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Nematodes (Mermithidae) parasitizing grasshoppers (Orthoptera: Acrididae) in the Pampean region, Argentina

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(With 1 figure)

Abstract

This work provides the results of a survey of entomonematodes parasites of grasshoppers in grasslands of the Pampean Region, Argentina. Nymphs of *Staurorhectus longicornis* Giglio-Tos, *Laplatacris dispar* Rhen, 1939, *Dichroplus elongatus* Giglio-Tos, 1894 and *Metaleptea brevicornis* (L.) (Orthoptera: Acrididae) were collected. Mermithidae was the only family registered with seven species: *Agamermis decaudata* Cobb, Steiner and Christie, 1923, *Amphimermis bonaerensis* Miralles and Camino, 1983, *Amphimermis dichroplusi* Camino and Lange, 1997, *Amphimermis ronderosi* Camino and Lange, 1997, *Hexamermis coclhearius* Stock and Camino, 1992, *Hexamermis ovistriata* Stock and Camino, 1992, and *Longimermis acridophila* Camino and Stock, 1989. The values of parasitism ranged between 1-12%, and intensity not overcome the number of 5.0 nematodes per larva. The nematodes observed showed specificity, not registering the same species of parasite in more than one host species. The Pampean region constituted an area with high diversity of mermithids where new species could be consider as bioregulator agents of this troublesome insect pests in agricultural areas of Argentina.

Keywords: nematodes, Acrididae, pest, agriculture, Argentina.

Nematóides (Mermithidae) parasitando gafanhotos (Orthoptera: Acrididae) nos Pampas região, a Argentina

Resumo

Este trabalho apresenta os resultados de uma pesquisa entomonematode parasitando gafanhotos em pastagens da região pampeana, Argentina. Ninfas de *Staurorhectus longicornis* Giglio-Tos, *Laplatacris dispar* Rhen de 1939, *Dichroplus elongatus* Giglio-Tos, 1894 e *Metaleptea brevicornis* (L.) (Orthoptera: Acrididae) foram coletados. Mermithidae era a única família registrado com sete espécies: *Agamermis decaudata* Cobb, Steiner and Christie, 1923, *Amphimermis bonaerensis* Miralles and Camino, 1983, *Amphimermis dichroplusi* Camino and Lange, 1997, *Amphimermis ronderosi* Camino and Lange, 1997, *Hexamermis coclhearius* Stock and Camino, 1992, *Hexamermis ovistriata* Stock and Camino, 1992, e *Longimermis acridophila* Camino and imagem, de 1989. Os valores de parasitismo variou entre 1-12%, e intensidade não superar o número de 5,0 nematóides por larva. Os nemátodos observados demonstraram especificidade, não registar as mesmas espécies de parasita em mais do que uma espécie de hospedeiro. A região pampeana constituída uma área com alta diversidade de mermithids onde novas espécies poderiam ser consideradas como agentes bio-reguladores deste incômodos insetos pragas em áreas agrícolas da Argentina.

Palavras-chave: nematóides, Acrididae, praga, agricultura, Argentina.

1. Introduction

Grasshoppers are a serious group of insects causing considerable problems in crop soils. Since they are both phytophagous and polyphagous, their feeding preferences often encompass entire plant families (Almeida and Câmara, 2008).

In Argentina, the Pampean region is an important area where farming is developed and products are obtained for both domestic consumption and for export. However, grasshoppers constitute an important variable in the farming economy of this region. This pest often exhibit "Outbreaks" significant magnitude, causing considerable damage to rangelands, pastures implanted and various crops (maize, soybean, sunflower, barley, sorghum) generating substantial economic losses (Cigliano et al.,

2000, 2002; De Wysiecki et al., 2000; Lange et al., 2005; Mariottini et al., 2012).

The growing interest in environmental quality has encouraged in recent years the search for new tools to control insects of agricultural importance of health and safer and compatible with the environment.

Entomonematodes are one of the highly influential agents regulating the population dynamics of insect pests through association with their hosts in relationships ranging from fortuitous to parasitic. Many investigators have recognized these parasites as potential biological control agents (Poulin, 2012). Results showed that are a safe and effective environmental alternative for controlling pests in crops of economic importance (Duncan et al., 2013; Gumus et al., 2015; Shapiro-Ilan et al., 2010).

