Parasitism in pupae synanthropic flies in Caldas Novas, Goiás

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Abstract

This study reports on the prevalence of parasitism in synanthropic flies collected at the altitudes of 740 and 1000 meters in Caldas Novas, State of Goiás. The substrates utilized were human feces, fruits, chicken viscera, fish and bovine kidneys. The pupae were obtained via the flotation method and were individually placed in gelatin capsules until the emergence of the adults or their parasitoids. From the altitude of 740 meters, 1255 muscoid Diptera were collected, from which 211 parasitoids emerged, while from the altitude of 1000 meters, 1691 parasitoids were collected, from which 1196 parasitoids emerged. The total prevalence of parasitism found was 10.3%. The prevalence of parasitism at 740 and 1000 meters was 13.5% and 9.1%, respectively. At the altitude of 740 meters, the greatest prevalence of parasitism found was of the parasitoid Spalangia drosophilae Ashmead (Hymenoptera: Pteromalidae), in Peckia chrysostoma (Wiedemann) (Diptera: Sarcophagidae), with a prevalence of 17.4%. At the altitude of 1000 meters, the greatest prevalence of parasitism found was of the parasitoid Gnathopleura quadridentata Wharton (Hymenoptera: Braconidae), in Sarcodexia lambens (Wiedemann) (Diptera: Sarcophagidae), with a prevalence of 56.0%.

Key words: Diptera, Hymenoptera, flies, parasitoids, altitude

Introduction

The flies included in the Muscomorpha infra-order (Guimarães et al., 2001) are of medical and veterinary importance, since they can produce myiasis and act on the transmission of pathogens to humans and animals (Ferreira, 1978; Marcondes, 2001). They have been found carrying more than 100 species of disease-causing organisms such as bacteria, protozoa and helminths (Greenberg, 1971).
In addition to chemical technique through insecticides, so-called natural regulators of various pests can be used as a means of controlling these insects in both agriculture and animal husbandry (Silveira et al., 1989).

Parasitoid hymenopterans are an important element of neotropical fauna because of their role in controlling the population of other insects that directly or indirectly and not yet well-qualified interfere with the trophic chains of most ecosystems (Perioto et al., 2004).

Aiming at an effective and safe method of fly control for humans and the environment, biological control studies of synanthropic flies are performed worldwide (Carvalho et al., 2004).

The objective of this study is to verify the percentage of parasitism in synanthropic flies collected at different altitudes in Caldas Novas, Goiás.

**Material and Methods**

The study was carried out from August 2003 to July 2004 in the Caldas Novas mountain range park, located in the city of Caldas Novas, Goiás, Brazil (17º 44´ S - 48º 37´ W).

The flies were collected by using traps, made of dark cans measuring 19 cm in height and 9 cm in diameter, with two openings resembling blinders, located in the lowest third of the can, to allow flies to enter. The top of the can was connected to a nylon funnel that was open at both ends, with the base pointing down. This was wrapped in plastic bags, so that when they were removed, the flies and parasitoids could be collected. The following items were used as baits: human feces, cattle kidneys, cattle liver, chicken, fruit and fish which were placed inside the cans, over a layer of earth.

10 traps were used for the altitude of 740 meters (17º 46´04” S - 48º 39´35” W) and 10 traps for the altitude of 1000 meters (17º 46´ 52” S - 48º 41´14” W), two for each type of bait that were hung on trees 1 meter from the ground, 2 meters from each other. The collected individuals were taken to the laboratory, sacrificed with ethyl ether and preserved in 70% alcohol for later identification.

To obtain the parasitoids, the contents of the traps were placed in plastic containers with a layer of sand for use as a substrate for transformation of the larvae into pupae. This sand was sifted after being in the fields for 15 days and the pupae were extracted from it.
and were individually placed in gelatin capsules (number 00) in order to obtain the flies and/or parasitoids.

The total percentage parasitism was calculated by means of the number of pupae parasitized, divided by the total number of pupae collected, and multiplied by 100. The percentage parasitism of each parasitoid species was calculated by means of the number of pupae parasitized per species of parasitoid, divided by the total number of pupae from that host, and multiplied by 100.

The preference of parasitoids for their hosts was tested by Chi-Square at 5% significance level.

**Results and Discussion**

At the altitude of 740 meters, 1255 dipterans were collected from which 211 parasitoids emerged, while at the altitude of 1000 meters 1691 parasitoids were collected, from which 1196 parasitoids emerged. The percentage of parasitism at 740 and 100 meters was 13.5% and 9.1%, respectively. The higher parasitism percentage obtained at 740 meters altitude may be related to the parasitoid search capacity and the availability of food resources.

At the altitude of 740 meters the highest percentage was obtained by the parasitoid *Spalangia drosophilae* Ashmead (Hymenoptera: Pteromalidae) in *Peckia chrysostoma* (Wiedemann) (Diptera: Sarcophagidae) with 17.4% (Table 1).

*Spalangia drosophilae* is cited in the literature as parasitoid of pups of small dipterans of the families Chloropidae, Drosophilidae, Muscidae, Sarcophagidae and Sepsidae (Marchiori et al., 2001; Marchiori et al., 2002).

