

DISTRIBUTION OF *Helianthus*, *Viguiera* AND *Tithonia* GENERA IN MEXICO

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Received: April 29, 1994

Accepted: July 11, 1995

SUMMARY

The objectives of this study were to determine the geographic and ecological distribution of *Helianthus*, *Viguiera* and *Tithonia* genera in Mexico in order to preserve their species and utilize them in plant breeding and taxonomic studies. Information from the Mexican herbaria: MEXU, ENCB and CIIDIR were used to localize the areas where wild species of *Helianthus*, *Tithonia* and *Viguiera* grow. Ten species of *Helianthus*, 19 of *Tithonia* and 88 of *Viguiera* were found. *Helianthus* has its main distribution surrounding the Sierra Madre Occidental and Sierra Madre Oriental highlands. *Helianthus annuus* has the widest distribution. *Tithonia* genus is mainly distributed in the highlands with *T. tubiformis* being the most abundant species in this ecological area. *Tithonia* genus possibly occupies the ecological area in the highlands like *Helianthus* does in the lowlands. *Viguiera* has the widest distribution being found in almost all the Mexican States.

Key words: Distribution in Mexico, *Helianthus*, sunflower, *Tithonia*, *Viguiera*, wild species.

INTRODUCTION

Present-day cultivated sunflower has little genetic variability while breeding to improve some traits such as drought tolerance, oil and protein quality, disease and pest resistance, requires a larger genetic pool to be successful. Greater genetic diversity exists in wild populations of the genus *Helianthus*. (Laferrière, 1986; Škorić and Vannozzi, 1984). For this reason it is necessary to locate, collect, study and classify the wild populations of this genus. This work was initiated in the 1920's and is continued today by many researchers (Gómez and González, 1991; Gómez and González, 1992; Seiler et al., 1991; Watson, 1929).

The genus *Helianthus* includes 50 species with a base chromosome number of $x=17$, and ploidy levels of $n=17$, $n=34$ and $n=51$. These species can be found in virtually all parts of the United States (Rogers et al., 1982). Several species extend into Southern Canada and few into Northern Mexico (Heiser, 1955; Heiser et al., 1969). The study of closely related genera of *Helianthus* is also necessary to get a better understanding of the genus (Heiser, 1978).

The closest genera to *Helianthus* are *Viguiera* and *Tithonia*. *Viguiera* differs from *Helianthus* in that its pappus of two or three awns or scales is not deciduous (sometimes is absent). An endemic species from Southern Baja California (*Viguiera similis*) shows

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intermediate characteristics between *Helianthus* and *Viguiera*. This species has a deciduous pappus and is considered a *Helianthus* species by many authors. *Helianthus* has probably developed from *Viguiera* or *Viguiera*-like ancestors (Heiser, 1978). Phylogenetic evidence based on restriction site mapping of chloroplast DNA (cpDNA) indicates that *Helianthus* genus is a member of the *Viguiera* assemblage, including the genera *Pappobolus*, *Simsia*, *Tithonia* and *Viguiera*. These results suggest also that the possible ancestor of *Helianthus* is formed by *Viguiera* section *Maculatae*, *Iostephane*, and *Viguiera* series *Viguiera* (Schilling and Jansen, 1989; Schilling et al., 1994).

Viguiera is an American genus with nearly 180 species with chromosome numbers $n=8$, $n=12$, $n=17$, $n=18$ and $n=34$. Nearly half are distributed in South America, with the remainder distributed from South Western United States to Central America, largely centered in Mexico from Durango to Oaxaca (Breedlove, 1986; Correll and Johnston, 1970; McVaugh, 1974; Shreve and Wiggins, 1964; Turner, 1987; Turner, 1989). Considering the total distribution of this genus, the greatest concentration of species is localized in South Central Mexico, Central Andes and South Central Brazil (Panero and Schilling, 1988).

The genus *Tithonia* comprises ten or so species with a chromosome number $n=17$. This genus is characterized by broad and hollow peduncles of the heads. *Tithonia* is distributed in Mexico and Central America, with one species in Arizona (Heiser, 1978; LaDuke, 1980; McVaugh, 1974; Rogers et al., 1982). A limited number of intergeneric hybridizations have been attempted between species of *Tithonia* and *Helianthus*. Christov (1991) reports successful crosses of cultivated sunflower *H. annuus* with *T. rotundifolia*. A revision of the wild species inventory of *Helianthus*, *Viguiera* and *Tithonia*, and their distribution in Mexico would supply useful information for enhancing the breeding of cultivated sunflower. The objectives of this study are to determine the geographical and ecological distribution of the species of *Helianthus*, *Viguiera* and *Tithonia* in Mexico.

MATERIALS AND METHODS

The geographic area for this study is almost the entire Mexican territory with an approximate combined area of 1,900,000 km², ranging in altitude from 0 to 3000 m. Soil texture varies widely from sandy to clay types. The species habitats include coastal dunes, xerophytic scrubs, halophytic scrubs, tropical deciduous forests, tropical perennial forests and temperate mountain forests, as well as many areas affected by man such as cultivated lands, road sides, and other disturbed areas.

