Parasitoids collected from artificial bovine dung pats exposed for different periods of time in Itumbiara, Goiás, Brazil

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ABSTRACT. Parasitoids were collected from artificial bovine dung pats exposed for different periods of time in pasture from January to October 2001 in Itumbiara, Goiás, Brazil. Cattle dung pats were exposed in pastures for periods of 24, 48, 72, 96, 120, 144, 168, 192, 216, and 140h and were, then individually taken to the laboratory for parasitoids extraction. A total of 100 dung pats were exposed in the pasture and 430 parasitoid individuals were recovered from them. The most abundant species extracted were: *Paraganaspis egeria* and *Spalangia drosophilae*. The majority of species was collected in cattle dung pats exposed for 24 h and 48 h.

Key words: Hymenoptera, Coleoptera, cattle dung, biocontrol, natural enemies.

RESUMO. Parasitóides coletados de fezes bovinas artificiais expostas em diferentes períodos de tempo em Itumbiara, Goiás, Brasil. Parasitóides foram coletados de massas artificiais de fezes bovinas, expostas por diferentes períodos de tempo em pastagens de janeiro a outubro de 2001 em Itumbiara, Goiás, Brasil. As fezes bovinas foram expostas nas pastagens por períodos de 24, 48, 72, 96, 120, 144, 168, 192, 216 e 240h e, posteriormente, levadas ao laboratório para extração e separação dos parasitóides. Um total de 100 massas de fezes bovinas foram expostas nas pastagens, nas quais 430 indivíduos de parasitóides foram coletados. As espécies mais abundantes foram: *Paraganaspis egeria* e *Spalangia drosophilae.* A maioria das espécies foi coletada em fezes bovinas expostas nos períodos de 24 e 48 horas.

Palavras-chave: Hymenoptera, Coleoptera, fezes bovinas, controle biológico, inimigo natural.

Introduction

During the last decade, there has been an increase in cattle farming in Central Brazil. In the states of *Mato Grosso* and *Goiás*, where large pasture areas prevail, beef cattle farming is the choice and the open range or extensive cattle management system is the most widely used (Almeida, 1996). Consequently, large groups of insects such as coprophagous species (beetles and flies), parasitoids, predators are found associated to bovine dung (Merrit and Anderson, 1977).

Diptera is one of the largest order insects, thus comprising a large number of species as well as individuals. In addition, these flies are of great medical and veterinarian importance since they may produce myiasis and may be vectors of pathogenic microorganisms to humans and animals (Chow, 1940; Greenberg, 1971). Flies have been found to carry disease-causing organisms such as: bacteria, protozoa and helminths (Greenberg, 1971). The association occurs because flies explore organic material and/or residues, which are produced by human or animal activity, specially feces and vegetal residues.

Associated with the flies, there is a diverse parasitoids fauna, which is responsible for the natural control of these flies. Among the main natural enemies of the flies are the Braconidae, Chalcididae, Pteromalidae, Encyrtidae, and Figitidae (Hymenoptera) (Silva, 1991). Since parasitoids occupy a higher trophic level, they act as determining factors on the population densities of their hosts due to the diversity of their physiological and behavioral adaptations (Matthews, 1974). In addition, being natural enemies of these pests, they may be used in biological control programs. The objective of this study was to evaluate the succession of parasitoid species in artificial bovine pats exposed in the pasture in *Itumbiara*, State of *Goiás*, Central Brazil.

