

Occurrence of fruit flies in coffee varieties in the State of São Paulo, Brazil

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A field survey was conducted from March 1998 to July 2000 to identify the Tephritoidea species and fruit fly parasitoids associated with coffee (*Coffea* spp.) in different areas of the State of São Paulo. More than 124,000 berries (159.0 kg; 106 samples) were collected from twelve coffee varieties and hybrids. About 19,450 puparia and 13,501 adults of Tephritoidea were recovered. An average infestation of 0.075 puparium of Tephritoidea per fruit and 58.8 puparia/kg of fruit were estimated from the total samples. The percentage of samples infested by Tephritidae was higher than 92%. *Anastrepha* and *Ceratitis capitata* adults were obtained from 67% and 71% of the samples, respectively. About 89.2% of adults were Tephritidae and 10.8% were Lonchaeidae. Above 70% of Tephritidae adults corresponded to *C. capitata*. From 1,677 *Anastrepha* females only *A. fraterculus* was found. Four species of Braconidae parasitoids were recovered: *Doryctobracon areolatus*, *D. brasiliensis*, *Utetes anastrephae* and *Opius* sp. Eucolilinae specimens were also recorded.

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INTRODUCTION

Among 195 *Anastrepha* species 94 are registered in Brazil besides *Ceratitis capitata* (ZUCCHI, 2000) which was found in 1901 infesting peaches in the state of São Paulo (LIMA, 1926). *Anastrepha fraterculus* is the most important fruit fly species of the economic importance in Brazil where it is widely spread and infests 67 commercial and non commercial hosts (ZUCCHI, 2000).

Because of the favorable climate and suitable hosts all year long, large quantities of insecticides are required for the control of

fruit flies in commercial fruit crops in the state of São Paulo. The insecticides are applied by covering spray (guava, mango, peach, plum, nectarine, persimmon) or toxic bait (citrus). According to ORLANDO & SAMPAIO (1973), in that region, midseason and late sweet orange varieties are more susceptible to fruit fly infestation because high populations are detected during coffee berry maturation. Only *C. capitata* (medfly), *A. fraterculus* (south american fruit fly) and *Anastrepha sororcula* had been reported in Brazil infesting coffee (LIMA, 1926, SOUZA *et al.*, 1975, MALAVASI *et al.*, 1980).

Coffee is considered a primary host of medfly (FONSECA & AUTUORI, 1936; CUCULIZA & TORRES, 1975; SAMPERIO, 1976; LIQUIDO *et al.*, 1990; KOLBE & ESKAFI, 1990; MALACRIDA *et al.*, 1992) and it may be named as the most important host in Brazilian rural areas. PUZZI & ORLANDO (1965) observed in different coffee varieties available mature berries during ten successive months per year. Just one cover spray of insecticide is generally made for controlling the leafminer *Perileucoptera coffeella* during coffee maturation period in Brazil. Thus high infestation rates, such as 0.5 puparium of Tephritidae per berry in average may be easily achieved in the state of São Paulo (RAGA *et al.*, 1996).

After coffee harvesting, tephritid adults migrate to orange orchards in order to acquire food and shelter. In terms of growing areas, São Paulo presents approximately 253.000 ha of the coffee plantations (Luiz Moricochi, personal information) and 855.195 ha of the orange production (IBGE, 2001). Thus, studies on ecology of fruit flies in coffee plants are essential to establish strategies for controlling tephritids in fruit crops, including sweet oranges.

MATERIAL AND METHODS

During the period from March 1998 to July 2000, 106 samples of twelve coffee varieties and hybrids (see Table 1) were collected from 26 São Paulo municipalities. A total of 124,000 ripe coffee berries (159.0 kg) were picked at random in the field. Samples were obtained from unsprayed trees and brought to the Laboratory of Economic Entomology of *Instituto Biológico*, located in Campinas County, State of São Paulo, Brazil. Berries were counted, weighed and placed into fruit-holding boxes containing sand on the bottom and covered with a piece of cotton cloth on the top. About 15-20 days later, the sand in boxes was sieved and puparia were transferred to a glass cage (6,000 cc) with a little amount of dry sand on the bot-

ton. The puparia were kept in the glass cage, at $25 \pm 2^\circ\text{C}$ and $70 \pm 10\%$ of relative humidity for 25 days to allow the maximum emergence rate. After the emergence, adults were fed with a mixture of sugar/yeast extract (3:1) and water. Identification of *Anastrepha* specimens were based on STONE (1942), STEYSKAL (1977) and ZUCCHI (1978). Braconids were identified according to LEONEL Jr. *et al.*, (1995) and eucoilins were identified by MSc Jorge Anderson Guimarães.

