

ECOLOGY, BEHAVIOR AND BIONOMICS

Species Diversity of Frugivorous Flies (Diptera: Tephritoidea) from Hosts in the Cerrado of the State of Mato Grosso do Sul, Brazil

MANOEL A. UCHÔA-FERNANDES¹, ISAIAS DE OLIVEIRA¹, ROSA M.S. MOLINA¹ AND ROBERTO A. ZUCCHI²

¹Depto. Ciências Biológicas, Universidade Federal de Mato Grosso do Sul (UFMS). Rodovia Dourados-Itahum, km 12 79804-970, Cidade Universitária, Dourados, MS, Brasil, e-mail: uchoa@ceud.ufms.br

²Depto. Entomologia, Fitopatologia e Zoologia Agrícola, ESALQ/USP, C. postal 9, 13418-900, Piracicaba, SP, Brasil e-mail: razucchi@esalq.usp.br

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Diversidade de Espécies de Moscas Frugívoras (Diptera: Tephritoidea) em Hospedeiros do Cerrado do Estado de Mato Grosso do Sul

RESUMO - Neste trabalho foram amostradas 35 espécies de frutos do cerrado em sete municípios do estado de Mato Grosso do Sul (janeiro de 1993 a março de 1997) para avaliar a infestação por moscas frugívoras. Ocorreram espécies de seis gêneros de Tephritoidea - *Anastrepha* Schiner, *Ceratitidis* MacLeay (Tephritidae); *Dasiops* Rondani, *Lonchaea* Fallén, *Neosilba* McAlpine (Lonchaeidae) e *Notogramma* Loew (Otitidae), em 29 espécies de frutos. As moscas-das-frutas (Tephritidae) colonizaram 19 hospedeiros e foram representadas por 11 espécies: *Anastrepha fraterculus* (Wied.), *A. grandis* (Macquart), *A. montei* Lima, *A. obliqua* (Macquart), *A. pickeli* Lima, *A. sororcula* Zucchi, *A. striata* Schiner, *A. turpiniae* Stone, *A. zenildae* Zucchi, *Anastrepha* sp. n. e *Ceratitidis capitata* (Wied.). De Lonchaeidae foram obtidos: *Dasiops inedulius* Steyskal, *Dasiops* spp., *Lonchaea* spp., *Neosilba zadolicha* McAlpine e *Neosilba* spp. As espécies de *Neosilba* foram as mais abundantes moscas frugívoras, ocorrendo em 22 hospedeiros. *Notogramma* foi o único gênero de Otitidae obtido. É discutida a associação entre moscas frugívoras e frutos hospedeiros.

PALAVRAS-CHAVE: Biodiversidade, mosca-das-frutas, Lonchaeidae, frugivoria, Brasil-Central

ABSTRACT - Thirty-five fruit species were sampled in seven municipalities located in the cerrado of the state of Mato Grosso do Sul (January 1993 to March 1997) in a study to evaluate the infestation by frugivorous flies. Species of six genera of Tephritoidea were reared from 29 host fruits: *Anastrepha* Schiner, *Ceratitidis* MacLeay (Tephritidae); *Dasiops* Rondani, *Lonchaea* Fallén, *Neosilba* McAlpine, (Lonchaeidae) and *Notogramma* Loew (Otitidae). Fruit flies (Tephritidae) were found in 19 host fruits and were represented by 11 species: *Anastrepha fraterculus* (Wied.), *A. grandis* (Macquart), *A. montei* Lima, *A. obliqua* (Macquart), *A. pickeli* Lima, *A. sororcula* Zucchi, *A. striata* Schiner, *A. turpiniae* Stone, *A. zenildae* Zucchi, *Anastrepha* n. sp. and *Ceratitidis capitata* (Wied.). From Lonchaeidae were reared: *Dasiops inedulius* Steyskal, *Dasiops* spp., *Lonchaea* spp., *Neosilba zadolicha* McAlpine and *Neosilba* spp. The species of *Neosilba* were the most abundant, occurring in 22 host fruits. *Notogramma* was the only genus of Otitidae obtained. The association between frugivorous flies and the fruit species is discussed.

KEY WORDS: Biodiversity, fruit fly, frugivory, Lonchaeidae, Mid-Western Brazil

Pomiculture is a relatively new economic activity in the state of Mato Grosso do Sul, Brazil, but with great potential. The climatic condition in this state is favorable for growing fruits and vegetables, with no interruption throughout the year, for several species of agricultural importance. The most cultivated fruits are: banana, citrus, watermelon, melon, pineapple, and mango, but there are also commercial orchards of avocado, Barbados cherry, cashew, guava, papaya, passion fruit, peach, and grape, among others. According to IBGE

(1996) the area under cultivation with citrus (orange, lime and tangerine) in 1993-1994 was 777 ha. The largest producers are in the municipalities of Terenos and Coxim.

