

Scientific Note

Anastrepha bistrigata Bezzi, 1919 and *Anastrepha striata* Schiner, 1868 (Diptera: Tephritidae) occurring sympatrically in Barreiras, Bahia, Brazil, and first record of both species in the state

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Abstract. *Anastrepha bistrigata* Bezzi, 1919 and *Anastrepha striata* Schiner, 1868 (Diptera: Tephritidae) infest guava (*Psidium guajava* L.), but only *A. striata* is considered a serious pest in all countries where it occurs. Both species also exploit several other host plants. They are frequently collected in fruit fly surveys in Brazil, but it is unusual to collect them in the same locality. For this reason, we report the co-occurrence of *A. bistrigata* and *A. striata* in Barreiras, Bahia, Brazil, which is also the first record of both species in this state. Information on morphological identification, distribution in Brazil, hosts, and sympatric occurrences of these species is also provided.

Keywords: identification, distribution, host plants, guava fruit fly, co-occurrence.

The original description of *Anastrepha bistrigata* Bezzi, 1919 (Diptera: Tephritidae) was based on specimens from state of São Paulo, Brazil (Bezzi 1919), collected in the municipality of Bauru (Norrbon 2002). *Anastrepha striata* Schiner, 1868 (guava fruit fly) was described from a female collected in Venezuela (unknown location) (Schiner 1868; Zucchi 1979; Norrbom 2002).

Anastrepha bistrigata and *A. striata* are sister taxa (MacPherson et al. 1999), included in the *striata* group (Norrbon et al. 1999; 2012). They had been placed in the *serpentina* group (Norrbon 2002), but *serpentina* and *striata* groups are not closely related based on molecular characters (Mengual et al. 2017). The *striata* group comprises three species, as *Anastrepha ornata* Aldrich, 1925 (not recorded in Brazil) is also included in the group (Norrbon et al. 1999; 2012). Both species can be distinguished from *A. ornata* by having scutum with U-shaped dark brown mark (Figs. 1C, D), abdominal tergites without brown markings, and wing with C-band and S-band connected or very narrowly separated, middle section of S-band broad, V-band not connected to basal extension of S-band, cell br with the hyaline area posterior to the pterostigma broadly extended to vein R_{4+5} (Figs. 1A, B). In turn, *A. bistrigata* and *A. striata* are morphologically similar, but can be easily distinguished from each other by the dark-brown dorsocentral vittae on the scutum uninterrupted at the transverse suture in *A. bistrigata* (Fig. 1C), and interrupted in *A. striata* (Fig. 1D). Regarding the female terminalia, both species have similar, broadly triangular, aculeus tip (Figs. 1F, H), but the aculeus of *A. bistrigata* (Fig. E) is longer (more than 3.0 mm long) than that of *A. striata* (Fig. G) (less than 2.5 mm long) (Norrbon 2002). Descriptions and illustrations of both species are available on-line (Norrbon et al. 2012).

Anastrepha bistrigata occurs only in Brazil (Norrbon 2022), with a restricted distribution, being present in only seven of the 26 Brazilian states, but in 4 of 5 geographical regions, namely, the Northeast (Maranhão), Central-West (Goiás and Mato Grosso do Sul), Southeast (Rio de Janeiro, Minas Gerais, and São Paulo) and South (Santa Catarina) (Zucchi & Moraes 2023) (Fig. 2). *Anastrepha striata* is widely

distributed in the American continent, from Mexico to Brazil, occurring in 19 countries (Norrbon 2022). In Brazil, it has been recorded in 13 states in four geographical regions, North (Acre, Amapá, Amazonas, Pará, Rondônia, Roraima, and Tocantins), Northeast (Maranhão and Piauí), Central-West (Goiás, Mato Grosso, and Mato Grosso do Sul), and Southwest (São Paulo) (Zucchi & Moraes 2023) (Fig. 2). Information on distribution and hosts for *A. striata* in the North region was compiled by Adaime et al. (2016). Neither species occurs in all states of the respective Brazilian regions. There is no record of *A. bistrigata* in the North region, and no record of *A. striata* in the South region, despite intensive fruit-fly surveys conducted in several locations in these regions.

