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Parasitoids of dipterous collected in cattle dung in the Regions Southern and Central of Goiás, Brazil

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ABSTRACT

This study had the objective of determining the species of parasitoids of Diptera from May 2003 to June 2004 in the Region Southern and from March 2012 to February 2013 in the Region Central of (Goiânia) Goiás, Brazil. The dipterous pupae were obtained by the flotation method. They were individually placed in gelatin capsules until the emergence of the flies and/or their parasitoids. The percentage of parasitism in the Region South was 12.4% and in the Region Central was 6.4%. The species more frequent were: *Gnathopleura quadridentata* Wharton, 1986 (Hymenoptera: Braconidae) with 25.6% in the Region Southern and *Aleochara notula* Erichson, 1839 (Coleoptera: Staphylinidae) with 26.1% in the Region Central.

KEYWORDS

Diptera; Hymenoptera; Biocontrol; Two Regions

1. INTRODUCTION

Among the means for controlling flies, chemical insecticides are the most widely used. However, these may lose their efficiency as populations become resistant to them [1]. The appearance of resistance to insecticides explains the growing need to introduce alternative control programs aimed towards fly control.

Parasitoids are agents responsible for reducing the populations of flies that proliferate on dung [2], cadavers and animal carcasses. Because parasitoids occupy a higher trophic level, they often act as determinant factors for the population density of their hosts, consequent to their great diversity of physiological and behavioral adaptations [3].

These insects are considered to be bioindicators of the biodiversity of ecosystems and are considered to be key species for maintaining the equilibrium of the communities in which they are included. In addition, since they are natural enemies of agricultural pests, they may be used in biological control programs [3].

This study had the objective of determining the species of parasitoids of dipterous that were present in bovine feces collected in the southern and central regions of the state of Goiás, Brazil.

2. MATERIAL AND METHODS

In the southern region of the state of Goiás, Brazil, the experiment was conducted on the Panamá farm, in the municipality of Panamá (18˚10'S and 49˚21'W). In the central region of Goiás, the experiment was conducted at the Veterinary and Zootechnics School of the Federal University of Goiás, in the municipality of Goiânia (16˚40'S and 49˚16''W) Brazil.

Every fortnight, 10 plates of fecal cake (of approximately 3 kg each) 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. After this period, the feces were taken to the laboratory for extraction of pupae by means of the flotation method. The pupae were removed with the aid of a sieve; they were counted and individually stored in gelatin capsules (number 00) until the flies and/or parasitoids emerged. The parasitoids and flies that emerged were identified with the aid of a stereoscopic microscope and were conserved in 70% alcohol.

The percentage parasitism of each parasitoid species was calculated by means of the number of pupae parasitized by each parasitoid species divided by the total number of pupae of that host, and multiplied by 100. The parasitoids' preference for their hosts was tested by means of the chi-square test, with 5.0% probability. The voucher material from the central region was deposited at the laboratory of the Veterinary Parasitology Center of the Federal University of Goiás (UFG), and the voucher material from the southern region was deposited at the laboratory of Institute of Itumbiara (ILES-ULBRA).

3. RESULTS AND DISCUSSION

Between May 2003 and June 2004 in the southern region and between March 2012 and February 2013 in the central region, 628 dipterous and 78 parasitoids and 359 dipterous and 23 parasitoids were collected, respectively.

It could be seen that in the southern region, greater diversity and quantity of parasitoids were obtained than those in the central region. The lower diversity in the central region was probably related to the low synanthropy of the species of dipterous insects and parasitoids collected in the region studied. The locality studied is now surrounded by human populations on all sides, which is not the case at the locality in the southern region of Goiás.

The differences between the two regions may also have been due to variations in the quality and availability of food resources or variations in host density. The type of feeding, animal handling and use of insecticides to combat the treatment of ectoparasites and endoparasites might also have differed.

In a study on synanthropy that is being conducted in Monte Alegre, state of Minas Gerais, the parasitoid species *Paraganaspis egeria* Díaz, Gallardo & Walsh (Hymenoptera: Figitidae) and *Spalangia cameroni* Perkins (Hymenoptera: Pteromalidae) showed high levels of synanthropy: −100 and +50, respectively.

