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Technical note

Diversity of melliferous flora in the State of Tamaulipas, Mexico

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Abstract:

Apiculture continues to grow steadily in Mexico as does interest in potential nectariferous and polliniferous flora in different states. An inventory was made of melliferous plant species in the state of Tamaulipas, Mexico, visited by *Apis mellifera* L. in different annual seasons. Field work was done between 2012 and 2015. Plant species whose flowers were visited by *A. mellifera* were documented, including data on life form, growth form, origin, resource production, vegetation type and flowering time. A total of 215 species were recorded belonging to 173 genera and 60 families of phanerogamic plants. Most are native species (87.91 %) and herbaceous (42.32 %). Fabaceae and Asteraceae are the most common families. The highest proportion of plants are nectariferous (45.12 %), followed by nectariferous-polliniferous (40 %) and polliniferous (14.88 %). Secondary vegetation and dry tropical forest contain the largest number of these species, and provide the greatest floral resources during the summer season.

Key words: Melliferous flora, Flowering season, Nectar, Pollen, Tamaulipas.

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Wild and cultivated flora are vital natural resources for humans because they provide multiple benefits. Seeds, flowers and fruit can be used directly by humans, while other products such as nectar can be processed by bees to produce honey[1]. Use of honey began in prehistory when people harvested honeycombs from beehives in holes or cracks in trees and rocks[2]. Before European contact in the 16th Century, beekeeping in Mexico concentrated on native bees (meliponiculture). It was not until the early 20th Century, about 1920, that modern apiculture practices employing *Apis mellifera* began to spread[3].

Wulfrath and Speck[4], and Ordetx *et al*[5] published the first studies on flora in Mexico used by *A. mellifera*, including nationwide inventories of melliferous plants. Regions such as the Yucatan Peninsula have been intensively studied to identify nectariferous-polliniferous flora[6-10]. Additional studies on apiculturally important flora have been done in states such as Michoacán[11], Colima[12], Guerrero[13], Chiapas[14] and Veracruz[15].

Various local studies of melliferous flora have been done throughout Mexico, the south having received much more attention than the north. In the state of Tamaulipas, in Mexico's northeast, a preliminary list was collated of the plants visited by *Apis mellifera* L. in the El Cielo Biosphere Reserve[16]. This was followed at the turn of the century by a catalog of the main nectariferous and polliniferous species in the state[1], and then a list of 147 wild and cultivated polliniferous and nectariferous plant species[17].

Floral diversity in Tamaulipas has been estimated at 5,000 wild species[18]; to date 4,278 species have been recorded[19]. The state's flora is distributed in twenty vegetation types defined by the Rangeland Coefficients Technical Advisory Commission (Comisión Técnico Consultiva de Coeficientes de Agostadero – COTECOCA), and there are extensive citrus orchards and other introduced melliferous agricultural crops[1]. Although Tamaulipas contains extensive floral resources it has not met its full potential for honey production; in other words, current honey production is not proportional to the existing plant resources. One reason for this underutilization is limited knowledge of melliferous native and introduced plant species[1].

Honey production in Tamaulipas ranks eighth nationwide and apiculture and honey consumption has increased significantly in recent years. For example, 14,069 beehives were registered in 2000, which increased to 17,764 in 2008 and 22,000 in 2010[20,21]. There are currently 350 registered producers in the state belonging to twelve beekeeping associations, which have an overall annual honey production of 716 t, valued at approximately 30 million pesos (~1.5 million dollars)[22].

The present study objective was to expand current knowledge of melliferous flora diversity in Tamaulipas, concentrating on the nectariferous and polliniferous plant species visited by *A. mellifera* in the different seasons and at various study sites. This data will help beekeepers to take full advantage of floral resources and more efficiently manage them, potentially resulting in greater honey production.

Located in northeast Mexico (22°12'31", 27°40'52" N; 97°08'38", 100°08'51" W), Tamaulipas is the seventh largest state in the country (7,982,900 ha). To the north is the border with the United States of America, to the south the states of Veracruz and San Luis Potosí, to the west the state of Nuevo León and to the east the Gulf of Mexico[23].

Its varied topography includes dry, semi-dry, warm, semi-warm and temperate climates. Semi-dry warm and dry very warm climates predominate on the coastal plain. In mountainous areas sub-humid semi-warm to sub-humid temperate climates occur, depending on slope orientation and altitude. The most characteristic soils of Tamaulipas are phaeozems, vertisols, luvisols, xerosols, cambisols, regosols, rendzines and lithosols. Others such as gleysols are common throughout the coastal zone and fluvisols are found on the banks of rivers and streams[23].

Tamaulipas includes a large portion of the Northeast Coastal Plain, which extends south from the Rio Grande along the Gulf of Mexico coastline. This is bordered to the west by the Sierra Madre Oriental mountains, with altitudes as high as 3,450 m. The twenty vegetation types defined by the COTECOCA include jungle, forest, bush, palm groves, grasslands, halophyte and wetlands groups, as well as agricultural areas[1]. Of the state's total area, 557,566 ha are used for irrigated agriculture; 1,118,412 ha for seasonal agriculture; 852,454 ha for forestry; 4,683,528 ha for livestock production; and 770,940 ha for other uses[1].