Fruit flies of the genus *Anastrepha* and *Ceratitidis capitata* (Tephritidae) are the most important pests to the Brazilian pomiculture (Zucchi 2000). In Mid-Western Brazil, at least in the states of Mato Grosso do Sul and Goiás, besides tephritids, species of the genera *Dasiops* and *Neosilba* (Lonchaeidae) are also important pests in citrus, guava, papaya, Barbados cherry,

passion fruit and other commercial fruits (Veloso *et al.* 1994, Uchôa-Fernandes & Zucchi 1999). Integrated pest management has been more difficult by the lack of basic studies on taxonomy, biology and ecology. In Brazil, records on the genera of Lonchaeidae associated with fruits are scarce. Regional surveys are very important because they can provide basic information for managing insect pest populations and their natural enemies.

The objective of this paper is to assess the diversity of fruit fly species and lonchaeids occurring in wild and cultivated fruits in the cerrado of the state of Mato Grosso do Sul.

Material and Methods

Collecting Host Fruits. Fruits, pods or flowers from 35 species (Table 1) were collected, from January 1993 to March 1997, in the cerrado of the municipalities of Anastácio (20° 31' 36" S, 55° 50' 12" W, 170 m), Aquidauana (20° 39' S, 55° 19' 50" W, 173 m), Coxim (18° 30' 12" S, 54° 45' W, 205 m), Dois Irmãos do Buriti (20° 39' S, 55° 19' 50" W, 315 m), Nioaque (21° 20' S, 55° 49' 45" W, 205 m), Rochedo (19° 57' 30" S, 54° 53' 10" W, 398m) and Terenos (20° 26'

Table 1. Frugivorous fly species reared in fruits, pods or flowers in 29 host plant species from seven municipalities of the state of Mato Grosso do Sul, Brazil (January/1993 to March/1997). () Number of specimens

Host plants	Tephritid species	Lonchaeidae and Otitidae	Collecting sites
Anacardiaceae			
Cashew, <i>Anacardium occidentale</i> L.	<i>Anastrepha</i> sp. (1 male)	-	Aquidauana
Mango, <i>Mangifera indica</i> L.	<i>Anastrepha</i> spp.(321) <i>Anastrepha obliqua</i> (170) <i>A. turpiniae</i> (1) <i>Ceratitis capitata</i> (13)	<i>Neosilba</i> spp. (23)	Aquidauana, Coxim, Terenos
Hog plum, <i>Spondias lutea</i> L.	<i>Anastrepha</i> spp. (1,145) <i>A. obliqua</i> (581)	-	Anastácio, Aquidauana
Red mombim, <i>Spondias purpurea</i> L.	<i>Anastrepha</i> spp. (226) <i>A. obliqua</i> (99) <i>A. sororcula</i> (2) <i>A. turpiniae</i> (1) <i>C. capitata</i> (3)	<i>Neosilba</i> sp. (1) <i>Dasiops</i> sp. (1)	Anastácio, Aquidauana, Coxim, Terenos
Annonaceae			
Sugar apple, <i>Annona squamosa</i> L.	-	<i>Neosilba</i> spp. (41)	Anastácio
<i>Duguetia furfuracea</i> St. Hil.	-	<i>Neosilba</i> spp. (200)	Aquidauana, Terenos
<i>Rollinia</i> sp.	-	-	Anastácio, Aquidauana, Terenos
Caricaceae			
Papaya, <i>Carica papaya</i> L.	-	<i>Neosilba</i> spp. (6)	Aquidauana
Caryocaraceae			
“Pequi”, <i>Caryocar brasilense</i> Camb.	<i>A. sororcula</i> (1)	<i>Neosilba</i> spp. (2,913) Otitidae (27)	Aquidauana, Rochedo, Terenos
Combretaceae			
Tropical almond, <i>Terminalia catappa</i> L.	<i>Anastrepha</i> spp. (3) <i>A. zenildae</i> (1) <i>C. capitata</i> (2,131)	<i>Neosilba</i> spp. (140)	Anastácio, Aquidauana
Cucurbitaceae			
Squash, <i>Cucurbita moschata</i> (Duch.)	<i>Anastrepha</i> spp. (50) <i>A. grandis</i> (21)	-	Aquidauana, Rochedo
Euphorbiaceae			
Cassava, <i>Manihot esculenta</i> Crantz	<i>Anastrepha</i> spp. (140) <i>C. montei</i> (76) <i>A. pickeli</i> (1)	-	Anastácio, Rochedo
“Maniçoba”, <i>Manihot</i> sp.	<i>Anastrepha</i> spp. (46) <i>Anastrepha</i> n. sp. (20)	<i>Neosilba</i> spp. (140) <i>Lonchaea</i> sp. (11)	Terenos
“Mamona”, <i>Ricinus comunis</i> L.	-	-	Anastácio
Mimosaceae			
Inga, <i>Inga laurina</i> (Sw.)	<i>C. capitata</i> (50)	<i>Neosilba</i> spp. (199)	Anastácio, Aquidauana, Dois Irmãos do Buriti
“Tamarindo”, <i>Tamarindus indica</i> L.	-	-	Anastácio, Terenos
“Cambaru”, <i>Dipterix alata</i> Vog.	-	-	Terenos

continua...

Tabela 1. Continuação.