The most frequent species in the bovine feces in the southern region was *Gnathopleura quadridentata* Wharton (Hymenoptera: Braconidae), accounting for 25.6% (**Table 1**). This was probably due to the host density or due to the seasonality factor presented by this species. *Gnathopleura quadridentata* behaves as a solitary parasitoid and emerges from the host's puparium. Species of the genus *Gnathopleura* have been used for biological control of Sarcophagidae and Muscidae [4]. Through using many dipterous insects as hosts, *G. quadridentata* remains present in the environment and has good potential as a biological control agent for pest species.

The most frequently observed species in the central region was *Aleochara notula* Erichson, 1839 (Coleoptera:

Table 1. Parasitoids collected in cattle dung in southern Goiás, in the period from May 2003 to June 2004 and in the central region of Goiás March 2012 to February 2013.

Taxonomic Group	Number of Parasitoids-Southern Region	Number Parasitoids-Central Region
Coleoptera:		
Staphylinidae;		
Aleochara notula	00	06
Hymenoptera:		
Braconidae:		
Gnathopleura quadridentata	20	00
Diapriidae:		
Trichopria sp.	01	00
Figitidae:		
Kleidotoma nigra	02	00
Neralsia splendens		04
Paraganaspis egeria	02	01
Triplasta atrocoxalis	02	00
Triplasta coxalis	08	00
Pteromalidae:		
Nasonia vitripennis	00	04
Pachycrepoideus vindemmiae	05	00
Spalangia cameroni	04	02
Spalangia drosophilae	07	04
Spalangia endius	02	00
Spalangia nigra	07	01
Spalangia nigroaenea	18	00
Spalangia sp.	00	01
Total	78	23

Staphylinidae), accounting for 26.1% (**Table 1**). This was probably due to its capacity to seek hosts or due to variations in the quality and availability of food resources. The larval phase of *A. notula* behaves as a solitary ectoparasitoid of pupae of Cyclorrhapha Diptera of the families Muscidae, Anthomyiidae, Coelopidae, Sarcophagidae and Psilidae [5]. In the adult phase, it behaves as a predator of eggs and larvae of these dipterous insects and can be used for biological control of flies.

The percentage parasitism observed in the southern region was 12.4%. The percentage parasitism observed in the central region was 6.4%. This variation in percentage parasitism may be associated with seasonal variations in environmental conditions. *Gnathopleura quadridentata* in the southern region presented the highest percentage parasitism, with 28.6% (**Table 2**), probably due to its search capacity.

Nasonia vitripennis (Walker, 1836) (Hymenoptera: Pteromalidae) was the species in the central region that presented the highest percentage parasitism, with 9.8% (**Table 3**). This was probably due to variations in the quality and availability of food resources or due to the ability of this species to search for food, or possibly because it is a polyphagous parasitoid. *N. vitripennis* behaves as a gregarious parasitoid: it is an ectoparasitoid in pupae of several species of dipterous families, particularly Calliphoridae, Muscidae, Sarcophagidae and Tachinidae [6]. It is a polyphagous insect that parasitizes more than 68 dipterous species [7].

In relation to the preferences of parasitoids for their hosts in bovine feces in the southern region, it was found that *G. quadridentata* showed preference for *Oxysarcodexia thornax* (Wiedemann) (Diptera: Sarcophagidae); *Kleidotoma nigra* (Hartig) (Hymenoptera: Figitidae) showed preference for *Brontaea quadristigma* (Thomson) (Diptera: Muscidae); *Pachycrepoideus vindemmiae* (Rondani) (Hymenoptera: Pteromalidae) showed preference for *Palaeosepsis* spp. (Diptera: Sepsidae); *Spalangia cameroni* Perkins showed preference for *Brontaea debilis* Williston (Diptera: Muscidae) and *Musca domestica* L. (Diptera: Muscidae); *Spalangia drosophilae* Ashmead (Hymenoptera: Pteromalidae) showed preference for *Archisepsis scabra* (Loew) (Diptera: Sepsidae) and *M. domestica*; *Spalangia endius* Walker (Hymenoptera: Pteromalidae) showed preference for *B. quadristigma* and *Palaeosepsis* spp.; *Spalangia nigra* Latrielle (Hymenoptera: Pteromalidae) showed preference for *Cyrtoneurina pararescita* Couri (Diptera: Muscidae) and *Ravinia belforti* (Prado & Fonseca) (Diptera: Sarcophagidae) and *Spalangia nigroaenea* Curtis (Hymenoptera: Pteromalidae) showed preference for *B. debilis*, *B. quadristigma*, *C. pararescita* and *R. belforti* ($X^2 = 715.24$; GL = 77; $P < 0.05$).

