

## Species of fruit flies (Diptera: Tephritidae) in a transect of the Amazonian Rainforest in Oiapoque, Amapá, Brazil

Rose B. Rodrigues Trindade<sup>1</sup> & Manoel A. Uchôa<sup>1, 2</sup>

<sup>1</sup> Laboratório de Insetos Frugívoros, Faculdade de Ciências Biológicas e Ambientais, Universidade Federal da Grande Dourados. Rodovia Dourados-Itaum, km 12, Caixa Postal 241, Cidade Universitária, 79804-970 Dourados, MS, Brazil.

<sup>2</sup> Corresponding author. E-mail: uchoa.manoel@gmail.com

**ABSTRACT.** Species of fruit flies (Tephritidae) were surveyed in a transect of the Amazonian Rainforest in the district of Clevelândia do Norte, municipality of Oiapoque, state of Amapá, Brazil. This study describes the diversity of fruit fly species sampled inside this transect (2.2 linear km). Eleven McPhail traps were serviced weekly from June 2002 to June 2003. A total of 55 samples were obtained, totaling 125 specimens of Tephritidae. *Anastrepha* Schiner, 1868 was the most abundant and diverse genus, with 18 species caught. Two new species, *A. oiapoquensis* Norrbom & Uchôa, 2011 and *A. siculigera* Norrbom & Uchôa, 2011, were discovered in this survey. *Anastrepha coronilli* Carrejo & González, 1993 (n = 40) was the most abundant species. Six species, *Anastrepha amita* Zucchi, 1979, *A. duckei* Lima, 1934, *A. flavipennis* Greene, 1934, *A. minensis* Lima, 1937, *A. pseudoparallela* (Loew, 1873), and *A. submunda* Lima, 1937, are recorded for the first time from Amapá. Three of them, *A. minensis*, *A. pseudoparallela*, and *A. submunda*, are reported for the first time from northern Brazil. This paper updates to 36 the number of frugivorous species of Tephritidae in Amapá.

**KEY WORDS.** *Anastrepha*; diversity; McPhail traps; northern Brazil.

The Amazon is the largest Rainforest in the world. In Brazil it occupies an area of approximately 5.5 million km<sup>2</sup>, representing about 50% of the Brazilian territory. It houses a rich plant diversity and a large number of native species of fruit trees, including various species of Anacardiaceae, Myrtaceae, and Sapotaceae (CAVALCANTE 1991), which are considered potential host plants for the species of frugivorous Tephritoidea (ZUCCHI 2008, UCHÔA & NICÁCIO 2010).

In the north region of Brazil, 60 species of *Anastrepha* have been recorded, representing 53.57% of the 112 species of the genus currently reported from the country (ZUCCHI 2008, NORRBOM & UCHÔA 2011). In addition to the species of *Anastrepha*, two introduced species, *Ceratitis capitata* (Wiedemann, 1824) and *Bactrocera carambolae* Drew & Hancock, 1994, also occur in Amapá (SILVA & RONCHI-TELES 2000, UCHÔA & NICÁCIO 2010).

The knowledge of the diversity, as well as the time of population outbreaks of a particular species of Tephritoidea with economic importance, is a prerequisite for the establishment of integrated pest management strategies of fruit fly populations (RONCHI-TELES & SILVA 2005). It appears to us that there are new species of *Anastrepha* in the Oiapoque region and some fruit fly species not yet recorded from northern Brazil or even from the country.

This paper describes the diversity of tephritid species along a transect in the Amazonian Rainforest at the municipality of Oiapoque, state of Amapá, Brazil, provides new records, and suggests ecological patterns for the populations.

## MATERIAL AND METHODS

This study was carried out in the district of Clevelândia do Norte (30°49'35"N, 51°51'39"W), about 2.5 km from the southern margin of the Oiapoque River. This region is located about 5 km south of the city of Oiapoque, Amapá, in the border with French Guiana, and harbors primary Rainforests. The area sampled presents the characteristic vegetation of dense highlands forest (CAVALCANTE 1991).

The climate is Ami type, according to KÖPPEN'S classification, with average annual temperature of 27°C, relative humidity of 82%, and annual rainfall greater than 3,000 mm. The dry period occurs from September to November, and the rainy season extends from December to June (ANA 2004).