In Brazil, larvae of *A. bistrigata* develop in seven host plants. They are associated mostly with species of *Psidium* (Myrtaceae), but they also attack fruits of *Pouteria gardneriana* (A.DC.) Radlk. (Sapotaceae) and *Spondias dulcis* Forst. (Anacardiaceae) (Zucchi & Moraes 2023). Guava (*Psidium guajava* L.) is the only economically important fruit attacked by *A. bistrigata*; although it is frequently collected in guava orchard, it is not considered a guava pest. The other *Psidium* species damaged by *A. bistrigata* are not grown commercially. On the other hand, *A. striata* is a polyphagous species associated with 47 host species, belonging to 17 families, in Brazil. Throughout its distribution in the Americas, 56 host species with validated infestations by *A. striata*, and 50 plant hosts with no validated record of infestation under natural field conditions, were listed by Liquido et al. (2018). *Anastrepha striata* is considered of economic importance by regulatory agencies (Norrbon 2022) for attacking species of the family Myrtaceae, especially guava, in tropical and subtropical regions of the Americas, where it is considered the main guava pest in several countries (Adaime et al. 2014).

The objective of this study is to report the sympatric occurrence of *A. bistrigata* and *A. striata* and record both species for the first time in the state of Bahia. The study area was a guava orchard (1.5 ha) located in the municipality of Barreiras (12°19'03.82"S 45°00'47.91"W), state of Bahia, Northeast region of Brazil. The climate is classified as Aw

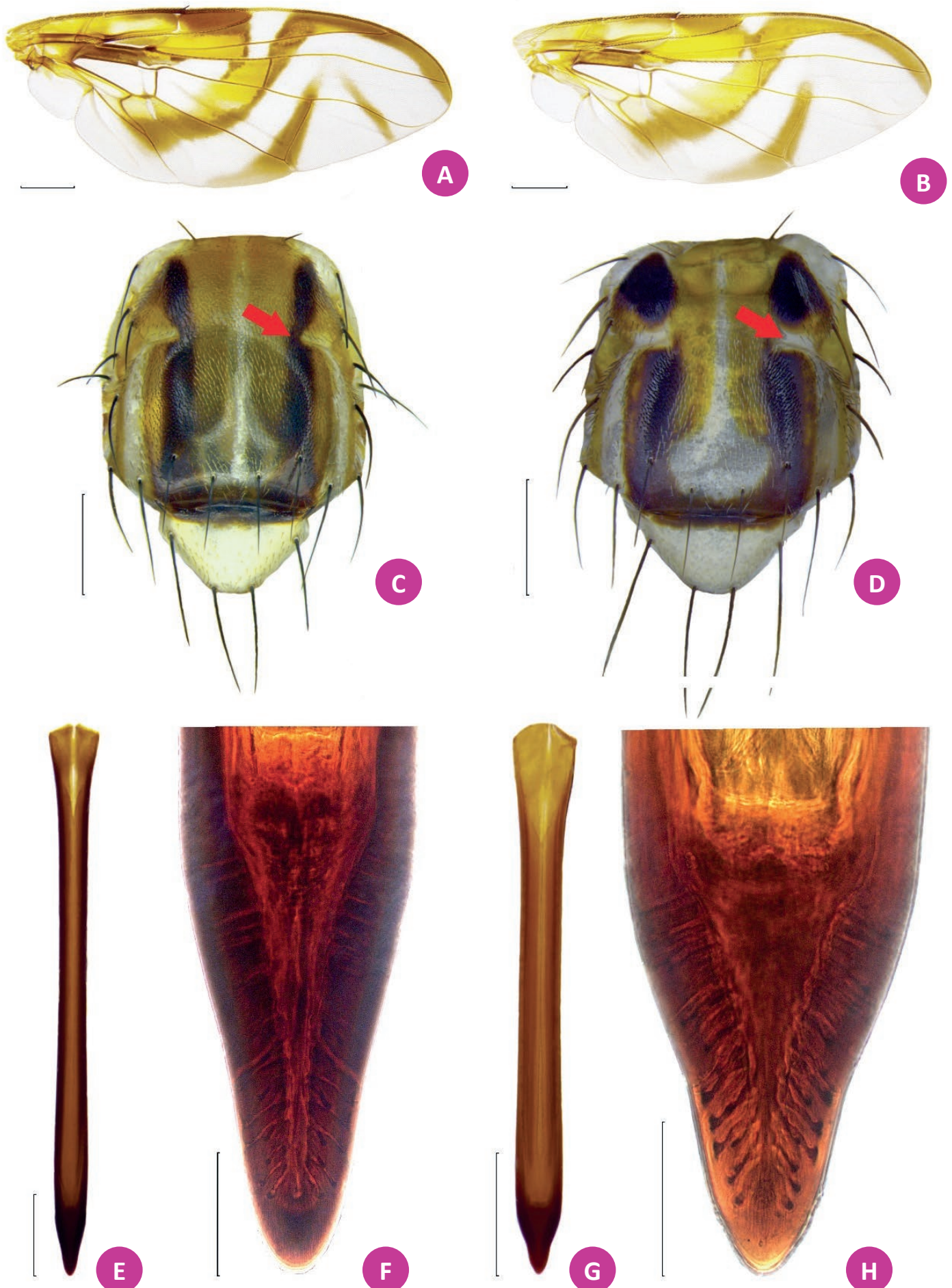


Figure 1. *Anastrepha bistrigata* (A, C, E, F); *Anastrepha striata* (B, D, G, H). Wing (A, B). Thorax (dorsal view) (C, D). Aculeus (ventral view) (E, G). Aculeus tip (ventral view) (F, H). Arrows show the uninterrupted (C) and interrupted (D) U-shaped mark on scutum.

