SCIENTIFIC NOTE

Mating Time of the West Indian Fruit Fly *Anastrepha obliqua* (Macquart) (Diptera: Tephritidae) under Laboratory Conditions

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Horário de Cópulas de *Anastrepha obliqua* (Macquart) (Diptera: Tephritidae) em Condições de Laboratório

RESUMO - O isolamento reprodutivo alocrônico parece ser um fator importante nos processos de especiação em Tephritidae, uma vez que a existência de horários de cópula específicos é uma característica comum de suas espécies. O horário de cópula de *Anastrepha obliqua* (Macquart) foi investigado usando observações segundo metodologia grupo-focal, durante dez dias, em condições de laboratório. O número de casais em cópula e de machos apresentando comportamento de chamado variou significativamente em relação ao horário do dia. As atividades sexuais mostraram-se concentradas no período vespertino, sendo que a chamada dos machos alcançou um pico entre 15:30h e 16:30h e as cópulas ocorreram mais freqüentemente entre as 14:00h e 16:30h.

PALAVRAS-CHAVE: Isolamento alocrônico, especiação, comportamento sexual

ABSTRACT - Allochronic reproductive isolation seems to be an important factor in speciation processes in Tephritidae since specific mating times are a widespread feature of its species. The timing of matings of the West Indian fruit fly, *Anastrepha obliqua* (Macquart) was investigated through group-focal observations, during ten days, under laboratory conditions. The number of observed matings and males exhibiting calling behavior varied significantly according to time of day. Sexual activities seemed to be concentrated in the afternoon period, with the male calling behavior reaching a peak between 3:30p.m. and 4:30p.m., and mating occurred most frequently from 2:00p.m. to 4:30p.m.

KEY WORDS: Allochronic isolation, speciation, sexual behavior

Anastrepha obliqua (Macquart) is considered a major fruit crop pest, since larval development occurs in economically important fruits such as mango (Aluja 1994). This species, commonly known as the West Indian fruit fly is endemic to Central and South America is probably the most widely distributed tephritid species occurring throughout almost the entire range of *Anastrepha*. Besides their economical relevance, *Anastrepha* fruit flies are considered good model organisms for genetic and evolutionary studies (Sugayama & Malavasi 2000). Nevertheless, knowledge of evolutionary processes of pest species is essential for the development of efficient management programs (Lewontin & Birch 1966).

The speciation processes in *Anastrepha* species have been explained by allochronic isolation analysis via specific mating times, which is a widespread phenomena and the most important precopulatory barrier described in this genus (Aluja *et al.* 2001, Miyatake *et al.* 2002). This means several Tephritidae species mate at particular times within a day (Lewontin & Birch 1966, Morgante *et al.* 1983, Aluja *et al.* 2001). Since sympatric species frequently show different mating time patterns, controversial models such as sympatric speciation and reinforcement have been proposed for this genus (Morgante *et al.* 1993, Aluja *et al.* 2001).

In the case of *A. obliqua*, a behavioral study conducted in Central America showed that its mating time is restricted to the early morning hours (Aluja & Birke 1993). On the other hand, a study conducted in Brazil (A. Malavasi, unpublished) has determined that the mating activities of this species occur in the afternoon. Therefore, the purpose of the present study is to provide a more accurate timing of sexual actitivities of *A. obliqua* using Brazilian specimens, and possibly to enlighten another widespread phenomena in *Anastrepha*; i.e. populational differentiation.

Adults of *A. obliqua* were raised from pupae obtained from infested carambola fruits collected in the municipality of Bariri, SP. Individuals were sexed three to five days after emergence and maintained isolated in acrylic cages (14 x

22 x 14 cm) provided with water and food medium consisting of 60 ml honey, 180ml hydrolized corn protein, 36 g yeast, 3 g Sustagen®, 270 g sugar and 1 g Nipagin®. The observations were conducted in the Fruit-Fly Laboratory (Universidade de São Paulo). Observations of the adult sexual behavior were made from 6:30 a.m. to 6 pm during ten days using natural sunlight and controlled temperature (25 ± 3°C). Fifteen couples, each couple kept in a seperate acrylic cage (14 x 22 x 14 cm), were observed following group-focal observational procedure (Altmann 1984) in thirty minute intervals. The sexual behaviors observed where "fanning" (male calling behavior) and mating. The data were analyzed using the Kruskal-Wallis (non-parametric ANOVA) and qui square tests for "fanning"and mating respectively.

