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Pathologies caused by *Coccinellimermis* Rubtzov (Nematoda: Mermithidae) in *Coccinella septempunctata* (L. Coleoptera: Coccinellidae)

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The nematode parasite, *Coccinellimermis*, causes irrevocable damages to various organs in the haemocoelic cavity of the lady beetle, *Coccinella septempunctata*. The fat bodies suffer much, since these are drained of their reserve materials by the parasites. This in turn tells upon the growth of the ovaries. Further the ovaries are pressed against the body wall and mutilated. The digestive system, heart, muscles and nerve branches in the abdominal cavity are damaged by the juvenile worms during the time of extrusion.

Key Words: *Coccinellimermis*, *Coccinella septempunctata*, **Juvenile mermithid, Endoparasite**

Introduction

Though several species of nematodes have been known to parasitize the Coccinellids (Richerson 1970, Hodek 1973), the information on the effects of the former on the anatomy, physiology and ethology of the latter is scanty and has never been spelt out. Hariri (1965) reports on the effect of nematodes on the ovary and fat bodies of *Adalia bipunctata* L. The abnormal behavioural patterns of the lady beetle, *Coccinella septempunctata* L. associated with the exit of the juvenile endoparasitic nematode, *Coccinellimermis* Rubtzov, have been described in detail by Rhamhalinghan (1985a,b). In view of the lady beetle's aphidophagous nature, further investigations on the pathologies caused by the nematode parasites, are much needed to throw some light on its biology and hence the present study.

Materials and Methods

The lady beetles that harboured and issued the nematodes (which were kept under observation till their death) were dissected immediately after death for thorough examination. Abdominal organs of these lady beetles were examined carefully and the degree of damages caused to the organs determined. The undamaged ovary in each infected specimen and the corresponding

ovaries in uninfected beetles of the same age group, had been weighed to assess the extent of damage. The fat bodies were examined thoroughly and classified into four arbitrary classes following the method of Anderson (1981) and the damages assessed. The total lipid content of the beetles, immediately after the emergence of the nematodes, was also determined following the method outlined by Hariri (1966). A single pan balance, sensitive to 0.01 mg, was employed. The data were analysed statistically using Student's t-test (Simpson et al. 1960).

Observations and Discussions

The endoparasites usually invade all the organs and tissues of the insect hosts (Wachek 1955, Welch 1959, 1963, Doutt 1963). Yet, of all the systems, the fat bodies and ovaries undergo considerable degeneration, since their development is directly related to the nutrition of the host, which is marred by the presence of the parasite.

Fat bodies: In the abdominal cavity of the healthy beetle the fat bodies are crowded together in great numbers, surrounding the gut and ovaries. These are yellowish white in colour, filled with large fat globules. Prior to the reproductive phase the haemocoel is filled with them. But in the infected lady beetles the adipose tissues are white in colour, small, shrunken and scattered in the peripheral region. The beetle is practically drained of its reserve constituents by the parasite and the observations show that this loss is more serious since the hosts are unable to recuperate even after the exit of the parasite.

The present work emphasizes the correlations between the depletion of reserves in the host and the growth of the juvenile mermithid and it suggests a direct causal connection between the recruitment of nutriment by the parasite, degeneration of fat body and the maldevelopment of the ovaries (table 1). Subjective method of estimation of fat body condition shows that in the infected beetles the fat bodies are maldeveloped and do not obscure the viscera, falling under class 1 of Anderson (1981). These have only a little amount of fat. But in the uninfected beetles of the same age (determined by the comparison of the colour of elytra), they fall under classes 3 and 4 of Anderson (1981). In these beetles, the fat bodies are well developed, showing numerous oil droplets and fill the abdomen.