Eleven plastic McPhail traps were employed in the survey. All were baited with hydrolyzed corn protein (5% v/v) stabilized with borax (pH 8.5 to 9.0). The traps were placed on the tree branches, 1.60 m above the ground, approximately 200 m apart from one another, along a linear 2.2 km transect. The first trap was placed at 30°48'56"N, 51°51'46"W and the last trap at 30°47'58"N, 51°51'53"W. Each trap was inspected weekly from June 15, 2002 to June 28, 2003 to remove the trapped insects and renew the bait. Because the transect area was homogenous, all flies sampled weekly from the 11 traps were put together, totaling 55 samples.

The collected fruit flies were stored in vials with 70% ethanol, transported to the Laboratório de Insetos Frugívoros,

Faculdade de Ciências Biológicas e Ambientais (FCBA), Universidade Federal da Grande Dourados (UFGD), and identified by M.A. Uchôa, using taxonomic keys and species descriptions (STONE 1942, STEYSKAL 1977, ZUCCHI 2000, NORRBOM 1997, NORRBOM & KORYTKOWSKI 2009). Voucher specimens were deposited in the Entomological Collection of the Museu da Biodiversidade, (FCBA, UFGD), Dourados, state of Mato Grosso do Sul.

Our data on the fruit flies included the numbers of females only, because keys are not yet available for the identification of *Anastrepha* males.

## RESULTS

A total of 125 adults in three Tephritidae genera were collected: *Anastrepha* Schiner, 1868, *Blepharoneura* Loew, 1873, and *Tomoplagia* Coquillett, 1910. Our sample included 30 males and 93 females of *Anastrepha*, a single male of *Blepharoneura*, and another of *Tomoplagia* (Tab. I).

In this survey, 18 *Anastrepha* species were sampled. Of those, six were new records for the state of Amapá, three had

not been previously recorded from northern Brazil, and two were new species, which have been described elsewhere (NORRBOM & UCHÔA 2011) (Tab. I).

This paper includes, in addition to original data, compilation records updating to 34 the number of *Anastrepha* species reported from Amapá (ZUCCHI 2008, SILVA *et al.* 2007, JESUS *et al.* 2008, NORRBOM & UCHÔA 2011), and a total of 36 species of fruit flies, because *Ceratitis capitata* (Wiedemann, 1824) and *Bactrocera carambolae* Drew & Hancock, 1994 are also present in the state (Fig. 1).

*Anastrepha* presented the highest richness ( $S = 18$ ) and abundance (98.4%). It was represented by four species groups according to the classification of NORRBOM *et al.* (1999). The *fraterculus* group was represented by 11 species: *A. amita* Zucchi, 1979, *A. coronilli* Carrejo & González, 1993, *A. distincta* Greene, 1934, *A. duckei* Lima, 1934, *A. flavipennis* Greene, 1934, *A. fraterculus* (Wiedemann, 1830), *A. furcata* Lima, 1934, *A. minensis* Lima, 1937, *A. mixta* Zucchi, 1979, *A. obliqua* (Macquart, 1835), and *A. sororcula* Zucchi, 1979; the *mucronota* group by *A. submunda* Lima, 1937; the *pseudoparallela* group by *A. binodosa*

Table I. Species of Tephritidae from Clevelândia do Norte, municipality of Oiapoque, Amapá: monthly capture, abundance, and frequencies (absolute and relative) (June 2002 to June 2003).

Species/species group	Months from 2002 to 2003												Frequencies		
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Absolute	Relative (%)
<i>Anastrepha amita</i> Zucchi F *							1							1	0.8
<i>A. binodosa</i> Stone P		2												2	1.6
<i>A. coronilli</i> Carrejo & González F		7	16	10	4	1			1		1			40	32.0
<i>A. dissimilis</i> Stone P					1	1		1						3	2.4
<i>A. distincta</i> Greene F										1	2			3	2.4
<i>A. duckei</i> Lima F *						1								1	0.8
<i>A. flavipennis</i> Greene F *				1										1	0.8
<i>A. fraterculus</i> (Wiedemann) F							2							2	1.6
<i>A. furcata</i> Lima F				1						1				2	1.6
<i>A. minensis</i> Lima F *								1						1	0.8
<i>A. mixta</i> Zucchi F					1	2	1							4	3.2
<i>A. obliqua</i> (Macquart) F									1					1	0.8
<i>A. oiapoqueensis</i> Norrbom & Uchôa U						3								3	2.4
<i>A. pseudoparallela</i> (Loew) P *				2		1	1	3	1	1				9	7.2
<i>A. rafaelli</i> Norrbom & Korytkowski R						1								1	0.8
<i>A. siculigera</i> Norrbom & Uchôa U										1				1	0.8
<i>A. sororcula</i> Zucchi F						2	1	2	1	4	6	1		17	13.6
<i>A. submunda</i> Lima M *										1				1	0.8
<i>Anastrepha</i> spp. (males)			2	10	6	5		1		4	1	1		30	24.0
<i>Blepharoneura</i> sp.							1							1	0.8
<i>Tomoplagia</i> sp.											1			1	0.8
Total of individuals	0	2	9	30	18	22	6	8	3	14	10	3	0	125	100.0

