SCIENTIFIC NOTE

Succession of Scarabaeidae on Bovine Dung in Itumbiara, Goiás, Brazil

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Sucessão de Scarabaeidae em Fezes Bovinas em Itumbiara, Goiás

RESUMO - A sucessão de Scarabaeidae em fezes bovinas depositadas em pastagens foi observada de janeiro a agosto de 2001 em Itumbiara, Goiás (18º25'S; 49º13'W). Fezes bovinas recém-excretadas foram expostas nas pastagens por um, dois, três, quatro, cinco, seis, sete, oito, nove e dez dias e posteriormente levadas para o laboratório para a separação e triagem dos Scarabaiedae presentes. Um total de 100 fezes bovinas foram expostas nas pastagens, das quais 3.220 espécimes de Sarabaeidae foram coletados. As espécies coletadas em maior número de indivíduos foram *Ataenius aequalis* Harold e *Aphodius lividus* Balth. A maioria das espécies foi coletada em fezes bovinas expostas pelo período de um e dois dias.

PALAVRAS-CHAVE: Arthropoda, Coleoptera, bovino, controle biológico

ABSTRACT - The succession of Scarabaeidae in cattle dung deposited in pasture were observed from January to August 2001 in Itumbiara County, State of Goiás, Brazil (18º25'S; 49º13'W). Fresh cattle dung pats were exposed on a pasture area for one, two, three, four, five, six, seven, eight, nine and ten days and then taken individually to the laboratory for screening and identification of the Scarabaeidae therein present. A total of 100 dung pads were exposed in the field from which 3,229 specimens of Scarabaeidae were recovered. The most frequent species found were: *Ataenius aequalis* Harold and *Aphodius lividus* Balth. The majority of specimens were collected in cattle dung exposed for one and two days.

KEY WORDS: Arthropoda, Coleoptera, bovine, biocontrol

Bovine fecal masses act as shelters or may be source of food for a rich and varied fauna, including sinanthropic Diptera of veterinarian importance, among which the horn-fly (*Haematobia irritans* L.) (Diptera: Muscidae) should be emphasized (Fletchmann *et al.* 1995). The *H. irritans* adults are hematophagous, however their eggs are deposited on bovine fecal masses, which is the ideal environment for development of their larvae and from where the fully developed adults attack the cattle (Fletchmann *et al.* 1995a)

The Scarabaeidae (Coleoptera) are generally coprophagous and inhabitants of excrements, where larvae and adults feed. They are considered very important in controlling sinanthropic flies that reproduce on bovine dung (Fletchmann *et al.* 1995a, Martin & Contel 1997a, Koller *et al.* 1999, Aidar *et al.* 2000) and parasitic gastrointestinal nematodes of bovines, besides improving soil structure and fertility (Calafiori 1979, Miranda *et al.* 2000, Fletchmann *et al.* 1995a).

They present a characteristic behavior of burying small portions of fecal mass in the soil as well as of burrowing galleries, causing aeration and at the same time dryness of the soil besides also burying larvae and eggs that are eventually present in the fecal mass attacked by them (Fletchmann *et al.* 1995a)

The objective of the present research work was to study the succession of the Scarabaeidae that occur on field exposed bovine dung pads, which are naturally visited by coprophagous species during periods of one to ten days on a pasture area in Itumbiara County, State of Goiás, Central Brazil.

The experiment was carried out at Vilela Farm, 5 km distant from downtown Itumbiara (18º25'S; 49º13'W), on the Paranaíba river shore. The area has approximately 29 ha where 50 heads of "Girolanda" breed dairy cattle are raised. Feces were collected immediately after being excreted in the corrals and mixed into two 20-liter buckets. Hand made dung pads of approximately 2 liters each were placed into 10 circular plastic trays (40 cm in diameter and 12 cm tall) containing a 5 cm layer of soil collected at the same site. The plastic trays were bottom-perforated to allow drainage of rainwater. These so prepared trays were then randomly placed at the ground level in the pasture at 9:00 o'clock AM, for arthropods visitation. At each one-day interval only one dung

pad was collected after one day to 10 days of field exposure. The feces were taken to the laboratory and placed in a Berlese funnel containing flasks filled with 70% ethanol, for approximately five days. The samplings were performed on January 15th, February 10th, March 11th, April 10th, May 15th, June 10th, July 15th, August 15th, September 10th, and October 15th 2001, totaling 10 samplings with 10 replication per treatment (time of exposure), during the study. The adults obtained by this process were counted and sent for identification. The preference of species for feces according to time of exposure was tested by Chi-square test at 5% probability.