In order to locate the wild species of *Helianthus*, *Viguiera* and *Tithonia* present in Mexico, three herbaria were visited, two at the national level: MEXU at the Universidad Nacional Autónoma de México and ENCB at the Instituto Politécnico Nacional (IPN), and one at the regional level: Centro de Investigación Interdisciplinaria para el Desarrollo Integral Regional (CIIDIR-IPN) at Durango. These herbaria were used to determine geographic location and ecological habitat of voucher specimens deposited from 1880 to present day including the recent ones collected by the senior author (Gómez and González, 1991; Gómez and González, 1992).

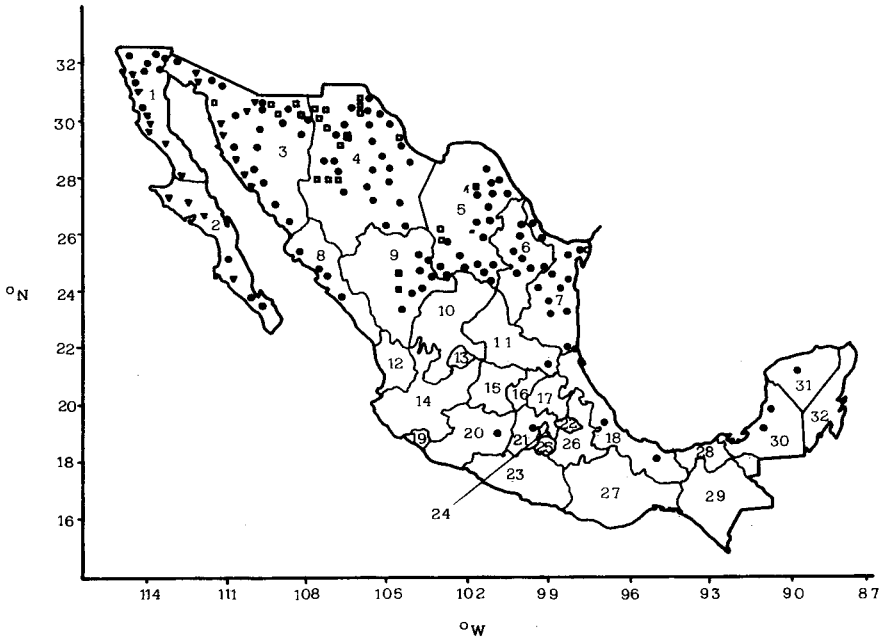


Figure 1. Distribution of *H. annuus* ●, *H. niveus* ▼, *H. petiolaris* □, *H. praecox* ○ and *H. maximiliani* ■ species in Mexico. Numbers refers to the Mexican States (see text). 1994.

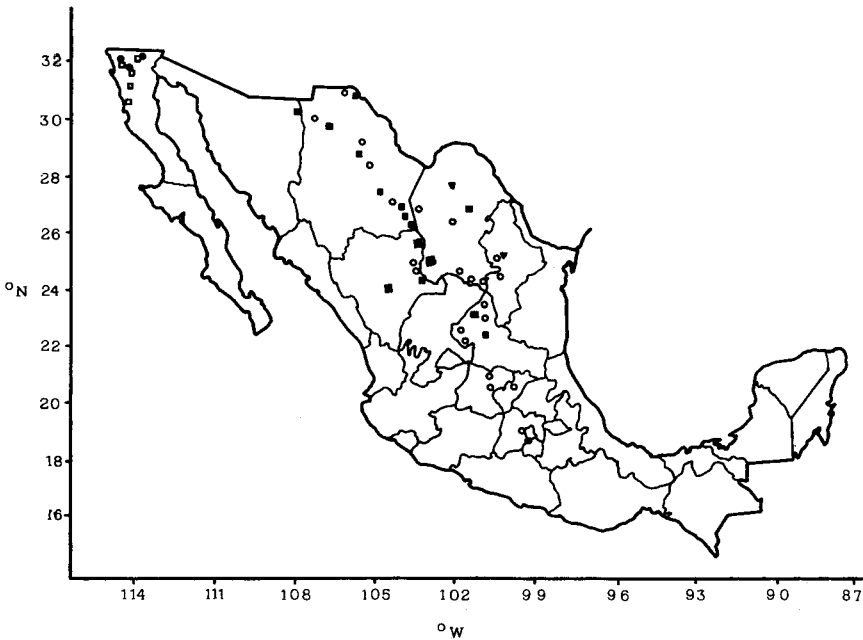


Figure 2. Distribution of the species *H. gracilentus* ●, *H. hirsutus* ▼, *H. californicus* □, *H. ciliaris* ○, *H. laciniatus* ■ species in Mexico. 1994.

RESULTS

Location and distribution of *Helianthus* species

A total of ten species of *Helianthus* from Mexico were recorded at the MEXU, ENCB and CIIDIR herbaria, listed in Table 1. Figures 1 and 2 show the distribution of the *Helianthus* species through the Mexican States. In these figures, the identification of Mexican states is as follows: 1. Baja California Norte, 2. Baja California Sur, 3. Sonora, 4. Chihuahua, 5. Coahuila, 6. Nuevo León, 7. Tamaulipas, 8. Sinaloa, 9. Durango, 10. Zacatecas, 11. San Luís Potosí, 12. Nayarit, 13. Aguascalientes, 14. Jalisco, 15. Guanajuato, 16. Querétaro, 17. Hidalgo, 18. Veracruz, 19. Colima, 20. Michoacan, 21. Estado de México, 22. Tlaxcala, 23. Guerrero, 24. Distrito Federal, 25. Morelos, 26. Puebla, 27. Oaxaca, 28. Tabasco, 29. Chiapas, 30. Campeche, 31. Yucatan, and 32. Quintana Roo.