Material and methods

The experiment was carried out at "Chácara Vilela", a small farm located in the district Village, 5

km away from *Itumbiara* city, State of *Goiás*, Central Brazil (18º25'S and 49º13'W), on the *Paranaiba* river margin. The property has an area of approximately 29 hectares, with 50 heads of "girolanda" breed dairy cattle. Fresh feces were collected immediately after deposition on the barn and mixed in four 20 L plastic buckets. Artificial pads of feces (approximately 2 L each) were produced and placed into 10 plastic containers (40 cm in diameter x 12 cm in height) containing a 5 cm layer of soil from the same site. The containers had the bottom perforated to allow water drainage and were then randomly placed at the soil level in the pasture to allow the colonization by arthropods. Cattle dung pat was individually retrieved from the field at 24 h intervals (24, 48, 72, 96, 120, 144, 168, 192, 216, and 240 h of exposure), and taken to the laboratory where they were kept for 10 days. Ten repetitions were done for each exposition time. Each bowl was covered with cheese cloth and maintained in the laboratory for collection of pupae by water flotation. Pupae were individualized into gelatin capsules (number 00) and maintained in the laboratory (temperature of 27ºC and humidity of 60±10%) until parasitoid hatching. The experiment was carried out from January to October 2001.

The prevalence rate of parasitism was calculated using the formula: P= (parasitized pupae/ total pupae)x100. The preference of species for time of feces exposure was tested by the Chi-square test, at 5,0% probability.

Results and discussion

Paraganaspis egeria (Hymenoptera: Figitidae) was the most frequent species (44,4%) followed by *Spalangia drosophilae* (Hymenoptera: Pteromalidae) (22,7%) of the parasitoids collected (Table 1). *Paraganaspis egeria* was collected from feces of all exposition times, with the exception of 216 h (Table 2). These results are similar to those of Marchiori *et al.* (2001). We consider these two species to be the most well adapted to pasture areas in Itumbiara.

In addition, *Trichopria* sp. (Hymenoptera: Diapriidae), *Neralsia splendens* (Hymenoptera: Figitidae), *P. egeria*, and *Aleochara notula* (Coleoptera: Staphylinidae) were collected in feces with 24, 48, and 72 h of exposure indicating that they probably are parasitoids of larvae of muscoids dipterans (Table 2). According to Diaz and Gallardo (1995; 1996), *N. splendens* and *P. egeria* are parasitoids of first instar larvae of *Sarcophagula occidua* (Diptera: Sarcophagidae) in bovine feces. The Figitidae are parasitoids of Diptera and behave as primary parasitoids of dipteran larvae. Guimarães and Mendes (1998), working with succession of Staphylinidae on bovine feces, found that *Aleochara* spp. were more abundant after 24 h of exposure, indicating that they are predators of eggs or larvae of Diptera.

Table 1. Frequency and percentage of different parasitoid species extracted from 100 artificial cattle dung pats exposed in a pasture for different periods of time in Itumbiara, State of Goiás, Central Brazil (18º25'S and 49º13'W), from January to August 2001

Taxonomic group	Frequency	Percentage
Figitidae: *Paraganaspis egeria*	191	44,4
Pteromalidae: *Spalangia drosophilae*	98	22,7
Figitidae: *Triplasta atrocoxalis*	51	11,9
Pteromalidae: *Spalangia* sp.	26	6,0
Diapriidae: *Trichopria* sp.	20	4,8
Pteromalidae: *Spalangia nigroaenea*	14	3,3
Staphylinidae: *Aleochara notula*	12	2,8
Pteromalidae: *Spalangia nigra*	06	1,4
Figitidae: *Triplasta coxalis*	05	1,2
Pteromalidae: *Spalangia endius*	03	0,7
Figitidae: *Neralsia splendens*	02	0,4
Figitidae: *Kleidotoma nigra*	01	0,2
Pteromalidae: *Spalangia cameroni*	01	0,2
Total	430	100,0

Table 2. Number of parasitoids and pupae from different parasitoid species extracted from 100 artificial cattle dung pats exposed in a pasture for different periods of time in Itumbiara, State of Goiás, Central Brazil (18º25'S and 49º13'W), from January to August 2001