Legend for species groups: (F) *fraterculus* group, (M) *mucronota* group, (P) *pseudoparallela* group, (R) *robusta* group, (U) unplaced. \* New record for Amapá.



Figure 1. Geographic distribution in Brazil of the *Anastrepha* species reported from Amapá, based on the present study (species 1, 6, 7, 8, 9, 10, 11, 12, 13, 17, 18, 19, 20, 24, 25, 28, 30, 32) and on previous records: SILVA *et al.* (2007), species 3, 4, 15, 16, 22, 26, 31, 33, 34, 35; JESUS *et al.* (2008), species 21; ZUCCHI (2008), species 2, 5, 14, 23, 27, 29; UCHÔA & NICÁCIO (2010), species 36; and PEREIRA *et al.* (2010), species 7 and 9 from states of Acre and Rondônia. Legend: (\*1) *Anastrepha amita*, (2) *A. anomala*, (3) *A. antunesi*, (4) *A. atrigona*, (5) *A. bahiensis*, (6) *A. binodosa*, (7) *A. coronilli*, (8) *A. dissimilis*, (9) *A. distincta*, (\*10) *A. duckei*, (\*11) *A. flavipennis*, (12) *A. fraterculus*, (13) *A. furcata*, (14) *A. hastata*, (15) *A. leptozona*, (16) *A. limae*, (\*17) *A. minensis*, (18) *A. mixta*, (19) *A. obliqua*, (20) *A. oiapoquensis*, (21) *A. parishi*, (22) *A. pickeli*, (23) *A. pseudanomala*, (\*24) *A. pseudoparallela*, (25) *A. rafaeli*, 26. *A. serpentina*, 27. *A. shannoni*, (28) *A. siculigera*, (29) *A. sodalis*, (30) *A. sororcula*, (31) *A. striata*, (\*32) *A. submunda*, (33) *A. turpiniae*, (34) *A. zenilda*, (35) *Bactrocera carambolae*, (36) *Ceratitidis capitata*. \*New records for the state of Amapá.

Stone, 1942, *A. dissimilis* Stone, 1942, and *A. pseudoparallela* (Loew, 1873); and the *robusta* group by *A. rafaeli* Norrbom & Korytkowski, 2009. The recently described species, *A. oiapoquensis* Norrbom & Uchôa, 2011 and *A. siculigera* Norrbom & Uchôa, 2011, are still not classified phylogenetically into species groups. *Anastrepha coronilli* was the most frequent and abundant (32%)

species of fruit fly in this survey (Tab. I). In Brazil, this species is restricted to the North, with reports from the states of Acre, Amapá, Amazonas, Rondônia, Roraima, and Tocantins (BOMFIM *et al.* 2007, ZUCCHI 2008, PEREIRA *et al.* 2010) (Fig. 1). The second most frequent species was *A. sororcula* (13.6%), followed by *A. pseudoparallela* (7.2%) (sensu NORRBOM 1997) (Tab. I).

## DISCUSSION

Previous studies recorded the occurrence of 25 *Anastrepha* species in the state of Amapá. SILVA *et al.* (2007) presented a list of 14 *Anastrepha* species: *A. antunesi* Lima, 1938, *A. atrigona* Hendel, 1914, *A. coronilli* Carrejo & González, 1993, *A. distincta* Greene, 1934, *A. fraterculus* (Wiedemann, 1830), *A. leptozona* Hendel, 1914, *A. limae* Stone, 1942, *A. obliqua* (Macquart, 1835), *A. pickeli* Lima, 1934, *A. serpentina* (Wiedemann, 1830), *A. sororcula* Zucchi, 1979, *A. striata* Schiner, 1868, *A. turpiniae* Stone, 1942, and *A. zenildae* Zucchi, 1979. ZUCCHI (2008) added 10 other records: *A. anomala* Stone, 1942, *A. bahiensis* Lima, 1937, *A. binodosa* Stone, 1942, *A. dissimilis* Stone, 1942, *A. furcata* Lima, 1934, *A. hastata* Stone, 1942, *A. mixta* Zucchi, 1979, *A. pseudanomala* Norrbom, 2002, *A. shannoni* Stone, 1942, and *A. sodalis* Stone, 1942. JESUS *et al.* (2008) reported the occurrence of *A. parishi* Stone, 1942.