Table 1. Location and habitats of *Helianthus* species in Mexico on 1994.

Species / subspecies	Location in the Mexican States and in the U.S.A.	Habitat <i>Helianthus annuus</i> L.
<i>Heliantus annuus</i> L.	From Baja California to Tamaulipas south to Sinaloa, Durango, San Luís, Potosí, Michoacan, Estado de Mexico, Veracruz, campeche and Yucatan	Wery widely distributed from wet to dry aeras on roadsides, distributed fields, along streams and irrigation chanel as well as a crop weed.
<i>Helianthus californicus</i> DC.	Baja California.	Dry rocky soils and damp to wet areas.
<i>Helianthus ciliaris</i> DC.	Chihuahua, Coahuila, Durango, Nuevo León, and San Luís Potosí.	Dry to damp alkaline soils on disturbed fields and as a crop weed.
<i>Helianthus gracilentus</i> Gray	Baja California .	Dry rocky mountain slopes, rocky hills with xerophytic scrubs and semitropical vegetation.
<i>Helianthus hirsutus</i> Raf.	Coahuila and Nuevo León.	Dry soils on open pine and oak forest.
<i>Helianthus laciniatus</i> Gray	Sonora, Chihuahua, Coahuila, Durango, and San Luís Potosí.	From wet to dry areas on roadsides, disturbed areas, along irrigation channels as well as a crop weed.
<i>Helianthus maximiliani</i> Schrad.	Chihuahua, Coahuila, and Durango.	Dry to moderately wet soils, as a weed or cultivated in urban and rural yards.
<i>Helianthus niveus</i> (Benth.) Brandegec	Sonora and Baja California.	Arid lands, sandy soils and coastal sand dunes, xerophytic scrubs.
<i>Helianthus petiolaris</i> Nutt.	Chihuahua, Sonora, and Coahuila.	Arid lands, sandy soils, xerophytic scrubs.
<i>Helianthus praecox</i> Engelm. & Gray	Tamaulipas.	Arid lands, sandy soils, xerophytic scrubs.

This genus is well known in the Northern States, from Western coast of Baja California to Eastern coast of Tamaulipas, as well as in isolated areas of the Southeast. *Helianthus annuus* has the widest distribution and is particularly well represented in the states of Sonora and Chihuahua, and widely distributed in the Northern part of the country. It is also found in isolated areas along the Gulf coast of Mexico to the Yucatan. *Helianthus petiolaris* is found in northern Sonora, Chihuahua, and Coahuila. *Helianthus niveus* is found in Baja California and the coast of Sonora. *Helianthus laciniatus* and *H. ciliaris* are distributed in isolated areas of the north central high plains and deserts, while *H. californicus* and *H. gracilentus* are localized in isolated areas of the state of Baja California. *Helianthus hirsutus* is localized in restricted areas of Nuevo León and Coahuila. Recently *Helianthus maximiliani* was reported and registered for the first time in Mexico; it was found in three small sites in Coahuila, Chihuahua and in some localities

of central Durango (González and Gómez, 1992), *H. praecox* is known only from northeastern Tamaulipas. The genus *Helianthus* has its main distribution at low to mid elevations (0-2000 m) surrounding the Sierra Madre Occidental and Sierra Madre Oriental, and occupies a wide range of habitats (Table 1).

Location and distribution of *Tithonia* species

A total of 19 species of *Tithonia* have been documented for Mexico (Table 2). *Tithonia* is mainly distributed from mid to high elevations (1100-2600 m) of the Sierra Madre Occidental, Sierra Madre Oriental, Altiplano Central, and Eje Neovolcánico. The general distribution of *Tithonia* species is shown in Figure 3, where it appears that the genus replaces *Helianthus* as the ecological equivalent. A great number of *Tithonia* species are located in areas where *Helianthus* is not present. Nevertheless, there are transition areas where both genera grow together. *Tithonia tubiformis* is the most abundant and widely distributed species of this genus.

Table 2. Location and habitats of *Tithonia* species in Mexico on 1994.

