

A comparison of sexual competitiveness and demographic traits of *Anastrepha obliqua* (Macquart) (Diptera: Tephritidae) among fruit-associated populations

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Abstract

The control of *Anastrepha obliqua* includes the sterilization of mass-reared insects grown in isolation in a constantly controlled environment. Through time, laboratory mass-reared colonies may produce flies with lower field performance. To recover the genetic variation and aptitude of mass-reared populations, wild insects are introduced into mass-reared colonies. Our aim in this study was to determine whether the host species from two localities influence the life history traits of *A. obliqua*. We collected flies as larvae from infested fruits of *Spondias purpurea*, *S. mombin*, *Mangifera indica* cv. 'piña', and *M. indica* cv. 'coche' from two localities in Chiapas, Mexico. There were significant differences in the mating competitiveness of males collected from mango cv. 'coche' compared with mass-reared males. There were no differences in the mating propensity between flies from the two localities, even in the number of matings, when weight was considered as a covariable. The mass-reared strain showed the earliest age at first oviposition. The locality affected the longevity and oviposition period, and these influenced the birth rate, intrinsic rate of increase, finite rate of population increase, mean generation time, and doubling time. According to the demographic parameters, the population of *S. mombin* would allow artificial colonization in less time, considering that it has a high reproduction rate starting at an early age. Even in the propensity test, it had the highest number of matings. However, males with greater sexual competitiveness and longevity for colonization corresponded to those collected from *S. purpurea*.

Keywords: *Mangifera indica*, *Spondias purpurea*, *Spondias mombin*, mating competitiveness, mating propensity, demographic parameters

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Introduction

The West Indian fruit fly, *Anastrepha obliqua* (Macquart) occurs throughout México, Central America, the Caribbean, and South America down to Southern Brazil. It is the major pest of mangoes (*Mangifera indica* L.) (Sapindales: Anacardiaceae) and

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plum fruits (*Spondias purpurea* L.) (Sapindales: Anacardiaceae) (Aluja *et al.*, 1987a, b; Aluja *et al.*, 1996). In Mexico, the control strategies available against *A. obliqua* include the Sterile Insect Technique (SIT), employed since 2001 (Artiaga-López *et al.*, 2004; Orozco *et al.*, 2004). A fruit fly mass-rearing colony for SIT application requires the collection of large numbers of wild insects obtained as larvae from infested fruits, which are then allowed to pupate. The emerging adults are then placed in an artificial environment that differs from their natural conditions (Moore *et al.*, 1985; Ochieng-Odero, 1994). This can result in the evolution of reproductive barriers between the mass-reared and wild populations (Rössler, 1975; Meza-Hernández *et al.*, 2004; Rull *et al.*, 2005). To avoid this and to improve the sexual competitiveness of mass-reared sterile flies, the colonies are renovated periodically. This can be done by replacing the old colony with wild flies, (Rössler, 1975), by outcrossing wild males with laboratory-adapted females (Shelly, 2001; Rull & Barreda-Landa, 2007; Gilchrist & Meats, 2014) and by selection (Quintero-Fong *et al.*, 2016; Sanchez-Rosario *et al.*, 2017).

In phytophagous insects, the host fruit can be an environmental factor that promotes genetically differentiated populations, and eventually, host-race formation. Singh & Cunningham (1981) and Helden *et al.* (1994) discussed that aphids often show variations in biological and ecological attributes of their populations as a result of heterogeneous environments and host plants. Some species of fruit flies have shown a high plasticity in life history traits in response to different environments, including the host, explaining in part the wide geographical distribution and host range of some species (Mkiga & Mwatawala, 2015; Hafsi *et al.*, 2016). In *A. obliqua*, it has been observed that females may prefer a host plant species for oviposition when they have a choice, but if they only have one option, they oviposit in a less preferred host (Aluja & Birke, 1993). Toledo & Lara (1996) found differences in the survival and reproduction between populations of *A. obliqua* collected from naturally infested *M. indica* and *Spondias mombin*. Thus, it can be expected that differentiated populations of *A. obliqua* can be found in different host species. If this is true, the refreshment or enrichment of mass-reared colonies should consider the extent of variation related to host fruits and localities in order to collect samples from one or several host-related populations with the traits better adapted for SIT purposes (Hernández *et al.*, 2009). Our goal in this study was to examine whether life history traits, by this meaning mating propensity and mating competitiveness, larval and adult weight, and demographic parameters of *A. obliqua*, are variable according to the host plant species.

