Fruit Flies of the Genus *Anastrepha* (Diptera: Tephritidae) From Some Localities of Paraguay: New Records, Checklist, and Illustrated Key

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ABSTRACT. This study deals with fruit flies of the genus *Anastrepha* Schiner (Diptera: Tephritidae) collected in McPhail traps in the municipalities of Concepción, Belén, Horqueta, Loreto (state of Concepción) and Santa Rosa (state of Misiones), Paraguay. In total, 17 species were captured, 9 of which are new records for Paraguay. All morphological characters used for species identification are illustrated.

RESUMEN. Se estudió las especies de moscas de las frutas del género *Anastrepha* Schiner (Diptera: Tephritidae), colectadas en trampas tipo McPhail en las localidades de Concepción, Belén, Horqueta, (Departamento de Concepción) y Santa Rosa (Departamento de Misiones). En total fueron capturadas 17 especies, de las cuales nueve especies corresponden a nuevos registros para el Paraguay. Todos los caracteres morfológicos para la identificación de las especies fueron ilustrados.

Key Words: diversity, McPhail traps, survey, occurrence, identification

Materials and Methods

This study was based in part on fruit flies sampled in the program “Moscas de las Frutas” of the “Servicio Nacional de Cualidad y Sanidad Vegetal y de Semillas (SENAVE)”. Specimens were collected in McPhail-type traps baited with hydrolyzed protein in the municipalities of Concepción, state of Concepción (23° 22’S, 57° 16’W, average temperature 25°C, and annual pluvial precipitation around 1,300 mm) and Santa Rosa, state of Misiones (26° 55’S, 56° 52’W, average temperature 23°C and annual pluvial precipitation around 1,600 mm), respectively, in the northern and southern parts of the Oriental region of Paraguay (Fig. 1), from May 2008 to 2009. These municipalities are about 600 km apart each other. In Concepción, McPhail-type traps were hung at 1.20 m above the ground level in plantation of *Cucurbita pepo* (L.) (zucchini). In Santa Rosa, traps were hung in apical third of trees such as *Averrhoa carambola* (L.) (star fruit), *Citrus maxima* (Burm.) Merr. (pummelo), and *Carica papaya* (papaya). These surveys of fruit flies were carried out to detect the occurrence of *Anastrepha grandis* (Macquart). A few samples from the municipalities of Belén, Horqueta, and Loreto, state of Concepción, were also studied.

Species identification was based only on females. The illustrated key includes all 21 species known from Paraguay, i.e., *Anastrepha* species captured in these surveys and the species previously recorded for Paraguay. The wings, mesonotum, and abdomen were observed through a stereomicroscope; images were taken with a digital camera and transferred to a computer. The aculei and teeth of the eversible membrane were photographed with a scanning electron microscope (Uramoto and Zucchi 2010). Further information on the species included in the key is found in Norrbom et al. (2012).

Voucher specimens are deposited at the Departamento de Entomología e Acarología, Escola Superior de Agricultura Luiz de Queiroz (ESALQ), Piracicaba, São Paulo, Brazil, and at the Museu de Entomologia del Facultad de Ciencias Agrarias, San Lorenzo, Paraguay.

Results

In total 5,795 fruit flies of the genus *Anastrepha* were collected (2,700 males and 3,095 females) in Concepción and Misiones. Based on females, 17 species were identified, belonging to 10 *Anastrepha* species groups, namely *daciiformis*, *dentata*, *fratriculus*, *grandis*, *mucronata*, *pseudoparallela*, *punctata*, *serpentina*, *spatulata*, and *striata*, and one unplaced species, according to the classification proposed by Norrbom et al. (2012). The *fratriculus* (four species) and *spatulata* (three species) groups were the largest; however, most groups were represented by a single species (Table 1). The most common species was *Anastrepha fraterculus* (Wiedemann), totaling ~71% of the specimens.
collected. The abundance of some species was quite different in both municipalities. For example, *Anastrepha sororcula* Zucchi was the second most prevalent species in Concepción, but few specimens were collected in Misiones, where *A. punctata* was the most common species. Most species showed frequencies below 2% (Fig. 2).

**Discussion**

The study of species of *Anastrepha* in Paraguay has been neglected. In the last seven decades, taxonomic studies on *Anastrepha* fruit flies have advanced little in Paraguay. No research on fruit flies and host plant associations has been conducted in the country.

