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Solanaceae diversity in the state of Jalisco, Mexico

Diversidad de la familia Solanaceae en el estado de Jalisco, México

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Abstract. Mexico is a center of diversity for Solanaceae. Our objective is to analyze the species diversity and geographical distribution of the Solanaceae in Jalisco. The data come from 3 405 herbarium specimens. An analysis of these specimens indicates that the Solanaceae in Jalisco are represented by 20 genera, 138 species and 140 taxa. Four genera, *Solanum* (55 species), *Physalis* (35), *Cestrum* (10) and *Lycianthes* (9) represent 79% of the total number of species. In contrast, *Brachistus, Browallia, Chamaesaracha, Jaltomata, Juanulloa, Lycium, Nectouxia, Nicandra* and *Nierenbergia* have only 1 species each. In Jalisco, the Solanaceae are widely distributed throughout the state occurring at altitudes ranging from sea level to 3 400 m. Mostly, they grow in conifer and oak forest (81 species) followed by tropical subdeciduous forest (57), tropical deciduous forest (54), and cloud forest (43). Fifty-one species are commonly found in disturbed and ruderal areas. *Lycianthes jalicensis*, *Physalis lignesens*, *P. longipedicellata*, *P. longiloba* and *P. tamayoi* are endemic to the state. These results indicate that Jalisco ranks fourth in species diversity for Solanaceae after the states of Oaxaca, Chiapas and Veracruz.

Key words: Solanaceae, distribution, species richness, Jalisco, Mexico.

Resumen. México es un centro de diversificación de la familia Solanaceae. El objetivo de este trabajo es analizar la riqueza y distribución de las especies de Solanaceae en Jalisco. Se examinaron 3 405 ejemplares de herbario y como resultado se registra la presencia de 138 especies y 140 taxones agrupadas en 20 géneros. Los géneros con el mayor número de especies son *Solanum* (55 especies), *Physalis* (35), *Cestrum* (10) y *Lycianthes* (9). Estos representan el 79% de las especies. En contraste, *Brachistus, Browallia, Chamaesaracha, Jaltomata, Juanulloa, Lycium, Nectouxia, Nicandra* y *Nierenbergia* están representados por una especie. En Jalisco, las solánaceas crecen desde el nivel del mar hasta los 3 400 m. Las especies habitan con más frecuencia en el bosque de pino y encino (81 especies), seguido de bosque tropical subcaducifolio (57), bosque tropical caducifolio (54) y bosque mesófilo de montaña (43). En vegetación secundaria o como ruderales crecen 51 especies, *Lycianthes jalicensis*, *Physalis lignesens*, *P. longipedicellata*, *P. longiloba* y *P. tamayoi* son endémicas de Jalisco. Basados en estos resultados, Jalisco constituye la cuarta entidad más rica en especies de Solanaceae en México después de Oaxaca, Chiapas y Veracruz.

Palabras clave: Solanaceae, distribución, riqueza de especies, Jalisco, México.

Introduction

Solanaceae are almost worldwide in distribution, however, the majority of genera and species are neotropical. The family encompases 96 genera and almost 2 300 species (D'Arcy, 1991). The genera with most species are *Solanum* L. (1,000), *Lycianthes* (Dunal) Hassl. (200), *Cestrum* L. (175), *Nicotiana* L. (95), *Physalis* L. (80), and *Lycium* L. (75), (D'Arcy, 1991; Martínez, 1999; Nee, 2001; Fukuda et al., 2001, Knapp et al., 2004). Floristic studies (Rodríguez and Vargas, 1994; Vargas and Rodríguez, 1993, 1995; Vargas, 1998; Vargas et al., 1998, 1999) have shown the presence of numerous species of Solanaceae in the state of Jalisco.

Jalisco is located in western Mexico between 22°45' and 18°55'N latitude and 101°28' and 105°42'W longitude (Fig. 1). Altitudes range from 0 to 4 300 meters above sea level. The state has a surface area of 80 137 km² which represents 4% of the Mexican territory. It includes 5 morphotectonic provinces: Northwestern Plains and Sierras, Sierra Madre Occidental, Central Plateau, Trans-Mexican Volcanic Belt, and Sierra Madre del Sur (Ferrusquía-Villafranca, 1993). As a consequence its flora includes phytogeographic elements from all 5 provinces.

Jalisco has several river basins with the most notable

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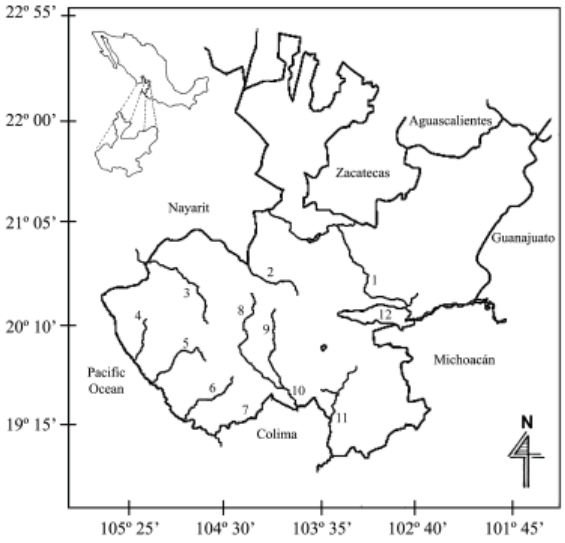

Figure 1. Location in Mexico of Jalisco State. 1: Lerma-Santiago River; 2: Ameca River; 3: Mascota River; 4: Tomatlán River; 5: San Nicolás River; 6: Purificación River; 7: Marabasco-Minatitlán River; 8: Ayuquila River; 9: Tuxcacuesco River; 10: Armería River; 11: Tuxpan River; 12: Chapala Lake.