Materials and methods

Insects

Infested fruits of *S. purpurea* (L.), *S. mombin* L., *M. indica* L. cv. 'piña', and *M. indica* cv. 'coche' were collected at two localities of Chiapas México. In Frontera Comalapa, (15°39' 29.95"N, 92°8'34.15"W), one fruit of purple mombin (*S. purpurea* (L.)) was collected and another fruit from mango piña (*M. indica* L. cv. 'piña') was also collected. In Huehuetan (15° 39' 29.95"N, 92°8' 34.15"W), one fruit from mombin (*S. mombin* L.) was taken and another from mango coche (*M. indica* cv. 'coche') was harvested. The collected fruits were placed in plastic trays (55 × 45 × 12 cm) and kept for 6 days in laboratory conditions (26 ± 1°C, 75 ± 5% R.H., and a photoperiod of 12:12

h L:D) until the larvae reached third instar. The fruits were then opened, and the larvae were extracted and were placed in plastic containers (10 cm wide × 12 cm high × 20 cm long) with coconut fiber (50% dust–50% short fiber: CF) (Coirtech, Colima, Mexico) to promote the pupariation (Aceituno-Medina *et al.*, 2017).

Each wild host-associated population per locality was considered as a treatment in the statistical analyses. A fifth treatment was a random sample of 1000 larvae taken from the Moscafrut mass-rearing facility (SAGARPA-IICA) located in Metapa de Domínguez, Chiapas, Mexico. This colony was initiated with flies from a laboratory colony at the Subtropical Agricultural Research Laboratory (ARS-USDA), in Weslaco, TX, USA. This strain was started with wild flies collected from *S. mombin* fruits in Veracruz, Mexico (Moreno *et al.*, 1997). The mass-rearing population was reared on an artificial diet (Artiaga-López *et al.*, 2004) for at least 113 generations with enrichment introductions of wild material in 2002 and 2011 (Orozco-Dávila *et al.*, 2014, 2017).

Mating competitiveness and propensity

The sexual competitiveness was defined as the number of matings of mass-reared males and wild males from the different fruit host with wild females in field cage conditions. The sexual mating propensity measures the mating index, defined as how 'eager' the males and females from the same population are to mate (Calkins & Parker, 2005). Accordingly, mating propensity in this work was determined using females and males from the same fruit host in field cages.

Males and females were released into field cages with open smaller cages (24.5 × 13 × 12 cm) containing flies held according to each host-related and mass-reared population. All the mating observations were done in field cages (3 m in diameter × 2 m in height) covered with amber mesh (ten threads per linear cm). An orange tree (*Citrus sinensis* L. Osbeck) (Sapindales: Rutaceae), approximately 2 m in height was centrally placed to provide environmental conditions close to field conditions. The mating propensity test was carried out in five independent field cages: (1) 30 *S. mombin* males + 30 *S. mombin* wild females, (2) 30 *S. purpurea* males + 30 *S. purpurea* wild females, (3) 30 mango cv. 'piña' males + 30 mango cv. 'piña' wild females, (4) 30 mango cv. 'coche' males + 30 mango cv. 'coche' wild females, and (5) 30 mass-reared males + 30 wild females (control). The mating competitiveness test was carried out in four independent field cages: (1) 30 *S. mombin* males + 30 mass-reared males + 30 *S. mombin* wild females, (2) 30 *S. purpurea* males + 30 mass-reared males + 30 *S. purpurea* wild females, (3) 30 mango cv. 'piña' males + 30 mass-reared males + 30 mango cv. 'piña' wild females, and (4) 30 mango cv. 'coche' males + 30 mass-reared males + 30 mango cv. 'coche' wild females. We ensured that all treatments were performed in all cages. The males were released at 6:00 h, and 15 min later (6:15 h), the females of the same treatment were released. When a mating was formed, it was collected with an entomological vial. We did 14 trials for *S. mombin*, eight for *S. purpurea*, eight for mango piña, eight for mango coche, and 14 for the mass-reared strain. The number of replicates depended on the level of infestation of the host fruit.

Observations and captures of mating pairs were conducted from 6:00 to 12:00 h, which is the time of major activity for *A. obliqua* (Aluja & Birke, 1993). To synchronize sexual maturity, wild flies were 16 days old and mass-reared flies were 11 days old (Meza-Hernández *et al.*, 2004). Males and females that had

mated were chilled for 10 min at 4°C and weighed using an analytical balance (Sartorius TE214S 201 g × 0.1 mg, Sartorius AG, Goettingen, Germany).