Field work was done between 2012 and 2015, during all four annual seasons. A sample of 27 apiaries was selected in eleven municipalities with different vegetation types (natural and agricultural) and physiographic characteristics (Table 1, Figure 1). Each apiary location was GPS logged (Garmin GPS73 geopositioner), using the Universal Transverse Mercator (UTM) coordinate system (Zone 14, WGS 84 datum). Flowering specimens were collected from a 2 km area surrounding each apiary, a distance based on the estimated average flight distance of *A. mellifera*[12]. Specimens were collected using scissors, plastic bags and a

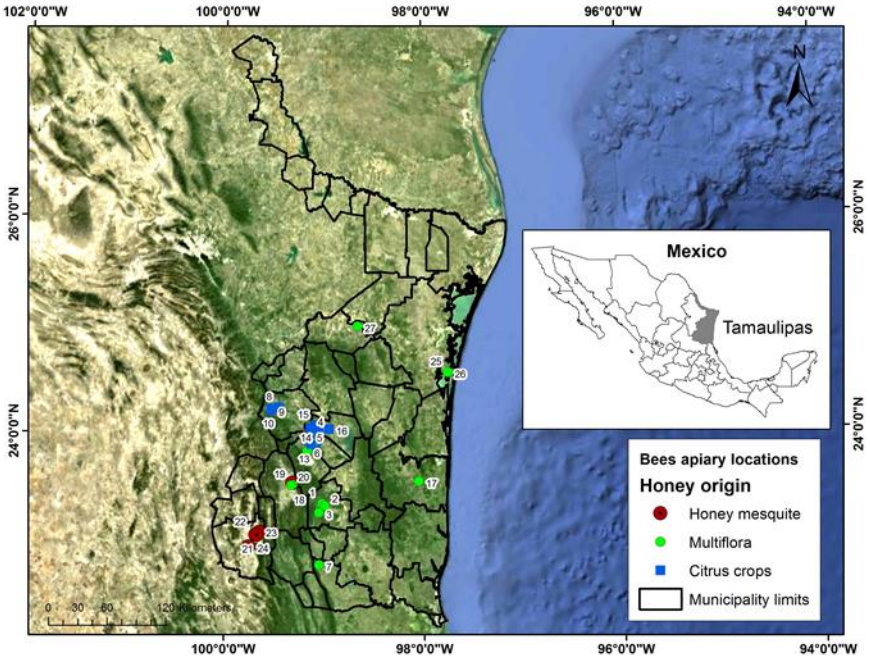
botanical press. Plant species frequently visited by *A. mellifera* were recorded by visually monitoring bee flower visits to a specific plant species for 5 to 10 min[24,25].

Table 1: Data for selected apiaries

No.	Municipality	Apiary	N	W	Alt. (m asl)	Veg. type
1	Llera	ANG	2582494	498097	497	MET/MEZ
2	Llera	LLE	2580148	500744	255	CA
3	Llera	SAJ	2573323	494835	396	CA
4	Güémez	PLA1	2659910	486284	203	CA
5	Güémez	SJU	2646193	485295	447	MET/MEZ
6	Victoria	CAB	2635979	482723	263	CA
7	Mante	CIN	2519777	494694	75	CA
8	Hidalgo	HID	2681353	453907	333	CA
9	Hidalgo	IND1	2678359	446361	398	CA
10	Hidalgo	IND2	2679732	445890	397	MEZ
11	Güémez	SAL1	2644211	491819	193	MSM
12	Güémez	SAL2	2644273	488584	202	MSM
13	Güémez	SAL3	2643413	486990	211	SBS
14	Padilla	ELQ	2655879	494452	184	MSM
15	Padilla	LAS	2662991	491708	187	MSM
16	Padilla	PLA	2658774	505310	161	SBS
17	Soto la Marina	LAV	2605370	597070	41	CA
18	Jaumave	SJO1	2603597	467749	631	CA
19	Jaumave	SJO2	2601748	467889	621	CA
20	Jaumave	SJO3	2601306	466370	650	MET/MEZ
21	Tula	FME	2553554	433556	1453	MET/MEZ
22	Tula	SAU1	2550791	429774	1293	SBC
23	Tula	SAU2	2550342	431098	1298	MEZ
24	Tula	TUL	2538716	422565	1118	MEZ
25	San Fernando	LMA1	2716847	627994	7	MEZ
26	San Fernando	LMA2	2717125	626482	8	MEZ
27	Burgos	MAR	2764173	534345	127	MET

CA= agricultural crop; MET= Tamaulipan thorny scrub; MEZ= mesquite; MSM= submontane scrub; SBS= semi-evergreen tropical forest, SBC= dry tropical forest.

Figure 1: Apiary location in study area



Collected botanical specimens were botanized and deposited in the Francisco González Medrano Herbarium of the Institute of Applied Ecology of the Autonomous University of Tamaulipas (Universidad Autónoma de Tamaulipas). First-hand data on local floral resources was collected from local beekeepers during field trips. They provided information on the plant species visited by bees and their flowering time and duration.

Using field data, databases and the literature, a species inventory was produced containing information on species grouping by life form (tree, bush, herbaceous); growth form (erect, ascending, decumbent, prostrate, creeping, climbing, rosette, epiphytic and floating); origin (native, introduced); and resource production (nectariferous, polliniferous or both). Species flowering period was recorded as well as the surrounding vegetation type. Family classification was done based on the international system established by the Angiosperm Phylogeny Group APG III[26].

A total of 215 species (including 1 subspecies and 1 variety) were found to be of interest for apiculture in Tamaulipas; these belong to 173 genera and 60 vascular plant families (Annex 1). The best represented family is Fabaceae (traditionally known as Leguminosae) with 35 species (16.28 %), followed by Asteraceae with 26 species (12.09 %). More than 50 % of these melliferous plant species belong to just eleven families (Table 2). The predominant genera were *Acacia* (6 species) and *Croton* and *Mimosa* (5 species each).

Table 2: Best represented families and genera among melliferous flora in Tamaulipas

Families	Genera	%	Species	%
Fabaceae	22	12.72	35	16.28
Asteraceae	21	12.14	26	12.09
Convolvulaceae	5	2.89	9	4.19
Euphorbiaceae	5	2.89	9	4.19
Malvaceae	6	3.47	9	4.19
Lamiaceae	6	3.47	8	3.72
Rutaceae	6	3.47	7	3.26
Boraginaceae	3	1.73	5	2.33
Sapindaceae	5	2.89	5	2.33
Scrophulariaceae	3	1.73	5	2.33
Verbenaceae	5	2.89	5	2.33
Subtotal	87	50.29	123	57.21
Remaining (49)	86	49.71	92	42.79
Total	173	100.00	215	100.00

Most (87.91 %) of the recorded species are native and the rest (12.09 %) are introduced. Of the 215 species, 91 are herbaceous, 74 are shrubs and 50 are trees. Growth forms varied with 169 erect, 24 climbing, 6 ascending, 6 prostrate, 5 rosette, 2 floating, 1 creeping and 1 epiphytic species.