Lauraceae			
Avocado, <i>Persea americana</i> Mill.	<i>A. striata</i> (1)	<i>Neosilba</i> spp. (20) Otitidae (99)	Aquidauana, Anastácio, Terenos
Malpighiaceae			
Barbados cherry, <i>Malpighia puniceifolia</i> L.	-	<i>Neosilba</i> sp. (2)	Aquidauana
Myrtaceae			
“Guavira”, <i>Campomanesia sessiflora</i> (Berg.)	<i>Anastrepha</i> spp. (286) <i>A. sororcula</i> (141) <i>A. zenildae</i> (4) <i>A. obliqua</i> (1) <i>C. capitata</i> (5)	<i>Neosilba</i> spp. (72) Otitidae (27).	Anastácio, Aquidauana, Nioaque, Rochedo, Terenos
“Cagaita”, <i>Eugenia dysinterica</i> Dc.	<i>Anastrepha</i> spp. (14) <i>A. obliqua</i> (3)	<i>Neosilba</i> spp. (33)	Aquidauana
“Uvaia”, <i>Eugenia uvalha</i> Camb.	-	<i>Neosilba</i> sp. (8)	Aquidauana
Jabuticaba, <i>Myrciaria jaboticaba</i> Baill.	<i>Anastrepha</i> spp. (64) <i>A. obliqua</i> (29) <i>A. sororcula</i> (9)	<i>Neosilba</i> sp. (1)	Anastácio, Aquidauana
Guava, <i>Psidium guajava</i> L.	<i>Anastrepha</i> spp. (2,494) <i>A. sororcula</i> (994) <i>A. turpiniae</i> (161) <i>A. striata</i> (50) <i>A. obliqua</i> (26) <i>A. zenildae</i> (19) <i>A. fraterculus</i> (9) <i>C. capitata</i> (382)	<i>Neosilba</i> spp. (292)	Anastácio, Aquidauana, Coxim, Terenos
“Araçá”, <i>Psidium</i> sp.	<i>Anastrepha</i> spp. (517) <i>A. sororcula</i> (167) <i>A. striata</i> (79) <i>A. fraterculus</i> (3)	-	Aquidauana
Jambolan plum, <i>Syzygium cumini</i> (L.)	<i>A. sororcula</i> (1)	<i>Neosilba</i> spp. (4)	Aquidauana
Moraceae			
Wild fig, <i>Ficus</i> sp.	-	-	Aquidauana
Oxalidaceae			
Carambola, <i>Averrhoa carambola</i> L.	<i>Anastrepha</i> spp. (73) <i>A. obliqua</i> (42) <i>C. capitata</i> (42)	<i>Neosilba</i> spp. (64)	Anastácio, Aquidauana
Passifloraceae			
Passion fruit, <i>Passiflora edulis</i> Sims	-	<i>Notogramma cimiciforme</i> (67) (Otitidae)	Aquidauana
Flowers of passion fruit, <i>P. edulis</i>	-	-	Anastácio, Aquidauana
Wild passion fruit, <i>Passiflora</i> sp.	-	<i>Neosilba</i> spp. (38) <i>N. zadolicha</i> (61) <i>N. cimiciforme</i> (22,Otitidae)	Terenos
Flowers of wild passion fruit, <i>Passiflora</i> sp.	-	<i>Dasiops inedulis</i> (5)	Terenos
Rutaceae			
Orange, <i>Citrus sinensis</i> (L.)	<i>A. turpiniae</i> (2) <i>C. capitata</i> (66)	<i>Neosilba</i> spp. (3,360) Otitidae (67)	Anastácio, Aquidauana, Terenos, Rochedo
Tangerine, <i>Citrus reticulata</i> (L.)	-	<i>Neosilba</i> spp. (213)	Anastácio, Aquidauana, Terenos
Sapindaceae			
“Água-pomba” <i>Melicoccus lepidopetalus</i> Radlk.	-	-	Anastácio
Solanaceae			
“Juá”, <i>Solanum viarum</i> Dun.	-	<i>Neosilba</i> sp. (246) Otitidae (9)	Aquidauana
Verbenaceae			
“Tarumã” <i>Vitex cymosa</i> Bert.	-	Otitidae (1)	Anastácio, Aquidauana

12° S, 54° 04' 54" W, 308m). These cities are located in the major fruit producing areas in the state of Mato Grosso do Sul. Collecting fruits, and fruit fly and lonchaeid rearings were done according to Uchôa-Fernandes & Zucchi (1999).

Fly Identification. The adults were identified in the Departamento de Entomologia, Fitopatologia e Zoologia Agrícola, Escola Superior de Agricultura "Luiz de Queiroz" (ESALQ), Universidade de São Paulo (USP), Piracicaba-SP, by the first author. For *Anastrepha* Schiner, mainly characteristics of the female aculeus and the chromatic patterns of the body and wings were considered (Lima 1934, Stone 1942, Blanchard 1961, Steyskal 1977, Zucchi 2000).