Demographic parameters

To estimate the survival of immature stages, we used 36 experimental units (EU) per population or treatment. Each EU consisted of ten eggs that were artificially inoculated in fruit or placed on an artificial diet and kept at 27°C and 70% R.H. Every day for 12 days, the EU were observed to record the proportion of eggs, first, second, and third larval instars. After 12 days, a daily sample of three fruits per treatment was dissected to determine the number of eggs and larvae at first, second, and third instar stages. The identification of each instar was made according to Elson-Harris (1988) as follows: first instar has a brown mouth hook, the second instar has a brown color in the apical part and black in the posterior part of the hook, and the third instar has a completely black hook.

The adult survival and fecundity was determined using cohorts of ten pairs of each treatment that were placed in 27 dm³ glass cages. Four replicates were done for each treatment (40 couples in total for each population). Adults were fed *ad libitum* with a mixture of sucrose and enzymatic yeast hydrolysate (3:1) (MP Biomedicals, Santa Ana, CA, USA) (Message & Zucoloto, 1989). Water was provided in a 500 ml plastic container with a strip of filter paper. Flies were kept at 26 ± 1°C, 75% R.H., and a 14:10 (L:D) h photoperiod. White 75 W fluorescent tubes placed 60 cm above the cages provided light, and the light intensity was ~3500 lux inside the cages. Dead flies by sex were recorded daily.

An oviposition and egg-collecting device was placed 1 day after the first mating was observed, usually when flies were 6 days old, and was replaced every 24 h. The oviposition devices were 4 cm diameter spheres made of furcellaran (Boller, 1968). These were made by dissolving 22.7 g of furcellaran (Burtonite 44C powder, Tic Gums Inc. Belcamp, MD, USA) in 1 liter of boiling water. Then, 1.6 ml of green food coloring (McCormick, Mexico, S.A. de C.V.) and 5.6 g of guava flavor powder (Frisco, Kraft Foods de Mexico, S.A. de C.V.) were added. The mixture was poured into spherical plastic templates (4 cm diameter), and the solidified spheres were wrapped with Parafilm membrane (American National Can™, Neenah, WI, USA). Every day for 130 days, a single oviposition device was hung from the top of each cage. After removal, the spheres were unwrapped, cut into thin slices, and dissolved in water (25–27°C) with a bubbling system (aquarium air pump, airflow of 3 liters min⁻¹, 4.5 p.s.i., 110 V, 50/60 Hz). The water was decanted, and the eggs from each daily collection were counted. Then, they were placed over pieces of black cloth placed over a moist sponge in a Petri dish (150 by 25 mm). The eggs were incubated for 5 days at 28 ± 1°C, and egg hatching was estimated by counting the number of unhatched eggs and neonate larvae under a stereomicroscope. Daily records of mortality and fecundity were used to construct life tables and determine demographic parameters.

Data analysis

Data of male weight (mg), female longevity (days), age at first oviposition (days), oviposition period (days), postoviposition period (days), and demographic parameters were estimated for each treatment in each cohort. We use analysis of

covariance to determine the effect of host fruit (fixed factor) on mating competitiveness and propensity, and the weight of the males was used as a covariable. We assumed that mango varieties and plant species provide different environments for *A. obliqua*; therefore, we declared five populations or treatments for the analyses of variance on the demographic parameters. After the means were compared using the Tukey's HSD test, additional demographic parameters were analyzed by orthogonal contrast grouping by host and locality, excluding the mass-reared group. Data on female longevity, age at first oviposition, oviposition period, and post-oviposition period were adjusted to normality and homoscedasticity by log-transformation. Analyses were carried out with the statistical program JMP version 5.0.1. Statistical Discovery Software (SAS Institute, 2003) and R Statistical Software (R Development Core Team, 2014).

Population demographic parameters were estimated from the daily proportion of surviving flies at age x (l_x), and daily female offspring per female (m_x), following methods described by Birch (1948), Hamilton (1966), and Carey (1993).

Results

Mating competitiveness and propensity

There were no significant differences in the average number of matings during the mating propensity test between wild males from mango cv. piña, mango cv. coche, *S. mombin*, *S. purpurea*, and mass-reared males ($F = 0.95$; $df = 4, 47$; $P = 0.4440$). The same trend was observed when the data were grouped by host and locality, and when male weight was considered as a covariable ($F = 0.11$; $df = 1, 23$; $P = 0.738$) (fig. 1).