Twelve of the 18 *Anastrepha* species caught in the traps in this research had been previously reported from Amapá (SILVA *et al.* 2007, ZUCCHI 2008, JESUS *et al.* 2008, NORRBOM & UCHÔA 2011). However, six others (*A. amita*, *A. duckei*, *A. flavipennis*, *A. minensis*, *A. pseudoparallela*, and *A. submunda*) are new records. Recently, NORRBOM & UCHÔA (2011) described *A. oiapoquensis* and *A. siculigera*, and reported the occurrence of *A. rafaelli* in Oiapoque, Amapá (Tab. I). The following species are also reported for the first time from northern Brazil: *A. minensis*, *A. pseudoparallela*, and *A. submunda* (Tab. I).

Our findings extend the range of *A. pseudoparallela* to all regions of Brazil. Regarding the species of fruit flies recorded from Amapá, *A. obliqua*, *A. sororcula*, *A. fraterculus*, *A. serpentina*, *A. distincta*, *A. zenildae*, and *C. capitata* are the most widespread in Brazil. *Anastrepha obliqua* occurs in all five regions and in all states, except in the state of Sergipe, where a survey has not been conducted; *A. sororcula* occurs in all regions and 22 states; *A. fraterculus* and *C. capitata* are reported in all regions and 21 states, followed by *A. serpentina*, found in all regions and 19 states; *A. distincta* is known from all regions and 18 states; *A. zenildae* is known from all regions (except South) and 17 states (Fig. 1).

Formerly, *A. minensis* had been reported only from southeastern Brazil. The record of this species from northern Brazil is probably due to the fact that in these two regions there are remnants of Atlantic and Amazonian forests, respectively, where species of *Myrciaria* (Myrtaceae) are found. Species of Myrtaceae produce the preferred host fruit of *Anastrepha* species in the *fraterculus* group (SILVA *et al.* 2010), and *Myrciaria* species are considered natural hosts of *A. minensis* (ZUCCHI 2008).

*Anastrepha obliqua* was rarely found in the traps. Although it is considered one of the most abundant species of fruit flies in orchards in northern Brazil (SILVA & RONCHI-TELES 2000, RONCHI-TELES & SILVA 2005, SILVA *et al.* 2007, BOMFIM *et al.* 2007), its low abundance in native forests was expected. Many species of frugivorous flies usually occur in natural environments, but represented by few individuals. In native forests, there is greater

diversity of hosts and natural enemies, with a tendency of having greater evenness among the different co-occurring species of fruit flies (BOMFIM *et al.* 2007, COSTA *et al.* 2009). Conversely, in fruit crop ecosystems, where host plant diversity is low and species of polyphagous fruit flies such as *A. obliqua* are favored, the opposite situation is found (SILVA *et al.* 2007, 2010). The latter authors examined fruit samples from orchards in several localities from northern and northeastern Brazil and found that *A. obliqua* was one of the most abundant and polyphagous species of fruit flies attacking fruits.

Although in this study 11 traps were used in only one year of survey, and a small transect of native forest (2.2 linear km) was sampled, the diversity of fruit flies found ( $S = 18$ ) can be considered similar to that in other surveys carried out in Brazil. For instance, GARCIA *et al.* (2003), in two years of sampling with 48 traps, captured 14 *Anastrepha* species in the western portion of the state of Santa Catarina. URAMOTO *et al.* (2005), in one year and using 84 traps, sampled 18 *Anastrepha* species in Piracicaba, state of São Paulo. CANESIN & UCHÔA (2007), during one year and using 11 McPhail traps in a fragment of native semideciduous forest in the south of the state of Mato Grosso do Sul, sampled 13 *Anastrepha* species.

