

FRUIT FLIES (DIPTERA: TEPHRITIDAE) INFESTING FRUITS
OF THE GENUS *PSIDIUM* (MYRTACEAE) AND THEIR
ALTITUDINAL DISTRIBUTION IN WESTERN VENEZUELA

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ABSTRACT

A survey of fruit flies infesting *Psidium* fruits was conducted in western Venezuela from June 1992 through December 1995. Of 201 fruit samples collected from 139 localities at altitudes between sea level and 2,000 m, four species of *Psidium* plants were found in the western region of Venezuela. These were *P. guajava* L. (10-1930 m), *P. guineense* Sw. (100-1950 m), *P. caudatum* McVaugh (1800-1950 m) and *P. friedrichsthalianum* (Berg) Niedenzu (35-1700 m). Four tephritid fly species were reared: *Anastrepha striata* Schiner, *A. fraterculus* (Wiedemann), *A. obliqua* (Macquart), and *Ceratitis capitata* (Wiedemann). All four fruit fly species emerged from *P. guajava*. *A. striata* was the most common on *P. guajava*, *P. guineense* and *P. friedrichsthalianum*, with an infestation range of 96.1%-97.0%. *P. caudatum* was more frequently infested by *A. fraterculus* (94.5% adults emergence); the plant's distribution was restricted to highlands. Observations on the altitudinal distribution of *A. striata* on *P. guajava* showed that the highest infestation (253.9 adults/kg fruits) occurred at about 1,000 m. The infestation rate of *P. guajava* by *A. fraterculus* and *A. obliqua* varied with elevation. In low elevation areas (0-1,200 m), *A. obliqua* was found more frequently than *A. fraterculus*, whereas *A. fraterculus* was found more frequently than *A. obliqua* in high altitude areas (1,201-2,000 m). *C. capitata* was erratically encountered in this study.

Key Words: *Anastrepha*, *Ceratitis capitata*, guava, *Psidium* spp., altitudinal distribution

RESUMEN

Desde junio de 1992 a diciembre de 1995 se estudiaron las moscas de las frutas (Diptera: Tephritidae) que infestan plantas del género *Psidium* en el occidente de Ve-

nezuela. Se recolectaron un total de 201 muestras de frutas en 139 localidades comprendidas desde el nivel del mar hasta 2,000 m de altitud. Se encontraron cuatro especies de plantas del género *Psidium*: *P. guajava* L. (10-1930 m), *P. guineense* SW. (100-1950 m), *P. caudatum* Mc Vaugh (1800-1950) y *P. friedrichsthalianum* (Berg) Niedenzu (35-1700 m). Se lograron criar cuatro especies de moscas de la Familia Tephritidae: *Anastrepha striata* Schiner, *A. fraterculus* (Weidemann), *A. obliqua* (Macquart) y *Ceratitis capitata* (Weidemann)]. De *P. guajava* emergieron las 4 especies de moscas de las frutas encontradas en el presente estudio. *A. striata* resultó ser la mosca más común en *P. guayaba*, *P. guineense* y *P. friedrichsthalianum* encontrándose infestaciones comprendidas entre 96.1%-97.0%. *P. caudatum* fue encontrada como la planta hospedera preferida por *A. fraterculus* con un 94.5%. Además, su distribución está restringida a tierras altas. La distribución altitudinal de *A. striata* muestra que la mayor infestación en frutos de *P. guajava* ocurre alrededor de los 1,000 m de altitud (253.9 adultos/Kg de frutas). La infestación relativa de *A. fraterculus* y *A. obliqua* en *P. guajava* varía con la altitud. En tierras bajas (0-1,200 m), *A. obliqua* se encontró como la especie predominante sobre *A. fraterculus*. En cambio, en tierras altas (1,201-2,000 m), *A. fraterculus* fue la especie predominante sobre *A. obliqua*. La distribución geográfica y altitudinal de *C. capitata* fue muy errática.

The Genus *Anastrepha* is endemic to the Americas and is restricted to tropical and subtropical environments. Its range extends from the southernmost part of the United States (Rio Grande Valley of Texas and southern Florida) to South America, with the exception of the southern parts of Argentina and Chile. Fruit flies of the genus *Anastrepha* compose one of the largest and most economically important insect groups in the tropics and subtropics due to their damage to cultivated fruits. This group comprises more than 190 identified species but hosts are known for less than half (Norrbom & Kim 1988).

