Some Biological Aspects of *Mermis subnigrescens* Cobb (Nematoda)

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Abstract

The life cycle of *Mermis subnigrescens* (Cobb) involves a parasitic stage which lasts from 4-10 weeks after ingestion of the egg by the orthopteran host. A post-parasitic stage in the soil lasts approximately 20 months during which time the female becomes gravid. The morphology of the egg is described. Chromatrophic responses apparently affect the number of eggs laid by the female. Experiments on host resistance to multiple infections shows some reduction in numbers of juveniles after initial infections. Host age does not appear to be a factor in resistance to infections.

Introduction

The life cycle of *Mermis subnigrescens* involves a single orthopteran host. Embryonated eggs of this species, containing a second stage juvenile, are deposited on vegetation by female worms in early summer during or immediately after a rain. Members of the family Acrididae or the family Tetigoniidae ingest the eggs which hatch in the anterior portion of the alimentary canal. Parasitic juveniles penetrate the intestinal wall, enter the haemocoel, and continue development.

Male juveniles usually remain in the host from 4 to 6 weeks, attaining length of 20 to 60 mm; female juveniles usually remain in the host from 8 to 10 weeks, attaining a length of 50 to 135 mm. Males reach sexual maturity shortly after the post-parasitic moult (5).

In late summer, the juveniles emerge from the haemocoel through the body wall of the host. Post-parasitic juveniles then enter the soil and undergo a moult approximately 2 to 4 months later. Female post-parasitic juveniles attain sexual maturity in the soil within 8 months after emergence from their host. The following spring, females may mate with males and begin egg production, or they may produce eggs parthenogentically. Egg production continues for a year but few, if any, eggs are laid before the end of this time, *i.e.*, approximately 20 months post-parasitic emergence (5).

The Egg

The eggs of *Mermis subnigrescens* are subspherical, somewhat compressed at the poles, and measure approximately 48-54μ from pole to pole and 50-56μ at the equator. Two protective coverings surround the egg. The outer, dark-brown covering, which may easily be broken and removed, has a fracture line across the equator.

Each hemisphere of the outer covering has a thickened area at the pole formed by the attachment of two many-branched, albuminous appendages or byssi (2). These apparently assist in attachment of the eggs to various surfaces and may also keep them together in small clumps.

At oviposition, each viable egg contains an infective second-stage juvenile. In the present studies, no evidence of moulting within the egg was observed. Eggs may remain viable throughout the summer on foliage (their dark color presumably shielding the juvenile from harmful sun rays) (5). Some eggs were kept in the laboratory on moist filter paper and retained their viability for over 6 months.

In 1968, maximum egg laying occurred during the second and third week of June. The first gravid female was found on May 22; the last gravid female was found the last week of June. Similar results were reported at Woods Hole, Mass., *i.e.*, the time of maximum egg deposition was usually during June and July, and that egg laying was controlled by weather conditions (2). In the present study, there were only light rains during July and the first part of August, 1968. These rains were apparently too light to bring appreciable numbers of mermithids to the surface since none was found.

Gravid females were kept in the laboratory for use as a source of eggs. They could be stimulated to lay eggs several times over a 2-3 month period. No eggs could be procured after the end of August and all gravid females died by the early part of October, 1968. This would seem to indicate that following egg laying, the spent female may live less than 2 months. Very few eggs remained in the uterus of the spent females, and cross sections of these worms show the trophosome to be nearly empty.

Chromotrophism

Cobb (3) described a type of chromotrophism associated with the egg laying of *Mermis subnigrescens*. According to his studies, release of eggs is due to the accumulation of the pigment haemoglobin in the anterior end and, to a lesser degree, throughout the body of the female. The presence of this pigment, in sunlight, provided the stimulus for egg laying (2, 4). It has been suggested that the distribution of hemoglobin in *Mermis subnigrescens* is more closely associated with respiratory functions and is particularly related to oxygen supply (6). They concluded that the concentration of pigment is not delimited enough to function in chromotropism. The present study indicates that although sunlight is not necessary for egg laying, it may influence it, since a greater number of eggs were laid when worms were placed in sunlight on moist filter paper than under like conditions in darkness. Numerous examples of other nematodes possessing haemoglobin may be cited and ample evidence exists that haemoglobin serves to transport oxygen in some nemotodes (1, 6, 7).

Experimental Infections

An experiment was carried out to determine if a grasshopper once infected with *Mermis subnigrescens* becomes resistant to additional infections. Fifty *Melanoplus* sp. (mostly *M. femurrubrum*) consisting of 32 females and 18 males were selected. One of the females died during the last half of the experiment. For this experiment, grasshoppers were each fed 5-10 eggs of *M. subnigrescens* placed on lettuce leaves. This procedure was carried out once every 2 weeks for a total of 3 feedings. One week after the last feeding, these grasshoppers were killed, dissected and examined for evidence of mermithid juveniles.

Table 1 shows a reduction in number of juveniles resulting from the second and third exposures. It can be assumed that throughout the life of the grasshopper, multiple exposures to mermithid eggs results in the grasshopper's acquisition of numerous parasites of various ages but that initial infections tend to be heavier.

TABLE 1. *Susceptibility of grasshoppers* (Melanoplus *spp.*) *to reinfection with* M. subnigrescens.

No. hosts infected	Average number juveniles per host exposure		
	1st feeding	2nd feeding	3rd feeding
31 females	4.10	2.75	2.8
18 males	3.14	2.00	2.3

Effect of Host Age on Experimental Infections

To determine if age was a factor in host resistance, 10 *Melanoplus femurrubrum* were selected at random for each of 6 age groups as shown in Table 2. Each grasshopper was starved for 24 hours and then fed individually a small pellet of cooked oatmeal into which were placed 10 eggs of *Mermis subnigrescens*. Three weeks later, the grasshoppers were sacrificed and examined for juvenile mermithids. Table 2 indicates that age seems to play no important role in resistance of *M. femurrubrum* to *M. subnigrescens* infections through the 17th week of life.

TABLE 2. *Effect of age of host on resistance to infection.*

Age of host when infected (in weeks)	Average number juveniles/host	Number of juvenile/host	
		Maximum	Minimum
4	4.3	5	3
6	4.1	5	3
8	4.1	6	3
12	4.6	6	4
15	4.2	6	3
17	3.9	5	2

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