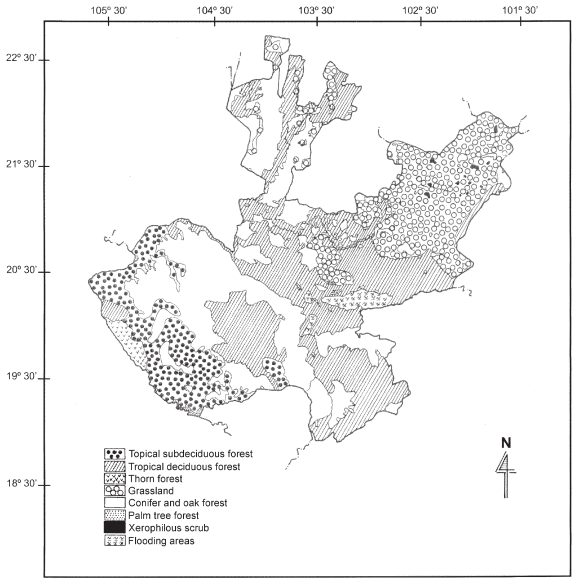

Figure 2. Types of vegetation in Jalisco, Mexico (From Rzedowski and McVaugh, 1966).

from the Lerma-Santiago River, which drains the northern and northeastern parts of the state. The Ameca river basin drains Central and Western Jalisco. The Mascota, Tomatlán, San Nicolás, Purificación, Marabasco-Minatitlán, Ayuquila, Tuxcacuesco, Armería, and Tuxpan rivers flow almost perpendicular to the Pacific Ocean and drain the coastal area. The southeastern corner is part of the Balsas River drainage basin. Lake Chapala, the largest freshwater lake in Mexico, is located at the eastern border of Jalisco and Michoacán. In addition, in south-central Jalisco, there are a series of seasonal and salty lakes forming the Zacoalco-Sayula land-locked system. A temperate climate with summer humidity and the tropical climate with summer humidity dominate the state (García, 1989; Villalpando and García, 1993). Rainfall is strongly seasonal extending from June to October. The northeastern corner and the coastal plains of Tomatlán in Jalisco are the driest areas, with less than 500 mm annually. In contrast, rainfall reaches its maximum, 1 600 mm in the uplands of the Sierras of Manantlán, Cacoma, Cuale and Mascota near the coastal plains (García et al., 1997a). Mean temperature ranges from 22° to 26°C in the coastal plains and 18° to 20°C at elevations of 1 600 m. Lastly, the mean temperature is less than 18°C in the highlands (García et al., 1997b).

Thirteen plant communities are present in Jalisco (Fig. 2; Rzedowski and McVaugh, 1966; Rzedowski, 1978). Forty-five to 50% of the state is characterized by deciduous and subdeciduous forests. They occur along the coastal plains as well as in canyons in the central part of the state from sea level to 1 600 m. Some areas, scattered within the tropical subdeciduous forest along the coastal plains, are dominated by palms of the genus *Orbignya* Mart. ex Endl. Conifer and oak forests are most common in the highlands between 800 and 3 400 m and account for approximately one fourth of the state's surface area. Lower elevational pine-dominated areas are found only in the western corner of the state. Cloud and fir-dominated forests are restricted to the ravines and protected steep slopes within the conifer and oak forest zones. Savannas are found between 400 and 800 m on the Pacific slope and represent a transition zone between the tropical subdeciduous forest and the oak forest. The thorn forest includes an area of the coastal plains in the western part of the state as well as a mezquite community within the tropical deciduous forest. Grasslands are restricted to the northeastern corner interspersed with the xerophilous scrub vegetation. The mangrove community follows the ocean shoreline in areas with low-energy waves. In contrast, beach and frontal dune vegetation extend along the coastline. The beach habitat occupies sandy substrate adjacent to open ocean that extends from mean tide line to the top of the frontal dune. Finally, freshwater lakes, where the aquatic vegetation is found, are generally located in the central part of the state. The objective of this paper is to

report and analyze the species diversity and distribution of Solanaceae in Jalisco.

Material and methods

The data come from 3 405 herbarium specimens held at the following herbaria: CHAPA, ENCB, F, GUADA, IBUG, IEB, MEXU, MICH, TEX, WIS, and ZEA. A database can be obtained upon request from the corresponding author. The determination of the specimens in herbaria was carried out using the identification keys in Bitter (1920), Standley (1924), Francey (1935, 1936), Correll (1962), Martínez (1966), Roe (1967, 1972), Waterfall (1967a,b,c), Hunziker (1969), D´Arcy (1973, 1978), D´Arcy and Eshbaugh (1974), Gentry and Standley (1974), Nee (1979, 1986, 1993), Whalen (1979, 1984), Davis (1980), Schilling (1981), Whalen et al. (1981), Knapp (1985, 2002), Bernardello and Hunziker (1987), Vargas and Rodríguez (1993), Bohs (1994), Rodríguez and Vargas (1994), Dean (1995), Vargas et al. (1998), and Spooner et al. (2004). Lastly, the species of *Physalis* and *Solanum* section *Petota* were verified by consultation of type specimens.

Table 1. Genera and species of Solanaceae in Jalisco

Genus	*Number of species*
Solanum L.	55
Physalis L.	35
Cestrum L.	10
Lycianthes(Dunal) Hassl.	9
Datura L.	6
Nicotiana L.	4
Bouchetia Dunal*, Brugmansia* Pers., *Capsicum* L., *Petunia* Juss., *Solandra* Sw.	2
Brachistus Miers*, Browallia* L.*, Chamaesaracha* (A. Gray) Benth.*, Jaltomata* Schltdl.*, Juanulloa* Ruiz et Pavón, *Lycium* L.*, Nectouxia* Kunth*, Nicandra* Adans.*, Nierenbergia* Ruiz et Pavón	1

Results

The Solanaceae in Jalisco are represented by 20 genera (Table 1), 138 species and 140 taxa (Table 2). *Solanum* (55 species), *Physalis* (35), *Cestrum* (10) and *Lycianthes* (9) are the most diverse genera and include 79% of the taxa. *Datura* (6), *Nicotiana* (4), *Bouchetia* (2), *Brugmansia* (2), *Capsicum* (2), *Petunia* (2), and *Solandra* (2) group only few species. In contrast, *Brachistus* Miers*, Browallia* L., *Chamaesaracha* (A. Gray) Benth., *Jaltomata* Schltdl., *Juanulloa* Ruiz et Pavón, *Lycium*, *Nectouxia* H.B.K., *Nicandra* Adans, and *Nierenbergia* Ruiz et Pavón are represented by only 1 species each (Table 1).

