Proc. Indian natn. Sci. Acad. **B53** No. 1 pp 31–34 (1987)

Pathophysiological Effects on the Ovaries in *Coccinellimermis* Rubtzov (Nematoda: Mermithidae) infected *Coccinella septempunctata* L. (Coleoptera: Coccinellidae): A Preliminary Report

M RHAMHALINGHAN
Department of Zoology, Government Arts College, Ooty 643 002, Nilgiris

(Received 14 October 1986; after revision 19 December 1986)

As a result of the infection of *Coccinella septempunctata* L. with juvenile nematode *Coccinellimermis* Rubtzov, ovarian growth in the host is retarded. Movement of the endoparasite possibly causes the rupture of ovarioles and also such injuries as perforation of oocytes, rupture of vitellarium wall and distortion of germaria.

Key Words: *Coccinellimermis, Coccinella septempunctata,* **Ovarian injuries**

Introduction

While considerable information is available regarding the injuries to the insect hosts by hymenopteran and mermithid parasites in general (Doutt 1963, Welch 1963), data on ovarian pathology of the hosts are very few.

Though *Parasitylenchus coccinellae* Iperti & van Waerebeke, *Howardula* sps. and *Mermis* sps. have been found to parasitize the coccinellids (Hodek 1973), the effects of these nematodes on the structural and functional aspects of ovaries have not been studied. Since investigations on the predators, parasites and pathogens of aphidophagous coccinellids are needed in view of their economic importance (Hodek 1973), the present study has been undertaken.

Materials and Methods

The materials and relevant methods are described elsewhere (Rhamhalinghan 1986a, b). The ovaries of infected beetles were weighed in a singlepan balance sensitive up to 0.01 mg. Since in many beetles, either the left or right ovary was badly damaged, only the undamaged ovary in each specimen was weighed. The weights of the corresponding ovaries in uninfected beetles, of the same age group, were also determined for comparison. The length (excluding the terminal filament) of 10 ovarioles and the maximum breadth of their basal eggs were measured with the help of an ocular micrometer. The ovaries were then stained by the method described by Lewis (1959) and the nature of damage noted. Figures were drawn with the help of a camera lucida.

Since the ground colour of the elytra changes from pale yellow through orange to deep red with age (Hawks 1920, Verma 1954, Richards 1981), the age of the infected beetles was roughly estimated by comparison of their elytral colour with that of the virgin females of known age. Ovarian weights were taken only in case of virgin uninfected females. Virgins did not oviposit inspite of the presence of well developed eggs in the vitellarium, presumably due to the lack of copulatory stimulus (Nayar et al. 1976). The ovary damage index (ODI) was calculated as:

$$ODI = \frac{(a-b)}{a} \times 100$$

where a and b indicate the weights of the ovaries of uninfected and infected beetles of the same age group respectively. This shows the magnitude of damage caused to the ovary by the parasites. Since the differences between the two age groups of infected beetles, regarding the length and breadth were negligible, groupwise analyses of their measurements have not been made. The feeding rate of the beetles

was determined, following the method of Kaddou (1960). Data were analysed statistically using Students' t-test (Simpson et al. 1960).

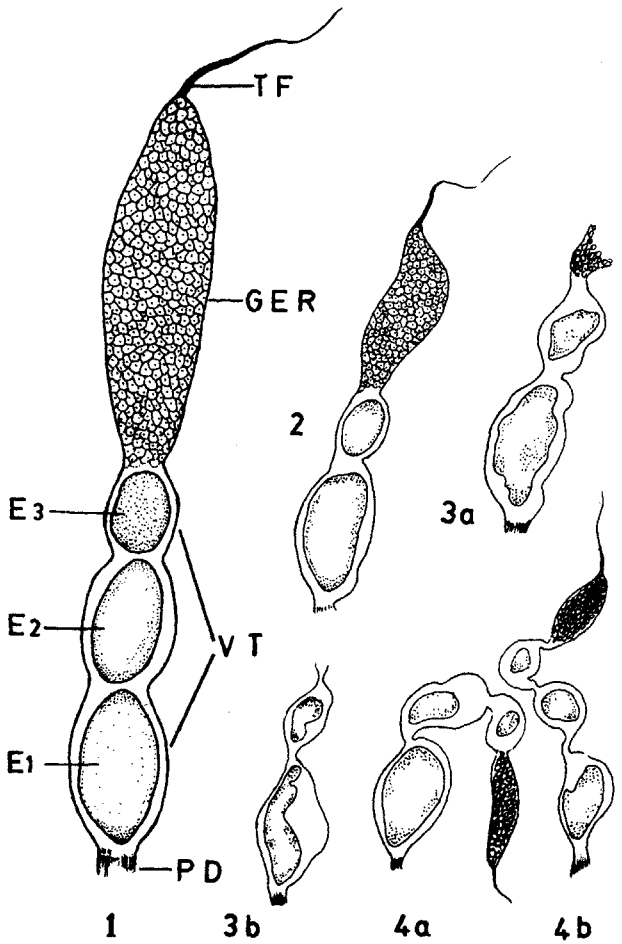
Results

(a) Abnormalities in ovaries

When compared with the ovaries of infected beetles, ovaries of uninfected beetles of age group 1 (30–45 d) weigh 4.22 times heavier and those of age group 2 (50–60 d) weigh 3.85 times heavier. Similarly the length and maximum breadth of the ovarioles of the uninfected beetles were 28.51% and 63.89% greater than those of infected beetles, respectively.