The knowledge of parasitic nematodes on acridids in Argentina is limited with studies of the taxonomy and biology of certain species (Camino and Stock, 1989; Camino and Lange, 1997; Miralles and Camino, 1983). In this study we present the results of a survey of entomonematodes parasites of grasshoppers in grasslands of the Pampean region, Argentina.

2. Material and Methods

The study was carried in grasslands of the Pampean Region, Buenos Aires province, Argentina. Samples were taken during the 2005-2010 years, from October to April (spring and summer seasons), in Brandsen (35º 10' 18" S, 58º 13' 48" W), Berazategui (34° 45′ 43.67″ S, 58° 12′ 26.02″ W), and Olavarría (36° 53' 57.12" S; 60° 19' 24" W) cities (see Figure 1). Insects were collected with an entomological net of 40 cm in diameter and 75 cm deep, through 200 strokes along four transects of about 3 m wide and 50 m long each. Each strike involved a 180º an arc through the vegetation. This proven methodology was to obtain representative samples of a community (Mariottini et al., 2012). Then, they were individually transported to the laboratory and maintained in plastic containers with wire–screened walls (15 x 10 cm) with 100 cc of sterilized moistened sand to emergence of mermithid nematodes (post-parasitic juveniles) from grasshoppers. Insects were maintained under these conditions for three weeks and then were dissected to determine the presence of other families of entomonematodes. Specimens that died before that period were also prospected. Identification of grasshoppers was made by Dr. C. Lange at the Center of Parasitological Studies and Vectors (CEPAVE).

Nematodes were transferred to a fixative of 50% (v/v) aqueous triethanolamine formalin, for 48 h and then placed in 100% triethanolamine formalin before transfer to glycerol for slow evaporation in order to clear the parasites (Seinhorst, 1959). The fixed specimens were used for taxonomic identification following the key of Poinar Junior (1977).

The following indices were calculated: parasitism percentage as the number of infected insects over the number of examined; intensity: the mean number of emerged nematodes over the total number of parasitized insects for the same nematode species and abundance: the mean number of emerged nematodes for each species from insect over the total of examined hosts (Bush et al., 1997).

Figure 1. Map of South America and Buenos Aires province, Argentine (left) and detail map of the area sampled (right). References: 1. Brandsen; 2. Berazategui; 3. Olavarria.

3. Results and Discussion

Nymphs of *Staurorhectus longicornis* Giglio-Tos (n=225), *Laplatacris dispar* Rhen, 1939 (n=346), *Dichroplus elongatus* Giglio-Tos, 1894 (n=358) and *Metaleptea brevicornis* (L.) (n=251) (Orthoptera: Acrididae) were collected from the Pampean region. Seven mermithid species were registered at the three locations: *Agamermis decaudata* Cobb, Steiner and Christie, 1923, *Amphimermis bonaerensis* Miralles and Camino, 1983, *Amphimermis dichroplusi* Camino and Lange, 1997, *Amphimermis ronderosi* Camino and Lange, 1997, *Hexamermis ovistriata* Stock and Camino, 1992; *Hexamermis coclhearius* Stock and Camino, 1992 and *Longimermis acridophila* Camino and Stock, 1989 (as shown in Table 1).

The percentage of parasitism ranged from 1 to 12%, the number of nematodes per insect between 2.6 to 5.0 and the mean abundance from 0.04 to 0.33. The nematodes presented specificity, not registering the same species of parasite in more than one host species. However, grasshoppers were parasitized by more than one species in *L. dispar* (3) and *D. elongatus* (2) (as shown in Table 1). The considerable increase of the dimensions of mermithid nematodes during their development inside the host could explain the low levels of intensity observed. The maximum

intensity (5) was recorded for *Amphimermis bonaerensis* in *L. dispar* (as shown in Table 2).

In our study, Mermithidae was the only family of nematodes isolated from the body cavity of acridids being always lethal for their hosts. Previous studies realized in wheat crops of the Pampean region, Argentina, showed a lower diversity of mermithids with a record of two species parasitizing Orthoptera (Gryllotalpidae and Gryllidae) and white grubs (Coleoptera: Scarabaeidae) (Camino and Achinelly, 2011; Camino at al. 2014).

