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HOST STATUS OF MAMEY SAPOTE, *POUTERIA SAPOTA* (SAPOTACEAE), TO THE WEST INDIAN FRUIT FLY, *ANASTREPHA OBLIQUA* (DIPTERA: TEPHRITIDAE) IN PUERTO RICO

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ABSTRACT

The authors evaluated the host status of mamey sapote, *Pouteria sapota* (Sapotaceae) to *Anastrepha obliqua* by collecting mature fruits and monitoring them for the emergence of larval Tephritidae. Fruits were also scarred and placed in cages with female *A. obliqua* and monitored for the emergence of larvae and adults. Multi-lure traps baited with putrescine and ammonium acetate were used to compare the number of flies in orchards of mamey sapote to the number of flies in nearby orchards of carambola (*Averrhoa carambola*: Oxalidaceae). There are a number of references citing mamey sapote as a host of *A. obliqua* in different countries. However, we only found two unidentified tephritid larva from 1,160 mamey sapote fruits collected in the field and these fly larvae did not survive to adulthood. We were not able to rear adult *A. obliqua* on scarred, mature fruit of mamey sapote, whereas we were able to do so on mango under identical conditions. Abundance in orchards based on trapping indicates that flies are very rarely encountered in orchards of mamey sapote compared with orchards of carambola. We conclude that in Puerto Rico mamey sapote has a very low (undetectable) rate of infestation by fruit flies in the family Tephritidae.

Key Words: Mamey sapote, *Pouteria sapota*, *Anastrepha*, hosts

RESUMEN

Se evaluó si el mamey sapote, *Pouteria sapota* (Sapotaceae) puede ser hospedero de la mosca de las frutas *Anastrepha obliqua*. Con este fin se colectaron frutas maduras las cuales fueron monitoreadas para detectar la presencia de larvas Tephritidae. Las frutas fueron también rasgadas y colocadas en jaulas conteniendo moscas hembras de *A. obliqua* e inspeccionadas regularmente para determinar si larvas y adultos emergían de las frutas. Trampas con cebo de putrescina y acetato de amonio fueron colocadas en los predios de mamey sapote y huertos cercanos de carambola (*Averrhoa carambola*: Oxalidaceae) para comparar la población de moscas de las frutas en estos huertos. Aunque varios escritos citan el mamey sapote como un hospedero de *A. obliqua*, los autores solo pudimos encontrar dos larvas en varios centenares de frutas y estas larvas no se desarrollaron a su estado adulto. Tampoco se pudo inducir oviposicion de moscas fruteras en frutas de mamey sapote con la superficie rasgada. Los datos obtenidos de las trampas indicaron una población insignificante de moscas de las frutas en huertos de mamey sapote en comparación con aquellos de carambola. Concluimos que en Puerto Rico el mamey sapote tiene un nivel de infestacion extremadamente bajo (indetectable) para las moscas de las frutas de la familia Tephritidae.

Translation provided by the authors.

Mamey sapote, *Pouteria sapota* (Jacq.) H.E. Moore & Stearn (Sapotaceae), is native to Central America (Morton 1987) and its fruits are prized throughout Central America and the Caribbean for their sweetness. It is currently cultivated and sold in Puerto Rico, but some growers would like to expand their market to include Latin American populations in the continental US. However, the possible introduction of new insect pests, including fruit flies in the genus *Anastrepha*, precludes importation of this fruit crop into the continental US. Gould & Hallman (2001) concluded that mamey sapote presents no discernible risk of transporting *Anastrepha suspensa* (Loew). However, a second species of economic importance, *A. obliqua* (Marquart), is present in Puerto Rico and the host-status of mamey sapote with respect to this fly is unclear. Cowley et al. (1992) defined a host as a fruit or vegetable that fruit flies oviposit in under field conditions and that these eggs subsequently develop into larvae, pupae and adults.

Anastrepha obliqua is not thought to occur in Florida (Steck 2001) so the importation of any fruit that may serve as a host for this tephritid poses a serious risk for agriculture in Florida and, potentially, elsewhere in the subtropical mainland. At least 13 reports indicate that the West Indian fruit fly, *A. obliqua*, does indeed use mamey sapote as a host (Emmart 1933; Stone 1942; Aczél 1950; Oakley 1950; Gonzalez Mendoza 1952;

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Blanchard 1961; Korytkowski & Ojeda Pena 1970; Weems 1970; Wasbauer 1972; Kandybina 1977; Norrbom & Kim 1988; White & Elson-Harris 1992; Fernández et al. 1998; Norrbom 2004). However, these reports are based on unreliable identifications of host and insect species (confusion remains about the plant or insect species names used in these reports), or are citations of unreliable literature.