Taxonomic group	Time of exposure (h), number of parasitoids and number of pupaes of flies									
	24	48	72	96	120	144	168	192	216	240
Diapriidae:										
Trichopria sp.		01	05	02	02		01	07	02	
Figitidae:										
Kleidotoma nigra						01				
Neralsia splendens	01		01							
Paraganaspis egeria	57	31	31	06	09	10	03	25		19
Triplasta atrocoxalis			08	16	05	14		08		
Triplasta coxalis						05				
Pteromalidae:										
Spalangia cameroni							01			
Spalangia drosophilae				53	25	09	04	05		02
Spalangia endius				03						
Spalangia nigra				04	02					
Spalangia nigroaenea				12	01					01
Spalangia sp.				08	14				03	01
Staphylinidae:										
Aleochara notula	05	05			01					01
Total	63	37	45	104	59	39	09	45	05	24
Number of pupae of flies	358	293	391	252	331	424	183	372	239	256

The presence of the parasitoids *Trichopria* sp, *Triplasta atrocoxalis* (Hymenoptera: Figitidae) and *P. egeria* in the exposure time of 120, 144, 168, 192, 216, and 240 h can be explained by being parasitoids of pupae or due to the possible presence of eggs and/or larvae of Diptera in the feces with those times of exposure. Sanders and Dobson (1966) stated that the Sepsidae are the first flies to visit feces, and possibly that they are not limited solely to fresh feces. According to Laurence (1955), some Diptera groups such as Sphaeroceridae and Sepsidae, seem to be non-demanding in terms of time of exposure of the substrate, since they may produce more than one generation in the same fecal mass. In the case of *Trichopria* sp., oviposition may occur on the host larva as well as on the pupae (Hanson and Gauld, 1995).

Species of *Spalangia* are predominantly associated to bovine dung and are parasitoids of Diptera pupae (Rueda and Axtell, 1985). In this experiment species of *Spalangia* occurred in the feces after 96h of exposure because species of these genus are parasitoids of fly pupae. Our results indicate that, in Itumbiara, pupae of muscoid flies may be found in bovine feces only after 96h of exposure. This is a very important finding since the horn fly adults preferentially oviposit on recently dropped fecal masses (Mendes and Linhares, 1999).

The most important period that the parasitoids are active occurred in fresh fecal pats (Table 2) with exposure times from 24 to 96h. Only in those parasitoid species found in fresh feces (24 and 48h) would be more suitable to be used in future horn fly control programs. Amaral (1996) found that the Hymenoptera reached their highest abundances in feces exposed for 144h.

The collected parasitoids showed the following for fecal pats: *Trichopria* sp. preferred feces exposed for 72 and 192h; *P. egeria* preferred feces exposed for 24, 48, 72, 192, and 240h; *T. atrocoxalis* for 72, 96, 144, and 198h exposed feces; *Spalangia cameroni* (Hymenoptera: Pteromalidae) for 72, 96 144 and 168h exposed feces; *Spalangia nigra* (Hymenoptera: Pteromalidae) for 72 and 240h of exposure; *Spalangia nigroaenea* (Hymenoptera: Pteromalidae) for 96h exposure; *Spalangia* sp. for 96 and 120h exposure; and *A. notula* for 24 and 48h of feces exposure in the field (X^2= 277,4; DF = 108; P< 0.0001).

The total prevalence rate of parasitism was 13.8% (430 parasitoids and 3099 flies). With regard to Table 3, it is verified that *Sarcophagula occidua* (Fabricius) (Diptera: Sarcophagidae) was the host, which presented greater diversity of parasitoids in the exposition time of 96 hours. The parasitoid *P. egeria* was responsible for the greater prevalence rate of parasitism in the six periods of dung pats exposition in the pasture. In the periods of 24, 48,72, 96, 120, 144, 168, 192, 216 and 240 hours, the higher parasitism occurred with the parasitoids: *P. egeria*, *P. egeria*, *P. egeria*, *S. drosophilae*, *S. drosophilae* and *S. nigra*, *P. egeria*, *S. cameroni*, *P. egeria*, *Trichopria* sp. and *P. egeria*. The prevalence rate of parasitism observed was 17.5%, 12.6%, 9.0%, 52.5%, 18.4%, 9.1%, 5.3%, 12.0%, 2.0%, and 9.3% in feces with 24, 48, 72, 96, 120, 144, 168, 192, 216, and 240h of exposure, respectively.