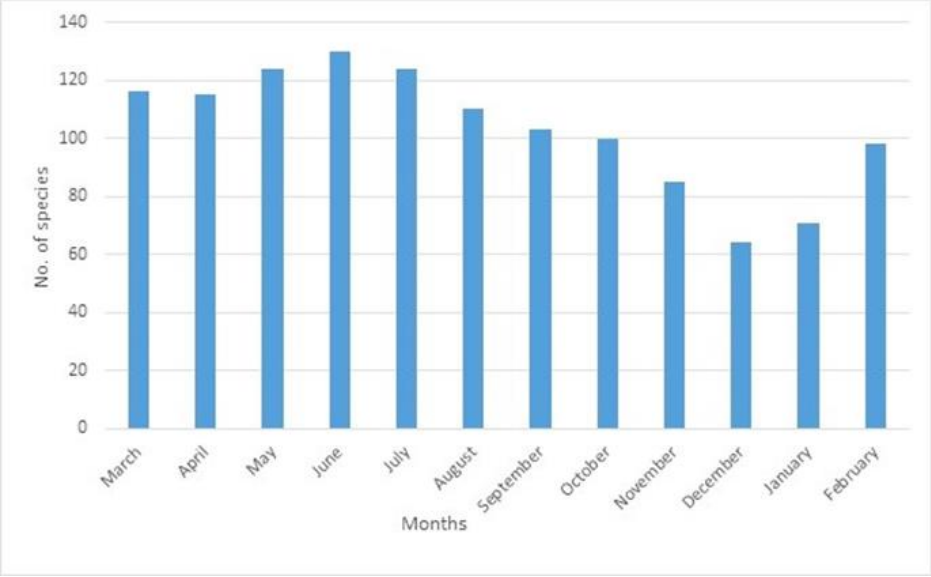
Melliferous plants were identified in 26 different vegetation types, including agricultural crops. Species diversity was highest (58 species) in secondary vegetation, although the natural vegetation types with the highest number of species were the dry tropical forest and Tamaulipan thorn scrub (Table 3). Cultivated species were not very diverse, with twelve agricultural crops and thirteen ornamentals. Of the 215 collected species, most (n= 97) are nectariferous, followed by the nectariferous-polliniferous (n= 86) and polliniferous species (n= 32).

Table 3: Melliferous species by vegetation type in Tamaulipas

Vegetation	Species	%
Secundary vegetation	58	26.85
Dry tropical forest	23	10.65
Tamaulipan thorn scrub	18	8.33
Aquatic vegetation	15	6.94
Mesquite	14	6.48
Semi-evergreen tropical forest	14	6.48
Ornamental crops	13	6.02
Annual agricultural crops	12	5.56
Submontane scrub	12	5.56
Oak forest	11	5.09
Microphyll desert scrub	8	3.70
Evergreen tropical forest	7	3.24
Pine forest	4	1.85
Rosetophyll desert scrub	4	1.85
Halophyte vegetation	2	0.93
Pine-oak forest	1	0.46

During the annual seasonal cycle flowering tended to decrease during the colder seasons. For example, in Tamaulipas 355 species are reported to flower in the spring, 364 in the summer, 288 in the autumn and 233 in the winter. During the study period the month with the most floral resources was June, with 130 available species, and that with the least was December, with 64 species (Figure 2).

Figure 2: Monthly flowering distribution of important melliferous plant species in Tamaulipas



The 215 species recorded here indicate that melliferous plant richness in Tamaulipas is notable, particularly since northern Mexico generally has a less diverse flora than southern Mexico. The present inventory constitutes the largest number of nectariferous-polliniferous plant species reported to date for Tamaulipas: far more than the 174 reported by Lara[16], the 150 reported by Villegas *et al*[1] and the 146 reported by González-Rodríguez *et al*[17]. As observed in these previous studies, the most important melliferous plant families are the legumes (Fabaceae) and the compounds (Asteraceae), which has also been reported in other states[12,13,27].

As mentioned previously[19], the largest proportion of melliferous species consists of natives since they are the most common floral resources in Tamaulipas. However, during winter citrus orchards (especially oranges) become a highly relevant nectar source for *A. mellifera* due to their vast extension in the state's central area[1].

Herbaceous plants (91 species) represented a higher proportion than did shrubs and trees, a trend reported elsewhere[28,29]. In terms of growth form, erect plants were the most common at the studied sites; in contrast, climbing plants have been reported to account for a large proportion of melliferous species in the states of Yucatan, Michoacán, Veracruz, Guerrero and Chiapas[7,10,13-15].

Secondary vegetation contains the greatest diversity of melliferous plant species in Tamaulipas (26.98%), perhaps due to the large number of herbaceous plants present in this and other vegetation types; a similar trend has been reported in Michoacán[28] and the Valley of Mexico[29]. Of note is that weed species such as *Argemone* spp. and *Helianthus annuus* subsp. *annuus* are common year-round in Tamaulipas. Weeds have also been reported as important melliferous plant species in countries such as India[30]. Of the natural vegetation communities, the dry tropical forest offers the most floral resources in the state; El Cielo Biosphere Reserve is an excellent example of this[16]. Both the dry tropical forest and the Tamaulipan thorn scrub are among the most widely distributed vegetation types in the state[23].

Nectariferous plants were the most diverse in the present study. This coincides with a report on melliferous flora in the state of Colima[11], although nectariferous-polliniferous species have been found to be more diverse in other studies[17-30].

In contrast to previous studies[11,27], melliferous floral resources were most abundant in Tamaulipas during summer. June was the most productive month since most species were flourishing, regardless of life form and vegetation type. However, all these species do not always provide abundant floral resources, as is the case with mesquite (*Prosopis* spp.) and citrus (*Citrus* spp.). Indeed, based on the current apicultural calendar, these species have the

greatest influence on monofloral honey production in Tamaulipas during the February-April period.