RESULTS AND DISCUSSION

Data summaries are presented on Table 1. In our study positive infestation of Tephritidae were obtained from March to August. It was recovered 19,450 puparia and 13,501 adults of Tephritoidea. An average infestation of 0.075 puparium of Tephritoidea per berry and 58.8 puparia per kg of berries were estimated from the total samples. 'Catuaí Vermelho' (red ripe berry), 'Catuaí Amarelo' (yellow ripe fruit) and 'Mundo Novo' (red ripe berry) were the most infested varieties in the present work. Those three varieties represent 85% of planted area in the state of São Paulo.

The highest values of puparia per kg of berries was obtained for a 'Catuaí Amarelo' sample of late harvest in dry period (August 1999) when suitable hosts for oviposition were rare. Based on puparia per kg of berries, a 'Mundo Novo' sample showed the highest value (876.7). Although few fruits were sampled, no puparia were recovered from 'Robusta' (*C. canephora*) and 'Moka' (peaberries).

The percentage of samples infested by Tephritidae was higher than 92%. *Anastrepha* and *Ceratitis capitata* adults were obtained from 67% and 71% of the samples, respectively. During 1949-1985 in Hawaii, 64.5% of coffee samples were infested by medfly (LIQUIDO *et al.*, 1990).

In the present study 89.2% of adults were Tephritidae and 10.8% were Lonchaeidae

Table 1.—Summary of Tephritidae and parasitoids reared from coffee collected in São Paulo from March 1998 to July 2000.

Variety/ Hybrid	N° Samples	N° berries		N° puparia	C/A (Range)	C/B (Range)	Tephritidae				Parasitoids								
		kg					Ceratitis capitata		Anastrepha sp.		Lon-		U.a		D.b		A.p.		
		A	B				female	male	female	male	female	male	chaetidae	chaetidae	Op.	D.b	Op.	D.b	A.p.
1. Catuaí Vermelho	26	32349	44.307	7,195	0.222 0.000-0.752	162.39 0.0-578.5	5631	4041	2520	1521	684	319	365	906	23	4	2	0	3
2. Catuaí Amarelo	25	30955	40.525	5,470	0.177 0.000-2.455	135.0 0.0-434.8	4020	2520	1259	1261	1284	636	648	216	13	6	0	1	2
3. Mundo Novo	35	33445	41.615	5,198	0.155 0.000-1.131	124.9 0.0-876.7	2825	1507	818	689	1057	491	566	261	24	38	1	0	4
4. Acaiaí	3	4000	6.050	138	0.035 0.000-0.047	22.8 0.0-29.4	109	12	7	5	95	44	51	2	0	0	1	0	0
5. Catuaí	1	1000	1.580	25	0.025	15.8	13	2	0	2	10	4	6	1	0	0	0	0	0
6. Icatu Vermelho	6	8000	9.775	959	0.120 0.016-0.544	98.1 10.7-477.2	597	405	200	205	134	60	74	58	5	2	6	0	2
7. Icatu Amarelo	2	2893	2.700	31	0.011 0.00-0.016	9.0 0.0-18.0	17	1	1	0	0	0	0	16	0	0	0	0	0
8. Robusta	2	2883	3.255	0	—	—	0	0	0	0	0	0	0	0	0	0	0	0	0
9. Bourbon Amarelo	2	3028	3.840	86	0.040 0.005-0.075	42.5 3.1-81.9	9	5	3	2	3	1	2	1	0	0	0	0	0
10. Caturra	2	3000	3.520	327	0.094 0.049-0.139	79.6 46.7-79.6	262	4	3	1	258	122	136	0	0	2	0	0	0
11. Obatã	1	1000	1.085	21	0.021	19.3	18	17	10	7	0	0	0	1	0	0	0	0	0
12. Moka	1	2000	0.750	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	106	124553	159.002	19,450	0.075	58.8	13,501	8514	4821	3693	3525	1677	1848	1462	65	52	10	1	11