In Venezuela there are four economically important *Anastrepha* species: the South American fruit fly, *A. fraterculus* (Wiedemann), the West Indian fruit fly, *A. obliqua* (Macquart), the guava fruit fly, *A. striata* Schiner, and the zapote fruit fly, *A. serpentina* (Wiedemann).

In the 1980's, cultivation of guava, *Psidium guajava*, in the northern region of Zulia State was expanded. By 1992, in the lake Maracaibo plain, about 4,000 ha of guava orchards were in production (Araujo et al. 1997). Several species of fruit flies of the family Tephritidae, especially *A. striata* and *C. capitata*, are very important from a quarantine point of view when fruit export is the objective.

P. guajava is found from sea level to 1,930 m in commercial orchards, backyards of houses, roadsides, pasture lands, and forests throughout western Venezuela. The work described in this paper was done to obtain basic information about the altitudinal distribution of different fruit flies infesting cultivated or wild fruits belonging to the family Myrtaceae, genus *Psidium*, which can be used in the economic management of these fruit flies.

MATERIALS AND METHODS

From June 1992 to December 1995, 201 *Psidium* spp. fruit samples were collected whenever available from sea level to 2,000 m elevation in 139 localities in the western Venezuelan states of Falcón, Mérida, Táchira, Trujillo, and Zulia comprising an area of 117,700 sq-km. The Northern and Southern borders of the study area are delimited

with latitudes 11°45'N and 7°32'N respectively, while Eastern and Western borders are delimited with longitudes 68°30'W and 72°40'W respectively.

Fruit samples were collected from four species of *Psidium*: *P. guajava* L. (common guava) from sea level to 1,930 m, *P. guineense* Sw. (mountain guava) from 100-1,950 m, *P. caudatum* McVaugh (jumangue) from 1,800-2,000 m, and *P. friedrichsthalianum* [Berg] Ndz. (cas or sour guava) from 35-1,700 m altitude. The total number of fruits collected from each *Psidium* spp. host plant comprised 7,015, 255, 3,816 and 59 fruits from *P. guajava*, *P. guineense*, *P. caudatum* and *P. friedrichsthalianum* respectively.

Following the technique described by Katiyar et al. (1995), fruit samples were incubated and processed in the laboratory. Mature fruits were picked from sample trees as well as from the ground and were placed in open top wooden boxes (30 × 20 × 10 cm). A sheet of plastic screening (about 4 mm/mesh) had been fitted about 2 cm from the bottom of each box. The wooden boxes containing fruit samples were placed in plastic rearing containers (35 × 24 × 13 cm). The tops of the rearing containers were fitted with a fine-screened window (15 × 8 cm) for aeration. Each container had a layer of moist sawdust about 2 cm deep at the bottom as a pupation media for the larvae. The fruit samples were taken to the laboratory in this manner. In the laboratory, samples were removed from rearing containers. The fruits were counted, weighed, and put back in the containers. Every 2-3 days the sawdust was sieved, and recovered larvae and pupae were placed in 500 cc plastic cups containing a thin layer (2-3 cm) of moist saw dust. Each container with pupae was placed inside an adult emergence cage to recover fruit flies and parasitoid adults. The emerged adults were preserved in 70% ethyl alcohol. Rearing was carried out in the laboratory at 26 ± 3°C and 60 ± 10% RH.

The climatic condition of the study area is characterized by a rainy season from April to November, followed by a dry period from December to March. The rainfall in Western Venezuela varies widely from one place to another. This variation can be observed in lowland areas (0-1,000 m) as well as in highland areas (1,001-2,000 m). During rainy season the temperature is slightly higher compared with the dry season. Table 1 presents climatic data (temperature, rainfall and RH) from 17 meteorological stations located between 5 and 2,200 m elevation in the study area.

Samples of fruit fly adults were identified by A. L. Norrbom, Systematic Entomology Laboratory, USDA, PSI, ARS, Washington, D.C.

RESULTS AND DISCUSSION

A total of 11,145 fruits (261.5 kg) were collected from four *Psidium* species. A total of 30,530 pupae and 20,970 adults of both sexes belonging to four species of tephritids were reared from these fruits.

Table 2 summarizes the relative abundance of each tephritid species infesting the four *Psidium* host plants (based on adult emergence/kg fruits). *P. guajava* was infested by all four tephritid species found, *P. guineense* by three species (*A. striata*, *A. fraterculus* and *A. obliqua*), *P. caudatum* by two species (*A. fraterculus* and *A. striata*) and *P. friedrichsthalianum* by two species (*A. striata* and *A. obliqua*). The results show that *A. striata* was the most common fruit fly pest of *Psidium* species in the western region of Venezuela. Based on total adult emergence from all four *Psidium* spp., the proportion of each species consisted of *A. striata* (73.9%), *A. fraterculus* (24.2%) and *A. obliqua* (1.9%).

