

**Pollen carriers and fruit development of *Psidium guajava* L.
(Myrtaceae) in the Neotropical region**

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Resumen: Se hicieron observaciones sobre las especies de insectos que visitan las flores de la guayaba, *Psidium guajava* L. (Myrtaceae), en San Felipe (Departamento de Retalhuleu) y Lago Amatlán (Departamento de Guatemala), Guatemala; en Sabanilla de Montes de Oca (Provincia de San José), en Guácimo, en Las Brisas de Pacuarito (Provincia de Limón) y en Turrúcares (Provincia de Alajuela), Costa Rica; en Santa Rosa de Quijos (Provincia de Napo), Río Verde, Baños (Provincia de Tungurahua), Ecuador y San José de Ocoa (Provincia de Peravia), República Dominicana. Los vectores de polen más abundantes en Costa Rica fueron: *Apis mellifera* L., *Bombus mexicanus* Cresson, *Trigona cupira* Smith, *T. amalthea* (Olivier), *T. silvestriana* Vachal, *T. dorsalis* Smith y *Lasiglossum* sp.; en el Ecuador: *A. mellifera* y una especie de *Xylocopa*; en Guatemala: *A. mellifera*, *B. mexicanus* y *T. cupira* y en República Dominicana *A. mellifera*. El polen es transportado por los insectos adherido al tórax, abdomen y la parte ventral de las alas, y entra en contacto con el stigma cuando el insecto camina sobre la flor. Las flores cubiertas con bolsas producían frutos, lo que indica la capacidad de autogamia. Además, se informa sobre las épocas de floración, cosecha y el tamaño de las frutas de *P. guajava* en relación con diferentes altitudes sobre el mar.

The common guava, *Psidium guajava* L. (Myrtaceae) is native to the New World tropics and subtropics. It is found both wild in pastures and cultivated in moist or dry thickets or "guayabales", and produces numerous edible fruits (4-12 cm long). The guava, known generally as "guayaba" in Spanish, is one of the most widely known tropical fruits, and is highly esteemed by many people.

According to Ruehle (1948), the Spanish chronicler Oviedo, who was in Haiti at intervals from 1514 to 1557, wrote the first account of *P. guajava* in 1526. Oviedo stated that the plant was common in many parts of the West Indies and that improved forms were planted by the local people. It was taken to Asia at an early date by the Spanish explorers and it is now spread throughout the tropics.

The open brush-flower of *P. guajava* seems to be adapted to both wind and insect pollina-

tion (Purseglove 1968). Hummingbirds and *Cetris dirrahoda* bees visit flowers of *P. guajava* in Venezuela and Jamaica respectively (Knuth 1899 and Raw 1979). Purseglove (1968) wrote that the flower is visited by bees (he did not specify in what region) and that self- and cross-pollination may occur. Using the dominant red mesocarp colour as a marker, natural cross-pollination has been shown to be about 35% (Purseglove 1968). The common practice of sexual (seed) rather than vegetative (cuttings) propagation has led to considerable genetic variability between generations of cultivars as a result of recombination; flavor, shape, colour of the flesh, Vitamin C content, etc. (K. Zimmerer 1985, pers. comm.).

To my knowledge no data has been published on insects visiting *P. guajava* in the neotropics. Hence the principal objective of this study was to present a check-list of pollen

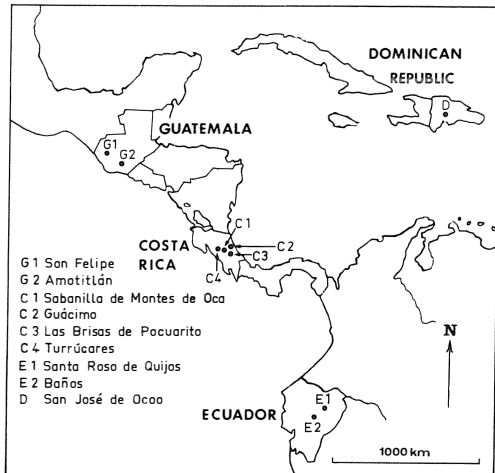


Fig. 1. Observation sites in the Dominican Republic, Costa Rica, Guatemala and Ecuador.

carriers of *P. guajava* in this region.

Field observations and collection of visiting insects (from early morning until late afternoon) on *P. guajava* were conducted in San Felipe (G1) (Department of Retalhuleu) and Lago Amatitlán (G2) (Department of Guatemala), Guatemala, October 24-25, 1985 and May 1-2, 1987, respectively. Observations were also conducted in San José de Ocoa (D) (Peravia Province) in the Dominican Republic, December 6, 1987. In Costa Rica, insects were observed in Sabanilla de Montes de Oca (C1) (San José Province), May 23, 1986, and May 7, 1987; in Guácimo (C2), April 22 and 26, 1986, and in Las Brisas de Pacuarito (C3) (Limón Province), May 6, 1986 and in Turrúcares (C4) (Alajuela Province), February 1, 1987. Additional observations were conducted in Ecuador: Santa Rosa de Quijos (E1) (Napo Province), November 4-6, 1986, and Río Verde, Baños (E2) (Tungurahua Province), February 24, 1987 (Fig. 1).