While in the infected beetles (after the emergence of the parasite) the average lipid content of the body is 1.16 mg, the same in

Table 1 *Effect of nematode parasitism on the females of* Coccinella septempunctata *L. The numbers within parenthesis indicate the range*

Trait	No. of specimens observed	Infected	Uninfected
Body weight (mg)	5	20.31±0.91 (19.20−21.44)	31.48±1.59* (29.78−33.46)
Ovarian weight (mg)	5	3.26±0.36 (2.92−3.86)	12.55±0.27* (12.18−12.66)
Total lipid (mg)	5	1.16±0.04 (1.11−1.21)	3.11±0.11* (2.92−3.21)

*Significant at 1% level

the uninfected beetles of the same age group is 3.11 mg, and the difference is statistically significant at 1% level (table 1). This proves the active absorption of lipids by the nematode parasite.

Mermithids cause considerable depletion of fat body tissues in larval simulids (Strickland 1911, Phelps & DeFoliart 1964). Baily and Gordon (1973) found that the fat bodies of the larvae of *Aedes aegypti* are reduced rapidly by the growing nematode *Reesimermis nielseni*. The increase in the nutritional needs of the parasites depletes initially the storage materials in the fat body and finally leads to the degeneration of the fat body in the hosts. The observations of Candon and Gordon (1977) support this view further. Ittycheriah et al. (1977) suggested that the parasitic stages of mermithids store lipids to provide the non-feeding free living stages with an energy fuel of high caloric value. Gordon et al. (1979) also found that the lipids are recruited from the fat body of the host.

Hariri (1965) found that the fat bodies of the nematode infected Coccinellid, *Adalia bipunctata*, were smaller than those of unparasitized beetles. For instance, a lone *C. septempunctata*, that issued two nematode juveniles, died within 6 hr after the exit of the parasites (Rhamhalinghan 1985a). The dissection showed that the fat bodies are in a highly atrophied condition, as though there are no fat bodies at all in the haemocoel. Undoubtedly the parasitic activities culminate in the death of the host, as the parasite robs the host of its nutrition, developmental activities and strength. The size and condition of the fat bodies form a reliable indicator of the activities of the endoparasites (Doutt 1963).

Damage to the ovaries: When the females are infected, the activity of the parasite first reflects on the fat body and finally on the ovaries. The effects on these two systems have been observed invariably by all authors working on the parasitic activity of nematodes (Beards 1940, Wachek 1955, Crisp, 1959, Welch 1959, 1960, 1963, Massey 1960). The gradual depletion of nutritive materials eventually tells upon the growth and development of the ovary.

Almost all organs are in a well-developed state in the newly emerged adult *C. septempunctata* except the ovaries. The growth and maturation of the ovaries depend entirely on the reserve constituents. When required materials are inadequately supplied, the growth of the ovary is disrupted. A single ovary weighs 3.26 mg in the infected beetle which is 12.55 mg in the uninfected beetles belonging to the same age group (table 1). The weight of the well developed ovary is approximately four times greater than that of the degenerated ovary. This indicates undoubtedly the extent of damage done by the endoparasites, by way of depletion of reserves in the host.

Further, in the present case the violent movements, of the juvenile nematode practically damage the very structure of the ovaries. The ovarioles are severed from the ovaries and the ovaries compressed, squeezed and distorted. Observations show that recovery is not possible from this pathological state, even after the exit of the parasite (Doutt 1963).

Body weight: The average body weight, before the emergence of the nematode parasite, is 26.71 mg which comes down to 20.31 mg after the escape of the parasite. On the contrary, the uninfected beetles of the same age group, which are robust, weigh 31.48 mg. This variation is presumably due to the removal of materials by the parasite that leads to the retarded growth of tissues in the host. The difference in body weight is highly significant statistically (table 1).

Damages to other systems: Considerable loss of haemolymph has been observed and discussed in detail in a previous paper

(Rhamhalinghan 1985b). In some specimens the tubular heart was punctured and cut transeversely. The nerve connections from the last abdominal ganglion to various regions of the abdomen were found to be severed. The highly branched tracheae around the ovaries and the digestive system were lacerated wildly. In two specimens, the posterior part of the ileum had been perforated and the undigested materials were sprinkled into the haemocoel. In a few specimens, one to two malpighian tubules had been severed from the gut either on the anterior or posterior side. It is presumed that these are brought about by the frenzied movements of the parasite at the time of escape from the haemocoelic cavity.

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