according to the Köppen-Geiger classification, with a rainy season from October to March (average annual temperature of 25.7 °C and average annual rainfall of 863 mm). The orchard is surrounded by livestock pastures, cerrado (savanna) vegetation, and horticulture fields. Scattered around the orchard are several fruit trees, such as, mango (*Mangifera indica* L., Anacardiaceae), grape, (*Vitis vinifera* L., Vitaceae), acerola (*Malpighia puniceifolia* L., Malpighiaceae), cashew (*Anacardium occidentale* L., Anacardiaceae), hog plum (*Spondias mombin* L., Anacardiaceae), and passion fruit (*Passiflora* sp., Passifloraceae).

Fruit flies were collected in ball traps (Fig. 3) baited with 600 mL of the commercial Cera Trap® food attractant, completing the level of the attractant in the traps as recommended by the manufacturer. Collections were carried out weekly from January to August 2021, totaling 30 collections. Five species of fruit flies were collected, namely, *Ceratitis capitata* (Wiedemann, 1824) (303 specimens) *Anastrepha fraterculus* (Wiedemann, 1830) (173), *Anastrepha obliqua* (Macquart, 1835) (5), *Anastrepha sororcula* Zucchi, 1979 (1), *Anastrepha zenildae* Zucchi, 1979 (3), *A. bistrigata* (3) and *A. striata* (14). Voucher specimens of *A. bistrigata* and *A. striata* were deposited in the collection of the Luiz de Queiroz Entomology Museum (MELQ), Piracicaba, state of São Paulo (numbers ESALQENT1749-54).

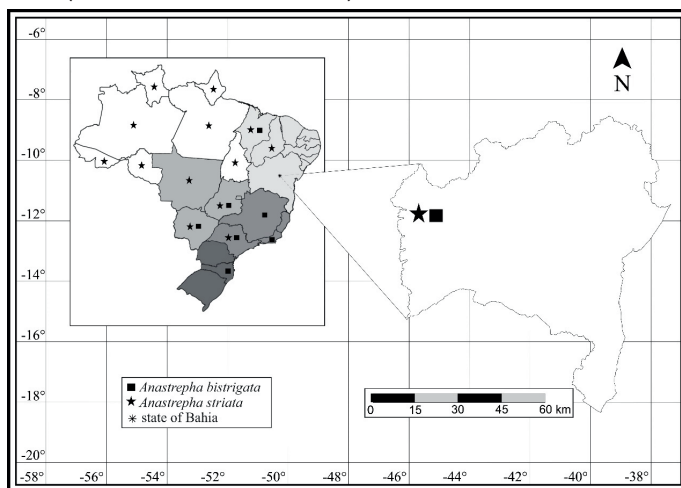


Figure 2. Distribution map of *Anastrepha bistrigata* and *Anastrepha striata* in the Brazilian regions, indicating the municipality of Barreiras, state of Bahia.



Figure 3. Ball trap hanging from a guava tree.

Anastrepha bistrigata and *A. striata* are multivoltine species, which differ in their geographic distributions and hosts (Selivon 2000). *Anastrepha bistrigata*, as mentioned above, is restricted to Brazil and is considered a specialist species, as it develops mainly in *Psidium* species. *Anastrepha striata* is widely distributed in the Americas, from Mexico to Brazil, and is a generalist species, developing in dozens of hosts of several families. The mating behavior of these two species is characterized by the specialist or generalist conditions. Thus, *A. bistrigata* has the typical behavior of a specialist species,

that is, the male chooses the fruit, defends its "territory" from other males, and, when the female seeks the fruit to lay eggs, the male forces copulation. On the other hand, *A. striata* has the characteristic behavior of a generalist species: males form groups (leks) and attract females by emitting a pheromone and producing sounds (Morgante et al. 1993; Selivon & Morgante 1997). Morgante et al. (1993) proposed an allopatric model of speciation for *A. bistrigata* and *A. striata*, with specialization in resource utilization by *A. bistrigata*. Laboratory observations showed that the species differ in behavior and periods of mating activity. *Anastrepha bistrigata* concentrates its mating activity in the morning and the mating behavior is simple. *Anastrepha striata* concentrates its mating activity in the afternoon and the court (lek) is composed of several males (Selivon & Morgante 1997). Aluja et al. (1993) described the daily behavior (feeding, resting, oviposition and mating) of *A. striata* in a greenhouse with vases of *P. guajava* (guava), *Manilkara achras* L. (sapodilla), *Citrus sinensis* Osbeck (orange) and *M. indica* (mango) trees. Under laboratory conditions, most males of *A. striata* are sexually mature at 14 days and females at approximately 17 days (Trassato et al. 2016).