Our objective was to estimate the likelihood of infestation of mamey sapote by *A. obliqua* by surveying the incidence of infestation in fruits collected from the field, assessing the incidence of infestation when *A. obliqua* females have no other host options, and by monitoring fruit fly populations in orchards of mamey sapote with baited traps. We used the principles outlined in Cowley et al. (1992) as guidelines for our investigation.

Materials and Methods

From Jun 2005 to Jun 2006 mature mamey sapote fruits of cultivars Magaña, Mayapan, Pantin (Key West), Tazumal, Pace, and Copan from orchards in Isabela and Corozal, PR, were scarred by removing approximately 20 cm^2 of skin from each fruit. Fruit were scarred in order to give access to the pulp, in case the fruit flies could only oviposit in damaged fruit. Mature fruits reveal a deep orange color when a thin layer of the coarse skin of the mamey sapote is removed. At this stage fruits are typically very hard and yield sticky latex when cut. Harvested mature fruits will ripen and soften over the next 3-6 days and no longer yield sticky latex. We decided to harvest fruit in this stage because that is the prevailing practice in PR: fruit left on the tree typically do not abscise until they have mummified, so we could not collect dropped fruit, as is often done with other species of fruits when surveying for fruit fly infestations. Different varieties of mameys were harvested as they were available.

The Isabela location is on the north coast on the west side of the island (18°28'18.97"N; 67°02'49.66"W) and is 15.24 meters above sea level. The mean rainfall for 2005 was 14.58 cm with a range per month of 0-21.59 cm. The mean rainfall for 2006 was 10.68 cm with a range per month of 0-23.42 cm. The mean temperatures for 2005 and 2006 were 24.58°C and 24.78°C, respectively. The Corozal location is on the north-central portion of the island (18°19'39.05" N; 66°21'38.04" W) and is 212.14 meters above sea level. The mean rainfall for 2005 was 20.6 cm with a range per month of 1.12-42.82 cm. The mean rainfall for 2006 was 13.69 cm with a range per month of 2.34-29.36 cm. The mean temperatures for 2005 and 2006 were 24.84°C and 25.29°C, respectively.

One week after scarring, all scarred fruits were harvested, weighed, and placed on a wire mesh over vermiculite. Harvested fruits were stored in a room at 25-27°C and approximately 60% RH (never less than 50% RH). The vermiculite was monitored weekly for the presence of fruit fly larvae or pupae. Any recovered larvae or pupae were collected and placed in a plastic Petridish with a small amount of moistened vermiculite and stored at 25°C and 85% RH in an environmental chamber (12:12 D:L) (White & Elson-Harris 1992). Petri-dishes containing pupae were monitored daily for the emergence of adults.

Between 1 and 4 mature mamey sapote fruits of each variety were scarred as described above and placed in collapsible mesh cages ($60 \times 60 \times 60$ cm) (Bioquip, Rancho Dominguez, CA) with 20 female and 20 male *Anastrepha obliqua* flies, 12 d post emergence. Fruit was exposed to flies for 48 h, removed and stored as described above to collect emerging larval tephrititids. Concomitantly, mature naturalized Mayaguezano variety mangoes that had been covered with brown paper bags when they were green (preventing infestation by fruit flies) were exposed to male and female *A. obliqua* under conditions identical to those described for the mamey sapote fruit. The exposure described was conducted for all 6 varieties of mamey and replicated 3 times for each variety. To ensure that the mangoes used in the cage-trials were not infested prior to the trials, mature mangoes that had been bagged were stored over vermiculite as described above and monitored for the emergence of larvae and pupae.

To demonstrate that fruit flies occurred at the experimental sites, 5 plastic multilure traps (A Better World, Inc.) baited with ammonium acetate and putrescine were placed in each mamey sapote orchard and monitored weekly. Five traps were also placed in nearby (120 m) carambola orchards (*Averrhoa carambola*: Oxalidaceae) and monitored weekly. All adult flies obtained from traps or from fruit were identified by the author (D.J.) and voucher specimens were deposited in the Entomological Laboratory of the Tropical Agriculture Research Station, Mayaguez, PR.

