

Floral Visitors of the Golden Rain Tree, *Cassia fistula* (Fabaceae), in Campeche, Mexico¹

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Abstract *Cassia fistula* L., known as the golden rain tree, is a flowering tree that is native to Asia but is used as an ornamental plant in public and private gardens in many areas of Mexico. It is also important for its antifungal, antibacterial, antioxidant, phytochemical, and medicinal properties. In this study, floral visitors of *C. fistula* were identified in the urban area of Escárcega, Campeche, Mexico in three public gardens during the month of May using entomologic nets. The insects were preserved with 70% alcohol, transported to the laboratory, and identified to species level using taxonomic keys. In total, 124 insects were collected representing 8 species belonging to 7 genera. Of those insects collected, *Trigona fulviventris* Guérin-Ménéville and *Trigona silvestriana* Vachal (Hymenoptera: Apidae) were the most abundant, accounting for almost 50% of the total specimens collected. Previous reports list 32 species of insects as floral visitors of *C. fistula* in Mexico. Our study adds six species to that list that had not been previously recorded: *Epicharis elegans* Smith, *Eulaema polychroma* (Mocsáry), *Melipona* sp., *T. silvestriana*, and *Xylocopa latipes* (Drury), which are all members of the family Apidae (order Hymenoptera), and *Parachartergus apicalis* (F.), a vespid (Hymenoptera: Vespidae).

Key Words Campeche, *Cassia fistula*, floral visitors, pollinators

Mexico is fourth among all countries in biological diversity of flora and fauna (Toledo et al. 2008). Its flora is represented by 22,000 species of wild phanerogamous plants, with the greatest diversity in the south and southeast areas of the country. The Yucatán Peninsula (Campeche, Quintana Roo, and Yucatán states), located in southeastern Mexico, has a plant record of 2,329 taxa in 956 genera and 161 families (Carnevali et al. 2010).

The state of Campeche is characterized by humid forests, mangroves, the Petén, the Tular, and the Sheets. Of its total surface area, 15% is in agricultural use and the planting of grasslands for livestock consumption (INEGI 2023). Campeche has a wealth of flora and fauna in combination with Mayan culture, which has made use of these resources for hundreds of years. Campeche also serves as a refuge for five of the six feline species reported from Mexico (CONABIO

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2023). Despite the presence of agriculture and livestock, a high degree of vegetative conservation occurs there (Báez et al. 2016).

Campeche bridges the Yucatan Peninsula with the continental mass of Mexico and has high plant diversity representative of those two regions. The state also has the highest elevation above sea level in the Yucatán Peninsula, making it the geographic area with the greatest diversity of vegetative types of the three states on the Yucatán Peninsula. It is, however, the state with the fewest studies on its flora and fauna (Góngora-Chin et al. 2017).

The 13 municipalities in the state are characterized by warm subhumid temperatures and rains in summer and vegetation that is medium-sized subevergreen forest. The average height of the plants varies from 15 to 30 m; in times of drought, they lose their leaves. Vegetative species include *Metopium brownei* (Jacquin) Urban (Anacardiaceae), *Bursera simaruba* (L.) Sargent (Burseraceae), *Bucida buceras* L. (Combretaceae), *Piscidia piscibula* (L.) Sargent (Fabaceae), *Manilkara zapota* (L.) P. Royen (Sapotaceae), *Brosimum alicastrum* Swartz (Moraceae), *Cordia dodecandra* A. de Condelle (Boraginaceae), and *Vitex gaumeri* Greenman (Verbenaceae), among others (García-Ramírez et al. 2016). In addition to the native species in the municipalities, a tree known locally as golden rain (*Cassia fistula* L.) is considered an ornamental and is widely used in public and private gardens because it beautifies these spaces with its golden flowers (Bahorun et al. 2005). The species is native to Asia and has spread throughout the world mainly as an ornamental. Different parts of the plant, however, have also been used in natural medicine, and it is also considered an important species in beekeeping activities (BSF 2023). Studies have been conducted on its antifungal and antibacterial components and activity (Bhalodia and Shukla 2011, Duraipandiyan and Ignacimuthu 2007, Phongpaichit et al. 2004), its antioxidant properties (Ilavarasan 2005, Irshad et al. 2012), its phytochemical properties (Ali 2014, Bahorun et al. 2005, Sharma 2017), and its medicinal properties (Mwangi et al. 2021, Rahmani 2015, Upadhyay 2020), among other studies focused on medicine and pharmacology.

