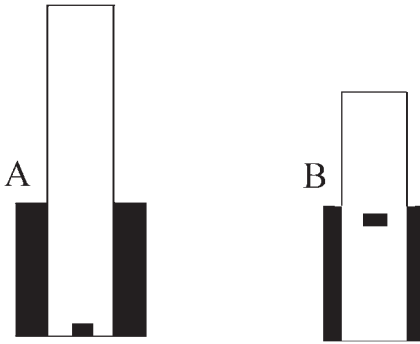


FIG. 4. Tube/tepal ideograms of new manfredas. A. *Manfreda paniculata* L. Hernández, R. Orellana & Carnevali. B. *Manfreda petskinil* R. Orellana, L. Hernández & Carnevali.

Succulent, acaulescent, perennial, rosettofilious plants, rosettes 30–50 cm tall, polycarpic. **Rhizome** globose 5–7 cm long, proliferating through the production of new rosettes from lateral meristems at the base of the inflorescence; **roots** succulent; **leaves** 7–30, linear-lanceolate, recurvate, somewhat flaccid, 18–38 cm long, 1–2 cm width, pale to dark green with darker green to reddish spots, these more vivid on some individuals and on leaves exposed to bright light, succulent, slightly channeled (ca. 1.4 mm at the widest section of the leaf), surface smooth, apex long attenuate with a short soft tip, margins achlorophyllous, hyalinous, denticulate with small, irregular teeth, 0.25–0.5 mm long. **Inflorescence** 1.3–1.6 m tall, a raceme or more often a panicle in well-developed plants with 2–5 branches; scape 1.1–1.35 m, with 3–6 internodes, green or reddish, often with darker blotches as in the leaves, subtended by linear to long triangular, papiraceous bracts 1–3 cm long, which are eventually deciduous, also presenting darker spots; floral parts 20–35 cm long, branches 15–23 cm long, suberect, at a 20–30° angle from the peduncle and rachis, densely flowered (up to 1.5 flowers per cm of branch length and up to 25 flowers on the longest uppermost branch), sterile portion of the branches 7–18 cm long, terete, with 2–4 internodes subtended by 0.8–1.2 cm long bracts similar in shape but smaller to those of the peduncle; floral bracts papyraceous, deltoid, 4–10 × ca. 3 mm, borne besides the solitary bracteole, bracteole 3–4 mm long, triangular, membranous, pedicels 1.0–1.5(2) mm long **Flowers** protandrous, solitary, 3.0–3.5 cm long from base of ovary to apex of

tepals, light green outside, glaucous, dull yellowish-green inside or with reddish tinges; perianth tube 5–7 mm long, broadly funnel-form; perianth lobes 12–15 × 2–4 mm, reflexed during the staminate phase of the flower, erect with age of the flower, during the pistillate phase of the flower, apex cucullate with a small terminal tuft of glandular, white trichomes; stamens diverging up to > 45° from the style in anthesis, inserted at the apex of the perianth tube, filaments filiform, 4–7 cm long, dark shiny reddish-brown; anthers dorsifixed 10–15 mm long, versatile, erect to slightly curved upon maturity, caducous. Ovary cylindrical 12–18 mm long, colored as the outer faces of the tepals, smooth when fresh, striate when dry; style linear 6.0–6.8 cm long, colored as stamens, stigma capitate to clavate, 3-lobed, 1–1.5 mm thick. Fruit trapezoidal or asymmetrically oblong to obovoid when immature, 10–15 mm long, 7–8 mm thick; mature fruits and seeds not seen.

**Paratypes:** MEXICO: Yucatán: Mpio. Chemax, 20 km de Valladolid rumbo a Puerto Juárez, 20° 40' N; 88° 00' 30" W, 2 Apr 1982 R. Orellana 87 (CICY). Mpio. Izamal, Cenote Xcolak, unos 14–15 km al E de Izamal por la vía Tunkas, 20° 54' 50" N; 88° 50' W, flowering in cultivation, 15 Abr 2000 G. Carnevali and I. M. Ramírez 6208 (CICY). Mpio. Mérida. Jardín Botánico CICY, 21° 01' 30" N; 89° 38' 30" W, 27 Mar 1998 R. Orellana 950 (CICY). Mpio. Tinum, Jardín Botánico Balancanché, 20° 39' N; 88° 31' W, 20 Jan 1990, S. Escalante 784 (CICY). Mpio. Uayma, Ejido Mucel de Pixoy, enfrente del Rancho San Pedro, 20° 43' 30" N; 88° 22' 00" N, 31 Mar 1984, E. Ucan, P. Galván and R. Lira 3294 (CICY).

**Etymology.** From the Mayan “hunpets’kinil” (“el que se mancha con el sol”: the one that becomes spotted or stained with the sun) in reference to the fact that leaves become conspicuously blotched and tinged upon exposure to strong sunlight.