U.a.= *Uietes anastrephae* D.a.= *Doryctobracon areolatus* D.b.= *D. brasiliensis* Op.= *Opius* sp. A.p.= *Aganaspis pelleranoi*

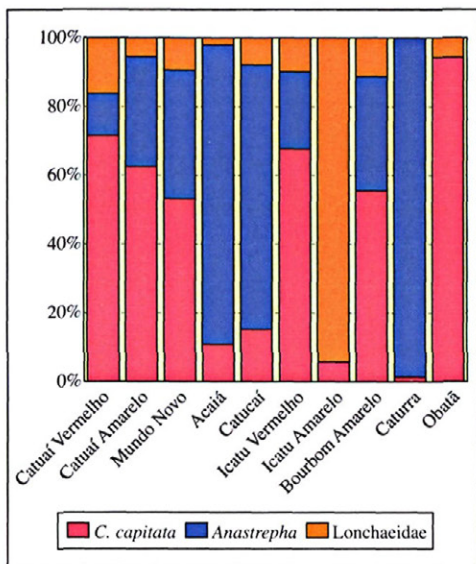


Fig. 1.—Comparative frequency of fruit fly diversity in coffee varieties in the state of São Paulo, during 1998/2000.

(probably *Neosilba* spp. and *Lonchaea* sp.). Above 70% of Tephritidae adults corresponded to *C. capitata* (Fig. 1). From 1,677 *Anastrepha* females only *A. fraterculus* were found.

Medfly and South American fruit fly infest both the exotic and native plants in Brazil.

From seven varieties observed during 1994 in the State of São Paulo 83.0% of adults were Tephritidae, from which 91.1% corresponded to medfly (RAGA *et al.*, 1996). The importance of coffee for medfly colonization has also been emphasized in many countries (ABASA, 1973; CUCULIZA & TORRES, 1975; JIRON & HEDSTRÖM, 1988; HARRIS & CAREY, 1989; HARRIS & LEE, 1989; VARGAS *et al.*, 1995). Moreover, some authors have observed losses on quality of coffee liquor from berries infested by medfly larva (GIBSON, 1970; CIVIDANES *et al.*, 1993).

Considering all the period of the present study, in March only 18.04% of tephritids were *Anastrepha* while in June (autumn-winter) this genus achieved 38.11% (Fig. 2). According to SOUZA FILHO *et al.* (2000), in June only tropical almonds (*Terminalia catappa*), citrus and loquat are available hosts for fruit flies in the State of São Paulo. During the beginning of the winter few specimens of *A. fraterculus* are captured into McPhail traps installed in the commercial fruit crops. Large quantities of medfly adults

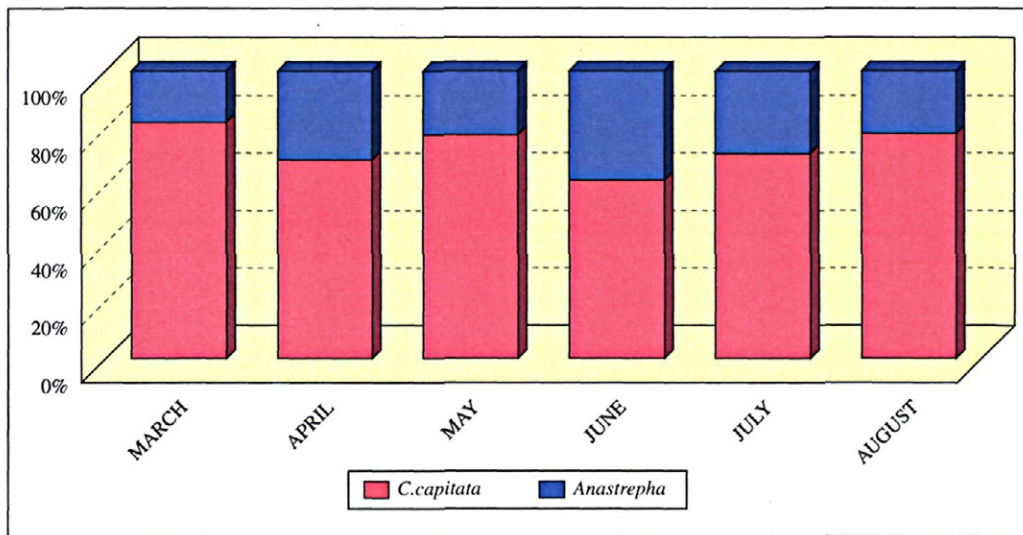


Fig. 2.—Comparative monthly frequency of Tephritidae diversity in coffee varieties in the state of São Paulo, during 1998/2000.