Species / subspecies	Location in the Mexican States and in the U.S.A.	Habitat
<i>Tithonia brachypappa</i> M.L. Rob.	Tamaulipas and San Luis Potosí.	(1)
<i>Tithonia calva</i> Sch.-Bip. var. <i>calva</i>	Sinaloa and Durango.	Open pine and oak forest and deciduous tropical forests.
<i>Tithonia calva</i> var. <i>auriculata</i> (T.S. Brandeg.) Blake	Sinaloa.	Forest openings and roadsides.
<i>Tithonia calva</i> var. <i>lancifolia</i> (R. & G.) Blake	Sonora, Sinaloa and Nayarit.	Oak woods and grasslands with oak woods.
<i>Tithonia diversifolia</i> (Hemsl.) Gray	Durango and Jalisco to Chiapas and Central America.	Oak forests and tropical forests.
<i>Tithonia fruticosa</i> Canby and Rose	Sonora, Chihuahua, Sinaloa and Durango.	Tropical forests and secondary vegetation.
<i>Tithonia koeltzii</i>	Jalisco.	(1)
<i>Tithonia longiradiata</i> (Bertol.) S.F. Blake	Hidalgo, Puebla, Veracruz and Oaxaca.	Oak woods, deciduous woods and secondary vegetation.
<i>Tithonia macrophylla</i> Watson	Jalisco and Guerrero.	Tropical woods.
<i>Tithonia pedunculata</i> Cronquist	Oaxaca.	Pine and oak forests, subtropical woods, thorny forest and savannah.
<i>Tithonia rotundifolia</i>	Coahuila, Nayarit, Colima, Jalisco, Puebla, Michoacan, Morelos, Edo. de Mexico, Guerrero and Oaxaca.	Disturbed fields, subtropical shrubs, deciduous tropical woods and subdeciduous tropical woods.
<i>Tithonia scaberrima</i> Benth.	Veracruz and Chiapas.	Pine woods and tropical woods.
<i>Tithonia schiedeana</i> Benth. et Thlor.	Jalisco.	(1)
<i>Tithonia speciosa</i> HBK.	Puebla.	(1)
<i>Tithonia tagetiflora</i> Desf.	Guerrero.	Tropical forests.
<i>Tithonia thurberi</i> Gray	Arizona (U.S.A), Sonora and Chihuahua.	Grasslands with oak forest in Arizona; in Sonora and Chihuahua in riparian and tropical woods.
<i>Tithonia tomentosa</i>	Michoacan.	(1)
<i>Tithonia tubiformis</i> (Jacq.) Coss.	From Chihuahua, Durango and Coahuila to Chiapas and Guatemala.	Oak woods, as a crop weed and along road sides.
<i>Tithonia woronowii</i> (Blake) H. Rob.	Michoacan.	Temperate forests.

(1) Lack of information in the herbaria's registries.

Table 3. Location and habitats of *Viguiera* species in Mexico on 1994.

Species / subspecies	Location in the Mexican States and in the U.S.A.	Habitats
<i>Viguiera adenophylla</i> S.F. Blake	Nuevo León, San Luís Potosí and Hidalgo.	Cold and mesic to open and dry oak forests.
<i>Viguiera angustifolia</i> (Hook. & Arn.) Blake	Sinaloa, Durango, Nayarit and Jalisco.	Grasslands and forest openings of oak and pine-oak forests.
<i>Viguiera annua</i> (M.E. Jones) Blake ²	Arizona, New Mexico, and Texas (U.S.A) and Sonora and Chihuahua.	Xerophytic scrubs.
<i>Viguiera apiculata</i> Blake	Guerrero.	(1)
<i>Viguiera benzionum</i> B. Turner	Oaxaca.	Humid places.
<i>Viguiera bicolor</i> Blake	Querétaro	(1)
<i>Viguiera brevifolia</i> Greenm	Durango.	(1)
<i>Viguiera budleiiformis</i> (DC.) Benth. & Hook.	Nayarit, Guanajuato, Querétaro, Michoacan, Distrito Federal, Hidalgo, Puebla, Edo. de México, Guerrero and Oaxaca	Disturbed fields, grasslands, scrubs and deciduous tropical woods and sometimes with oaks.
<i>Viguiera ciliata</i> (Rob. & Greenm.) Blake var. <i>hispida</i> (A. Gray) (A.Gray)	Western U.S.A, Sonora and Durango.	Along streams and irrigation channels as well as a crop weed.
<i>Viguiera cordata</i> (Hook. & Arn.) D'Arcy var. <i>cordata</i>	From Sinaloa and San Luís Potosí to Chiapas and Central America.	Humid places of pine or oak temperate forests, occasionally in subdeciduous tropical forests.
<i>Viguiera cordata</i> var. <i>websteri</i> (Turner) McVaugh	Nayarit, Jalisco, Michoacan and Guerrero.	Open pine or oak woods and sub deciduous tropical woods.
<i>Viguiera cordifolia</i> A. Gray	South Western U.S.A, and from Sonora to Coahuila until Zacatecas and San Luís Potosí.	Grasslands, xerophytic scrubs and forest openings of oak or pine woods.
<i>Viguiera cordifolia</i> var. <i>latisquama</i> Greenm.	Durango and Zacatecas.	Grasslands.
<i>Viguiera deltoidea</i> A. Gray var. <i>deltoidea</i>	Baja California.	Hill sides, tablelands and stream sides.
<i>Viguiera deltoidea</i> var. <i>chenopodina</i> (Greene) S.F. Blake	Baja California.	Dry deposits, sandy plains and tablelands.
<i>Viguiera deltoidea</i> var. <i>parishii</i> (Greene) Vasey & Rose	Southern Arizona and California (U.S.A) to Sonora and Baja California.	Tablelands, arid hillsides and stream sides.
<i>Viguiera deltoidea</i> var. <i>tastensis</i> Brandegee	Baja California.	Stream sides, rocky hills with xerophytic scrubs and semitropical vegetation.
<i>Viguiera dentata</i> (Cav.) Spreng. var. <i>dentata</i>	South Western U.S.A to Chiapas and Guatemala.	Grasslands, scrubs, deciduous tropical woods and forest openings in temperate woods.
<i>Viguiera dentata</i> var. <i>helianthoides</i> (HBK.) Blake	Northern Mexico to Yucatan.	Crop weed and along roadsides.
<i>Viguiera dentata</i> var. <i>lancifolia</i> S.F. Blake	Arizona (U.S.A) and Sonora.	Arid lands and edge of impounded waters.
<i>Viguiera ensifolia</i> (Sch.-Bip.) Blake	Durango, Nayarit, Zacatecas, and Jalisco.	Oak pine woods or fir tree woods, occasionally in grasslands with oak woods.
<i>Viguiera eriophora</i> Greenm. ssp. <i>eriophora</i>	Puebla and Oaxaca.	Deciduous tropical woods and sclerophile woods.
<i>Viguiera eriophora</i> ssp. <i>poblana</i> Panero & Schilling	Puebla.	Deciduous tropical woods.

