Study of the biological characteristics of parasitoids (Hymenoptera) of flies (Diptera) in Goiás, Brazil

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Abstract

Parasitoids are important regulators of insect populations and stand out as the main group of natural enemies in agricultural systems. The objective of this study was to verify the biological characteristics of parasitoids of flies in the State of Goiás, Brazil. The pupae were obtained using the flotation method. They were individually placed in gelatin capsules until the adult flies or their parasitoids emerged. The study was in period from 2000 to 2014. In this paper, most of the parasitoids of flies show biological characteristics as being endoparasitoids, koinobiont, larval and solitary,

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Introduction

The flies are important to the study of their characteristics such as medical and veterinary vectors of etiological agents, such as protozoan cysts, helminthes eggs,
pathogenic bacteria, viruses and fungi (Marchiori and Silva Filho, 2005). Parasitoids are organisms that cause the death of their hosts (biological control) to complete their development and act as parasites only in the larval stage, when they develop in only one host, having adults’ free life (Batista Filho 2006) (Figure 1). The great majority of parasitoid species is quite specific in the choice of their hosts. There are also those generalists, who attack more than a hundred hosts (Batista Filho 2006).

Parasitoids are important regulators of insect populations and stand out as the main group of natural enemies in agricultural systems. They are present in various orders of insects and their adaptation to a parasitic behavior is seen most diversely and abundantly in the order Hymenoptera (Panizzi and Parra, 2009).

Parasitoids are considered bioindicators for the biodiversity of ecosystems, and are considered as key species for maintaining the equilibrium of the communities in which they are included. In addition, since they are natural enemies of insects, they may be used in biological control programs of agricultural pests (Scatolini and Penteado-Dias, 1997). Another application of parasitoids may be related to the study of Forensic Entomology, which consists of the use of ecological data and the development of scavenger insects to estimate the postmortem interval in criminal investigations (Marchiori, 2017).

A new application process for the parasitoids is related to the urbanization process, they revealed that the urbanization affected negatively or had no effect on the parasitoids (Fenoglio et al. 2009). For this reason further research will need to be carried out to observe this phenomenon.

The objective of this study is to describe the biological characteristics of parasitoid of flies in Goiás, Brazil.

Material and Methods
The parasitoids were collected by using five traps (Ferreira 1978). The following items were used as baits: human feces, cattle kidneys, cattle liver, fish and fruit which were placed inside the cans, over a layer of earth. 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 (Marchiori and Silva Filho 2005).
Every fortnight, 10 plates of fecal cake were produced from fresh bovine feces that were collected immediately after defecation in pastures of Brachiaria brizantha (Hochst ex. A. Rich) and in corrals. The material was collected in plastic buckets and was homogenized. It was then placed in 10 round plastic supports of 20 cm in diameter, with a hole to allow rainwater to drain away. This methodology was used for precise determination of the time between the emission of the fecal cake and its collection. The feces remained...
exposed (five in the pastures and five in the corrals) for 15 days. The experiment was performed according to Marchiori et al. (2014).

The feces collected originated from chickens that were reared in a cage system. The feces that accumulated under the cages varied in terms of moisture content, ranging from pasty to firm. Fresh feces (pasty), which were collected immediately after emission, were placed in five basins of 30 cm in diameter and 12 cm in height, and were left in an appropriate environment, in a dry location, for 15 days (Marchiori et al. 2014). The studies were in period from 2000 to 2014.

Table 1. Biological characteristics of parasites of flies collected in Goiás, Brazil.

<table>
<thead>
<tr>
<th>Taxonomic Group</th>
<th>Stage of parasitism</th>
<th>Type of parasitism</th>
<th>Number of individual pupae</th>
<th>Types of parasitoids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalcididae</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Solitary</td>
<td>Kainobiont</td>
</tr>
<tr>
<td>Aphereta sp.</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Gregarious</td>
<td>Kainobiont</td>
</tr>
<tr>
<td>Blatyrhina sp.</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Solitary</td>
<td>Kainobiont</td>
</tr>
<tr>
<td>Nem西roides sp.</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Solitary</td>
<td>Kainobiont</td>
</tr>
<tr>
<td>Tachiniphagia</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Gregarious</td>
<td>Kainobiont</td>
</tr>
<tr>
<td>Euphlebia</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Solitary</td>
<td>Kainobiont</td>
</tr>
<tr>
<td>Eristalis sp.</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Gregarious</td>
<td>Kainobiont</td>
</tr>
<tr>
<td>Kiefferina sp.</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Solitary</td>
<td>Kainobiont</td>
</tr>
<tr>
<td>Panagandrupes egerie</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Solitary</td>
<td>Kainobiont</td>
</tr>
<tr>
<td>Trichostoma</td>
<td>Larval</td>
<td>Endoparasitoid</td>
<td>Solitary</td>
<td>Kainobiont</td>
</tr>
</tbody>
</table>

Caption
### Results and Discussion

The *Spalangia* genus presented a larger number of species (Table 1). The species of...

<table>
<thead>
<tr>
<th>Genus</th>
<th>Host</th>
<th>Parental Type</th>
<th>Feeding Type</th>
<th>Koinobiont</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Spalangia</em></td>
<td>Pupal</td>
<td>Ectoparasitoid</td>
<td>Solitary</td>
<td>Koinobiont</td>
</tr>
<tr>
<td><em>Spalangia</em></td>
<td>Endoparasitoid</td>
<td>Solitary/Gregarious</td>
<td>Koinobiont</td>
<td></td>
</tr>
</tbody>
</table>

*Parasitoid larvae eclose inside the larva, but the adult or adults emerge from the puparium. Parasitoid pupae eclose in the pupa and the adult or adults emerge from the puparium.* Endoparasitoid larvae develop inside the body of the host. Ectoparasitoid larvae develop on the host. Solitary refers to a parasitoid out of each parasitized pupae. Gregarious species in a single host may occur the development of several individuals. Koinobiont allow the host to continue its development while feeding on it. Koinobiont which inhibit any host activity and development at the time of parasitization.

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**Caption**

**Figure 1. Tachinobia** sp. (Hymenoptera: Eulophidae) – parasitoid.
(Hymenoptera: Pteromalidae) comprises pupal parasitoids associated with flies of the families (Marchiori and Linhares, 1999).

Table 1 shows the biological characteristics of the parasitoids of dipterous muscoids collected in Brazil. 55.0% of the species obtained were larval parasitoids and 45.0% pupae. Most behave as and solitary forming small pupae, probably resulting from competition for food. Most insect parasitoids (Hymenoptera) are koinobionts.

When a parasitoid species has as its host an insect considered to be a pest, it becomes a potential biological control agent. It is estimated that there are about 200,000 species of parasitoids distributed mainly in the orders Hymenoptera and Diptera. Several families are sources of parasitoids for biological control agents such as Aphelinidae, Braconidae, Encyrtidae, Eulophidae, Ichneumonidae, Pteromalidae, Platygastridae and Trichogrammatidae (Batista Filho 2006).

**Literature Cited**


