

## Capture of *Anastrepha sororcula* (Diptera: Tephritidae) in McPhail and Jackson Traps with Food Attractant and Virgin Adults

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### ABSTRACT

*This study evaluated the capture of A. sororcula in the traps baited with the conspecific virgin adults and food attractant in two orchards. The first was the Orchard of the Universidade Federal da Grande Dourados (OUFGD) and the second, the Orchard of the Sindicato Rural de Dourados (OSRD). The capture of A. sororcula in McPhail and Jackson traps was carried out using the corn hydrolysed protein (CHP), control (no flies), virgin males (5, 10 and 15), five virgin females and five virgin couples. The average number of the flies caught in the traps with the corn hydrolysed protein was significantly higher than all the other treatments. There was no significant capture of A. sororcula females in the traps baited with the conspecific virgin males, females or the couples.*

**Key words:** Sexual attraction, Fruit fly, Guava orchard

### INTRODUCTION

Studies about the fruit flies are mandatory in all the countries in which the fruit production is commercially explored since these insects are the key pests in the fruit plantations. In the global terms, it is estimated that the direct and indirect losses caused by the fruit flies exceed the amount of two billion dollars/year. The tephritids are the most serious problem in the horticulture worldwide and the main factor that prevents natural fruits from being commercialized all over the world (R. A. Zucchi, pers. comm.).

In Brazil, the losses in fruit production due to the high control costs of the fruit flies and the loss of the export market vary between 120 and 200 million dollars annually. There is practically no country with a minimally organized agriculture which has no legislation about quarantine barriers to fruit flies (R. A. Zucchi, pers.comm.). Among the fruits cultivated for the commercial purposes, the economic importance of the guava (*Psidium guajava* L., 1753) has increased since it is used on natural and also in the processing industries in diverse forms (Gonzaga-Neto, 2001; Cboudbury, 2001; Matias et al., 2005).

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The fruit flies are one of the most serious pests in guava plantations. *Anastrepha sororcula* Zucchi (1979), *A. fraterculus* (Wiedemann, 1830) and *A. zenilidae* Zucchi (1979) are the main species associated with this fruit species (Barbosa, 2001); *A. sororcula* is predominant in the state of Mato Grosso do Sul, Brazil (Uchôa-Fernandes et al., 2003). Although the guava is economically important due to its high aggregate values (1.5 to 2 dollars/kg) in the local market, there is little research done related to the fruit fly population management. The chemical control has shown to be a routinely used method (Barbosa, 2001). However, since the fruit fly larvae develop inside the fruits, the chemical pesticide effects are significantly diminished.

The use of the pheromones has been highlighted as an important tool for the Integrated Pest Management of different insect species. The use of the sex pheromone in the sticky traps is an efficient method of monitoring several pests. However, studies are still necessary for the development of the strategies of the monitoring and control of the fruit flies with the pheromone traps (Vilela and Della Lucia, 2001).

The behavioral studies are necessary, including the chemical communication of *Anastrepha* species for the implementation of the synthetic pheromone-based traps in the monitoring and/or populational control of *Anastrepha* flies in the field. The aim of this work was to evaluate the capture of *A. sororcula* in the traps baited with the food attractant and virgin adults in two different environments.

## MATERIAL AND METHODS

### Study areas

The bioassays were carried out from January to April, 2005. The adults were obtained from the guava fruits collected in the field and were kept under a 12 h photoperiod (6 a.m. to 6 p.m.). The field assay was conducted in the orchards of the Universidade Federal da Grande Dourados (OUFGD), (22°11'46"S and 54° 55' 59"W) and the Sindicato Rural de Dourados-MS (OSRD), (22° 13' 34"S and 54°43'55"W). The OUGFD comprised 4.0 ha, was surrounded by the pasture areas, and had the following fruit trees: mango (*Mangifera indica* L.), Surinam cherry (*Eugenia uniflora* L.), avocado (*Persea americana* Mill.), Spanish prune (*Spondias purpurea* L.), tamarind

(*Tamarindus indica* L.), jaboticaba (*Myrciaria cauliflora* Berg), banana (*Musa* spp.), guava (*Psidium guajava* L.), rose apple (*Eugenia jambos* L.), Plum (*Prunus domestica* L.), star fruit (*Averrhoa carambola* L.), persimmon (*Diospyros kaki* L.), jackfruit (*Artocarpus integrifolia* L.), grape (*Vitis vinifera* L.), fig (*Ficus carica* L.), West Indian cherry (*Malpighia emarginata* D. C.), peach (*Prunus persica* L.), lemon (*Citrus* sp.), "castanha-do-maranhão", (*Bombacopsis glabra* Pasq. A. Rob.) and coffee (*Coffea arabica* L.). During the study period, the following plants bore the fruit: guava, mango, grape, avocado, star fruit and jaboticaba.