In the data for the average number of matings in the competitiveness test, the pairwise comparisons only show significant differences between males from mango cv. 'coche' vs. mass-reared males ($t = 2.31$; $df = 1, 20$; $P = 0.0317$), although in all cases, the largest number of matings corresponded to the wild males (fig. 2).

Demographic parameters

Females collected from *S. purpurea* showed the longest longevity, whereas females from the mass-reared strain showed the shortest ($F = 8.90$; $df = 4, 135$; $P < 0.0001$). Age at first oviposition was shorter for mass-reared females than for wild females recovered from fruits ($F = 34.63$; $df = 4, 135$; $P < 0.0001$). The longest oviposition period was observed in females from *S. purpurea*, compared with females from mango fruits and the mass-reared group ($F = 3.57$; $df = 4, 135$; $P = 0.009$). Post-oviposition period was shortest for mass-reared females ($F = 4.69$; $df = 4, 135$; $P = 0.0014$) (table 1) compared with wild females.

Orthogonal contrasts indicate that significant differences could be attributed to host fruit (including the mass-reared strain as a fifth level) only in the age at first oviposition. The locality significantly affected the longevity, oviposition period, birth rate, intrinsic rate of increase, finite rate of population increase, mean generation time, and doubling time (tables 2 and 3).

Survival curves were similar for immature stages across treatments, and small differences were observed in female adults (fig. 3). The mass-reared females showed a survival rate less than other treatments after they are 60 days old. The

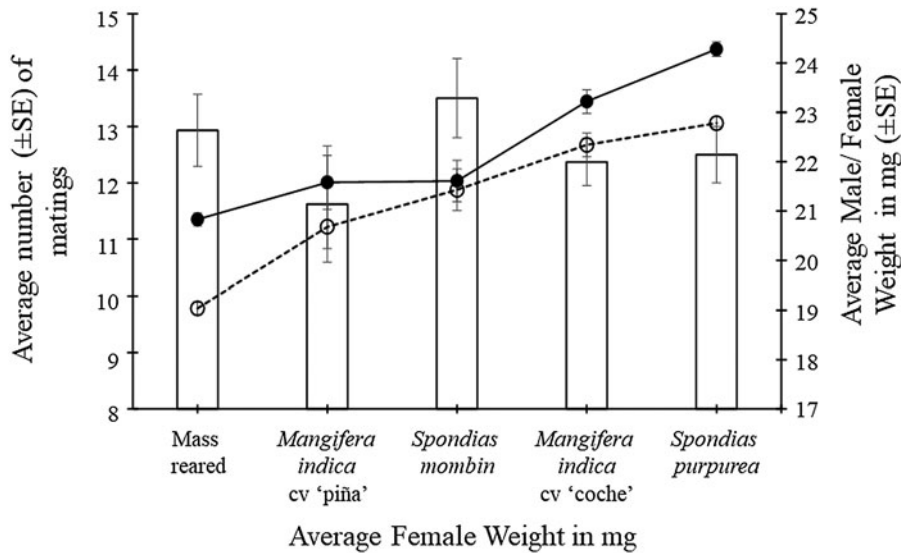


Fig. 1. Matings and weight by host associated population (barrs), for male (---) and female (—) during the propensity mating test host-related population fruit of *Anastrepha obliqua* and mass reared strain.