The results also show that *A. striata* was the most common fruit fly in three *Psidium* spp. (*guajava*, *guineense*, and *friedrichsthalianum*) with an infestation range of 96.1%-97.0% (based on number of adults emerged/kg fruit). Whereas *A. fraterculus*

TABLE 1. ANNUAL CLIMATIC DATA¹ (TEMPERATURE, RAINFALL AND RELATIVE HUMIDITY) IN WESTERN VENEZUELA.

Weather station	State	Data period (years)	Latitude (N)	Longitude (W)	Altitude (m)	Annual temperature (°C)			Annual rainfall (mm)			RH (%) Mean
						Mean	Min	Max	Mean	Min	Max	
Sta. Barbara	Zulia	67-98	08°58'	71°53'	5	28.4	23.9	33.2	1297	768	1813	83
Coro	Falcón	82-92	11°25'	69°41'	16	27.8	25.0	32.7	362	189	613	75
Maracaibo	Zulia	81-98	10°41'	71°38'	45	29.2	24.9	33.4	484	234	688	75
El Isiro	Falcón	82-92	11°18'	69°37'	72	29.0	24.7	34.5	570	258	926	68
Machiques	Zulia	50-98	10°03'	72°33'	99	28.2	22.7	33.6	1500	1011	2196	66
Sto. Domingo	Táchira	82-92	07°35'	72°04'	327	23.7	20.4	29.2	2854	2496	3572	84
San Antonio	Táchira	85-95	07°51'	72°27'	377	25.9	21.9	31.4	712	312	1168	72
Valera	Trujillo	86-96	09°21'	70°37'	582	24.4	20.1	29.7	1071	743	1380	81
Colón	Táchira	85-95	08°02'	72°15'	760	22.3	19.3	25.7	1513	996	1937	79
Churuguara	Falcón	74-84	10°48'	69°30'	920	22.7	16.8	27.1	729	466	1328	NA
Tovar	Mérida	69-90	08°20'	71°44'	952	21.9	17.7	26.7	1069	550	1622	73
La Grita	Táchira	74-84	08°08'	71°59'	1270	21.4	15.6	26.5	795	467	1911	82
Mérida	Mérida	51-98	08°36'	71°11'	1479	19.1	15.3	24.7	1732	1159	2302	80
San Giusto	Trujillo	80-90	09°17'	70°12'	1499	18.0	13.0	24.4	1848	1335	2574	81
Boconó	Trujillo	91-91	09°16'	70°13'	1560	18.0	11.6	23.9	1570	1437	1742	75
Sto. Domingo	Mérida	78-83	08°52'	70°40'	2155	15.6	10.5	20.4	1233	700	1780	NA
Betania	Táchira	84-94	07°28'	72°26'	2210	15.1	9.6	20.5	1035	763	1368	NA

¹ Provided by Ministerio del Ambiente y de los Recursos Naturales Renovables de Venezuela (MARNR). NA, not available.

TABLE 2. RATE OF FRUIT INFESTATION OF *PSIDIUM* SPECIES BY *ANASTREPHA* SPP. IN THE WESTERN REGION OF VENEZUELA, 1992-1995.

Host fruit	Adult emergence/kg			
	<i>A. striata</i>	<i>A. fraterculus</i>	<i>A. obliqua</i>	Totals
<i>P. guayaba</i> ¹	110.6	2.4	1.3	114.3
<i>P. guineense</i> ²	91.2	0.4	2.4	94.0
<i>P. caudatum</i> ³	0.8	13.7	0.0	14.5
<i>P. friedrichsthalianum</i> ⁴	29.8	0.0	1.2	31.0

¹Indicates (n = 185 samples and 249.2 Kg).

²Indicates (n = 5 samples and 3.1 Kg).

³Indicates (n = 7 samples and 6.9 Kg).

⁴Indicates (n = 4 samples and 2.3 Kg).

was the predominant species in *P. caudatum* (the emerged adults were 94.5% *A. fraterculus* and 5.5% *A. striata*). *P. caudatum* is a native wild *Psidium* species found at relatively high elevation (1,500-2,000 m) and has a small fruit, mean weight of 1.8 g.

