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Natural Enemies of *Chrysomya albiceps* (Wiedemann) (Diptera: Calliphoridae) Collected in States Goiás and Minas Gerais, Brazil

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Abstract

Chrysomya albiceps (Wiedemann) (Diptera: Calliphoridae) is of great medical importance because it produces myiasis. It has a significant role as a predator of other dipterous larvae. Moreover, this dipterous insect is of great importance with regard to public health because it mechanically carries pathogens to humans. This study had the objective of ascertaining the species of parasitoids of *C. albiceps* in human feces, cattle liver, cattle kidney, chicken viscera, fish and pig carcasses in Goiás and Minas Gerais, from October 1999 to November 2013. Pupae were obtained by means of the flotation method. They were individually placed in gelatin capsules until the adult flies or their parasitoids emerged. *Nasonia vitripennis* (Walker) (Hymenoptera: Pteromalidae) was the most frequent species with a percentage of 42.4%. *Pachycrepoideus vindemmiae* was the species that showed a highest percentage of parasitism.

Keywords: biocontrol, insects pests, baits, parasitoids, flotation

1. Introduction

Species of blowflies are popularly known in Brazil as gadflies. Their larvae may be biontophagous or scavengers and can cause obligatory or optional myiasis, thus taking on great importance regarding animal health (Greenberg, 1971, Mabika et al., 2012).

Chrysomya albiceps (Wiedemann) (Diptera: Calliphoridae) is of great medical importance because it produces myiasis. It has a significant role as a predatory other dipterous larvae. Moreover, this dipterous insect is of great importance with regard to public health because it mechanically carries pathogens to humans and animals (Queiroz et al., 1996; Mabika et al., 2012; Radhakrishnan et al., 2012; Marchiori, 2014a, 2014b, 2014c).

The adults of *C. albiceps* feed on a wide variety of substances, including flower nectar, urban garbage, fallen fruit, human feces and other animal products such as liver, beef and fish (Queiroz, 1996; Mabika et al., 2012; Radhakrishnan et al., 2012).

Parasitoids are responsible for reducing the populations of dipterous that proliferate on various substrates. Evaluation of these species for natural control over these insects pests is important for enabling studies that aim towards subsequent selection of species for use in biological control programs (Marchiori et al., 2000).

The aim of this study was to report on parasitoids of *C. albiceps* collected in the states of Goiás and Minas Gerais, Brazil.

2. Material and Methods

2.1 Experiment with Pig Carcasses

In a natural area, two pig carcasses (*Sus scrofa*) scavengers. Underneath the cages, metal trays with sawdust were placed to collect the pupae. The pupae were extracted by means of flotation in water. The pupae were individually placed in gelatin capsule. 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 (size number 00) in order to obtain the dipterous and/or parasitoids. This substrate was used as best attract the species *C. albiceps*

2.2 Experiment with Human Feces, Cattle Kidneys, Cattle Liver, Chicken Viscera and Fish

The dipterous 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 dipterous 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 dipterous and parasitoids could be collected. The following items were used as baits: human feces, cattle kidneys, cattle liver, chicken viscera and fish which were placed inside the cans, over a layer of earth. Five traps were used and they were hung on trees at a height of one meter above the ground, two meters apart from each other. The insects collected were taken to the laboratory, sacrificed with ethyl ether and kept in 70% alcohol for further 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 (size number 00) in order to obtain the dipterous and/or parasitoids. These substrates were used as best attract the species *C. albiceps*.

2.3 Percentage of Parasitism

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.

2.4 Collection Period

Years and Monthly of collection: 1999 (October and December) – 2001 (March, April, May and June) - 2003 (August and September) - 2004 (April, May, November and December) – 2005 (March, April, May, June, July, August, September, October and December) – 2006 January, February, March, April, May, June, July, August, September, October, November and December) 2007 (January, February, March, April, May, June, July, August, September, October, November and December), 2008 (January, February, March, April and May) and 2013 (November).

3. Results and Discussion

From October 1999 to November 2013, we obtained 5314 pupae of *C. albiceps*, from which 132 pupae 824 parasitoids emerged (Table 1).