Cassia fistula belongs to the Fabaceae family, which is of economic importance and species richness among the angiosperms. The genus *Cassia* is distributed on continents with tropical regions (e.g., Africa, Asia, America) (Kenicer 2005, Scheidegger and Rando 2023, Souza and Lorenzi 2019). The pollinating insects or floral visitors of *C. fistula* are little known in Mexico and other countries (Rocha et al. 2022); thus, it is important to know the floral visitors of *C. fistula* for a better understanding of its reproduction, the pollinators that visit it, and pollinator conservation. Therefore, in the present study, floral visitors of *C. fistula* were identified in the urban area of the municipality of Escárcega, Campeche, Mexico.

Materials and Methods

The study was conducted in the City of Escárcega, belonging to the municipality of the same name. It is in the center of the state of Campeche, which is situated in southeastern Mexico, located between the parallels 18°36'25"N and 90°43'35"W, at an altitude of 60 m. The climate, according to the Köppen classification modified by García (1988), is A1(i)g, which corresponds to a warm subhumid

climate with rains in the summer that begin in May and continue in June, with a maximum in September. Average relative humidity is 49.7%, and the monthly temperature fluctuates from 5 to 7°C (López-Torres and Tamarit-Urías 2005).

The collection sites used in this study were three public gardens containing at least two to three *C. fistula* plants per site (e.g., Escárcega Higher Technological Institute, Ciudad del Carmen Municipal Park, and Railway Soccer Stadium). Floral visitors were sampled and collected on weekdays in May, when the *C. fistula* plants were flowering in Campeche. Insects were collected by sweeping the plants using entomologic nets between the hours of 9 a.m. and 12 p.m., which is when flying insects are at their greatest activity. The collected insects were placed in jars with 70% alcohol, transported to the Food Industries Engineering Laboratory of the Higher Technological Institute of Escárcega, and eventually identified to species level using taxonomic keys.

Results

In total, 124 insects were collected. These included eight species belonging to seven genera from the order Hymenoptera. Those were identified as *Epicharis elegans* Smith, *Apis mellifera* L., *Eulaema polychroma* Mocsary, *Melipona* sp., *Parachartergus apicalis* F., *Trigona fulviventris* Guérin-Méneville, *Trigona silvestriana* Vachal, and *Xylocopa latipes* Drury (Table 1). All but one of these species are members of the family Apidae; *P. apicalis* is a member of the family Vespidae. Of the eight species collected, *T. fulviventris* was collected most frequently, 38 of 124 (31%), followed by *T. silvestriana* (22 = 18%), *Ep. elegans* (15 = 12%), *Eu. polychroma* (11 = 9%), *P. apicalis* (11 = 9%), *X. latipes* (10 = 8%), *Melipona* sp. (10 = 8%), and *A. mellifera* (7 = 6%). Six of the eight species had not been previously reported visiting *C. fistula* as pollinators. These were *Ep. elegans*, *Eu. polychroma*, *Melipona* sp., *T. silvestriana*, *X. latipes*, and *P. apicalis* (Table 1).

Discussion

Trigona fulviventris and *T. silvestriana* were the most frequent floral visitors of *C. fistula* we observed in this study, accounting for 48.8% of the total specimens collected. Both species are stingless bees, a group with their greatest diversity in southeastern Mexico (Arnold et al. 2018). Forty-six species of stingless bees have been reported in Mexico, with 12 of those from the state of Campeche (Pat-Fernández et al. 2018). *Trigona fulviventris* has been reported in 13 states (e.g., Campeche, Chiapas, Guerrero, Jalisco, Michoacán, Morelos, Nayarit, Oaxaca, Puebla, Querétaro, Quintana Roo, Tamaulipas, and Yucatán), whereas *T. silvestriana* has been reported in 4 states (e.g., Campeche, Chiapas, Quintana Roo, and Yucatán) (Discover Life 2023).

Only seven *A. mellifera* workers were collected in our study. This represented only 5.6% of the total insects collected. This was an unexpected result because *A. mellifera* has been reported in all states of Mexico. It is an introduced species and has great cultural and commercial value in the country. Its low occurrence in our study is not representative of results obtained in other studies (Baena-Díaz

Table 1. List of insect species visiting *Cassia fistula* flowers in Campeche, Mexico.