Table 3. The prevalence rate of parasitism from different parasitoid species extracted from 100 artificial cattle dung pats exposed in a pasture for different periods of time in Itumbiara, State of Goiás, Central Brazil (18º25'S and 49º13'W), from January to August 2001

Hours	Host- nº of pupae	Parasitoids	Frequency	Prevalence
24	*Sarcophagula occidua*-108	*Aleochara notula*	05	4,6
		Neralsia splendens	01	0,9
		Paraganaspis egeria	57	52,7
48	*Sarcophagula occidua* -231	*Aleochara notula*	05	2,2
		Paraganaspis egeria	31	13,4
		Trichopria sp.	01	0,4
72	*Palaeosepsis* spp.-160	*Paraganaspis egeria*	01	06
		Trichopria sp.	03	1,8
	Sarcophagula occidua- 224	*Neralsia splendens*	01	0,4
		Paraganaspis egeria	30	13,4
		Trichopria sp.	02	0,9
		Triplasta atrocoxalis	08	3,5
96	*Palaeosepsis* spp.- 137	*Paraganaspis egeria*	01	0,7
		Spalangia drosophilae	03	2,2
		Triplasta atrocoxalis	16	11,6
	Sarcophagula occidua- 107	*Paraganaspis egeria*	05	4,7
		Spalangia drosophilae	50	46,7
		Spalngia endius	03	2,8
		Spalangia nigra	04	3,7
		Spalangia nigroaenea	12	11,2
		Spalangia sp.	08	7,5
		Trichopria sp.	02	1,9

To be continue...

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Hours	Host- nº of pupae	Parasitoids	Frequency	prevalence
120	*Archsepsis scabra*- 02	*Spalangia drosophilae*	01	50,0
	Palaeosepsis spp.- 114	*Paraganaspis egeria*	05	4,3
		Spalangia drosophilae	21	18,4
		Trichopria sp.	02	1,7
		Triplasta atrocoxalis	05	4,3
	Ravinia belforti- 04	*Spalangia nigra*	02	50,0
	Sarcophagula occidua- 201	*Aleochara notula*	01	0,4
		Paraganaspis egeria	04	1.9
		Spalangia drosophilae	03	1,5
		Spalangia nigroaenea	01	0,4
		Spalangia sp.	14	6,9
144	*Palaeosepsis* spp.- 347	*Kleidotoma nigra*	01	0,2
		Paraganaspis egeria	01	0,2
		Spalangia drosophilae	04	1,2
		Triplasta coxalis	05	1,4
		Triplasta atrocoxalis	14	4,0
	Sarcophagula occidua- 56	*Paraganaspis egeria*	09	16,7
		Spalangia drosophilae	05	8,9
168	*Brontaea debilis*- 09	*Spalangia cameroni*	01	11,1
	Palaeosepsis spp.- 98	*Paraganaspis egeria*	03	3,0
		Spalangia drosophilae	04	4,0
		Trichopria sp.	01	1,0
192	*Palaeosepsis* spp.- 181	*Spalangia drosophilae*	03	1,6
		Trichopria sp.	07	3,8
		Triplasta atrocoxalis	08	4,4
	Sarcophagula occidua -142	*Paraganaspis egeria*	25	17,6
		Spalangia drosophilae	02	1,4
216	*Palaeosepsis* spp. 164	*Spalangia* sp.	03	1,8
	Sarcophagula occidua -13	*Trichopria* sp.	02	15,3
240	*Palaeosepsis* spp- 144	*Paraganaspis egeria*	05	3,4
		Spalangia drosophilae	02	1,3
	Sarcophagula occidua- 77	*Aleochara notula*	01	1,2
		Paraganaspis egeria	14	18,1
		Spalangia nigroaenea	01	1.2
		Spalangia sp.	01	1,2

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