Tamaulipas clearly offers extensive melliferous floral resources, as shown in the present study of species visited by *Apis mellifera*. The Fabaceae and Asteracea families provide the most floral resources for bees. The highest proportion of melliferous species are native (87.91 %) and herbaceous (42.32 %), and are mainly nectar producers. Secondary vegetation and dry tropical forest are the most important plant communities for honey production in the state, particularly during the summer. The data provided in the present study can be the foundation for more efficient apiculture practices in Tamaulipas by allowing beekeepers to manage apiaries and thus take greater advantage of melliferous floral resources year-round.

Acknowledgements

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Annex 1. Melliferous plant species inventory in Tamaulipas, Mexico. AR = Tree; AB = Bush; HI = Herbaceous; ER = Erect; AS = Ascending; DE = Decumbent; PS = Prostrate; RA = Creeping; RO = Rosette; TR = Climbing; FL = Floating; NA = Native; IN = Introduced; NE = Nectar; PO = Pollen; NP = Nectar-pollen; BP = Pine forest; BE = Oak forest; BE = Oak-pine forest; MDM = Microphyll desert scrub; MDR = Rosetophyll desert scrub; MSM = Submontane scrub; MET = Tamaulipan thorn scrub; MEZ = Mesquite; SMS = Semi-evergreen tropical forest; SBS = Low semi-evergreen tropical forest; SBC = Dry tropical forest; VH = Halophyte vegetation; VA = Aquatic vegetation; VS = Secondary vegetation; CA = Agricultural crop; CO = Ornamental crop.

FAMILY	Scientific Name	Life form /Growth form /Origin/Vegetation type	Common Name (Spanish)	Floral Resource	Spring		Summer			Fall			Winter			
					M	A	M	J	J	A	S	O	N	D	J	F
ACANTHACEAE	*Avicennia germinans* (L.) L.	AR/ER/NA/VA	Mangle blanco	N	x	x	x	x	x	x	x	x	x	x	x	x
ASPHODELACEAE	*Aloe vera* (L.) Burm. f.	HI/RO/IN/CA	Sábila	N	x	x										
AMARANTHACEAE	*Amaranthus hybridus* L.	HI/ER/NA/VS	Quelite	N	x	x	x	x	x	x	x	x				
ANACARDIACEAE	*Mangifera indica* L.	AR/ER/IN//CA	Mango	N	x	x								x	x	x
	Rhus microphylla Engelm.	AB/ER/NA/MDM	Correoso	N			x	x								
	Rhus virens Lindh. ex A. Gray	AB/ER/NA/BPE	Lantrisco	N	x	x	x	x	x	x	x	x	x	x		x
	Schinus terebinthifolia Raddi	AR/ER/IN/CO	Cimarrón	NP								x	x			
ANNONACEAE	*Annona globiflora* Schltdl.	AB/ER/NA/SBC	Chirimoya	NP				x	x	x	x	x				
APOCYNACEAE	*Asclepias angustifolia* Schweigg.	HI/ER/NA/BE		N			x		x		x	x				
	Asclepias curassavica L.	HI/ER/NA/VS	Quiebra muelas	N	x	x	x	x	x	x	x	x	x	x	x	x
	Cascabela thevetia (L.) Lippold	AB/ER/NA/CO	Cabeza de víbora	N	x	x	x	x	x	x	x	x	x	x	x	x
ARECACEAE	*Acrocomia aculeata* (Jacq.) Lodd. ex Mart.	AR/ER/NA/SMS	Coyol	NP	x	x	x	x	x	x	x					
	Brahea berlandieri Bartlett	AB/ER/NA/BE	Palmito	N	x										x	x
	Sabal mexicana Mart.	AR/ER/NA/SBC	Palma real	NP	x	x	x									x
ASPARAGACEAE	*Agave lecheguilla* Torr.	AB/RO/NA/MDR	Lechuguilla	NP	x	x	x	x	x							
	Dasylirion berlandieri S. Watson	AB/RO/NA/MDR	Sotol	NP				x	x							
	Yucca filifera Chabaud	AR/ER/NA/MET	Palma china	N	x	x	x									x
	Yucca treculeana Carrière	AR/ER/NA/MET	Pita	N	x	x										x
ASTERACEAE	*Baccharis salicifolia* (Ruiz & Pav.) Pers.	AB/ER/NA/VA	Jara	NP				x	x	x	x	x	x			
	Bidens odorata Cav.	HI/ER/NA/VS	Aceitilla	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Bidens pilosa L.	HI/ER/NA/VS	Aceitilla	NP	x	x	x		x	x					x	x
	Bidens squarrosa Kunth	HI/TR/NA/SMS	Té huasteco	N									x	x	x	x
	Borrichia frutescens (L.) DC.	HI/ER/NA/VH	Saladilla	P				x	x	x				x	x	
	Chromolaena odorata (L.) R.M. King & H. Rob.	HI/TR/NA/MET	Limpiatuna	NP	x	x							x	x	x	x
	Cirsium mexicanum Dc.	HI/ER/NA/VS	Cardo	NP	x	x	x									

