

A NEMATODE (*DELADENUS* SP.: NEOTYLENCHIDAE) ASSOCIATED WITH *RHYSSA* SPP. (HYMENOPTERA: ICHNEUMONIDAE), PARASITES OF SIRICID WOODWASPS

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Abstract

In 1965 nematodes were recorded from three species of *Rhyssa* in shipments received from India and Europe. The nematodes from European *Rhyssa* spp. are now known to be *Deladenus* sp. The growth and reproduction of the nematodes reduces the fecundity and longevity of their hosts. Many of the larval nematodes invade the reproductive system in female hosts, and transfer of the nematodes probably occurs during probing by infested females. The pathological effects of this nematode on both sexes of the host are described. Since the siricid woodwasps, the host of *Rhyssa*, are also subject to infestation by nematodes, a comparison is made between characteristic symptoms in both insects.

INTRODUCTION

In June 1965, specimens of *Rhyssa himalayensis* Wilk. imported from India to control *Sirex noctilio* (F) in Tasmania, were dissected to investigate possible causes of their high transit mortality. Some were found to contain adult and young stages of a nematode in the body cavity. Subsequently, samples of both living and dead individuals of *R. himalayensis* from sites in Kashmir and Kulu (Punjab) were dissected and nematodes found in *Rhyssa* from each area, the overall infection rate being about 20 per cent.

Nematodes were also found in *Rhyssa persuasoria* L. sent in the (Australian) winter in 1965 from England, where they had emerged in insectaries from logs collected at sites throughout western Europe. The level of infestation in a large shipment from several sites was about 30 per cent in both sexes. A small number (20) of male *R. persuasoria* emerged in the Hobart insectaries a few weeks after oviposition by these European stocks. Four of these contained nematodes. Nematodes have also been found in the offspring of *R. persuasoria* received from Europe in the winter of 1964. Some insects from this stock had already been released in a pine plantation near Hobart in the spring of 1964.

In 1965 a small number (9 individuals) of *Rhyssa amoena* Grav. was received in Tasmania from Europe. Two females were parasitized by nematodes.

Nematode infection of rhyssines had not been reported previously, though a nematode was discovered in 1962 in their hosts, the Siricidae, in New Zealand (Zondag 1962). The possibility of the same species of nematode attacking both parasite and host is discussed later in this paper.

Specimens of these nematodes were sent to Dr. R. A. Bedding, who has recently described the life-cycle of *Deladenus* spp., associated with siricids and their parasites (Bedding 1967). He has identified the nematodes from *R. persuasoria* as *Deladenus* sp. and those from *R. himalayensis* are probably of the same genus.

DESCRIPTION AND PATHOLOGY OF THE INFECTION

General

In the aspects described in this paper, *R. himalayensis* and *R. persuasoria* appeared identical and are considered together. Only adult nematodes were found in emerging *Rhyssa* adults. The internal organs of the host were little affected at first, but as the nematode larvae developed within the parent and were discharged into the haemocoel, various tissues and organs of the host were attacked. In moribund hosts these remained only as a disorganized mass in the body cavity. Insects infested with large numbers of adult nematodes died shortly after the massive release of nematode larvae.