Discussion

The Solanaceae are widespread in Jalisco. They grow from the sea level to 3 400 m in the Nevado de Colima and are found in 11 out of the 13 vegetation communities described for Jalisco (Fig. 2, Table 2). They have not been collected in either savanna or palm forest. Eighty one taxa grow in conifer and oak forests whereas the tropical subdeciduous forest hosts 57 species. Fifty-four and 43 species have been reported from the tropical deciduous forest and the cloud forest, respectively. Furthermore, 28 species grow in grasslands and 11 species in thorn forests. Twelve species of Solanaceae are elements of the fir-dominated forest and 11 species prefer seasonally flooded areas. Seventeen species occur in the xerophilous scrub and mangrove is the habitat for *Physalis acutifolia*, *Solanum diphyllum* and *S. tampicense*. Finally, *P. minuta* grows only in the beach strand and frontal dune vegetation. Various species grow in more than 1 vegetational community (Fig. 3; Table 2).

Some species are frequent in conifer and oak forest, tropical subdeciduous forest, and tropical deciduous forest. These include *Solanum americanum*, *S. nigrescens*, and *S. ferrugineum*. Other less common species but recorded throughout the state are *Cestrum confertiflorum, C. tomentosum, C. terminale, Jaltomata procumbens, Lycianthes moziniana, Physalis angulata, P. lagascae, P. nicandroides, P. waterfallii, Solanum dulcamaroides, S. elaeagnifolium, S. erianthum, S. grayi* var. *grandiflorum, S. lycopersicun* var. *cerasiforme, S. nigrescens, S. pseudocapsicum, S. refractum,* and *S. umbellatum*. Less frequently, we can find *Brachistus stramoniifolius*, *Capsicum annuum* var. *aviculare*, *Cestrum nitidum, C. thyrsoideum, Nicotiana plumbaginifolia, Petunia parviflora, Physalis orizabae, P. pruinosa, P. pubescens, P. sulphurea, Solanum adscendens*, *S. appendiculatum, S.*

Table 2. Species of Solanaceae in Jalisco, Mexico; voucher collections, and types of vegetation where they occur. PTF: palm tree forest; TDF: tropical deciduous forest; TSDF: tropical subdeciduous forest; TF: thorn forest; DR: disturbed and ruderal vegetation; S: savanna, G: grassland; XS: xerophilous scrub; COF: conifer and oak forest; CF: cloud forest; AF: *Abies* forest; FA: flooding areas; MC: mangrove community; BD: beach and dune vegetation; and C: cultivated

Taxon	*Voucher collection*	*Vegetation type*
Bouchetia arniatera B. L. Rob.	Conifer and oak forest, Huejúcar, *R. Ramírez 667* (IBUG)	COF
Bouchetia erecta Dunal	Grassland, Ojuelos de Jalisco, *Puga 5657* (IBUG)	G, COF
Brachistus stramoniifolius (Kunth) Miers	Cloud forest, Autlán de Navarro, *A. Rodríguez* and *E. Dean 2122* (IBUG)	TDF, TSDF, DR, CF
Browallia speciosa Hook.	Tropical deciduous forest, Arandas, *G. León 41* (IBUG)	TDF
Brugmansia candida Pers.	Cloud forest, Zapotlán el Grande, *R. Ramírez et al. 3342* (IBUG)	TSDF, CF, C
Brugmansia suaveolens (Humb. et Bonpl. ex Willd.) Bercht. et J. Presl	Cultivated, Guadalajara, *S. Gutiérrez 24* (IBUG)	TSDF, C
Capsicum annuum L. var. *annuum*	Cultivated, Yahualica, *R. Jiménez 12* (IBUG)	C
Capsicum annuum L. var. *aviculare* (Dierb.) D'Arcy et Eshbaugh	Tropical deciduous forest, San Gabriel, *F. J. Santana et al. 2225* (IBUG)	TDF, TSDF
Capsicum ciliatum (Kunth) Kuntze	Tropical deciduous forest, Amatitán, *Puga 3410* (IBUG)	TDF, TSDF
Cestrum anagyris Dunal	Conifer and oak forest, Venustiano Carranza, *A. Rodríguez, J. Reynoso* and *L. Viguieras 1328* (IBUG)	COF, CF
Cestrum aurantiacum Lindl.	Cloud forest, Autlán de Navarro, *R. Ramírez, F. J. Santana* and *S. Gonz*ález *1134* (IBUG, ZEA)	COF, CF
Cestrum confertiflorum Schltdl.	Conifer and oak forest, Tequila, *A. Rodríguez* and *L. Guzmán 671* (IBUG)	TSDF, COF, CF, AF
Cestrum dumetorum Schltdl.	Conifer and oak forest, Cuautitlán de García Barragán, *F. J. Santana* and *L. Guzmán 3313* (ZEA)	TDF, COF
Cestrum glanduliferum Kerber ex Francey	Tropical subdeciduous forest, Casimiro Castillo, *F. J. Santana 4404* (IBUG, ZEA)	TDF, TSDF
Cestrum nitidum M. Martens et Galeotti	Conifer and oak forest, Tala, *A. Rodríguez 304* (IBUG)	COF, CF, AF
Cestrum nocturnum L.	Cultivated, Zapopan, *M. Cházaro 7787* (IBUG)	C
Cestrum terminale Francey	Conifer and oak forest, San Gabriel, *A. Rodríguez* and *E. Dean 2126* (IBUG)	COF, CF, AF
Cestrum thyrsoideum Kunth	Conifer and oak forest, Tecalitlán, *R. Ramírez* and *O. Reyna 110* (IBUG)	TDF, COF, CF
Cestrum tomentosum L. f.	Conifer and oak forest, Tala, *A. Rodríguez* and *J. Reynoso 1151* (IBUG)	TDF, TSDF, DR, G, XF, COF, CF
Chamaesaracha cernua (Donn. Sm.) Hunz.	Tropical subdeciduous forest, Casimiro Castillo, *R. Cuevas, L. Guzmán* and *G. López 3879* (IBUG, ZEA)	TDF, TSDF
Datura ceratocaula Ortega	Flooding areas, Jocotepec, *R. McVaugh 26573* (IBUG)	TSDF, FA