	Conoclinium coelestinum (L.) DC.	HI/ER/NA/VA		P											x	
	Elephantopus mollis Kunth	HI/ER/NA/VS		NP	x								x	x	x	x
	Flourensia laurifolia DC.	AB/ER/NA/MSM	Hoja ancha	NP					x	x	x	x	x	x	x	x
	Gochnatia hypoleuca (DC.) A. Gray	AB/ER/NA/MSM	Ocotillo	NP							x	x	x	x	x	x
	Helianthus annuus L. subsp. *annuus*	HI/ER/NA/VS	Polocote	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Helianthus annuus var. *macrocarpus* (DC.) Cockerell	HI/ER/NA/CA	Girasol	NP				x	x				x	x		
	Mikania cordifolia (L. f.) Willd.	HI/TR/NA/VA	Guaco	NP	x	x	x	x	x						x	x
	Parthenium hysterophorus L.	HI/ER/NA/VS	Amargoso	N	x	x	x	x	x	x	x	x	x			x
	Pluchea carolinensis (Jacq.) G. Don	AB/ER/NA/VA	Santa María	NP	x	x	x	x							x	x
	Pluchea salicifolia (Mill.) S.F. Blake	AB/ER/NA/VA	Santa Isabel	NP	x	x									x	x
	Roldana aschenborniana (S. Schauer) H. Rob. & Brettell	AB/ER/NA/BE	Barba	P	x											x
	Senecio salignus DC.	AB/ER/NA/VA	Jarilla	NP				x	x	x	x	x	x			
	Simsia eurylepis S.F. Blake	HI/ER/NA/VS	Chimalaco	NP	x	x	x	x	x	x	x	x	x			
	Sonchus oleraceus L.	HI/ER/IN/VS	Borraja	NP	x											x
	Tithonia diversifolia (Hemsl.) A. Gray	HI/ER/IN/VS	Botón de oro	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Tridax coronopifolia (Kunth) Hemsl.	HI/AS/NA/VS	Coronilla	P											x	x
	Tridax procumbens L.	HI/PO/NA/VS	Hierba del monte	NP			x			x	x	x			x	x
	Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray	HI/ER/NA/VS	Hierba de la bruja	NP	x											x
	Verbesina persicifolia DC.	AB/ER/NA/VS	Hierba del toro	N			x									
	Zinnia elegans Jacq.	HI/ER/IN/CO	Cartulina	NP	x	x	x	x	x	x	x	x	x	x	x	x
BASELLACEAE	*Anredera vesicaria* (Lam.) C.F. Gaertn.	HI/TR/NA/SBC	Hierba de la difunta	NP								x	x			
BIGNONIACEAE	*Amphilophium crucigerum* (L.) L.G. Lohmann	HI/TR/NA/SMS	Lengua de vaca	NP	x	x	x	x								
	Tecoma stans (L.) Juss. ex Kunth	AB/ER/NA/SBC	Tronadora	N	x	x	x	x	x	x	x	x	x	x	x	x
	Crescentia alata Kunth	AR/ER/NA/SBC	Guaje cirial	N	x	x	x	x	x	x	x	x	x	x	x	x
	Parmentiera aculeata (Kunth) Seem.	AB/ER/NA/SBC	Chote	N					x	x	x	x	x			
BORAGINACEAE	*Cordia boissieri* A. DC.	AR/ER/NA/MET	Anacahuita	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Cordia dentata Poir.	AR/ER/NA/SBC	Baboso	N	x	x	x	x								
	Ehretia anacua (Terán & Berland.) I.M. Johnst.	AR/ER/NA/MEZ	Anacua	N	x											x
	Heliotropium angiospermum Murray	HI/ER/NA/VS	Alacrancillo	N			x	x	x	x	x	x				
	Heliotropium calcicola Fernald	HI/ER/NA/MSM		N				x	x	x						
BROMELIACEAE	*Tillandsia usneoides* (L.) L.	HI/EP/NA/BE	Paixtle	N	x	x	x	x								x
	Bromelia pinguin L.	AB/RO/NA/SBC	Huapilla	NP	x	x	x									
	Hechtia glomerata Zucc.	HI/RO/NA/MDR	Huapilla	N				x	x							

CACTACEAE	*Cylindropuntia leptocaulis* (DC.) F.M. Knuth	AB/ER/NA/MET	Tasajillo	NP		x	x	x	x							
	Opuntia engelmannii Salm-Dyck ex Engelm.	AB/ER/NA/MET	Nopal	NP		x	x	x	x							
	Pachycereus marginatus (DC.) Britton & Rose	AB/ER/NA/MDM	Órgano	N	x	x										x
	Stenocereus griseus (Haw.) Buxb.	AB/ER/NA/MET	Pitayo	P	x		x									
CANNABACEAE	*Celtis pallida* Torr.	AB/ER/NA/MET	Granjeno	N	x	x										
CANNACEAE	*Canna indica* L.	HI/ER/NA/VS	Platanillo	NP	x	x	x	x	x	x	x	x	x	x	x	x
CAPPARACEAE	*Quadrella incana* (Kunth) Iltis & Cornejo	AB/ER/NA/MSM	Vara blanca	NP			x	x	x	x	x	x				
COMBRETACEAE	*Conocarpus erectus* L.	AB/ER/NA/VA	Mangle botoncillo	NP	x	x	x	x	x	x	x	x	x	x	x	x
COMMELINACEAE	*Commelina erecta* L.	HI/AS/NA/VS	Hierba del pollo	P	x	x	x	x	x	x	x	x				
CONVOLVULACEAE	*Evolvulus alsinoides* (L.) L.	HI/PS/NA/MET	Ojo de víbora	N											x	
	Ipomoea batatas (L.) Lam.	HI/TR/NA/SBS	Frijolillo	N		x	x	x	x							
	Ipomoea carnea subsp. *fistulosa* (Mart. ex Choisy) D.F. Austin	AB/ER/NA/VS	Mañanita	N	x	x	x	x	x	x	x	x	x	x	x	x
	Ipomoea pes-caprae (L.) R. Br.	HI/RA/NA/VH	Riñonina	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Jacquemontia nodiflora (Desr.) G. Don	HI/TR/NA/MEZ	Campanita	N								x	x			
	Jacquemontia oaxacana (Meisn.) Hallier f.	HI/TR/NA/SBS	Campanita azul	N								x	x			
	Jacquemontia pentantha G. Don	HI/TR/NA/SBS	Campanita azul	N								x	x			
	Operculina pinnatifida (Kunth) O'Donell	HI/TR/NA/VS	Gallinita	N				x	x	x	x					
	Turbina corymbosa (L.) Raf.	HI/TR/NA/SBS		N	x								x	x	x	x
CUCURBITACEAE	*Citrullus lanatus* (Thunb.) Matsum. & Nakai	HI/PS/IN/CA	Sandía	NP			x	x	x	x	x	x	x	x		
	Cucumis melo L.	HI/PS/IN/CA	Melón	NP						x						
	Luffa aegyptiaca Mill.	HI/TR/IN/VS	Estropajo	N								x				
	Momordica charantia L.	HI/TR/IN/SBS	Guadalupana	N	x	x	x	x	x	x	x	x	x	x	x	x
CUPRESACEAE	*Taxodium mucronatum* Ten.	AR/ER/NA/VA	Sabino	N						x	x	x	x			
EBENACEAE	*Diospyros palmeri* Eastw.	AR/ER/NA/MSM	Chapote	N	x						x	x	x			
	Diospyros texana Scheele	AR/ER/NA/MSM	Chapote prieto	N	x									x	x	x
EUPHORBIACEAE	*Jatropha dioica* Sessé	AB/ER/NA/MDM	Sangre de drago	NP					x	x						
	Croton argenteus L.	HI/ER/NA/VS	Puntilla	NP		x			x							
	Croton cortesianus Kunth	HI/ER/NA/MEZ	Palillo	P				x								
	Croton niveus Jacq.	AR/ER/NA/SBC	Olivo	NP	x	x	x	x	x	x						
	Croton punctatus Jacq.	HI/ER/NA/VS	Hierba del jabalí	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Croton reflexifolius Kunth	AB/ER/NA/SBC	Matilla	NP			x	x	x	x	x	x				
	Cnidoscolus multilobus (Pax) I.M. Johnst.	AB/ER/NA/SBC	Mala mujer	NP	x	x	x	x	x	x						x
	Euphorbia heterophylla L.	HI/ER/NA/VS	Contrahierba	N			x	x	x	x	x	x				