Spirurida and Mermithidae were mentioned by Poinar Junior (1975) as the only nematode families cited in grasshoppers. This could be related with the biology parasite/host. The adults of the Order Spirurida occur in the digestive tract of definitive vertebrate hosts, requiring an invertebrate intermediate host to complete their development. Mermithids can easily enter grasshoppers, showing a remarkable degree of parasite-host synchronization (Baker, 1986). Females can migrate from the soil onto the vegetation and there lay eggs during periods of high moisture. Those eggs, later consumed by the locusts along with the vegetal material hatch in the gut; the juveniles subsequently pass through the gut wall into the hemocoel and increase considerably in size inside the host. Nematodes kill the host with their emergence to the soil where they molt into the adult stage to complete the cycle (Poinar Junior, 1979).

Mermithids have been observed infecting orthopterans with high levels of infection and mortality (Mongkolkiti and Hosford, 1971; Webster and Thong, 1984). A major disturbance in the host metabolism are manifest by host tissue degeneration and retarded development, resorption and suppression of oocyte and the testes, and degeneration of the thoracic muscles reducing the flight ability in the adult hosts (Baker, 1986). Most of the mermithid species constitute a significant regulatory influence on the population dynamics of plague insects. Studies reported that mermithid nematodes can control insect populations (Baker and Capinera, 1997; Poinar Junior, 1979). In this way, Baker (1986) observed that parasites of locusts and grasshoppers in New South Wales were totally dependent on the availability of hosts for survival. If host number was low, parasite numbers was even lower. An increase in host number may provide an unlimited number of insects. So they can produce major epidemics when the infections cause the sharp decline in the population in a short term.

We can conclude that the Pampean region from Argentina is an area with high diversity of mermithid nematodes for grasshoppers. Further studies on the life cycle, longevity, seasonality and host-parasite dynamics should be applied to determine whether the density of nematode populations

Table 1. Mermithids parasites of grasshoppers from the Pampean region.

NEMATODE SPECIES	HOST SPECIES	LOCATION
Agamermis decaudata	*Laplatacris dispar*	Brandsen
Amphimermis bonaerensis	*Laplatacris dispar*	Berazategui
Amphimermis dichroplusi	*Dichroplus elongatus*	Olavarría
Amphimermis ronderosi	*Metaleptera brevicornis*	Brandsen
Hexamermis coclhearius	*Dichroplus elongatus*	Brandsen
Hexamermis ovistriata	*Staurorhectus longicornis*	Brandsen
Longimermis acridophila	*Laplatacris dispar*	Brandsen

Table 2. Grasshoppers parasitized by mermithids in the Pampean region, Argentina. Prevalence (P), Mean number of nematodes per infected host, intensity (I), Mean abundance (A), total number of parasites per host (N).

	M. brevicornis				*S. longicornis*				*D. elongatus*				*L. dispar*			
	P	**I**	**A**	**N**	**P**	**I**	**A**	**N**	**P**	**I**	**A**	**N**	**P**	**I**	**A**	**N**
MERMITHIDAE																
Agamermis decaudata	-	-	-	-	-	-	-	-	-	-	-	-	12	2.6	0.31	109
Amphimermis bonaerensis	-	-	-	-	-	-	-	-	-	-	-	-	1	5	0.04	15
Amphimermis dichroplusi	-	-	-	-	-	-	-	-	9	3.1	0.30	98	-	-	-	-
Amphimermis ronderosi	8	2.7	0.2	55	-	-	-	-	-	-	-	-	-	-	-	-
Hexamermis coclhearius	-	-	-	-	-	-	-	-	12	2.8	0.33	120	-	-	-	-
Hexamermis ovistriata	-	-	-	-	12	2.6	0.32	72	-	-	-	-	-	-	-	-
Longimermis acridophila	-	-	-	-	-	-	-	-	-	-	-	-	6	4.3	0.26	90

registered in our study, are depending on the availability of their hosts, being able to regulate the populations of these pest insects.

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