The constancy of species was determined by the formula of Bodenheimer (1938): C = P x 100/N, where P = number of samplings containing the species and N = the total number of samplings. According to the percentages obtained, the species were divided into the following categories: constant species (X) – present in more than 50% of the samplings; accessory species (Y) – present in 25% to 50% of the samplings; and accidental species (Z) – present in less than 25% of the samplings.

The dominance of species was determined by the formulas of Laroca & Mielke (1975) that establish an Upper limit (UL) = $n_1 . F_0 / n_2 + (n_1 . F_0)$ x 100; where: $n_1 = 2(K + 1)$ and $n_2 = 2(N – K + 1)$; and a Lower limit (LL) = $[n_1 . F_0 / n_2 + (n_1 . F_0)]$ x 100, where: $n_1 = 2(N – K + 1)$ and $n_2 = 2(K + 1)$. In these formulas N = total number of individual captured; K = number of individual of each species; F_0 = a value obtained in the table of distribution of F, at 5% probability (F > 1) for degrees of freedom of n_1 and n_2. The species that presented LL higher than UL, when K = 0, were considered dominants.

Frequency and abundance indexes were also calculated for the Scarabaeidae collected. Classes of frequency were established for the species using the confidence interval of 5% probability as follow: lf = little frequent, f = frequent, and vf = very frequent.

For the abundance index (Silveira Neto *et al.* 1976), the following classes were established for the species: r = rare, in which the number of individuals of that species was smaller than the lower limit of the confidence interval (CI) at 1% probability; d = disperse, in which the number of individuals of that species were among the lower limits of the confidence interval (CI) at 5% and 1% probability; C = common, in which the number of individuals was within the limits of the confidence interval (CI) a 5% probability; a = abundant, in which the number of individuals was among the upper limits of the confidence interval (CI) at 5% and 1% probability; v = very abundant, in which the number of individuals was above the upper limit of the confidence interval (CI) a 1% probability; and s = super abundant, in which the number of individuals was highly above the upper limit of the confidence interval (CI) a 1% probability.

The species *Ataenius aequalis* Harold had the highest number of individuals collected, reaching 67.3%, followed by the species *Aphodius lividus* Balth., with 10.7% of the Scarabaeidae collected (Table 1). It is believed that these species are the best adapted in pasture areas in Itumbiara. These two species were also the most frequently collected in another experiment carried out by Marchiori & Linhares (2001) in Itumbiara County, State of Goiás, with feces exposed for an eight-day period of exposure in the pastures.

Table 1. Number of specimens of different species of Scarabaeidae collected by dissection of bovine fecal masses pads, exposed at the ground level in a pasture for periods of one to 10 days in Itumbiara County, State of Goiás, Central Brazil, from January to October 2001.

Scarabaeidae species	Total number/species	Percentage
A. viridis	13	0.5
Aphodius sp.1	74	2.4
Aphodius sp.2	77	2.5
A. nigrita	63	2.0
A. lividus	344	10.7
Ataenius sp.1	27	0.9
A. aequalis	2,206	68.4
C. lituratus	16	0.5
D. bos	30	0.6
D. gazella	297	9.3
Euparia sp.	02	0.1
O. hirculus	39	1.3
O. ranunculus	04	0.1
T. externepunctatum	37	1.1
Total	3,229	100,0

Alves & Nakano (1977) suggest that the species *A. lividus*, *Ataenius* sp. and *Dichotomius bos* Mannerheim may represent the most important aerators, buriers and tunnel-former species of bugs in bovine feces. Coprophagous Coleoptera of large biomass should be selected for studies directed to their use as biological control agents of the horn-fly (Alves 1977, Calafiori 1979, Fletchmann *et al.* 1995)

Digitonthophagus gazella Fabricius may be considered an exotic species that colonizes the Brazilian "Cerrados" (savanna). It is a para coprideous insect of African origin that digs branched galleries below or beside dung pads and has been used in biological control programs of the horn-fly (Rodrigues 1985; Martins & Contel 1997b; Miranda *et al.* 1998, 2000).

The majority of Scarabaeidae species, ca 85.7%, present peaks of occurrence in one-day old feces, except for *Aphodius nigrita* Fabricius and *A. aequalis*, which present peaks in four-days old and eight-days old bovine feces, respectively (Table 2). This finding is important since the adults of the horn-fly oviposit preferentially in freshly-excreted fecal masses (Guimarães 1990).