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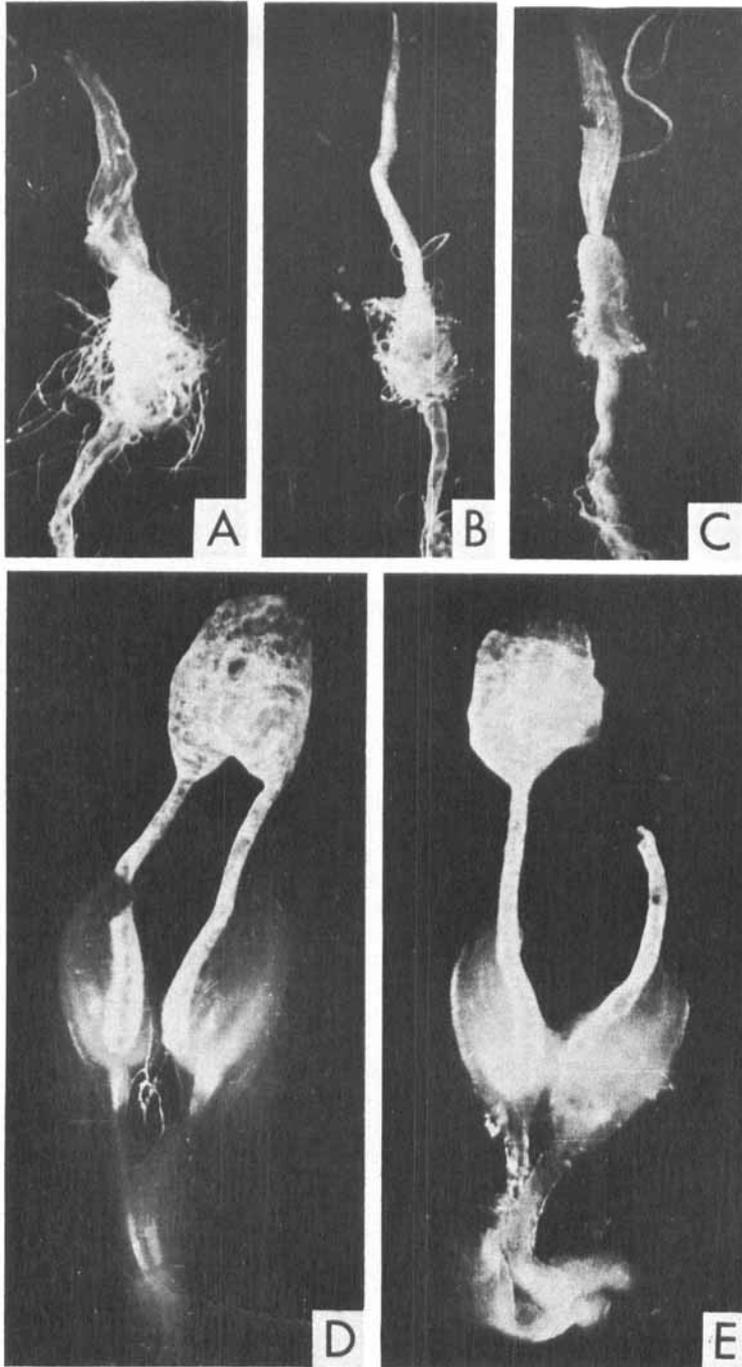


PLATE I

A-C.—Alimentary canal of *Rhyssa persuasoria* L.: (A) gut of healthy nematode-free specimen; (B, C) guts of nematode infested specimens. Note the reduction of the ventriculus and Malpighian tubules in diseased specimens.

D, E.—Male reproductive system of *Rhyssa persuasoria*: (D) from healthy male; (E) from nematode infested male. There appears to be no significant effect of parasitism. Areas of testes and vas deferens, which appear incomplete, are due to absence of pigment. This is a normal variation.

The number of adult nematodes per host varied considerably. In small insectary-bred male *Rhyssa* which completed their life cycle within 3 months, only one adult nematode occurred. In the overseas shipments, up to forty adult nematodes were estimated in large females.

Males

There was little evidence of deleterious effects on the male reproductive organs. When the larval nematodes were released from the adult female into the body cavity of the host, there was a slight reduction in the size of the fused testes (Plate I, D & E), but this may be attributable to the increasing age of the host insects. No nematodes were found within the male reproductive system.

Females

Large numbers (30-40) of adult nematodes were present throughout the body cavity, but many of these congregated in the eighth and ninth segments in the region of the musculature of the ovipositor. In most cases, the *Rhyssa* eggs degenerated early in the infestation, followed by the oocytes and nutritive cells, leaving finally only the walls of the ovarioles. The accessory glands at the base of the oviducts, which are said to secrete "albumin" (Bugnion 1904) lost their white appearance and became translucent (Plate II, A & B). The "glande multifide" (Bugnion 1904) did not attain its normal floating position in the mid-gut region, but moved into the region of segments eight and nine and lodged in the musculature of the ovipositor. The vesicle of the gland became flaccid and the branches were reduced, but it did not act as a storage site for the young nematodes. When the nematode larvae were discharged from the parent, large numbers were found within the genital system and the general body cavity of *Rhyssa*. The oviducts, ampullae and paired accessory glands were packed with nematode larvae lying parallel to each other and more or less immobile (Plate IIC). In some recently dead insects, living larvae were seen in the ovipositor and in the valves of the sheath. Only in one individual were any mature ova present when the nematode larvae were released. This *Rhyssa* had only light infestation (10-12 adult nematodes) and had lived for at least six weeks. Five eggs remained in the ovaries, three of which appeared normal while the contents of the other two were completely replaced by nematode larvae, and therefore would not have been viable.