It is known that in primary forests (e.g., Amazonian Rainforest) the stability and heterogeneity of the vegetation are higher than in secondary forests and this favors species richness in groups of phytophagous insects such as *Anastrepha* (BOMFIM *et al.* 2007). In this genus, species richness tends to agree with the diversity of plant species. The diversity of fruit trees in a natural forest increases the likelihood of occurrence of monophagous species of fruit flies (*sensu* ALUJA & MANGAN 2008) and, therefore, increases the probability of a greater diversity of Tephritoidea in the ecosystem. This pattern is also common in other groups of arthropods (ALTIERI & LETOURNEAU 1984, ANDOW 1991, BRAGANÇA *et al.* 1998).

A future and important step of our research will be to investigate the host fruits of each captured species of fruit fly, in order better understand the relationships among them and the diversity of their host plants in the Amazonian Rainforest.

## ACKNOWLEDGMENTS

We thank Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for the Magister Scientiae grant to RBRT and for the postdoctoral fellowship (process 1030/09-4 BEX) to M.A. Uchôa. We also thank Allen L. Norrbom (Systematic Entomology Laboratory-USDA, Washington-D.C.) and three anonymous reviewers for their comments on the manuscript.

## LITERATURE CITED

- ALTIERI, M.A. & D.K. LETOURNEAU. 1984. Vegetation diversity and insect pest outbreaks. *CRC Critical Review in Plant Sciences* 2: 131-169.