According to the results achieved until the moment, it is possible to conclude that the most intense action of Scarabaeidae occurred in the fresher bovine fecal pads (Table 2) with one or two days of field exposure. Doube (1990), Fletchmann & Rodrigues (1995) and Fletchmann *et al.* (1995a) obtained similar data. In the ecological succession of insects occurring in bovine feces, the coprophagous species found in fresher feces (one and two days old) would be the most suitable ones for a selection aiming at a future fly-control program.

In relation to preference of species by the age of feces, the following results were obtained: *Agamopus viridis* (Boucomont), *Aphodius* sp 1, *Aphodius* sp 2, *Canthon*

Table 2. Number of specimens of different species of Scarabaeidae collected by dissection of bovine fecal masses pads after different times of exposure at the ground level in a pasture in Itumbiara County, State of Goiás, Central Brazil, from January to October 2001.

Taxonomic group	Time of field exposure (hours)									
Scarabaeidae	24	48	72	96	120	144	168	192	216	240
A. viridis	06	04	02							01
Aphodius sp.1	58	12					02			02
Aphodius sp.2	57	16					03			01
A. nigrita	11	13	15	18	01	01		02		02
A. lividus	115	93	26	07	48	05	03	21	25	01
Ataenius sp.1				01	05	01	18	02		
A. aequalis	121	266	182	224	192	232	216	287	259	227
C. lituratus	10	06								
D. bos	10	03	07	01	01	02	02	01		03
D. gazella	123	64	61	31	10	04		03		01
Euparia sp.					02					
O. hirculus	11	10	03		02	02	01	04		06
O. ranunculus	04									
T. externepunctatum	26	07	04							
Total	552	494	300	282	261	247	245	320	284	244

lituratus (Germar) and *Onthophagus hirculus* Mannerheim preferred the one- and two-day old feces; *A. nigrita* preferred the one-, two-, three- and four-day old feces; *A. lividus* had preference for the one-, two-, five- and six-day old feces; *Ataenius* sp 1 for five- and seven-day old feces; *D. bos* for one- and three-day old feces; *D. gazella* for one-, two-, three- and four-day old feces; and *Trichillum externepuctatum* Borre preferred the one-, two- and three-day old feces ($\lambda^2 = 1421.26$; DF = 99; $P < 0.0001$).

As far as the method used for collecting coprophagous Coleoptera is concerned, Fletchmann *et al*. (1995a) emphasize that if the objective is to follow population fluctuation or to perform a survey of the main species occurring in a given area, light traps would be the the best option. However if the goal is to achieve more precise data involving interactions with different types of fecal masses, the dissection of fecal masses would be the most adequate method.

The pitfall traps are more appropriated for median and large-sized species, but for both cases one cannot interfere in the assemblage of species, which are present in bovine fecal masses in pasture areas. According to specialists diverse types of traps should be used simultaneously for a better sampling of the different groups of Coleoptera that form the coprophagous Scarabaeidae complex.

In relation to the fauna indexes shown on Table 3, the majority of species belong to the following categories: accessories (71.4%), non-dominants (92.8%), little frequent (78.6%), and disperse (42.9%). Among the Scarabaeidae, *A. aequalis* looms as the constant, dominant, most frequent and very abundant species.

Those species that occurred in fresher fecal masses, should be selected for further studies aiming at their use in biological control programs of flies, with special emphasis on the horn-fly *H. irritans.*

Table 3. Fauna indexes of different Scarabaeidae species collected by dissection of bovine fecal masses pads, which had been exposed at the ground level in a pasture for periods of one to 10 days in Itumbiara County, State of Goiás, Central Brazil, from January to October 2001.

Scarabaeidae species	A[1]	D[2]	F	AB
A. viridis	Z	ND	lf	d
Aphodius sp.1	Z	ND	lf	c
Aphodius sp.2	Z	ND	lf	c
A. nigrita	Z	ND	lf	d
A. lividus	X	ND	f	a
Ataenius sp.1	Z	ND	lf	d
A. aequalis	X	D	vf	sa
C. lituratus	Z	ND	lf	d
D. bos	Z	ND	lf	d
D. gazella	Y	ND	f	va
Euparia sp.	Z	ND	lf	r
O. hirculus	Y	ND	lf	d
O. ranunculus	Z	ND	lf	r
T.externepunctatum	Z	ND	lf	c

A[1] = constancy: constant species (X) - present in more than 50% of the samplings; accessory species (Y) - present from 25% to 50% of the samplings; accidental species (Z) - present in less than 25% of the samplings. D[2] = dominance (ND = non-dominant and D = dominant). F = frequency (lf: little frequent, f: frequent, vf: very frequent). AB= abundance (r: rare, d: disperse, c: common, a: abundant, va: very abundant, sa: super-abundant).

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