Ceratitis capitata (Wied.) is the only species of this genus in Brazil and, it is easily recognized by the diagnosis discussed by Foote (1980). The genera of Lonchaeidae were identified using keys and original descriptions (Korytkowski & Ojeda 1971, McAlpine & Steyskal 1982, McAlpine 1987, Norrbom & McAlpine 1997) and *Notogramma cimiciforme* Loew (Otitidae) was identified by Dr. Allen L. Norrbom (National Museum of Natural History, Washington-D.C., USA). *Neosilba zadolicha* McAlpine was identified by means of morphology and male terminalia (McAlpine & Steyskal 1982) and *Dasiops inedulius* Steyskal, based on aculeus shape (Norrbom & McAlpine 1997).

Plant species were identified by botanists at the Herbário Central da Universidade Federal de Mato Grosso do Sul (UFMS) and Departamento de Botânica, Universidade de São Paulo (USP) in São Paulo. Voucher specimens of the insects were deposited at Coleção Zoológica (ZUFMS), Universidade Federal de Mato Grosso do Sul (UFMS) in Campo Grande-MS and at Coleção Entomológica do Departamento de Entomologia, Fitopatologia e Zoologia Agrícola, ESALQ-USP in Piracicaba-SP. Voucher specimens of host plants were deposited at the Herbário Central da UFMS in Campo Grande-MS and at Coleção de Botânica, Departamento de Botânica, USP, in São Paulo-SP.

Results and Discussion

Host Fruits. Species of six genera of frugivorous Tephritoidea were reared: *Anastrepha*, *Ceratitis* (Tephritidae), *Dasiops*, *Lonchaea*, *Neosilba* (Lonchaeidae), *Notogramma* and other unidentified genera of Otitidae. The highest number of specimens belong to *Neosilba* and *Anastrepha* (Table 2). Out of 35 fruit species sampled in 18 families, were obtained frugivorous flies from 29 plant species (Tables 1 and 3). Only in six fruit species no adult flies were collected: *Melicoccus lepidopetalus*, *Rollinia* sp., *Dipterix alata*, *Ficus* sp., *Ricinus communis* and *Tamarindus indica* (Tables 1 and 4).

Tephritidae. Ten *Anastrepha* species were collected: *A. fraterculus* (Wied.), *A. grandis* (Macquart), *A. montei* Lima, *A. obliqua* (Macquart), *A. pickeli* Lima, *A. sororcula* Zucchi, *A. striata* Schiner, *A. turpiniae* Stone, *A. zenildae* Zucchi and *Anastrepha* n. sp. (Table 3). The occurrence of these species besides *C. capitata* (Wied.) was reported recently

Table 2. Genera of Tephritoidea (Diptera) with species reared in host fruits from seven municipalities of the state of Mato Grosso do Sul, Brazil (January/1993 to March/1997).

Genera	Males (n)	Females (n)	Total
<i>Anastrepha</i> Schiner	2,670	2,715	5,385
<i>Ceratitis</i> MacLeay	1,366	1,326	2,692
<i>Dasiops</i> Rondani	0	6	6
<i>Lonchaea</i> Fallén	2	9	11
<i>Neosilba</i> McAlpine	3,774	4,303	8,077
<i>Notogramma</i> Loew and other Otitidae	163	156	319
Total	7,970	8,510	16,490

in the state of Mato Grosso do Sul (Uchôa-Fernandes & Zucchi 2000).

The tephritids (*Anastrepha* spp. and *C. capitata*) were reared from 19 host fruits. In the genus *Anastrepha*, whose identification is based on the female, *A. sororcula* was the species with the largest abundance (1,315), followed by *A. obliqua* (951) and *A. turpiniae* (165). The largest number of individuals of those three species was obtained from two hosts: guava (*Psidium guajava* L.), for *A. sororcula* and *A. turpiniae*, and hog plum (*Spondias lutea* L.), for *A. obliqua* (Table 3). *A. sororcula* was more common than *A. fraterculus* in four municipalities sampled: Anastácio, Aquidauana, Coxim and Terenos (Table 1), where only nine specimens of *A. fraterculus* were collected, in spite of the fact that it is a common species in guava orchards in other Brazilian regions (Nascimento et al. 1982).

A. sororcula, followed by *A. turpiniae* and *A. striata*, were more common in guava than *A. zenildae*, which infests largely guava in the semi-arid Northeast of Brazil (Araújo et al. 2000, Canal et al. 1998a). Also, in Nova Soure (BA), in a transition between Atlantic forest and the caatinga, most specimens of *Anastrepha* caught in traps were *A. sororcula* (A.S. Nascimento, pers. comm.). Similar to other Brazilian regions (Bressan & Teles 1991, Zahler 1991, Morgante 1991, Aguiar-Menezes & Menezes 1996), *A. obliqua* also prefers Anacardiaceae fruits in the cerrado of Mato Grosso do Sul.