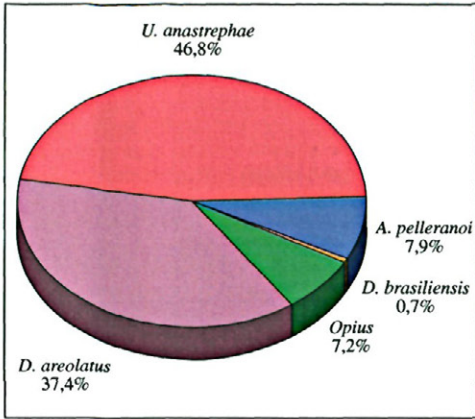


Fig. 3.—Comparative frequency of parasitoid complex in coffee varieties in the state of São Paulo, during 1998/2000.

migrate from coffee plantations to the orchards on frutification stage at the end of the winter.

Doryctobracon areolatus (Szépligeti), *D. brasiliensis* (Szépligeti), *Utetes anastrephae* (Viereck) and *Opius* sp. were the Braconidae parasitoids emerged from the coffee samples collected in the State of São Paulo (Fig. 3). The Eucolilinae *Aganaspis pelleranoi* (Brèthes) was registered in 'Catuaí Vermelho',

'Catuaí Amarelo', 'Mundo Novo', and 'Icatu Vermelho'.

In Brazil, *D. areolatus* is related to 10 *Anastrepha* species and medfly whereas *D. brasiliensis* has only 3 *Anastrepha* species reported as host (LEONEL JR. *et al.*, 1995; AGUIAR-MENEZES & MENEZES, 1997; CANAL & ZUCCHI, 2000). In Brazil, *D. areolatus* and *U. anastrephae* are registered in *C. arabica* (LEONEL Jr. *et al.*, 1995). Eucolilids are solitary endoparasitoids that oviposit in the larval stage of cyclorhaphous Diptera and emerge as adult from the host puparium. *Aganaspis* species are the only eucolilids utilized in fruit fly biological control programs. Medfly, south american fruit fly and *Neosilba* are known hosts of *A. pelleranoi* (WHARTON *et al.*, 1998). In Brazil, *A. pelleranoi* is reported for *Anastrepha* sp. in coffee (GUIMARÃES *et al.*, 1999).

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RESUMEN

RAGA A., D. A. DE OLIVEIRA PRESTES, M. F. SOUZA FILHO, M. E. SATO, R. C. SILOTO, R.A ZUCCHI. *Bol. San. Veg. Plagas*, 28: 519-524.

Se ha hecho un estudio de campo, en la provincia de São Paulo, Brazil, en el periodo de Marzo/98 a Julio/00 con la finalidad de identificar las especies de Tephritoidea y parasitoides asociados con frutos de café (*Coffea* spp.). Más de 124.000 cerezas (159,0 Kg; 106 muestras) relativas a una docena de materiales genéticos, entre variedades e híbridos, fueron recogidas. De las muestras se ha obtenido un total de 19.450 puparios y 13.501 adultos de Tephritoidea. Las infestaciones medias de 0,075 puparios de Tephritoidea por fruto y de 58,8 puparios por quilo de fruto fueron calculados en el total de las muestras. El porcentaje de muestras infestadas por Tephritoidea fue mayor de 92%. De las muestras se obtuvieron adultos de *Anastrepha* y *Ceratitis capitata* en un 67% y 71%, respectivamente. De los adultos emergidos de las muestras, un 89,2% fueron de Tephritoidea y 10,8% de Lonchaeidae. Más del 70% de los adultos de Tephritoidea correspondieron a *C. capitata*. De las 1.667 hembras de *Anastrepha*, solamente se encontró *A. fraterculus*. Se recuperaron cuatro especies de Braconidae: *Doryctobracon areolatus*, *D. brasiliensis*, *Utetes anastrephae* y *Opius* sp.. También se registraron especímenes de Eucolilinae.

Palabras clave: Insecto, moscas de la fruta, *Ceratitis capitata*, *Anastrepha fraterculus*, Braconidae.

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