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

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Received: April 9, 2015 – Accepted: October 26, 2015 – Distributed: February 28, 2017

(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 Metaeleptea 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.

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.,...
2. Material and Methods

The study was carried out 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 (35° 10’ 18” S, 58° 13’ 48” W), Berazategui (34° 45′ 43.67″ S, 58° 12′ 26.02″ W), and Olavarria (36° 53’ 57.12” S; 60° 19’ 24” W) cities (see Figure 1). Insects were collected with an entomological net (15 x 10 cm) with 100 cc of sterilized moistened sand and maintained in plastic containers with wire-screened walls through 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 containing 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).

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 coclearius 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.

<table>
<thead>
<tr>
<th>NEMATODE SPECIES</th>
<th>HOST SPECIES</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agamermis decaudata</td>
<td>Lapatacris dispar</td>
<td>Brandsen</td>
</tr>
<tr>
<td>Amphimermis bonaerensis</td>
<td>Lapatacris dispar</td>
<td>Berazategui</td>
</tr>
<tr>
<td>Amphimermis dichroplusi</td>
<td>Dichroplus elongatus</td>
<td>Olavarria</td>
</tr>
<tr>
<td>Amphimermis ronderosi</td>
<td>Metaleptera brevicornis</td>
<td>Brandsen</td>
</tr>
<tr>
<td>Hexamermis cocleaearius</td>
<td>Dichroplus elongatus</td>
<td>Brandsen</td>
</tr>
<tr>
<td>Hexamermis ovistriata</td>
<td>Staurorhactus longicornis</td>
<td>Brandsen</td>
</tr>
<tr>
<td>Longimermis acridophila</td>
<td>Lapatacris dispar</td>
<td>Brandsen</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th></th>
<th>M. brevicornis</th>
<th>S. longicornis</th>
<th>D. elongatus</th>
<th>L. dispar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P   I   A   N</td>
<td>P   I   A   N</td>
<td>P   I   A   N</td>
<td>P   I   A   N</td>
</tr>
<tr>
<td><strong>MERMITHIDAE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agamermis decaudata</td>
<td>-   -   -   -</td>
<td>-   -   -   -</td>
<td>-   -   -   -</td>
<td>12  2.6  0.31  109</td>
</tr>
<tr>
<td>Amphimermis bonaerensis</td>
<td>-   -   -   -</td>
<td>-   -   -   -</td>
<td>-   -   -   -</td>
<td>1   5   0.04  15</td>
</tr>
<tr>
<td>Amphimermis dichroplusi</td>
<td>-   -   -   -</td>
<td>-   -   -   -</td>
<td>-   -   -   -</td>
<td>9   3.1  0.30  98</td>
</tr>
<tr>
<td>Amphimermis ronderosi</td>
<td>-   -   -   -</td>
<td>-   -   -   -</td>
<td>-   -   -   -</td>
<td></td>
</tr>
<tr>
<td>Hexamermis coclaearius</td>
<td>8   2.7  0.2  55</td>
<td>-   -   -   -</td>
<td>-   -   -   -</td>
<td></td>
</tr>
<tr>
<td>Hexamermis ovistriata</td>
<td>-   -   -   -</td>
<td>12  2.8  0.33 120</td>
<td>-   -   -   -</td>
<td></td>
</tr>
<tr>
<td>Longimermis acridophila</td>
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<td>12  2.6  0.32  72</td>
<td>-   -   -   -</td>
<td>6    4.3  0.26  90</td>
</tr>
</tbody>
</table>
registered in our study, are depending on the availability of their hosts, being able to regulate the populations of these pest insects.

Acknowledgements

This study was partially supported by Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Universidad Nacional de La Plata (UNLP), and Comisión de Investigaciones Científicas de la provincia de Buenos Aires (CIC), Argentina.

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