Effect on longevity

The mean life span of uninfested *Rhyssa* when carbohydrate food was provided was about seven weeks (minimum under ambient summer temperatures about four weeks), whereas that of *Rhyssa* infested with nematodes was only two and a half weeks. Two females with few (10-12) adult nematodes lived approximately six weeks.

Transfer of larval nematodes

As no viable, infected eggs were found in nematode-infested *Rhyssa*, and normal glandular activity was disrupted, transfer of infective stages of the nematode into healthy *Rhyssa* larvae probably occurred during probing by infested females. Samples from logs on which a population of *Rhyssa* had oviposited, including some infested by nematodes, yielded nematodes only in *Rhyssa*, and not in *Sirex* larvae. Adult nematodes only were found in fully-developed *Rhyssa* larvae about two months after oviposition.

COMPARISON OF NEMATODE INFECTION OF *Sirex* AND *Rhyssa*

The pathological effects and life-history of *Deladenus* sp. affecting *Rhyssa* differ from those of nematodes found in *Sirex* as described by Zondag (1962). The major differences are summarized in Table 1.

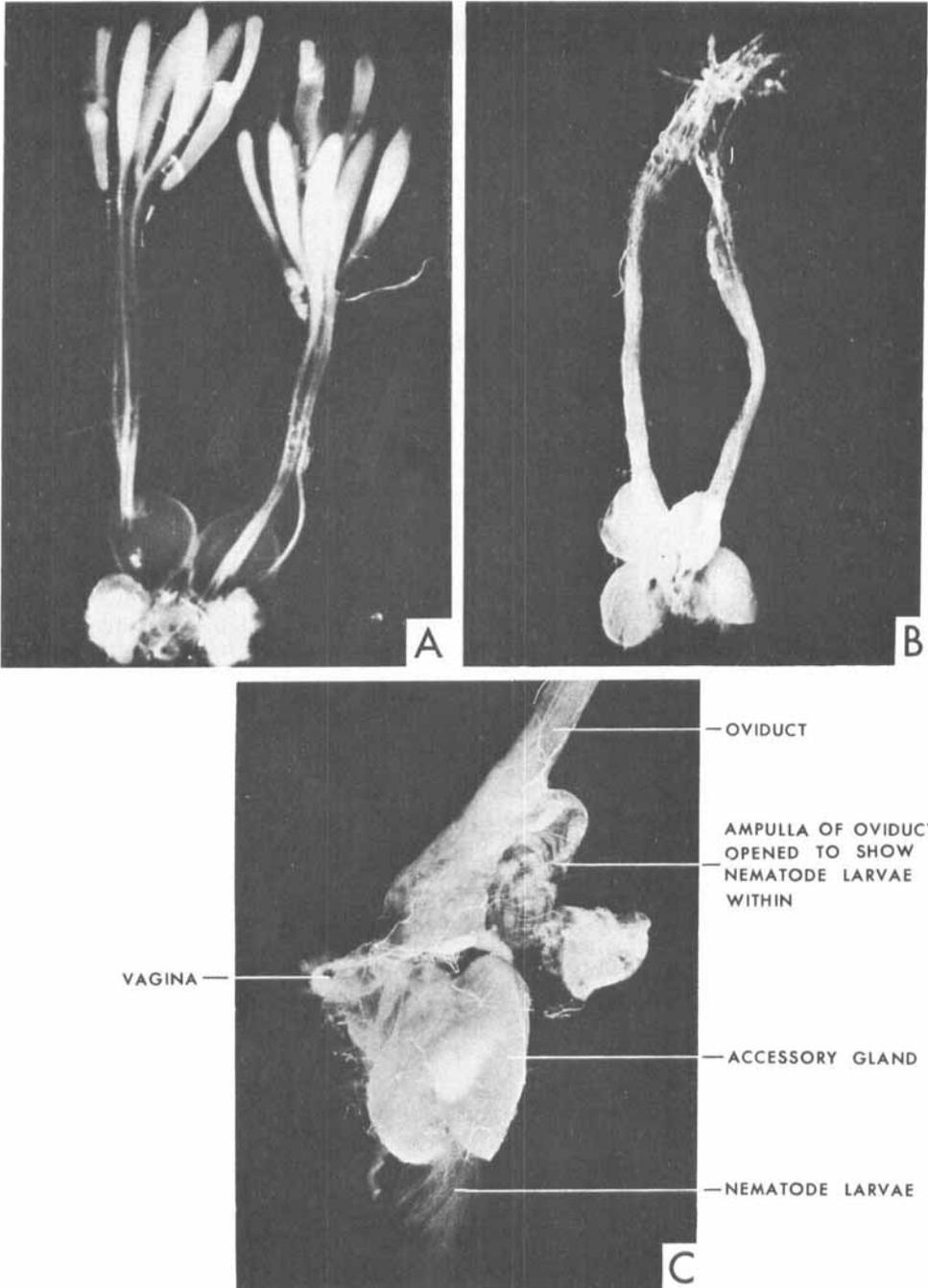


PLATE II

Female reproductive system of *Rhyssa persuasoria* L.: (A) from healthy female; (B) from nematode infested female, note the absence of eggs in the ovarioles of the infected female and the degeneration of the accessory glands; (C) posterior end of oviduct from nematode-infested *Rhyssa persuasoria*, the accessory gland has been opened also to show the nematode larvae within.

TABLE 1
COMPARISON BETWEEN EFFECTS OF NEMATODES ON *Sirex* AND *Rhyssa*

	<i>Sirex</i> (Data from Zondag 1962)	<i>Rhyssa</i>
Stage of development reached by nematodes at the time of host emergence.	Adults, intermediate and young stages in pupae and adults of <i>Sirex</i> .	Adults only in <i>Rhyssa</i> adults at emergence. Young stages released several days later.