	Ricinus communis L.	AB/ER/IN/VS	Higuerilla	NP	x									x	x	x
FABACEAE	*Acacia angustissima* (Mill.) Kuntze	AR/ER/NA/BE	Barba de chivo	P					x	x	x					
	Acacia constricta Benth.	AB/ER/NA/MDM	Huizachillo	P				x	x							
	Acacia coulteri Benth.	AR/ER/NA/SBC	Palo de arco	P			x	x								
	Acacia farnesiana (L.) Willd.	AB/ER/NA/VS	Huizache	P	x											x
	Acacia rigidula Benth.	AB/ER/NA/MET	Gavia	P	x											x
	Acacia schaffneri (S. Watson) F.J. Herm.	AB/ER/NA/MDM	Huizache chino	P	x											x
	Bauhinia divaricata L.	AB/ER/NA/SBC	Pata de vaca	N	x	x	x	x	x	x	x	x	x			x
	Caesalpinia mexicana A. Gray	AB/ER/NA/VS	Hierba del potro	N	x	x	x	x	x	x	x	x	x	x	x	x
	Canavalia villosa Benth.	HI/TR/NA/SBC	Frijolillo	NP				x	x	x	x	x	x			
	Dalea greggii A. Gray	AB/DE/NA/BE	Oreganillo	N								x				x
	Dalea lutea (Cav.) Willd.	AB/AS/NA/BE	Pinito	P								x				x
	Delonix regia (Bojer ex Hook.) Raf.	AR/ER/IN/CO	Framboyán	N	x	x	x	x	x	x	x	x				
	Ebenopsis ebano (Berland.) Barneby & J.W. Grimes	AR/ER/NA/MEZ	Ébano	N			x		x			x	x			
	Erythrina herbacea L.	AB/ER/NA/SBC	Colorín	NP	x	x	x	x								
	Eysenhardtia polystachya (Ortega) Sarg.	AB/ER/NA/MEZ	Vara dulce	N			x	x	x	x	x	x				
	Eysenhardtia texana Scheele	AB/ER/NA/MET	Vara dulce	N			x	x	x	x	x	x	x			
	Gliricidia sepium (Jacq.) Kunth ex Walp.	AR/ER/IN/CO	Palo de sol	NP	x	x	x						x	x	x	x
	Havardia pallens (Benth.) Britton & Rose	AR/ER/NE/MET	Tenaza	N			x	x	x	x						
	Leucaena leucocephala (Lam.) de Wit	AR/ER/IN/VS	Guaje	NP	x	x	x	x	x	x						
	Lysiloma divaricatum (Jacq.) J.F. Macbr.	AR/ER/NA/SBC	Rajador	N			x	x	x	x						
	Mimosa biuncifera Benth.	AB/ER/NA/MDM	Uña de gato	P		x	x	x	x	x	x					
	Mimosa diplotricha C. Wright ex Sauvalle	AB/TR/IN/VS	Sierrilla	P		x	x	x	x							
	Mimosa monancistra Benth.	AB/ER/NA/MET	Charrasquillo	P				x	x	x	x					
	Mimosa pigra L.	AB/ER/NA/VA	Choveno	P				x	x	x	x	x				
	Mimosa pudica L.	HI/ER/NA/VS	Vergonzosa	P				x	x	x	x	x	x			
	Parkinsonia aculeata L.	AR/ER/NA/VS	Retama	N	x	x	x									x
	Parkinsonia texana var. macra (I.M. Johnst.) Isely	AR/ER/NA/MEZ	Palo verde	N	x	x										
	Piscidia piscipula (L.) Sarg.	AR/ER/NA/SBC	Chijol	N		x		x								
	Pithecellobium dulce (Roxb.) Benth.	AR/ER/NA/SBC	Guamúchil	NP	x	x	x						x	x	x	x
	Prosopis glandulosa Torr.	AR/ER/NA/MET	Mezquite	NP		x	x	x								
	Prosopis laevigata (Humb. & Bonpl. ex Willd.) M.C. Johnst.	AR/ER/NA/MET	Mezquite	NP	x	x										
	Prosopis tamaulipana Burkart	AR/ER/NA/MEZ	Mezquite	N	x											x
	Senna atomaria (L.) H.S. Irwin & Barneby	AR/ER/NA/SBC	Palo de zorrillo	N		x	x	x	x							