In general *A. striata* was the dominant fruit fly in *Psidium* species except *P. caudatum* in the western part of Venezuela. *A. striata* is also reported as the major pest of *P. guajava* in several other Latin American countries. In Costa Rica, 97.8% of fruit samples were reported infested by *A. striata* (Jiron & Hedström 1988), and in Ecuador *A. striata* emerged from 70.8% of fruit samples examined (Hedström 1987).

Figure 1A shows the relative intensity of infestation by *A. striata* in *P. guajava* at different altitudes (8 strata). Results demonstrate that the most prevalent distribution for *A. striata* infestations occur between 500 to 1,500 m and the highest infestations occur at about 1,000 m.

Figure 1B shows the altitudinal distribution of *A. fraterculus* and *A. obliqua*. The results show that at low altitudes (0-1,200 m), *A. obliqua* was more prevalent than *A. fraterculus*, whereas at higher altitudes (1,201-2,000 m), *A. fraterculus* was more prevalent than *A. obliqua*. Similar results, which indicate that *A. obliqua* prefers lowland zones and *A. fraterculus* prefers higher elevation areas, have been found in other studies (Celedonio-Hurtado et al. 1995, Eskafi & Cunningham 1987, Hedström 1987).

C. capitata was reared only from seven fruit samples of *P. guajava* collected between 50-1650 m. The distribution of these fruit samples were four (Zulia state) at 0-250 m and one each from 250-500 m (Trujillo state), 1250-1500 m (Táchira state), and 1500-1750 m (Mérida state) elevation ranges. The altitudinal distribution and presence of this fruit fly was erratic and the infestation rate was very low (1.4 adults/Kg).

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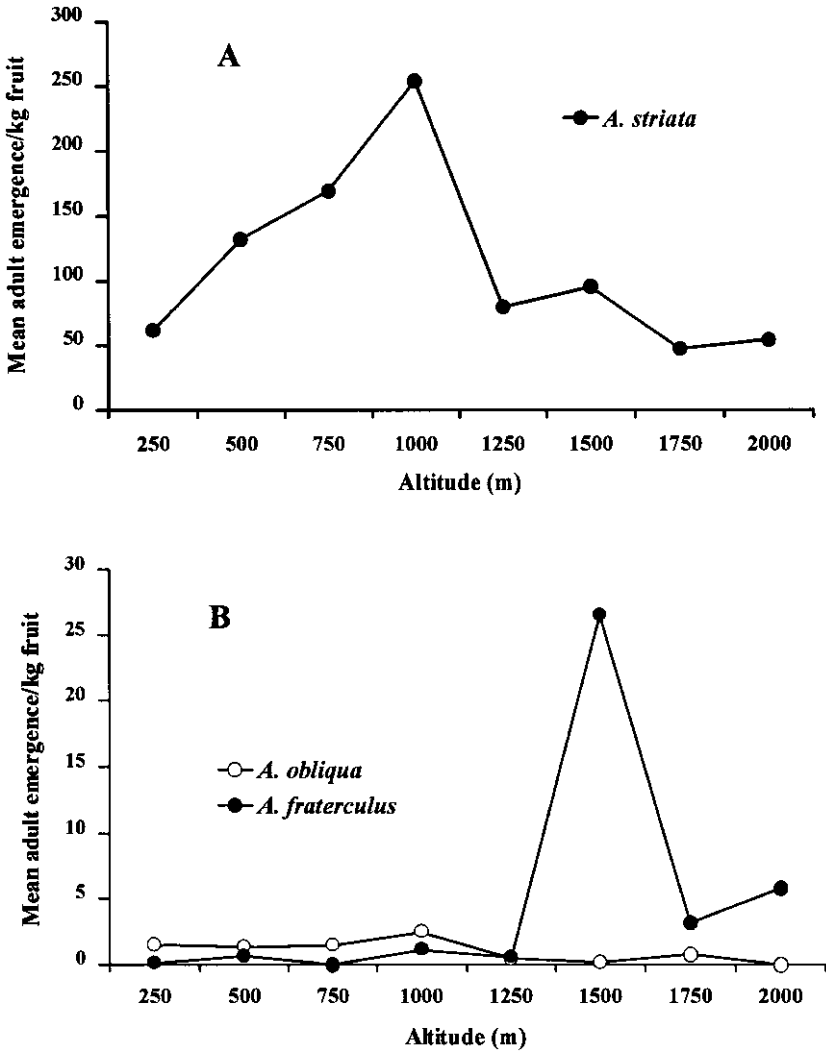


Fig. 1. Infestation of *Psidium guajava* by three tephritid species in western Venezuela, 1992-1995. (A) by *A. striata*. (B) by *A. obliqua* and *A. fraterculus*.

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