Tabla 2. Continues

Taxon	*Voucher collection*	*Vegetation type*
Datura discolor Bernh.	Disturbed and ruderal vegetation, Ixtlahuacán del Río, *A. Rodríguez, J. Reynoso* and *J. Suárez 1350* (IBUG)	TDF, TSDF, DR, XS, COF
Datura inoxia Mill.	Conifer and oak forest, Bolaños, *H. Luquín, F. J. Santana* and *R. Ornelas 100* (IBUG)	TSDF, DR, G, COF, FA
Datura kymatocarpa A. S. Barclay	Tropical deciduous forest, El Limón, *Puga 1978* (IBUG)	TDF, DR
Datura quercifolia Kunth	Disturbed and ruderal vegetation, San Juan de los Lagos, *M. Chávez 1982* (IBUG)	TDF, DR
Datura stramonium L.	Disturbed and ruderal vegetation, Cocula, *C. Ramírez 14* (IBUG)	TDF, TSDF, DR, G, COF, FA
Jaltomata procumbens (Cav.) J. L. Gentry	Conifer and oak forest, Tala, *A. Rodríguez* and *J. Reynoso 1426* (IBUG)	TDF, TSDF, DR, G, COF, CF
Juanulloa mexicana (Schltdl.) Miers	Oak forest, Cabo Corrientes, *O. Tellez 5866* (MEXU)	TDF, TSDF, COF
Lycianthes ciliolata (M. Martens et Galeotti) Bitter	Tropical subdeciduous forest, Cuautitlán de García Barragán, *D. DeNiz et al. 173* (IBUG, ZEA)	TSDF, COF, CF
Lycianthes heteroclita (Sendtn.) Bitter	Tropical subdeciduous forest, Casimiro Castillo, *M. Martínez 63* (IBUG)	TSDF
Lycianthes jalicensis E. Dean	Tropical subdeciduous forest, Casimiro Castillo, *W. R. Anderson 12717* (IBUG: paratype)	TSDF
Lycianthes lenta (Cav.) Bitter	Tropical deciduous forest, *Cihuatlán, A. Rodríguez, R. Ramírez* and *H. Arreola 2077 (IBUG)*	TDF
Lycianthes manantlanensis Aaron Rodr. et O. Vargas	Cloud forest, Cuautitlán de García Barragán, *R. Cuevas, E. Sánchez* and *F. J. Santana 5009* (IBUG, ENCB, MEXU, MO, WIS, ZEA)	TSDF, CF
Lycianthes moziniana (Dunal) Bitter	Conifer and oak forest, Bolaños, *A. Rodríguez 467* (IBUG)	TSDF, COF, CF
Lycianthes pringlei (B. L. Rob. et Greenm.) Bitter	Tropical deciduous forest, Poncitlán, *L. M. González 2104* (IBUG)	TDF
Lycianthes rantonnei (Carrière) Bitter	Cultivated, Guadalajara, *J. López 1* (IBUG)	C
Lycianthes surotatensis Gentry	Cloud forest, Autlán de Navarro, *A. Rodríguez, R. Ramírez* and *J. Suárez 909* (IBUG)	TDF, TSDF, COF, CF
Lycium carolinianum Walter	Tropical deciduous forest, Atoyac, *E. Villegas* and *M. Macías 175* (IBUG)	TDF, XS, FA
Nectouxia formosa Kunth	Conifer and oak forest, Tapalpa, *R. Soltero* and *R. González 104* (IBUG)	COF, CF
Nicandra physalodes (L.) Gaertn.	Tropical deciduous forest, Talpa de Allende, *R. Ramírez,J. A. Pérez de la Rosa* and *R. González 1866* (IBUG)	TDF, TSDF, DR, G, COF, CF, AF, FA
Nicotiana glauca Graham	Disturbed and ruderal vegetation, Tala, *A. Rodríguez 1252* (IBUG)	TDF, TSDF, DR, G, COF
Nicotiana plumbaginifolia Viv.	Tropical deciduous forest, Ejutla, *F. J. Santana 8031* (IBUG)	TDF

Tabla 2. Continues

Taxon	*Voucher collection*	*Vegetation type*
Nicotiana tabacum L.	Cultivated, Atoyac, *E. Villegas* and *M. Macías 141* (IBUG)	DR, C
Nicotiana trigonophylla Dunal	Tropical deciduous forest, San Martín de Bolaños, *A. Flores et al. 68* (IBUG)	TDF
Nierembergia angustifolia Kunth	Grassland, Ojuelos de Jalisco, *L. A. García* and *M. Harker. 492* (IBUG)	DR, G, XS, FA
Petunia hybrida Vilm.	Cultivated, Guadalajara, *Puga 266* (IBUG)	C
Petunia parviflora Juss.	Flooding areas, Ojuelos de Jalisco, *L. A. García* and *M. Harker. 400* (IBUG)	FA
Physalis acutifolia (Miers) Sandwith	Mangrove commnunity, Tomatlán, *R. McVaugh et al. 25310* (MICH, MEXU)	MC
Physalis aggregata Waterf.	Tropical deciduous forest, Jocotepec, *A. Rodríguez 553* (MEXU, IBUG, IEB)	TDF, TSDF, CV
Physalis ampla Waterf.	Disturbed and ruderal vegetation, Tlajomulco de Zúñiga, *C. Cortés* and *E. Ortiz 526* (IBUG)	DR, G
Physalis angulata L.	Tropical deciduous forest, Hostotipaquillo, *A. Rodríguez* and *J. Suárez 871* (MEXU, IBUG, ENCB)	TDF, TSDF, DR, COF
Physalis angustiphysa Waterf.	Conifer and oak forest, Tapalpa, *A. Rodríguez* and *J. Suárez 9*74 (IBUG)	COF
Physalis chenopodifolia Lam.	Disturbed and ruderal vegetation, Acatic, *O. Vargas 901* (IBUG)	TSDF, DR
Physalis cinerascens (Dunal) Hitchc.	Grassland, Teocaltiche, *Puga 5333* (IBUG)	G, XS
Physalis cordata Mill.	Tropical subdeciduous forest, Casimiro Castillo, *R. Cuevas* and *R. Cuevas 3556* (IBUG, WIS, ZEA)	TSDF, TF
Physalis coztomatl Dunal	Conifer and oak forest, Zapotlán el Grande, *R. Ramírez et al. 1730* (IBUG)	COF
Physalis glutinosa Schltdl.	Conifer and oak forest, Mezquitic, *L. M. González 3176* (IBUG, CIIDIR-DGO, IEB)	COF
Physalis gracilis Miers	Conifer and oak forest, Cuautitlán de García Barragán, *O. Vargas 800* (IBUG)	COF
Physalis hastatula Waterf.	Xerophilous scrub, Ojuelos de Jalisco, *M. Harker* and *P. Carrillo 1213* (IBUG)	XS
Physalis hederifolia A. Gray	Conifer and oak forest, Zapopan, *W. B. Legit 2825* (MEXU)	COF
Physalis lagascae Roem. et Schult.	Tropical deciduous forest, Jocotepec, *A. Rodríguez, M. Cházaro* and *R. Soltero* (IBUG, IEB, MEXU)	TDF, TSDF, DR, COF
Physalis leptophylla (B. L. Rob.) Greenm.	Tropical subdeciduous forest, La Huerta, *R. Ramírez, A. Wong* and *G. Flores 3819* (IBUG)	TSDF, COF
Physalis lignescens Waterf.	Conifer and oak forest, Venustiano Carranza, *O. Vargas 825* (IBUG)	COF, CF
Physalis longiloba O. Vargas, M. Martínez et Dávila	Conifer and oak forest, Autlán de Navarro, *O. Vargas 873* (ENCB, IBUG, IEB, MEXU, NY, ZEA)	COF, CF