Results

A total of 1160 mamey sapote fruits weighing 777 kg were collected from orchards in Corozal and Isabela, PR (Table 1). Of the fruit collected, only 1 fruit of the Tazumal variety, harvested on 21 Nov 2005, yielded 2 larval tephritids and these did not become adults. None of the 15 mamey sapote fruits exposed to colonies of *A. obliqua* yielded larvae, while mango fruit similarly exposed yielded an average of 5.8 ± 0.7 (mean ± SE) larvae (Table 2). Control mangoes that had been bagged when green and not exposed to *A. obliqua* in cage-trials did not produce any larvae or pupae. The number of adult *Anastrepha obliqua* observed per trap per week in mamey sapote orchards was always 2 or less (Fig. 1). Traps in

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TABLE 1. COLLECTIONS OF MAMEY SAPOTE BY DATE AND VARIETY.

Variety	Dates collected	Number of fruit	Kg of fruit	Total fruit per variety	Total kg per variety
Magania	18-Aug-05	14	17.5	48	56.8
	23-Aug-05	12	15.0		
	13-Sep-05	22	24.3		
Mayapan	24-Jun-05	15	12.3	369	259.6
	15-Jul-05	15	11.6		
	16-Aug-05	15	13.6		
	13-Apr-06	242	155.5		
	5-Jun-06	82	66.6		
Tazumal	28-Jul-05	8	3.9	238	102.7
	30-Aug-05	2	1.5		
	6-Sep-05	2	0.9		
	18-Oct-05	80	29.5		
	21-Nov-05	146	66.9		
Pantin	16-Aug-05	5	4.2	97	83.7
	13-Sep-05	10	5.6		
	20-Sep-05	2	1.8		
	2-Jun-06	80	72.1		
Pace	24-Jun-05	15	10.2	156	103.6
	15-Jul-05	15	10.4		
	30-Aug-05	4	3.1		
	20-Sep-05	24	14.9		
	22-Feb-06	98	65.0		
Copan	3-Jun-05	6	3.4	252	170.2
	28-Jul-05	10	6.1		
	29-Sep-05	6	3.7		
	21-Nov-05	42	61.2		
	13-Dec-05	64	31.0		
	19-Jan-06	124	64.8		
Total		1160	776.6		

nearby carambola orchards indicated that adult *A. obliqua* were present and, at times, abundant (1 trap in Corozal had 103 flies in it one week) in the area being surveyed (Fig. 1). Traps in the carambola orchards also caught *A. suspensa* adults in numbers similar to those reported for *A. obliqua*, but these data will be published in a future manuscript.

TABLE 2. FLY PUPAE RECOVERED FROM FRUIT EXPOSED TO 20 MALE AND 20 FEMALE *ANASTREPHA OBLIQUA* (12 D POST EMERGENCE) FOR 48 H.

			Pupae recovered			
Date		Fruit/rep	Rep 1	Rep 2	Rep 3	Mean + SE
13-Apr-06	Mango	5	5	7	3	5.0 + 1.2
	Mayapan	2	0	0	0	0.0 + 0.0
3-May-06	Mango	5	8	2	4	4.7 + 1.8
	Tazumal	3	0	0	0	0.0 + 0.0
8-May-06	Mango	5	3	3	7	4.3 + 1.4
	Magania	1	0	0	0	0.0 + 0.0
15-May-06	Mango	5	13	5	8	8.7 + 2.4
	Pace	4	0	0	0	0.0 + 0.0
2-Jun-06	Mango	5	5	6	9	6.7 + 1.2
	Pantin	3	0	0	0	0.0 + 0.0
5-Jun-06	Mango	5	9	4	3	5.3 + 1.9
	Copan	2	0	0	0	0.0 + 0.0