Table 3. Location and habitats of *Viguiera* species in Mexico on 1994.

Species / subspecies	Location in the Mexican States and in the U.S.A.	Habitats
<i>Viguiera excelsa</i> (Willd.) Benth. & Hook. var. <i>excelsa</i>	San Luis Potosí, Guanajuato, Queretaro, Distrito Federal, Hidalgo, Puebla and Estado de México	Grasslands and shrubs especially in secondary communities.
<i>Viguiera excelsa</i> var. <i>megacephala</i> (Robins. & Greenm.) Blake	Guerrero.	(1)
<i>Viguiera excelsa</i> var. <i>pachycephala</i> (DC.) B. Turner	Nayarit, Zacatecas, San Luis Potosí, Jalisco, Guanajuato and Michoacan.	Grasslands, open oak forests and deciduous tropical woods.
<i>Viguiera flava</i> (Hemsl.) Blake	Durango, Zacatecas, Michoacan and Estado de México.	Grasslands and open oak and pine-oak forests.
<i>Viguiera flava</i> var. <i>papposa</i> Blake	Durango.	(1)
<i>Viguiera gentryi</i> B. Turner	Sonora.	Hillsides of oak woods.
<i>Viguiera goldmanii</i> Greenm.	Durango.	Temperate woods.
<i>Viguiera guerrerana</i> Panero & Schilling	Guerrero.	Deciduous tropical woods and shrubby woods.
<i>Viguiera grahamii</i> McVaugh	Jalisco.	Open forests with grasslands in oak and pine oak woods.
<i>Viguiera greggii</i> (A. Gray) Blake	Durango.	(1)
<i>Viguiera hemsleyana</i> Blake	Jalisco, Michoacan, Guerrero, Estado de México and Oaxaca.	Forest openings with grasslands or shrubs, in oak woods or pine- oak woods.
<i>Viguiera hypargyrea</i> Greenm.	Durango and Aguascalientes.	(1)
<i>Viguiera hypochlora</i> (Blake) Blake	Nayarit, Jalisco, Michoacan and Estado de México.	Oak or oak-pine woods.
<i>Viguiera iltisii</i> B. Turner	Jalisco.	Forest openings of oak-pine woods.
<i>Viguiera insignis</i> Miranda	Puebla and Oaxaca.	Oak woods and deciduous tropical woods.
<i>Viguiera kingii</i> McVaugh	Nayarit.	Grasslands and along road sides.
<i>Viguiera laciniata</i> A. Gray	California (U.S.A) and Baja California.	Hillsides, rocky tablelands and edge of impounded waters.
<i>Viguiera lanata</i> (Kell.) A. Gray	Cedros and Natividad islands, but possibly in Baja California.	(1)
<i>Viguiera latibracteata</i> (Hemsl.) Blake	Sinaloa, Durango, Nayarit and Jalisco.	Forest openings of oak or pine woods, along side roads and crop fields.
<i>Viguiera linearis</i> (Cav.) Sch.- Bip.	From Chihuahua to Nuevo León, south to Michoacan, Distrito Federal and Puebla.	Shrubs and grasslands, sometimes with oak or pine especially in disturbed fields.
<i>Viguiera linearis</i> var. <i>acutior</i> Blake	Queretaro.	(1)
<i>Viguiera linearis</i> var. <i>genuina</i> Blake	Durango.	(1)
<i>Viguiera longifolia</i> (Rob. & Greenm.) Blake	From Arizona, New Mexico, and Texas (U.S.A) to Durango, San Luis Potosí, and Zacatecas. Also in Chiapas.	(1)
<i>Viguiera aff ludens</i> (Shinners) Johnst.	Queretaro.	(1)

Table 3. Location and habitats of *Viguiera* species in Mexico on 1994.