The number of calling males increased throughout the day (H = 34,987, P < 0,001) and reached its highest number between 3:30 p.m. and 4:30 p.m. (Fig. 1). The number of matings followed the same patterns (χ^2 = 15,2, P < 0,05), although most matings occurred slightly earlier in the day, with a peak between 2 p.m. and 3 p.m. (Fig. 2). Therefore, we conclude that *A. obliqua* sexual activities are concentrated in the afternoon.

This is also the case in *A. striata* (Schiner) which mates more frequently from 3 p.m. to 5 p.m. (Aluja 1993, Selivon & Morgante 1996). The timing of sexual activities in *A. obliqua* differs from several other *Anastrepha* species, such as *A. ludens* (Loew) and *A. suspense* (Loew) that mate most frequently in the late afternoon and early evening (Burk 1983) and *A. fraterculus* Wiedmann and *A. bistrigata* (Bezzi) that mate dominantly during the morning (Morgante *et al.* 1983, Selivon & Morgante 1996, see Aluja *et al.* 2001 for a overall review in the *Anastrepha* genus).

The results obtained in this study contrast to those obtained by Aluja & Birke (1993) in Mexico, suggesting that there is a populational differentiation.

These results also have interesting implications when compared with those obtained for *A. fraterculus* complex (Malavasi *et al.* 1983, Morgante *et al.* 1983, De Lima *et al.* 1994), which was treated as a single species until results of crossing experiments and discovery of substantial differences in genetical criteria led to the description of at least two seperate species (Selivon *et al.* 1999). Informal observations (F. Henning, unpublished) suggest differences in mating times between these recently described *A. fraterculus* species. This is particularly interesting, given the fact that the allochronic barrier is, as mentioned earlier, the most important described precopulatory barrier in *Anastrepha.*

The difference in mating times between *A. obliqua* and *A.* sp.2 aff. *fraterculus* is also noteworthy since these species mate readily in no-choice breeding experiments (Dos Santos *et al.* 2001) yielding a pattern of codominance in relation to timing of mating in F_1 hybrids (F. Henning & S. R. Matioli, unpublished).

The question of which *A. obliqua* and *A. fraterculus* mate in natural conditions, since they present a certain degree of mating time superposition in the morning hours, should be addressed considering other pre-copulatory isolation factors such as spatial restrictions and female selectivity towards specific characteristics of sounds produced by "fanning".

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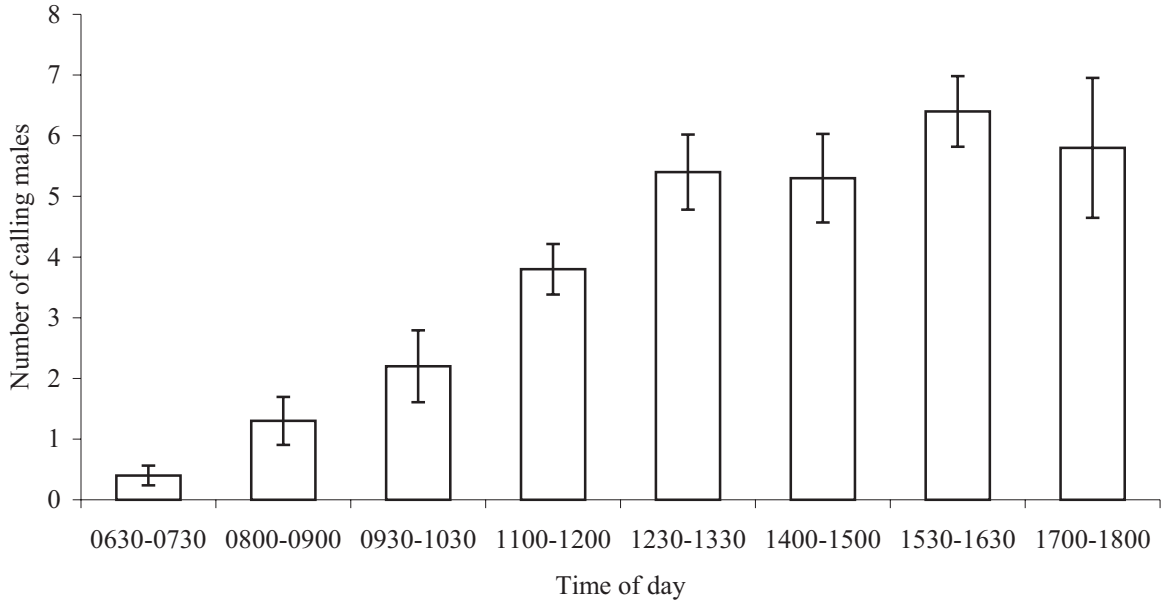