The orchard of the Sindicato Rural de Dourados (2.5 ha), located near a native riparian forest, had the following host plants: peach, fig, guava, mango, custard apple (*Annona squamosa* L.), soursop (*Annona muricata* L.), banana, coconut (*Cocos nucifera* L.), and grape. Guava and the fig trees had fruits throughout all the field experiments. The weather data such as temperature, relative humidity, rainfall and wind speed were obtained from the weather station of Embrapa Agropecuária Oeste, Dourados-MS, 15 km from the orchard of UFGD and 10 km from the orchard of Sindicato Rural.

### *A. sororcula* adults for the bioassay

The adults of *A. sororcula* were obtained from the guava fruits naturally infested and collected in the region of Dourados-MS. The fruits were kept in the laboratory for 40 days so that all the frugivorous larvae could complete their development, as proposed by Uchôa-Fernandes and Zucchi (1999). The 3<sup>rd</sup> instar larvae were collected on an interval of 12 h, placed in the transparent acrylic recipients (300 mL) containing the sterilized sand moistened with the drinking water until the completion of the pupal stage and adult emergence. The newly emerged adults were removed from the acrylic cages, separated by the sex and kept in the cages in different environments. The cages were built by the transparent PET bottles (25 cm height X 10 cm diameter) covered with the *voil* cloth and kept at 26°C and 70% relative humidity. The flies were fed the drinking water and an artificial diet (Salles, 1992) containing 100 g of the brown sugar, 500 mL hydrolyzed protein, 100 mL sterilized water and 10 g honey.

### Capture of *A. sororcula* with Jackson and McPhail traps

Seven Jackson traps and seven McPhail traps were set up in the field within 30 m from each other. Sexually mature males (7 to 12 days old) and females (14 days old) (Facholi-Bendassolli and Uchôa-Fernandes, 2006) were tested as an attractant in the traps. The males, the females and the couples were kept in the metallic cages (4.0 cm x 2.0 cm x 2.0 cm) covered with the elastic fabric and fixed in the interior of the traps. Each Jackson trap received a card smeared with Biocontrole® entomological glue. The cards were placed on the bottom of the traps in order to retain the insects attracted by the odor source. In the Jackson traps, a piece of cotton was moistened with the hydrolyzed protein Tephritid® and was inserted in a plastic lid and placed inside the cage. The cotton was moistened with the hydrolyzed protein every morning. The traps with the hydrolyzed protein were used to check the presence of the fruit flies in the orchard. Two bioassays were carried out in the two orchards, each one set up at the ends of each orchard. The first bioassay was installed with the Jackson traps involving the following treatments: 1) control (no flies), 2) five virgin males, 3) 10 virgin males, 4) 15 virgin males, 5) five couples, 6) hydrolyzed corn protein (10% v/v) and 7) five virgin females. Thus, in each of the four collecting points of the experiment, a total of 35 males and 10 females were used. In the second bioassay, McPhail traps were used, also with the hydrolyzed corn protein (10% v/v). The same procedure of the first bioassay was followed. The McPhail and Jackson traps were hung at about 1.6 m from the soil level under the shadow of fruit trees and randomly distributed.

The traps had a piece of the cotton moistened in drinking water, which was placed on the floor of the cages. The adults that occasionally died in the interior of the traps were substituted by others of the same age. All the flies used as the bait, as well as the ones captured by the traps, were placed in recipients with alcohol 70% and identified.

### Data Analysis

This study analyzed three variables: the baits, traps and locality in relation to the average number of the captured adults of *A. sororcula* at the four collecting points. The same procedure was repeated for seven days for all the treatments. Kruskal-Wallis and Mann-Whitney tests were used

in order to compare the hypothesis of the equality between the averages of the treatments and for the multiple comparisons *a posteriori* among the averages. The correlation index of Pearson was used to verify if the number of the adults of *A. sororcula*, captured in the McPhail and Jackson traps presented any relationship to the climatic factors. All the results were analyzed considering the significance level of 5% of the probability.