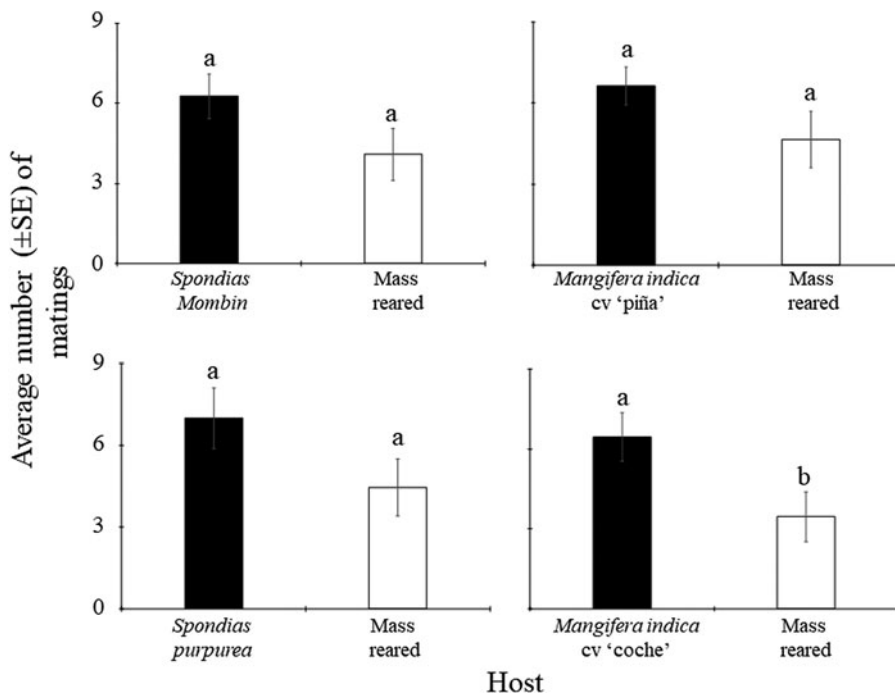


Fig. 2. Matings during the mating propensity test of *Anastrepha obliqua* from two host fruits in two different regions and a mass reared strain. [■] Wild male. [□] Mass reared male.

flies from *S. purpurea* showed a sudden decrease in survival between 30 and 60 days old, then this trend leveled off compared with other host fruits. The second longest lifespan was observed in females from this host (fig. 3).

The mass-reared females started and finished oviposition of eggs earlier than females collected from wild fruits (fig. 4).

Gross fecundity and the net reproductive rate (R_0) did not show significant differences across host-related populations

($F = 1.87$; $df = 4, 15$; $P = 0.168$). The mass-reared strain showed the highest birth rate ($F = 7.36$; $df = 4, 15$; $P = 0.002$) and the highest intrinsic rate of increase (r_m) ($F = 8.65$; $df = 4, 15$; $P = 0.001$). This resulted in the greatest finite rate of population increase (λ) ($F = 8.72$; $df = 4, 15$; $P = 0.001$) and the shortest mean generation ($F = 8.65$; $df = 4, 15$; $P = 0.004$) and doubling times ($F = 6.48$; $df = 4, 15$; $P = 0.0031$). Death rates were not significantly different between groups ($F = 2.02$; $df = 1, 15$; $P = 0.142$) (table 3).

Table 1. Mean (SE) longevity, age at first oviposition, oviposition, and post-oviposition period of *Anastrepha obliqua* females emerging from two different fruit host species collected in two localities and from a mass-rearing colony.

Host fruit × Locality	<i>n</i>	Longevity	Age at first oviposition	Oviposition period	Post-oviposition period
<i>Spondia purpurea</i> – Frontera Comalapa	22	91.27 ± 4.67a	42.90 ± 0.44c	35.91 ± 5.35a	12.63 ± 2.97a
<i>Mangifera indica</i> cv. – ‘piña’ – Frontera Comalapa	30	86.30 ± 3.74ab	49.50 ± 1.04a	27.07 ± 3.37ab	9.73 ± 2.12ab
<i>Spondia mombin</i> – Huehuetan	31	76.71 ± 2.56bc	44.16 ± 0.43bc	22.32 ± 2.30b	10.23 ± 1.78a
<i>Mangifera indica</i> cv. ‘coche’ – Huehuetan	29	80.79 ± 2.01ab	46.93 ± 1.04ab	20.34 ± 1.37b	13.52 ± 1.61a
Mass-reared colony	28	66.89 ± 2.02c	37.89 ± 0.28d	25.96 ± 2.44ab	3.04 ± 0.66b

Lower case letters that differ within columns indicate a significant difference between the means of the five populations.

Table 2. Analysis by orthogonal contrast of the effect of the host fruit species and locality on the demographic traits of *Anastrepha obliqua*.

Demographic parameters	Host fruit			Locality		
	<i>F</i>	df	<i>P</i>	<i>F</i>	df	<i>P</i>
Longevity	0.0212	1, 135	0.8846	10.7700	1, 135	0.0013
Age at first oviposition	37.8754	1, 135	0.0001	0.7494	1, 135	0.3882
Oviposition period	3.1926	1, 135	0.0762	11.2467	1, 135	0.0010
Post-oviposition period	0.0104	1, 135	0.9187	0.1305	1, 135	0.7185
Gross fecundity (eggs/female)	2.3253	1, 15	0.1481	0.6457	1, 15	0.4342
Net fecundity (R_0) (female eggs/female)	0.2006	1, 15	0.6606	0.2061	1, 15	0.6563
Intrinsic rate of increase (r_m) (1/days)	0.6764	1, 15	0.4237	11.0709	1, 15	0.0036
Finite rate of population increases (λ)	0.6572	1, 15	0.4302	11.8826	1, 15	0.0036
Birth rate (b)	0.1442	1, 15	0.7094	16.7254	1, 15	0.0037
Death rate (d)	0.8469	1, 15	0.3804	0.1369	1, 15	0.7165
Mean generation time (T) (days)	0.0233	1, 15	0.8807	14.2105	1, 15	0.0018
Doubling time (DT) (days)	0.0042	1, 15	0.9494	14.7758	1, 15	0.0016