Close observations of the behaviour of insects visiting flowers of *P. guajava* were carried out in order to determine their efficiency in transferring pollen between flowers. Insects on *P. guajava* flowers were collected with a net or by the use of a killing bottle. The insects were killed and the presence of pollen grains of *P. guajava* attached to their body and wings was determined.

The white, one-day flowers of *P. guajava* usually opened in the early morning hours,



Fig. 2. *Bombus mexicanus* Cresson visiting flower of *Psidium guajava* L. Pollination is effected when the stigma receive pollen grains from the body and/or wings of the vector, from previously visited flowers. Drawing by Inga Thomasson.

normally between 5:30 and 8:00 a.m. ($n = 20$). The insects arrived flying and alighted on the flowers. While feeding on nectar and/or pollen grains, the visitors repeatedly came into contact with the stigma, where pollen was deposited. New pollen grains from numerous stamens of the flower were at the same time attached to the body and wings of the visiting insects (Fig. 2).

At the study sites in Costa Rica, observed pollen carriers of *P. guajava* were *Apis mellifera* L., *Bombus mexicanus* Cresson, and *Trigona cupira* Smith, *T. amalthea* (Olivier), *T. silvestriana* Vachal, *T. dorsalis* Smith, and *Lasioglossum* sp.; in the Dominican Republic *A. mellifera*; and in Guatemala *A. mellifera*, *B. mexicanus*, and *T. cupira*. In Ecuador, visiting *Xylocopa* sp. and large numbers of *A. mellifera*, were registered (Table 1).

On May 6 and July 7, 1987, in Sabanilla de Montes de Oca, Costa Rica, individual flowers ($n = 8$ in both cases) of *P. guajava* were bagged during 6 days, in order to prevent insects from pollinating the flowers. Flowers bagged in May were hand-pollinated with pollen grains from the same individual tree, while flowers bagged in July were left untouched. Of the bagged flowers, 100% developed fruits, which suggests that both self- and cross-pollination may occur (even between flowers of the same individual tree).

TABLE 1

Bees visiting Psidium guajava L. in the Dominican Republic, Guatemala, Costa Rica, and Ecuador

	Observation sites								
	(G1)	(G2)	(C1)	(C2)	(C3)	(C4)	(E1)	(E2)	(D)
Apidae									
<i>Apis mellifera</i> L	X	—	—	X	—	X	X	X	X
<i>Bombus mexicanus</i> Cresson	—	X	X	—	—	—	—	—	—
<i>Trigona cupira</i> Smith	X	—	X	—	—	—	—	—	—
<i>T. silvestriana</i> Vachal	—	—	X	X	X	X	—	—	—
<i>T. amalthea</i> (Olivier)	—	—	—	X	—	—	—	—	—
<i>T. dorsalis</i> Smith	—	—	—	X	—	—	—	—	—
<i>Trigona</i> spp.	X	X	X	X	X	X	X	X	—
Halictidae									
<i>Lasioglossum</i> sp.	—	—	—	—	X	—	—	—	—
Anthophoridae									
<i>Xylocopa</i> sp.	—	—	—	—	—	—	X	—	—

(G1) = San Felipe, Guatemala; (G2) = Lago Amatitlán, Guatemala; (C1) = Sabanilla de Montes de Oca, Costa Rica; (C2) = Guácimo, Costa Rica; (C3) = Las Brisas de Pacuarito, Costa Rica; (C4) = Turrúcares, Costa Rica; (E1) = Santa Rosa de Quijos, Ecuador; (E2) = Baños, Ecuador, (D) = San José de Ocoa, Dominican Republic.

In addition, in Puerto Rico, the Virgin Islands and Hispaniola, *P. guajava* sets fruits year round (Little *et al.* 1977). In Costa Rica the number of flowering periods seems to depend mostly on the geographical altitude. During 1986 and 1987, in Guácimo (120m), the principal flowering periods occurred in January-February and August-September (with less distinguishable intermediate periods of certain individual trees). During the same years in both Turrúcares (600 m) and Sabanilla de Montes de Oca (1200m), the trees carried flowers only once a year, from April to July. At the observation site in Guácimo, fruit (\bar{x} = 5.5 ± 0.8 cm long, n = 10) developed and fell from the trees about 18 weeks after fruit set. Ripe fruits in Turrúcares (\bar{x} = 4.6 ± 1.2 cm long, n = 16) and Sabanilla de Montes de Oca (\bar{x} = 3.8 ± 1.2 cm long, n = 10) began to fall from the trees after about 14.5 and 22.5 weeks, respectively. In Milagro on the Ecuadorian coast (Hedström 1987), fruits of *P. guajava* (\bar{x} = 5.9 ± 1.1 cm long, n = 20) fell already 12 weeks after fruit set.

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