Tabla 2. Continues

Taxon	*Voucher collection*	*Vegetation type*
Physalis longipedicellata Waterf.	Conifer and oak forest, Autlán de Navarro, *R. McVaugh* and *J. Sooby 13828* (MICH)	COF, CF
Physalis mcvaughii Waterf.	Cloud florest, Ayutla, *R. McVaugh 22034* (MICH)	CF
Physalis microcarpa Urb. et Ekman	Conifer and oak forest, Cuautitlán de García Barragán, *F. J. Santana* and *S. Lemus 6030* (IBUG, ZEA)	DR, COF
Physalis minuta Griggs	Beach and dune vegetation, La Huerta, *H. Arreola* and *L. Guzmán 455a* (IBUG)	BD
Physalis nicandroides Schltdl.	Tropical deciduous forest, Jocotepec, *A. Rodríguez, M. Cházaro* and *R. Soltero 996* (IBUG)	TDF, TSDF, TF, DR, G, COF
Physalis orizabae Dunal	Conifer and oak forest, Tecalitán, *O. Vargas 817* (IBUG)	COF
Physalis patula Mill.	Xerophilous scrub, Ojuelos de Jalisco, *P. Carrillo, M. Harker* and *Puga* 498 (IBUG)	TSDF, DR, XS, COF
Physalis philadelphica Lam.	Conifer and oak forest, Tala, *A. Rodríguez* and *J. Reynoso 1425* (IBUG)	TDF, TSDF, TF, DR, G, COF, C
Physalis pruinosa L.	Tropical deciduous forest, Tala, *A. Rodríguez* and *J. Reynoso 1473* (MEXU, IBUG, ENCB, IEB)	TDF, TSDF, DR, COF
Physalis pubescens L.	Conifer and oak forest, Ixtlahuacán del Río, *A. Rodríguez, J. Reynoso* and *J. Suárez 1357* (IBUG)	TSDF. DR. COF
Physalis sancti-josephii Dunal	Cloud florest, Autlán de Navarro, *L. Guzmán* and *L. Hernández 984* (IBUG, ZEA)	COF, CF
Physalis solanaceus (Schltdl.) Axelius	Conifer and oak forest, Tala, *A. Rodríguez* and *J. Reynoso 1436* (IBUG)	DR, G, COF
Physalis sordida Fernald	Grassland, Ojuelos de Jalisco, *R. McVaugh 16836* (MICH)	G, XS
Physalis subrepens Waterf.	Cloud florest, Autlán de Navarro, *O. Vargas 863* (IBUG, MEXU, ZEA)	COF, CF
Physalis sulphurea (Fernald) Waterf.	Flooding areas, Ocotlán, *Puga 1457* (IBUG)	TSDF, DR, FA
Physalis tamayoi O. Vargas, M. Martínez et Dávila	Conifer and oak forest, Tapalpa, *O. Vargas 876* (IBUG, MEXU, NY)	COF
Physalis volubilis Waterf.	Conifer and oak forest, Mazamitla, *A. Rodríguez* and *J. Reynoso 1325* (IBUG)	COF
Physalis waterfallii O. Vargas, M. Martínez et Dávila	Conifer and oak forest, Chiquilistlán, *A. Rodríguez 986* (ENCB, IBUG, MEXU)	COF
Solandra grandiflora Sw.	Tropical subdeciduous forest, Tequila, *Puga 6070* (IBUG)	TSDF, C
Solandra guttata D. Don	Tropical deciduous forest, Ixtlahuacán del Río, *A. Rodríguez, J. Reynoso* and *J. Suárez 1348* (IBUG)	TDF, TSDF, COF
Solanum adscendens Sendtn.	Tropical deciduous forest, Tala, *A. Rodríguez 1283* (IBUG)	TDF, TSDF, G