	Stizolobium pruriens (L.) Medik.	HI/TR/NA/SMS	Picapica	N								x				
	Tamarindus indica L.	AR/ER/IN/CA	Tamarindo	N	x	x	x	x	x	x	x	x	x	x	x	x
FAGACEAE	*Quercus polymorpha* Schltdl. & Cham.	AR/ER/NA/BE	Encino	N	x	x	x	x								
SALICACEAE	*Neopringlea integrifolia* (Hemsl.) S. Watson	AR/ER/NA/MSM	Corva gallina	NP	x	x	x	x	x	x						x
	Xylosma flexuosa (Hemsl.) S. Watson	AR/ER/NA/SBC	Capulín de corona	NP	x	x	x	x	x	x	x	x	x	x	x	x
LAMIACEAE	*Callicarpa acuminata* Kunth	AR/ER/NA/SBC	Uvilla	N				x	x	x	x					
	Leonotis nepetifolia (L.) R. Br.	HI/ER/NA/VS	Betónica	NP				x	x	x	x					
	Marrubium vulgare L.	AR/ER/IN//VS	Manrubio	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Salvia ballotiflora Benth.	AB/ER/NA//MSM	Santa Isabel	N	x				x	x						
	Salvia connivens Epling	HI/ER/NA/BE		N						x		x	x			
	Salvia sp.	HI/ER/NA/BE		N	x	x	x	x	x	x	x	x	x	x	x	x
	Teucrium cubense Jacq.	HI/ER/NA/VS	Verbena	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Vitex negundo L.	AB/ER/IN/CO	Árbol de la miel	N	x	x	x	x	x	x	x	x	x	x	x	x
LAURACEAE	*Litsea glaucescens* Kunth	AB/ER/NA/BE	Laurel	N	x	x	x									x
	Nectandra salicifolia (Kunth) Nees	AR/ER/NA/SBS	Aguacatillo	NP	x	x	x									
	Persea americana Mill.	AR/ER/NA/CA	Aguacate	N	x											x
LOASACEAE	*Cevallia sinuata* Lag.	HI/AS/NA/VS	Ortiguilla ceniza	NP	x	x	x	x	x	x	x	x	x			x
LYTHRACEAE	*Lagerstroemia indica* L.	AB/ER/IN/CO	Crespón	P				x			x					
MALPIGHIACEAE	*Malpighia glabra* L.	AB/ER/NA//SBS	Manzanita	NP	x	x	x	x	x	x	x	x	x			
MALVACEAE	*Abutilon abutiloides* (Jacq.) Garcke ex Hochr.	HI/ER/NA/VS	Malva rasposa	P							x	x				
	Abutilon trisulcatum (Jacq.) Urb.	HI/ER/NA/VS	Tronadora	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Gossypium hirsutum L.	HI/ER/NA//CA	Algodón	NP	x						x	x	x	x	x	x
	Malvastrum americanum (L.) Torr.	HI/ER/NA/VS	Malva	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Malvastrum coromandelianum (L.) Garcke	HI/ER/NA/VS	Malva loca	P			x	x	x		x	x		x	x	x
	Malvaviscus arboreus Cav.	AB/ER/NA/SBS	Manzanita	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Melochia pyramidata L.	HI/ER/NA/VS	Malva	NP		x	x	x	x	x		x				x
	Melochia tomentosa L.	HI/ER/NA/VS	Malva rosa	P		x	x	x	x	x					x	
	Waltheria indica L.	HI/ER/NA/VS	Hierba del soldado	NP	x	x	x							x	x	x
MELIACEAE	*Trichilia havanensis* Jacq.	AB/ER/NA/SMS	Estribillo	NP	x	x	x									
	Azadirachta indica A. Juss.	AR/ER/IN/CO	Neem	N			x									
	Melia azedarach L.	AR/ER/IN/CO	Canelo	NP	x	x	x	x	x	x	x	x	x	x	x	x
MUSACEAE	*Musa paradisiaca* L.	AB/ER/IN/CA	Plátano	N	x	x	x	x	x	x	x	x	x		x	x
MYRTACEAE	*Psidium guajava* L.	AB/ER/NA/SBC	Guayabo	NP	x	x	x	x	x	x	x	x				
NYCTAGINACEAE	*Boerhavia coccinea* Mill.	HI/ER/NA/VS	Pegajosa	N		x	x		x	x	x	x				
	Boerhavia erecta L.	HI/AS/NA/VS	Pega pega	P					x		x					
NYMPHAEACEAE	*Nymphaea ampla* (Salisb.) DC.	HI/FL/NA/VA	Panza de vaca	P	x	x	x	x	x	x	x	x	x	x	x	x