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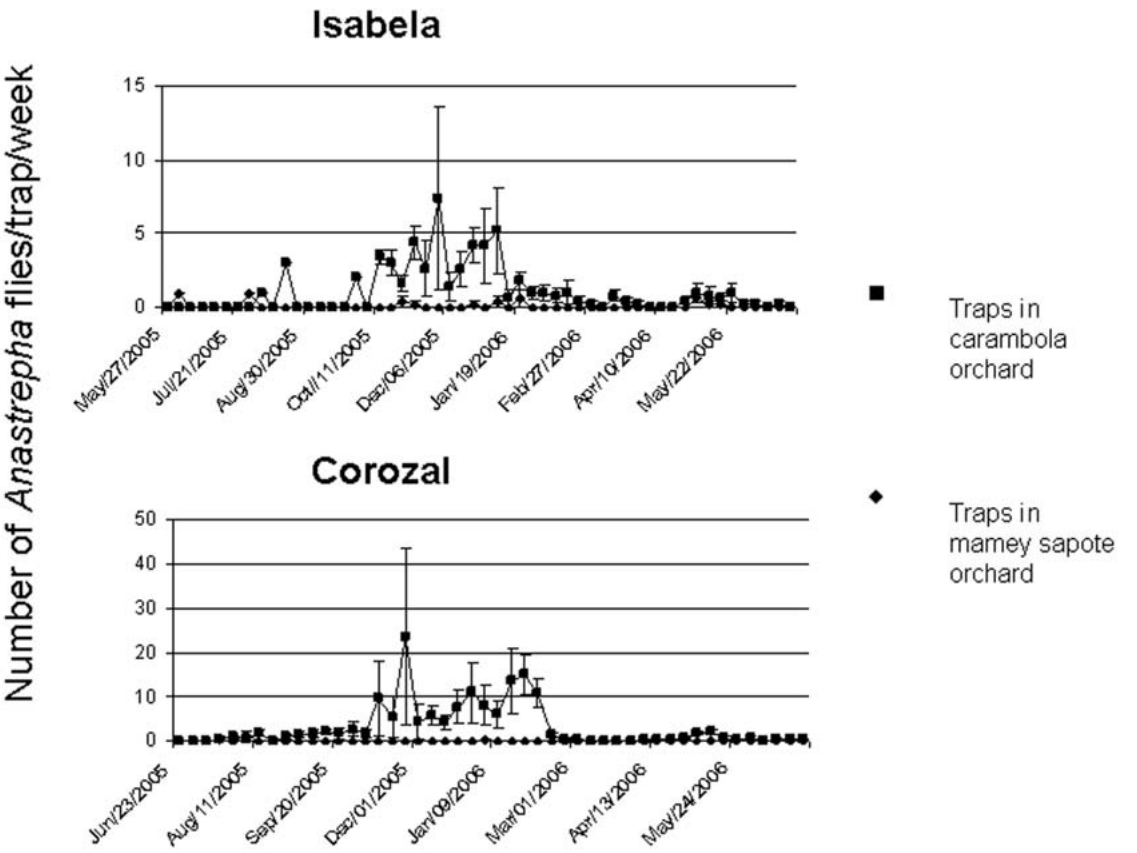


Fig. 1. Mean number of *Anastrepha obliqua* per trap per week (± SEM) in orchards of mamey sapote and carambola at Isabela and Corozal, Puerto Rico (n = 5 traps per orchard).

Discussion

Our data show that the likelihood of infestation of mamey sapote by *A. obliqua* is extremely small. Similar methods have been used to demonstrate the non-host status of litchi and longan (*Litchi chinensis* Sonn. and *Euphoria longana* (Lour.), respectively: Sapindaceae) and mamey sapote to *A. suspensa* (Gould et al. 1999; Gould & Hallman 2001). We collected more than 1000 mature mamey sapote fruits and reared only 2 larvae from these. These larvae did not survive to adulthood. Fruit exposed to fecund female fruit flies did not yield any larvae or pupae. This indicates that either *A. obliqua* females refuse to oviposit in mamey sapote fruit or that eggs put in mamey sapote are unlikely to develop.

We noted that the process of scarring mamey sapotes yields a sticky latex, in common with many sapotaceaous plants (Morton 1987). This latex persists for up to 24 h. After this time the scar is healed, resulting in a rough, corky tissue. We suspect that the latex and the corky tissue may preclude oviposition by *A. obliqua*. *Anastrepha serpentina* is known to oviposit in sapotaceous hosts that release sticky latex upon being punctured and presumably have adapted their oviposition behavior to deal with this defense system (Aluja et al. 2000). *Anastrepha obliqua* often infest mangoes and other anacardiaceous fruits (White & Elson-Harris 1992) that exude sticky polyphenolic resins (Morton 1987; Zomlefer 1994). Females may oviposit when the fruit is ripe and the resin levels in the peel are reduced. There is also reason to believe that mango cultivars vary in their susceptibility to *A. obliqua* and that the level of infestation is correlated with the density of resin canals in the fruit peel (Alex Segarra, unpubl.).

Mamey sapote has the potential to become an important tropical fruit crop in Southern Florida and Puerto Rico. We have compiled evidence that mamey sapote is an extremely unlikely host of *A. obliqua* in Puerto Rico and that the threat of transporting larval fruit flies of this species in fruit of mamey sapote is not likely.

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