In relation to the attraction of parasitoids towards dipterous insects in the central region, it was found that *A. notula* was attracted to *Sarcophagula occidua* Fabricius

Table 2. Parasitoids collected in feces of cattle in the southern region of Goiás, in the period from May 2003 to June 2004.

Hosts	Number of pupae	Parasitoids	Number of pupae parasitized	Percentagem
Archisepsis scabra	40	*Spalangia drosophilae*	04	10.0
Brontaea debilis	56	*Spalangia cameroni*	01	1.8
		Spalangia nigroaenea	02	3.6
Brontaea quadristigma	49	*Kleidotoma nigra*	02	4.1
		Spalangia cameroni	01	2.0
		Spalangia drosophilae	01	2.0
		Spalangia endius	01	2.4
		Spalangia nigroaenea	05	10.0
Cyrtoneurina pararescita	151	*Spalangia nigra*	03	2.0
		Spalangia nigroaenea	05	3.3
Musca domestica	10	*Spalangia cameroni*	01	1.0.0
Oxysarcodexia thornax	70	*Gnathopleura quadridentata*	20	28.6
Palaeosepsis sp.	107	*Paraganaspis egeria*	02	1.9
		Spalangia drosophilae	02	1.9
		Spalangia endius	01	0.9
		Triplasta atrocoxalis	02	1.9
		Triplasta coxalis	08	7.5
		Trichopria sp.	01	1.0
Ravinia belforti	63	*Pachycrepoideus vindemmiae*	05	7.9
		Spalangia cameroni	01	1.6
		Spalangia nigra	04	6.4
		Spalangia nigroaenea	06	9.5
Total of pupae: 628			78	14.0

Table 3. Parasitoids collected in feces of cattle in the central region of Goiás, in the period from March 2012 to February 2013.

Hosts	Number of pupae	Parasitoids	Number of pupae parasitized	Percentagem
Brontaea quadristigma	83	*Spalangia drosophilae*	1	1.2
Brontaea debilis	77	*Spalangia drosophilae*	2	2.6
		Spalangia cameroni	2	2.6
		Spalangia nigra	1	1.3
		Spalangia sp.	1	1.3
Cyrtoneurina pararescita	41	*Neralsia splendens*	2	4.9
		Nasonia vitripennis	4	9.8
Palaeosepsis spp.	80	*Spalangia drosophilae*	1	1.3
		Aleochara notula	6	7.5
Sarcophagula occidua	78	*Neralsia splendens*	2	2.6
		Paraganaspis egeria	1	1.3
Total of pupae:	359	-	23	6.4

(Diptera: Sarcophagidae); *N. vitripennis* to *C. pararescita*; *N. splendens* to *C. pararescita* and *S occidua*; *P. egeria* to *S. occidua*; *S. cameroni* to *B. debilis*; *S. drosophilae* to *B. debilis*, *B. quadristigma* and *Palaeosepsis* spp and *S. nigra* to *B. debilis* ($X^2 = 47.28$; G = 8; $P < 0.05$).

Through this study, knowledge of the bioecology and geographical distribution of parasitoids of dipterous insects that develop in bovine feces in Brazil has been increased.

It is known that fly control using insecticides usually selects resistant populations. New methods for fly control are therefore needed, and one possible method for controlling these insects is to use natural enemies such as parasitoids. Such agents may be responsible for reducing the sizes of synanthropic fly populations in nature.

The emergence of resistance to insecticides justifies the growing need to implement alternative control programs, with the aim of controlling flies.

4. CONCLUSIONS

The lower diversity in the central region was probably related to the low synanthropy of the species of dipterous insects and parasitoids collected in the region studied.

Nasonia vitripennis was the species in the central region that presented the highest percentage of parasitism. This was probably due to variations in the quality and availability of food resources or due to the ability of this species to search for food, or possibly because it is a polyphagous parasitoid.

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