Tabla 2. Continues

Taxon	*Voucher collection*	*Vegetation type*
Solanum aligerum Schltdl.	Cloud florest, Autlán de Navarro, *R. Cuevas* and *L. Guzmán* (IBUG, ZEA)	COF, CF
Solanum americanum Mill.	Tropical deciduous forest, Tala, *A. Rodríguez* and *J. Reynoso 1122* (IBUG)	TDF, TSDF, DR, G, COF, AF
Solanum angustifolium Mill.	Disturbed and ruderal vegetation, Autlán de Navarro, *H. Iltis* and *M. Nee 1663* (IBUG, WIS, ZEA)	TDF, DR, COF
Solanum aphyodendron S. Knapp	Cloud forest, Casimiro Castillo, *A. Rodríguez, R. Ramírez* and *J. Suárez 908* (IBUG)	COF, CF
Solanum appendiculatum Dunal	Conifer and oak forest, Tapalpa, *A. Rodríguez* and *J. Suárez 576* (IBUG)	COF, CF
Solanum betaceum Cav.	Cultivated, San Sebastián del Oeste, *M. J. Saínz* and *G. Peña 156* (IBUG)	C
Solanum brevipedicellatum K. E. Roe	Conifer and oak forest, Talpa de Allende, *F. J. Santana 783* (IBUG)	TSDF, DR, COF, CF
Solanum bulbocastanum Dunal	Tropical deciduous forest, Cuquío, *A. Rodríguez* and *V. Alvarez 2581* (IBUG)	TDF, COF, CF
Solanum campechiense L.	Tropical deciduous forest, Cihuatlán, *A. Rodríguez 2075* (IBUG)	TDF, TSDF, DR
Solanum candidum Lindl.	Conifer and oak forest, Tala, *A. Rodríguez* and *O. Vargas 2098* (IBUG)	TDF, DR, G, COF, CF
Solanum cardiophyllum Lindl.	Conifer and oak forest, Tala, *A. Rodríguez* and *O. Vargas 2103* (IBUG)	TDF, G, COF
Solanum chrysotrichum Schltdl.	Conifer and oak forest, Cuautitlán de García Barragán, *R. Cuevas 1280* (IBUG, WIS, ZEA)	DR, COF, CF
Solanum corymbosum Jacq.	Disturbed and ruderal vegetation, Ojuelos de Jalisco, *A. Rodríguez et al.* 2569a (IBUG)	DR, G, XS
Solanum dasyadenium Bitter	Conifer and oak forest, Totatiche, *A. Rodríguez et al. 2326* (IBUG)	COF
Solanum diphyllum L.	Mangrove community, Puerto Vallarta, *R. Ramírez et al. 3782* (IBUG)	TDF, DR, MC
Solanum dulcamaroides Dunal	Conifer and oak forest, Tala, *A. Rodríguez* and *J. Reynoso 1095* (IBUG)	TDF, TSDF, COF, CF, FA
Solanum ehrenbergii (Bitter) Rydb.	Disturbed and ruderal vegetation, Valle de Guadalupe, *A. Rodríguez, Puga* and *S. González 1321A* (IBUG)	TSDF, DR, XS
Solanum elaeagnifolium Cav.	Disturbed and ruderal vegetation, Mezquitic, *A. Rodríguez 504* (IBUG)	TSDF, TF, DR, G, XS
Solanum erianthum D. Don	Tropical deciduous forest, Atoyac, *R. Ramírez 3389* (IBUG)	TDF, TSDF, DR, COF
Solanum ferrugineum Jacq.	Tropical deciduous forest, Poncitlán, *A. Rodríguez* and *L. Guzmán 267* (IBUG)	TDF, TSDF, TF, DR, G, COF, CF
Solanum fructo-tecto Cav.	Tropical deciduous forest, Zacoalco de Torres, *Puga 3075* (IBUG)	TDF, DR, G
Solanum grayi Rose var. *grandiflorum* Whalen	Tropical deciduous forest, Tequila, *A. Rodríguez, O. Pérez* and *F. Richard 357* (IBUG)	TDF, TSDF, DR, G, XS, CF

Tabla 2. Continues

Taxon	*Voucher collection*	*Vegetation type*
Solanum guerreroense Correll	Conifer and oak forest, Venustiano Carranza, *D. S. Correll 14342a* (IBUG, PTIS)	COF
Solanum hazenii Britton	Tropical subdeciduous forest, La Huerta, *Puga* and *S. Carvajal 9882 (IBUG)*	TDF, TSDF, DR
Solanum heterodoxum Dunal	Grassland, Ojuelos de Jalisco, *L. A. García 244* (IBUG)	G
Solanum hougasii Correll	Conifer and oak forest, Venustiano Carranza, *A. Rodríguez* and *J. Suárez 949* (IBUG)	COF, CF, AF
Solanum iopetalum (Bitter) Hawkes	Conifer and oak forest, Chiquilistlán, *A. Rodríguez* and *J. Suárez 540* (IBUG)	COF, CF, AF
Solanum lanceolatum Cav.	Conifer and oak forest, Tuxpan, *Puga 16484* (IBUG)	DR, COF, CF
Solanum lignescens Fernald	Tropical deciduous forest, La Huerta, *A. Solis-Magallanes* 3128 (IBUG)	TDF
Solanum lycopersicum L. var. *cerasiforme* (Dunal) D. M. Spooner, G. J Anderson et R. K. Jansen	Conifer and oak forest, Autlán de Navarro, *S. Zamudio 4775* (IBUG)	TDF, TSDF, TF, DR, G, COF
Solanum lycopersicum L. var. *lycopersicum*	Cultivated, San Cristóbal de la Barranca, *R. López 12* (IBUG)	C
Solanum marginatum L. f.	Conifer and oak forest, Zapotlán el Grande, *J. Reynoso 2218* (IBUG)	DR, COF
Solanum morelliforme Bitter et Münch	Cloud forest, Tolimán, *F. J. Santana* and *B. Benz 5839* (IBUG, ZEA)	CF
Solanum myriacanthum Dunal	Disturbed and ruderal vegetation, Zapopan, *A. Rodríguez et al. 1491* (IBUG)	TDF, DR, COF
Solanum nigrescens M. Martens & Galeotti	Conifer and oak forest, Venustiano Carranza, *A. Rodríguez 2112* (IBUG)	DR, G, XS, COF, CF, AF
Solanum nigricans M. Martens et Galeotti	Autlán de Navarro, *A. Rodríguez* and *E. Dean 2117* (IBUG)	TSDF, COF, CF, AF
Solanum pinnatisectum Dunal	Xerophilous scrub, Lagos de Moreno, *A. Rodríguez, O. Vargas* and *E. Villegas 2574* (IBUG)	TF, DR, XS
Solanum polyadenium Greenm.	Conifer and oak forest, Jocotepec, *A. Rodríguez, M. Cházaro* and *R. Soltero 1013* (IBUG)	COF
Solanum pseudocapsicum L.	Tropical deciduous forest, Tolimán, *A. Rodríguez, R. Soltero* and *H. Arreola 2058* (IBUG)	TDF, TSDF, DR, G, COF, FA
Solanum pubigerum Dunal	Conifer and oak forest, Jocotepec, *A. Rodríguez, M. Cházaro* and *R. Soltero 1006* (IBUG)	COF, CF, AF
Solanum refractum Hook. et Arn.	Tropical deciduous forest, Tala, *A. Rodríguez* and *J. Reynoso 1432* (IBUG)	TDF, TSDF, TF, DR, COF
Solanum rostratum Dunal	Tropical deciduous forest, Cuquío, *A. Rodríguez, J. Reynoso* and *J. Suárez 1362* (IBUG)	TDF, TSDF, TF, DR, G, XS, COF
Solanum schlechtendalianum Walp.	Cloud forest, Autlán de Navarro, *A. Rodríguez* and *E. Dean 2123* (IBUG)	TDF, CF
Solanum seaforthianum Andrews	Disturbed and ruderal vegetation, Atoyac, *A. Rodríguez 2108* (IBUG)	TSDF, DR, COF, CF, C