Intensive surveys with traps have been carried out by the SENA VE, but specimens have not been preserved properly or deposited in museum collections. Here, based on part of the specimens surveyed by SENA VE, 17 species are identified, of which 9 are new records.

![Map of localities](image)

**Fig. 1.** Localities where *Anastrepha* species were captured.

**Table 1.** Species of *Anastrepha* in samples collected from May 2008 to 2009 by SENA VE

<table>
<thead>
<tr>
<th>Species groups</th>
<th><em>Anastrepha</em> species</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>daciformis</td>
<td><em>A. daciformis</em> Bezzi</td>
<td>2</td>
</tr>
<tr>
<td>dentata</td>
<td><em>A. zernyi</em> Lima*</td>
<td>2</td>
</tr>
<tr>
<td>fraterculus</td>
<td><em>A. amita</em> Zucchi*</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><em>A. fraterculus</em> (Wied.)</td>
<td>1, 2</td>
</tr>
<tr>
<td></td>
<td><em>A. sororcula</em> Zucchi</td>
<td>1, 2</td>
</tr>
<tr>
<td></td>
<td><em>A. turpinae</em> Stone*</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>A. grandis</em> (Macquart)</td>
<td>2</td>
</tr>
<tr>
<td>mucronota</td>
<td><em>A. elegans</em> Blanchard</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><em>A. undosa</em> Stone</td>
<td>1</td>
</tr>
<tr>
<td>pseudoparallela</td>
<td><em>A. dissimilis</em> Stone*</td>
<td>1, 2</td>
</tr>
<tr>
<td>punctata</td>
<td><em>A. punctata</em> Hendel</td>
<td>1, 2</td>
</tr>
<tr>
<td>serpentina</td>
<td><em>A. serpentina</em> (Wied.)*</td>
<td>1</td>
</tr>
<tr>
<td>spatulata</td>
<td><em>A. haywardi</em> Blanchard*</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>A. montei</em> Lima</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>A. pickeli</em> Lima*</td>
<td>1</td>
</tr>
<tr>
<td>striata</td>
<td><em>A. striata</em> Schiner*</td>
<td>1, 2</td>
</tr>
<tr>
<td></td>
<td>Not assigned to a species group</td>
<td>1, 2</td>
</tr>
</tbody>
</table>

*New records for Paraguay; 1, Concepción; 2, Misiones.

![Frequency chart](image)

**Fig. 2.** Frequencies of species of *Anastrepha* (females) captured in McPhail-type traps in the municipalities of Concepción (state of Concepción) and Santa Rosa (state of Misiones), Paraguay, from May 2008 to 2009.
in Paraguay (Table 1). Five species, namely Anastrepha dissimilis Stone, A. fraterculus, A. punctata, Anastrepha rheediae Stone, and Anastrepha striata Schiner were trapped in Concepción as well as in Misiones. A. rheediae was previously misidentifed as Anastrepha nascimientoi Zucchi (Arias 2010). Four species—Anastrepha barbiellinii Lima, A. distincta, A. macrura, and A. pseudoparallela—previously recorded in Paraguay were not recovered in this study.

Including the species from SENAVE surveys studied here and those from literature data, 21 species are known in Paraguay. Certainly, more species will be found when surveys can be conducted throughout Paraguay.

Some Anastrepha species of economic and/or quarantine importance such as A. fraterculus, A. grandis, A. sororcula, and A. striata occur in Paraguay (Table 2). However, an intriguing point is that Anastrepha obliqua (Macquart), a quite common and broadly distributed species in the Americas, has not yet been detected. The record of A. grandis in the state of Concepción refers to individuals collected in the 1930s (Norrbom 1993). This species has not been collected in SENAVE surveys in Concepción in recent years (“N.L.F., unpublished data”).

### Illustrated Key to Species of Anastrepha From Paraguay

1. Wing without marginal hyaline spot beyond apex of vein R₁
   2. Wing with marginal hyaline spot beyond apex of vein R₁
   3. S-band complete (central part present), scutum with sublateral dark stripes, aculeus more than 6 mm long, tip nonserrate (Figs. 3, 25, and 47).......................... A. grandis (Macquart)
   4. S-band incomplete (central part absent).............................. 33. Cell f₂+₃ hyaline except apex, V-band (basal arm), brown, pale presutural lateral stripe on scutum complete, abdominal tergite with apical white bands (Figs. 4, 46, and 47).......................... A. daciformis Bezz
– Cell $r_{2+3}$ entirely infuscated, V-band pale and diffuse, pale presutural lateral stripe absent on scutum, abdominal tergites with somewhat T-shaped medial yellow or white area (Figs. 5, 48, and 49)  