In four Brazilian states (Goiás, Maranhão, Mato Grosso do Sul, and São Paulo), both *A. bistrigata* and *A. striata* have been recorded; in other states, the records refer to one or the other species. However, both species were collected in the same locality, in McPhail traps baited with diluted guava juice hung in guava trees at the experimental station of the Embrapa Genetic Resources and Biotechnology, in Brasília (Federal District), Goiás state (Viana et al. 2019). For the other states, it is not clear if the *A. bistrigata* and *A. striata* were collected in the same locality. Unfortunately, much information on *Anastrepha* fruit flies in Brazil is available only in unpublished records, mostly in abstract books of scientific conferences, and is often difficult to recover.

Therefore, our records from Barreiras, state of Bahia, reveal that this municipality is the second locality where *A. bistrigata* and *A. striata* occur sympatrically in Brazil. Also, our record from Barreiras is the first record of *A. bistrigata* and *A. striata* in this state, extending the distribution of both species to nine and 14 Brazilian states, respectively. In addition, information about the occurrence of *A. bistrigata* and *A. striata* in a single location is of interest to infer about speciation, as well as providing an opportunity to study them concurrently under natural field conditions, for example, through analysis of co-occurrence.

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Authors' Contributions

RAZ drafted the first version of the manuscript. All authors critically revised the text and approved the final manuscript. TSA, DCC, and AELR carried out the studies in the guava orchard. Fruit flies were identified by TAS, MS and RAZ. MS composed the distribution map and plates. TSA took the trap photo.

Conflict of Interest Statement

The authors declare no competing interests.

References

- Adaime, R; Pereira, J. D. B.; Deus, E. G.; Jesus-Barros, C. R. (2014) Host plants and geographical distribution of *Anastrepha striata* Schiner (Diptera: Tephritidae) in Brazil. Macapá: Embrapa Amapá. <https://ainfo.cnptia.embrapa.br/digital/bitstream/item/120371/1/CPAF-AP-2014-DOC-74-Host-plants.pdf>.
- Adaime, R; Sousa, M. S. M.; Pereira, J. F. (2016) *Anastrepha* species and their hosts in the Brazilian Amazon. <http://anastrepha.cpfap.embrapa.br/>. Access on: 18.vii.2023.
- Aluja, M.; Jácome, I.; Birke, A.; Lozada, N.; Quintero, G. (1993)