Mediterranean fruit fly, *C. capitata*, is widespread in Brazil: Bahia, Minas Gerais, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, Rio Grande do Sul, Maranhão, PERNANBUCO, Ceará, Rio Grande do Norte, Espírito Santo, Goiás (Malavasi et al. 2000), Mato Grosso do Sul (Uchôa-Fernandes & Zucchi 2000), Rondônia (Ronchi-Teles & Silva 1996), Pará (Silva et al. 1998), and Amapá (Silva & Ronchi-Teles 2000). This species is distributed throughout Brazil and it was the fruit fly species with the largest number of individuals reared from the fruits (Table 3). For *C. capitata* the major host was tropical almond (*Terminalia catappa* L.), native to the Malay Peninsula (Liquido et al. 1991), to which medfly seems to present strong adaptation. The infestation by medfly of *T. catappa* also occurred in several Brazilian regions (Morgante 1991, Ronchi-Teles & Silva 1996, Canal et al. 1998b, Veloso et al. 1994) and around the world (Liquido et al. 1991). Medfly shows strong colonization in

Table 3. Frugivorous Tephritoidea reared in fruits, pods or flowers from seven municipalities of the state of Mato Grosso do Sul, Brazil (January/1993 to March/1997).

Species	Municipality / site	Hosts and (specimens)
Tephritidae		
<i>Anastrepha</i> spp. (males)		(2,670)
<i>A. fraterculus</i> (Wiedemann)	Aquidauana, Terenos	Guava (9), "araçá" (3)
<i>A. grandis</i> (Macquart)	Faz. Ranchinho, Rochedo	Squash (21)
<i>A. montei</i> Costa Lima	Rochedo, Anastácio	Fruits of cassava (76)
<i>A. obliqua</i> (Macquart)	Anastácio, Aquidauana, Coxim, Terenos	Mango (170), hog plum (581), red mombim (99), "guavira" (1), "cagaita" (3), jabuticaba (29), guava (26), carambola (42)
<i>A. pickeli</i> Costa Lima	Faz. Ranchinho, Rochedo	Fruits of cassava (1)
<i>A. sororcula</i> Zucchi	Anastácio, Aquidauana, Coxim, Nioaque, Rochedo, Terenos	"Araçá" (167), red mombim (2), guava (994), "guavira" (141), jabuticaba (9), jambolan plum (1), "pequi" (1)
<i>A. striata</i> Schiner	Aquidauana, Terenos	Avocado (1), "araçá" (79), guava (50)
<i>A. turpiniae</i> Stone	Aquidauana, Coxim, Terenos	Red mombim (1), mango (1), Guava (161), orange (2)
<i>A. zenildae</i> Zucchi	Aquidauana, Rochedo, Terenos	Guava (19), "guavira" (4) and tropical almond (1)
<i>Anastrepha</i> sp. n.	Colônia Jamic, Terenos	"Maniçoba" (20)
<i>Ceratitidis capitata</i> (Wiedemann)	Anastácio, Aquidauana, Terenos	Red mombim (3), mango (13), tropical almond (2,131), inga (50), guava (382), "guavira" (5), carambola (42), orange (66)
Lonchaeidae		
<i>Dasiops</i> spp.	Anastácio	Red mombim (1)
<i>D. inedulis</i> Steyskal	Colônia Jamic, Terenos	Flowers of wild passion fruit (5)
<i>Lonchaea</i> spp.	Colônia Jamic, Terenos	"Maniçoba" (11)
<i>Neosilba</i> spp.	Anastácio, Aquidauana, Coxim, Dois Irmãos do Buriti, Nioaque, Rochedo, Terenos	Mango (23), red mombim (1), sugar apple (41), Duguetia (200), papaya (6), "pequi" (2,913), tropical almond (140), "maniçoba" (140), avocado (20), inga (199), Barbados cherry (2), "cagaita" (33), guava (292), "guavira" (72), jabuticaba (1), jambolan plum (4), uvaia (8), carambola (64), wild passion fruit (38), orange (3,360), tangerine (213), "juá" (246)
<i>N. zadolicha</i> McAlpine	Colônia Jamic, Terenos	Wild passion fruit (61)
Otitidae		
<i>Notogramma cimiciforme</i> Loew	Aquidauana, Terenos	Passion fruit (67), wild passion fruit (22)

Anastrepha spp.: Only males - specific identification is based on females.

guava, *P. guajava* (native) but also in orange, *C. sinensis*, (exotic) as well.

The occurrence of many individuals of medfly in guava shows a good adaptation also in Mid-Western Brazil. Medfly had higher infestation in guavas than the native species *A. fraterculus* and *A. zenildae*. However, it should be pointed out that most of the samples were collected in urban areas. It is known that *C. capitata* in urban areas tends to overcome the native species of the genus *Anastrepha* (Haji *et al.* 1991, Harris 1993, Canal *et al.* 1998b).

The occurrence of *C. capitata* in *Inga laurina* is a new record. In Brazil species of *Inga* are usually attacked by *A. distincta* Greene, which occurs in the surveyed region and was caught in McPhail traps (Uchôa-Fernandes & Zucchi 2000), but has not been reared from fruits yet. However, the pods of *I. laurina* attacked by medfly were collected in urban

areas of Anastácio and Aquidauana. Only species of *Neosilba* emerged from *I. laurina* pods sampled in the forests.