A. macrura Hendel

4. Aculeus tip 0.02–0.05 mm wide ....................................................... 5
– Aculeus tip more than 0.05 mm wide ............................................. 7

5. Scutum yellowish with two black spots on posterior margin, aculeus 1.5 mm long (Figs. 6, 26, and 52)  

A. punctata Hendel
– Scutum without pair of black spots on posterior margin ............... 6

6. All wing bands connected, aculeus more than 2 mm long, tip with fine serrations (Figs. 7 and 27)  

Anastrepha zeryyi Lima
– C- and S-bands connected and V-band separated, aculeus <2 mm long, tip nonserrate or with irregular margin (Figs. 8, 9, 28, and 29)  

Anastrepha montei Lima

7. Mesonotum brown except for pale stripes, abdomen brown with yellow T-shaped medial mark, wing bands dark brown, V-band without distal arm (Figs. 10, 30, and 50)  

A. serpentina (Wiedemann)
– Mesonotum and abdomen predominantly orange .......................... 8

8. Scutum with dark stripes .................................................................. 9
– Scutum without dark stripes ............................................................ 10

9. Scutum with one pair of dark stripes (usually interrupted at transverse suture) merging with a band on posterior margin to form U-shaped mark, C-band, and S-band usually separate V-band, distal arm sometimes faint, vein $r_{2+3}$ not sinuous, aculeus 1.9–2.5 mm long (Figs. 11, 31, and 53)  

A. striata Schiner
– Scutum with two pairs of longitudinal reddish-brown stripes and a band on posterior margin, C-band separate and S- and V-bands united, vein $r_{2+3}$ distinctly sinuous, aculeus more than 4.5 mm long (Figs. 12, 32, and 54)  

Anastrepha undosa Stone

10. Mediotergite and/or scutellum without dark lateral marks ......... 11
– Mediotergite and/or scutellum with dark lateral marks ............. 16

11. Aculeus tip with serrations extending beyond end of cloacal opening, aculeus about 1.5 mm long (Figs. 13 and 33)  

Anastrepha pickeli Lima
– Aculeus tip with serrations not extending beyond end of cloacal opening ................................................................. 12

12. V-band without distal arm, aculeus <2.0 mm long, tip with subacute teeth (Figs. 14 and 34)  

Anastrepha haywardi Blanchard
– V-band with distal arm, aculeus more than 2.0 mm long ............ 13

13. Aculeus tip with diminutive serrations on apical 0.2 (Figs. 15 and 35) ................................................. A. barbiellini Lima
- Aculeus tip with serrations on more than apical half .......... 14
14. Aculeus tip with conspicuous teeth and with constriction at base of serrate part (Figs. 16 and 36) ... Anastrepha elegans Blanchard
- Aculeus tip with minute serrations and without constriction at base of serrate part ......................................................... A. pseudoparallela (Loew)
15. Serrated part 0.85–1.11 times length of tip, with medium or large serrations, aculeus tip serrations extending onto dorsal side basally (Figs. 17 and 37) ................. A. punctata, 53. A. striata, 54. A. undosa.
16. Aculeus tip with serrations beyond end of cloacal opening, eversible membrane denticles with large bases, longer that length of denticles (Figs. 19, 39 and 40) ................................. A. rheediae Stone
- Aculeus tip with serrations not extending beyond end of cloaca opening, eversible membrane denticles with bases not unusually large............................................................................... 17

17. Aculeus tip with serrations on less than apical half..................... 18
- Aculeus tip with serrations at least on apical half.........................19

18. Aculeus longer than 2 mm (Figs. 20 and 41).......
A. distincta Lima
- Aculeus <2 mm long (Figs. 21 and 42).................. Anastrepha anita Zucchi

19. Aculeus tip with slight constriction at base of serrate part, 0.30–0.36 mm long (Figs. 22 and 43). . Anastrepha turpiniae Stone
- Aculeus tip with distinct constriction at base of serrate part, <0.30 mm long.................................................................................20

20. Aculeus tip length 0.25–0.29 mm (distinctly longer than wide) (Figs. 23 and 44) ............................ A. fraterculus (Wiedemann)
- Aculeus tip length 0.17–0.20 mm (slightly longer than wide) (Figs. 24 and 45)............................ A. sororcula Zucchi

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