NATIVE HYMENOPTERAN PARASITOIDS ASSOCIATED WITH FRUIT FLIES (DIPTERA: TEPHRITIDAE) IN SANTA CATARINA STATE, BRAZIL

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The present paper describes the parasitoids of fruit flies from the western portion of Santa Catarina state, an area which is a growing producer of citrus in the state (Koller et al. 1999) and which has not been surveyed thoroughly in the past. We collected 9,197 mature fruit from trees or on the soil comprising 46 species belonging to 25 families in the six towns Anchiesta (26°53'S and 53°33'W), Chapecó (27°06'S and 53°16'W), Cunha Porã (26°07'S and 53°16'W), Palmitos (27°06'S and 53°16'W), São Carlos (27°07'S and 53°00'W), and Xanxerê (26°87'S and 52°40'W), Santa Catarina. Each fruit was weighed and put in a plastic container with about seven centimeters of sterilized sand, and covered with a net. The containers were kept in the entomology laboratory of the Agricultural and Environmental Science Center at the Universidade Comunitária Regional de Chapecó at 25 ± 3°C, 70 ± 10% and a 12-h photoperiod. After five days, the sand with pupae was transferred to lab Petri dishes containing filter
| Vegetal specie   | S  | N  | PaT | Braconidae                  | Figitidae and Diapriidae | %P  | TIP  |
|-----------------|----|----|-----|-----------------------------|--------------------------|-----|-----|
| Fabaceae        |    |    |     |                             |                          |     |     |
| Inga sellowiana | 5  | 246| 2   | L. anastrephae (100.0)      |                          | 4.1 | 4.7 |
| Myrtaceae       |    |    |     |                             |                          |     |     |
| Psidium cattleianum | 11 | 635| 42  | D. areolatus (19.0)         | A. pelleranoi (19.0)     | 1.9 | 2.1 |
|                 |    |    |     | D. brasiliensis (33.3)      |                          |     |     |
|                 |    |    |     | Opius sp. (9.7)             |                          |     |     |
|                 |    |    |     | U. anastrephae (19.0)       |                          |     |     |
| Eugenia involucrata | 3  | 446| 46  | D. areolatus (69.6)         |                          | 46.9| 47.9|
|                 |    |    |     | Opius bellus (8.7)          |                          |     |     |
|                 |    |    |     | Opius sp. (4.3)             |                          |     |     |
|                 |    |    |     | U. anastrephae (17.4)       |                          |     |     |
| Psidium guajava | 17 | 190| 147 | D. brasiliensis (2.0)       | A. pelleranoi (49.0)     | 20.1| 20.3|
|                 |    |    |     | Opius bellus (1.1)          | T. anastrephae (45.9)    |     |     |
|                 |    |    |     | Opius sp. (2.0)             |                          |     |     |
| Feijoa sellowiana | 2  | 80 | 58  | D. areolatus (48.3)         |                          | 11.6| 14.3|
|                 |    |    |     | D. brasiliensis (48.3)      |                          |     |     |
|                 |    |    |     | Opius bellus (3.4)          |                          |     |     |
| Myrcianthes pungens | 2  | 52 | 6   | D. brasiliensis (100.0)     |                          | 28.5| 46.1|
| Campomanesia xanthocarpa | 4  | 702| 4   | D. brasiliensis (100.0)     |                          | 7.7 | 12.5|
| Britoa guazumaefolia | 6  | 255| 48  | D. areolatus (16.7)         | A. pelleranoi (3.5)      | 7.1 | 8.8 |
|                 |    |    |     | D. brasiliensis (37.5)      | O. anastrephae (8.3)     |     |     |
| Eugenia pyriformis | 5  | 264| 4   | D. areolatus (100.0)        | A. pelleranoi (100.0)    | 3.0 | 4.0 |
| Rosaceae        |    |    |     |                             |                          |     |     |
| Prunus domestica | 5  | 109| 26  | D. brasiliensis (23.1)      |                          | 16.1| 16.8|
|                 |    |    |     | U. anastrephae (76.1)       |                          |     |     |
| Prunus avium    | 2  | 18 | 8   | D. areolatus (75.0)         |                          | 24.2| 50.0|
|                 |    |    |     | U. anastrephae (25.0)       |                          |     |     |