At the altitude of 1000 meters the highest percentage of parasitism was found by the parasitoid *Gnathopleura quadridentata* Wharton (Hymenoptera: Braconidae) in *Sarcodexia lambens* (Wiedemann) (Diptera: Sarcophagidae) with 56.0% (Table 2).

*Gnathopleura quadridentata* has a preference for muscoid dipterans, especially for Sarcophagidae (Shenefelt, 1974). This parasitoid is solitary, and emerges from the host puparium. Species of the genus *Gnatopleura* have been used for biological control of Sarcophagidae and Muscidae (Wharton, 1979). *Spalangia drosophilae* and *G. quadridentata* presented the highest percentage of parasitism at 740 and 1000 meters,
respectively, probably due to parasitoid search ability and availability of food resources and density.

740 meters *Aphaereta* sp. (Braconidae) showed preference for *P. chrysostoma*; *Brachymeria podagrica* Fabricius (Chalcididae) by *Oxysarcodexia thornax* (Walker) (Sarcophagidae); *G. quadridentata* by *O. thornax*; *Hemencyrtus* sp. (Encyrtidae) by *P. chrysostoma*; *Pachycrepoides vindemmiae* (Rondani) (Pteromalidae) by *Drosophila* sp. (Drosophilidae) and *Fannia pusio* (Wiedemann) (Fanniidae); *S. drosophilae* by *P. chrysostoma*; *Spalangia endius* Walker (Pteromalidae) by *F. pusio* and *O. thornax* and *Spalangia* sp. by *F. pusio* ($X^2 = 220.73$: $GL = 21$; $P < 0.05$).

At the altitude of 1000 meters *G. quadridentata* preferred *O. thornax* and *S. lambens*; *Hemencyrtus* sp. *Chrysomya albiceps* (Wiedemann) (Calliphoridae) and *O. thornax*; *Leptopilina bouardi* Barbotin et al (Figitidae) by *Drosophila* sp.; *Nasonia vitripennis* (Walker) (Pteromalidae) by *P. chrysostoma*; *P. vindemmiae* by *F. pusio*; *S. drosophilae* by *F. pusio* and *P. chrysostoma*; *S. endius* by *Ophyra* sp. (Muscidae); *Spalangia* sp. by *O. thornax* and *Trichopria* sp. (Diapriidae) by *C. albiceps* ($X^2 = 5290.42$: $GL = 48$; $P < 0.05$).

Regarding substrate, the highest percentage of parasitism at 740 meters was obtained in human feces with 6.7% (84/1255) and at 1000 meters also in human feces with 60.0% (1013/1591) (Table 3).

Studies on the faunal composition of parasitoid hymenoptera in the Neotropical region are scarce, despite the diversity, biological, ecological and economic importance of these insect groups (Perioto et al, 2003).

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Table 1. Synanthropic dipterans and their parasitoids collected from various substrates at an altitude of 740 meters in Caldas Novas, Goiás, from August 2003 to July 2004.

| Substrate/Specie of | Frequency | Specie       | n° of pupae | n° of pupae parasitized | Percentage |
|---------------------|-----------|--------------|-------------|-------------------------|------------|
| Feces:              |           |              |             |                         |            |
| Brontoea sp.        | 1         |              |             |                         |            |
| C. albiceps         | 10        |              |             |                         |            |
| C. megacephala      | 1         |              |             |                         |            |
| Fannia pusio        | 236       | P. vindemmiae| 27          | 27                      | 11.4       |
|                     |           | S. drosophilae| 2           | 2                       | 0.8        |
|                     |           | S. nigra     | 4           | 4                       | 1.7        |
|                     |           | Spalangia sp.| 1           | 1                       | 0.4        |
| M. domestica        | 2         |              |             |                         |            |
| O. thomax           | 169       | G. quadridentata| 25        | 25                      | 14.8       |
| P. chrysotoma       | 138       | B. podagrica | 1           | 1                       | 0.7        |
|                     |           | S. drosophilae| 24          | 24                      | 17.4       |

Table 1 (Continued). Synanthropic dipterans and their parasitoids collected from various substrates at an altitude of 748 meters in Caldas Novas, Goiás, from August 2003 to July 2004.