Species / subspecies	Location in the Mexican States and in the U.S.A.	Habitats
<i>Viguiera michoacana</i> (Turner & Davies) McVaugh	Michoacan.	Thorny woods and deciduous tropical woods, sometimes as a crop weed.
<i>Viguiera microphylla</i> Vasey & Rose	Baja California.	Sandy plains and edge of impounded waters.
<i>Viguiera mirandae</i> Panero & Schilling	Morelos.	Oak mesic woods.
<i>Viguiera montana</i> Rose	Durango.	(1)
<i>Viguiera morelensis</i> Greenm.	Morelos.	(1)
<i>Viguiera multiflora</i> (Nutt.) Blake	Durango.	(1)
<i>Viguiera multiflora</i> var. <i>macrocephala</i> (Heiser) B. Turner B. Turner	Durango.	(1)
<i>Viguiera neocronquistii</i> B. Turner	Oaxaca.	Mesophyle mountain woods.
<i>Viguiera nesomii</i> B. Turner	Nuevo León.	Rocky hillsides with shrubs.
<i>Viguiera oaxacana</i> (Greenman) S.F. Blake	Oaxaca and Puebla.	Deciduous tropical woods and low woods.
<i>Viguiera ovata</i> (A. Gray) S.F. Blake	Chiapas.	(1)
<i>Viguiera palmeri</i> A. Gray var. <i>palmeri</i>	Jalisco and Michoacan.	Hillsides and gorges with deciduous tropical woods.
<i>Viguiera palmeri</i> var. <i>coalcomana</i> B. Turner	Michoacan.	(1)
<i>Viguiera palmeri</i> var. <i>rzedowski</i> McVaugh	Jalisco.	Deciduous tropical woods.
<i>Viguiera parkinsonii</i> (Hemsl.) Blake	Sinaloa, Durango, Nayarit and Jalisco.	grasslands and shrubs in oak woods and deciduous tropical woods.
<i>Viguiera pinnatiloba</i> (Sch.-Bip.) Blake	South of Mexico.	(1)
<i>Viguiera pinnatiloba</i> (Sch.-Bip.) Blake var. <i>megaphylla</i> Butt. <i>megaphylla</i> Butterwick	Oaxaca.	Deciduous tropical woods.
<i>Viguiera pringlei</i> B.L. Rob. & Greenm.	Nayarit and Jalisco.	Pine or oak woods and transition zones with tropical woods.
<i>Viguiera purisimae</i> Brandegee	Baja California.	Streams and low lands.
<i>Viguiera puruana</i> Paray	Michoacan, Guerrero and Estado de Mexico with a disjunctive area in Chiapas.	Deciduous tropical woods and mixed deciduous woods in the basin of Balsas river and mesophyle woods in Chiapas.
<i>Viguiera quinquerradiata</i> (Cav.) A. Gray	Nayarit, Zacatecas, Aguascalientes, Guanajuato, Jalisco, Michoacan, Hidalgo and Guerrero.	Oak woods and deciduous tropical woods.
<i>Viguiera reyrobinsonii</i> B. Turner	Durango.	(1)
<i>Viguiera rhombifolia</i> (Rob. & Greenm.) Blake	Durango.	(1)
<i>Viguiera rosei</i> Greenm.	Zacatecas, Aguascalientes and Jalisco.	Grasslands.
<i>Viguiera schultzii</i> Blake	Nayarit and Jalisco.	Pine or oak woods.

Table 3. Location and habitats of *Viguiera* species in Mexico on 1994.

Species / subspecies	Location in the Mexican States and in the U.S.A.	Habitats
<i>Viguiera seemannii</i> Sch.-Bip.	Durango and Sinaloa.	(1)
<i>Viguiera sessilifolia</i> DC.	Zacatecas, Aguascalientes, Guanajuato, Jalisco, San Luís Potosí, Querétaro and Estado de Mexico.	Oak-pine woods.
<i>Viguiera sharpii</i> Panero & Schilling	Guerrero.	Semidry oak or oak-pine woods.
<i>Viguiera similis</i> (Brandegee) S.F. Blake	Baja California Sur.	Sandy soils.
<i>Viguiera sphaerocephala</i> (Dc.) Hemsl.	Jalisco, Michoacan, Hidalgo, Estado de Mexico, Morelos and Guerrero.	Deciduous tropical woods, forest openings of oak woods and mesophyle woods.
<i>Viguiera splendens</i> Panero & Schilling	Jalisco and Michoacan.	Deciduous tropical woods and oak woods.
<i>Viguiera stenoloba</i> Blake	From New Mexico and Texas (U.S.A) to Durango, Coahuila, Nuevo León and Tamaulipas.	Xerophytic scrubs.
<i>Viguiera stenoloba</i> var. <i>chihuahuensis</i> Butterwick	Chihuahua and Durango.	Xerophytic scrubs.
<i>Viguiera subincisa</i> Benth.	Baja California.	Sandy and rocky soils.
<i>Viguiera tenuis</i> A. Gray	Sinaloa, Durango, Colima, Jalisco, Michoacan, Guerrero, Morelos, Estado de Mexico, Oaxaca, Chiapas and Central America.	Disturbed areas in oak-pine woods or oak woods and deciduous tropical woods.
<i>Viguiera tomentosa</i> A. Gray	South of Baja California.	Streams, bottom of valleys and rocky hills.
<i>Viguiera torresii</i> B. Turner	Guerrero.	Edge of impounded waters.
<i>Viguiera trachyphylla</i> Blake	From San Luís Potosi to Queretaro and Hidalgo, probably also in Oaxaca.	Xerophytic scrubs and open oak woods.
<i>Viguiera urticiformis</i> (DC.) Hemsl.	Guanajuato and Jalisco.	(1)
<i>Viguiera vorobikae</i> B. Turner	Chihuahua.	Forest openings of temperate woods.
<i>Viguiera woronowii</i> (Blake) H. Rob.	Michoacan.	Temperate woods.