Figure 1. Frequency distribution of calling time in *A. obliqua* males. Values represent means ± SE. n = 306 (number of observations).

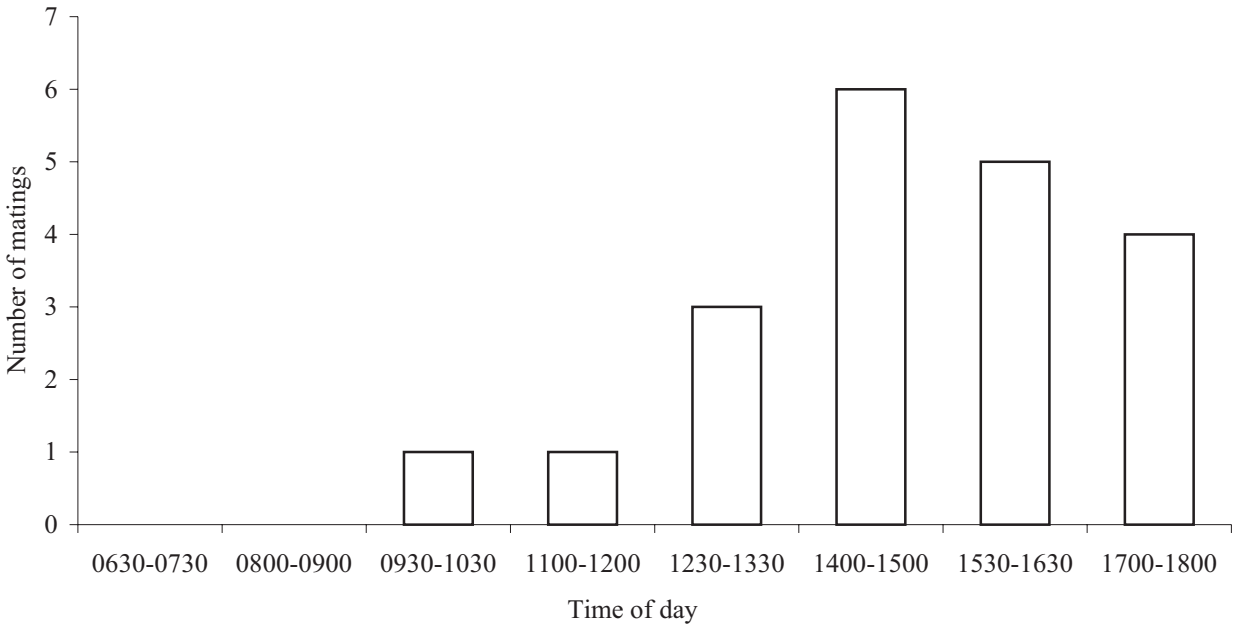

Figure 2. Frequency distribution of mating time in *A. obliqua*. Values represent total sums of observations. n = 20 (number of matings).

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