| Substrate/Specie of | Frequency | Specie       | n° of pupae | n° of pupae parasitized | Percentage |
|---------------------|-----------|--------------|-------------|-------------------------|------------|
| Inver:              |           |              |             |                         |            |
| C. albiceps         | 30        |              |             |                         |            |
| O. thomax           | 166       | G. quadridentata| 1          | 1                       | 0.6        |
|                     |           | P. vindemmiae| 3           | 3                       | 1.3        |
|                     |           | S. drosophilae| 2           | 2                       | 1.2        |
|                     |           | S. nigra     | 5           | 5                       | 3.0        |
| Chickens:           |           |              |             |                         |            |
| P. chrysotoma       | 149       | Aphidoletesp.| 20          | 1                       | 0.4        |
|                     |           | G. quadridentata| 20       | 20                      | 0.6        |
|                     |           | Hemerobi tsp.| 9           | 1                       | 0.6        |
|                     |           | S. drosophilae| 26          | 26                      | 16.3       |
| Fruits:             |           |              |             |                         |            |
| Drosophila sp.      | 141       | P. vindemmiae| 16          | 16                      | 11.3       |
| Fish:               |           |              |             |                         |            |
| C. albiceps         | 4         |              |             |                         |            |
| O. thomax           | 157       | B. podagrica | 3           | 3                       | 1.5        |
|                     |           | G. quadridentata| 3          | 3                       | 1.5        |
|                     |           | Hemerobi tsp.| 2           | 1                       | 0.5        |
|                     |           | P. vindemmiae| 1           | 1                       | 0.5        |
|                     |           | S. drosophilae| 16          | 16                      | 16.3       |
| Total               | 1295      |              | 211         | 169                     |            |
Table 2. Synanthropic dipterans and their parasitoids collected from various substrates at an altitude of 1000 meters in Caldas Novas, Goiás, from August 2003 to July 2004.

| Substrate | Frequency | Species | n° of pupae | n° of pupae parasitized | Percentage |
|------------|-----------|---------|--------------|--------------------------|------------|
| Feces:     |           |         |              |                          |            |
| Brontispa sp. | 10        |         |              |                          |            |
| C. albiceps | 92        | T. nigriceps | 25         | 4                        | 4.3        |
|            |           | H. mercurialis | 15         | 2                        | 2.2        |
| F. paula   | 71        | P. vindimaiae | 1          | 1                        | 1.4        |
| M. domestica | 130      |         |              |                          |            |
| Ophiura sp. | 74        | H. mercurialis | 10         | 2                        | 2.7        |
|            |           | S. endius | 13           | 13                       | 17.6       |
|            |           | S. vitripennis | 5          | 5                        | 4.3        |
|            |           | G. quadristriata | 28         | 28                       | 56.0       |
| S. calcitrans | 57       |         |              |                          |            |
| Urine:     |           |         |              |                          |            |
| F. paula   | 57        | S. drosophilae | 2          | 2                        | 3.0        |
| Megazelia sp. | 114      |         |              |                          |            |
| Ophiura sp. | 25        | H. mercurialis | 28         | 5                        | 20.0       |
| O. thorax   | 17        | S. vitripennis | 2          | 2                        | 11.4       |
| P. chrysostoma | 99      | G. quadristriata | 4          | 4                        | 4.6        |
|            |           | N. vitripennis | 945        | 32                       | 32.3       |
|            |           | S. drosophilae | 21         | 1                        | 1.0        |

Table 2 (Continued). Synanthropic dipterans and their parasitoids collected from various substrates at an altitude of 1000 meters in Caldas Novas, Goiás, from August 2003 to July 2004.

| Substrate | Frequency | Species | n° of pupae | n° of pupae parasitized | Percentage |
|------------|-----------|---------|--------------|--------------------------|------------|
| Chicken:   |           |         |              |                          |            |
| C. albiceps | 82        |         |              |                          |            |
| C. megacephala | 58      |         |              |                          |            |
| M. domestica | 61       |         |              |                          |            |
| Ophiura sp. | 23        | H. mercurialis | 21         | 4                        | 17.4       |
| O. thorax   | 101       | N. vitripennis | 3          | 1                        | 1.0        |
| P. chrysostoma | 62      | G. quadristriata | 17         | 17                       | 16.8       |
| Fruit:     |           |         |              |                          |            |
| Drosophila sp. | 66      | L. bouardi | 5           | 5                        | 7.6        |
| S. lambens  | 10        | N. vitripennis | 4          | 1                        | 10.0       |
| S. calcitrans | 1        |         |              |                          |            |
| Fish:      |           |         |              |                          |            |
| C. albiceps | 51        |         |              |                          |            |
| F. paula   | 11        | P. vindimaiae | 1          | 1                        | 9.1        |
| O. thorax   | 16        | G. quadristriata | 6          | 6                        | 37.5       |
| P. chrysostoma | 189     | H. mercurialis | 25         | 3                        | 1.6        |
|            |           | S. drosophilae | 6          | 6                        | 3.2        |
| S. lambens  | 96        |         |              |                          |            |
| S. triulatus | 1        |         |              |                          |            |
| Total       | 1091      |         | 1196         | 14                       | 154        |
Table 3. Percentage of parasitism obtained in human feces, beef liver, chicken, fish and fruit at altitudes of 740 and 1000 meters in Caldas Novas, GO, from August 2003 to July 2004.

| Altitude          | Substrate | Feces | Liver | Chicken | Fish | Fruit |
|------------------|-----------|-------|-------|---------|------|-------|
| 740 meters altitude |           |       |       |         |      |       |
| Number of parasitized pupae | 84 | 11 | 29 | 9 | 16 |
| Parasitism percentage (%) | 6.7 | 0.9 | 2.3 | 0.7 | 1.3 |
| 1000 meters altitude: |           |       |       |         |      |       |
| Number of parasitized pupae | 64 | 46 | 22 | 6 | 16 |
| Parasitism percentage (%) | 3.8 | 2.7 | 1.3 | 0.4 | 0.9 |