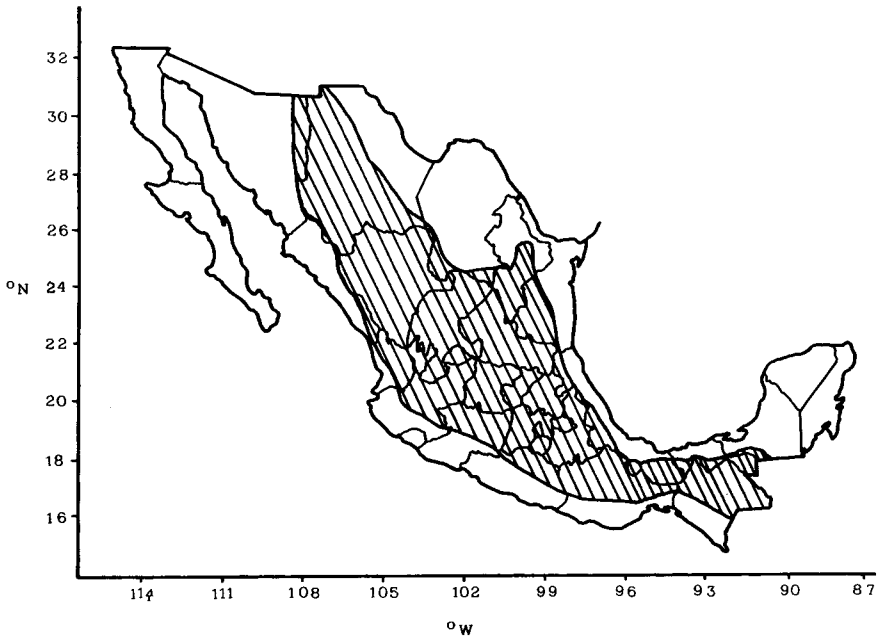


Figure 3. General distribution of the genus *Tithonia* (striped area) in Mexico, 1994.

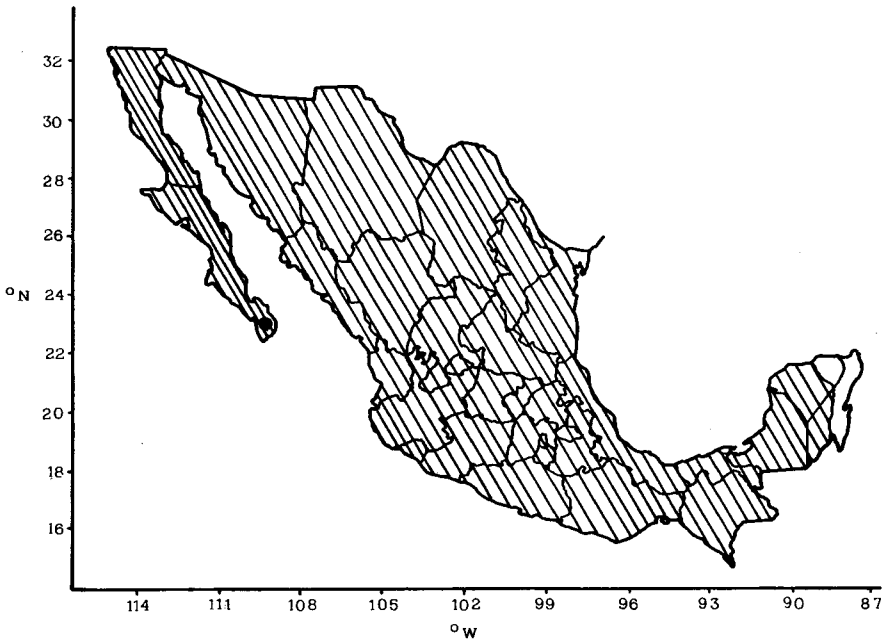


Figure 4. General distribution of the genus *Viguiera* (striped area) with the location of *V. similis* ● in Mexico, 1994.

Location and distribution of *Viguiera* species

According to herbaria records, a total of 88 species of *Viguiera* have been found in Mexico, which are shown in Table 3. Many of them have been studied by several authors like *V. greggii*, *V. montana* and *V. stenoloba* by González-Elizondo et al., (1991), *V. lanata* by Shreve and Wiggins (1964), and *V. reyrobinsonii* by Turner (1987). Figure 4 shows the general distribution for *Viguiera*, which is generally found in all the country. This figure shows the location of *Viguiera similis*, the species apparently closely related to *Helianthus*. The distribution of *Viguiera similis* is restricted in distribution to the area of the Sierra de la Laguna, at the extreme south of Baja California Sur.