Guava was the host with the largest tephritid diversity: six species of *Anastrepha* and *C. capitata* from which emerged the largest number of *Anastrepha* specimens (Table 1). *A. obliqua* and *C. capitata*, followed by *A. sororcula*, infested the largest number of host fruit species. Surprisingly, *A. fraterculus*, a generalist species with wide geographical range in south of Brazil, was obtained only from two host fruits (Table 3).

Lonchaeidae. The species of *Neosilba* had an absolute predominance over all frugivorous flies, mainly in the orange, *Citrus sinensis* (L.), tangerine, *C. reticulata* (L.) and "pequi", *Caryocar brasiliense* Camb. Species of *Neosilba* occurred in 22 host fruit species (Table 3), in the seven municipalities

Table 4. Indices of infestation and viability of 3rd-instar larvae (L3) of frugivorous flies in 35 plant species in the “cerrado” from the state of Mato Grosso do Sul, Brazil (January/1993 to March/1997).

Host plants	N ^o of fruits and () samples	kg	L3 (n)	Flies (n)	Parasitoids (n)	Index L3/fruit L3/kg		Larval viability (%)	Species
Anacardiaceae									
Hog plum, <i>Spondias lutea</i>	640 (3)	7.430	1,834	1,145	32	2.86	246.84	64.2	<i>A. obliqua</i>
Red mombim, <i>S. purpurea</i>	484 (8)	6.885	574	231	3	1.19	83.37	40.7	<i>A. obliqua</i> <i>A. sororcula</i> <i>A. turpiniae</i> <i>C. capitata</i> <i>Neosilba</i> sp. <i>Dasiops</i> sp.
Cashew, <i>Anacardium occidentale</i>	14 (1)	2.077	4	2	0	0.28	1.92	50.0	<i>Anastrepha</i> sp.
Mango, <i>Mangifera indica</i>	93 (9)	43.811	1,190	357	0	12.80	27.16	30.0	<i>A. obliqua</i> , <i>A. turpiniae</i> <i>Ceratitis capitata</i> <i>Neosilba</i> spp.
Annonaceae									
Sugar apple, <i>Annona squamosa</i>	39 (4)	5.702	43	42	1	1.10	7.54	100.0	<i>Neosilba</i> spp.
<i>Duguetia furfuracea</i>	204 (8)	11.464	234	200	3	1.15	20.42	86.8	<i>Neosilba</i> spp.
<i>Rollinia</i> sp.	8 (5)	1.413	5	0	0	0.62	3.54	0	none
Caricaceae									
Papaya, <i>Carica papaya</i>	21 (1)	5.820	131	6	0	6.24	22.51	4.6	<i>Neosilba</i> sp.
Caryocaraceae									
“Pequi”, <i>Caryocar brasiliense</i>	562 (15)	77.251	3,967	2,941	22	7.06	51.35	74.7	<i>Neosilba</i> spp. <i>A. sororcula</i> Otitidae
Combretaceae									
Tropical almond, <i>Terminalia catappa</i>	443 (10)	15.323	2,760	2,363	2	6.23	180.12	85.7	<i>C. capitata</i> <i>Neosilba</i> spp. <i>A. zenildae</i>
Cucurbitaceae									
Squash, <i>Cucurbita moschata</i>	2 (2)	2.496	51	51	0	25.50	20.43	100.0	<i>A. grandis</i>
Euphorbiaceae									
Casava, <i>Manihot esculenta</i>	1,760 (4)	4.119	638	309	12	0.36	154.89	50.3	<i>A. montei</i> <i>A. pickeli</i>
“Maniçoba”, <i>Manihot</i> sp.	455 (6)	7.918	424	197	0	0.93	53.55	46.5	<i>Anastrepha</i> sp. n. <i>Neosilba</i> spp. <i>Lonchaea</i> sp.
“Mamona”, <i>Ricinus communis</i>	5,519 (5)	11.980	0	0	0	0	0	0	none
Mimosaceae									
Inga, <i>Inga laurina</i>	1,545 (6)	11.427	544	249	1	0.35	47.61	46.0	<i>Neosilba</i> spp. <i>C. capitata</i>
“Cambaru”, <i>Dipterix alata</i>	223 (2)	4.278	0	0	0	0	0	0	none
“Tamarindo”, <i>Tamarindus indica</i>	771 (3)	6.615	0	0	0	0	0	0	none
Moraceae									
Wild fig, <i>Ficus</i> sp.	239 (2)	2.401	0	0	0	0	0	0	none
Lauraceae									
Avocado, <i>Persea Americana</i>	50 (4)	17.041	264	134	0	5.28	15.49	50.8	<i>A. striata</i> <i>Neosilba</i> spp. Otitidae
Malpighiaceae									
Barbados cherry, <i>Malpighia punicifolia</i>	435 (1)	0.854	3	2	0	0.007	3.513	66.7	<i>Neosilba</i> sp.

continua...

Tabela 1. Continuação.