## RESULTS AND DISCUSSION

The number of the adults of *A. sororcula* captured in the OUFGD and in the OSRD was low during most of the sampling period (Table 1).

For both the traps, the average number of *A. sororcula* adults caught with the hydrolyzed protein was significantly higher ( $p < 0.05$ ) in comparison to the other treatments (Table 2). When the number of *A. sororcula* flies captured in both the orchards was separately analyzed, McPhail traps with the hydrolyzed protein captured a significantly higher number of *A. sororcula* flies, in comparison to the other treatments with the conspecific adults. In the Jackson traps with the hydrolyzed protein, although a higher number of *A. sororcula* adults were caught in relation to the other baits and McPhail traps, no significant differences were detected ( $p > 0.05$ ) between the treatments (Table 2).

Although, the temperature has been considered important in the population behavior of the flies (Tardelli et al., 2004), the average number of *A. sororcula*, captured in the OUFGD and the OSRD orchards, did not show any significant difference when related to the different climatic variables. The result showed that the climatic variables did not interfere in the capture of *A. sororcula* adults, according to the correlation analysis of Pearson: temperature ( $r = 0.087$ ;  $p = 0.225$ ), relative humidity ( $r = -0.058$ ;  $p = 0.423$ ), rainfall ( $r = -0.096$ ;  $p = 0.183$ ) or wind speed ( $r = -0.077$ ;  $p = 0.281$ ). During the experimental period, the temperature ranged between 24° to 28° C, the relative humidity (%RH) between 51% to 82%, rainfall (accumulated weekly average) from 0 to 19 mm, and the wind speed varied between 3.7 and 13.4 m/s.

**Table 1** - Number of adults of *Anastrepha sororcula* captured in two commercial guava orchards in the region of Dourados-MS, Brazil (from February to April, 2005).

Local	Treatments	Period							
		19 to		5 to		22 to		17 to	
		25/February/2005		11/March/2005		25/March/2005		23/April/2005	
		Jackson	McPhail	Jackson	McPhail	Jackson	McPhail	Jackson	McPhail
OSRD	Control	0	0	0	0	0	0	0	0
	5 males	0	0	0	0	3 (♀)	0	0	0
	10 males	0	0	0	1 (♂)	0	1 (♂)	1 (♀)	0
	15 males	0	0	0	1 (♀)	0	0	0	2 (1♀ 1♂)
	5 couples	0	0	0	0	0	1 (♀)	1(♀)	0
	Protein	0	0	0	2 (♀)	0	16 (8♀8♂)	8 (4♀4♂)	19 (9♀ 10♂)
	5 females	0	0	0	0	0	1 (♀)	0	1 (♀)
OUFGD	Control	0	0	0	0	0	0	0	0
	5 males	0	0	0	0	0	0	0	0
	10 males	0	0	0	0	0	1(♂)	0	0
	15 males	0	0	0	0	0	2 (♂)	0	0
	5 couples	0	0	0	1 (♀)	0	0	1 (♀)	1(♂)
	Protein	0	0	5 (♀)	3 (♀)	0	2 (♀)	5(3♀2♂)	25(15♀10♂)
	5 females	0	1 (♀)	0	0	0	0	0	0

**Table 2** - Average number of adults of *A. Sororcula* captured in McPhail and Jackson traps with different types of attractive in relation to the number of captured individuals in two commercial guava orchards in the region of Dourados - MS.

Traps\ Bait	Answer variable: Average number of captured flies (Standard Deviation) (Repetitions)							X <sup>2</sup> (P)	Mann-Whitney
	a = protein	b = zero male	c = 5 male	d = 10 male	e = 15 male	f = 5 couples	g = 5 female		
McPhail and Jackson	0.76 (1.11)(28)	0.00 (0.00)(28)	0.03 (0.08)(28)	0.01 (0.05)(28)	0.02 (0.07)(28)	0.04 (0.09)(28)	0.03 (0.08)(28)	43.434 (0.000)	a>b=c=d =e=f=g
MacPhail	1.20 (1.34)(14)	0.00 (0.00)(14)	0.00 (0.00)(14)	0.00 (0.00)(14)	0.04 (0.09)(14)	0.04 (0.09)(14)	0.05 (0.11)(14)	29.638 (0.000)	a>b=c=d =e=f=g
Jackson	0.32 (0.62)(14)	0.00 (0.00)(14)	0.05 (0.11)(14)	0.02 (0.07)(14)	0.04 (0.09)(14)	0.04(0.09) (14)	0.00 (0.00)(14)	20.213 (0.003)	a=b=d=e =g