	Nymphaea elegans Hook.	HI/FL/NA/VA	Lampazo	P					x		x		x			
OLEACEAE	*Fraxinus berlandieriana* A. DC.	AR/ER/NA/VA	Fresno	N	x	x	x	x						x	x	x
ONAGRACEAE	*Ludwigia octovalvis* (Jacq.) P.H. Raven	HI/ER/NA/VA	Jarcia	N		x	x			x	x	x		x	x	x
	Oenothera rosea L'Hér. ex Aiton	HI/ER/NA/VS	Hierba del golpe	NP		x	x	x	x	x						
PAPAVERACEAE	*Argemone grandiflora* Sweet	HI/ER/NA/VS	Chicalote blanco	P	x	x	x	x	x	x	x	x	x	x	x	x
	Argemone ochroleuca Sweet	HI/ER/NA/VS	Chicalote	N	x	x	x	x	x	x	x	x	x	x	x	x
	Argemone mexicana L.	HI/ER/NA/VS	Chicalote amarillo	N	x	x	x	x	x	x	x	x	x	x	x	x
	Bocconia frutescens L.	AB/ER/NA/SBS	Calderona	NP	x	x	x	x	x	x	x	x	x			x
PASSIFLORACEAE	*Turnera diffusa* Willd.	HI/ER/NA/MSM	Damiana	N	x	x	x	x	x	x	x	x				x
PETIVERIACEAE	*Rivina humilis* L.	HI/ER/NA//SBC	Cordilínea	N	x	x	x	x	x	x	x	x	x	x	x	x
PINACEAE	*Pinus cembroides* Zucc.	AR/ER/NA/BP	Pino piñonero	N		x	x	x								
	Pinus teocote Schltdl. & Cham.	AR/ER/NA/BP	Ocote	N		x	x	x								
PLANTAGINACEAE	*Maurandya antirrhiniflora* Humb. & Bonpl. ex Willd.	HI/TR/NA/MSM	Hierba del corazón	NP				x	x	x	x	x				
PLUMBAGINACEAE	*Plumbago auriculata* Lam.	HI/ER/IN/CO	Jurica	P	x	x	x	x	x	x	x	x	x	x	x	x
POACEAE	*Sorghum halepense* (L.) Pers.	HI/ER/IN/VS	Zacate Johnson	P	x	x	x	x	x	x	x	x				
	Zea mays L.	HI/ER/NA/CA	Maíz	P						x	x					
POLYGONACEAE	*Antigonon leptopus* Hook. & Arn.	HI/TR/NA/VS	Flor de San Diego	N	x	x	x	x	x	x	x	x	x	x	x	x
	Persicaria glabra (Willd.) M. Gómez	HI/ER/NA/VA	Chilillo	N			x				x		x			x
RHAMNACEAE	*Condalia hookeri* M.C. Johnst.	AR/ER/NA/MEZ	Brasil	NP				x	x	x	x					
	Karwinskia humboldtiana M.C. Johnst.	AB/ER/NA/MEZ	Coyotillo	N				x			x					
ROSACEAE	*Lindleya mespiloides* Kunth	AB/ER/NA/BP	Manzanilla silvestre	N			x	x	x	x						
	Vauquelinia corymbosa Bonpl.	AR/ER/NA/BP	Sierrilla	P		x	x	x								
RUBIACEAE	*Hamelia patens* Jacq.	AB/ER/NA/SBS	Chacloco	NP				x	x	x	x	x	x			
RUTACEAE	*Casimiroa greggii* (S. Watson) F. Chiang	AR/ER/NA/SBS	Chapote amarillo	N	x	x										
	Citrus aurantifolia Swingle	AR/ER/IN/CA	Limón	N	x											x
	Citrus sinensis (L.) Osbeck	AR/ER/IN/CA	Naranjo	N	x											x
	Esenbeckia runyonii C.V. Morton	AR/ER/NA/SBS	Limoncillo	NP				x	x							
	Helietta parvifolia (A. Gray ex Hemsl.) Benth.	AB/ER/NA/MSM	Barreta	NP		x	x	x	x	x	x	x	x	x		
	Murraya paniculata (L.) Jack	AB/ER/IN//CO	Limonaria	N	x	x	x	x	x							
	Zanthoxylum fagara (L.) Sarg.	AB/ER/NA/MET	Colima	NP										x	x	x
SAPINDACEAE	*Koelreuteria bipinnata* Franch.	AR/ER/IN/CO	Chino	N												
	Serjania brachycarpa A. Gray ex Radlk.	HI/TR/NA/MEZ	Guía	N		x		x	x						x	
	Urvillea ulmacea Kunth	HI/TR/NA/MEZ	Coronilla	N				x		x			x			x
	Paullinia tomentosa Jacq.	HI/TR/NA/SBS	Arete de novia	N						x	x	x	x	x	x	x
	Sapindus saponaria L.	AR/ER/NA/SBC	Jaboncillo	N	x								x	x	x	x
SAPOTACEAE	*Sideroxylon celastrinum* (Kunth) T.D. Penn.	AR/ER/NA/MEZ	Coma	N	x	x	x	x	x	x	x	x	x			x

SCROPHULARIACEAE	*Buddleja scordioides* Kunth	HI/ER/NA/MSR	Escobilla	N			x	x									
	Buddleja sessiliflora Kunth	AB/ER/NA/VS	Tepozán	NP	x	x	x	x	x	x							
	Capraria mexicana Moric. ex Benth.	AB/ER/NA/VS	Jara	NP	x							x	x	x	x	x
	Leucophyllum frutescens (Berland.) I.M. Johnst.	AB/ER/NA/MET	Cenizo	NP		x		x			x		x			
	*Leucophyllum pruinosum I.*M. Johnst.	AB/ER/NA/MDM	Cenizo	NP				x	x	x		x	x			
SOLANACEAE	*Datura stramonium* L.	HI/ER/NA/VS	Toloache	NP		x	x	x	x	x	x	x	x			
	Lycopersicon esculentum Mill.	HI/ER/NA/VS	Tomate	N	x	x								x	x	x
	Solanum erianthum D. Don.	AB/ER/NA/VS	Salvadora	NP	x	x	x	x	x	x	x	x	x	x	x	x
TAMARICACEAE	*Tamarix aphylla* (L.) H. Karst.	AR/ER/IN/CO	Rompevientos	NP			x	x	x	x	x	x				
VERBENACEAE	*Verbena carolina* L.	HI/ER/NA/VS	Hierba del negro	NP	x	x	x	x	x	x	x	x	x	x	x	x
	Citharexylum berlandieri B.L. Rob.	AB/ER/NA/MEZ	Revienta cabras	NP			x	x	x	x	x	x	x			
	Lantana hirta Graham	HI/ER/NA/MEZ	Peonía colorada	N	x	x	x	x	x	x	x	x	x	x	x	x
	Lippia graveolens Kunth	HI/ER/NA/MSM	Orégano	N							x	x	x			
	Petrea volubilis L.	AB/TR/NA/SMS	Guirnalda	N	x	x	x							x		
VITACEAE	*Cissus verticillata* (L.) Nicolson & C.E. Jarvis	HI/TR/NA/SBS	Hierba del buey	N	x	x	x	x	x	x	x	x				
ZYGOPHYLLACEAE	*Guaiacum angustifolium* Engelm.	AB/ER/NA/MET	Guayacán	N	x	x	x	x	x	x	x					
	Kallstroemia maxima (L.) Hook. & Arn.	HI/PS/NA/VS	Verdolaga de abrojo	N					x							
	Kallstroemia parviflora Norton	HI/PS/NA/VS	Quesillos	P					x							
	Larrea tridentata (DC.) Coville	AB/ER/NA/MDM	Gobernadora	NP			x	x	x	x	x					
			TOTAL		**116**	**115**	**124**	**130**	**124**	**110**	**103**	**100**	**85**	**64**	**71**	**98**