Table 3. Means + SE of demographic parameters of *Anastrepha obliqua* females emerging from two different host fruit species collected in two localities and from a mass-reared colony. Four cohorts of ten couples each one.

Demographic parameters	Origin of evaluated adults (host fruit × locality)				
	Mass-reared	<i>Spondias purpurea</i> – Comalapa	<i>Mangifera indica</i> cv. ‘piña’ – Comalapa	<i>Spondias mombin</i> – Huehuetan	<i>Mangifera indica</i> cv. ‘coche’ – Huehuetan
Gross fecundity (eggs/female)	567.16 ± 128.51a	584.42 ± 134.14a	308.92 ± 42.66a	375.2 ± 34.47a	370.46 ± 69.04a
Net fecundity (R_0) (female eggs/female)	307.97 ± 66.86a	249.45 ± 102.79a	196.22 ± 38.11a	251.22 ± 30.15a	249.85 ± 34.83a
Intrinsic rate of increase (r_m) (1/days)	0.1207 ± 0.0033a	0.0961 ± 0.0038b	0.0898 ± 0.0058b	0.1070 ± 0.0028ab	0.1065 ± 0.0045ab
Finite rate of population increases (λ)	1.1283 ± 0.0037a	1.1008 ± 0.0042b	1.0941 ± 0.0063b	1.1129 ± 0.0015ab	1.1125 ± 0.0050ab
Birth rate (b)	0.1167 ± 0.0026ab	0.0978 ± 0.0031c	0.0898 ± 0.0036b	0.1043 ± 0.0016bc	0.1095 ± 0.0064a
Death rate (d)	−0.0040 ± 0.0007a	0.0018 ± 0.0008a	−0.0003 ± 0.0022a	−0.0026 ± 0.0023a	0.0029 ± 0.0032a
Mean generation time (T) (days)	51.61 ± 1.75b	63.49 ± 1.85a	62.70 ± 3.78a	55.14 ± 0.87ab	55.29 ± 0.58ab
Doubling time (DT) (days)	6.3202 ± 0.1204b	8.3546 ± 0.5000a	8.3581 ± 0.5857a	6.9503 ± 0.0704ab	6.9932 ± 0.1904ab

Lower case letters that differ within rows indicate a significant difference between the means of the five populations.

Discussion

The host fruit and locality affected the sexual competitiveness, propensity, larval and adult weights, and the demographic parameters of *A. obliqua*. According to the demographic parameters, the population of *S. mombin* showed

the highest reproduction rate starting at an early age. Even in the propensity test, it had the highest number of matings. However, males with greater sexual competitiveness and longevity corresponded to those collected from *S. purpurea*.

We found significant differences in the competitiveness between mango cv. coche vs. mass-reared only, but, in all other

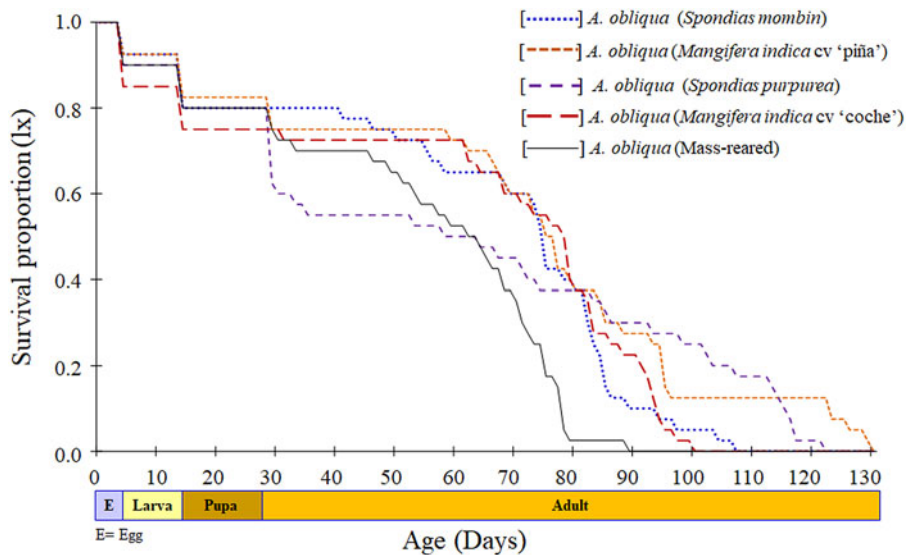


Fig. 3. Survival of *Anastrepha obliqua* females collected from two host fruits, from two localities, and a mass-reared strain.