Site of larval nematodes in host.	Young mainly confined to reproductive organs of hosts, both ♂ and ♀. Few only in body cavity.	Young mainly free in body cavity, some in ♀ reproductive system, none within ♂ reproductive system.
Effect on male organs.	Testes become hypertrophied.	Organs virtually unaffected.
Effect on female organs.	Eggs remain in adult female <i>Sirex</i> . Though degenerate and non-viable, they contain larval nematodes and act as vehicles for the transfer of the nematodes to new host trees.	♀ organs degenerate. <i>Rhyssa</i> eggs rarely found when infective stages released from parent nematode. Larval nematodes are stored in the accessory glands of <i>Rhyssa</i> and possibly transmitted during "oviposition".

Nematodes have not been found in *R. persuasoria* or *R. lineolata* (Kirby) established in New Zealand, although nematode infestation of *Sirex* reached 95 per cent. in some areas (Zondag—personal communication). Conversely, samples from logs on which nematode-infested *Rhyssa persuasoria* had oviposited in Tasmania in the winter of 1965 yielded nematodes from *Rhyssa* larvae only.

DISCUSSION

From the evidence at present available, it seems that there is a complex of nematodes affecting the Siricidae and their parasites. These nematodes may be of significance in the biological control of *Sirex* in Australia. No nematodes have been found yet in *Sirex* from various sites in Tasmania and Victoria. Some nematode-infested *R. persuasoria* (and possibly *R. himalayensis*) from 1964 cultures may have been released already at sites in Tasmania. If a different species of nematode is confined to the larval parasites of *Sirex*, then cultures of nematode-free *Rhyssa* must be bred before further releases of these parasites are made at new locations in Tasmania and in Victoria.

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