Tabla 2. Continues

Taxon	*Voucher collection*	*Vegetation type*
Solanum sisymbriifolium Lam.	Tropical deciduous forest, Atoyac, *Puga* and *J. Suárez 1991* (IBUG)	TDF, FA
Solanum stenophyllidium Bitter	Conifer and oak forest, Zapopan, *A. Rodríguez* and *L. Guzmán 318* (IBUG)	COF
Solanum stoloniferum Schltdl.	Conifer and oak forest, Tala, *A. Rodríguez 1278* (IBUG)	XS, COF
Solanum tampicense Dunal	Mangrove commnunity, La Huerta, *J. Reynoso* and *R. Ramírez 1191* (IBUG)	MC
Solanum tridynamum Dunal	Tropical deciduous forest, Atoyac, *A. Rodríguez 2107* (IBUG)	TDF, TSDF, TF, DR, XS, COF, CF
Solanum trifidum Correll	Conifer and oak forest, Chiquilistlán, *A. Rodríguez* and *J. Suárez 976* (IBUG)	COF, AF
Solanum tuberosum L.	Cultivated, Tapalpa, *A. Rodríguez 953* (IBUG)	C
Solanum umbellatum Mill.	Conifer and oak forest, Zapopan, *A. Rodríguez* and *J. Suárez 1446* (IBUG)	TDF, TSDF, TF, DR, COF
Solanum verrucosum Schltdl.	Conifer and oak forest, Tequila, *A. Rodríguez 623b* (IBUG)	COF, AF
Solanum wendlandii Hook. f.	Cultivated, Villa Obregón, *S. Carvajal 113* (IBUG)	TSDF, C
Solanum wrightii Benth.	Cultivated, Guadalajara, *L. M. González 928* (IBUG)	C

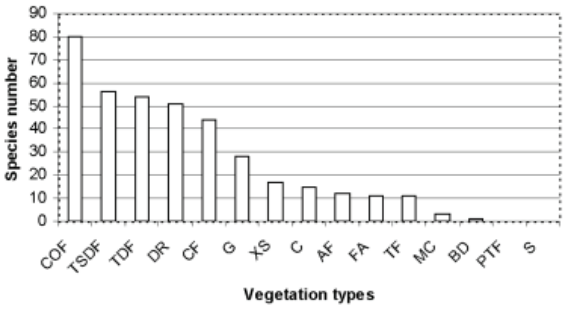

Figure 3. Species diversity for Solanaceae in the vegetation types of Jalisco, Mexico. COF: conifer and oak forest; TSDF: tropical subdeciduous forest; TDF: tropical deciduous forest; DR: disturbed and ruderal vegetation; CF: cloud forest; G: grassland; XS: xerophilous scrub; C: cultivated; AF: *Abies* forest; FA: flooding areas; TF: thorn forest; MC: mangrove community; BD: beach and dune vegetation; PTF: palm tree forest and S: savanna.

bulbocastanum, S. candidum, S. chrysotrichum, S. hougasii, S. iopetalum, S. nigricans, S. pubigerum, S. stoloniferum, S. trifidum, and *S. verrucosum*. Lastly, *Cestrum anagyris, C. aurantiacum, Chamaesaracha cernua, Datura quercifolia, Lycianthes pringlei, L. stephanocalyx, L. surotatensis, Physalis aggregata, P. angustiphysa, P. cinerascens, P. cordata, P. coztomatl, P. chenopodifolia, P. glutinosa, P. solanaceus, P. volubilis, Solanum aligerum, S. angustifolium, S. aphyodendron, S. brevipedicellatum, S. cardiophyllum, S. fructo-tecto, S. guerreroense, S. hazenii, S. pinnatisectum, S. stenophyllidium*, and *S. tridynamum* have been collected in only a few areas.

Other species are known only from areas with particular environmental conditions. For instance, *Lycium carolinianum* grows exclusively around salty and periodically flooded lakes in south-central Jalisco. Similarly, *Datura ceratocaula* is a subacuatic species found only in seasonal ponds. *Physalis acutifolia*, *Solanum diphyllum*, and *S. tampicense* occur only in the mangroves while *Physalis minuta* grows only in the beach and frontal dune plant community. *Juanulloa mexicana* is an epiphytic shrub growing on *Lysiloma* sp. (Vargas-Rodríguez et al. 2006). *Solanum verrucosum* reaches the highest altitudinal range at 3 400 m.