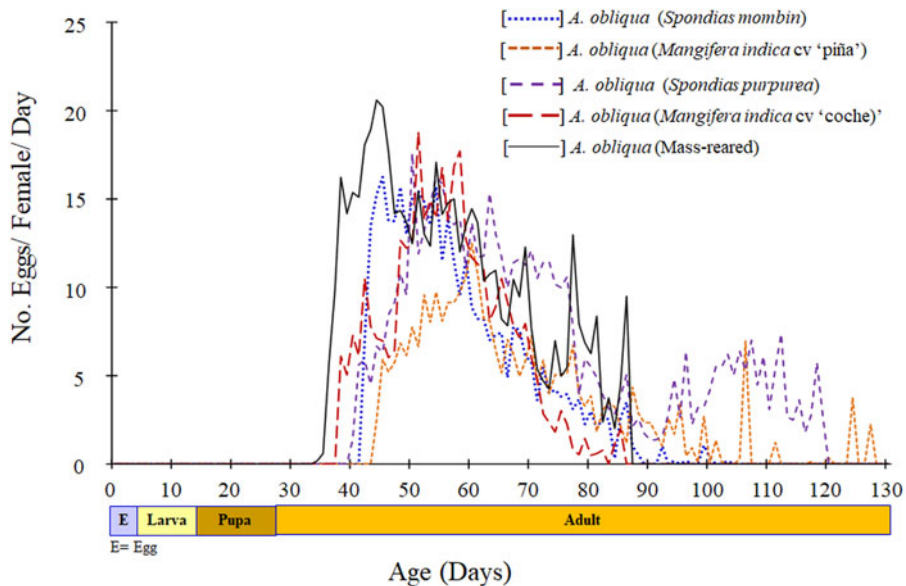


Fig. 4. Fecundity of *Anastrepha obliqua* females collected from two host fruits, from two localities, and a mass-reared strain.

comparisons, the wild males were selected at least twice as often as mass-reared males by the wild females. Although the mating propensity test indicated that there are no significant differences in the mating behavior of flies between host fruits or locality, the sexual mating propensity indicated that 43% of the mass-reared males mated while the competitiveness test indicated that only 10% of the mass-reared males mated. The sexual mating propensity is a qualitative measure, indicating that 30.40% of the males and females collected from the different fruit hosts mated under field cage conditions. These results suggest that mass-reared males had a low level of competence for mating, which could be a result of the artificial methods used to maximize mass production, compromising their sexual competence. Research with other tephritid

fruit fly species has shown some degree of reproductive isolation between mass-reared and wild flies (McInnis *et al.*, 1996; Miyatake & Shimizu, 1999). However, the factors and traits of reproductive isolation selection are not yet known. A periodic renewal of mass-reared colonies is highly recommended, but it is necessary to first check for mating compatibility and competitiveness of the introduced strain with the target populations, as was done for *A. ludens* in Orozco-Dávila *et al.* (2007).

Our data indicated that the weight of males did not modify the host fruit effect on the competitiveness of *A. obliqua*. Weight has been frequently suggested as an indicator of vigor or fitness for fruit flies (Liedo *et al.*, 2007), but studies show different results. Our findings are in accordance with *Rhagoletis cerasi* (L.) (Diptera: Tephritidae) (Jaastad, 1998).

Heavier males of *Ceratitis capitata* Wiedemann (Diptera: Tephritidae) and *Anastrepha suspensa* Wiedemann (Diptera: Tephritidae) display greater sexual calling activity as well as greater efficiency in marking and defending territory when forming leks, indicating that male weight is a key factor selected by females (Burk & Webb, 1983; Churchill-Stanland *et al.*, 1986).