DISCUSSION

The genus *Helianthus* is the main focus of the present study with its contribution to the genetic improvement of the cultivated *H. annuus*, so it will be the only genus discussed. There were some differences between the location and distribution observed by some collectors many years ago and the present species distribution. The main cause of this is associated with human activities. In some cases these activities stimulate the spread of species and populations. This is the reason why places with the largest and most variable populations are road sides, irrigation channels, and agricultural lands. This phenomena has been observed mainly for *H. annuus* and *H. laciniatus*. But the former is more aggressive in colonizing new habitats. Now *Helianthus annuus* can be found in central Durango and along the coast of the Gulf of Mexico, where it was not reported before.

In some cases, human activities disrupt the normal reproduction and establishment creating a danger of extinction of the species such as *H. petiolaris*, *H. niveus* and *H. gracilentus* which have been observed growing mainly along the roads and highways. In these places, the species face a potential danger of extinction. Due to the periodical actions of maintenance of these sites, many populations are seriously damaged and diminished every year. Fifteen locations have been reported for populations of *H. niveus*, but now only 11 sites have plants. Five locations have been reported for populations of *H. gracilentus*, but only one population can now be located.

Human activities have eliminated the populations of *H. californicus*, *H. hirsutus*, *H. ciliaris* and *H. praecox* from previously reported locations. These are drastic examples of the dangerous impact of human activities on the extinction of these species. No one can say for sure if these species have been eliminated in Mexico, but other populations should be found and studied to help the preservation of these species for the future.

CONCLUSIONS

This study presents useful information about the geographical distribution and location of the species of *Helianthus*, *Tithonia* and *Viguiera* genera in Mexico and the general ecological habitats where they can be found. Populations of these genera can be found over a wide range of ecological habitats, from xerophytic scrubs in the deserts of North Central Mexico, oak and pine forests in mountains with a temperate climate, to hot and humid tropical forests. Additional populations of *Helianthus* have to be collected

for ecological, botanical and genetic studies and for further utilization in sunflower breeding. The results of this study also contribute information useful for planing the conservation of genetic variability of these three genera, save them from the extinction and preserve these valuable natural resources.

ACKNOWLEDGMENTS

The authors would like to thank the authorities of INIFAP and CIIDIR in Mexico and the University of Pisa in Italy for the support given to this research, contract INIFAP-E.C. No. TS2*-0231-I(A). Authors also thank the University of Udine for the facilities provided for this publication. Special thanks go to Prof. G.P. Vannozzi for his review and suggestions for the publication of this study and Dr. Margherita Menichincheri for the French translation of the summary.

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DISTRIBUCION DE LOS GENEROS *Helianthus*, *Viguiera* Y *Tithonia* EN MEXICO

RESUMEN

El objetivo de éste estudio fue determinar la distribución geográfica y ecológica de los géneros *Helianthus*, *Viguiera* y *Tithonia* en México, a fin de preservar sus especies y utilizarlas en mejoramiento genético y estudios taxonómicos. Se utilizó información de los herbarios mexicanos: MEXU, ENCB y CIIDIR, para localizar las áreas donde crecen las especies silvestres de *Helianthus*, *Viguiera* y *Tithonia*. Se encontraron diez especies de *Helianthus*, 19 de *Tithonia* y 88 de *Viguiera*. *Helianthus* se distribuye principalmente circundando los altiplanos de la Sierra Madre Occidental y de la Sierra Madre Oriental. *Helianthus annuus* es la especie más ampliamente distribuida. El género *Tithonia* se encuentra principalmente distribuido en los altiplanos, donde *T. tubiformis* es la especie más abundante en esta zona ecológica. El género *Tithonia* posiblemente ocupa el área ecológica en los altiplanos, tanto como lo hace *Helianthus* en las tierras bajas. *Viguiera* tiene la distribución más amplia, encontrándose en casi todos los estados mexicanos.

DISTRIBUTION DES GENRES DE *Helianthus*, *Viguiera* ET *Tithonia* EN MEXIQUE

RÉSUMÉ

Cet étude avait l'objectif de déterminer la distribution géographique et écologique des genres *Helianthus*, *Viguiera* et *Tithonia* en Mexique pour préserver leurs espèces et les utiliser pour études de taxonomie et d'amélioration génétique. Pour localiser les zones où les espèces sauvages de *Helianthus*, *Viguiera* et *Tithonia* poussent, ont été employées les informations descendues de herbiers mexicains: MEXU, ENCB, CIDIR. Dix espèces de *Helianthus*, 19 de *Tithonia* et 88 de *Viguiera* ont été trouvées. *Helianthus* est diffus surtout autour des zones des haut plateaux de la Sierra Madre Occidental et Oriental. En ces zones *Helianthus annuus* a la plus ample diffusion. Le genre *Tithonia* est diffus surtout dans les zones des haut plateaux avec *T. tubiformis*, qui est l'espèce la plus copieuse in cette zone écologique. En général le genre *Tithonia* occupe la zone écologique des haut plateaux, tandis que *Helianthus* est diffus dans la plaine et dans zones des haut plateaux de basse altitude. *Viguiera* est le genre le plus diffus: en effet a été trouvé en presque tous les Etats mexicains.