The endemic species of Solanaceae in Jalisco are *Lycianthes jalicensis*, *Physalis lignescens*, *P. longipedicellata, P. longiloba,* and *P. tamayoi*. Other species are endemic to Jalisco and neighboring states. For

instance, *Physalis volubilis* and *P. waterfallii* are endemic to Jalisco and Michoacán whereas *P. hastatula* has been collected only on the border between the states of Jalisco, Aguascalientes, and Guanajuato. *Physalis aggregata* and *Solanum guerreroense* were known only from the type locality in Oaxaca and Guerrero, respectively. Therefore, the collections for both of these species from Jalisco represent disjunct populations or range extensions. No genus is endemic to Jalisco. Nor are any species of Solanaceae listed in the Mexican Endangered Species Act (NOM-059-ECOL-2001, 2002).

In Jalisco, 51 native species occur in disturbed areas and ruderal vegetation. *Datura stramonium*, *Jaltomata procumbens*, *Physalis nicandroides*, *Solanum americanum*, *S. elaeagnifolium*, *S. lycopersicum* var. *cerasiforme*, and *S. rostratum* are favored by these disturbed ecological conditions. Two South American species introduced here, *Nicandra physalodes* and *Nicotiana glauca*, are very common in disturbed areas. In contrast, *Solanum marginatum* and *S. sisimbriifolium*, other introduced species in Mexico, are rare in the state of Jalisco. *Solanum marginatum* occurs as an invasive ruderal in marginal areas of the conifer and oak forest whereas *S. sisymbriifolium* grows in salty environments and tropical deciduous forest.

Solanaceae are important vegetable crops and others are cultivated as ornamentals. The economies of the counties of Mazamitla and Tapalpa depend on the cultivation of potato (*Solanum tuberosum*). Similarly, the tomato (*Solanum lycopersicum*) is an important crop in the counties of Sayula and Autlán de Navarro. Peppers (*Capsicum annuum* var. *annuum*) and husk tomatillo (*Physalis philadelphica*) are extensively cultivated in Yahualica and Cuquío. *Brugmansia candida* and *B. suaveolens* are commonly planted in the uplands as ornamentals and as living fencepost while *Cestrum nocturnum* and *Petunia hybrida* are used extensively as ornamentals throughout the state. Likewise, *Solandra grandiflora* is a preferred ornamental along the coast and in the vicinity of Lake Chapala. *Lycianthes rantoneii, Solanum seafortianum, S. wendlandi* and *S. wrightii* are ornamentals common in the Guadalajara metropolitan area (the second largest city in Mexico). Finally, tobacco (*Nicotiana tabacum*) is extensively cultivated in Jalisco.

Some wild species of Solanaceae represent sources of food in Jalisco. The fruits of *Physalis philadelphica* and the tubers of *Solanum cardiophyllum* and *S. ehrenbergii* are collected and consumed locally. Similarly, but less frequently, the fruits of *Jaltomata procumbens*, *Solanum americanum,* and *S. lycopersicum* var. *cerasiforme* are eaten in Jalisco. Lastly, the tubers of *Solanum stenophyllidium* also represent sources of food in the northern parts of the state.

As expected, the areas with the highest number of species correspond to nature preserves, national parks, and biosphere reserves in Jalisco. Comprehensive floristic studies have been published for these areas that include the Chamela Biological Station (Lott, 1993), Sierra de la Primavera Natural Reserve (Rodríguez and Reynoso, 1992), and the Manantlán Biosphere Reserve (Vázquez et al., 1995). The Guadalajara and Zapopan counties in central Jalisco, also evince a high number of species. Most likely, this result is correlated with the intensity of botanical exploration of the area considering that the botanical research centers are located there. These 2 counties include most of the Guadalajara metropolitan area. In contrast, we did not find any herbarium specimens documenting the presence of species of Solanaceae in the counties of Cuautla, Chimaltitán, Degollado, Guachinango, Manuel M. Diéguez, Mexticacán, Totatiche, Unión de San Antonio, and Villa Hidalgo. Certainly, it is an artifact of botanical collection.

The presence of 5 morphotectonic provinces in Jalisco could contribute to the species diversity of Solanaceae in the state. The south and the southeastern parts of Jalisco share floristic affinities with the states of Michoacán, Guerrero and Oaxaca through the Sierra Madre del Sur. *Physalis aggregata*, *Solanum guerreroense*, and *S. iopetalum* show this geographical distribution pattern. *Lycianthes manantlanensis*, *P. gracilis*, *P. minuta*, *S. morelliforme*, *S. brevipedicellatum*, and *S. bulbocastanum* are elements of the flora of Chiapas and Central America that have been found in Jalisco. Similarly, the Trans-Mexican Volcanic Belt, which spans Mexico from coast to coast, allows some floristic affinities with central and eastern Mexico. *Physalis coztomatl*, *P. subrepens*, *P. volubilis*, *S. polyadenium*, and *S. verrucosum* are examples of this geographical pattern. The Central Plateau extends to the northeastern corner of Jalisco as well as in other regions of Mexico. As a result, xeric taxa such as *P. cinerascens*, *P. glutinosa*, *P. sordida*, *S. corymbosum*, *S. dasyadenium*, *S. elaeagnifolium*, and *S. fructo-tecto*, typical of northern Mexico, are found there. The southern boundary of the Sierra Madre Occidental touches northern Jalisco and therefore these 2 regions share *P. hederifolia* and *S. stenophyllidium*. Finally, *Solanum grayi* is a common species of the Northwestern Plains and Sierras and reaches its southernmost geographical distribution at the northwestern part of Jalisco.

The results of this analysis show that the Solanaceae flora of Jalisco is the fourth most species diverse in Mexico, after Oaxaca, Chiapas, and Veracruz. Rodríguez (2004) reported the presence of 19 genera and 165 species in the state of Oaxaca with 7 species endemic to that state. Similarly, 24 genera and 164 species haven been reported

for Chiapas, in southeastern Mexico (Breedlove, 1986). Four species are endemic to Chiapas. The Solanaceae in Veracruz, on the Gulf of Mexico slope, are represented by 138 species in 21 genera (Nee, 1986, 1993). Four species are endemic to Veracruz. These numbers are similar to those reported in the floras of Guatemala (27 genera and 182 species; Gentry and Standley, 1974; Knapp et al. 2006), Nicaragua (22 genera and 117 species; D´Arcy, 2001), and Panama (21 genera and 140 species; D´Arcy, 1973).

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