Generally, there were differences in the demographic parameters between the mass-reared strain and strains from other host fruits. Carey (1984) and Krainacker *et al.* (1987, 1989) found that host species affected the demographic parameters of *C. capitata*, even in varieties where there can be differences. According to Papadopoulos & Katsoyannos (2004), *C. capitata* showed differences in the duration of the larval stage, mortality rate, pupal period, longevity, and fecundity when they were developed in three different varieties of apples (*Malus domestica* Borkh) (Rosales: Rosaceae), namely, Golden Delicious, Granny Smith, and Red Delicious. Sugayama *et al.* (1998) reported the same findings for *A. fraterculus*, concluding that flies developed in guava fruits (*Psidium guajava* L.) (Myrtales: Myrtaceae) had higher survival and reproduction rates than apple cultivars Golden Delicious, Gala, and Fuji. In turn, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) showed a higher pupal recovery rate with guava fruit than with banana (*Musa paradisiaca* L.) (Zingiberales: Musaceae) (Rauf *et al.*, 2013). In the case of *A. obliqua*, Celedonio-Hurtado *et al.* (1988) found differences in the immature developmental time and survival when flies were reared on *M. indica*, *S. mombin*, and artificial diets. Thus, the host fruit affects demographic parameters, but probably the extent of this depends on experimental micro-environmental factors that cannot be identified in all treatments.

Despite the effect of the host on the population parameters of fruit fly species, the ability to exploit different host species seems to be the most important adaptation trait for survival and reproduction in wild condition. Some of the most economically important tephritid pests have the ability to infest large numbers of hosts (Aluja & Mangan, 2008). Although *A. obliqua* is restricted to plant species of the Anacardiaceae family, it still can be considered an oligophagous species that has the ability to switch hosts. This ability probably compensates for the loss in fitness attributed to one particular host.

The shorter time to initiate reproduction in the mass-reared strain is consistent with the previous reports for *A. obliqua* and other mass-reared tephritid species (Carey & Vargas, 1985; Foote & Carey, 1987; Vargas & Carey, 1989; Miyatake & Yamagishi, 1992; Miyatake, 1998; Hernández *et al.*, 2009). This shorter time can be explained by the selection of early reproducing individuals during colonization. Sexual maturation in wild females is delayed while longevity increased. This could mean a trade-off between reproduction and longevity exists, because females from mass-rearing showed the shortest lifespan and the earliest age at first oviposition as a result of their high developmental rate to sexual maturation. Fast development is a highly desirable trait for mass-rearing. It results in greater population growth rates and, therefore, more efficient rearing (Liedo & Carey, 1994). The differences in the parameters of populations, such as the finite rate of population increase, the generation, and doubling times, can be attributed to this characteristic of mass-reared strains.

Our results showed non-significant difference between host fruits, but Aluja & Birke (1993) reported that females of *A. obliqua* preferred mombin fruits over mango fruits for ovipositing when both were available. When only mangos were

available, they oviposited in them, indicating that *A. obliqua* could identify a mombin as a host that provides more nutritional advantages, and this choice affects the life history traits of the males and females of the emerged flies and their fitness (Kaspi *et al.*, 2002; Passos-Roriz & Joachim-Bravo, 2013; Hafsi *et al.*, 2016). In this sense, our results indicate that for the Malthusian intrinsic rate of population increase, r_m , and most of the demographic parameters, which relate reproduction and survival rates, a population from *S. mombin* would allow artificial colonization in less time, considering that it has a high reproduction rate at an early age. Even in the propensity test, it had the highest number of matings. However, males with greater sexual competitiveness and longevity for colonization corresponded to those collected from *S. purpurea*. In mass-reared males, the artificial food compared with a fruit host could be providing some additional nutritional advantage, but with the consequence of diminished competitiveness. According to Boggs & Freeman (2005), increasing allocation and bioavailability of larval food resources improves age-specific survival and reproduction as result of the efficient digestion and assimilation of nutrients that, once absorbed, exert a positive effect on growth and life history traits (Carbonell-Capella *et al.*, 2014). This could explain the differences in survival and reproduction of *A. obliqua* developed in the different host fruits compared with flies developed in artificial food under mass-rearing conditions.

According to the demographic parameters, the population of *S. mombin* would allow artificial colonization in less time, considering that it has a high reproduction rate starting at an early age. However, males with greater sexual competitiveness and longevity for colonization corresponded to those collected from *S. purpurea*. Although a better and safer approach would be to start with a genetically diverse colony, it is recommended to cross individuals of *S. mombin* and *S. purpurea* populations, and the resulting hybrid could be used to establish a colony for mass breeding.

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