- ALUJA, M. & R.L. MANGAN. 2008. Fruit fly (Diptera: Tephritidae) host status determination: critical conceptual, methodological, and regulatory considerations. *Annual Review of Entomology* 53: 273-502.
- ANA. 2004 Totais pluviométricos de longo período na Sub-bacia 30 (do rio Oiapoque ao rio Araguari). Agência Nacional de Águas, available online at: <http://www.ana.gov.br/gestao/RecHidricos/InfoHidrologicas> [Accessed: 17/IX/2008]
- ANDOW, D.A. 1991. Vegetational diversity and arthropod population response. *Annual Review of Entomology* 36: 561-586.
- BRAGANÇA, M.A.L.; O.D. SOUZA & J.C. ZANUNCIO. 1998. Environmental heterogeneity as a strategy for pest management in *Eucalyptus* plantations. *Forest Ecology and Management* 102: 9-12.
- BOMFIM, D.A.; M. A. UCHÔA & M.A. L. BRAGANÇA. 2007. Biodiversidade de moscas-das-frutas (Diptera, Tephritoidea) em matas nativas e pomares domésticos de dois municípios do Estado do Tocantins, Brasil. *Revista Brasileira de Entomologia* 51: 217-223.
- CANESIN, A. & M.A. UCHÔA. 2007. Análise faunística e flutuação populacional de moscas-das-frutas (Diptera, Tephritidae) em um fragmento de floresta semidecídua em Dourados, Mato Grosso do Sul. *Revista Brasileira de Zoologia* 24: 185-190.
- CAVALCANTE, P.B. 1991. *Frutas comestíveis da Amazônia*. Belém, Edições CEJUP, Museu Paraense Emílio Goeldi, 5<sup>th</sup> ed., 279p.
- COSTA, S.G.M.; R.B. QUERINO; B. RONCHI-TELES; M.A.M. PENTEADO-DIAS & R.A. ZUCCHI. 2009. Parasitoid diversity (Hymenoptera: Braconidae and Figitidae) on frugivorous larvae (Diptera: Tephritidae and Lonchaeidae) at Adolpho Duke Forest Reserve, Central Amazon Region, Manaus, Brazil. *Brazilian Journal of Biology* 69: 363-370.
- GARCIA, F.R.M.; J.V. CAMPOS & E. CORSEUIL. 2003. Análise faunística de espécies de moscas-das-frutas (Diptera: Tephritidae) na região oeste de Santa Catarina. *Neotropical Entomology* 32: 421-426.
- JESUS, C.R.; N.M. OLIVEIRA; M.F. SILVA-FILHO; R.A. SILVA & R.A. ZUCCHI. 2008. First record of *Anastrepha parishi* Stone (Diptera, Tephritidae) and its host in Brazil. *Revista Brasileira de Entomologia* 52: 135-136.
- NORRBOM, A.L. 1997. Revision of the *Anastrepha benjamini* species group and the *A. pallidipennis* complex (Diptera: Tephritidae). *Insecta Mundi* 11: 141-157.
- NORRBOM, A.L. & C.A. KORYTKOWSKI. 2009. A revision of the *Anastrepha robusta* species group (Diptera: Tephritidae). *Zootaxa* 2182: 1-91.
- NORRBOM, A.L. & M.A. UCHÔA. 2011. New species and records of *Anastrepha* (Diptera: Tephritidae) from Brazil. *Zootaxa* 2835: 61-67.
- NORRBOM, A.L.; R.A. ZUCCHI & V. HERNÁNDEZ-ORTIZ. 1999. Phylogeny of the genera *Anastrepha* and *Toxotripa* (Trypetinae: Toxotripini) based on morphology, p. 299-342. In: M. ALUJA & A.L. NORRBOM (Eds). *Fruit Flies (Tephritidae): Phylogeny and evolution of behavior*. Boca Raton, CRC Press, 944p.
- PEREIRA, J.D.B.; D.P. BURITI; W.P. LEMOS; W.R. SILVA & R.A. SILVA. 2010. Espécies de *Anastrepha* Schiner (Diptera: Tephritidae), seus hospedeiros e parasitóides nos Estados do Acre e Rondônia, Brasil. *Biota Neotropica* 10: 441-446.
- RONCHI-TELES, B. & N.M. SILVA. 2005. Flutuação populacional de espécies de *Anastrepha* Schiner (Diptera: Tephritidae) na região de Manaus, AM. *Neotropical Entomology* 34: 733-741.
- SILVA, J.G.; V.S. DUTRA; M.S. SANTOS; N.M.O. SILVA; D.B. VIDAL; R.A. NINK; J.A. GUIMARÃES & E.L. ARAUJO. 2010. Diversity of *Anastrepha* spp. (Diptera: Tephritidae) and associated Braconid parasitoids from native and exotic hosts in Southeastern Bahia, Brazil. *Environmental Entomology* 39: 1457-1465.
- SILVA, N.M. & B. RONCHI-TELES. 2000. Moscas-das-frutas nos estados brasileiros: Amapá, Amazonas, Pará, Rondônia e Roraima, p. 203-209. In: A. MALAVASI & R.A. ZUCCHI (Eds). *Mosca-das-frutas de importância econômica no Brasil: Conhecimento básico e aplicado*. Ribeirão Preto, FAPESP, Holos, 327p.
- SILVA, R.A.; S.L.O. XAVIER; M.F. SOUZA FILHO; W.R. SILVA; D.B. NASCIMENTO & E.G. DEUS. 2007. Frutíferas hospedeiras e parasitóides (Hym., Braconidae) de *Anastrepha* spp. (Dip., Tephritidae) na Ilha de Santana, Estado do Amapá, Brasil. *Arquivos do Instituto Biológico de São Paulo* 74: 153-156.
- STEYSKAL, G.C. 1977. *Pictorial key to species of the genus Anastrepha (Diptera: Tephritidae)*. Washington, D.C., Entomological Society of Washington, 35p.
- STONE, A. 1942. *The fruit flies of the genus Anastrepha*. Washington, D.C., United States Department of Agriculture, Miscellaneous Publication 439, 112p.
- UCHÔA, M.A. & J.N. NICÁCIO. 2010. New records of Neotropical fruit flies (Tephritidae), lance flies (Lonchaeidae) (Diptera: Tephritoidea), and their host plants in the South Pantanal and adjacent areas, Brazil. *Annals of the Entomological Society of America* 103: 723-733.
- URAMOTO, K.; J.M.M. WALDER & R.A. ZUCCHI. 2005. Análise quantitativa e distribuição de populações de espécies de *Anastrepha* (Diptera: Tephritidae) no Campus Luiz de Queiroz, Piracicaba, SP. *Neotropical Entomology* 34: 33-39.
- ZUCCHI, R.A. 2000. Taxonomia, p.13-24. In: A. MALAVASI & R.A. ZUCCHI (Eds). *Mosca-das-frutas de importância econômica no Brasil: Conhecimento básico e aplicado*. Ribeirão Preto, FAPESP, Holos, 327p.
- ZUCCHI, R.A. 2008. Fruit flies in Brazil – *Anastrepha* species their host plants and parasitoids. Available online at: [www.lea.esalq.usp.br/anastrepha](http://www.lea.esalq.usp.br/anastrepha) [Accessed: 26/V/2011]

Submitted: 17.I.2011; Accepted: 17.VI.2011.

Editorial responsibility: Gabriel L.F. Mejdalani