**Taxonomic relationships.** *Manfreda paniculata* is here hypothesized as the closest relative of *M. petskinil*. The later species is a much smaller plant with a shorter, much less complex inflorescence. The species was cited by Verhoek-Williams (1975) (*R. S. Flores* 1, F; not seen by authors), Lott and García-Mendoza (1994), and Espejo-Serna and Ló-

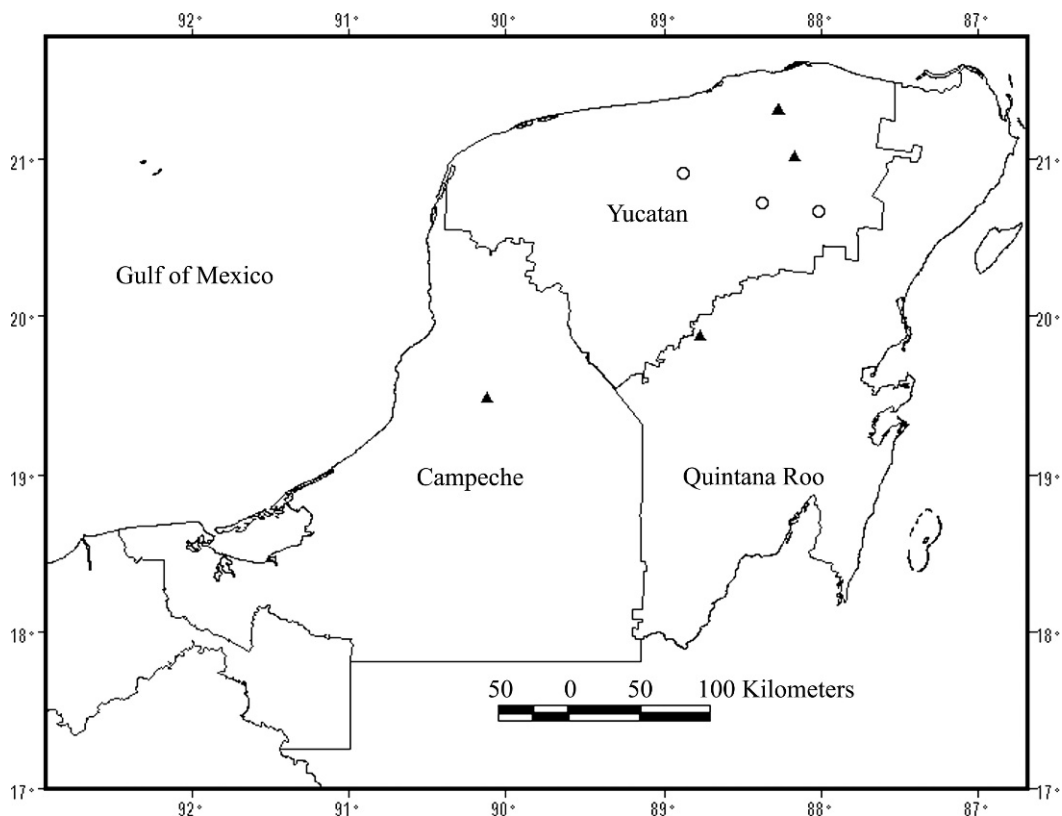


FIG. 5. Distribution of *Manfreda* in the Mexican Yucatan Peninsula. Triangles = *Manfreda paniculata*. Circles = *Manfreda petskinil*.

pez-Ferrari (1992) as *Manfreda variegata* (Jacobi) Rose, from which the new species differs by its puberulent and denticulate leaves, ascendant flowers, and filament insertion at tube mouth. *Manfreda petskinil* has also been confused in dry specimens with *M. scabra* (Ortega) McVaugh, but in this species the flowers are smaller with proportionally much shorter stamens (ca. 2–2.5 times longer than the perianth lobes vs. at least 3.5 times longer in *M. petskinil*), and the style is as thin as the stamens and barely distinguishable from them (*M. scabra* has styles much thicker than the stamens). The stamens in the new species are widely divergent as opposed to the commonly subparallel stamens of most *Manfreda* species. The flowers of *M. petskinil* are almost sessile but conspicuously pedicellate in *M. paniculata*. Phylogenetic analyses are required to address questions regarding the evolution of the point of insertion of the stamens on the corolla, and of the structure of the inflorescences within the Agavoideae, since these two new species

feature states in these characters that are intermediate between the genera *Manfreda* and *Agave*.

**Phenology and reproductive biology.** Flowers from January to April; fruits from March to June. Flowers are produced successively for about two weeks with 3–5 flowers simultaneously open per branch. We lack reliable data as to synchronicity of flowering under natural populations, but cultivated plants flower more or less asynchronously. Casual observations with cultivated plants at private collections and botanical gardens indicate either the need for pollinating vectors or autoincompatibility, since no fruits are produced naturally in these individuals. After flowering occurs, the inflorescence-bearing rosette activates an axillary meristem near the center of the rosette which pushes the main rosette laterally; thus, in a mature rosette leaves from different phenophases coexist. The plants also produce new lateral rosettes, eventually developing into



large clumps under favorable growing conditions.

**Distribution and habitat.** *Manfreda petskinil* is only known from a few localities at the NNE portion of the Mexican Yucatán Peninsula, all within the boundaries of the Yucatán State. It is apparently rare or only locally common. It occurs in open or shady areas over limestone rocky shallow soils (rendzines, “tzekeel” in Mayan), growing associated with secondary or primary tropical deciduous to subdeciduous forests, often found close to the sinkholes (“cenotes”), from 5–30 m altitude. See Fig. 5 for distributional maps of both new species of *Manfreda*.

**Ethnobotany.** Fresh leaves of *Manfreda petskinil* are used against strong, permanent headaches by placing them over the forehead. The species is known by the common Mayan names “kabal ch’elem” (*E. Ucan*, *P. Galván* and *R. Lira* 3294, CICY.), meaning “dwarf Agave” and “hunpets’kinil”, a name that suggested the specific epithet. *Manfreda pestkinil* has an unrealized horticultural potential because of its handsome foliage and ease of growth under tropical conditions or in greenhouses in the temperate zone.

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