Myrtaceae									
"Araça", <i>Psidium</i> sp.	1,313 (5)	10.380	789	517	67	0.60	76.01	74.0	<i>A. sororcula</i> <i>A. striata</i> , <i>A. fraterculus</i>
Guava, <i>P. guajava</i>	1,728 (13)	89.772	4,365	3,168	120	2.53	48.62	75.3	<i>A. sororcula</i> <i>A. turpiniae</i> <i>A. striata</i> <i>A. obliqua</i> <i>A. zenildae</i> <i>A. fraterculus</i> <i>C. capitata</i> <i>Neosilba</i> spp.
"Guavira", <i>Campomanesia sessiflora</i> .	8,179 (9)	19.662	836	391	16	0.10	42.52	48.7	<i>A. sororcula</i> <i>A. zenildae</i> <i>A. obliqua</i> <i>C. capitata</i> <i>Neosilba</i> spp.
Jabuticaba, <i>Myrciaria jабoticaba</i>	2,539 (9)	14.374	128	65	0	0.05	8.90	50.8	<i>A. obliqua</i> <i>A. sororcula</i> <i>Neosilba</i> sp.
Jambolan plum, <i>Syzygium cumini</i>	2,067 (3)	9.049	13	5	0	0.006	1.437	38.5	<i>A. sororcula</i> <i>Neosilba</i> sp.
"Cagaita", <i>Eugenia dysinterica</i>	80 (2)	0.704	95	47	0	1.187	134.94	49.5	<i>A. obliqua</i> <i>Neosilba</i> spp.
Uvaia, <i>Eugenia uvalha</i>	22 (1)	0.288	19	8	0	0.864	65.97	42.1	<i>Neosilba</i> spp.
Oxalidaceae									
Carambola, <i>Averrhoa carambola</i>	225 (8)	13.906	302	179	0	1.342	21.72	59.3	<i>A. obliqua</i> <i>C. capitata</i> <i>Neosilba</i> spp.
Passifloraceae									
Passion fruit, <i>Passiflora edulis</i>	33 (1)	2.400	81	67	0	2.454	33.75	82.7	<i>Notogramma cimiciforme</i> (Otitidae)
Wild passion fruit, <i>Passiflora</i> sp.	98 (4)	5.198	221	121	0	2.255	42.52	54.8	<i>Neosilba</i> spp. <i>N. zadolicha</i> <i>N. cimiciforme</i>
Flowers of wild passion fruit, <i>Passiflora</i> sp.	78 (3)	0.116	52	5	0	0.667	448.27	9.6	<i>Dasiops inedulis</i>
Rutaceae									
Orange, <i>Citrus sinensis</i>	2,346 (179)	357.260	5,700	3,694	194	2.43	15.95	68.2	<i>Neosilba</i> spp. <i>C. capitata</i> <i>A. turpiniae</i> Otitidae
Tangerine, <i>C. reticulata</i>	134 (18)	21.597	355	241	51	2.65	16.43	82.3	<i>Neosilba</i> spp. Otitidae
Sapindaceae									
"Água-pomba", <i>Melicoccus lepidopetalus</i>	1,147 (22)	34.43	24	0	0	0.02	2.46	0	None
Solanaceae									
"Jua", <i>Solanum viarum</i>	749 (5)	10.395	289	255	2	0.39	27.80	88.9	<i>Neosilba</i> spp. Otitidae
Verbenaceae									
"Tarumã", <i>Vitex cymosa</i>	1,076 (3)	5.372	4	1	0	0.004	0.74	25.0	Otitidae
Total	35,321 (367)	814.53	25,939	16,993	526	-	-	-	-

Anastrepha spp.: Only males - specific identification based on females; () Number of samples.

sampled (Table 2). The species of the other genera were rarely reared from fruits. Except for *Dasiops inedulius* and *Neosilba zadolicha*, other species of Lonchaeidae were not identified due to the lack of taxonomic reviews for the neotropical lonchaeids. Only one specimen of *Dasiops* sp. emerged from *Spondias purpurea* (red mombim) and 11 individuals of *Lonchaea* spp. were reared in wild cassava fruits - *Manihot* sp. (Tables 1 e 3).

In spite of the economic importance of some species of Lonchaeidae that occur as pests on fruit and vegetables in several countries, such as Colombia (Steyskal 1978, 1980, Chacon & Rojas 1984, Peñaranda et al. 1986), Peru (Korytkowski & Ojeda 1971), Porto Rico (Romero & Ruppel 1962), Costa Rica (Sánchez et al. 1991) and USA (Moffitt & Yarus 1961, Norrbom & McAlpine 1997), the knowledge of these dipterous is still incipient. Also in Brazil, research on the damage in fruits and vegetables by lonchaeids is very scarce.

The number of *Neosilba* reared from citrus fruits in the sites surveyed is quite superior (3,360 adults) to the number of *Anastrepha* (2) and *C. capitata* (66) (Table 1). These results suggest the economic importance of *Neosilba* sp. as a pest in citrus fruits. Other authors also reported infestation by lonchaeids in oranges (Malavasi & Morgante 1980, Raga et al. 1997) and in coffee berries (Raga et al. 1996) in the state of São Paulo. Studies should be made to evaluate the importance of *Neosilba* for pomiculture in Brazil.