The average number of *A. sororcula* adults, captured in the orchard of the Sindicato Rural ( $0.14 \pm 0.47$ ) with both the traps using the hydrolyzed protein, was significantly higher ( $Z=2.19$ ;  $p=0.029$ ) than in the OUFGD ( $0.11 \pm 0.52$ ). The higher population of *A. sororcula* found in the OSRD could probably be due to the fact that this orchard was surrounded by a native riparian forest reserve. The wild hosts in this environment could be a repository for *A. sororcula* populations during the inter harvest period. Conversely, the orchard of UFGD, which was surrounded by the pasture

areas, probably did not offer alternative hosts to *A. sororcula* during the inter harvest period.

The fruit fly males are believed to be responsible for releasing the sexual pheromones for the attraction of conspecific females for mating and copulation (Nation, 1989; Vilela and Della Lucia, 2001). Although in Mexico the capture of the females of *A. suspensa* in the traps with the virgin males has been reported (Perdomo et al., 1975, 1976), the results of this study showed that despite the fact that the males inside the cages showed quick wing vibration movements and extrusion of

the anal pouch, the capture of the females of *A. sororcula* in the traps with the conspecific virgin males was not significant. The observations of the wing vibration behavior inside the cages was similar to that described by Facholi-Bendassolli and Uchôa-Fernandes (2006), who characterized *A. sororcula* sound emission during the calling behavior. During the calling behavior the male fruit flies start wing fan movements, probably to direct the air jet above the abdominal surface and extrude the anal pouch. These actions would increase the body temperature and also help in the pheromone dispersion (Nation, 1989). The fruit odors can also completely inhibit the sexual attraction to the male pheromone in active females (Robacker and Garcia, 1990). The volatiles released by *A. sororcula* males remain still unknown and there is no information whether they are chemically similar to those released by the preferential host plants (Myrtaceae) or not.

In the analysis considering the setup with all the treatments regarding the two trap models (McPhail and Jackson), the numbers of the adults caught in the McPhail traps ( $1.2 \pm 1.34$ ) and in the Jackson traps ( $0.3 \pm 0.62$ ) were not significantly different ( $Z= 1.5$ ;  $p= 0.13$ ). According to Bressan et al. (1991), the spherical shape of the traps, associated with the yellow color, was more attractive to the females than to the males of *Anastrepha* species. Bressan et al. (1991) also observed that the traps with the yellow spheres were able to capture a higher number of *A. fraterculus* females in comparison to the number of the males.

In this study, results indicated that although there was no significant difference between the tested models, McPhail traps (yellow and semi-spheric) captured almost four times more individuals of *A. sororcula* than Jackson traps (Table 1). This suggested that in the experiments involving the adults as a source of the natural pheromones in the field, visual stimulus (yellow color) and the trap shape (semi-spheric) should be considered regarding the attraction of *A. sororcula* males.

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## RESUMO

As moscas-das-frutas constituem um grupo de pragas responsáveis por grandes prejuízos econômicos à fruticultura mundial. *Anastrepha sororcula* Zucchi, é a principal espécie de tefritídeo que ataca a goiaba em Mato Grosso do Sul. O objetivo desta pesquisa foi avaliar a captura de adultos de *A. sororcula* em armadilhas com atrativo alimentar e adultos virgens, em dois ambientes. Os bioensaios iniciaram-se com a criação de *A. sororcula* no Laboratório de Insetos Frugívoros da Universidade Federal da Grande Dourados (UFGD). As pesquisas de campo foram desenvolvidas nos pomares da UFGD e do Sindicato Rural de Dourados (SRD)-MS. A captura de adultos de *A. sororcula* em armadilhas McPhail e Jackson foi avaliada para os tratamentos: proteína hidrolisada de milho, testemunha (sem moscas), machos virgens (5, 10 e 15), 5 fêmeas virgens e 5 casais. O número médio de indivíduos capturados nas armadilhas com proteína foi significativamente maior que nos demais tratamentos. O número médio de adultos de *A. sororcula*, capturado com o tratamento proteína no SRD foi significativamente superior ao do pomar da UFGD. Não ocorreu captura significativa de fêmeas de *A. sororcula* nas armadilhas com machos virgens co-específicos como atrativo.

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