Most of the ovarioles in control beetles show two well developed eggs with yellow yolk and a small third oocyte (figure 1) while in infected beetles 58.2% of the ovarioles harbour a single abnormal white basal oocyte (figures 5a to h, 5k to m). While in 19.7% of ovarioles a second egg, in the process of growth, is observed (figures 2, 3a, b), in 4.7%, a third egg is also found in the vitellarium (figures 4a, b). The remaining 17.4% ovarioles do not show the zone of growth or vitellarium (figures 5i, j). In a few ovarioles, the basal eggs are shrunken but pale yellow, showing the presence of a little yolk (figures 2, 3a, b).

In many infected beetles the wall of vitellarium appeared collapsed and variously folded to give the appearance of a thick membranous sheath. About 6 to 22 ovarioles in each infected beetle were perforated and the oocytes are disfigured. Several ovarioles are severed from the calyx of the oviduct. In two specimens the right ovary was completely detached from the oviduct.



Figures 1–4. 1, Well developed ovariole of uninfected *Coccinella septempunctata*. **E_1, E_2, E_3,** Eggs; **GER,** Germarium; **PD,** Pedicel; **TF,** Terminal filament; **VT,** Vitellarium (×200); **2, The ovariole from the parasitized lady beetle (the eggs are devoid of yolk) (×100); 3a–b,** The shrunken oocytes in vitellarium (×100); **4a–b,** The deformed ovarioles (×100)

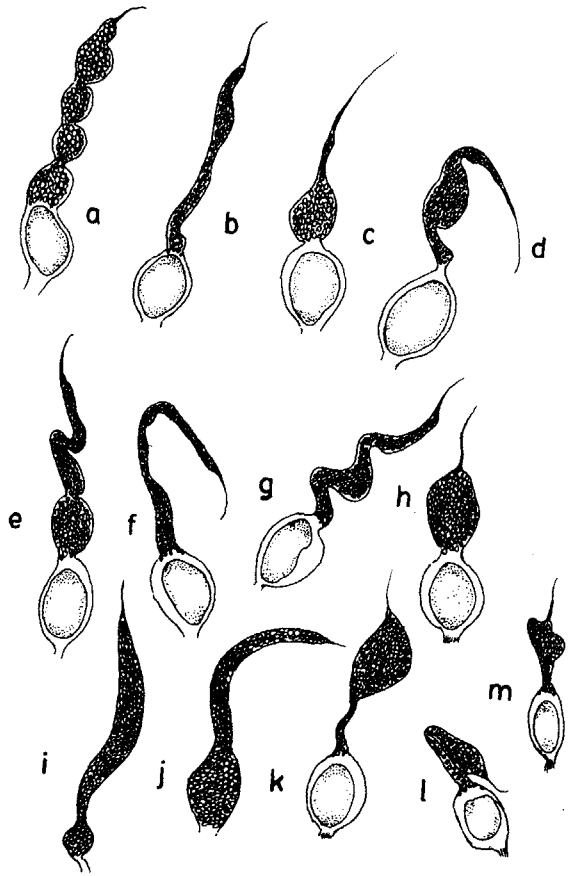


Figure 5a–m. Deformed germaria. Basal eggs are devoid of yolk and maldeveloped (×100)

The germaria are damaged in a few cases and they appear shrivelled, beaded and distorted in various ways. Often the inner cells of the germaria are not clear (figures 5a to 5m). The terminal filaments are severed in a few ovarioles.

(b) Mating inhibition

The infected females generally do not respond to copulatory attempt by males. Either they escape from the males or immediately turn away their abdomen. In a few instances they try to drive the males away.

(c) Feeding Rate

Aphid intake is greatly reduced in infected beetles. While the healthy beetles devour an average of 87 aphids/day, the infected ones take 60 aphids/day (about 31% less than the former) prior to emergence of parasite.

Discussion

The mean ovary damage index of the infected beetles (75.66%) shows a high degree of effect of parasitisation (tables 1, 2). The retarded growth of ovaries is presumably due to nutritional insufficiency (Rhamhalinghan 1986a). This may be termed the 'Physiological injury', since the ovaries become non-functional. The white colour of the basal oocytes in most of the ovarioles also substantiates this observation. This is further supported by the degenerate condition of fat body and the decreased lipid content of the infected beetles (Rhamhalinghan 1986a).