- Basic patterns of behavior in wild *Anastrepha striata* (Diptera: Tephritidae) flies under field-cage conditions. *Annals of the Entomological Society of America*, 85(6): 776-793. doi: [10.1093/aesa/86.6.776](https://doi.org/10.1093/aesa/86.6.776)
- Bezzi, M. (1919) Una nuova especie brasiliana del genere *Anastrepha* (Dipt.). *Bollettino del Laboratorio di Zoologia Generale e Agraria della Regia Scuola Superiore d'Agricoltura*, 13: 3-14.
- Liquido, N. J.; Lee, K. L. K.; Tateno, A. P. K.; Santamaria, J.; Ching, A. J. F.; Hanlin, M. A.; Marnell, S. A. (2018) Host plant records of the guava fruit fly, *Anastrepha striata* Schiner (Diptera: Tephritidae), Version 1.1. *USDA Compendium of Fruit Fly Host Information (CoFFHI)*, Edition 4.0. Access on: 18.viii.2023.
- McPheron, B. A.; Han H. Y.; Silva, J. G.; Norrbom, A. L. (1999) Phylogeny of the genera *Anastrepha* and *Toxotrypana* (Trypetinae: Toxotrypanini) based upon 16S rRNA mitochondrial DNA sequences. In: Aluja, M.; Norrbom, A. L. (Eds.), *Fruit Flies (Tephritidae): Phylogeny and Evolution of Behavior*, pp. 343-361. Boca Raton: CRC Press.
- Mengual, X.; Kerr, P.; Norrbom, A. L.; Barr, N. B.; Lewis, M. L.; Stapelfeldt, A. M.; Scheffer, S. J.; Wood, P.; Islam, M.-S.; Korytkowski, C.A., et al. (2017) Phylogenetic relationships of the tribe Toxotrypanini (Diptera: Tephritidae) based on molecular characters. *Molecular Phylogenetics and Evolution*, 113: 84-112. doi: [10.1016/j.ympev.2017.05.011](https://doi.org/10.1016/j.ympev.2017.05.011)
- Morgante, J. S.; Selivon, D.; Solferini, V. N.; Matioli, S. R. (1993) Evolutionary pattern in specialist and generalist species of *Anastrepha*. In: Aluja, M.; Liedo, P. (Eds.), *Fruit Flies: Biology and Management*, pp. 15-20. New York: Springer-Verlag.
- Norrbom, A. L. (2002) A revision of the *Anastrepha serpentina* species group (Diptera: Tephritidae). *Proceedings of the Entomological Society of Washington*, 104(2): 390-436.
- Norrbom, A. L. (2022) Tephritidae databases. *Anastrepha striata*. In: Liquido, N. J.; Norrbom, A. L.; McQuate, G. T.; Suiter, K. A.; Yee, W. L.; Chang, C. L. (Eds.), *The USDA compendium of fruit fly host information (CoFFHI)*. Edition 5.0. <https://coffhi.cphst.org/>. Access on: 16.viii.2023.
- Norrbom, A. L.; Korytkowski, C. A.; Zucchi, R. A.; Uramoto, K.; Venable, G. L.; McCormick, J.; Dallwitz, M. J. (2012) (onwards) *Anastrepha* and *Toxotrypana*: descriptions, illustrations, and interactive keys. Version 9 April 2019. <https://www.delta-intkey.com/>. Access on: 16.viii.2023.
- Norrbom, A. L.; Zucchi, R. A.; Hernández-Ortiz, V. (1999) Phylogeny of the genera *Anastrepha* and *Toxotrypana* (Trypetinae: Toxotrypanini) based on morphology. In: Aluja, M.; Norrbom, A. L. (Eds.), *Fruit flies (Tephritidae): Phylogeny and evolution of behavior*, pp. 299-342. Boca Raton: CRC Press.
- Schiner, I. R. (1868) Diptera. In: *Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859, unter den Befehlen des Commodore B. von Wüllerstorff-Urbair. Zoologischer Theil. Zweiter Band. 1. Abtheilung, [Sect.] B, [Art. I].* Vienna: Karl Gerold's Sohn.
- Selivon, D. (2000) Biologia e padrões de especiação. In: Malavasi, A.; Zucchi, R. A. (Eds.), *Moscas-das-frutas de Importância Econômica no Brasil - Conhecimento Básico e Aplicado*, pp. 25-28. Ribeirão Preto: Holos.
- Selivon, D.; Morgante, J. S. (1997) Reproductive isolation between *Anastrepha bistrigata* and *A. striata* (Diptera, Tephritidae). *Brazilian Journal of Genetics*, 20(4): 583-585. doi: [10.1590/S0100-84551997000400005](https://doi.org/10.1590/S0100-84551997000400005)
- Trassato, L. B.; Lima, A. C. S.; Bandeira, H. F. S.; Monteiro Neto, J. L. L. (2016) Sexual behavior of *Anastrepha striata* Schiner (Diptera: Tephritidae) under laboratory conditions. *Revista Brasileira de Ciências Agrárias*, 11(4): 298-303. doi: [10.5039/agraria.v11i4a5396](https://doi.org/10.5039/agraria.v11i4a5396)
- Viana, J. P. C.; Viana, M. C.; Rocha, H. M. C.; Benito, N. P.; Silva, M. L. (2019) Análise faunística e flutuação populacional de moscas-das-frutas (Diptera Tephritidae) capturadas em goiabeira (*Psidium guajava* L.) no Distrito Federal. In: Jasper, M. (Org.), *Coletânea nacional sobre entomologia*, pp. 63-72. Ponta Grossa: Atena Editora.
- Zucchi R. A. (1979) Sobre os tipos de *Anastrepha parallela* (Wied., 1830), de *A. striata* Schiner, 1868 e de *A. zernyi* Lima, 1934 (Diptera, Tephritidae). *Revista Brasileira de Entomologia* 23: 263-266.
- Zucchi, R. A.; Moraes, R. C. B. (2023) Fruit flies in Brazil – *Anastrepha* species their host plants and parasitoids. Piracicaba, SP: ESALQ, University of São Paulo. <http://www.lea.esalq.usp.br/anastrepha>. Access on: 16.viii.2023.