1S—sample, 2n—number of fruit, 3PaT—parasitoids total, 4%P—Parasitism percentage, 5TIP—total index Parasitism.
| Vegetal specie          | S  | N   | PaT | %P  | TIP |
|------------------------|----|-----|-----|-----|-----|
| Eriobotrya japonica    | 9  | 1166| 48  | 4.3 | 5.9 |
|                        |    |     |     | D. areolatus (8.3) |   |
|                        |    |     |     | D. brasiliensis (41.6) |   |
|                        |    |     |     | Opius bellus (4.3) |   |
|                        |    |     |     | Opius sp. (4.2) |   |
|                        |    |     |     | U. anastrephae (41.6) |   |
| Pyrus communis         | 2  | 62  | 4   | 14.8| 33.3|
|                        |    |     |     | A. pelleranoi (100.0) |   |
| Prunus persica         | 16 | 562 | 18  | 1.2 | 1.6 |
|                        |    |     |     | A. pelleranoi (66.7) |   |
|                        |    |     |     | O. anastrephae (11.1) |   |
| Total                  | 89 | 4787| 461 |     |     |

1S—sample, n—number of fruit, PaT—parasitoids total, %P—Parasitism percentage, TIP—total index Parasitism.
paper dampened with distilled water. Flies and parasitoids were counted after seven days.

The relationship between a fly species and its parasitoids was determined only when a single species of fly was held in an emergence container (Canal et al. 1994).

The total index of parasitism (TIP) was calculated as the number of parasitoids emerged × 100/number of flies emerged + number of parasitoids emerged. The relative frequency of fly species and parasitoids (RF) was defined as number of samples of a given species collected × 100/total number of collected species according to Matrangolo et al. (1998), and the parasitism percentage was calculated as %P = total parasitism × 100/total pupae, which was modified from Silveira Neto et al. (1997).

Species of Anastrepha were identified with Steyskal’s key (1997) and Zucchi’s key (2000b), which includes only Brazil species. The Braconidae were identified according to the key of Canal & Zucchi (2000). The flies and parasitoids belonging to other families were sent to Prof. Dr. Manoel Araécio Uchóa Fernandes, Biologist Jorge Anderson Guimarães, Dr. Allen Norrbom, and Prof. Dr. Roberto Antonio Zucchi for identification.

Of the 46 fruit species collected, 35 were infested by fruit flies, but only 14 of these fruit species contained parasitoids (Table 1). A total of 682 samples of parasitoids belonging to nine species and three families were obtained, as follows: D. areolatus, D. brasiiliensis, O. bellus, Opinius sp., U. anastrephae (Braconidae), A. pelleranoi, O. anastrephae (Figitidae), and Trichopria anastrephae (Diapriidae).

Of the 461 hymenopterans associated with a particular fruit fly, A. pelleranoi was the most common and represented 25.6% of the total, followed by D. brasiliensis, which was associated with 21.1% of the total. Aguiar-Menezes et al. (2001) previously reported the particular fruit fly, U. anastrephae, which was modified from Silveira Neto et al. (1997). The high percent parasitism in E. involucrata was previously observed in Eugenia involucrata, followed by Prunus avium and Myrcianthes pungens. These indexes are higher than those obtained by Leonel, Jr. et al. (1996), Salles (1996) and Matrangolo et al. (1998), but are similar to those of Guimarães et al. (1999).

The high percent parasitism in E. involucrata was previously observed by Salles (1996) in the Rio Grande do Sul state, and may be due, as he suggested, to the thin peel and small size of the fruit. Guimarães et al. (2000) previously observed affinity of A. pelleranoi to the Myrtaceae fruit, which we confirmed. Sivinski (1991), Sivinski et al. (1997, 2000) and Hickel (2002) found that braconid parasitism was negatively correlated to fruit pulp thickness, and we showed that weight data correlated to parasitism.

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![Table 2](image-url)

**Table 2. Association between collected parasitoids and fruit flies in six different localities in the West of Santa Catarina, Brazil, during 1998-2000.**

| Parasitoids | A. fraterculus | Neosilba sp. |
|------------|----------------|--------------|
| **Braconidae** | X              | X            |
| D. areolatus | X              | X            |
| D. brasiiliensis | X              | X            |
| O. bellus | X              | X            |
| Opinius sp. | X              | X            |
| U. anastrephae | X              | X            |
| **Diapriidae** |                |              |
| T. anastrephae | X              |              |
| **Figitidae** |                |              |
| A. pelleranoi | X              | X            |
| L. anastrephae |              |              |
| O. anastrephae |              | X            |

The high percent parasitism in E. involucrata was previously observed by Salles (1996) in the Rio Grande do Sul state, and may be due, as he suggested, to the thin peel and small size of the fruit. Guimarães et al. (2000) previously observed affinity of A. pelleranoi to the Myrtaceae fruit, which we confirmed. Sivinski (1991), Sivinski et al. (1997, 2000) and Hickel (2002) found that braconid parasitism was negatively correlated to fruit pulp thickness, and we showed that weight data correlated to parasitism.
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