The shrunken condition of the pale yellow basal oocytes in a few ovarioles of the infected beetles of age group 1 indicates resorption of oocyte substance leading to vacuolisation in the yolk-filled region (Sahai 1978).

Table 1 *Morphometric traits* of ovary in* Coccinella septempunctata

Group	Ovarioles				Ovary weight (mg)		
	Length (mm)		Breadth (mm)		Age group (days)	Range	Mean
	Range	Mean	Range	Mean			
Infected	1.60–1.85	1.73±0.08	0.21–0.33	0.26±0.04	30–45	2.15–2.65	2.37±0.23
					50–60	2.92–3.86	3.26±0.36
Uninfected	1.86–3.39	2.42±0.30	0.56–0.79	0.72±0.06	30–45	9.38–10.45	10.01±0.53
					50–60	12.18–12.92	12.55±0.27

*The differences in the morphometric traits between the infected and unifected beetles are statistically significant at 0.05% level

As the fat body of the hosts losses its reserves (Rhamhalinghan 1986a), resorption might occur as a process of compensation (figures 3a, b, 4a, b). Disappearance of yolk granules from the oocytes is reported in the parasitized squash bug, *Anasa tristis* Deg. (Beard 1940). Starvation and shortage of food also lead to resorption of egg within a fairly short time (Bhide 1980). Further, the insects generally have the ability to resorb the oocytes even after different stages of growth (Sahai 1978). While frequent copulation takes place in a healthy *C. septempunctata*, in infected females this does not happen. While the precise cause for this is difficult to ascertain, it is evidently a manifestation of parasitic effect.

The perforations, distortions and severance of the ovarioles may be brought about by the frenzied movements of the nematode in the body cavity, perhaps when they are trying to escape from the host (Rhamhalinghan 1986a), since routine monthly dissections show that in most of the infected beetles (87.5%), prior to the emergence of the parasite, the organs are not damaged.

Table 2 *Weight of the ovary and ovary damage index (ODI) in* Coccinella septempunctata

Age group (days)	Weight (mg)		ODI (%)
	Infected	Uninfected	
30 – 45	2.22	9.38	76.33
„	2.15	10.45	79.42
„	2.65	10.45	74.64
„	2.45	9.76	74.90
Average	2.37 ± 0.23	10.01 ± 0.53	76.32
50 – 60	3.10	12.66	75.51
„	3.86	12.45	68.99
„	3.28	12.92	74.61
„	3.15	12.18	74.14
„	2.92	12.55	76.73
Average	3.26 ± 0.36	12.55 ± 0.27	75.00

References

Beard R L 1940 Parasitic castration of *Anasa tristis* DeG. by *Trichopoda pennipes Fab.* and its effect on reproduction; *J. econ. Ent.* **33** 269–272

Bhide M 1980 Cytological observations in the corpus luteum and resorptive bodies of *Poecilocerus pictus* Fabr.; *J. Sci. Res.* **2** 191–195

Doutt R L 1963 Pathologies caused by insect parasites; in *Insect Pathology* Vol. II 393–422, ed. E A Steinhaus (New York: Academic Press)

Hawkes O A M 1920 Observations on the life history, biology and genetics of the ladybird beetle, *Adalia bipunctata; Proc. Zool. Soc. Lond.* **1920** 475–490

Hodek I 1973 *Biology of Coccinellidae* pp 196–214 (The Hague: Dr W Junk N V)

Kaddou I K 1960 The feeding behaviour of *Hippodamia quinquesignata* larvae; *Univ. Calif. Publs. Ent.* **16** 181–230

Lewis T 1959 The annual cycle of *Limothrips cerealium* Haliday and its distribution in a wheat field; *Entomologica exp. appl.* **2** 187–203

Nayar K K, Ananthakrishnan T N and David B V 1976 *General and Applied Entomology* pp 94–97 (New Delhi: Tata McGraw Hill)

Rhamhalinghan M 1986a Pathologies caused by *Coccinellimermis* in *Coccinella septempunctata* L.; *Proc. Indian natn. Sci. Acad.* **B52** 228–231

—— 1986b First record of *Coccinellimermis* Rubtzov, from India; *J. Bombay nat. Hist. Soc.* (In Press)

Richards A M 1981 *Rhyzobius ventralis* and *R. forestieri*, their biology and value for scale insect control; *Bull. ent. Res.* **71** 33–46

Sahai Y 1978 Histochemical and cytological studies on the resorptive bodies of *Poecilocerus pictus* Fabr.; *Biochem. Exptl. Biol.* **14** 305–310

Simpson G G, Anne R and Lewontin R C 1960 *Quantitative Zoology* pp 176–184 (USA: Harcourt, Brace and World, Inc.)

Varma B K 1954 Evolution of colour pattern in *C. septempunctata* L. var. *divaricata* Oliv.; *Indian J. Agric. Sci.* **24** 133–136

Welch H E 1963 Nematode infections; in *Insect Pathology*, Vol. II 363–392 ed. E A Steinhaus (New York: Academic Press)