Table 1. Parasitoids of *Chrysomya albiceps* collected in states of Goiás and Minas Gerais, from October 1999 to November 2013

Total of pupae - *C. albiceps*	Substrates	Parasitoids	*Years and Months of Collection	Number of individuals	Number of pupae parasitizing	***%
168	Feces	*H. herbertii*	2003 (A, S) - 2004 (A, M)	27**	04	1.1
		Trichopria sp.	2004 (A, N, D) - 2005 (M, A)	25	25	14.9
3941	Carcass	*P. egeria*	1999 (O, D)	5	5	0.1
		S. endius	1999 (O, D)	7	7	0.2
1088	Cattle kidney and Cattle liver	*N. vitripennis*	2005 (M, A, M, J, J, A, S, O, D)	692**	56	5.1
29	Chicken viscera	*B. podagrica*	2001 (M, A, M, J)	04	04	13.8
45	Carcass and Fish	*P. vindemmiae*	2006 (J–D), 2007(J-D), 2008 (J, F, M, A , M)	30	30	66.6
43	Catlle liver	*Tachinobia* sp.	2013 (N)	30**	1	2.3
		Total		824	132	

*Years and Monthly of collection: 1999 (October and December) – 2001 (March, April, May and June) - 2003 (August and September) - 2004 (April, May, November and December) – 2005 (March, April, May, June, July, August, September, October and December) – 2006 January, February, March, April, May, June, July, August, September, October, November and December) 2007 (January, February, March, April, May, June, July, August, September, October, November and December), 2008 (January, February, March, April and May) and 2013 (November).

**Gregarious parasitoids (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).

*** Percentage of parasitism.

There were four specimens of *Brachymeria podagrica* (Fabricus) (Hymenoptera: Chalcididae); 25 of *Trichopria* sp. (Hymenoptera: Diapriidae); four of *Hemencyrtus herbertii* Ashmead (Hymenoptera: Encyrtidae); 56 of *Nasonia vitripennis* (Walker) (Hymenoptera: Pteromalidae); five of *Paraganaspis egeria* Díaz, Gallardo and Walsh (Hymenoptera: Figitidae); seven of *Spalangia endius* (Walker) (Hymenoptera: Pteromalidae); 30 of *Pachycrepoideus vintemmiae* (Rondani) (Hymenoptera: Pteromalidae); and one of *Tachinobia* sp. (Table 1).

The most frequent species was *N. vitripennis*, accounting for 42.4% of the individuals collected. This species behaves as gregarious parasitoid and is an ectoparasitoid in pupae of several species of Diptera families, particularly Calliphoridae, Muscidae, Sarcophagidae and Tachinidae (Rivers and Denlinger 1995). It is a polyphagous insect parasite over 68 species of Diptera (Whiting 1967, Marchiori 2013a, 2013b, Marchiori 2014b, 2014c).

The total frequency of parasitism was 1.6%, probably due to the presence of gregarious parasitoids. *Pachycrepoideus vindemmiae* was the species that showed highest frequency of parasitism, possibly due to variations in the quality and availability of food resources or the density of hosts (Table 1).

Pachycrepoideus vindemmiae is considered to be a solitary parasitoid that controls a great number of Diptera in the families Anthomyiidae, Calliphoridae, Muscidae, Sarcophagidae, Tachinidae and Tephritidae. This species presents diversified (cosmopolitan) distribution and it has been found in North America and Africa (Gauld and Bolton 1988, Marchiori and Penteado-Dias 2010, Marchiori 2013a, 2013b, Marchiori et al. 2013).

The species *B. podagrica* occurs almost everywhere in the world and lives associated with Diptera synanthropic and other flies emerging from their pupae (Delvare and Boucek 1992, Marchiori 2001).

Several species of the family Encyrtidae have been successfully used in biological control programs. *Hemencyrtus herbertii* Ashmead (Hymenoptera: Encyrtidae) behaves as a parasitoid larvae, developing internally in the host body and emerging from the puparium (Noyes 1980, Gauld and Bolton 1988).

Diaz et al. (1996) found *P. egeria* immature stages of Diptera in Argentina (Diptera). According to these authors, in Brazil this species is found in the states of São Paulo and Mato Grosso do Sul.

Spalangia endius is a solitary parasitoid containing a great number of Diptera in the families Anthomyiidae, Drosophilidae, Calliphoridae, Muscidae, Sarcophagidae and Tephritidae (Hanson and Gauld 1995).

Species *Tachinobia* behave as gregarious parasitoid pupae of Lepidoptera and Diptera (Boucek 1977, La Salle 1994).

Species of the genus *Trichopria* are usually parasitoids of the immature stages of Diptera (Legner et al. 1976).

As an alternative to insecticides, insects called regulators can also be used as natural controls, both in agriculture and in animal breeding. Chemical control over insects in urban and rural environments is difficult because of the danger of contamination of humans, animals and the environment. Therefore, biological control of flies through using microhymenopterous parasitoids meets the need for alternatives for dealing with the problem, because of its safety, ease of handling and low cost (Silveira et al. 1989, Carvalho et al. 2003).

4. Conclusion

Nasonia vitripennis (Walker) (Hymenoptera: Pteromalidae) was the most frequent species with 42.4%. The total frequency of parasitism was 1.6%. *Pachycrepoideus vindemmiae* was the species that showed a highest percentage of parasitism.

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