Larvae of *N. zadolicha* attack fruits of a wild species of passion fruit (*Passiflora* sp., Passifloraceae) and larvae of *Dasiops inedulius* Steyskal infest floral buds of that same species (Table 1). According to Norrbom & McAlpine (1997), at least 12 species of *Dasiops* feed in plants of the genus *Passiflora*. *D. inedulius* is considered an important pest in *P. edulis* and *P. quadrangularis* L., sweet passion fruit, in the USA (Norrbom & McAlpine 1997) and Colombia (Peñaranda et al. 1986). Its larvae develop in floral buds, feeding in the ovaries of the flowers, causing the fall of the floral buds and new fruits (Peñaranda et al. 1986).

Otitidae. Some 319 otitids were reared (Table 2), but only *Notogramma cimiciforme* Loew was identified. It feeds on sour passion fruit, *P. edulis* and in a wild *Passiflora* sp., representing 28% of all Otitidae obtained (Table 3). *N. cimiciforme* presents a wide geographical distribution, occurring in the USA, from Mexico to Panama, Cuba, Jamaica, Guyana, Venezuela, Colombia, Brazil, Ecuador, Peru and, according to Steyskal (1968), it was introduced in Oceania.

Infestation Indices and Larval Viability. The highest infestation indices, when considering the number of third instar larvae (L3) by fruit, were obtained in squash (*Cucurbita moschata*) infested exclusively by *A. grandis*; mango (*Mangifera indica*) - infested by *A. obliqua*, *A. turpiniae*, *C. capitata* and *Neosilba* spp.; “pequi” (*Caryocar brasiliense*) attacked almost exclusively by *Neosilba* spp. and the tropical almond (*Terminalia catappa*), highly infested by *C. capitata* (Tables 3 and 4). In mango the losses can be attributed mainly to *A. obliqua*, because 82% of all frugivorous flies in this fruit belong to the West Indian fruit fly (Table 1). If the index L3/kg of fruits is considered, the largest infestation

levels occurred in hog plum (*Spondias lutea*), tropical almond (*T. catappa*), cassava (*Manihot esculenta*), “cagaita” (*Eugenia dysinterica*), red mombim (*Spondias purpurea*) and “araçá” (*Psidium* sp.), respectively. In that last case, there is a tendency of high indices in fruit of lower biomass (Table 4), according to Malavasi & Morgante observations (1980).

Although the biomass of floral buds of wild passion fruit has been very low, only 0.116 g, a very high index of infestation was verified (448.27 L3/kg), with low larval viability (9.6%), and all *D. inedulius*. The largest rates of larval viability occurred in sugar apple (*A. squamosa*) infested by *Neosilba* spp.; in squash by *A. grandis*; in “juá” by species of *Neosilba*; in sour passion fruit by the otitid *N. cimiciforme*; in tangerine by *Neosilba* spp. and in guava by several *Anastrepha* species (Table 4), with the predominance of *A. sororcula*. In guava, *C. capitata* and *Neosilba* spp. also occurred (Table 3).

New Records. This is the first large survey of frugivorous flies in the state of Mato Grosso do Sul (MS). Before this work, as published in Uchôa-Fernandes & Zucchi (2000), only *A. rheediae* was recorded in MS (Malavasi et al. 1980). Including also the state of Mato Grosso (MT), because the split from that state occurred in 1977, the number of *Anastrepha* species recorded for the whole region was nine: one in MS (*A. rheediae*) and eight in MT - *A. grandis*, *A. punctata* (as *A. minor*), collected in Fazenda Murtinho - MS, *A. dissimilis*, *A. leptozona* and *A. mixta*, collected in the district of Utariti, municipality of Diamantino - MT; *A. sororcula*, *A. obliqua* and *A. daciformis* (without record of locality, Uchôa-Fernandes & Zucchi 2000). These are all the records on frugivorous Tephritoidea and its hosts in these two Brazilian states. There was no record of medfly in MS until the beginning of this work (1992).

A. sororcula in jambolan plum (*Syzygium cumini*) and in “pequi” (*Caryocar brasiliense*) and *A. turpiniae* in red mombim (*S. purpurea*); mango (*M. indica*) and orange (*C. sinensis*) are the first records of hosts for these species (Table 1). Also it was observed that species of three genera: *Dasiops*, *Lonchaea* and *Neosilba* (Lonchaeidae) are associated with host fruits in Mato Grosso do Sul, with predominance of the species of *Neosilba*.

Larvae of *Neosilba* spp. were found in a larger number of host fruit species than fruit fly larvae. The diversity of fruit fly species in the cerrado of MS is high in relation to that of other areas studied in Brazil.

Eleven species of parasitoids were detected attacking larvae or pupae of frugivorous flies. Five species of Braconidae parasitize tephritids; four Eucilinae species (Figitidae) attack larvae of *Neosilba* (Lonchaeidae), including a new species of *Trybliographa* (*T. infuscata* Gallardo, Díaz & Uchôa-Fernandes), and two pteromalid species are associated with pupae of both families of Tephritoidea (Uchôa-Fernandes et al. in prep.).

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