Order	Family	Species	Previous Reports	Current Report
Coleoptera	Chrysomelidae	<i>Maecolaspis trivalis</i> (Boheman)	X	
	Coccinellidae	<i>Coccinella septempunctata</i> L.	X	
Diptera	Muscidae	<i>Muscina prolapsa</i> (Harris)	X	
	Syrphidae	<i>Episyrphus balteatus</i> (De Geer)	X	
	Pentatomidae	<i>Dichelops melacanthus</i> (Dallas)	X	
Hemiptera				
Hymenoptera	Apidae	<i>Apis mellifera</i> L.	X	X
		<i>Bombus morio</i> (Swederus)	X	
		<i>Centris</i> F.	X	
		<i>Epicharis elegans</i> Smith		X
		<i>Eulaema cingulata</i> (F.)	X	
		<i>Eulaema polychroma</i> (Mocsáry)		X
		<i>Eulaema tropica</i> L.	X	
		<i>Exaerete lepeletieri</i> Oliveira & Nemésio	X	
		<i>Melipona beecheii</i> Bennett	X	
		<i>Melipona</i> sp. 1 Illiger		X
		<i>Plebeia frontalis</i> (Friese)	X	
		<i>Tetragonisca angustula</i>	X	
		<i>Trigona fulviventris</i> (Latreille)	X	X

Table 1. Continued.

Order	Family	Species	Previous Reports	Current Report
		<i>Trigona fuscipennis</i> (Friese)	X	
		<i>Trigona silvestriana</i> (Vachal)		X
		<i>Trigona spinipes</i> (F.)	X	
		<i>Xilocopa latipes</i> (Drury)		X
		<i>Xylocopa Latreille</i>	X	
		<i>Xylocopa frontalis</i> (Olivier)	X	
		<i>Camponotus melanoticus</i> Santschi	X	
	Formicidae	<i>Crematogaster erecta</i> (Mayr)	X	
		<i>Dolichoderus imitator</i> Emery	X	
		<i>Priochilus gracillimus</i> Smith	X	
	Pomplidae	<i>Sphex ingens</i> Smith	X	
	Sphecidae	<i>Parachartergus apicalis</i> (F.)		X
	Vespidae	<i>Polistes canadensis</i> (L.)	X	
		<i>Polybia ignobilis</i> (Haliday)	X	

et al. 2022, Discover Life 2023, Martínez-Cesáreo et al. 2016) and might be due to the lack of apiaries in the vicinity of the gardens surveyed in our study.

Delgado-Salinas and Sousa-Sánchez (1977) listed four species of floral visitors and pollinators they recorded on *C. fistula*. Among those, their report of *Xylocopa* and *Eulaema* species coincided with our observation of representatives of those genera in our study (e.g., *X. latipes* and *Eu. polychromata*); however, they reported *Eulaema cingulata* (F.) and *Eulaema tropica* (the latter considered a synonym of *Parachartergus polychromata*) from Tuxtla, Veracruz. The four species Godínez Espinosa (2019) reported as floral visitors on *C. fistula* in Campeche included *T. fulviventris*, which we also reported in our study. A greater diversity of floral visitors was reported in Brazil by Rocha et al. (2022), who recorded 19 species visiting and pollinating *C. fistula*.

Previous studies list 32 species of insects as floral visitors on *C. fistula* (Table 1). We add five identified species to that list with ones that had not been previously reported. Those are *Ep. elegans*, *Eu. polychroma*, *T. silvestriana*, *X. latipes*, and *P. apicalis*. We also added an unidentified species of the genus *Melipona*. This updated list (Table 1) has 85% of recorded floral visitors belonging to the order Hymenoptera, with the remaining represented by two families of Coleoptera, two families of Diptera, and one family of Hemiptera.

In conclusion, our results expand and update the list of known insect species that visit and pollinate the flowers of the golden rain tree, *C. fistula*, in Campeche, Mexico. These results also should promote more exhaustive studies and in additional locations to complement the information provided here. Floral visitors to *C. fistula* participate in the pollination of many flowering plants and thus provide an important environmental service with economic impact for cultivated plants.

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